Technical analysis of measures to improve consumer awareness of emissions and fuel consumption of vehicles

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ABSTRACT

This study aimed to provide the European Commission with evidence-based recommendations for policy measures that improve consumer awareness of light duty vehicles' fuel economy and emissions. The study considered improvements to existing measures, such as the Car Labelling Directive, but also the introduction of new measures that can complement or substitute existing measures.

Detailed analysis of the potential impacts of the short-listed measures was undertaken for three main categories: economic, environmental, and social impacts. The measures were grouped into the topics that they address, reflecting different policy elements: Changes to the information channels through which information is communicated; Changes to the information elements that are communicated; Extension of the scope of the Directive; and Increase in the level of harmonisation of implementation in the Member States.

Analysis of potential impacts was based on literature and desk research findings, targeted surveys and interviews with key stakeholders, a consumer experiment/randomised controlled trials (RCTs) conducted with over 8,000 consumer participants in three EU countries (Germany, Poland and Spain) and SULTAN modelling to assist in quantifying selected impacts of the measures assessed.

Conclusions were drawn for each of the policy elements listed above, before making recommendations relating to a future revision of the Car Labelling Directive.

Executive Summary

This study aimed to provide the European Commission with evidence-based recommendations for policy measures that improve consumer awareness of light duty vehicles' fuel economy and emissions. For this purpose, the study considered improvements to the existing measures, such as the Car Labelling Directive, but also the introduction of new measures that can complement or substitute existing measures.

A long-list of 91 policy options was developed to address identified problems and drivers. A systematic screening approach consistent with the Better Regulation Guidance resulted in a short-list of 26 measures.

Detailed analysis of the potential impacts of the short-listed measures was undertaken for three main categories: economic, environmental, and social impacts. The measures were grouped into the topics that they address, reflecting different policy elements:

- Changes to the **information channels** (IC) through which information is communicated;
- Changes to the **information elements** (IE) that are communicated;
- Extension of **the scope** (S) of the Car Labelling Directive; and
- Increase in the level of **harmonisation** (H) of implementation of the Directive in the Member States.

The analysis was undertaken based on a combination of the following:

- **Literature and desk research findings**: Desk research was undertaken throughout the study and identified relevant reports and research evidence relevant to the issues.
- **Stakeholder inputs**: Included feedback from a stakeholder panel (representing consumers and vehicle manufacturers); a targeted survey of national authorities in EU Member States and targeted interviews with a range of affected stakeholders, both contributing to collecting data on expected costs and effectiveness of implementation of the short-listed measures; and data requests to specific stakeholders to fill any gaps.
- **Results from a consumer experiment conducted for this study**: Randomised controlled trials (RCTs) were conducted with over 8,000 consumer participants from three countries (Germany, Spain and Poland) in an online environment that simulated a third-party website where consumers get information on vehicles to buy or lease. It aimed to obtain robust statistical conclusions as to the effectiveness of different policy measures, focusing on those elements for which there is lack of evidence or consensus in the literature. Four experimental treatments have been tested with consumers related to a new label design including additional information elements, timing of label display and customisation of the information shown. The results of these experiments fed into the quantitative analysis.
- **SULTAN modelling:** Results from the consumer experiment were used as inputs to the SUstainabLe TrANsport (SULTAN) model to assist in quantifying selected impacts of the measures assessed.

Limitations of the analysis

The quantitative analysis on the impacts of the measures is based on the consumer responses in the behavioural experiment. There is uncertainty on the conversion of the consumer response findings into actual real-world purchase decisions, which could not be quantified as part of this project's research.

The analysis also assumes that there are no restrictions in the supply of efficient vehicle models as these are strongly driven by the CO_2 regulation targets. In other words, it assumes that the models chosen by the consumers will be effectively available for lease/purchase. The consumer information (e.g. label) is thus not to be understood as

triggering an increase of the supply of ZEV, but rather as orienting consumers in their choices amongst vehicle types and models available on the market.

Conclusions and recommendations

Conclusions and recommendations for each of the policy elements addressed in this study are outlined below.

Information channels

- The provision of information through online channels (such as the label to be shown online and the use of web-platforms for vehicle comparisons) could have the highest impact on the sales of new xEVs (i.e. PHEV, BEV). The share of these powertrains could increase up to 5 percentage points in 2030, compared to the baseline, which would have a positive effect in terms of reduced greenhouse gas and air pollutant emissions[1].
- Whilst the provision of the label online is likely to generate negligible costs, there is a more substantial cost associated with the development and maintenance of the websites for vehicle comparisons (up to €35,000 one-off costs and €217,000 annual recurring costs). It is however worth noting that a number of Member States[2] have already implemented similar solutions. Some Member States (IE, HR, AT, FR, SI, EE) have also suggested that this solution should be centralised and provided at the EU-level, which would eliminate costs for authorities.
- The use of the quote to provide relevant information is an additional information channel not currently considered by the Directive, but which could deliver positive impacts with little/no costs, if Total Cost of Ownership (TCO) information is provided via this channel: sales of new xEVs could increase up to 2 percentage points in 2030, compared to the baseline (also with benefits in reduced greenhouse gas and air pollutant emissions). The expected effects of this channel (quote) cannot be disentangled from the effects of the provision of the TCO information which will make xEVs a more attractive choice over time compared to conventional powertrains, as the price of the former is expected to decrease.
- The provision of information in dynamic advertising would extend current requirements of the Directive on promotional literature. It was not possible to quantify the impacts arising from this channel, but this is expected to generate less benefits (than the provision of information through other channels) as it mainly affects choices indirectly by enhancing familiarity and consequently the use of information provided by other information channels during the purchase stage. The information that can be communicated via this channel is also more limited. There are also differences between mediums, with the provision of information in online promotional materials expected to be more effective compared to radio or TV. In addition, stakeholders from the advertising industry have identified a potential loss of revenues for their sector.
- The removal of the requirements to use more traditional channels currently mandated in the Directive such as the printed guide and the poster is expected to have little to no impacts. Indeed, some Member States have moved to the exclusive provision of the electronic version of the guide[3]. There is, however, a risk of excluding certain population segments with lower digital skills, which could be

[1] The range of the upper bound estimates reflects the actual definition of the measures considered: the results of the provision of the label online also take into account the effects of providing new information elements (e.g. costs, air pollutants) in this label that cannot be disentangled; the results of the provision of web-platforms consider both the effects of providing information online (similar to those of the online label) but also allowing users to customise specific settings (e.g. mileage) to obtain more relevant information.

[2] Including DK, FR, ES, BE, FI, EE, SE, AT according to (Ricardo and TEPR, 2016)

[3] Including AT, IT, BE, EE, FI, NL, PT, SE, SK according to (Ricardo and TEPR, 2016).

minimised by requiring the provision of the printed version of the guide when requested by the consumer.

- The provision of an interactive display could also in part replace the use of the poster and may deliver benefits by providing more relevant and tailored information to consumers, This could affect sales of new xEVs, which could increase up to 1.5 percentage points in 2030, compared to the baseline (and also emissions reductions). However, there is an associated cost to dealers for providing these devices, which should not be neglected. The number of devices available in the showroom is also important to determine their use and thus their impacts.
- Other channels to communicate information considered such as the use of information campaigns and training events are anticipated to bring small benefits but also at a small cost.

Information elements

- Provision of cost information (running costs on the label and TCO for other information channels) and information on air pollutants and electric range are found to bring the most significant benefits.
    - Provision of TCO information is expected to lead to increase in share of xEVs sold by approximately 2 percentage points in 2030, compared to the baseline (and also emissions reductions). It is expected to facilitate comparisons between powertrains, especially in the future, when prices and TCO of xEVs decrease and the gap between conventional powertrains and alternative ones narrows down. Not all information channels are viewed as appropriate for provision of this information.
    - Provision of running costs is expected to increase share of xEVs in sales by up to 0.2 percentage points in 2030. They are also expected to contribute to the decisions that lead to more TCO savings for lower-income households (overall up to 3.7% reductions in TCO can be expected if running costs are provided).
    - Adding information on air pollutants or electric range can be expected to lead to the increase the share of xEVs in sales by up to 0.1-0.2 percentage points, compared to the baseline. Consumers understand, trust and value these elements when making choices. There are important design and methodological considerations to make which can further improve their effectiveness. The information on air pollutants is better understood when presented in the context of local air quality restrictions, due to its direct practical value to the consumers.
    - No significant costs are expected to arise for businesses if these information elements are provided, as most of these elements will be available in the Certificate of Conformity (CoC) or a database in which businesses could directly use to comply with the new information provision requirements. There might be costs for the automotive industry associated to those elements if and where they are in charge of the calculations. The provision of TCO information and air pollutant emissions is likely to cause more significant costs to the authorities as there is a potential need to take into account local air quality restrictions and reflect them on the label.
- Other information elements with more limited impacts include: tax information, but only if appropriate fiscal incentives are in place; the provision of a QR code with a link to a comparison website (although there could be resource and cost implications for the authorities to develop and maintain the electronic resources accessed through a QR code).

- Provision of real-world values is not anticipated to lead to significant impacts in terms of awareness or choices, although there is a possibility to contribute positively through trust of the consumers.
- Despite raised awareness, the provision of WTW CO_2 emissions information is expected to lead to less sustainable choices (reduction of share of xEVs in sales of up to 1 percentage point in 2030 compared to the baseline). This is due to less apparent differences between powertrains in the eyes of consumers. In addition, authorities found that the provision of WTW emissions will lead to significant costs associated with the need to establish a methodology, collect and update the data regularly and the communication.

Scope of the requirements

- Analysis has shown that extending requirements (including some of the information channels and information elements described above) to new vans is expected to bring important environmental, economic and social benefits at a low cost.
- Extending the new potential requirements (including the display of the label online that contains new information elements such as running costs, air pollutants and electric range) to new vans is expected to result in an increase in sales of xEVs and more efficient vans, leading to emission reductions compared to the baseline in 2030.
- The strongest benefits would arise for small commercial organisations and private buyers which are likely to be less aware of this relevant information. An aspect to consider is that vans are sold in a different way compared to passenger cars and thus the most effective channels might differ (e.g., online channel more important than the physical label in the showroom). Nevertheless, labelling for new vans has already been introduced in some countries, such as Denmark, Spain, Poland, Sweden and Austria.
- Extending the requirements to used cars is expected to result in positive benefits, especially considering that, in some European countries, the used car market is three times larger than the new car market. Finland has extended the requirements of the Directive to used cars, on a voluntary basis.
- Message consistency can be particularly improved by targeting used and new cars. To a certain extent, used car buyers can benefit more from the information provided than new car buyers as the first value more the information on fuel economy, being a significant proportion of vehicle operating costs. In particular, it can directly benefit lower income consumers that are more likely to buy used cars. However, environmental benefits are likely to be smaller given the smaller choice of more efficient cars in the second-hand market.
- Extending the scope to used cars could result in significant one-off costs for authorities associated with database adaptation (i.e., redesign of IT platform) and the collation of data on used cars. There are also significant challenges associated with implementing the requirements to used cars that can limit its effectiveness:
    - There is a risk for information reliability for used cars as the emission performance of older cars can get worse and the running costs/TCO can be hard to predict, depending of the age of the used cars. One solution could be to limit the inclusion of used cars up to a certain age.
    - Monitoring and enforcement are difficult due to the private sale of used cars. A large part of this market is informal as used cars are often sold by private sellers. This would be minimised if only the formal market would be covered.
- Extending the requirements to rental vehicles is not expected to result in significant benefits as consumers whom rent these vehicles tend to base their choice of car on vehicle class and price, whereas fuel economy and environmental considerations are less relevant.

Harmonisation

- Increasing the level of harmonisation across all EU Member States could lead to positive impacts for the environment and society, by increasing familiarity, understanding and trust on the information provided and channels used to communicate it.
- Level of positive impact depend on the design and/or methodological specification made. It is also likely to vary from Member State to Member State, with the most significant impacts likely to be realised in those countries where the existing approach to implementation of the Directive differs the most to the harmonised approach being proposed.
- Harmonisation is expected to positively impact the functioning of the internal market but balance is needed. The flexibility to adapt the requirements to national circumstances is also important.
- It is expected that there will be compliance and administration costs for public authorities at the Member State level, related to:
    - the need to make changes to the label and methodologies that contribute to data displayed in the label;
    - updating databases;
    - internet-based services that use new data/methodologies; and
    - promotional material that attempts to communicate the changes that have been implemented.
- Aspects that are more likely to benefit from harmonisation at the EU level include:
    - Harmonising the design of the label, through taking a similar approach to label design to that used in the EU Energy Labelling Directive (2017/1369) (e.g. using coloured band representation with letters signifying each band, usually A to G);
    - Specifying the method underlying the way in which vehicles are assigned to a category (e.g., absolute, relative);
    - Specifying emission values that determine the way in which cars are assigned to assigned to a category (e.g., CO_2 emissions relating to each band); and
    - Establishing methodologies/rules determining how assumptions for the calculations should be made and adjusted.

Recommendations on the preferred combination of policy measures

Overall, the following recommendations can be made for a future revision of the Car Labelling Directive:

- Provision of the following **additional information elements: running costs, air pollutants, and electric range** whenever the label is displayed (physical or online)**.**
- The **provision of the label online** which includes additional information elements (running costs, air pollutants, and electric range, as identified above).
- The **harmonisation of certain design elements, style of the label and methodological aspects**. In particular, the use of a similar style to that of the EU Energy Label seems appropriate. However, flexibility should be retained in other areas to enable Member States to reflect national circumstances.
- Additionally, it is recommended that the guide is made available in electronic format and that the production of a printed guide is made optional (although made available on request). Also, the requirement to present a poster in the showroom could be replaced with the provision of an interactive display that enables configuration of vehicle models.

The following measures could also generate benefits and their implementation should be considered as part of a future revision of the Car Labelling Directive or a different policy instrument provided the challenges identified can be resolved:

- **Websites that allow vehicle comparisons** are expected to bring additional benefits if they enable customisation of the information to the consumers' circumstances and where additional information is able to be provided. In addition to the provision of the new label (with the additional information elements described above), the provision of the following information elements should also be considered: fuel economy and CO_2 emissions for different drive cycles, charge time, customised cost measures (e.g., running costs or TCO tailored to a user-defined time period, location), additional information (e.g., map of charging points). However, there is a more significant cost associated with the development of these websites and thus there is a need to consider whether it should be implemented at the EU or Member State level;
- Requiring the **provision of TCO whenever the price of the vehicle is displayed** could also generate positive impacts, especially in the long-term. However, the calculation methodology should be defined beforehand to ensure comparability.
- Extending the requirements on promotional literature to **dynamic advertising**, and in particular, online advertising could also have an impact, although benefits are smaller. If adopted, further consideration of the information elements to include is crucial. A simplified information standard (e.g., only colour band for CO_2 emissions but not the values) seems more appropriate for this channel.
- **Extending the scope of these requirements to vans and used cars** could also deliver benefits to a smaller extent and thus it should be considered. For these vehicle categories, it is particularly important that information on costs is provided through the relevant channels. However, there are challenges associated with implementing the requirements to used cars which would need to be addressed to ensure that these benefits are indeed realised (e.g., only include the formal market).

Résumé analytique

Cette étude visait à fournir à la Commission européenne des recommandations fondées sur des données probantes pour l'élaboration de mesures politiques visant à sensibiliser les consommateurs aux économies de carburant et aux émissions des véhicules légers. À cette fin, l'étude envisageait des améliorations à apporter aux mesures existantes, telles que la directive sur l'étiquetage des voitures, mais aussi l'introduction de nouvelles mesures susceptibles de compléter ou de remplacer les mesures existantes.

Un longue liste de 91 options politiques a été élaboré dans le but de résoudre les problèmes et les facteurs identifiés. Une approche d'analyse systématique conforme au Guide pour une meilleure réglementation a abouti à une liste réduite de 26 mesures.

Une analyse détaillée des impacts potentiels des mesures présélectionnées a été entreprise pour trois grandes catégories : impacts économiques, environnementaux et sociaux. Ces mesures ont été regroupées en fonction des thèmes qu'elles abordent, avec les différents éléments politiques suivants :

- Modification des **canaux d'information** (CI) par lesquels l'information est communiquée ;
- Modification des **éléments d'information** (EI) qui sont communiqués ;
- Elargissement du **champ d'application** (C) de la directive sur l'étiquetage des voitures ; et
- Renforcement du niveau d'**harmonisation** (H) de la mise en œuvre dans les États membres.

L'analyse a été réalisée sur la base d'une combinaison des éléments suivants :

- **Résultats de la recherche théorique et documentaire** : une recherche documentaire a été entreprise tout au long de l'étude et a identifié des rapports pertinents ainsi que des données de recherche pertinentes pour les questions abordées.
- **Contribution des parties prenantes** : elles comprenaient les commentaires d'un panel de parties prenantes (représentant les consommateurs et les constructeurs automobiles) ; une enquête ciblée auprès des autorités nationales des États membres de l'UE et des entretiens ciblés auprès d'un éventail de parties prenantes concernées, contribuant à la fois à la collecte de données sur les coûts attendus et à l'efficacité de la mise en œuvre des mesures présélectionnées ; et des demandes de données communiquées à des parties prenantes spécifiques afin de combler les éventuelles lacunes.
- **Résultats d'une expérience menée auprès des consommateurs pour les besoins de cette étude** : des essais contrôlés randomisés (ECR) ont été menés auprès de plus de 8 000 consommateurs participants issus de trois pays (Allemagne, Espagne et Pologne) dans un environnement en ligne simulant un site Internet tiers où les consommateurs obtiennent des informations sur des véhicules à acheter ou à louer. Cette expérience visait à obtenir des conclusions statistiques solides sur l'efficacité des différentes mesures politiques, en se concentrant sur les éléments pour lesquels il existe un manque de données factuelles ou de consensus dans la documentation. Quatre traitements expérimentaux ont été testés auprès des consommateurs à propos d'un nouveau concept d'étiquette comprenant des éléments d'information supplémentaires, la date d'apposition de l'étiquette et la personnalisation des informations affichées. Les résultats de ces expériences ont alimenté l'analyse quantitative.
- **Modélisation SULTAN** : les résultats de l'expérience menée auprès des consommateurs ont été utilisés comme données dans le modèle SUstainabLe TrANsport (SULTAN) afin de contribuer à quantifier certains impacts des mesures évaluées.

Limites de l'analyse

L'analyse quantitative de l'impact des mesures est basée sur les réponses des consommateurs lors de l'expérience comportementale. Il existe une incertitude quant à la conversion des résultats de la réponse des consommateurs en décisions d'achat réelles, qui n'a pas pu être quantifiée dans le cadre des recherches de ce projet.

L'analyse suppose également qu'il n'y a pas de restrictions dans l'offre de modèles de véhicules efficaces, car ceux-ci sont fortement déterminés par les objectifs de la réglementation sur le CO2. En d'autres termes, elle suppose que les modèles choisis par les consommateurs seront effectivement disponibles à la location/achat. L'information du consommateur (par exemple l'étiquette) ne doit donc pas être comprise comme déclenchant une augmentation de l'offre de ZEV, mais plutôt comme orientant les consommateurs dans leurs choix parmi les types et modèles de véhicules disponibles sur le marché.

Conclusions et recommandations

Les conclusions et recommandations pour chacun des éléments de politique abordés dans cette étude sont présentées ci-dessous.

Canaux d'information

- La fourniture d'informations via des canaux en ligne (tels que l'étiquette à afficher en ligne et l'utilisation de plateformes Internet pour obtenir des comparaisons de véhicules) pourrait impacter les ventes de nouveaux xEV (c.-à-d. de PHEV et de BEV) le plus. La part des ventes de ces engins pourraient augmenter de cinq points de pourcentage en 2030par rapport au scénario de référence, ce qui aurait un effet positif en termes de réduction des émissions de GES et de la pollution[4].
- Si la mise à disposition de l'étiquette en ligne est susceptible de générer des coûts négligeables, il existe un coût plus important associé au développement et à la maintenance des sites Internet pour les comparaisons de véhicules (jusqu'à 35 000 € de coûts ponctuels et 217 000 € de coûts récurrents annuels). Il convient toutefois de noter qu'un certain nombre d'États membres[5] ont déjà mis en œuvre des solutions similaires. Certains États membres (IE, HR, AT, FR, SI, EE) ont également suggéré que cette solution soit centralisée et fournie au niveau de l'UE, ce qui éliminerait les coûts pour les autorités nationales.
- L'utilisation du devis afin de fournir des informations pertinentes représente un canal d'information supplémentaire qui n'est pas actuellement envisagé par la directive, mais qui pourrait avoir des effets positifs avec peu ou pas de coûts, si les informations sur le coût total de possession (CTP) sont fournies par l'intermédiaire de ce canal : les ventes de xEV neufs pourraient augmenter de deux points de pourcentage en 2030 par rapport au scénario de référence (entraînant ainsi une réduction des émissions de GES et dela pollution atmosphérique). Les effets attendus de ce canal (devis) ne peuvent être dissociés des effets de la mise à disposition des informations sur le CTP qui feront des xEV un choix plus attractif au fil du temps par rapport aux groupes motopropulseurs conventionnels dans la mesure où le prix des xEV devrait baisser.
- La fourniture d'informations par le biais de publicités dynamiques élargirait les exigences actuelles de la directive sur la documentation promotionnelle. Il n'a pas été possible de quantifier les impacts découlant de ce canal, mais cela devrait

[4] La fourchette des estimations de la limite supérieure reflète la définition existante des mesures envisagées : les résultats de la mise à disposition de l'étiquette en ligne prennent également en compte les effets de la mention dans cette étiquette de nouveaux éléments d'information (par exemple : les coûts, les polluants atmosphériques) qui ne peuvent être dissociés ; les résultats de la mise à disposition de plateformes Internet prennent en compte les effets de la mention d'informations en ligne (similaires à ceux de l'étiquette en ligne), mais aussi les effets de la personnalisation par les utilisateurs de paramètres spécifiques (par exemple : le kilométrage) afin d'obtenir des informations plus pertinentes.

[5] Notamment les États suivants : DK, FR, ES, BE, FI, EE, SE, AT (Ricardo and TEPR, 2016)

générer moins d'avantages (que la fourniture d'informations via d'autres canaux) dans la mesure où cela affecte principalement les choix de manière indirecte en améliorant la familiarisation et, par conséquent, l'utilisation des informations fournies par d'autres canaux d'information lors de la phase d'achat. Les informations susceptibles d'être communiquées par le biais de ce canal sont également plus limitées. Il existe également des différences entre les modes de communication, la communication d'informations via le support promotionnel disponible en ligne devant être plus efficace que dans le cas de la radio ou de la télévision. De plus, les acteurs de l'industrie de la publicité ont identifié une perte potentielle de revenus pour leur secteur.

- La suppression des exigences relatives à l'utilisation de canaux plus traditionnels figurant actuellement dans la directive, tels que le guide imprimé et l'affiche, devrait avoir peu ou pas d'impact. En effet, certains États membres sont passés à la fourniture exclusive de la version électronique du guide[6]. Il existe cependant un risque d'exclusion de certains segments de la population ayant des compétences numériques limitées, mais ce risque pourrait être minimisé en exigeant la fourniture de la version imprimée du guide à la demande du consommateur.
- La mise à disposition d'un écran interactif pourrait également remplacer en partie l'utilisation de l'affiche, et cette solution pourrait offrir des avantages, fournissant aux consommateurs des informations plus pertinentes et personnalisées. Ceci pourra affecter les ventes de xEV neufs, qui pourraient augmenter de 1.5 points de pourcentage en 2030par rapport au scénario de référence (entraînant ainsi une réduction des émissions de GES) année. Cependant, il existe pour les revendeurs un coût associé à la fourniture de ces dispositifs, qui ne doit pas être négligé. Le nombre de dispositifs disponibles dans le showroom est également important pour déterminer leur utilisation et donc leur impact.
- D'autres canaux envisagés pour la communication des informations, tels que l'utilisation de campagnes d'information et d'événements de formation, devraient apporter des avantages mineurs, mais également à un faible coût.

Éléments d'information

- La fourniture d'informations sur les coûts (coûts de fonctionnement sur l'étiquette, et CTP pour les autres canaux d'information) et d'informations sur les polluants atmosphériques et l'autonomie électrique est considérée comme apportant les avantages les plus significatifs.
    - La fourniture d'informations sur le CTP devrait augmenter la part des ventes de xEV à hauteur d'environ deux points de pourcentage en 2030 par rapport au scénario de référence (ainsi entrainant une baisse des émissions de GES). Cela devrait faciliter les comparaisons entre les groupes motopropulseurs, en particulier à l'avenir, lorsque les prix et le CTP des xEV baisseront et que l'écart entre les groupes motopropulseurs conventionnels et les groupes alternatifs se réduira. Tous les canaux d'information ne sont pas considérés comme étant appropriés pour fournir ces informations.
    - L'intégration des coûts de fonctionnement devrait augmenter la part des ventes de xEV à hauteur d'environ 0.2 points de pourcentage en 2030 par rapport au scénario de référence. Cela devrait également contribuer aux décisions qui conduisent à des économies accrues en termes de CTP pour les ménages à faible revenu (globalement, jusqu'à 3,7% de réduction du CTP peuvent être attendus si l'information sur les coûts de fonctionnement est intégrée).

[6] Notamment les États suivants : AT, IT, BE, EE, FI, NL, PT, SE, SK (Ricardo and TEPR, 2016).

  - L'ajout d'informations sur les polluants atmosphériques ou l'autonomie en mode électrique devrait augmenter la part des ventes de xEV à hauteur d'environ 0.1-0.2 points de pourcentage en 2030 par rapport au scénario de référence. Les consommateurs comprennent ces éléments qu'ils apprécient et auxquels ils se fient lors de leurs choix de véhicules. Il y a des facteurs importants à prendre en compte en matière de conception et de méthodologie qui peuvent encore améliorer leur efficacité. Les informations sur les polluants atmosphériques sont mieux comprises lorsqu'elles sont présentées dans le contexte des restrictions locales en matière de préservation de la qualité de l'air, en raison de leur intérêt pratique immédiat pour les consommateurs.
  - Aucun coût significatif ne devrait s'appliquer pour les entreprises si ces éléments d'information sont fournis, car la plupart de ces éléments seront disponibles dans le certificat de conformité (CdC) ou dans une base de données que les entreprises pourraient directement utiliser afin de se conformer aux nouvelles exigences en matière de communication d'informations. Il pourrait y avoir des coûts associés à ces éléments pour l'industrie automobile si les calculs y afférents sont à sa charge. La fourniture d'informations sur le CTP et les émissions de polluants atmosphériques est susceptible d'entraîner des coûts plus importants pour les autorités, car il est possible qu'il soit nécessaire de prendre en compte les restrictions locales en matière de protection de la qualité de l'air et de les mentionner sur l'étiquette.

- D'autres éléments d'information ont des impacts plus limités, tels que : les informations fiscales, mais uniquement si des incitations fiscales appropriées sont en place ; la fourniture d'un QR code avec un lien vers un site Internet de comparaison (bien qu'il puisse y avoir, pour les autorités, des implications en termes de ressources et de coûts pour développer et maintenir les ressources électroniques accessibles via un QR code).
- La fourniture de valeurs réelles ne devrait pas conduire à des impacts significatifs en termes de sensibilisation ou de choix, bien qu'une contribution positive soit possible grâce à la confiance des consommateurs.
- Malgré une meilleure sensibilisation, la fourniture de données sur les émissions de CO2 WTW devrait conduire à des choix moins durables (réduction de la part desventes de xEV jusqu'à un point de pourcentage en 2030 par rapport au scénario de référence). Cela s'explique par une différence moins apparente entre les groupes motopropulseurs aux yeux des consommateurs. En outre, les autorités ont constaté que la fourniture de données sur les émissions de CO2 WTW entraînera des coûts importants associés à la nécessité d'établir une méthodologie et de collecter et actualiser les données régulièrement, ainsi qu'à la communication.

Champ d'application des exigences

- L'analyse a démontré que l'élargissement des exigences (y compris pour certains des canaux d'information et éléments d'information décrits ci-dessus) aux véhicules utilitaires neufs devrait apporter d'importants avantages environnementaux, économiques et sociaux, à un faible coût.
- L'élargissement des nouvelles exigences potentielles (y compris l'affichage de l'étiquette en ligne contenant de nouveaux éléments d'information tels que les coûts de fonctionnement, les polluants atmosphériques et l'autonomie électrique) aux véhicules utilitaires neufs devrait entraîner une augmentation des ventes the xEVs et de véhicules utilitaires plus efficaces, entrainant ainsi une réduction des émissions de GES en 2030par rapport au scénario de référence.
- Les plus grands bénéficiaires seraient les petites organisations commerciales et les acheteurs privés qui sont probablement moins conscients de ces informations

pertinentes. Il convient de souligner que les véhicules utilitaires sont vendus d'une manière différente par rapport aux voitures particulières, et que les canaux d'information les plus efficaces peuvent donc différer (par exemple, le canal d'information en ligne est plus important que l'étiquette physique affichée dans le showroom). Néanmoins, l'étiquetage des véhicules utilitaires neufs a déjà été introduit dans certains pays, comme le Danemark, l'Espagne, la Pologne, la Suède et l'Autriche.

- L'élargissement des exigences aux voitures d'occasion devrait entraîner des avantages positifs, d'autant plus que, dans certains pays européens, le marché des voitures d'occasion est trois fois plus important que celui des voitures neuves. La Finlande a étendu les exigences de la directive aux voitures d'occasion, sur la base du volontariat.
- La cohérence des messages peut être particulièrement améliorée en ciblant les voitures d'occasion et les voitures neuves. Dans une certaine mesure, les acheteurs de voitures d'occasion peuvent davantage bénéficier des informations fournies que ne le font les acheteurs de voitures neuves, car les premiers attachent plus d'importance aux informations portant sur la consommation de carburant, laquelle représente une part importante des coûts de fonctionnement des véhicules. En particulier, cela peut profiter directement aux consommateurs à faible revenu qui sont plus susceptibles d'acheter des voitures d'occasion. Cependant, les avantages environnementaux seront probablement moindres étant donné que le choix de voitures plus performantes sur le marché de l'occasion est plus restreint.
- L'élargissement du champ d'application aux voitures d'occasion pourrait entraîner, pour les autorités, des coûts ponctuels importants associés à l'adaptation de la base de données (c'est-à-dire à la refonte de la plateforme informatique) et à la collecte des données sur les voitures d'occasion. Il existe également des difficultés importantes associées à l'application des exigences aux voitures d'occasion qui peuvent limiter son efficacité :
    - Il existe un risque concernant la fiabilité des informations pour les voitures d'occasion, car les performances des voitures plus anciennes en matière d'émissions peuvent se détériorer et les coûts de fonctionnement et le CTP peuvent être difficiles à prévoir en fonction de l'âge des voitures d'occasion. Une solution pourrait consister à limiter l'inclusion des voitures d'occasion jusqu'à un certain âge.
    - La surveillance et l'application sont difficiles en raison des ventes privées de voitures d'occasion. Une grande partie de ce marché est en effet informelle car les voitures d'occasion sont souvent vendues par des vendeurs privés. Cette difficulté serait minimisée si seul le marché formel était couvert.
- L'élargissement des exigences aux véhicules de location ne devrait pas entraîner d'avantages importants, car les consommateurs qui louent ces véhicules ont tendance à fonder leur choix de voiture sur la catégorie et le prix du véhicule, alors que les économies de carburant et les considérations environnementales sont moins pertinentes.

Harmonisation

- Le renforcement du niveau d'harmonisation dans tous les États membres de l'UE pourrait avoir des effets positifs pour l'environnement et la société, en améliorant la familiarisation, la compréhension et la confiance accordée aux informations fournies ainsi que les canaux utilisés afin de les communiquer.
- Le niveau d'impact positif dépend de la conception et/ou des spécifications méthodologiques. Il est également susceptible de varier d'un État membre à l'autre, les impacts les plus importants étant susceptibles de se produire dans les pays où l'approche actuelle de mise en œuvre de la directive diffère le plus de l'approche harmonisée qui est proposée.

- L'harmonisation devrait avoir un impact positif sur le fonctionnement du marché intérieur, mais un équilibre est nécessaire. La flexibilité requise afin d'adapter les exigences aux contextes nationaux est également importante.
- On s'attend à ce que les autorités publiques de chaque État membre aient à supporter des coûts de conformité et d'administration liés :
    - à la nécessité d'apporter des modifications à l'étiquette et aux méthodologies utilisées pour renseigner les données affichées sur l'étiquette ;
    - à la mise à jour des bases de données ;
    - aux services en ligne qui utilisent de nouvelles données/méthodologies ; et
    - au support promotionnel qui tente de communiquer les changements qui ont été mis en œuvre.
- Les aspects les plus susceptibles de bénéficier d'une harmonisation au niveau de l'UE sont notamment les suivants :
    - Harmonisation de la conception de l'étiquette, en adoptant une approche similaire à celle utilisée dans le cadre de la directive européenne sur l'étiquetage énergétique (2017/1369) (par exemple, en utilisant une représentation comportant des bandes colorées assorties de lettres explicitant la signification de chaque bande, allant généralement de A à G) ;
    - Spécification de la méthode sous-jacente à l'affectation des voitures à une catégorie (par exemple : absolue, relative) ;
    - Spécification des valeurs d'émission qui déterminent la manière dont les voitures sont affectées à une catégorie spécifique (par exemple : les émissions de CO2 associées à chaque bande) ; et
    - Établissement de méthodologies/règles déterminant la manière dont les hypothèses doivent être formulées et ajustées pour les calculs.

Recommandations sur la combinaison préférée de mesures politiques

Dans l'ensemble, les recommandations suivantes peuvent être proposées pour une future révision de la directive sur l'étiquetage des voitures :

- Mise à disposition des **éléments d'information supplémentaires suivants : coûts de fonctionnement, polluants atmosphériques et autonomie électrique** lorsque l'étiquette est affichée (de manière physique ou en ligne).
- **Mise à disposition de l'étiquette en ligne** qui comprend des éléments d'information supplémentaires (coûts de fonctionnement, polluants atmosphériques et autonomie électrique, comme indiqué ci-dessus).
- **Harmonisation de certains éléments de conception, du modèle d'étiquette et des aspects méthodologiques**. En particulier, l'utilisation d'un modèle similaire à celui de l'étiquette énergétique de l'UE semble appropriée. Cependant, la flexibilité devrait être conservée dans d'autres domaines afin de permettre aux États membres de prendre en compte les contextes nationaux.
- De plus, il est recommandé que le guide soit mis à disposition sous format électronique et que la production d'un guide imprimé soit rendue facultative (bien que disponible sur demande). De plus, l'exigence relative à la présentation d'une affiche dans le showroom pourrait être remplacée par la mise à disposition d'un affichage interactif permettant la configuration des modèles de véhicules.

Les mesures suivantes pourraient également générer des avantages, et leur mise en œuvre devrait être envisagée dans le cadre d'une future révision de la directive sur l'étiquetage des voitures ou d'un autre instrument politique à condition que les difficultés identifiées puissent être résolues :

- **Les sites Internet qui permettent de comparer des véhicules** devraient apporter des avantages supplémentaires s'ils permettent de personnaliser les informations en fonction de la situation des consommateurs et si des informations supplémentaires peuvent être fournies. Outre la mise à disposition de la nouvelle étiquette (avec les éléments d'information supplémentaires décrits ci-dessus), la fourniture des éléments d'information suivants devrait également être envisagée : économies de carburant et émissions de CO2 pour différents cycles de conduite, temps de charge, mesures personnalisées des coûts (par exemple : coûts de fonctionnement ou CTP adaptés à une période et à un lieu définis par l'utilisateur), informations supplémentaires (par exemple : carte des bornes de recharge). Cependant, le développement de ces sites Internet entraîne un coût plus important et il est donc nécessaire de se demander s'il doit être mis en œuvre au niveau de l'UE ou des États membres ;
- Le fait d'exiger **la communication du CTP chaque fois que le prix du véhicule est affiché** pourrait également générer des impacts positifs, notamment sur le long terme. Cependant, la méthodologie de calcul doit être définie afin de garantir la comparabilité.
- L'élargissement des exigences en matière de documentation promotionnelle à la **publicité dynamique**, et en particulier à la publicité en ligne, pourrait également avoir un impact, même si les avantages sont moindres. Si ce point est adopté, il est important de procéder à un examen plus approfondi des éléments d'information à inclure. Une norme d'information simplifiée (par exemple : uniquement les bandes de couleurs pour les émissions de CO2 mais pas les valeurs) semble plus appropriée pour ce canal.

L'élargissement de la portée de ces exigences aux véhicules utilitaires et aux voitures d'occasion pourrait également offrir des avantages dans une moindre mesure et devrait donc être envisagé. Pour ces catégories de véhicules, il est particulièrement important que les informations sur les coûts soient fournies par les canaux appropriés. Cependant, l'application de ces exigences aux voitures d'occasion soulève des difficultés qui devraient être abordées afin de s'assurer que ces avantages se concrétisent (par exemple : en n'incluant que le marché formel).

1. Introduction and overview

1.1. Introduction

Ricardo, the Behavioural Insights Team (BIT) and Transport and Environmental Policy Research (TEPR) have been commissioned to provide support to the European Commission on "Technical analysis of measures to improve consumer awareness of emissions and fuel consumption of vehicles" (hereafter, the 'project'). The project was commissioned by the European Commission's DG Climate Action (hereafter 'the EC').

This Draft Final Report provides:

- a summary of the approach to evidence collection (Section 1.3);
- an overview of the identification of policy measures (Section 0);
- an analysis of the impacts of the policy measures (Section 3);
- an overview of design and methodological elements (Section 4);
- a comparison of the policy measures and synergies (Section 0); and
- conclusions and recommendations (Section **Error! Reference source not found.**).

1.2. Background, scope and objectives of the study

The importance of measures to improve consumer awareness of the fuel economy and CO_2 emissions of new cars has been recognised at the European level since the mid-1990s. The Car Labelling Directive (1999/94/EC) is the most important legal instrument at the EU level setting out measures to stimulate the demand for more fuel-efficient cars.

The Car Labelling Directive requires the provision of information on the fuel economy and CO_2 emissions of new cars and sets out the basic requirements that the established information tools (i.e., the label, poster/display, guide, promotional literature) must meet e.g. the units, for presenting the information on fuel economy and CO_2 emissions, and relevant minimum dimensions, e.g. for the label. It however also leaves Member States with a high degree of flexibility, since these requirements are not very prescriptive. In fact, many Member States have gone beyond the basic requirements, which has led to a lack of uniform implementation.

Since its adoption in 1999, the Directive has been amended once (in 2003[7]) and complemented by two Commission Recommendations[8] to Member States on how to implement particular aspects of the Directive. More recently, the new Light Duty Vehicle (LDV) CO_2 Regulation ((EU) 2019/631) requires the Commission to review the Car Labelling Directive by the end of December 2020 and put forward legislative proposals if appropriate. This underlines the continuing importance of demand-side policies for reducing transport's CO_2 emissions.

The aim of this study was therefore to provide the European Commission with evidence-based recommendations for policy measures that improve consumer awareness of light duty vehicles' fuel economy, CO_2 emissions and air pollutant emissions. For this purpose, the study considers improvements to the existing measures, such as the Car Labelling

7 Commission Directive 2003/73/EC allowed the poster to be replaced (or complemented) by an electronic display.

8 Commission Recommendation 2003/217/EC recommending that Member States extend the Directive's provisions relating to promotional material, which the Directive defines as 'printed matter', to other forms of promotional material, including that transmitted electronically, Commission Recommendation (EU) 2017/948 recommending how Member States should transition from presenting the fuel economy and CO_2 values measured under the New European Driving Cycle (NEDC) to its successor the Worldwide harmonised Light-Duty Test Procedure (WLTP)

Directive, but also the introduction of new measures that can complement or substitute existing measures.

The study covers both regulatory and non-regulatory measures, at EU and Member State level, that can integrate the existing framework for both passenger cars and light commercial vehicles. It takes into account the specific context of all EU Member States, as well as the relevant policies and trends at both European and international level.

To this end, the present study has considered a number of important issues that have emerged or gained greater importance more recently:

- **The change in the test cycle** used to measure the fuel economy and CO_2 emissions of new cars.
- **The forthcoming transition to zero and low-carbon mobility**. The next decade is expected to see a significant transition to zero and low-carbon vehicles; however, the Directive in its current form does not require accurate information to be provided on alternative powertrains such as electric and hydrogen vehicles. Thus, it will be important that consumers are well informed of the benefits of different powertrains so that they are able to make fair comparisons. This opens up a range of possibilities on how to communicate information a way that is understandable, clear and fair – aspects that have to some extent been explored in recent studies but needs further investigation in the context of this project. Moreover, the inclusion of different types of information is also a possibility, such as 'electric range' and 'energy consumption'.
- **The potential to extend the Directive to include light commercial vehicles**. This has been done already in some countries, and has been under consideration for some time. Regulation (EU) 2019/631 setting CO_2 emission performance standards for new passenger cars and light commercial vehicles (LCVs) called for the Commission to consider options for introducing a fuel economy and CO_2 emissions label for new LCVs.
- **Changing purchasing habits of consumers**. For example, new car buyers now visit a showroom less frequently, and an increasing proportion of car buyers undertake research on the internet. The proposed study will therefore need to reflect on the extent to which it might be important to legislate on the way in which relevant information is presented on the internet and what the implications for the Directive's other communication means might be. Linked to this is potential to use other digital means to communicate information to potential consumers. The increasing prevalence of smart phones has opened up more possibilities to manufacturers for presenting information, and to consumers for searching for and accessing information. The potential for the use of more digital technology in car showrooms could also usefully be explored, although consideration would need to be given to how this complements the existing mechanisms, particularly the label. Digital technology will also be important in helping dealers illustrate to consumers the potential impact on CO_2 emissions performance of configuring a new car differently with respect to the WLTP test cycle.
- **The increased political profile and consumer awareness of air quality**. There are also calls for air quality information to help consumers understand the compatibility of different vehicles with "low emission zones" that have been, or will be, introduced by some cities across the EU. For new cars, information on air pollutant emissions performance would not bring much in the way of added value if it were simply to state the Euro standard, as all new cars have to comply with this standard (although it could be of value for used vehicles). On the other hand, providing information on actual emissions might be problematic as this information is not generally publicly available. Furthermore, many countries, e.g. Germany, already have established systems in place for indicating to motorists whether or not their car is allowed in a particular 'environmental' zone.

- **The importance of trust and perceived reliability of the information**. The "dieselgate" scandal shook public confidence in the reliability of information on air pollutants, and there is a growing awareness of a gap between real-world pollutant emissions performance and test cycle performance. Revisions to the testing approaches aim to reduce this problem, and there may also be a complementary role in the communication of such information to help restore public trust and increase understanding. This means that aspects such as the official source and verifiability of any information provided should be considered, as well as potential supporting actions to raise awareness and trust of that information.
- **The consistency, coherence and coverage of information** that will be communicated to consumers. Regulation (EU) 2019/631 also called for the forthcoming study to review the need for better designed and further harmonised Union requirements for labelling. It will be important to identify the extent of a common approach across the EU, bearing in mind the pan-European nature of the EU car market. This could also imply a change of the legal instrument used (i.e. moving from a Directive to a Regulation), as is the case with the energy label for electric appliances (Regulation (EU) 2017/1369). Information on a specific model of car will be included in its Certificate of Conformity (CoC), which has been updated in the last couple of years to take account of the WLTP. Basing any information communicated to consumers on that in the CoC will guarantee the consistency and coherence of the information and will thus ensure that it is available across the whole of the EU. Any other data that a future legislative proposal requires be communicated to consumers may need to satisfy similar conditions, which would currently prove to be more challenging for some potential information that could be of interest to consumers, such as the actual emissions of air pollutant, e.g. NO_x, real-world CO_2 and life cycle emissions.

1.3. Overview of methodology

The methodological approach taken to meet the objectives of the project was based on the Better Regulation principles and informed by a range of research tools. It included the following tasks:

- **Problem tree and identification of objectives**, to agree on the key problem areas and drivers that require a policy response, and establish the overall objectives of the intervention;
- **Identification of measures,** to develop and screen the range of policy responses into a short-list of measures validated by stakeholders;
- **Detailed design of short-listed measures,** to characterise further the retained measures to allow the detailed assessment of their impacts and consultation with stakeholders;
- **Assessment of impacts,** to assess and/or quantify the impacts of the retained measures against a baseline (no-change) scenario; and
- **Comparison of measures**, to bring the evidence together and provide an assessment of the preferable policy measures/options.

The research tools that supported the analysis are summarised in

Table 1-1 (more details are provided in stated annexes).

Table 1-1: Research tools used in this study

Research tools	Description and objectives	Contributed to
Data collection	Ran throughout the course of the study and fed into the subsequent tasks (see Annex A).	All tasks
Engagement with a panel of key stakeholders	The panel was made up of two stakeholders – one representing vehicle manufacturers, and a second representing consumers. It was set up to provide guidance, advice and review of the proposed methods and produced results (see Annex A).	• Problem tree • Identification of measures • Detailed design of short-listed measures • Assessment of impacts
Targeted survey of national authorities	To collect data on expected costs and effectiveness of implementation of the short-listed measures. Aimed at competent authorities responsible for the implementation of the policy measures, which vary by Member State (see Annexes A and B).	Assessment of impacts
Targeted interviews	To gather information on the expected impacts and practical implementation of the short-listed measures for each stakeholder group. Covering a range of affected stakeholders, including industry and consumer organisations (see Annexes A and B).	Assessment of impacts
Data requests	For gap-filling of any data gaps that emerge after the other research tools (see Annex A).	Assessment of impacts
Consumer survey	Randomised controlled trials (RCTs) were conducted with over 8,000 participants in three countries (Germany, Spain and Poland) in an online environment that simulated a third-party website where consumers get information on vehicles to buy or lease. To obtain conclusions as to the effectiveness of different information elements of the retained measures, which in turn feed into the quantitative analysis (see Annex G).	Assessment of impacts*
SULTAN Modelling	Modelling undertaken using the SUstainabLe TrANsport (SULTAN) model to develop the baseline scenario and quantify the impacts of the measures under consideration (see Annex A). Inputs included outputs from the consumer survey.	Assessment of impacts*

* *There is uncertainty on the conversion of the consumer response findings into actual real-world purchase decisions, which could not be quantified as part of this project's research. The analysis also assumes that there are no restrictions in the supply of efficient vehicle models, i.e. the models chosen by the consumers will be effectively available for lease/purchase.*

2. Identification of policy measures

A set of policy measures was developed to address the problems and the drivers as identified and represented in the problem tree provided in Annex C.

Their identification involved three main steps in line with the Better Regulation Guidelines:

- Development of a full list of all possible measures;
- Initial screening of the long-list of measures; and
- Short-listing of measures.

In total, 91 measures were included in the long-list on the basis of desk research and stakeholder input (see Annex D). The list intended to identify potential improvements to provisions of the Car Labelling Directive, as well as other measures to raise consumer awareness (both at EU and Member State level) that would address the problems and the drivers previously identified. These measures were identified based on:

- findings of the evaluation of the car labelling Directive;
- new issues and issues for which information is scarce (e.g. air pollutant emissions, electric and other alternative powertrains);
- evidence and findings from around the world;
- evidence and findings from transport and other sectors (e.g. energy label); and
- exploratory interviews with the panel of key stakeholders.

An initial screening of this long-list of measures was conducted by the project team, and later validated by the stakeholder panel and DG CLIMA. The screening was qualitative in nature (based on literature review findings and expert judgement) and aimed to narrow down the long list in a sensible manner so that less preferable measures were discarded. Further details on the screening outcomes and discarded measures is provided in Annex E.

Following the screening exercise, 26 of the most promising measures were retained in the short list, which, when combined, address all the identified problem drivers (see

Table 2-1).

The measures were grouped into the topics that they address, reflecting different policy elements:

- Changes to the information channels (IC) through which information is communicated;
- Changes to the information elements (IE) that are communicated;
- Extension of the scope (S) of the Directive; and
- Increase in the level of harmonisation (H) of implementation in the Member States.

Table 2-1: Short-list of policy measures

Key:

Drivers: (D1) Limited information on performance of alternative powertrains; (D2) Incomplete information on GHG emissions (e.g. upstream); (D3) Current information tools do not cover all categories of vehicles; (D4) Limited and/or inaccurate information on air pollutant emissions; (D5) Limited and/or inaccurate information on fuel economy in real world conditions; (D6) Increasing role of new information channels and diminished relevance of traditional channels; (D7) Presentation of the information provided is inadequate; (D8) Implementation of the Car Labelling Directive differs among MS

Short-listed measures	Main driver/s (see Annex C)
Measures that implement changes to the information channels (IC) through which information is communicated	
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	(D6)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	(D6)
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	(D6)
IC4: Remove the requirement to present a poster/electronic display in the showroom	(D6)
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	(D6)
IC6: Make a platform available- in web version or mobile app - containing the information on all models and facilitate their comparison	(D6) (D7)
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	(D6) (D7)
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	(D6) (D7)
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	(D6) (D7)
Measures that implement changes to the information elements (IE) that are communicated	
IE0: Include information on taxes	
IE1: Include WTW emissions	(D1) (D2)
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	(D4) (D7)
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	(D4) (D7)
IE4: Include Total Cost of Ownership	(D1) (D5) (D7)
IE5: Include running costs	(D1) (D5) (D7)
IE6: Include information on type approved electric range	(D1) (D7)
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	(D1) (D7)
IE8: Include real-world CO_2 emissions and fuel consumption	(D2) (D5) (D7)

Short-listed measures	Main driver/s (see Annex C)
IE9: Include information on real-world electric range	(D1) (D7)
IE10: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	(D4) (D5) (D6) (D7)
IE11: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	(D4) (D5) (D6) (D7)
Measures that extend the scope (S) of the Directive	
S1: Extend requirements to [new] vans	(D3)
S2: Extend requirements to used vehicles	(D3)
S3: Extend requirements to [new] leased/ rental vehicles	(D3)
Measures increasing the level of harmonisation (H) of the implementation in Member States	
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	(D8)

The detailed design of the short-listed measures is provided in Annex F to characterise further the retained measures and allow the detailed assessment of their impacts. It sets out how each measure is anticipated to be operationalised, the stakeholders affected and any other considerations, which has been used as the basis for testing their effectiveness in the consumer survey experiments and for the discussion of a wider set of impacts and considerations (e.g. costs and challenges related to implementation) with the stakeholder group for this study.

This number of potential policy measures could be combined in different ways. Thus, these aspects have been analysed independently in the first instance, and can be subsequently combined into overall policy options/packages once the preferred variations are selected. This also takes into consideration that the problem drivers likely need to be addressed by a combination of measures.

3. Analysis of impacts of policy measures

This section provides the assessment of the impacts of the policy measures identified in Section 0 against a baseline (no-change) scenario. It is organised as follows:

- Section 3.1 provides an **overview of the baseline scenario and the key baseline indicators** based upon the SULTAN model;
- Section 3.2 provides an **analysis of the expected effectiveness of the short-listed measures in raising consumer awareness and influencing vehicle choices** as well as an overview of the level of support amongst stakeholders;
- Section 3.3 provides an **assessment of the impacts of the short-listed measures for three main categories** (economic, environmental, and social impacts) on the basis of the analysis of their effectiveness in Section 3.2 and in comparison to the baseline scenario in Section 3.1.

The analysis is based on a combination of literature and desk research findings, stakeholder inputs, and results from the consumer experiment conducted for this study as well as SULTAN modelling outputs. With respect to the stakeholder inputs, their views are summarised in this section, making specific reference to the stakeholder organisation where possible. Other stakeholders that participated wished to remain anonymous and thus their contributions are only attributed to the category they represent (e.g. authority, industry association, etc.).

No specific policy packages which address all the problem drivers identified were pre-defined for this study. Instead, the short-listed measures are assessed below in individual groups of measures targeting specific problem drivers and thus reflecting different policy elements that contribute to raising consumer awareness (e.g. channels used, information provided, scope of application, etc):

- **Measures that implement changes to the information channels through which information is communicated** – mainly targeting Driver D6 on changes in the role of information channels;
- **Measures that implement changes to the information elements that are communicated** – mainly targeting Drivers D1, D2, D4, D5 and D7 on the lack of or limited provision of certain information elements to consumers;
- **Measures that extend the scope of the Directive** – mainly targeting Driver D3 on the lack of coverage of certain vehicle categories;
- **Measures increasing the level of harmonisation of implementation in the Member States** – mainly targeting Driver D8 on issues with the implementation of the current legal framework.

Once the preferred measures and their variations were identified, the conclusions in Section 6 provide recommendations on the combination of the policy measures into overall policy options/packages that, on the whole, address the identified problems and their drivers.

Design and methodological measures/aspects have not been short-listed and assessed in this section. Instead, they are considered further in Section 4.

3.1. Baseline scenario

3.1.1. Overview

In order to assess the impact of the policy measures, a baseline scenario is needed that describes the expected evolution of the level of consumer awareness and the vehicle market in the case of no changes to the existing Car labelling Directive 1999/94 and no further adoption of other related consumer awareness measures. This baseline scenario also needs to include the effects of important policies and targets (as they are currently defined in legislation) which are expected to have an impact on the vehicle market (e.g. the post-2020 car and van CO_2 standards as defined in (European Commission, 2019a)).

The baseline scenario defined for this study includes existing policies and measures (see Section 3.1.3) and assumes that the two main problems associated with the lack of/limited consumer awareness of fuel economy and emissions from road vehicles identified and their drivers will persist in the absence of further EU level intervention. In general, it is also assumed that no further action will be taken by Member States unilaterally; any deviations from this assumption are discussed in the relevant sections on the assessment of the impacts of the measures below.

It is worth considering that some of the short-listed measures (or their variations) have already been implemented by several Member States (e.g. Denmark) or will likely be implemented in the near future (e.g. Germany). In cases where countries have already gone beyond the basic requirements of the Directive, these are considered to be a part of the baseline scenario. The following section describes the current implementation of the Directive and other relevant measures.

3.1.2. Current implementation of Directive 1999/94/EC and other related consumer awareness measures

The Car Labelling Directive (1999/94/EC) establishes a number of specific requirements on how information relating to the fuel economy and CO_2 emissions of new passenger cars offered for sale or lease in the EU should be made available to consumers so that consumers can make an informed choice. Whilst all Member States have transposed these requirements into national law, the Directive also allows a certain degree of flexibility on how those requirements should be applied in practice, including the adoption of additional requirements.

Regarding the **information channels through which information is communicated,** the Directive requires information on fuel economy and CO_2 emissions to be displayed via the following information channels:

- A **fuel economy label** for all new cars to be displayed at the point of sale (Article 3).
- A **guide on fuel economy and CO_2 emissions** that should be available at the point of sale and from designated bodies (Article 4).
- A **poster (or a display)** showing the official fuel consumption and CO_2 emissions data of all new passenger car models displayed or offered for sale or lease at, or through, the respective point of sale (Article 5). In 2003, Directive 2003/73/EC1 required that, in addition to (or even instead of) the poster/display, information on fuel economy and CO_2 emissions should also be displayed on an electronic screen.
- All **promotional literature** must contain the official fuel consumption and specific CO_2 emission data for the passenger car model to which it refers (Article 6).
- Additionally, in 2003, Commission Recommendation 2003/217/EC (European Commission, 2003) recommended, rather than required, Member States to ensure that promotional material transmitted electronically or stored using electronic, magnetic or optical media should contain information on a car's fuel economy and CO_2 emissions.

In addition, some Member States have adopted further requirements in relation to the use of information channels, such as the exclusive provision of an electronic guide[9], and the provision of a website allowing vehicle comparisons[10].

Regarding **the information elements that are communicated**, the Directive only requires the provision of information on the official fuel consumption and official specific emissions of CO_2 for the model concerned (appropriate units specified). Annexes I to IV set out in detail the information elements that are to be communicated for each of the information channels. In addition, Commission Recommendation (EU) 2017/948 recommended Member States to transition from presenting the fuel economy and CO_2

[9] Including AT, IT, BE, EE, FI, NL, PT, SE, SK according to (Ricardo and TEPR, 2016).

[10] Including DK, FR, ES, BE, FI, EE, SE, AT according to (Ricardo and TEPR, 2016).

values measured under the New European Driving Cycle (NEDC) to using those measured under its successor the Worldwide harmonised Light-Duty Test Procedure (WLTP)[11].

However, some Member States have gone beyond these requirements and also required additional information elements to be provided, including fuel consumption values for different drive cycles, vehicle taxes, safety ratings, noise, air pollutant emissions, and information on electricity consumption for electric and hybrid vehicles[12].

Regarding **the scope of the Directive**, this is currently defined as 'new passenger cars offered for sale or lease in the Community' (Article 1, further specified by Article 2). However, the label has been extended to cover new vans in some countries, such as Denmark, Spain, Poland, Sweden and Austria, and used cars in Finland and Germany.

Finally, regarding **harmonisation of implementation in the Member States**, the Directive allows Member States a certain amount of flexibility when it comes to the design and presentation of information on the label, as the layout of the label is not specified in the Directive, and nor does it specify the information to include (other than fuel consumption/CO_2 emissions). This has led to a variation in the way the label has been implemented in EU Member States as concluded by the previous evaluation study (Ricardo and TEPR, 2016). The design of the label is a key example of how this flexibility has been used by Member States, for example the following approaches have been taken:

- **Energy Labelling Regulation (2017/1369) style label** using a coloured A to G scale (e.g. Denmark, France, Finland, Germany, Ireland, Netherlands, Romania and Spain);
- A **scaled colour-coded comparison** (e.g. Austria);
- A **continuous comparative label** (e.g. Belgium);
- A **list format** (e.g. Hungary, Italy and Sweden); and
- **No specified format** (e.g. Czech Republic, Poland).

Whilst a number of Member States have taken the Energy Label Regulation approach to the label design, there are still further variations, including the number of coloured CO_2 bands/categories used, whether a relative or absolute approach has been taken to assigning vehicles to categories, and emissions values used to determine the way in which a vehicle is assigned to a category.

Due to this flexibility in the Directive, it is worth noting that some of the short-listed measures (or their variations) have already been implemented in certain Member States, including:

- Information channels:
    - IC3: Guide to be made available in electronic format and production of a printed guide to be made optional
    - IC6: Make a platform available- in web version or mobile app - containing the information on all models and facilitate their comparison
- Information elements:
    - IE0: Include information on taxes;
    - IE5: Include running costs; and

[11] The application of WLTP becomes exclusive from 2021 onwards for type approval (up until then NEDC equivalent values are also presented for assessing compliance with the CO_2 standards which were set on this basis). Member States therefore need to transpose their domestic labelling legislation to take into account WLTP before the end of 2020 to ensure that this information will be used to display on labels (as NEDC figures will no longer be available).

[12] The Evaluation of Directive 1999/94/EC identified implementation of additional information in 2016 as follows: fuel consumption values for different drive cycles (IE, DE, FR, BG, FI, SI, UK), vehicle running costs (UK, DE, IE, FI, DK, EE, FI), taxes applicable to the specific model (UK, DE, IE, FI, DK), safety ratings (DK), noise (AT, NL, FI), air pollutant emissions (FI, SI), and information on electricity consumption for electric and hybrid vehicles (DE, UK) (Ricardo and TEPR, 2016).

- IE6: Include information on type approved electric range.

- Expanding the scope of the Directive:
  - S1: Extend the requirements to (new) vans; and
  - S2: Extend the requirements to used vehicles.

3.1.3. Analysis of the evolution of key SULTAN baseline indicators

This section provides an overview and evolution of main indicators of the vehicle market in the baseline scenario, based upon the updated SULTAN[13] baseline (see Annex Section 0 for further information on the SULTAN model and this update). This baseline/business-as-usual (BAU) scenario has been calculated to be consistent with the Commission's baseline scenario for the EU Long Term Strategy for the EU27 countries (European Commission, 2018). (Hence, the scenario does not take into account the current and potential future impacts of the global COVID-19 pandemic).

Some of the key policies included in this EC modelling baseline scenario include (amongst others:

- Post-2020 CO_2 standards for cars and vans (as adjusted to align with the car and van CO_2 standards from the updated regulation (European Commission, 2019a)).
- Clean Vehicles Directive;
- Directive on the Deployment of Alternative Fuels Infrastructure;
- Renewables Energy Directive; and
- Fuel Quality Directive.

The following subsections provide a summary of the baseline scenario outputs grouped into the following areas:

- New vehicle registrations and the vehicle fleet – Section 3.1.3.1.
- Energy consumption and GHG emissions – Section 3.1.3.2.
- Air quality pollutant emissions – Section 3.1.3.3.
- Costs to society and end-users – Section 3.1.3.4.

3.1.3.1. New vehicle registrations and the vehicle fleet

Figure 3-1 provides an illustration of the breakdown in the in the EU light-duty vehicle new vehicle registrations and the whole vehicle fleet between cars and light commercial vehicles (LCVs – including vans), based on the projected increase in the EU27 vehicle parc up to 2050. The subsequent Figure 3-2 provides a corresponding breakdown by powertrain type in new vehicle registrations and the vehicle parcs for cars and LCVs, which shows registrations of xEVs (PHEVs[14], BEVs[15] and FCEVs[16]) reaching almost 40% by 2030 (~65% by 2050) for cars and over 26% (~58% by 2050) for LCVs.

[13] SUtainabLe TrANsport model

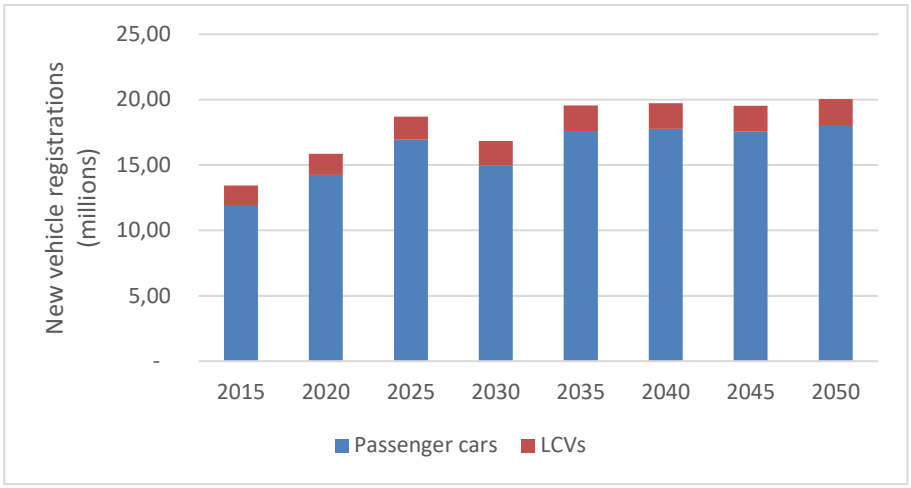
[14] PHEV = Plug-in Hybrid Electric Vehicle

[15] BEV = Battery Electric Vehicle

[16] FCEV = Fuel Cell Electric Vehicle

Figure 3-1: New vehicle registrations and total fleet – Baseline scenario

New vehicles



Vehicle fleet

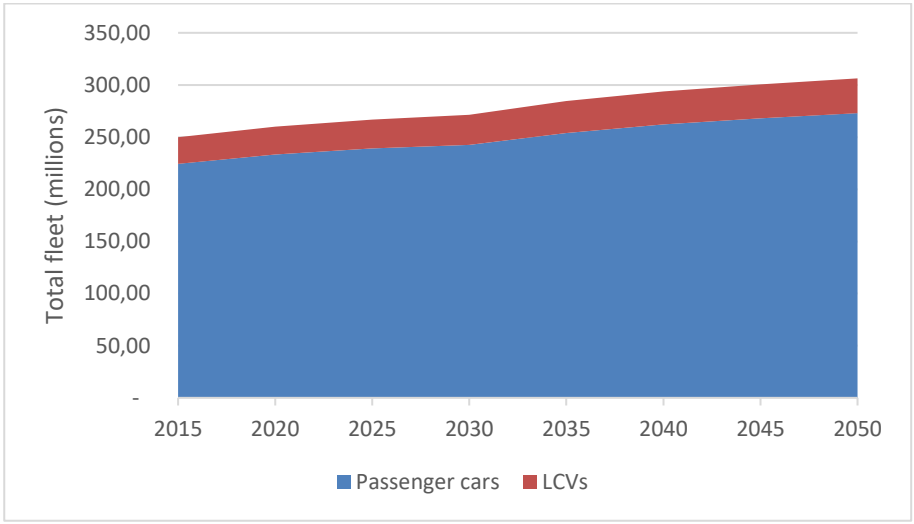
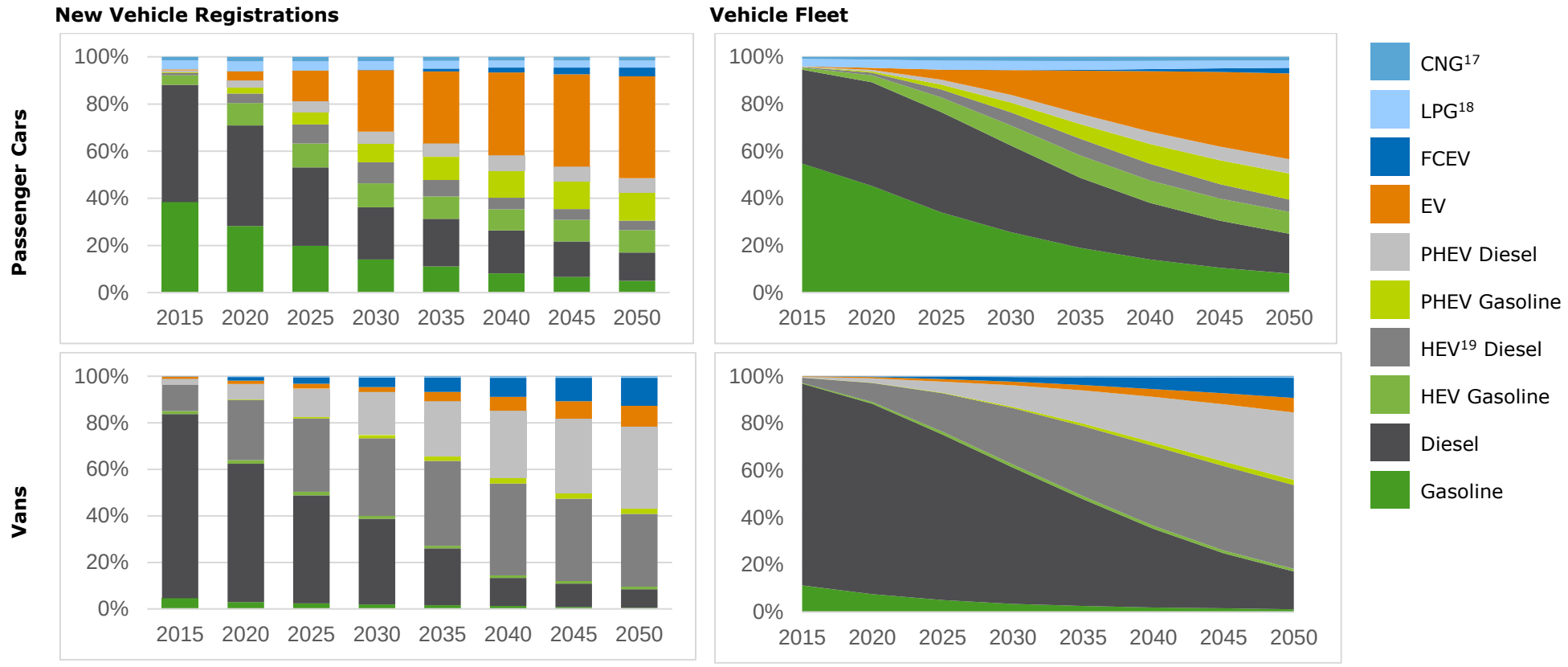


Figure 3-2: Composition of the light-duty vehicle fleet by powertrain type – Baseline scenario



[17] CNG = Compressed Natural Gas

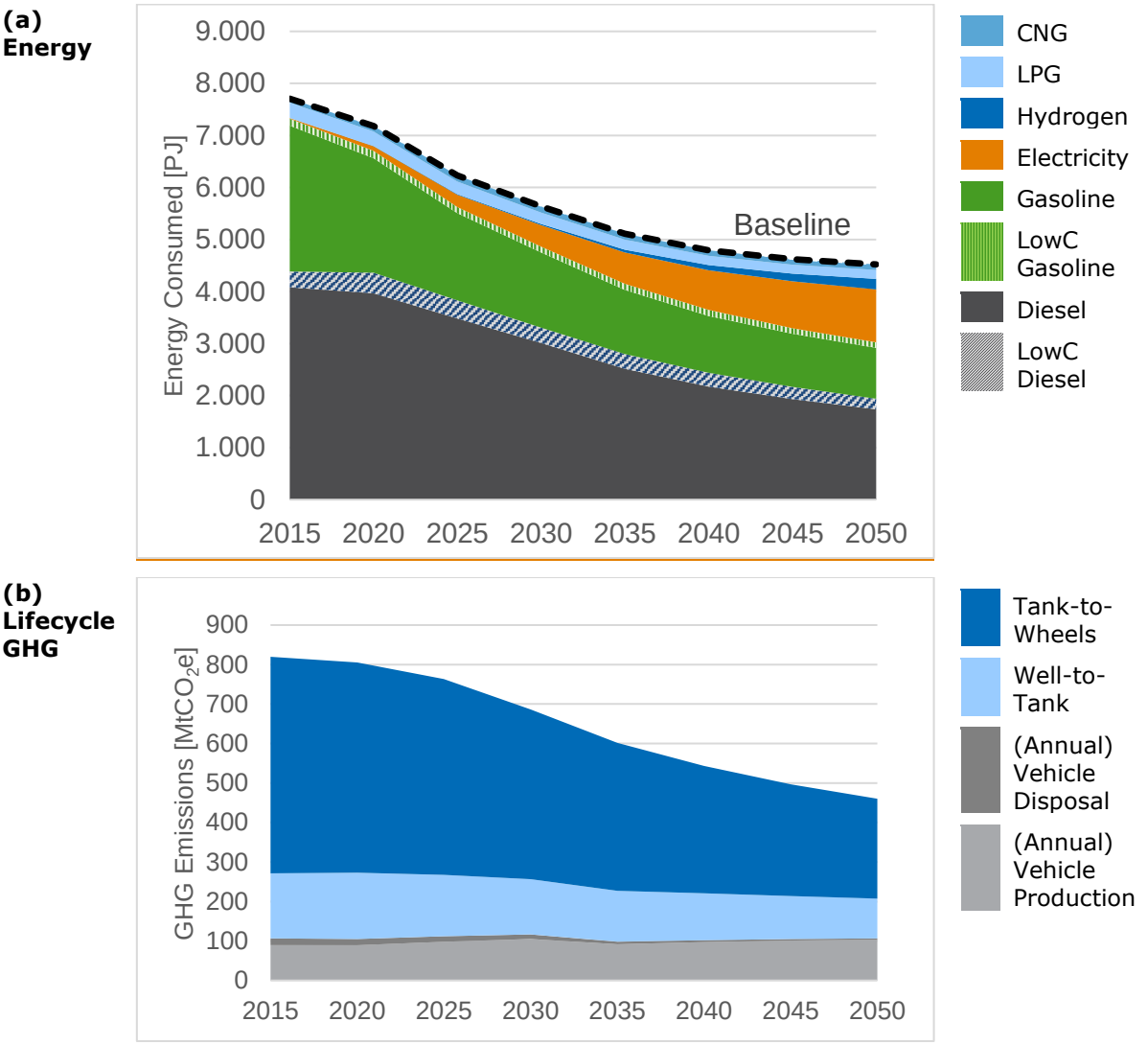
[18] LPG = Liquefied Petroleum Gas

[19] HEV = Hybrid Electric Vehicle

3.1.3.2. Energy consumption and GHG emissions

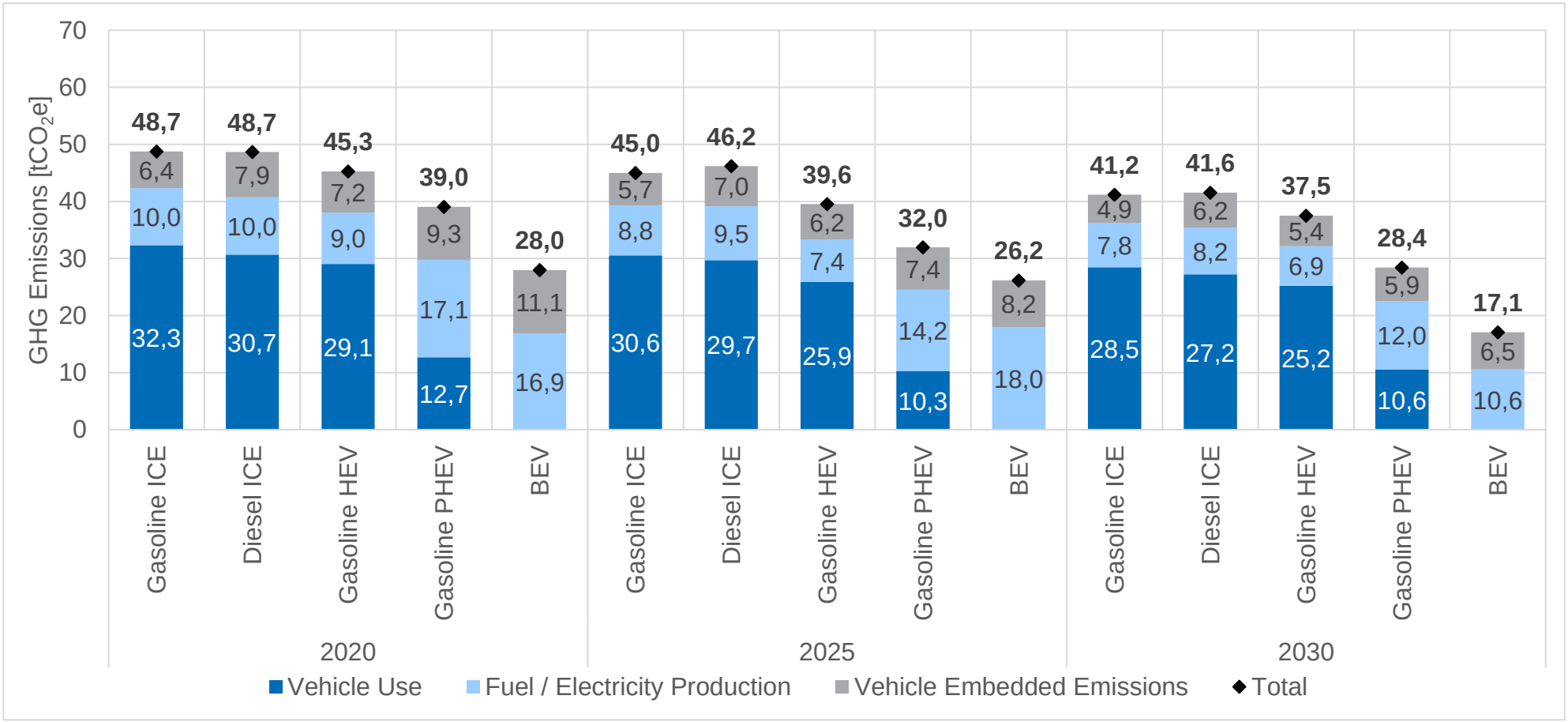
Figure 3-3 provides a summary of the breakdown in total EU27 energy consumption and calculated life-cycle GHG emissions from light-duty vehicles for the baseline scenario. These are both projected to significantly decline over the next decades – due to a combination of the impacts of the CO_2 regulations and further future penetration of more efficient electric vehicles into the vehicle fleet. Embedded GHG emissions resulting from the manufacturing and disposal of vehicles have been calculated based on SULTAN's LCE (life-cycle emissions) module, which was also updated based on our recently completed vehicle LCA project for DG CLIMA (Ricardo et al., 2020). These emissions are projected to increase somewhat in future years, due to the increase in the vehicle fleet and uptake of xEVs (with higher impacts from manufacturing) balanced against improvements in overall manufacturing impacts from materials and energy consumption, which are projected to decline also as the electricity mix improves. These trends are also illustrated in Figure 3-4, which provides a breakdown in the life-cycle impacts from average new passenger cars for various powertrain types, and how these are projected to change from 2020-2030.

Figure 3-3: Energy consumption and GHG emissions from light-duty vehicles – SULTAN Baseline scenario*



Notes: LowC = low carbon fuels, i.e. biofuels and low carbon synthetic fuels. * The SULTAN baseline scenario has been calibrated based on the EC's baseline scenario for the EU Long Term Strategy for the EU27 countries (European Commission, 2018). Embedded emissions from vehicle manufacturing and disposal were not calculated in the EC modelling, however are calculated here based on the new vehicle fleet mix as defined in this scenario.

Figure 3-4: Breakdown of lifecycle GHG emissions from average passenger cars, by powertrain type for 2020 new vehicles – SULTAN Baseline scenario



Note: Results are for average passenger cars, since more diesel passenger car models are sold in the larger vehicle market segments, indicating that the average diesel car is different (larger and heavier) than the average petrol car, hence manufacturing impacts are higher and also the diesel vehicle fuel consumption is not as low as would be the case for a vehicle of a similar size to the average gasoline car.

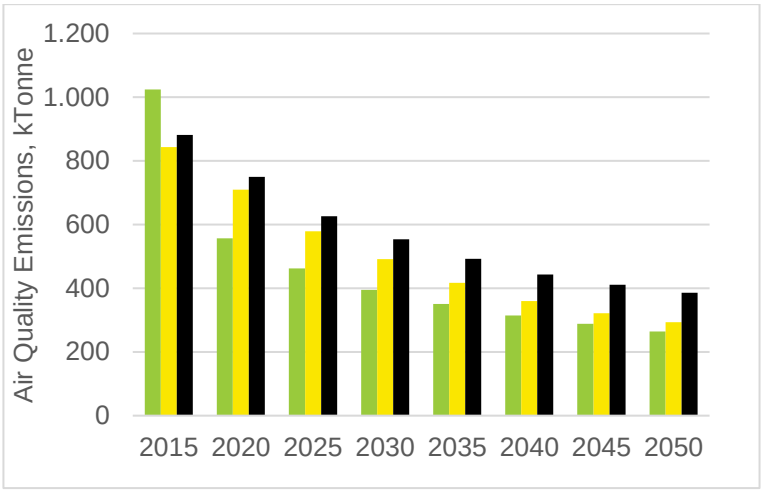
3.1.3.3. Air quality pollutant emissions

Figure 3-5 provide a summary of (a) the total well-to-wheel (WTW) emissions of particulates, oxides of sulphur (SOx) and oxides of nitrogen (NOx) from EU27 LDVs (i.e. direct/exhaust, plus emissions from fuel production), and (b) the breakdown of total air quality pollutant and GHG externalities (i.e. monetised emissions) for LDVs. WTW emissions are reported here to provide a more holistic comparison of the impacts: whilst the exhaust emissions are zero for electric vehicles, there are impacts resulting from the production of electricity (and also of other fuels) that should ideally be included. The monetisation of impacts (i.e. 'externalities') allows for a more objective comparison of the importance/significance impacts of different pollutants on a similar basis.

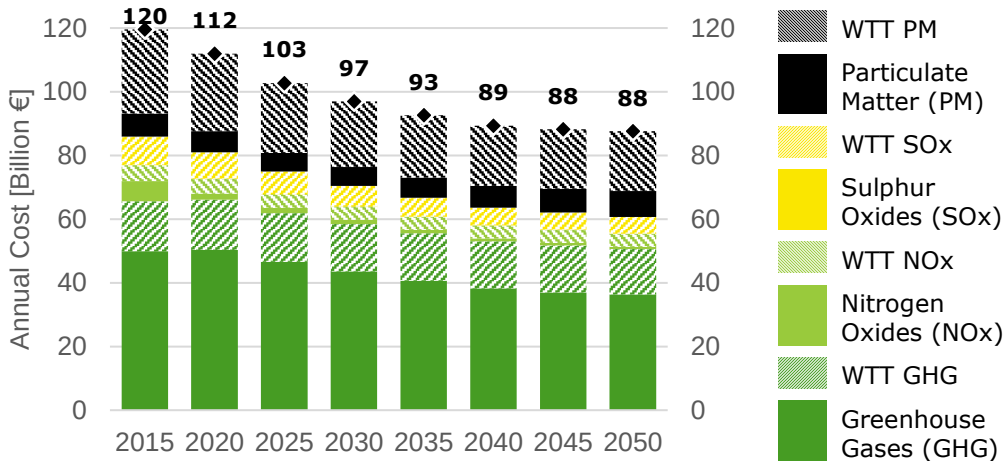
The charts show that due to a combination of cleaner and more efficient vehicles, and take-up of xEVs, overall emissions and externalities are projected to decrease significantly in the future. The charts also show that for air quality pollutants, the impacts of fuel production are projected to be higher than the impacts from direct/exhaust emissions from the vehicle – mainly as a result of recent actions to reduce tailpipe emissions. The charts also show that direct emissions of particulates could increase in the future due to increased activity and/or a larger vehicle fleet, as most emissions are now due to tyre and brake wear, which are expected to be similar also for xEVs.

Figure 3-5: Air quality pollutant emissions and externalities for light-duty vehicles – SULTAN Baseline scenario

(a) Air quality emissions (vehicle + upstream WTT)



(b) Air quality and GHG emission external cost breakdown by vehicle direct and WTT emissions



3.1.3.4. Costs to society and end-users

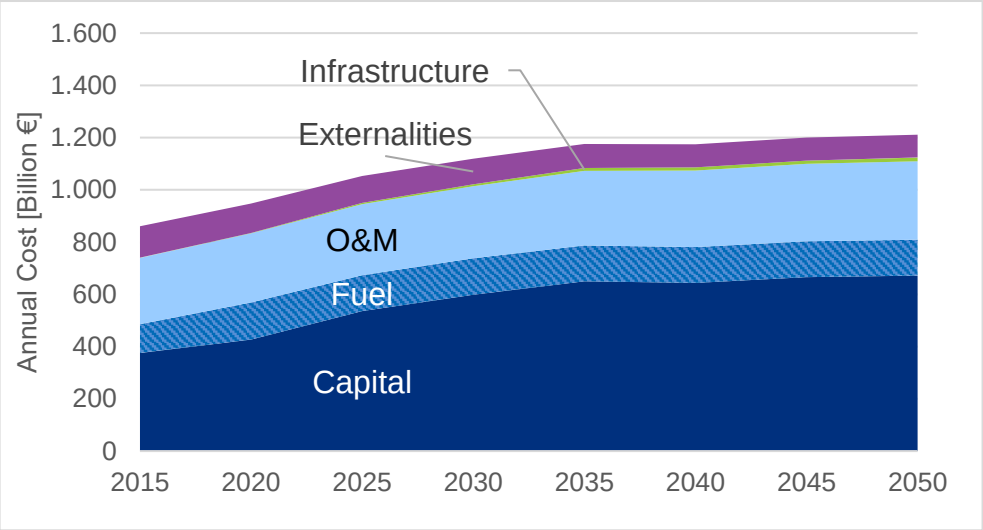
Figure 3-6 provides a summary of the calculated total annualised costs (a) to society and (b) to the end-user, for the EU27 LDV fleet for the baseline scenario. In both cases, total fleet costs are projected to increase in the future due to the growth in the EU vehicle fleet

(see earlier Figure 3-1), however overall net fiscal revenues from taxes are projected to decrease due to a reduction in fuel consumption resulting from the uptake of more efficient vehicles (driven by the CO_2 regulations and uptake of xEVs).

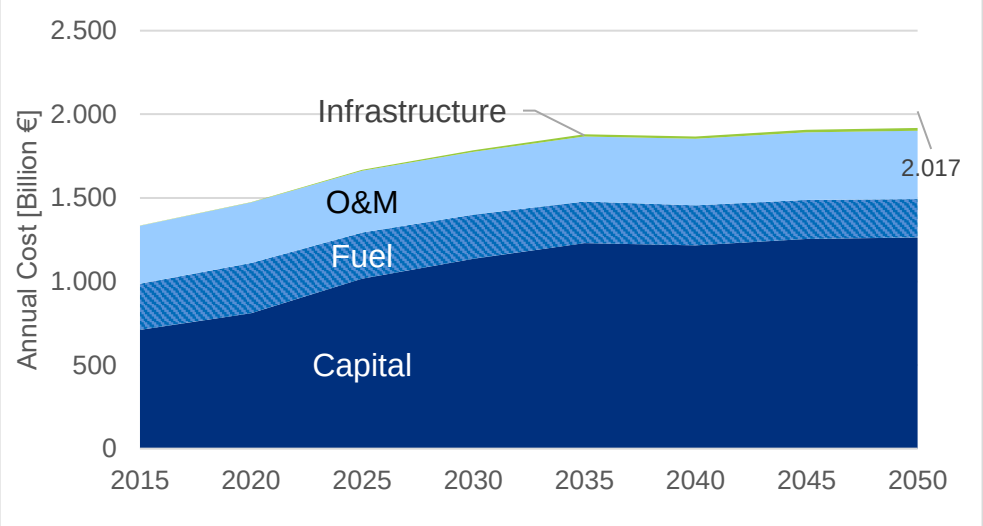
Figure 3-7 also provides a summary of the calculated discounted total cost of ownership (TCO) for society and end-users for average new vehicles for different powertrain types and how this is calculated to change between 2020-2030. The charts do not include any incentives for xEVs (which improve the TCO of new xEVs for the 2020 situation). As illustrated in the charts, the TCO of electric vehicles (without any purchase incentive) under average use conditions is anticipated to drop below those of conventional powertrain vehicles between 2025 and 2030 from both the societal and end-user perspectives.

Figure 3-6: Total annualised light-duty vehicle fleet costs to society (including externalities), and costs to end-users (including taxes) – SULTAN Baseline scenario

(a) Cost to society



(b) Cost to end-users



Notes: Capital = Annualised capital costs of purchasing new vehicles (Discount Rate = 4% for society, 10% for end-users); Fuel = costs for fuel and electricity; O&M = other annual vehicle operating and maintenance costs; Infrastructure = annualised costs for installation and operating electric charging and other alternative fuel infrastructure. Externalities = monetised costs of GHG and air quality pollutant emissions (societal analysis only).

Table 3-1: Net fiscal revenue from LDVs for the SULTAN baseline scenario

Baseline/BAU	2020	2025	2030	2035	2040	2045	2050
Net Fiscal Revenue, €Bn	344	360	360	334	341	334	326

Notes: Net fiscal revenue is calculated from end-user (with taxes) costs minus direct societal costs (excluding taxes, and not including externalities/other indirect costs).

Figure 3-7: Total Cost of Ownership for average passenger cars, societal (including externalities), end-user perspectives (including taxes) – SULTAN Baseline scenario

(a) TCO – social

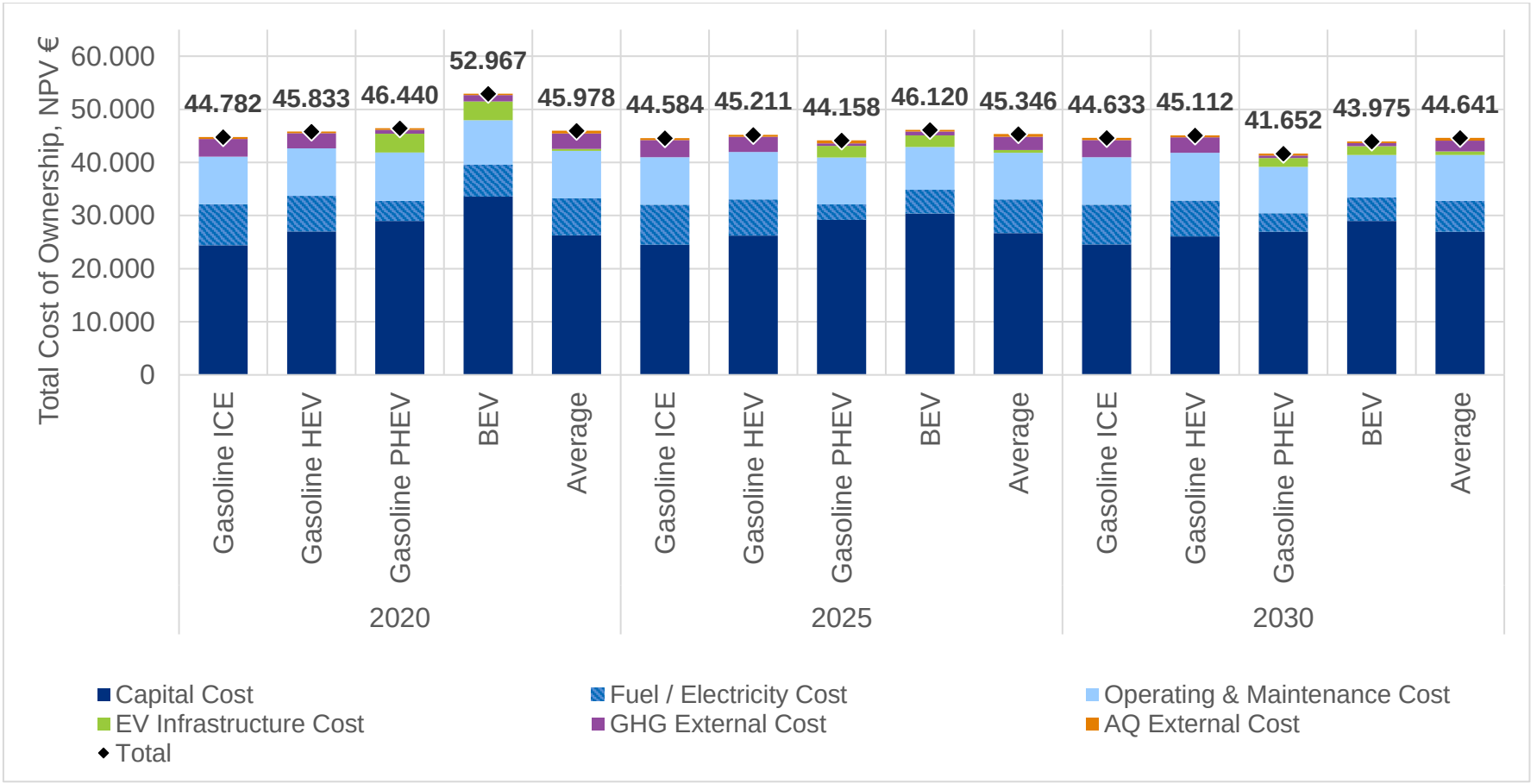
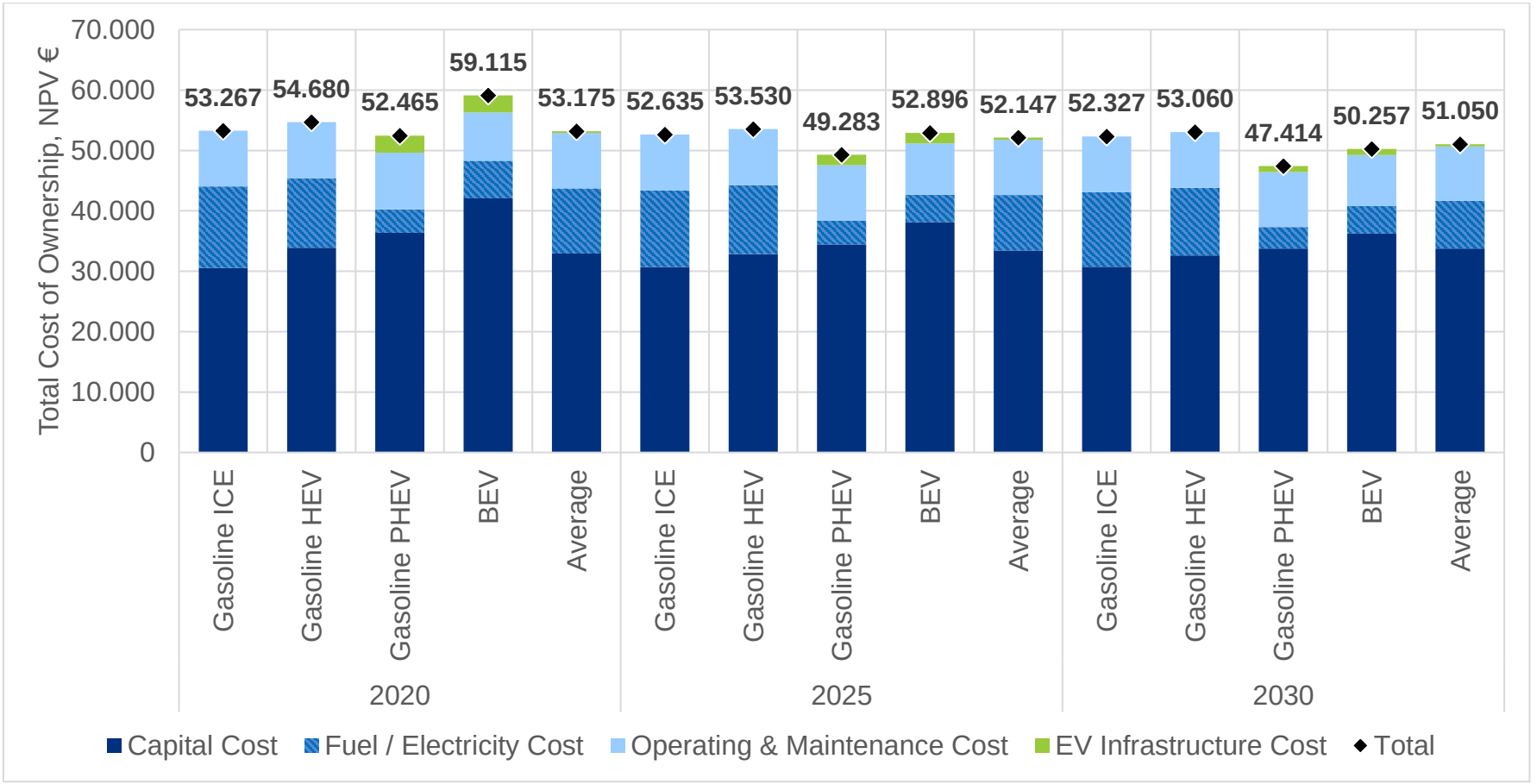


Figure 3-7: Total Cost of Ownership for average passenger cars, societal (including externalities), end-user perspectives (including taxes) – SULTAN Baseline scenario

(b) TCO for end-users



Notes: Capital cost= capital costs of purchasing new vehicles; Fuel = costs for fuel and electricity; O&M = other annual vehicle operating and maintenance costs; Infrastructure = annualised costs for installation and operating electric charging and other alternative fuel infrastructure. Externalities = monetised costs of GHG and air quality pollutant emissions (societal analysis only). Future costs over the life of the vehicle are discounted to purchase year (with Discount Rate = 4% for society, 10% for end-users).

3.2. Expected effectiveness of short-listed policy measures and level of support amongst stakeholders

This section provides an assessment of the effectiveness of each measure in raising consumer awareness of fuel consumption and emissions as well as influencing vehicle choices for each group of measures under consideration:

- Measures that implement changes to the **information channels** through which information is communicated;
- Measures that implement changes to the **information elements** that are communicated;
- Measures that **extending the scope** of the Directive;
- Measures increasing the level of **harmonisation** of implementation in the Member States.

Each group of measures is anticipated to influence consumer awareness and vehicle choices differently and, to a large extent, cumulatively. As described in the previous evaluation study of the Car Labelling Directive (Ricardo and TEPR, 2016), the causal chain of the tools implemented by the Directive is complex: relevant information first needs to be provided, and then consumers need to see/read it and understand it so that they can use this awareness and knowledge to inform their purchasing/leasing decisions. By addressing issues at the different stages of this causal chain and targeting different problem drivers, each group of measures potentially raise awareness and have an impact on vehicle choices in specific and non-mutually exclusive ways.

Effectiveness of the measures in terms of raising consumer awareness of fuel consumption and emissions as well as influencing vehicle choices is examined using evidence from the available literature. In addition, the views of stakeholders and their level of support for the different measures is also provided below.

The conclusions from the analysis are summarised in tables at the end of each section. In general, colour coding is used to refer to the direction (positive or negative) and size (small or large) of any expected effects (see Table 3-2**Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**).

Table 3-2: Coding used to present expected effects

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

3.2.1. Measures implementing changes to the information channels through which information is communicated

Nine measures have been considered which entail changes to the information channels through which information is communicated.

All of these measures can raise awareness and have an impact on vehicle choices by **increasing consumers' exposure to relevant information at different stages in their purchasing decision process and/or by enhancing the relevance and understanding of the information provided**. Only if the relevant information reaches the consumers (and at the most appropriate timing in their decision process) can this information be used to inform future vehicle choices. In addition, how this information is communicated and how frequently it is provided also determines the extent to which it will be understood and used to inform vehicle choices. This suggests that the most effective channels in raising awareness and influencing vehicle choices are those that provide information in a **relevant, timely and frequent way**.

To facilitate their assessment, this section examines the proposed measures in groups:

1. Measures that focus on the **provision of information through online channels** (i.e., IC1: label to be shown online, IC6: make a web-platform available to facilitate comparison of vehicles) which increase exposure to relevant information and at an

early stage in the decision-making process as **compared to more traditional channels used in the showroom** (i.e., IC3: guide to be made available in electronic format and the production of a printed guide to be made optional, IC4: remove the requirement to present a poster/electronic display in the showroom).

2. Measures that focus on the **provision of information through channels that provide tailored information and/or facilitate comparisons** (i.e., IC2: label information to be shown in interactive displays, IC6: make a web-platform available to facilitate comparison of vehicles, IC7: use of a quote to provide information where an estimate of the price is provided), thereby increasing the relevance or understanding of the information provided.
3. Measures that focus on **extending the provision of information to additional channels** (i.e., IC5: information to be shown in dynamic promotional material, IC8: awareness campaigns and IC9: training for new drivers) thus increasing exposure to relevant information during pre-purchasing stages and the frequency of information provision.

The analysis is primarily based on the findings from the literature and desk research, and complemented by stakeholder input as well as findings from the consumer experiments conducted for this study for certain measures.

Online vs traditional channels

A number of the measures under consideration enable the provision of information through online channels (i.e., IC1: online label, IC6: web-platform for vehicle comparisons) which increase exposure to relevant information at the early stages of the customer decision journey.

Evidence from the literature shows that the internet has become an important source of information when consumers are selecting their next vehicle to buy/lease. A recent survey conducted by McKinsey of consumers based in the US, China, and Germany (McKinsey & Company, 2020) found that over 80% of respondents use online sources which were used 20% more often than offline sources during the customer decision journey. Another 2018 survey undertaken by Deloitte in four EU Member States (969 respondents in Belgium, 758 in France, 1,336 in Germany and 908 in Italy) concluded that websites[20] are relevant sources of information used by consumers when they considered purchasing or leasing their current vehicle, although offline sources and dealerships[21] were found to be more significant for their decision, according to the respondents (Deloitte, 2018).

The importance of the internet as a source of information for vehicle purchases/leases was also recognised in earlier studies assessing the performance of car labelling schemes (Ricardo and TEPR, 2016; EPA, 2010a; APEC, 2015; LowCVP and TEPR, 2018; Allcott and Knittel, 2019).

The consumer experiments conducted for this study also point to the effectiveness of online channels. In particular, one of the treatments displayed information on CO_2 emission earlier in the decision process (see Annex G.1.2 for more details on the treatments). In this setting, the participants could see the colour-coded CO_2 emission band (e.g. A, B, C, etc) right from the start, when all the models were displayed in the carousel in the third-party website. We believe this early display of information can be used as a proxy for online channels: the carousel with CO_2 emission bands would represent the first step in the decision process (online research and comparison of many models, with the label being displayed online), while looking at more detailed information after clicking in the different car models would represent the second step in the decision process (visiting the dealership and learning more about few selected models, where the full label is displayed). The results show that participants which saw the CO_2 emission band earlier made more sustainable choices, that is, they selected a higher share of alternative powertrains and more efficient vehicles in general. We believe that this result should be partially attributed to the early display of information, achievable in real life through using online channels.

[20] Including manufacturer websites, dealer websites and other retail websites

[21] Including salespeople at the dealership as well as family, friends and co-workers

On the other hand, the provision of information at the showroom only could be too late in the decision-making process as consumers do not appear to visit the showroom very frequently and only once they have pre-selected a number of vehicles. The McKinsey study (2020) found that consumers visit the dealership two or three times before a purchase. According to the Deloitte survey, 70% of German respondents visited the showroom where they purchased the vehicle once or twice and 72% Italian respondents visited it twice or three times. Anecdotal evidence from Ford also indicates that their customers in Europe visit a dealership only 1.2 times (Automotive News, 2019). In addition, a recent study commissioned by Facebook also found that car buyers only visit the dealership after they have selected two or three brands or models (Facebook, 2018).

Vehicles are also now being sold online, which means the purchase funnel can be partially or fully digital. Traditionally, purchases were linked to a physical dealership, but this is expected to change in the future, and is likely to be accelerated by the COVID-19 pandemic, which has imposed restrictions on physical sales. Deloitte's survey results show that between 36% and 53% of respondents, depending on their country, are somewhat or very interested in purchasing a vehicle online directly from a manufacturer. The percentage is lower (between 11% and 33%) when considering other online retail websites (e.g. Amazon) (Deloitte, 2018). Similarly, the PwC survey of German consumers reveals that two in every three respondents would purchase a car online and half of them through third party websites. Manufacturers such as Ford, Volkswagen, PSA have recently implemented solutions to allow or incentivise online sales (Automotive News, 2019). These were plans made prior to the COVID 19 pandemic, which is likely to reinforce this trend (Strategy&, 2020).

However, dealerships remain important sources of information and are found to be a decisive factor in the customer decision journey, especially for the older generation. According to the Deloitte survey (Deloitte, 2018), traditional information sources were found to be useful for all respondents but digital sources become more relevant for the younger generation (Gen Y/Z, i.e., those born in the 1980s onwards).

There is therefore a risk of excluding consumers with lower digital skills if online channels completely substitute the more traditional channels. This concern was expressed by BEUC (the European consumer organisation), T&E (Transport & Environment), and the Belgian[22] and Austrian[23] authorities that commented that the tools used should be fair, and accessibility to information should be maintained for all consumers. T&E also added that consumers are more likely to look at physical copies of information about vehicles and thus printed materials remain important.

As a result, the removal of the requirements associated with the use more traditional channels in the showroom (i.e., print the guides and present a poster/electronic display in the showroom) could potentially decrease access to relevant information if these traditional channels are indeed widely used. The previous studies that have assessed the performance of the Directive in Member States (LowCVP and TEPR, 2018; Ricardo and TEPR, 2016) have concluded that online versions of the guide are more widely used, whereas the printed guide is not well-used by consumers. In fact, many countries (AT, IT, BE, EE, FI, NL, PT, SE, SK) have already moved to the exclusive provision of electronic copies of the guide (Ricardo and TEPR, 2016). The printed version of the guide thus seems to be obsolete and demand for the physical copies was found to be decreasing. In addition, the presentation of the poster/electronic display was also found to bring little added value according to the same studies (LowCVP and TEPR, 2018; Ricardo and TEPR, 2016). The recognition of the poster by consumers seems to be low and thus was found to be ineffective at informing them or changing their behaviour.

These findings suggest that these traditional channels are no longer widely used or seen as useful. It is also worth noting that the physical label would continue to be provided in showrooms so the traditional channels would not be completely replaced, and the findings suggest that the poster and guide add little value beyond that of the physical label.

[22] FPS public health

[23] Environment Agency Austria

Nevertheless, to minimise any negative effects on consumers with lower digital skills, ZPS (a Slovenian Consumers' Association) suggested that there should be a requirement to print the guide when requested by consumers. Over time, the share of the population with lower digital skills is also expected to decrease and thus this risk will eventually be negligible (European Commission, 2020).

In addition, online channels can provide more information that can also be more easily updated, and it is thus easier to keep these channels relevant, compared to the traditional channels. This becomes more important in the current environment where vehicle technologies are rapidly changing, and new offers are put on the market. The previous evaluation study (Ricardo and TEPR, 2016) found that one of the biggest limitations of the guide was related to the provision of static information (e.g. in pdf form) that is not regularly updated in line with changes in car performance and specifications. This was also the view of an authority that participated in this study which suggested that a vehicle comparison website can be more effective. (FIA, 2017) also highlighted the importance of websites to provide additional information.

Overall, the above evidence suggests that the provision of an online label (IC1) and web-platform for vehicle comparisons (IC6) can be important to raise awareness and influence purchase/leasing decisions. These channels provide relevant information (i.e., more information and more easily updated) in a timely (i.e., early stages) and frequent (i.e., always available) way. The provision of similar labels (tyre, energy efficiency) via online channels was already suggested by earlier studies (Viegand Maagøe, 2016; EUR-Lex, 2017) and has been required by legislation (i.e., tyre energy label as mandated by Regulation (EU) 2020/740 and the energy efficiency label as mandated by Regulation (EU) 2017/1369). The use of a website is also recommended in the literature (EPA, 2010b; EPA, 2011; US Department of Energy, 2015; Yang, 2015). We note in particular the experience of the US where a website that allows for vehicle comparisons and calculations of relevant performance and cost metrics was put in place (US Department of Energy, 2015; APEC, 2015). In addition, a number of Member States (including DK, FR, ES, BE, FI, EE, SE, AT) have also already developed fully searchable online databases which allow vehicle comparisons.

On the other hand, it appears that the removal of the requirements to print the guide (IC3) and provide a poster/electronic display (IC4) in the showroom will have little negative effect on awareness since most consumers do not seem to use nor find these channels useful beyond the information already provided by the physical label or electronic version of the guide. Those with lower digital skills might be more affected, but this is expected to decrease over time. In the meantime, the option to provide physical copies of the guide in the showroom when requested could minimise this issue.

Channels that increase the relevance or understanding of the message

Some of these measures also enable the provision of information through channels that increase the relevance or understanding of the information provided (i.e., IC2: interactive display, IC6: web-platform for vehicle comparisons, IC7: quote).

The use of interactive interfaces, such as the interactive display and the web-platform for vehicle comparisons, can be important to provide information that is tailored and thus *more* relevant to individual consumers.

Configuration of vehicles, in particular, has become more relevant with the change in the test cycle to WLTP, as there is a wide range of fuel consumption/CO_2 emission figures for the same vehicle model, depending on the options/equipment considered in addition to the base model. This issue has been raised by a number of stakeholders that participated in the consultation for this study (Finnish authority, two OEMs, an industry association) which suggested that the new WLTP figures can be a source of confusion for consumers. Configuration allows the presentation of a more tailored figure rather than a range, thus enabling better comparisons between specific vehicle models.

The results from the consumer behavioural experiments undertaken for this study show that the provision of information that can be tailored to the specific circumstances of each consumer is expected to encourage the choice of more efficient powertrains: with

customisation of a limited set of information[24], a participant was 1.1% more likely to choose a PHEV and 0.5% more likely to choose a BEV; on the other hand, a participant was 0.8% less likely to choose a petrol or diesel car. These results are expected to represent the lower bound of the effects of customisation given that participants could only tailor two different metrics.

In the case of the interactive display (IC2), it is worth noting that this is only proposed to be available at the point of sale. Based on the argument and evidence provided above regarding online channels, this suggests that this measure could be less effective than the web-platform (IC6) to the extent that the information is being provided only at the showroom which is visited less frequently. An authority and two OEMs consulted for this study also pointed to the fact that this channel becomes less relevant if the label or relevant information is available online. In addition, a vehicle manufacturer (anon) and a national authority highlighted the importance of online configurators to justify that the interactive display should be optional only.

However, the interactive display (IC2) could also provide *relevant and complementary information* at the appropriate timing for those that visit the showroom, i.e., when the consumer will be deciding on which options and extras to include in the vehicle. This is the view of ZPS, VZBV (Federation of German Consumer Organisations), a Belgian authority (FPS public health) and T&E, which find this channel to still be relevant and/or complementary to the display of the label near/on the car in the showroom. T&E also suggested that the effectiveness of this channel also depends on how many devices are available in the showroom: they argued that consumers are unlikely to use the display if there are queues and thus they should be provided in sufficient numbers if they are to replace the poster or electronic display. VZBV also suggested that, whilst the interactive display is important to provide more detailed information on a specific car, it does not facilitate comparisons per se. They added that, for this purpose, a poster/electronic display would be more appropriate.

In addition, the provision of information next to the price of the vehicle (e.g. in a quote) (IC7), could also potentially increase its relevance and understanding.

The presentation of the Total Cost of Ownership (TCO) next to the price of the vehicles in the consumer behavioural experiments conducted for this study shows that it can have an effect on choices. However participants were less likely to choose more efficient powertrains, compared to those for which the TCO was not presented next to the vehicle price. We note that this could be related to the information communicated rather than the channel itself: it is possible that the information communicated (i.e., TCO) did not make the lower carbon vehicles more attractive (due to the high upfront costs of alternative powertrains) and thus did not encourage the purchase of these vehicles. More details on these effects are provided in the following section on the measures implementing changes to the information elements.

There is also the potential for the provision of information through a quote to create confusion amongst consumers as argued by some stakeholders (the Finnish authority, and the Advertising Association). According to the Advertising Association, it could even lead to 'cognitive failure' due to information overload. For BEUC, it was also important that this did not become an advertising tool.

Overall, the above evidence suggests that the web-platform for vehicle comparisons (IC6) could also be effective at influencing vehicle choices by allowing for customisation of the information and thus increasing the relevance of the information provided. Similarly, the interactive display (IC2) could be effective but possibly to a lesser extent since it is only provided in the showroom (and thus less frequently), although it can complement the information provided by other channels (at an appropriate timing for those that visit the showroom).

On the other hand, the limited available evidence on the use of quotes to provide relevant information (IC7) suggests that it can be effective at raising consumer awareness and

[24] Participants could select annual mileage and share of driving in urban road vs motorways, only.

influence vehicle choices by enhancing understanding of the information but this largely depends on the information communicated, which could also be confusing for consumers.

Additional channels extending exposure and frequency of information provision

Finally, some of the measures extend the provision of information to additional channels (i.e., IC5: dynamic advertising, IC8: awareness campaigns, IC9: training for new drivers) thus increasing exposure to relevant information during pre-purchasing stages and increasing overall frequency of information provision.

Being frequently exposed to information is important to build familiarity and trust, which can in turn improve the effectiveness of the information tools/channels used during the purchase stages, including the label as concluded in two studies (Haq and Weiss, 2016) (LSE, 2013). The consumer behavioural experiments conducted for this study also support this: on average, participants that spent longer in the experiment (which can be used as a proxy for frequency and intensity of exposure) were also more likely to choose lower carbon vehicles (5 extra minutes are, on average, associated to a decrease of 1 gCO_2/km in the selected vehicles). Time spent in the experiment is also associated with statistically significantly higher comprehension, trust and utility scores – all beneficial in terms of processing the information and consumer awareness.

In the case of dynamic advertisements (e.g. TV, radio, online) (IC5), the available evidence suggests that it could also be important to raise awareness of directly relevant information (on vehicle attributes/performance) in addition to building trust and familiarity with the information provided by other channels. However, this exposure happens at very early stages before the actual purchase process starts and thus could be less effective at influencing vehicle choices, i.e., only indirectly affecting choice.

Albeit focused on printed material (covered by the current requirements of the Directive), the previous evaluation study (Ricardo and TEPR, 2016) found a similar level of awareness of promotional material compared to the label, which suggests that consumers do become aware of the information provided at pre-purchase stages. In addition, in Denmark, the coloured classes are shown in dynamic advertisements, which seems to contribute to consumer recognition of the information.

The study also concluded that promotional materials can have an impact on vehicle choices suggested by the increase in the use of environmental information in car marketing in some countries (Ricardo and TEPR, 2016). This finding could apply to dynamic forms of advertisement too. In addition, a car labelling study (Codagnone et al, 2016) found that information on fuel savings can have a more significant impact on consumers when it is presented in promotional materials (including online advertisement but not television)[25] than on car labels because the information is provided in an environment in which consumers pay more attention.

However, according to the stakeholders consulted for this study[26], this is likely to be a less effective channel to influence vehicle choices for a number of reasons. It is harder to communicate technical information (as suggested by EGTA), information is likely to be less visible (as suggested by BE authority) and shown at a very fast rate (one OEM, an NGO, EGTA) which will affect comprehension. There is also a concern about information overload (as indicated by a national association of the advertising industry).

As such, it appears that there could be differences in the effectiveness of dynamic advertising in raising awareness and influencing vehicle choices depending on the extent to which it is easier or more difficult to provide information in a way that consumers can directly use. This will vary with the medium (e.g. TV, radio, online) used for dynamic

[25] "For the purpose of this study, promotional material is a graphic artefact (not written text only, but not a video) that may appear in different media (point of sale leaflets, advertising in magazines and newspapers, online advertising, etc., except television) promoting a particular car (Codagnone et al, 2016).

[26] An authority, one OEM, ACEA, an industry association, the European Association of Television and Radio Sales Houses (EGTA), European Magazine Media Association (EMMA) and European Newspaper Publishers' Association (ENPA)

advertisement. In particular, evidence on online advertising suggests it could have an impact on awareness.

As already concluded in the previous evaluation study (Ricardo and TEPR, 2016), the impacts of promotional material are also dependent on how clearly the information is communicated to consumers. This is in line with the comments provided by the various stakeholders that participated in the consultation for this study[27], which have made a number of suggestions and raised concerns about how the information could be presented in these channels.

As such, this channel could play a role in raising awareness and influencing vehicle choices in two ways:

(1) by increasing awareness of directly relevant information (i.e., on vehicles consumers would potentially purchase/lease);

(2) by enhancing familiarity and consequently increasing the use of information provided by other information channels during the purchase stage.

The provision of information in online promotional materials, in particular, appears to be more effective. The use of online promotional materials was also recommended by earlier studies, e.g. (APEC, 2015; ANEC and BEUC, 2014; Viegand Maagøe, 2016; Yang, 2015).

Information campaigns (IC8) and training events for new drivers (IC9) can play a similar role whereby they can help build familiarity, trust and understanding of the information provided by other information channels. A 2016 study (AIRUSE, 2016) found that long term public education campaigns focused on the environmental impacts of vehicles are important to enhance consumers' understanding of vehicle emissions and their differences. Similarly, (US Department of Energy, 2015) explained that successful outreach and education efforts are essential for providing fuel economy information to help consumers use and further share the information. A number of studies that evaluated the impact of different labelling schemes also recommended the dissemination of information and/or education programmes to increase knowledge of these schemes (Haq and Weiss, 2016; Viegand Maagøe, 2016; London Economics, 2014) and alter consumers' perceptions (Teisl, 2008).

However, compared to dynamic advertising, the information provided in these information campaigns (IC8) and training events for new drivers (IC9) could be directly less relevant, i.e., it might not be about the environmental performance of the vehicles but focus only on improving an understanding of that information when provided by other channels.

Conclusions

The discussion included above is largely supported by stakeholder inputs to this study. According to the majority of the stakeholders, most of the measures are expected to be effective to a great or some extent (between 19 and 26 of 24-28 stakeholders responding – varies with the option), except for the measure to remove the requirement to present a poster/electronic display in the showroom (IC4). In the comments provided, stakeholders identified also a number of elements that can affect the effectiveness of these measures such as where the online label should appear, the design of the online label, enforcement and monitoring challenges, among others. Some of these considerations are discussed in Section 4 below.

The table below summarises the conclusions from the analysis above. Overall, it can be concluded that:

- The measures regarding the provision of an online label (IC1) and the web-platform for vehicle comparisons (IC6) are expected to be the most effective at raising consumer awareness of emissions and fuel economy and influencing vehicle choices as they provide information in a relevant, timely and/or frequent way.
- Measures related to the provision of information in dynamic advertising (IC5) as well as information campaigns (IC8) and training events (IC9), on the other hand, are

[27] an authority, one OEM, BEUC, ZPS, VZBV, T&E, Advertising Association, a national association of the advertising industry

expected to be less effective on their own but are potentially important to build familiarity and trust which increases the effectiveness of other information channels. They affect choices indirectly. In particular, the provision of information via online promotional tools appears to be quite effective at raising awareness of relevant information.

- The removal of the requirements to use more traditional channels that are only provided in the showroom such as the printed guide (IC3) and the poster (IC4) is anticipated to have little negative effects on the consumer awareness of emissions and fuel economy. To minimise any adverse effects, the provision of the printed version of the guide could still be mandated when requested by the consumer.

Table 3-3: Summary of expected effectiveness in raising consumer awareness and influencing vehicle choices from Information Channel measures

Measure	The information channel is contributing to the provision of information that is:			Impact
	Relevant	Timely	Frequent	
IC1: Label/information to be shown online (for manufacturers and dealers – purchase and lease-related sites, second-hand vehicle apps, etc.)	✓✓ [+] Use of online channel allows provision of information that is relevant and kept up-to-date, whilst allowing for further complementary information to be provided	✓✓ [+] Use of online channel ensures information is provided at an early stage in the decision process and when a consumer needs it.	✓/× [+] Use of online channel allows provision of information that is available at all times. [-] However, consumers with lower digital skills will not have easy access to this information	✓✓ [+] Expected to be very effective at raising awareness for majority of society, apart from those that have low digital skills.
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	✓✓ [+] Use of interactive interface allows configuration that will provide more relevant and tailored information [+] Relevant to better communicate the complexity of WLTP figures [+] Results from experiment show that it can encourage the choice of lower carbon vehicles.	✓/× [+] Only provided at the point of sale which could be too late in the decision process [-] However, the type of information provided could be complementary to other channels and at the stage when the consumer needs it.	× [-] Only provided in the showroom which is not frequently visited	✓ [+] Expected to be quite effective at influencing choices for those that visit the showroom. But this depends on how many devices are available. It also appears to be an improvement on the (static) poster/electronic display
IC3: Guide to be made available in electronic format and production of a	✓/0 [+] Online version of the guide allows provision of information that is	O [O] No effect	O [O] No effect	O [O] No major impact on awareness

Measure	The information channel is contributing to the provision of information that is:			Impact
	Relevant	Timely	Frequent	
printed guide to be made optional	relevant and kept up-to-date Makes a source of information optional but evidence shows limited use of printed version of the guide			
IC4: Remove the requirement to present a poster/electronic display in the showroom	×/0 [-/+] Makes a source of information optional but evidence shows limited added-value	O [O] No effect	O [O] No effect	O [O] No major impact on awareness
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	✓/× [+] Provides directly relevant information but difficult to communicate technical information, especially through some mediums (e.g. TV, radio) where information is less visible and shown rapidly	× [-] Too early in the decision process	✓✓ [+] Increases exposure to build familiarity and trust	✓ [+] Expected to be effective at raising awareness of directly relevant information as well as building on familiarity and trust that increases the effectiveness of other information channels [+] There are differences between mediums, with the provision of information in online promotional materials expected to be more effective.
IC6: Make a platform available- in web version or mobile app – containing the information on all models and facilitate their comparison	✓✓ [+] Use of online channel allows provision of information that is relevant and kept up-to-date, whilst allowing for further complementary information to be provided [+] By enabling configuration, it will provide more relevant and	✓✓ [+] Use of online channel ensures information is provided at an early stage in the decision process and when a consumer needs it.	✓/× [+] Use of online channel allows provision of information that is available at all time [-] However, consumers with lower digital skills will not have easy access to	✓✓ [+] Expected to be very effective at raising awareness for majority of society, apart from those that have low digital skills. [+] In addition, by allowing customisation of information, it can enable

Measure	The information channel is contributing to the provision of information that is:			Impact
	Relevant	Timely	Frequent	
	tailored information [+] More relevant to better communicate the complexity of WLTP figures [+] Results from experiment show that it can encourage the choice of lower carbon vehicles		this information	better comparisons and thus influence vehicle choices.
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	✓ [+] Results from experiment show that it can affect vehicle choices However, information provided could potentially confuse consumers	O [O] No effect	O [O] No effect	✓ [+] Expected to be effective at influencing choices. But this depends on the information provided.
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	× [-] Limited provision of directly relevant information on vehicle performance	× [-] Too early in the decision process	✓✓ [+] Increased exposure to build familiarity and trust	O [O] Limited effectiveness at raising awareness– only to build familiarity and trust in the information and thereby enhancing the effectiveness of other information channels
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	× [-] Limited provision of directly relevant information on vehicle performance	× [-] Too early in the decision process	✓✓ [+] Increased exposure to build familiarity and trust	O [O] Limited effectiveness at raising awareness– only to build familiarity and trust and thereby enhancing the effectiveness of other information channels

3.2.2. Measures implementing changes to the information elements that are communicated

Thirteen measures that entail changes to the information elements that are communicated have been considered, including:

- Measures that propose making certain information elements obligatory, in addition to the existing ones (i.e., adding information on costs, air pollutants, range and charge time for Battery Electric Vehicle (BEV) and Plug-in Hybrid Electric Vehicle (PHEV) to the label, including the links to additional information as a QR code).
- Measures that specify methodological aspects on how certain values are calculated (i.e., display WTW or tailpipe CO_2 emissions; display type approved or real-world emissions, fuel consumption and electric range).

All of these measures can have an impact on raising consumer awareness through **delivering to the consumers pieces of information, potentially relevant for their purchasing decision process, which are at the same time difficult and/or time-consuming to obtain if not provided**. By proactively providing this information, the measures maximise the probability of consumers actually using it to make their purchase decisions, provided they understand, trust and value it. Moreover, by providing it, the measures may **correct for the biases and/or misperceptions** the consumers might have on, for example electric ranges.

The findings from the consumer experiments undertaken for this study are a key source for this analysis. Many of the elements were included in the experiment, so it is possible to provide quantitative evidence on them, using the data from consumer experiment. The main challenge of this approach, however, is that several elements were implemented at the same time (on the same label or in the same treatment) and together with other significant changes, making the analysis of impacts on an element by element basis more difficult. For example, such information elements as information on running costs and information on air pollutants are shown on the same label. Moreover, as the previous section explains, new label was implemented together with another significant change: displaying the CO_2 emission band early in the experiment (on the carrousel), as a proxy for online channel. That is why the analysis is more precise when we consider impacts of several measures as a package, as if they were implemented simultaneously.

The relative importance of different information elements can still be assessed through their relative contributions to overall understanding, trust and usefulness of the information provided. Using our experimental data, we have calculated that comprehension is closely related to the trust, and trust, in its turn, is closely related to the perceived usefulness of the information.

In our experiment, a participant with full comprehension score had, on average, 10% higher trust score, compared to a participant with zero comprehension score. At the same time, a participant with full trust score has scored, on average, 60% higher in terms of perceived usefulness of the labels, compared to a participant with zero trust score.

Finally, perceived usefulness of the label is positively related to choices in our experiment. The analysis shows that those with full usefulness score have made choices with, on average, 28.5 gCO_2/km lower tailpipe emissions, compared to choices of those with zero usefulness score. In addition, those with full comprehension score have made choices with, on average, 9.6 gCO_2/km lower tailpipe emissions compared to those with zero comprehension score.

Having understood this relationship between understanding, trust, perceived usefulness and choices, we can conclude on relative impacts of different information elements included in our consumer experiment by looking at their relative usefulness and trustworthiness. To conclude on the effectiveness of the measures that have not been a part of the experiment, we use findings from our literature review and stakeholder engagement.

Measures that focus on the provision of cost information

Three of the measures focus on the provision of cost information (i.e. IE5: Include Total Cost of Ownership, IE6: Include running costs, IE7: Include information on taxes).

Evidence from the literature shows that **the costs are most important and effective driver of decisions** (LowCVP and TEPR, 2018; IEEP, 2006; Lane, 2012). Fuel economy is the top reason why people are opting for fuel-efficient or alternate-fuel vehicles, especially in the context of fuel price uncertainty and on average high fuel prices (Capgemini, Cars Online 08/09: 10th Annual Global Automotive Study: Tracking Consumer Buying Behavior in Both Mature and Emerging Markets., 2008; Capgemini, Cars Online 09/10: Understanding Consumer Buying Behavior in a Volatile Market., 2009). The results of the eye-tracking portion of the research on eco-labels show that cost-related information is the most important to consumers (EPA, Current Status and Potential Role of Eco-labels in Informing Environmentally Friendly Purchases, 2015).

But **despite of the high importance of the cost information for decisions, there is evidence that people do not remember it**. Most consumers do not optimize their fuel economy decisions and make large errors when asked to estimate their gasoline costs and savings over time (EPA, Environmental Protection Agency Fuel Economy Label: Literature Review, 2010a). Another study found no households analysed their fuel costs in a systematic way in their vehicle purchases (Turrentine, 2007). So, providing this information to the consumers is expected to be beneficial for them.

Requiring information on running costs and vehicle taxation is considered to bring added value (Yang, 2015), as when asked about importance, many potential buyers identify not only the vehicle purchasing cost, but also fuel consumption, running costs and tax incentives (FIA, 2017).

Some Member States already provide information on taxes applicable to the specific model (UK, DE, IE, FI, DK) (Ricardo and TEPR, 2016), which is expected to be an effective signal to consumers (Codagnone et al, 2016; ANEC and BEUC, 2014) recommend that all Member States should provide tax related information. It is worth to note, however, that tax information can only be effective under appropriate set of fiscal incentives.

Fuel economy is considered to be better communicated through running costs as it is often viewed in the context of running costs, rather than as an environmental proxy; and running costs are given more importance than efficiency per se, or environmental concerns (LowCVP and TEPR, 2018; Codagnone, 2013). Inclusion of running costs was recommended by all three of the reviews for the European institutions and by ANEC and BEUC (Carroll, 2014), as well as by (Codagnone, 2013) on the basis of their work with consumers. Information on running costs has also already been included in various Member State labels (UK, DE, IE, FI, DK, EE, FI).

Looking at real choices of consumers in surveys or experimental studies, running costs was considered one of the most important information on the label (LowCVP and TEPR, 2018; LSE, 2013). Another empirical evidence of the importance of fuel cost information is provided by (D'Haultfœuille et al., 2016) who have found that the recent decline in CO_2 emissions for new vehicle in France can be partially explained by the increase in fuel prices.

In our experiment, only 28% of those in one of the treatments with new label design (where running costs are provided) stated that they do not trust running costs and about 36% of participants listed running costs as one of the most useful information elements (out of up to three most important elements).

Most stakeholders stated that provision of running costs would help raise awareness at least to some extent (22 of 26) and less than a half (10 of 26) expect to have problems or issues with implementation of this measure. The main problems and methodological challenges identified for this measure are the need to adjust the costs frequently, need to make assumptions on annual mileage and fuel costs. If implemented, it was, in general, recommended to harmonise the mileage across EU (i.e. 15,000 km/ year and use Member State-specific fuel prices).

A study suggests that **providing information on the total cost of ownership is likely to affect consumer choice** (Durmortier et al, 2015). They find that respondent rankings of vehicles are unaffected by information on five-year fuel cost savings, however, adding information about total cost of ownership increases the probability that small/mid-sized car consumers express a preference to acquire a conventional hybrid, plug-in hybrid, or a battery-electric vehicle.

We have dedicated one of the treatments in our consumer experiment to test this and found that provision of TCO helps consumers to make more rational choices. Under current price levels, this means, on average, slightly higher share of conventional powertrains (+1.88% for petrol and +0.74% for diesel vehicles) and lower shares for alternative powertrains (-1.08% for hybrid petrol, -0.72% for plug-in hybrid and -0.83% for electric vehicles). At the same time, we have observed more efficient vehicles being chosen, with average energy consumption being 0.4% lower than BAU. This behaviour reflects well the current ranking of the powertrains in terms of TCO, where alternative powertrains are still more expensive, on average. In the future, however, when electric and plug-in hybrid vehicles will have lower TCO than conventional powertrains, provision of TCO is expected to lead to more alternative powertrains being selected, following the rational choices.

In our experiment, only about 25% of those in one of the treatments where TCO is provided stated that they do not trust TCO and about 42% of participants in those treatments listed TCO as one of the most useful information elements (out of up to three most important elements). Only a third of participants in those treatments, however, have responded correctly to the TCO comprehension question, indicating that, in the future, as information spreads and becomes more common, higher magnitudes of impacts can be expected.

Although there were some concerns among stakeholders on whether provision of TCO will help or confuse consumers, most stakeholders stated that provision of TCO would help raise awareness at least to a small extent (20 of 26) but more than a half (14 of 26) expect to have problems or issues with implementation of this measure. The main problems and methodological challenges identified for this measure are the need to adjust the costs frequently, need to make assumptions on annual mileage, fuel costs, maintenance costs, insurance, subsidies, taxes, battery replacement costs discount rates, which is challenging to do at EU level. If implemented, it was, in general, recommended to have it only for certain information channels, such as standardised online platforms for comparison or, if not, harmonise and simplify the methodology as much as possible, respecting at the same time national differences.

Another challenging issue is to decide on timing, for both, running costs and TCO. According to some studies, longer periods are thought to be more effective for consumers, as the differences between powertrains are more pronounced (Codagnone et al, 2016; Camilleri, 2014) suggest longest reasonable term, (Codagnone, 2013) suggests that running costs over five years are most effective; European Parliament, 2010 state that consumers prefer the labels to display 1 to 3 years' running costs). Other studies, however, suggest shorter periods (EPA, 2010b) suggest monthly figures and annual cost figures, (LSE, 2013) find monthly costs more effective). Our experiment used monthly running costs.

Measures that focus on the provision of information on air pollutants

Two of the measures focus on the provision of information on air pollutants (i.e. IE3: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online, IE4: For second hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car, e.g. the next Euro emission level/ new vehicle).

Consumers do not usually link fuel usage with air pollution (AIRUSE, 2016). Although health benefits are serious, they are not apparent to the consumers. Consumers are believed to be responsive to more practical information on local air quality zones restrictions being implemented in many Member States, as indicated in our interviews with stakeholders. Some web comparison sites already provide this information voluntarily, as a response to the demand of the consumers (e.g. Germany, Spain).

Several Member States already include this information on label (e.g. Denmark) (Ricardo and TEPR, 2016) and a number of national stakeholders called for the inclusion of information on air pollutant emissions to be included on the label, although others thought that there was a risk that the label would be less clear if more information of this type was added.

Our experiment has included information on air pollutants in all treatments with the new label referring to the air quality zones restrictions. Indeed, this way of presentation was

easy to understand for the consumers: 74% of consumers in treatments with new label have answered correctly the comprehension question on air pollutants.

In our experiment, less than 20% of those in one of the treatments with new label design (where information on air pollutants is provided) stated that they do not trust this information and about 21% of participants listed air pollutants as one of the most useful information elements (out of up to three most important elements). Those who were interested in new cars have considered this information slightly more important than those shopping for a used car (22% for new cars vs. 20% for used cars).

Most stakeholders stated that provision of information on air pollutants would help raise awareness at least to a small extent (21 of 26 for both new and used cars) but some (8 of 25 for new and 11 of 25 for used cars) expect to have problems or issues with implementation of these measures. The main problems and methodological challenges identified for these measures include being redundant and possibly confusing if CO_2 emissions are provided, lack of reliable information for used cars, problem with NEDC and WLTP values for used cars, high administrative costs. If implemented, there were recommendations to postpone the implementation until 2025 when Certificates of Conformity will be electronic and exclude private sellers in case of used cars.

Measures that focus on the provision of information specific to BEV or PHEV

Two of the measures focus on the provision of information specific to BEV or PHEV (i.e. IE8: Include information on type approved electric range; IE10: Include the information on charge time, including details on the power of the charger that was assumed in the calculations).

In general, there is a consensus in the literature that electric range and charging time are among the barriers that get in a way of consumers purchasing electric vehicles (EPA, Environmental Protection Agency Fuel Economy Label: Literature Review, 2010a; The Boston Consulting Group, 2009; The Boston Consulting Group, 2010)). Range anxiety is often listed among the factors that contribute to the decision not to buy an electric vehicle. Provision of this information is expected to be helpful, as in general, currently ranges are significantly higher than the majority of the consumer believe.

Many studies agree on the need to ensure that information provided to consumers on plug-in electric vehicles includes range, i.e. the distance a vehicle could travel on one charge (LSE, 2013); or both electric driving range and charging time information (EPA, 2010b; LowCVP and TEPR, 2018; APEC, 2015) as these are viewed as important elements for consumer awareness.

Our experiment has included information on electric range in all treatments with the new label, expressed in km of distance. This way of presentation was somewhat challenging for consumers to understand: 55% of consumers in treatments with the new label correctly answered the comprehension question on electric range.

In our experiment, 29% of those in one of the treatments with a new label design (where information on electric range is provided) stated that they do not trust this information and about 27% of participants listed driving range as one of the most useful information elements (out of up to three most important elements).

Most stakeholders stated that provision of information on electric range would help raise awareness to least a small extent (24 of 26 respondents), but expected charge time to be less effective (21 of 26 agreed that provision of this information would raise consumer awareness at least to a small extent). 2 out of 26 of respondents expect to have problems or issues with providing information on electric driving range and 8 of 26 expect issues with proving information on charging times. For electric range, the main problems and methodological challenges identified include the variations across drive cycles. For charging time, the main problems and methodological challenges include the need to deal with variations across chargers of different types and different power output levels (which lead to significant differences in charging times for any particular vehicle model). If implemented, there were recommendations to use the highest possible charger power, and

to include this information as additional, for example accessed through QR code, where consumers would be able to calculate their charging time based on charge power available in their home.

Measures that focus on the provision of additional information in reduced format

Two of the measures focus on the provision of additional information in reduced format (i.e. IE11: Include QR code / barcode / link to more details, e.g. other driving cycles, other price assumptions; IE12: Include QR code / barcode / link to other tools, e.g. fuel economy calculator).

Being concerned with potential information overload (Ricardo and TEPR, 2016), but acknowledging the importance of provision of some additional elements, many studies have proposed to include a link to more detailed information online (e.g. to product databases, comparison websites) via QR code (AIRUSE, 2016; EUR-Lex, 2017; EPA, Revisions and Additions to Motor Vehicle Fuel Economy Label, 2011), or an easily remembered URL (such as "itsimple.com") be provided to help reinforce the educational messages and be easy to remember (EPA, 2010b). There are also suggestions to include other information available online, such as location of charging points (APEC, 2015).

Although our experiment had included a QR code on the label, there was no possibility to track how many participants have actually used it. Also, we believe such elements will be useful in practice, when consumers make real decisions over longer time periods, compared to the experiment. One of the treatments in our consumer behavioural experiment included some additional information in a form of customisable annual mileage and urban/extra-urban driving, which helped consumers to see running costs and TCO specific to their driving behaviour. This customisation turned out to be beneficial in terms of consumer awareness and likelihood of choice for alternative powertrains. This gives us grounds to believe that other types of additional information can also be beneficial, provided that they do not produce information overload and do not confuse the consumers.

Most stakeholders stated that a QR code directing consumers to online comparison platforms would help raise awareness to at least a small extent (18 out of 26 respondents shared this view), but a QR code directing consumers to additional information/more details would be less effective (17 out of 26 agreed that provision of this information would raise consumer awareness at least to a small extent). 5 out of 26 of respondents expect to have problems or issues with implementation of QR codes linking to online comparison platforms and 7 out of 26 respondents expect problems with implementation of QR codes directing consumers to more detailed information. For both measures, the main problems and methodological challenges identified include the need to standardise the information provided and determine at what level (EU-wide or for each Member State) it is provided. If implemented, there were recommendations to (a) show EU-level information on the label and include links to national information, or (b) include a link to a centralised EU-level website with sufficient customisation of national details, or (c) make it optional, or (d) include only in configurators and price listings (not in advertisement).

Measures that focus on methodological aspects of information elements

Finally, some of the measures concern the methodology on how the values for certain elements are being calculated impacting indirectly through understanding and trust. Three of the measures focus on the provision of real-world values (i.e. IE1: Include real-world CO_2 emissions; IE13: Include real-world fuel consumption information; IE9: Include information on real-world electric range) and one measure (IE2) suggest including information on WTW CO_2 emissions.

Some literature sources suggest that the label needs to take account of real-world performance (AIRUSE, 2016; LowCVP and TEPR, 2018). Most stakeholders stated that including information on real world fuel consumption, CO_2 emissions and electric range would help raise awareness to at least a small extent (22 out of 26 respondents), but 9 of the 26 of respondents expect to have problems or issues with implementation of these measures. The main problems and methodological challenges identified include potential information overload (if these are provided in addition to type approved values), difficulty in gathering the information, problems associated with the use of correction factors to transform type approved to real-world values. There were also mentions of problems

related to the fact that real-world values can be potentially misleading to consumers, as they depend on driving style, which is personal and out of control of OEMs, so real-world values will still reflect averages that do not represent everyone.

There is also a claim that WTW (or even life cycle) approach is more appropriate than tailpipe, especially in the longer term with higher penetration of PHEV and BEVs and intensity of use of biofuels (AIRUSE, 2016; Ricardo and TEPR, 2016; Haq and Weiss, 2016; ANEC and BEUC, 2014). Using tailpipe emissions is said to be a factor that may discourage EV manufacturers from improving the energy efficiency of their vehicles (APEC, 2015). Moreover, some studies found evidence that WTW emissions have a stronger impact on consumers (LSE, 2013).

We have dedicated one of the treatments in our consumer experiment to test whether provision of WTW CO_2 emissions would actually help consumers to make better choices. We found that, on average, this did not lead to lower overall tailpipe or WTW emissions. Consumers that saw WTW CO_2 emissions on the label, instead of tailpipe emissions, on average, were 0.58% less likely to choose a diesel vehicle, 0.87% less likely to choose a plug-in hybrid vehicle and 1.26% less likely to choose electric vehicle. They were 2.06% more likely to choose a petrol and 0.64% more likely to choose a hybrid petrol vehicle. At the same time, participants chose more efficient vehicles within each powertrain when they were shown WTW emissions. Average fuel consumption was 0.2% lower in this case (average among all powertrains), compared to tailpipe emissions.

The fact that in WTW treatment consumers did not choose alternative powertrains more often, but did choose more efficient vehicles within each powertrains, can be explained as follows. With WTW emissions, consumers saw less variation across models with respect to CO_2 emission bands. That is, with WTW emissions, fewer vehicles fell in the "A" or "B" (green) bands, and almost all models were "C", "D" or "E" (yellow or red). So, the consumers probably placed less weight to CO_2 emissions and more weight on other aspects for their decision-making, such as costs or purchase price/ lease. If this is so, in the future, as the EU power grid decarbonises, more and more models will fall in "A" and "B" (green) bands under WTW, and the differences in choice between WTW and tailpipe will gradually disappear.

The level of trust in CO_2 emissions was not different for the WTW treatment with respect to other treatments with a new label design (around 23% of participants stated they did not trust the emission values in label design treatments based on tailpipe emissions compared to 22% for label designs based on a WTW treatment of emissions). We also observe similar levels of usefulness: 31% of participants have listed CO_2 emissions as one of the three most useful information elements in tailpipe treatments, and 30% did so in the WTW treatment. 81% of participants responded correctly to the comprehension question related to CO_2 emissions in tailpipe treatment, and 79% did so in WTW treatment.

21 of 26 stakeholders stated that provision of WTW CO_2 emissions would help raise awareness at least to a small extent but approximately half of respondents expect to have problems or issues with implementation of this measure. The main problems and methodological challenges identified for this measure are difficulties in calculating and updating information, the complexity and irrelevance of some information to consumers, the potential need for Member State-specific electricity grid emissions factors that will change annually (or even building in the flexibility for consumers to choose their own factors). Other problems mentioned were the fact that cars are manufactured in one country and used in another, making the same car more attractive in one country than in others (due to circumstances that the consumers cannot control) and, finally, the fact that power sector is included in Emissions Trading Scheme (ETS), although the stakeholder who stated ETS would be a problem did not specify further what specific issues are expected because of that. It is important to note that there was no consensus among stakeholders on whether a single set of EU-wide emission factors for the power sector should be used, or whether these factors should vary across Member States, if this measure is to be implemented.

Conclusions

The table below summarises the conclusions from the analysis above. Overall, it can be concluded that the **cost information (and specifically running costs and TCO) and information on type approved electric range are expected to contribute most to consumer awareness**; information on taxes, air pollutants and additional information in the form of QR codes linking to vehicle comparison websites are also likely to have relatively important impacts in terms of consumer awareness. The rest of the measures -- charging times, QR codes linking to more detailed information, real world or WTW emissions - are less likely to impact consumer awareness significantly.

Table 3-4: Summary of effectiveness in raising consumer awareness and influencing vehicle choices from Information Element measures

Measure	Provision of information element is contributing to			Impact
	Understanding	Trust	Usefulness	
IE0: Include information on taxes	? No evidence on understanding, trust and usefulness			✓ [+] Effective, but only under appropriate set of fiscal incentives
IE1: Include WTW emissions	✓✓ [+] Very good understanding: most consumers (about 79%) answered correctly to the comprehension question, very similar to tailpipe understanding (about 81%)	✓ [+] Moderate trust: some consumers do not trust this information (about 23%), potentially limiting effectiveness but not different with respect to tailpipe (about 22%)	✓✓ [+] High perceived usefulness: a fair share of consumers (about 30%) considers this one of the most useful information elements not different with respect to tailpipe (about 31%)	O [O] As effective at raising awareness as tailpipe emissions but lower impact on choices
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	✓✓ [+] Very good understanding: most consumers (about 74%) answered correctly to the comprehension question	✓✓ [+] High trust: low share of consumers does not trust this information (about 19%)	✓ [+] Moderate perceived usefulness: a low share of consumers (about 22%) considers this one of the most useful information elements	✓ [+] Moderately effective at raising awareness: moderate perceived usefulness despite of good understanding, likely to be very sensitive to format/ design
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	✓✓ [+] Very good understanding: most consumers (about 75%) answered correctly to the comprehension question	✓✓ [+] High trust: low share of consumers does not trust this information (about 20%)	✓ [+] Moderate perceived usefulness: a low share of consumers (about 20%) considers this one of the most useful information elements	✓ [+] Moderately effective at raising awareness: relatively low perceived usefulness despite of good understanding, likely to be very sensitive to format/ design and difficult to implement in a credible way

Measure	Provision of information element is contributing to			Impact
	Understanding	Trust	Usefulness	
IE4: Include Total Cost of Ownership	×× [-] Very low understanding: very few consumers (about 33%) answered correctly to the comprehension question, potentially limiting trust and effectiveness	✓ [+] Moderate trust: some consumers do not trust this information (about 25%), potentially limiting effectiveness	✓✓ [+] High perceived usefulness: a high share of consumers (about 42%) considers this one of the most useful information elements, despite of low understanding	✓✓ [+] High impact at raising awareness, incentivises rational choices, provided the levels of understanding and trust are good
IE5: Include running costs	? No evidence	✓ [+] Moderate trust: some consumers do not trust this information (about 28%), potentially limiting effectiveness	✓✓ [+] High perceived usefulness: a fair share of consumers (about 36%) considers this one of the most useful information elements	✓✓ [+] Relatively high impact at raising awareness, good way to communicate fuel consumption and CO_2 emissions
IE6: Include information on type approved electric range	× [-] Low understanding: few consumers (about 55%) answered correctly to the comprehension question, potentially limiting trust and effectiveness	✓ [+] Moderate trust: some consumers do not trust this information (about 29%), potentially limiting effectiveness	✓ [+] Moderate perceived usefulness: a low share of consumers (about 27%) considers this one of the most useful information elements	✓✓ [+] Potentially very effective at raising awareness: relatively low perceived usefulness possibly explained by low level of trust and understanding
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	× [-] Risk of information overload, with potentially negative impacts on understanding, trust and perceived usefulness			O [O] Not likely to be effective at raising awareness significantly, although potentially helpful to the consumers with misbelieves about PHEVs and BEVs, but risk of information overload
IE8: Include real-world CO_2 emissions and fuel consumption	× [-] Risk of information overload (if provided in addition to type approved CO_2 emissions), with potentially negative impacts on understanding, trust and perceived usefulness			O [O] Less effective at raising awareness than type approved emissions: implementation challenges may diminish trust
IE9: Include information on	×			O

Measure	Provision of information element is contributing to			Impact
	Understanding	Trust	Usefulness	
real-world electric range	[-] Risk of information overload (if provided in addition to type approved range), with potentially negative impacts on understanding, trust and perceived usefulness			[O] Less effective at raising awareness than type approved range: implementation challenges may diminish trust
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	? No evidence on understanding, trust and usefulness			✓ [+] Potentially effective at raising awareness: especially helpful if implemented at EU level
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	× [-] Risk of information overload (if provided in addition to other links), with potentially negative impacts on understanding, trust and perceived usefulness			O [O] Not likely to be effective at raising awareness significantly, although potentially helpful to the consumers with driving behaviour different from average

3.2.3. Measures extending the scope of the Directive

Three measures to extend the scope of the Directive have been considered in terms of raising consumer awareness, including:

- Extending the scope to new vans;
- Extending the scope to used vehicles; and
- Extending the scope to rental vehicles

All of these measures are expected to have an impact on raising consumer awareness by **extending the exposure to fuel economy and emissions information to a higher number of consumers.** In addition, a more comprehensive vehicle scope is expected to make the **underlying message/signal to consumers more consistent**, improving overall awareness. However, the extent to which the information will be used, and influence vehicle choices will depend on **consumers' profiles**. The latter will influence the extent to which consumers are likely to be interested in the information provided and in turn influence vehicle choices. In this way, the effectiveness of these measures to raise awareness and impact vehicle choices will depend on the extent to which they increase exposure to relevant information and on how important this information is to the consumers.

Analysis of the effectiveness of these measures is mainly based on findings from the literature and desk-research, stakeholder inputs, and when applicable, findings from consumer experiment.

Extending the scope to new vans

Extending the requirements of the Directive to new vans (S1) can provide easy to understand information to help consumers differentiate the fuel economy and emissions of a variety of van models with different fuels and emission control techniques (AIRUSE,

2016). Providing easy to understand relevant information was highlighted by ADEME as key to raise awareness amongst van consumers.

Extending the requirements to new vans is likely to significantly impact on the number of new vehicles targeted by measures. In 2018, roughly 1.7 million new vans were registered across the EU-27, representing around 12% of all new motor vehicle registrations (ICCT, 2019). Moreover, demand for new vans in the EU has increased in 2018, marking the sixth consecutive year of growth (ACEA, 2019).

When considering the consumer profile of van buyers, it is important to distinguish between two groups of consumers with different characteristics: commercial and private, where commercial van buyers dominate the new van market. For this first type of consumer, economic considerations are the key purchasing factors, and are more relevant than for passenger car buyers. Evidence shows that vehicle pricing and operating costs are ranked first in terms of importance for the purchase of company vans, whereas it is ranked tenth for private passenger cars (Ricardo-AEA and TEPR, 2011). Stakeholders[28] consulted also indicated that economic considerations are even more important for van buyers than passenger car buyers to reduce costs of ownership.

However, it was argued in the literature that effectiveness in raising awareness is limited for commercial van buyers as these consumers are already aware of the relevant information that is provided related to new cars via the Directive and already take it into consideration when choosing a van. A study for the European Commission suggested that a fuel efficiency label for vans was potentially not as relevant as that for cars, as fuel efficiency was already an important consideration in their purchase (TNO et al., 2004). This was also highlighted by one consumer organisation representative in the stakeholder engagement for this study. Counterarguments suggest that fuel economy and the impact on running costs varies widely amongst different van models with similar functionality. In this way, van consumers would benefit from more transparent information about fuel consumption for otherwise similar vehicles which have different fuel efficiencies (Ricardo and TEPR, 2016).

While the majority of purchases of new vans are by large commercial organisations, many operators are small, and some vans in particular are bought by private individuals. The literature suggests that extending the requirements would at least benefit some private buyers of these vehicles, which would in turn have some environmental benefits and could act as a stimulus to more technical improvements in the industry (Ricardo-AEA and TEPR, 2011; AIRUSE, 2016).

Literature suggested that adopting this measure is feasible as CO_2 emissions and fuel economy of new vans are measured as part of the existing type approval process (AEA and TEPR, 2011). This is also supported by 20 stakeholders consulted as part of this study that identified no problems with making the current requirements available for this new vehicle class. In addition, there are examples of Member States that have successfully introduced labelling for new vans, such as Denmark, Spain, Poland, Sweden and Austria. A Danish representative in a previous study suggested that there were positive indicators for the scheme and pointed to the important link between the information on fuel consumption that is provided by the label and the annual circulation tax, similar to the case for passenger cars[29] (Ricardo-AEA and TEPR, 2011). The interviewed national authorities for Denmark and Austria in our study highlighted there were no issues with extending the label to new vans in their countries.

BEUC and T&E identified potential problems pointing to the need to harmonise the requirements applicable to new vans across the EU. An aspect to consider when implementing the requirements for vans is that these are sold in a different way compared

[28] Four of the interviewed stakeholders, including two national authorities, a manufacturer and ZPS

[29] Denmark operates a van labelling scheme for vans up to 3,500 kg in weight. Vans were included into the same labelling system as passenger cars as vans are included in the annual taxation system used for cars. Each type of van that is available to purchase from a showroom must have an official energy label. Where fuel consumption information is not available for that specific model, then a formula is applied to estimate the fuel consumption per km. This estimation will result in a higher annual tax than if they were able to calculate fuel consumption (Ricardo-AEA and TEPR, 2011).

to passenger cars. A large proportion of vans are not sold on forecourts, thus the way in which information on fuel economy and CO_2 emissions is communicated may differ to passenger cars (Ricardo-AEA and TEPR, 2011). The most effective methods that could be used may not be a label on the vehicle itself, but other media such as the internet may be more relevant. Despite the communication method, BEUC and T&E highlighted the need for the requirements to new vans to be harmonised across the EU.

Extending the scope to used vehicles

The second measure is concerned with extending the scope to used vehicles (S2). New passenger cars are only a small part of the picture for individual motorised transport. Most consumers do not buy new cars but do buy second-hand cars. The current exclusion of used cars from the Directive is thus seen as a factor potentially limiting the effectiveness of the Directive (ANEC and BEUC, 2014; BEUC, 2019; Ricardo and TEPR, 2016).

Extending the requirements to used cars can reach a much larger target audience. In some European countries, the used car industry is three times larger than the new car sector (BCA, 2012). Furthermore, imports of used cars exceed the number of domestic new registrations in a number of Eastern EU countries (LT, PL, LV, BG, SK, CZ). Thus, the second-hand car market represents an important consumer group. Moreover, the majority of car buyers will never buy a brand-new vehicle (Ricardo-AEA and TEPR, 2011).

As stated in the monitoring report (Ricardo-AEA and TEPR, 2011), some dealers thought that customers assume new cars would automatically have better fuel economy than older cars. However, this is not always the case, particularly when comparing vehicles of different sizes. Therefore, extending the requirements for used passenger cars could help sell smaller, less polluting models. It can also reinforce the public education message that car models differ in terms of environmental performance and fuel economy and increase overall recognition of the Directive (AIRUSE, 2016; Haq and Weiss, 2016).

In terms of consumer profile, literature suggests the purchasers of used cars are likely to be more sensitive to fuel price (Ricardo-AEA and TEPR, 2011; Ricardo and TEPR, 2016). Energy consumption becomes more relevant for buyers on the second-hand market compared to the new car market as upfront price differentials are less pronounced for used cars. Thus, extending the requirements to used cars is expected to be more effective if information on costs is provided, as is proposed by the new measures under consideration in this study.

The limited evidence from the UK, where a voluntary labelling scheme for used cars is in place, suggests that extending the current requirements to used cars can impact consumer choices (Ricardo and TEPR, 2016). In 2009, a similar label to the new car label was adopted for used cars, providing information on fuel costs for 12,000 miles as well as the vehicle excise duty for one year. Evidence gathered by LowCVP for this evaluation[30] demonstrated strong support for the scheme from consumers. More than half of recent and intending used car buyers were familiar with the label in the first year of implementation, which demonstrates how the new and used car labels are complementary in raising awareness of fuel economy in purchase choices. Finland[31] has also extended the requirements of the Directive to used cars. Alternatively, in Germany the ADAC EcoTest provides an environmental ranking and labelling scheme for new and used cars since 2003 (Ricardo and TEPR, 2016).

Results from the consumer experiment, where new measures proposed in this study, including information on costs was tested showed similar behaviours between used car buyers and new car buyers in terms of vehicle choice. Providing information on the new label resulted in 2% more used cars buyers choosing electric vehicles compared to the baseline than new car buyers. Results also showed that used car buyers are 1% more likely

[30] Evaluation consisted of a consumer study of 143 people who had bought a nearly new (less than six month old) or used car since November 2009. It also consisted on in-depth telephone interviews with 9 UK dealerships participating in the used-car labelling scheme during August 2010 (LowCVP, 2010).

[31] Finland has an online database developed by the government covering new passenger cars where consumers can also check used car's consumption and emission data and print their own car label by providing the registration number. As suggested by Finnish Transport and Communications Agency (Traficom), consulted in our study, providing this information free of charge to used car dealerships was very useful in the country.

to choose hybrid cars and 0.5% more likely to choose plug-in hybrid cars than new car buyers compared to the baseline.

Despite the support found in literature, our consumer experiment results and successful implementation of this measure in some countries, 14 of the interviewed stakeholders identified significant issues/problems with implementing this measure. The most common recurring problems referred to was associated to the challenges for enforcement and monitoring. CO_2 data for used cars is available from 2001 onwards, therefore a label will only be able to be produced for vehicles registered in or after 2001. In terms of monitoring, a large part of this market is informal as used cars are often sold by private sellers online. Stakeholders agreed that regulation can be easily imposed on the commercial, formal and regulated part of this market, but identified difficulties in enforcing it on the informal market. Moreover, FIA suggested that it can act as a catalyst for fraud. 16 of the interviewed stakeholders stated that if the Directive were extended to used cars, it should only be mandatory for commercial sellers (otherwise sellers will not do it, as a result of the cost of compliance) while remaining voluntary for private sellers. This was also supported by the literature (ANEC and BEUC, 2014; BEUC, 2019). BEUC and the Finnish national authority suggested that private sellers should have access to an online platform where they can easily download the used car label.

The original fuel economy and CO_2 of used cars were measured according to the NEDC, which does not yet accurately reflect real-world emissions. Stakeholders suggested the old NEDC could get unfair advantage compared to new WLTP vehicles with more realistic consumption values. However, consumers are expected to compare different cars that are similar in age so the most likely scenario is that they will be comparing NEDC values with other NEDC value or WLTP values with other WLTP values rather than converting NEDC values to WLTP values.

As suggested by Verbraucherzentrale Bundesverband, another consumer organisation and a national authority, as cars are used, their fuel consumption and CO_2 emissions can change and is dependent on several factors such as the extent of use, the quality of the maintenance. The emission performance of older cars can get worse and the running costs/TCO can be hard to predict, depending of the age of the used cars. There is therefore a risk on regarding information reliability for used cars, which needs to be considered when developing requirements for these cars.

Two stakeholders suggested the focus of the Directive should remain on raising awareness and influencing vehicle choice for new vehicles so that ultimately cleaner vehicles enter the second-hand market. However, some stakeholders provided other solutions. One of the interviewed manufacturers suggested limiting the inclusion of used cars up to a certain age (e.g. 3 years) as after a certain time it really depends on how the owner of the car took care of it (whether the engine is in the same condition as before or not, accidents, etc.). ACEA suggested asking manufacturers to send electronic data presented in the certificate of conformity (CoC) to a centralised database that everyone can access. This is a mandatory requirement associated with Regulation (EU) 2018/858 as of mid-2026, so by 2029 or 2030 Member States would already have the information for 5-year old cars.

In general, if the identified issues are addressed, 19 of the stakeholders agreed that the extension of the requirement to used cars can have an impact in raising awareness on fuel economy and emissions.

Extending the scope to rental cars

One of the measures refers to extending the scope to final consumers of rental cars (S3). Users are responsible for paying for fuel used, thus labelling rental cars may generate demand for more efficient vehicles, encouraging consumers to rent from companies with more efficient cars. This, in turn, may influence the purchase decisions of the rental car market (Ricardo-AEA and TEPR, 2011). In addition, the rental market plays a role in providing second-hand vehicles into the private car market, so it could be beneficial to encourage lower emitting vehicles in this sector, as was highlighted by one stakeholder. The market for rental cars in Europe is growing, however it is small. France has the largest rental car market in the region, with a total fleet size of 237.2 thousand cars in 2018 (Market Research Reports, 2019).

As suggested by stakeholders consulted in this study, consumers of rental cars tend to base their choice of car on vehicle class and price, whereas fuel economy and environmental considerations are less relevant. Companies renting cars from rental companies tend to care more about more efficient choices, but they already have their own systems in place to evaluate fuel efficiency and emissions information when ordering a rental car. As highlighted by one of the manufacturers interviewed for this study, current systems are of a high standard so extending the requirements to rental cars might not have any impact for commercial consumers and would imply additional work.

Regarding influence on vehicle choices, literature and stakeholders consulted to support this study suggested that rental vehicle consumers are unable to select lower CO_2 emitting cars within a category/class as they generally only know the category/class of car they are renting ('small', 'medium' etc), but not the make and model (Ricardo-AEA and TEPR, 2011). Thus, effectiveness in raising awareness and influencing vehicle choice is expected to be limited.

For rental cars that are new, there were no problems identified with providing this information by the interviewed stakeholders. However, problems described above will apply to used rental cars.

Conclusions

Discussions for the measures that propose extending the requirements of the Directive are largely supported by stakeholders' inputs and literature. Most stakeholders and previous studies identified that the measures to extend the requirements to new vans (S1) and used cars (S2) would be effective to a great or some extent, whereas extending the requirements to rental cars (S3) was expected to have limited effectiveness.

The table below summarises the conclusions from the analysis above:

- The measure proposing the extension to used cars (S2) is expected to effective at raising consumer awareness of emissions and fuel economy and encouraging the purchase of more efficient vehicles given the significantly large market that can be reached through this measure. Moreover, through this measure, consistency of the message is greatly improved, allowing consumers to compare used and new cars.
- The measure related to extending the requirements to new vans (S1) is also expected to be effective overall, as the market for new vans is significant and is expected to continue to grow. However, this measure is expected to be less effective for commercial van buyers as these consumers are already well-aware of this information.
- Extending the requirements to rental vehicles (S3) is anticipated to have a limited effect given the small market share and the low likelihood for these consumers to consider fuel economy as part of their rental decisions with respect to vehicle choices.
- The most important barriers to the extension of the label to some types of vehicle are (1) the ability to measure the CO_2 emissions and fuel economy of vehicles in a consistent and agreed way across the EU and (2) enforcement and monitoring. Both problems have been identified for the measure that proposes extending the requirement to used cars (S2), potentially limiting the effectiveness of this measure if not addressed. The second problem is associated to extending the requirements to the informal market.

Table 3-5: Summary of expected impacts on raising consumer awareness from extending the scope of the Directive

Measure	Effectiveness is likely to depend on		Impact
	Increased exposure	Consumers' profile	
S1: Extend requirements to [new] vans	✓ [+] Significant market representing 12% of new vehicle sales in EU-27. Effectiveness is expected to increase in the future, as vans will represent a higher share of urban trips.	✓ [+] Private van buyers are likely to be interested in information on fuel economy, as suggested by interviewed stakeholders [O] Medium/large businesses are already exposed to this information and take it into consideration in its cost calculations, thus limiting the value added of this measure.	✓ High potential to be effective at raising awareness for small businesses, which are not usually as aware as larger fleet owners of fuel economy. Limited impacts for medium/ large businesses, which tend to be very aware of fuel economy for cost reasons.
S2: Extend requirements to used vehicles	✓✓ [+] Potential to reach the large used car market in Europe. [+] Message consistency can be particularly improved through this measure allowing buyers to compare used and new cars. [-] However, effectiveness would be likely influenced by whether a methodology is defined to allow for reliable calculations for used cars and whether private sellers voluntarily participate in the scheme (the latter would apply if extended to the informal market)	✓ [+] Cost is a key consideration for second-hand car buyers and operating costs are a big part of overall costs. Thus, this measure is expected to be very effective, especially if information on costs is provided (as suggested by the new measures under consideration in this study)	✓ Potential to reach a significantly large proportion of car buyers and considerably increase the consistency of the message/signal of the Directive. Monitoring, enforcement and methodological issues should also be addressed before implementing this measure to ensure its effectiveness.
S3: Extend requirements to [new] rental vehicles	O [O] Limited market for rental vehicles.	O [O] The main criteria for choosing a car to rent is vehicle class and price. [O] Commercial car consumers tend to care about more efficient choices, but they already have systems in place to evaluate this information, limiting the effectiveness of this measure.	O Limited impact on rental vehicle choice as market is limited and main criteria for renting a car is vehicle class and price. Limited impact for commercial rental car consumers as they are already aware of

Measure	Effectiveness is likely to depend on		Impact
	Increased exposure	Consumers' profile	
			this information and have high standard systems in place

3.2.4. Measures increasing the level of harmonisation of implementation in the Member States

A single measure proposing increased harmonisation across all EU Member States on the measures to raise consumer awareness (H1) is considered. As described in Section 3.1.2, the current car labelling Directive allows Member States a certain amount of flexibility when it comes to the design and presentation of the information to be provided to consumers. For example, the layout of the label is not specified in the Directive, nor does it specify how the information could be presented (other than using official estimates of fuel consumption/CO_2 emissions). This has led to a variation in the way the Directive has been implemented in EU Member States - predominantly in the design of the label, but also potentially methodological aspects.

Increased harmonisation can raise awareness and have an impact on vehicle choices by **reinforcing the message/signal to consumers, making it more consistent**. If the same information is provided in a uniform way, consumers viewing information on vehicles across Member States will be able to more easily recognise, understand and use the information, which raises overall awareness. In addition, if there are options to present the information or methodological approaches that can be used that are more effective at raising awareness and influencing vehicle choices (by making information clearer, etc.), harmonisation **ensures that the optimal or most appropriate approaches are used across the EU**, thereby increasing the overall effectiveness of the tools used by the Directive. At the same time, some degree of flexibility is still needed to reflect national circumstances and thus only certain elements would benefit more from being harmonised.

Potential label design features and the specification of assumptions/methodologies could be harmonised in revised legislation (potential effectiveness of such aspects are considered further in Section 4). If there is agreement/ clear winners, and if the Commission decides to update the legal instrument (either a revised Directive or a new Regulation) then they may want to specify in more detail the design and methodological aspects. Through specifying these design and/or methodological aspects via revised legislation, there will be a level of harmonisation across EU Member States.

Support for further harmonisation of the implementation of the Directive has been raised before by a number of stakeholders. The evaluation of the Directive, undertaken in 2016, reported that many of the EU level stakeholders interviewed for the study supported the greater specification – i.e. more harmonisation across Member States – of some elements of the Directive, as did various respondents to the public online consultation (Ricardo-AEA, 2016). It was argued by several of the stakeholders that the lack of a specification of the format of the label was a problem, as was the omission of information that is more relevant to consumers, such as running costs and vehicle taxation.

A large proportion of stakeholders consulted for the evaluation argued for a greater level of harmonisation through the use of an instrument (Regulation) that will ensure greater uniformity (such as a colour-coded absolute labelling scheme). More than half (54%) stated that the Directive is too flexible and would prefer a more harmonised approach. However, it was recognised that such a change needs to be balanced against the need to ensure flexibility to take into account national parameters, particularly in relation to national fiscal measures (Ricardo and TEPR, 2016).

The evaluation also considered the flexibility that Member States currently have with the existing requirements, and noted that some Member States have taken advantage of the flexibility to deliver better labels than required (e.g. making use of the colour coded label). However, half of Member States have not made use of this flexibility, while others have implemented labels that appear to be confusing for consumers (Ricardo and TEPR, 2016).

The potential harmonisation of aspects of the Directive has also been discussed elsewhere in the literature. In a study prepared by ANEC and BEUC (ANEC and BEUC, 2014) it is agreed that key elements of the Directive should be harmonised in order to create synergies between Member States. However, they also acknowledge that some flexibility should be retained in order to adapt the legislative instrument to reflect national circumstances. In terms of the aspects of the Directive that could be harmonised, they conclude that the following aspects should be considered:

- Use of a colour-coded comparative rating scale ranging from class A to class G as the main focus of the label;
- Classification of cars along the A-G rating scale according to their absolute emission levels ("absolute labelling system");
- Use of well-to-wheel CO_2 emissions as the measure of comparison in order to make all vehicle types comparable;
- Set CO_2 thresholds of the labelling classes at EU level; and
- Periodically tighten the criteria for achieving the rating classes to keep up with technological change.

In a more recent publication (BEUC, 2019), BEUC again recommends that the label should be harmonised at the EU level for the majority of parameters, while leaving some flexibility to be adapted to national circumstances (e.g. tax incentives). They also support the use of a Regulation rather than a Directive as the legislative instrument.

Evidence from the literature supports the view that increased harmonisation of the label and methodologies/assumptions at EU level (implemented in all EU Member States) could result in additional positive impacts on raising consumer awareness. AIRUSE (2016) suggest that a common label across the EU would be an effective measure considering the multinational nature of the car industry and the fact that cars can be bought easily by residents of one Member State in a different Member State. Through requiring a harmonised approach to the label, the use of multiple labelling systems in different countries could be avoided, **reducing consumer confusion**. In addition to reducing confusion, reducing the ambiguity regarding information presented to consumers where it previously differed between EU Member States could lead to an increase in trust of consumers. (Haq and Weiss, 2016) state a need for standardisation across the EU in order to ensure consumers are provided with **comprehensive but understandable information** that reflects the performance of a car and allows **transparent comparisons** across car models. (BEUC, 2019) supports the harmonisation of the label (format and context) so that all EU consumers have **access to the same information** about car models.

The impacts of increased harmonisation across EU Member States will vary depending on the design/methodological changes made. However, it is assumed that changes made would be implemented in the context of improving the effectiveness of the label (i.e. increasing consumer awareness and influencing positive consumer vehicle choices). Although the nature of harmonising the label design and methodologies used will ultimately affect all EU Member States, the scale of changes implemented will vary depending on the current design/methods used in each Member State.

At an individual Member State level, if the baseline design/methodology differs greatly from that proposed by revised legislation (i.e. basic/minimal information is currently provided), then it could be reasonably expected that effectiveness increases assuming that more effective label/methodologies have been specified. Conversely, if a minimum common denominator approach is taken to harmonisation across EU Member States, then consumer awareness is unlikely to improve.

If the legislation was to be revised (updated Directive or introduction of a Regulation), then the Commission may want to further specify design and/or methodological aspects. This would effectively increase harmonisation across the EU Member States, the subject of measure ***H1: Increase the level of harmonisation across all EU Member States on the measures to raise consumer awareness***. The rationale for further specification of design and methodological aspects is considered in more detail in Section 4. However, this section considers in more detail which aspects could be harmonised.

Harmonisation of design and methodological aspects

As mentioned above, there are a number of design elements of the label that currently differ between Member States, some of which could benefit from further specification at the EU level. These are discussed in more detail below.

Presentation of fuel economy/CO_2 emissions (e.g. similar to EU Energy Labelling Regulation approach or alternative): Many EU Member States have taken a similar approach to the EU Energy Labelling Regulation in terms of presenting specific emissions of CO_2, i.e. using coloured band representation with letters signifying each band (usually A to G). However, as there is no standardised approach required, approaches vary between Member States, with at minimum providing the required information in a list format.

The EU Energy Efficiency Directive (2012/27/EU) (which preceded the EU Energy Labelling Regulation) aimed to encourage consumers to buy more energy efficient products by informing them about the energy use of products through a mandatory harmonised EU energy label. However, the Impact Assessment for the proposed Energy Labelling Regulation stated of the existing Directive that "*the objective of reducing negative environmental impacts of products, in particular energy use, cannot be sufficiently achieved by the Member States, because this would lead to divergent national provisions and procedures (while having similar objectives) that would generate undue costs for industry (and eventually consumers) and constitute obstacles to the free movement of goods within the EU*". Therefore harmonised EU rules in energy labelling and the underlying measurements and testing were developed to ensure that the same model of a product has the same published energy class throughout the EU in the form of the Regulation for EU Energy Labelling (European Commission, 2015).

For this study, stakeholders were asked in surveys and interviews whether the design of the label, based on that used in the EU Energy Labelling Regulation (2017/1369), should be harmonised. 24 out of 29 stakeholders agreed that it should. Only one stakeholder elaborated on their response, mentioning that the design is already well-known by consumers. Just 6 out of 29 stated that the design of the label should be harmonised based on another design, with those supporting harmonisation with the EU energy label citing that consumers are already familiar with the Energy Labelling Regulation design. The majority of stakeholders (24 out of 28) consider that that harmonising the label based on the design of the Energy Labelling Regulation would be effective in raising awareness (small to great extent) with only 10 out of 28 stakeholders potentially considering an alternative design to be effective.

Method underlying the way in which cars are assigned to an emissions category (e.g. absolute, relative): The way in which cars are compared differs; they are either compared against all new cars on the market (absolute comparison) or categorised according to comparison against cars in a similar size class (relative comparison). The latter is where a car is categorised in comparison to a weighted average of other cars in the same category.

Whilst the literature and previous evaluation suggests that an absolute approach should be taken, our study considered whether the method underlying the way in which cars are assigned a category (e.g. absolute, relative etc.) should be harmonised. 27 out of 29 stakeholders agreed that it should[32]. Limited feedback was provided, although AVERE suggested that the information should be communicated in a clear and simple manner so that it does not impact on ease of understanding. Two Member States stated their preference for the absolute approach[33], whereas a further two stakeholders suggested that a relative approach is preferred[34]. Again, the majority of stakeholders (25 out of 28 respondents) considered that harmonising the method underlying the way in which cars are assigned to a category would be effective (small to great extent) in raising awareness.

Emission values that determine the way in which cars are assigned to a category (e.g. CO_2 emissions relating to each band): Differences also exist in the definition of

[32] Two respondents did not know

[33] BE and other national authority (anon)

[34] Verbraucherzentrale Bundesverband and leasing representative (anon)

the energy efficiency classes, whereby Member States have adopted different definitions for the same band category.

In surveys and interviews for this study, 25 out of 29 stakeholders agreed that the emission values that determine the way in which cars are assigned to a category (e.g. CO_2 emissions relating to each band) should be harmonised (three did not know and one disagreed). A Member State in agreement that emission values should be determined clarified that they should be accompanied with a timetable as to when categories should be updated (FI). Another pointed out that the values should ensure that it will not be easy to fill Category A, building in ambition for manufacturers to achieve lower emissions (Verbraucherzentrale Bundesverband). The majority of stakeholders (25 out of 28 respondents) considered that harmonising the method identifying emissions values to determine the way in which cars are assigned to a category would be effective (small to great extent) in raising awareness.

Additional information presented to consumers: The Directive is silent on the inclusion – or not – of information beyond the basic information required by it. In practice, additional information included by Member States has included air pollutant emissions (including Euro standards, eligibility for access to air quality zones), information on costs (running costs, Total Cost of Ownership, tax), information on electric range/charging times, other additional information.

Harmonise the minimum requirements for additional information included in QR codes: Building upon the last design/information element, this point considers whether 'additional information' that could potentially be included and accessed via a QR code on the label should also be harmonised, i.e. information and source specified within the legislation. Our study considered with stakeholders whether minimum requirements for additional information provided in QR codes should be harmonised. 19 out of 29 stakeholders agreed that they should, with a further 8 stakeholders did not know and two disagreed. In terms of effectiveness in raising consumer awareness, 18 out of 27 stakeholders considered harmonising minimum requirements for additional information in QR codes to be effective (small to great extent).

BEUC pointed out that whilst they potentially support access to additional information via a QR code, other essential information should be provided on the label and additional information should be complementary. They also point out that the information provided via the QR code should be designed and operated by a public authority (rather than privately/manufacturers). ACEA agreed that the use of QR codes to enable access to additional information could be beneficial, although there needs to be a balance in terms of the volume of information that is included/provided.

Establish rules for communicating CO_2 emissions under WLTP values (e.g. all vehicle models versus basic vehicle models): Whilst CO_2 emissions under WLTP values may be presented for the 'basic vehicle model', what is considered to be the 'basic model' may differ between manufacturers (e.g. in some cases there are more 'extras' (additional features) on selected basic models compared with others, meaning models are not strictly comparable). Additionally, it may be more appropriate to provide CO_2 emissions under WLTP values for all models, e.g. taking into account the specification of the model that the consumer is considering purchasing. This latter approach would enable better comparison between specific vehicle models. For this study, stakeholders were asked whether rules should be established for communicating CO_2 emissions under WLTP values - 24 out of 29 stakeholders agreed that they should (two disagreed and three did not know). 20 out of 28 respondents considered that establishing harmonised rules for communicating CO_2 emissions under WLTP values to be effective in raising consumer awareness (small to great extent).

Establish (specify) methodologies/rules determining how assumptions for the calculations should be made and adjusted: If it is agreed that additional information should be included on the label, then the Commission may wish to decide whether to further specify appropriate methodologies. This may include calculations/assumptions relating to fuel prices, average distanced travelled etc. When consulted for this study, 22 out of 29 stakeholders agreed that such assumptions should be harmonised - 3 disagreed and 4 did not know. 22 out of 28 respondents considered that establishing these methodologies/rules would be effective in increasing consumer awareness (small to great extent).

BEUC agreed that a common methodology should be specified at the EU level, which would enable Member States to use country-specific values/assumptions for selected values (i.e. average electricity costs, miles per year etc. Another stakeholder (ZPS - Zveza potroÅinikov Slovenije) suggested that due to the variation in fuel/electricity prices in the Member States, a European average should be used. (Verbraucherzentrale Bundesverband) points out that information such as fuel prices, mileage, insurance costs, taxes, running costs/TCO etc are all Member State specific and should remain that way on the label. However, the methodological aspects to reach some of the figures could be harmonised.

The table below summarises the conclusions from the analysis above. Overall, it can be concluded that:

- Increased level of harmonisation across EU Member States through further specifying label design and methodological/assumption approaches is likely to have a positive impact on reducing consumer confusion, increasing familiarity with and understanding of the label/information and restoring trust.
- In turn, these impacts may also positively affect consumer awareness. According to stakeholders consulted for this study, the harmonisation of the following aspects at the EU level are likely to be the most effective in terms of raising consumer awareness:
    - The design of the label, based on that used in the Energy Labelling Regulation (2017/1369);
    - Method underlying the way in which specific vehicle models are assigned to an emissions category (e.g. absolute or relative comparisons of emissions performance);
    - Emission values that determine the way in which cars are assigned to assigned to a category (e.g. CO_2 emissions relating to each band); and
    - Establish (specify) methodologies/rules determining how assumptions for the calculations should be made and adjusted.
- However, it was also acknowledged that it is important to retain a degree of flexibility in order for Member States to adapt to reflect national circumstances. This may include aspects such as local air quality or tax-related information.

Table 3-6: Summary of expected impacts on raising consumer awareness from Harmonisation measures

Measure	Increased harmonisation has an impact on:			Impact
	Familiarity	Understanding	Trust	
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	✓ [+] Depending on the design specified (e.g. based on that of the EU Energy Efficiency label), familiarly amongst consumers could be increased	✓ [+] Through further specifying the design aspects of the label (and selected methodologies/ assumptions), consumer understanding is likely to improve, potentially increasing consumer awareness	✓ [+] Harmonisation of information provided about cars across EU MSs may lead to increased trust amongst consumers, particularly where there were previously differences	✓ Increased familiarity, understanding and trust depending on design/methodology specification made which could lead to increased consumer awareness. Greater impacts expected in MSs with a lower baseline (i.e. where most changes required).

3.3. Assessment of economic, environmental and social impacts

Impacts are assessed for three main categories: economic, environmental, and social impacts.

There are two main direct impacts arising from the implementation of the short-listed policy measures:

- **Impact on vehicle sales and parc composition** (e.g. shift to different powertrains or more efficient vehicles). The magnitude of this impact depends on the actual measure and its level of effectiveness at raising consumer awareness and influencing vehicle choices as summarised in Section 3.2 above.
- **Impact on costs** both in terms of compliance or enforcement with any proposed scheme (for businesses and public authorities).

The remaining impacts will arise as a result of the changes brought by the impact on vehicle sales and include the **environmental impacts** (in terms of energy use, GHG emissions, air quality pollutant emissions), other **economic impacts** (in terms of costs to consumers and households, costs to professional vehicle users, etc.) and **social impacts** (in terms of income distribution and social inclusion, and public health).

Our **overall approach to the assessment of impacts** can be summarised as follows:

- For some policy measures and impact categories, we used the SULTAN model to assess the impacts of policy measures.
- For other policy measures and impact categories, we used alternative approaches aiming to assess the magnitude of the impacts. Where possible, this is based on additional evidence on the relative effectiveness of the measures. We use it to draw parallels between the impacts arising from measures that can be analysed based on SULTAN outputs and other measures.
- In other cases, only a qualitative assessment of impacts was possible.

For the **SULTAN modelling of the impacts**, the findings from the consumer behavioural experiment have been translated into changes to input variables for the SULTAN model. Specifically, we have used experimental data to calculate the differences between the control and experimental treatments described in Annex G. The differences in consumer choices have been expressed in terms of:

- Differences in the mix of powertrains (shares of diesel and gasoline ICEV, HEV, PHEV and BEV);
- Differences in efficiency of the vehicles, that is, in average energy consumption for each of the considered powertrains (fuel consumption for diesel and gasoline ICEV, HEV, and PHEV, and electricity consumption for PHEV and BEV).

Limitations of the analysis: There is uncertainty on the conversion of the consumer response findings into actual real-world purchase decisions, which could not be quantified as part of this project's research. The analysis also assumes that there are no restrictions in the supply of efficient vehicle models as these are strongly driven by the CO_2 regulation targets. In other words, it assumes that the models chosen by the consumers will be effectively available for lease/purchase. The consumer information (e.g. label) is thus not to be understood as triggering an increase of the supply of ZEV, but rather as orienting consumers in their choices amongst vehicle types and models available on the market.

More details on the approach are provided in Annex A (section A.3.1).

Whilst no specific packages of policy measures (i.e., policy options) have been defined, the following scenarios have been developed and assessed in SULTAN. They combine several measures and thus can be used as a proxy to derive the impacts of the individual policy measures under consideration as outlined in Table 3-7.

The elaboration of four scenarios reflects the groupings of the measures for which the evidence on impacts is scarce, or the consensus is not reached in the literature. Our selection of scenarios reflects those information elements and channels for which existing research and evidence of effectiveness is limited, while implementation is possibly

challenging, due to technical or administrative difficulties. Suggested scenarios correspond to the experimental treatments, developed on the basis of team's expert judgement and drawing upon the results of the literature where available. The scenarios **should not be viewed as substitutes but as complements**: we expect the effects to be cumulative when many measures are implemented at the same time.

These scenarios are used as the basis to quantify the impacts of the measures, where possible, or illustrate the expected direction of impacts, where exact quantification is not appropriate. The measures are expected to enter into force in 2025 and impacts are assessed until 2030.

It is worth noting that some of the short-listed measures (or their variations) have already been implemented in certain Member States as summarised in Section 3.1. However, the consumer experiment findings were applied equally to all Member States and, as such, the SULTAN results represent the upper bound of the expected effects for these measures.

Table 3-7: Description of policy scenarios assessed with SULTAN

Scenario	Scenario description	Proxy for the following measures
New Label	Implementation of a new label based on EU energy-efficiency design (including provision of information on running costs, air pollutants, tailpipe CO_2 emissions, fuel economy for combined cycle, electric range and QR code leading to additional information). New label to be shown in the point of sale and online on web resources of car manufacturers, dealers and third parties.	Label/information to be shown online (IC1) For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online (IE3) Include running costs (IE6) Include information on type approved electric range (IE8) Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions) (IE11) Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator) (IE12)
WTW	Implementation of changes to current label to contain information on WTW emissions instead of tailpipe CO_2 emissions. Results have been adjusted for the period after 2020 to reflect changes in the relative WTW emissions of conventional and electric vehicles due to significant decarbonisation of electricity.	Include WTW emissions (IE1)
TCO	Maintenance of the current labels but implementation of an obligation to provide information on TCO at the point of sale and exposure. Results from the consumer experiment have been adjusted in the period after 2020 to reflect changes in the relative TCO of different powertrain types in the BAU scenario.	Include Total Cost of Ownership (IE5) Car manufacturers/ dealers to present information of interest in a quote provided (IC7)
Custom	Maintenance of the current label but addition of flexibility to adjust information on running costs and TCO according to consumer driving behaviour at the point of sale and exposure (annual mileage and urban/ extra-urban driving).	Label information to be provided in interactive displays (IC2) Make a platform available- in web version or mobile app - containing the information on all models and facilitate their comparison (IC6)

3.3.1. Impact on vehicle sales and parc composition

The primary impact of the proposed measures will be on vehicle sales and the composition of the vehicle parc. If the measures are effective in raising awareness of emissions and fuel/energy consumption of vehicles as well as influencing vehicle choices, this can result in a change in vehicle sales towards more energy efficient vehicles. The magnitude of this impact depends on the actual measure and its level of effectiveness which was assessed in Section 3.2 above.

In principle, the more effective a measure is at raising awareness and influencing vehicle choices, the higher impacts it can have in terms of the sales of vehicles. As such, the assessment summarised in Table 3-3 to Table 3-6 in the previous section provide an indication of the measures which can have the most significant impact on vehicle sales as well as their direction (i.e., more awareness of environmental-related performance of vehicles leads to the choice of cleaner vehicles). However, it is worth noting the following factors which can undermine this causal effect:

- *The intention–action gap*: Studies have shown that high awareness of the environmental impact of vehicles does not necessarily translate into a higher willingness to pay for less polluting vehicles (Folkvord, 2020). This is due to a range of other vehicle attributes (e.g. price, safety, performance) which also determine purchase decisions.
- *The type of information provided*: The consumer experiments conducted for this study have shown that not all pieces of information should be expected to clearly enhance the benefits of more efficient and less polluting vehicles. For example, provision of information on WTW CO_2 emissions contributes to consumer awareness but it will not lead to more sustainable choices for all consumers.

In the case of the consumer experiment conducted for this study, the results not only allow us to analyse the changes in the level of awareness but also to conclude on how these translate to changes in vehicle choices (i.e., the participants were asked to select vehicles to test drive). Nevertheless, these hypothetical choices in our online experiment might not translate into exactly the same purchase/lease decisions in real life situations for two reasons:

- *Test drive versus purchase/ lease decision.* The fact that a car has been selected as one out of two for a test drive does not imply that there is a 50/50 chance that each of them will be purchased/leased. However, not having any evidence or statistics on how test drive behaviour translates in purchase/lease decisions[35], we assume both selected cars have an equal chance to be selected by the consumer after the test drive.
- *Hypothetical versus real choices.* The fact that hypothetical (and not real) choices are analysed is a limiting factor of many online experiments, adherent to the methodology that has been used in this study. Although participants did not receive incentives that would encourage them to behave in the truthful way, we believe the results are still credible and represent well real choices, on average. We believe so because of exhaustive initial screening of participants (restricted to car owners or potential owners) and useful and engaging topic of the experiment. The interview time has also been monitored and the data has been cleaned to eliminate those participants who finished the tasks too fast, as these are, as experience shows, more likely to answer the questions randomly rather than truthfully.

In summary, with no sufficient evidence from our experiment to determine the actual impact on sales, we use average choices as a proxy for potential new vehicle sales.

The SULTAN model uses outcomes of the consumer experiment as inputs. As explained above, SULTAN uses the changes in frequency of choice as well as changes in energy consumption for each powertrain, under different experimental treatments. We construct

[35] We have analysed first and second choices separately and did not find systematic differences. This might be (partially) explained by the fact that participants had an opportunity to change their selections during the experiment as many times as they wanted. So, the definition of first and second choices is not clear in these cases.

scenarios for SULTAN on the basis of our five treatments (one control and four experimental treatments). The SULTAN model translated these inputs into the expected changes in the EU-wide vehicle sales and parc composition.

Table 3-8 shows that, compared to the baseline, the sales of new xEVs (i.e., PHEVs and BEVs) could increase in the EU under the NewLabel scenario (by 27% in 2025 and 16% in 2030), under the Custom scenario (by 5% in 2025 and 3% in 2030) and under the TCO scenario (by 2% in 2025 and 3% in 2030). This impact represents only the effects of the consumer awareness measures considered under each scenario. The relatively high uptake of xEV estimated, particularly for 2025, reflects in part the fact that xEV sales under the baseline are relatively small and thus the impact of the measures that define these scenarios represent more substantial changes. Over time, as the sales of new xEVs are expected to increase in the baseline, the effects of the new measures appear smaller, except in the case of the TCO scenario. The TCO scenario is anticipated to lead to increasingly higher sales of xEVs over time (from 2% in 2025 to 7% in 2030, compared to the baseline) since the measures included in this scenario are expected to make xEVs more attractive over time (as explained above, the relative TCO of xEVs vs conventional powertrains will improve as the price of xEVs decreases over time).

On the other hand, the WTW scenario is anticipated to lead to a decrease in the sales of xEVs compared to the baseline (by 9% in 2025 and 4% in 2030). This is because the provision of WTW CO_2 emissions (instead of tailpipe emissions) is not effective at making xEVs a more attractive purchase as discussed previously.

These changes are reflected in the variations in the vehicle parc composition in 2030 illustrated in

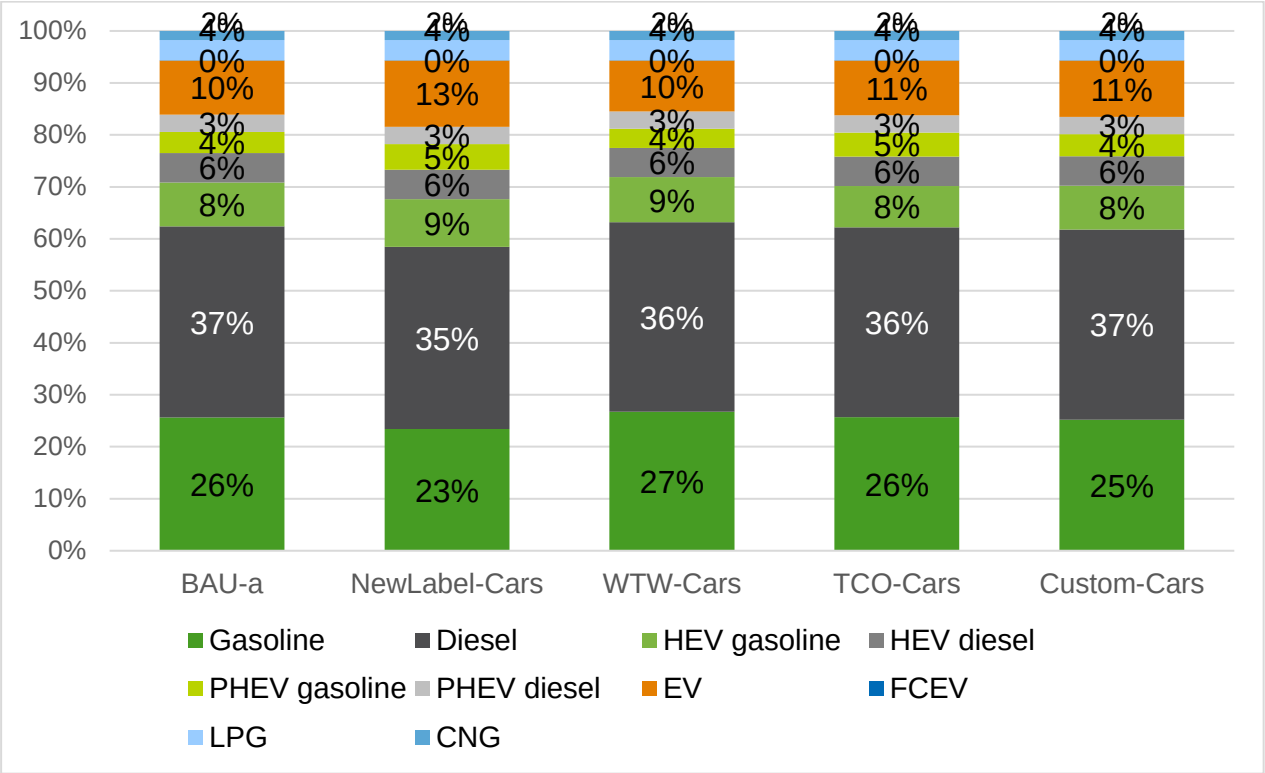
Figure 3-8. Overall, the share of xEVs in the fleet in 2030 increases to 18%-21% (depending on the scenario) compared to 17% in the baseline. In the case of the WTW scenario, the share of xEVs is relatively the same as in the baseline.

In addition to the changes in mix of powertrains, the measures can result in the choice of more efficient vehicle models for the same powertrain: improvements in energy efficiency are observed in several scenarios, mostly driven by changes in efficiency of chosen petrol and diesel vehicles. In the NewLabel scenario, there is, on average, a 0.6% decrease in energy consumption of the new cars, due to better choices; a 0.4% decrease in the TCO scenario; and a 0.3% decrease in the WTW scenario; there is also an increase in energy consumption in Custom scenario (about 0.4%) in 2025.

Table 3-8: Total sales of new xEVs and change compared to the baseline

Cars only	Total new xEVs sales			Change compared to BAU (%)		
Scenario	2020	2025	2030	2020	2025	2030
BAU	1,358,759	3,870,163	5,888,091	0%	0%	0%
NewLabel	1,358,759	4,903,339	6,801,915	0%	27%	16%
WTW	1,358,759	3,509,398	5,654,342	0%	-9%	-4%
TCO	1,358,759	3,960,777	6,280,586	0%	2%	7%
Custom	1,358,759	4,068,329	6,063,365	0%	5%	3%

Figure 3-8: Vehicle parc (cars) composition by powertrain, 2030



Measures implementing changes to the information channels through which information is communicated

The analysis of the effectiveness of the different measures related to information channels analysed in Section 3.2 above suggest that:

- The provision of information through a web-platform (IC6) is anticipated to lead to more significant changes in vehicle sales. The results from the SULTAN model indicate that this measure could lead to higher sales of xEV. This is demonstrated by the Custom scenario (representing effects of the provision of tailored information) and the NewLabel scenario (representing the provision of information online) in combination.
- The provision of an online label (IC1) can also lead to changes in vehicle sales towards more efficient powertrains. This is captured by the NewLabel scenario, however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel.
- The use of interactive displays (IC2), through the provision of tailored information, can also result in higher sales of xEVs (as captured by the Custom scenario in SULTAN).
- Finally, the use of a quote to provide relevant information (IC7) is also expected to lead to an increase in sales of xEVs (as captured by the TCO scenario). This includes also the effect of the type of information being provided, i.e., the TCO and cannot be disentangled. The more pronounced effect over time is likely to be driven by the type of information provided (i.e., TCO) rather than the channel used (i.e., quote)

As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform).

In addition, the above analysis on effectiveness also suggests that the provision of relevant information on dynamic advertisement (IC5) could also have an impact on vehicle sales, since the measure is indirectly effective at raising awareness and enhancing the effects of other information channels. As such, it is anticipated the impact of the provision of the

online label (captured by scenario NewLabel) can be enhanced if further combined with the dissemination of information in dynamic advertising.

The remaining measures, which were found to be less effective at raising awareness or have little effects, are expected to have small impacts on vehicle sales, if any.

The overall impacts of measures related to information channels are summarised in Table 3-9, including the upper bound of the expected increase in the sales of xEV powertrains on the basis of the relevant scenarios modelled in SULTAN.

Table 3-9: Overall impacts of measures related to information channels on vehicle sales and parc composition

Policy measure	Impact on vehicle sales and parc composition
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓✓ On the basis of the NewLabel scenario, up to 27% increase in sales of xEV powertrains compared to the baseline in 2025 and 16% in 2030 (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel). This is expected to lead to a higher share of xEVs in the fleet over time
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	✓ On the basis of the Custom scenario, up to 5% increase in sales of xEV powertrains compared to the baseline in 2025 and 3% in 2030, leading to a higher share of xEVs in the fleet over time
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	O Small to negligible impact expected
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Small to negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisements	✓ Increase in sales of xEVs expected by increasing the effectiveness of other channels, leading to a higher share of xEVs in the fleet over time
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓✓ On the basis of the NewLabel and Custom scenarios, up to 32% increase in sales of xEV powertrains compared to the baseline in 2025 and 18% in 2030, leading to a higher share of xEVs in the fleet over time
IC7: Car manufacturers / dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	✓ On the basis of the TCO scenario, up to 2% increase in sales of xEV powertrains compared to the baseline in 2025 and 7% in 2030 (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel). This is expected to lead to a higher share of xEVs in the fleet over time.
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O Small to negligible impact expected

Policy measure	Impact on vehicle sales and parc composition
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Small to negligible impact expected

Measures implementing changes to the information elements that are communicated

The overall impacts of measures related to information elements, including those not tested in consumer experiment and not assessed in SULTAN, are summarised as follows.

The results from the SULTAN model indicate that in NewLabel scenario the sales of new xEVs are higher than in the baseline: by 27% in 2025 and by 16% in 2030. The NewLabel scenario includes addition of running costs, information on air pollutants, electric range; but also introduces changes on how early the information on CO_2 emissions is displayed. So, all these **information elements together** can be expected to contribute up to 1 million in additional sales for xEVs in 2025 and 2030. We use additional insights from our consumer experiment to conclude on relative contribution of different information elements to this total.

We do not have quantitative evidence from the consumer experiment on information on taxes but expect its inclusion to lead to more sustainable choices. Impacts are expected to be similar to providing information on running costs, but would be of a lower magnitude due to the fact that not all Member States have fiscal incentives in place and for some Member States, where there are such incentives, these are weaker than the differences in running costs.

Consistent with the literature findings on the most important information elements, our analysis of the results of the consumer experiment also shows that consumers value cost information, and in particular information on **running costs.** Provision of this information leads to a higher likelihood of consumers selecting vehicles with alternative powertrains.

We calculate that the inclusion of running costs, on average, contributes 8.4% to the total usefulness score[36] of the label. Assuming that the total usefulness score is a representative indicator of consumer choices, we conclude that the provision of running costs should explain 8.4% of the difference in xEVs sales between the SULTAN NewLabel and BAU scenarios, that is – around 80,000 additional sales for xEVs by 2030. Our results also indicate that the impact on choices is stronger for used vehicles, compared to new vehicles.

Provision of **TCO**, in line with its high perceived value to consumers, **is expected to lead to a higher likelihood of choice for alternative powertrains, and it is expected to become more effective in the longer term,** when prices and the TCO of xEVs decrease and the gap between conventional powertrains and alternative ones narrows. We observe that the provision of TCO information helps consumers to make more rational choices. This leads to a lower share of xEVs currently; however, is expected to lead to a higher share of PHEV already in 2025 and a higher share of both PHEV and BEV by 2030, as the purchase price and TCO of xEVs go down, relative to traditional powertrains. On average, this also leads to consumers choosing more energy efficient vehicles. According to SULTAN outputs in the TCO scenario, the sales of new xEVs will be higher than the baseline: by 2% in 2025 and by 7% in 2030. So, the provision of TCO is expected to lead to approximately 90,000 additional sales for xEVs in 2025 and 390,000 additional sales in 2030.

Provision of information on **air pollutants also appear to be of high importance** and is also expected to lead to more sustainable car choices. We calculate that information on air pollutants, on average, contributes 6.9% to the total usefulness score of the label. Assuming that the total usefulness score is representative of how consumers make vehicle choices, we conclude that provision of this information should explain 6.9% of difference

[36] Total usefulness score reflects the degree of usefulness of the labels for the participants I the experiment. The question was "How useful were the labels in deciding which vehicles to shortlist?", with possible answers "Not at all", "A little", "Moderately", "Very is a normalised". The score has been normalized to 1.

in xEVs sales between SULTAN NewLabel and BAU scenarios, that is – around 70,000 xEVs by 2030. Our results also indicate that with respect to the provision of information on air pollutants, the impacts on choices do not differ significantly for used and new vehicles. Information on **electric driving range has a high level of importance** too and its provision is expected to lead to more sustainable car choices. We calculate that information on electric range, on average, contributes 7.6% to the total usefulness score of the label. Assuming that the total usefulness score is representative of how consumers make vehicle choices, we conclude that provision of this information should explain 7.6% of difference in xEVs sales between SULTAN NewLabel and BAU scenarios, that is – around 75,000 xEVs by 2030.

No quantitative evidence from consumer experiment is available on provision of a QR code with link to a comparison website, but we expect this element to lead to more sustainable choices.

Provision of real-world values is also not expected to lead to significant impacts in terms of awareness or choices, although there is a possibility to contribute positively through trust.

Finally, **provision of WTW emissions leads to less sustainable choices**, compared to only providing information on tailpipe emissions. This is explained by the less apparent difference in overall emissions performance between different powertrain types in the eyes of consumers. Despite comparable consumer awareness levels, the provision of information on WTW CO_2 emissions leads to less sustainable choices than when only information on tailpipe emissions is provided. The SULTAN results show that under the WTW methodology, 360,000 less xEV are expected by 2025 and 230,000 less xEVs are expected by 2030 in terms of annual sales, compared to BAU. Under WTW less models fall in "A" or "B" bands (green), and most of them are agglomerated in "C", "D" or "E" bands (yellow or red). This representation is likely to make comparison across models less prominent under WTW compared to tailpipe (e.g. the difference between "E" (red) versus "C" (yellow) for WTW, is less apparent than the difference between "E" (red) and "B" (light green) for tailpipe). This differences in colour bands is likely to be responsible for the result.

Table 3-10: Overall impacts of measures related to information elements on vehicle sales and parc composition

Measure	Impact on vehicle sales and parc composition
IE0: Include information on taxes	✓ Not assessed quantitatively, but small positive change in vehicle sales and parc composition is expected
IE1: Include WTW emissions	×× On the basis of the WTW scenario, reduction in sales of xEVs (230,000 less xEVs in 2030 compared to baseline).
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	✓✓ On the basis of NewLabel scenario, increase in sales of xEVs (70,000 xEVs in 2030 compared to the baseline)
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	✓✓ On the basis of NewLabel scenario, increase in sales of xEVs (similar magnitude as for new cars)
IE4: Include Total Cost of Ownership	✓✓ On the basis of TCO scenario, increase in sales of xEVs (90,000 additional sales for xEVs in 2025 and 390,000 additional sales in 2030, compared to the baseline)

Measure	Impact on vehicle sales and parc composition
IE5: Include running costs	✓✓ On the basis of NewLabel scenario, increase in sales of xEVs (80,000 additional sales for xEVs in 2030 compared to the baseline).
IE6: Include information on type approved electric range	✓✓ On the basis of NewLabel scenario, increase in sales of xEVs (75,000 xEVs in 2030 compared to the baseline)
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	O No or negligible impacts expected
IE8: Include real-world CO_2 emissions and fuel consumption	O No or negligible impacts expected
IE9: Include information on real-world electric range	O No or negligible impacts expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	✓ Not assessed quantitatively but positive impacts are expected
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No or negligible impacts expected

Measures extending the scope of the Directive

The results from the SULTAN model are informative in quantifying the expected change in vehicle sales and parc composition from extending the scope of the Directive to new vans (S1). While we cannot quantify the impact on vehicle sales and parc composition from extending the current requirements of the Directive to new vans, we can assess the impact when new measures tested in the consumer experiment would also be covering vans. The impacts of the label for vans have been estimated by restricting the sample to those individuals in the consumer experiment whose choices are assumed to be closer to potential choices of businesses[37]. These are used as a proxy for those interested to purchase/ lease vans.

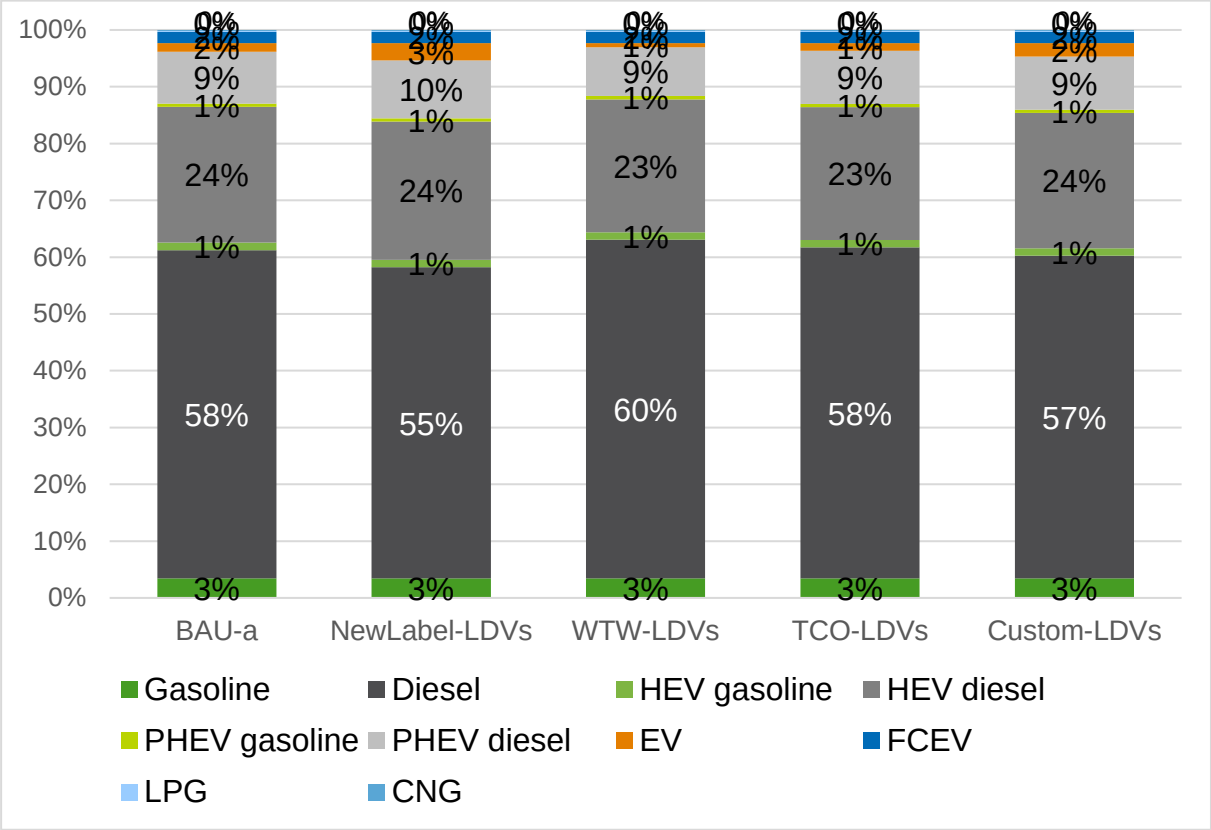
Table 3-11 shows that the sales of xEVs could increase by 30% under the NewLabel scenario in 2025 compared to the baseline and this effect is expected to remain until 2030, even though the magnitude of the effect is expected to be lower. In turn, we can expect changes in the vehicle parc composition as shown in Figure 3-9, where there is a slight increase in xEVs in the fleet by 2030 in the NewLabel compared to the baseline.

Table 3-11: Number of xEVs in the van parc per scenario

Vans	Total new xEVs sales			Change compared to BAU (%)		
Scenario	2020	2025	2030	2020	2025	2030
BAU	160,818	312,899	483,912	0%	0%	0%
NewLabel	160,818	407,777	583,307	0%	30%	21%
WTW	160,818	259,894	443,236	0%	-17%	-8%
TCO	160,818	303,993	506,371	0%	-3%	5%
Custom	160,818	352,122	525,003	0%	13%	8%

[37] Participants who described themselves as "When choosing a car, I focus mainly on economic aspects (price, fuel economy, and other costs)".

Figure 3-9: Vehicle parc (vans) composition by powertrain, 2030



It can be assumed that extending the requirements to new vans can provide more information for the decision-making process which can also influence the second-hand van market (Ricardo-AEA and TEPR, 2011; Norris et al, 2019). However, this is not considered in the scope of this measure.

It is not possible to quantify in SULTAN the expected change in vehicle sales and parc composition for the measure that proposes extending the scope of the Directive to used cars (S2). However, evidence of extending the current requirements to used cars was assessed by a study on the voluntary used car label adopted in the UK previously described in Section **Error! Reference source not found.**. The study found that almost two-thirds of car-buyers said the used car label influenced their choice of vehicle, indicating the label was effective in encouraging consumers to choose more fuel-efficient vehicles. This increased demand is expected to translate into higher sales of more fuel-efficient new car sales over time (LowCVP, 2010).

In addition, the consumer experiment results show that extending potentially new requirements would be effective and lead to an increase in the sales of xEVs, especially as they include information on costs. Results showed that changes in vehicle choices were similar for those consumers that indicated they would buy a used car compared to those that would buy a new car, when comparing the NewLabel with the baseline. For both, used and new car consumers, the choice of electric vehicles increased the most compared to other powertrains when presented with the NewLabel. The increase in choice of electric vehicles was 2% higher for used car buyers than for new car buyers. Assuming vehicle choices as a proxy on vehicle sales, it is anticipated that there is a positive impact in vehicle sales by extending the requirements to used cars. As mentioned in Section **Error! Reference source not found.**,3.2 a higher positive impact is expected for used car buyers than new car buyers as the first value more the information on fuel economy as it is a significant proportion of operating costs.

Nevertheless, the full extent of these effects is only expected to be realised provided the challenges associated with the implementation of this measure can be adequately resolved. These concern mainly the difficulty to monitor and enforce these requirements in the informal market where cars are sold by private sellers. As such, it is likely that only a share

of the used car market could be appropriately covered by these requirements (e.g., formal market) thus limiting the effectiveness of this measure.

Extending the requirements to rental vehicles is expected to have smaller to negligible impacts on raising awareness and influencing vehicle choices, thus it is not expected to have significant impacts on vehicle sales and parc composition. The overall impacts of measures related to extending the scope of the Directive are summarised in

Table 3-12, including the upper bound of the expected increase in the sales of xEV powertrains on the basis of the relevant scenarios modelled in SULTAN.

Table 3-12: Overall impacts of measures related to extending the scope of the Directive on vehicle sales and parc composition

Policy measure	Impact on vehicle sales and parc composition
S1: Extend requirements to [new] vans	✓✓ On the basis of the NewLabel scenario, 30% increase in sales of xEV powertrains compared to the baseline in 2025 and 21% increase compared to the baseline in 2030 . This is expected to lead to a higher share of xEVs in the fleet over time
S2: Extend requirements to used vehicles	✓ Not assessed quantitatively, but small positive change in vehicle sales and parc composition is expected
S3: Extend requirements to [new] rental vehicles	o Small or negligible impact

Measures increasing the level of harmonisation of implementation in the Member States

As discussed in Section 3.2, it is anticipated that an increased level of harmonisation across all EU Member States on the measures to raise consumer awareness (H1) will lead to increased familiarity, understanding and trust (depending on the design and/or methodological specification made), which could lead to a positive impact on consumer awareness. Although the impacts cannot be quantified, this potential increased consumer awareness also has the potential to positively impact on consumer vehicle choices, and subsequently on sales of xEVs and the composition of the vehicle parc (after a transition phase as consumers become aware of the new design/approach). Positive impacts are most likely to be realised in those Member States where the existing approach to implementation of the Directive differs the most to the harmonised approach being proposed. Conversely, minimal impacts would be expected on vehicle sales and parc composition in those Member States where the existing label and methodologies/assumptions are currently similar to those being proposed. Due to increased awareness amongst consumers, demand for cleaner vehicles may increase, which in turn may encourage manufacturers to produce more cleaner vehicles.

The overall impacts of measures related to increased harmonisation across all EU Member States are summarised in Table 3-13.

Table 3-13: Overall impacts of measures on harmonisation on vehicle sales and parc composition

Policy measure	Impact on vehicle sales and parc composition
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on sales of xEVs and composition of the vehicle parc.

3.3.2. Environmental impacts

3.3.2.1. Impacts on the use of energy and level of greenhouse gas emissions

Changes in the vehicle sales analysed in Section 3.3.1 above will lead to impacts on the type and quantity of fuels/energy used in the transport sector and the level of greenhouse gas (GHG) emissions. The impacts depend on the changes in class and powertrain of the vehicles purchased compared to the baseline.

The impacts in the level of GHG emissions have been estimated on the basis of the vehicle's life cycle, taking into account impacts from the production, use and disposal of vehicles. This analysis captures the full extent of their impacts and thus provides a more holistic comparison of the impacts. The assumptions on the energy mix are based on the EC's baseline scenario for the EU Long Term Strategy for the EU27 countries (European Commission, 2018)

The results from the SULTAN model show that the level of lifecycle GHG emissions can be up to 1.29% lower under the NewLabel scenario in 2025 compared to the baseline and this downward trajectory is expected to remain until 2030 where the GHG emissions are 3.36% lower compared to the baseline (Table 3-14). Both the TCO and Custom scenarios are also anticipated to achieve GHG emission reductions (0.66% and 0.17% in 2030, respectively)[38].

The change in GHG emissions observed is, in part, driven by the increased use of electricity (8% to 10% depending on the scenario, compared to 8% in the baseline) due to the higher number of xEVs in the fleet (as concluded earlier) and a decrease in the use of more conventional fuels (Figure 3-10). The overall energy use is also expected to be lower in these scenarios, compared to the baseline (although the effect is less pronounced for the TCO and Custom scenario), due to the introduction of more efficient powertrains and/or more efficient vehicle models in the fleet.

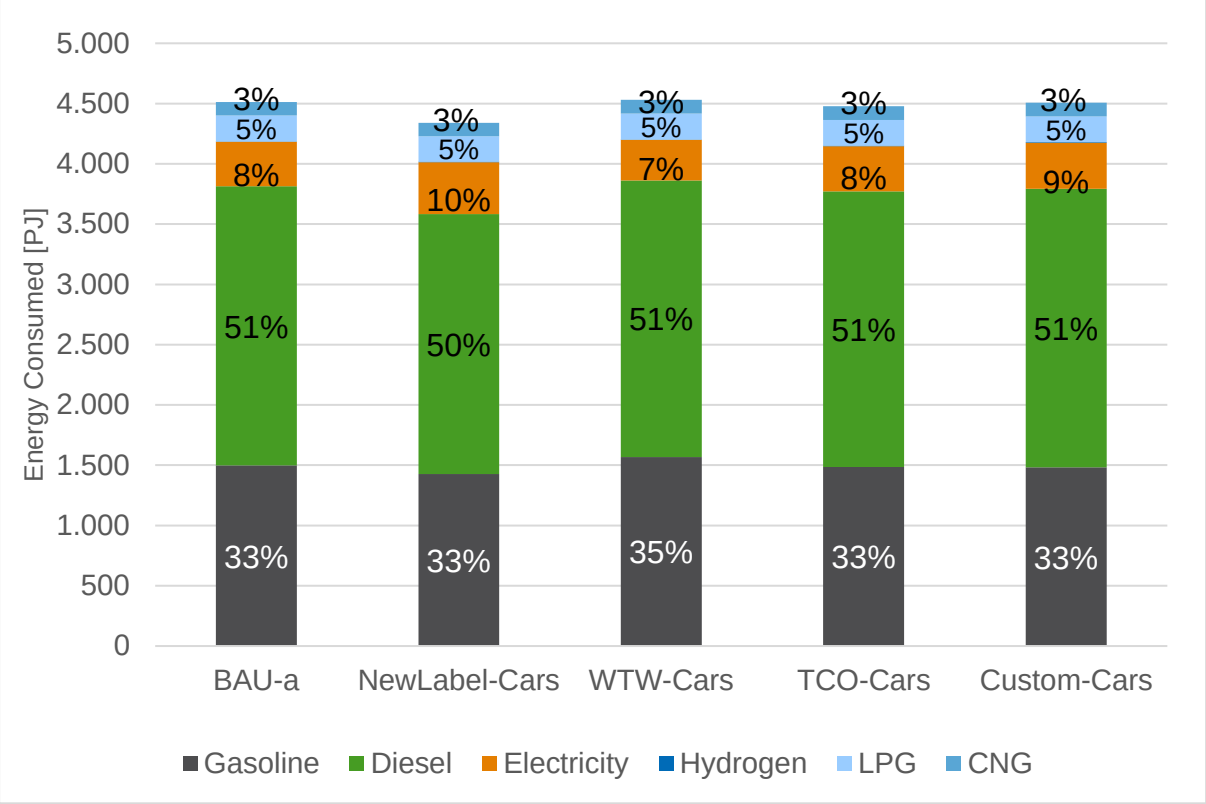
On the other hand, the WTW scenario is anticipated to lead to an increase in lifecycle GHG emissions in 2025 and 2030 compared to the baseline. This reflects the expected decrease in the share of xEVs in the fleet at the expense of a higher share of gasoline cars as demonstrated by the increase in the use of this fuel type. Interestingly, under the WTW scenario, a small decrease in the use of diesel is also expected. Overall energy use is expected to be slightly higher in this scenario.

Table 3-14: Calculated change in average total lifecycle GHG (passenger cars only, $MtCO_2eq$)

	2020	2025	2030
Baseline (BAU)	537	460	399
NewLabel (vs BAU)	*0.00%*	*-1.29%*	*-3.36%*
WTW (vs BAU)	*0.00%*	*0.25%*	*0.54%*
TCO (vs BAU)	*0.00%*	*-0.13%*	*-0.66%*
Custom (vs BAU)	*0.00%*	*-0.05%*	*-0.17%*

[38] We note that whilst the results are relatively small, the measures are complementary and thus the scenario results can be added up.

Figure 3-10: Energy consumption by fuel type (2030, cars only)



Measures implementing changes to the information channels through which information is communicated

On the basis of the SULTAN outputs described above, the main measures related to information channels that are found to have a more significant impact, leading to overall lower energy use and lifecycle GHG emissions, are:

- The provision of information through a web-platform (IC6) which combines the effects of the provision of tailored information (as represented by the Custom scenario) and the provision of information online (as represented by the NewLabel scenario).
- The provision of an online label (IC1), whose impacts are captured by the NewLabel scenario. However, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel.

In addition, the use of a quote to provide relevant information (IC7), as captured by the TCO scenario, and the use of interactive displays (IC2), whose impacts are captured by the Custom scenario, can also deliver reductions in GHG emissions, albeit smaller.

Whilst not possible to quantify the GHG impacts of other measures, the earlier analysis on the effectiveness of the provision of information in dynamic advertising (IC5) suggest that this measure could also increase the sales of more efficient vehicles and thus lead to lower emissions. In combination with the use of other information channels, Section 3.2.1 has demonstrated that it could help enhance the effectiveness and thus impacts of the online label (captured by scenario NewLabel).

Other measures, which include the removal of the requirements to use more traditional channels that are only provided in the showroom such as the printed guide (IC3) and the poster (IC4) as well as the provision of information through information campaigns (IC8) and training events (IC9), are expected to have smaller to negligible impacts on energy use and GHG emissions on the basis of the earlier analysis which found the measures to be less effective at influencing vehicle choices and thus impacting vehicle sales.

Overall, the stakeholder input supports these conclusions: the majority of the stakeholders consulted suggested that measures IC1 (online label), IC2 (interactive display), IC6 (web-

platform) and IC7 (quote) can lead to a decrease (small or large) in energy use and GHG emissions. On the other hand, the largest share of stakeholders indicated that measures IC3 (printed guide) and IC4 (poster) are likely to have no impact on energy use/GHG emissions. In addition, they also found measure IC5 (dynamic advertising) to lead to no significant impacts, whereas our analysis suggest that this channel can have an indirect effect.

The overall impacts of measures related to information channels are summarised in Table 3-15, including the upper bound[39] of the expected reduction in lifecycle GHG emissions on the basis of the relevant scenarios modelled in SULTAN.

Table 3-15: Overall impacts of measures related to information channels on energy use and GHG emissions

Policy measure	Impact on energy use and GHG emissions
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓✓ On the basis of the NewLabel scenario, up to 3.36% GHG emission reduction in 2030 compared to the baseline (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	✓ On the basis of the Custom scenario, up to 0.17% GHG emission reduction in 2030 compared to the baseline
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	O Small to negligible impact expected
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Small to negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	✓ Further reduction in GHG emissions expected by increasing the effectiveness of other channels
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓✓ On the basis of the NewLabel and Custom scenarios, up to 3.53% GHG emission reduction in 2030 compared to the baseline
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	✓ On the basis of the TCO scenario, up to 0.66% GHG emission reduction in 2030 compared to the baseline (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC8: Awareness campaigns to highlight changes made to the legislation via media	O Small to negligible impact expected

[39] As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform) and/or it is not possible to disentangle the effects of measures assessed together in the consumer experiments.

Policy measure	Impact on energy use and GHG emissions
(e.g. TV, printed, billboards, social media)	
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Small to negligible impact expected

Measures implementing changes to the information elements that are communicated

Section 3.3.1 comments on the impacts on different information elements on parc composition. Quantitative changes in energy use and GHG emissions presented in the table below have been be derived from this analysis.

The overall impacts of measures related to information elements, including those not tested in consumer experiment, are summarised as follows.

Making provision of certain information elements obligatory: Consistent with our findings in terms of sales and parc composition, the outputs of SULTAN model in the NewLabel scenario (which includes provision of information on running costs, air pollutants and electric range) is expected to lead to lower energy consumption and lower GHG emissions, compared to BAU.

Provided that information on running costs, on average, contributes 8.4% to the total usefulness score of the label, we apply this share to the total GHG impacts estimated by SULTAN for NewLabel scenario (-1.29% in 2025 and -3.36% in 2030). We conclude that provision of running costs may account for approximately a 0.11% decrease in lifecycle GHG emissions from passenger cars by 2025 and up to a 0.28% decrease by 2030.

Following the same logic for air pollutants, provided that information on air pollutants, on average, contributes 6.9% to the total usefulness score of the label, we conclude that provision of this information may account for a 0.09% decrease in lifecycle GHG emissions from passenger cars by 2025 and up to 0.23% decrease by 2030.

Information on electric range contributes, on average, to 7.6% to the total usefulness score of the label, so we conclude that provision of this information may account for a 0.1% decrease in lifecycle GHG emissions from passenger cars by 2025 and up to 0.26% decrease by 2030.

Information on taxes and the provision of a QR code that links to further information are also expected to contribute to reducing lifecycle GHG emissions, but to a lower (and unquantified) extent.

Provision of information on TCO, as discussed earlier, has a relatively low effectiveness in the short and medium term, if compared to other information elements, and is expected to become more effective in the longer term. We observe that provision of TCO information helps consumers to make more rational choices, which leads to a different mix of powertrains and improvements in fuel efficiency. According to the SULTAN TCO scenario, provision of TCO is expected to lead to 0.13% lower lifecycle GHG emissions by 2025 and 0.66% lower GHG emissions by 2030.

Not all stakeholders agreed on the importance of the information elements in terms of their impacts on energy use and GHG emissions. A few stakeholders have suggested in the interviews that no impacts are expected, mainly due to the fact that other factors are significantly more relevant than the label, such as choices being a consequence of product offerings, which in its turn is partially determined by the passenger car CO_2 regulation.

However, some stakeholders expect positive impacts, at least for some measures, such as providing information on running costs, TCO and driving range on the label, with caveats for the last two. Some stakeholders mentioned that provision of TCO information might lead to an increase in energy use if consumers are more concerned about resale value than

fuel efficiency. Other stakeholders suggested that provision of electric range might have negative impacts on lifecycle emissions through higher demand for larger batteries.

Measures that specify methodological aspects on how certain values are calculated: Provision of WTW emissions leads to worse outcomes with respect to energy consumption and GHG emissions. Real-world methodology is not expected to lead to significant differences, with respect to the BAU scenario.

According to the SULTAN WTW scenario, provision of information on WTW emissions is expected to lead to 0.25% higher lifecycle GHG emissions by 2025 and 0.54% higher GHG emissions by 2030. This result is in line with some of the opinions expressed by stakeholders. One stakeholder suggested that provision of WTW emissions might lead to a small increase in GHG emissions, as it could offset the difference between electric vehicles and gasoline, making gasoline seem less bad in comparison to electric.

Table 3-16: Overall impacts of measures related to information elements on energy use and GHG emissions

Policy measure	Impact on energy use and GHG emissions
IE0: Include information on taxes	✓ Not assessed quantitatively. Impacts expected similar to running costs, but of a lower magnitude.
IE1: Include WTW emissions	×× On the basis of WTW scenario, strong negative impacts are expected
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	✓✓ On the basis of NewLabel scenario, strong positive impacts but lower magnitude than in case of running costs.
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	✓✓ On the basis of NewLabel scenario, strong positive impacts, the impacts on choices do not differ significantly for used and new vehicles.
IE4: Include Total Cost of Ownership	✓✓ On the basis of TCO scenario, strong positive impacts.
IE5: Include running costs	✓✓ On the basis of NewLabel scenario, strong positive impacts.
IE6: Include information on type approved electric range	✓✓ On the basis of NewLabel scenario, strong positive impacts comparable in magnitude to running costs.
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	O No impact expected
IE8: Include real-world CO_2 emissions and fuel consumption	O No impact expected
IE9: Include information on real-world electric range	O No impact expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	✓

Policy measure	Impact on energy use and GHG emissions
	Not assessed quantitatively but positive impacts are expected.
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No impact expected

Measures extending the scope of the Directive

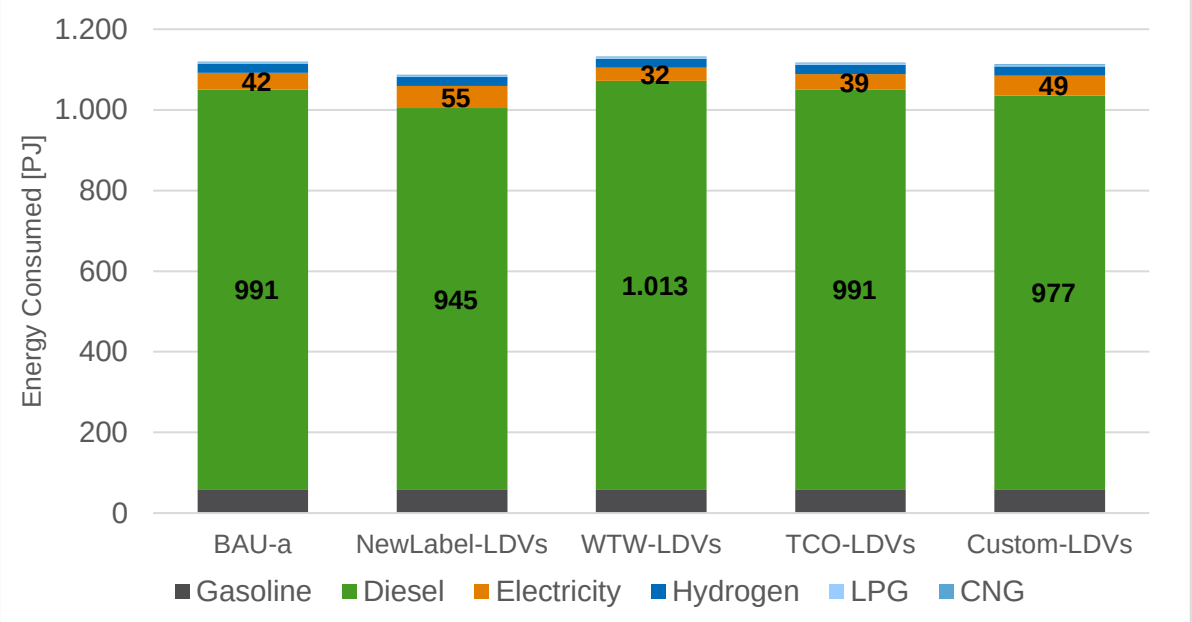
Similar to passenger cars, results from SULTAN from extending the potential new requirements of the Directive (i.e. new measures tested in the consumer experiment) to new vans show that the level of GHG emissions decrease 0.8% in the NewLabel scenario compared to the baseline by 2025 and reductions are also expected to remain and deepen until 2030 where the GHG emissions are 2.4% lower compared to the baseline (Table 3-17). Considering other new additional requirements to the NewLabel can also result in reductions in GHG emissions from S1. This suggests small positive impacts on GHG are expected from extending the requirements to cover vans.

Table 3-17: Calculated change in average total lifecycle GHG (van only)

	2020	2025	2030
Baseline (BAU)	114	110	104
NewLabel (vs BAU)	*0.00%*	*-0.85%*	*-2.41%*
WTW (vs BAU)	*0.00%*	*0.34%*	*0.96%*
TCO (vs BAU)	*0.00%*	*0.10%*	*0.02%*
Custom (vs BAU)	*0.00%*	*-0.26%*	*-0.69%*

As observed for passenger cars, the SULTAN results for the impacts on energy use suggest a decrease in total energy used of around 2% in the NewLabel scenario compared to the baseline (**Error! Reference source not found.**). The consumption of electricity doubles in this scenario compared to the baseline, as more electric vans are expected to be sold. Similarly to passenger cars, lower total reductions in emissions are expected from the other modelled scenarios for vans. The limited stakeholder inputs support our results, with 10 out of 23 stakeholders indicating a small decrease in energy use from Scenario S1.

Figure 3-11: Energy consumption by fuel type and scenario (vans only)



Regarding the measure to extend the scope to used cars (S2), it is not possible to quantify its impacts. S2 is expected to result in more energy efficient cars being used more intensively compared to less efficient cars, thereby leading to reductions in emissions. The choice of used cars depends on choices originally made in the new car market, but S2 could help retire more polluting vehicles earlier. In addition, by encouraging the purchase of more fuel-efficient second-hand vehicles, CO_2 emissions from cars may be indirectly reduced as the residual value of more efficient models is expected to increase. In this way, the purchase of new more fuel-efficient models may increase (LowCVP, 2010).

Regarding impacts on energy used, the majority of stakeholders[40] indicated this measure can lead to a decrease in energy used, with 8 stakeholders suggesting the decrease would be small. Regarding impacts on GHG emissions, only 10 out of 23 stakeholders supported that extending the scope to used vehicles could have a decrease in emissions, with 8 stakeholders indicating only a small decrease is expected. ZPS mentioned that a small decrease is expected for used vehicles as there would be several used cars that are not so efficient choices in the market, at least in the near future.

Extending the requirements to rental vehicles is expected to have small to negligible impacts on vehicle sales and parc composition, thus we do not anticipate significant impacts on GHG emissions and energy use from this measure.

The overall impacts of the measures related to extending the scope are summarised in Table 3-18.

Table 3-18: Overall impacts of measures related to extending the scope of the Directive on energy use and GHG emissions

Policy measure	Impact on energy use and GHG emissions
S1: Extend requirements to [new] vans	✓✓ On the basis of the NewLabel scenario, up to 2.4% GHG emission reduction and up to 2% reduction in energy use in 2030 compared to the baseline
S2: Extend requirements to used cars	✓ Not assessed quantitatively. Potentially limited, but positive impacts are expected
S3: Extend requirements to rental vehicles	o Small to negligible impact expected

Measures increasing the level of harmonisation of implementation in the Member States

As with other measures, increased effectiveness in consumer awareness is anticipated to lead to an increase in xEV vehicle sales and positive changes in the composition of the vehicle parc. An increase in the level of harmonisation across all EU Member States on measures to raise consumer awareness (H1) is anticipated to lead to positive impacts on reducing energy use and level of GHG emissions associated with these changes in vehicle sales/composition. It is not possible to quantify the GHG impacts of the measure, and it is likely to vary, depending on the way in which the measure is implemented (i.e. design and methodological aspects specified and affected Member States).

Overall, the stakeholder input supports the view that increasing the level of harmonisation across EU Member States will lead to a decrease in both energy use and GHG emissions. Aspects that are considered by stakeholders to be particularly effective when harmonised contributing to this decrease include adopting the label style used in the Energy Labelling Regulation (13 out of 21 respondents anticipated that there would be either a small or a large decrease in energy use and GHG emissions); specifying the method underlying the way in which cars are assigned to a category (e.g. relative/absolute) (12 out of 19

[40] 12 out of 23 stakeholders, covering all stakeholder groups

respondents), and specifying the emissions values used that determine the way in which cars are assigned to a category (e.g. CO_2 emissions relating to each band) (12 out of 18 respondents). The overall impacts of measures related to harmonisation are summarised in Table 3-19.

Table 3-19: Overall impacts of measures related to harmonisation on energy use and GHG emissions

Policy measure	Impact on energy use and GHG emissions
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/methodological elements specified and extent to which MSs are affected by implanted changes. Potential for positive impact on reduction in GHGs.

3.3.2.2. Impacts on air quality

Similar to the impact category described above, changes in vehicle sales would also lead to changes in air quality. This assessment is undertaken on the basis of the results on vehicle sales described above using the SULTAN model to estimate impacts in terms of NOx, SOx, PM emissions (including tailpipe and upstream emissions).

Error! Reference source not found. shows that the NewLabel scenario and the TCO scenario are expected to deliver reductions in emissions of all pollutants considered (NOx, PM and SOx), compared to the baseline scenario. This can be explained by the changes in vehicle fleet analysed above.

On the other hand, the Custom scenario is shown to also lead to lower emissions of NOx and SOx, compared to the baseline, but not PM emissions. This is due to an increased use of electricity, but a similar overall energy consumption (i.e. no substantial decreases in the use of other fuels instead), compared to the baseline.

Similarly, the WTW scenario is associated with lower emissions of NOx and PM, compared to the baseline. This is likely linked to a decrease in the use of diesel in this scenario, as concluded in the section above. However, an increase in SOx emissions is expected driven by the increased use of gasoline, compared to the baseline.

Table 3-20: Calculated change in WTW air quality pollutant emissions (passenger cars only, kt pollutant)

NOx emissions	2020	2025	2030
Baseline (BAU)	430	353	296
NewLabel (vs BAU)	*0.00%*	*-2.88%*	*-4.25%*
WTW (vs BAU)	*0.00%*	*-0.45%*	*-0.69%*
TCO (vs BAU)	*0.00%*	*-0.22%*	*-1.30%*
Custom (vs BAU)	*0.00%*	*-0.09%*	*-0.09%*

PM emissions	2020	2025	2030
Baseline (BAU)	734	621	511
NewLabel (vs BAU)	*0.00%*	*-0.86%*	*-2.35%*
WTW (vs BAU)	*0.00%*	*-0.11%*	*-0.17%*
TCO (vs BAU)	*0.00%*	*-0.16%*	*-0.66%*
Custom (vs BAU)	*0.00%*	*0.10%*	*0.07%*

SOx emissions	2020	2025	2030
Baseline (BAU)	705	588	471
NewLabel (vs BAU)	*0.00%*	*-1.70%*	*-4.13%*
WTW (vs BAU)	*0.00%*	*0.23%*	*0.55%*

SOx emissions	2020	2025	2030
TCO (vs BAU)	*0.00%*	*-0.18%*	*-0.86%*
Custom (vs BAU)	*0.00%*	*-0.04%*	*-0.22%*

Measures implementing changes to the information channels through which information is communicated

As for the energy use and GHG emission impacts, the SULTAN results demonstrate that the use of a web-platform to facilitate vehicle comparisons (IC6) is likely to have a substantial impact on air quality, leading to a reduction in NOx and SOx emissions (and to a lesser extent PM emissions) over time, as it combines the effects of the NewLabel scenario (in which relevant information is made available online) and the Custom scenario (in which information can be personalised by the consumer in line with their specific circumstances).

Similarly, the use of the online label (IC1) is expected to generate important reductions in air pollutant emissions as captured by the NewLabel scenario. This is the upper bound estimate of the impact since this scenario also includes the provision of additional information in the label, which is also likely to have an effect, as described in the following section on the measures that implement changes to the information elements communicated.

In addition, the use of a quote to provide relevant information (IC7) can deliver reductions in NOx, PM and SOx emissions as demonstrated by the TCO scenario. In the case of the use of the interactive display in the showroom (IC2), any improvements in air quality are likely to be small and limited to reductions in emissions of NOx and PM, up to the extent captured by the Custom scenario.

Finally, showing relevant information on dynamic advertisement (IC5) could also have an impact on air quality, leading to lower pollutant emissions, to the extent that the measure is effective in encouraging the sales of cleaner vehicles, albeit only indirectly as argued in the Section 3.2.1 above. It was not possible to quantify the impact of this measure specifically through the consumer experiments and SULTAN modelling conducted for this study but the analysis suggests that, if combined with the use of the online label, it could be important to reinforce the message and enhance the effectiveness and thus the impacts of that channel.

The remaining measures, which were found to be less effective at raising awareness and thus are not likely to translate into substantial new vehicle sales, are expected to have quite small impacts, if any.

The above analysis is supported by the views provided by the stakeholders that participated in the consultation for this study, where the largest share (between 14 and 18, depending on the measure, of 27 or 28 respondents) indicated they expected a decrease (small or large) from measures IC1 (online label), IC2 (interactive display), IC6 (web-platform) and IC7 (quote). For the other measures, i.e., IC3 (printed guide) and IC4 (poster), the majority of stakeholders responding (between 15 and 19) were of the view that they will have no effect on air quality. On the other hand, 13 of 28 stakeholders suggested that the measure IC5 (dynamic advertising) would have no significant impacts, whereas our analysis suggest that this channel can have an indirect effect.

The overall impacts of measures related to information channels are summarised in Table 3-21, including the upper bound[41] of the expected change in air pollutant emissions on the basis of the relevant scenarios modelled in SULTAN.

[41] As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform) and/or it is not possible to disentangle the effects of measures assessed together in the consumer experiments.

Table 3-21: Overall impacts of measures related to information channels on air quality

Policy measure	Impact on air quality
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓ Significant improvements in air quality expected: On the basis of the NewLabel scenario, emission reductions of up to 4.25% of NOx, 2.35% of PM and 4.13% of SOx compared to the baseline in 2030 (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	? Unclear Small improvements in air quality expected in terms of NOx and SOx only: on the basis of the Custom scenario, emission reductions of up to 0.09% of NOx and 0.22% of SOx compared to the baseline in 2030, but an increase of up to 0.07% of PM emissions
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	O Small to negligible impact expected
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Small to negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	✓ Further reduction in air pollutant emissions expected by increasing the effectiveness of other channels
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓✓ Significant improvements in air quality expected: on the basis of the NewLabel and Custom scenarios, emission reductions of up to 4.34% of NOx, 2.28% of PM and 4.35% of SOx compared to the baseline in 2030
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	✓ Improvements in air quality expected: on the basis of the TCO scenario, emission reductions of up to 1.30% of NOx, 0.66% of PM and 0.86% of SOx compared to the baseline in 2030 (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O Small to negligible impact expected
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Small to negligible impact expected

Measures implementing changes to the information elements that are communicated

The overall impacts of measures related to information elements, including those not tested in the consumer experiment, are summarised as follows.

Making provision of certain information elements obligatory: Consistent with SULTAN findings in terms of energy consumption and GHG emissions, provision of information on running costs, air pollutants and electric range is expected to lead to a decrease in the air quality pollutant emissions.

Provided that usefulness of running costs, on average, contributes 8.4% to the total usefulness score of the label, we apply this share to the total impacts on air pollutants estimated by SULTAN for NewLabel scenario (-2.88% in 2025 and -4.25% in 2030 for NOx; -0.86% in 2025 and -2.35% in 2030 for PM; -1.7% in 2025 and -4.13% in 2030 for SOx). We conclude that provision of running costs may account for about 0.11% of decrease of lifecycle GHG emissions from passenger cars by 2025 and up to 0.28% decrease by 2030. 13 of 25 stakeholders stated that they expect provision of this information will lead to a small or large decrease in the level of air pollutants.

We calculate that usefulness of running costs, on average, contributes 8.4% to the total usefulness score of the label. Assuming total usefulness score is a representative of choices, we can that provision of running costs may account for about 0.24% of decrease in NOx, 0.07% decrease in PM and 0.14% decrease in SOx from passenger cars by 2025 (and up to 0.36% decrease in NOx, 0.19% decrease in PM, and 0.35% decrease in SOx by 2030).

Following the same logic for air pollutants, provided that usefulness of information on air pollutants, on average, contributes 6.9% to the total usefulness score of the label, we conclude that provision of this information may account for about 0.2% of decrease in NOx, 0.06% decrease in PM and 0.12% decrease in SOx from passenger cars by 2025 (and up to 0.29% decrease in NOx, 0.16% decrease in PM, and 0.28% decrease in SOx by 2030). 16 of 25 stakeholders have said they expect provision of this information will lead to a small or large decrease in the level of air pollutants in case of new cars and 13 of 25 – in case of used cars.

Electric range, on average, contributes 7.6% to the total usefulness score of the label, so we conclude that provision of this information may account for about 0.22% of decrease in NOx, 0.07% decrease in PM and 0.13% decrease in SOx from passenger cars by 2025 (and up to 0.31% decrease in NOx, 0.17% decrease in PM, and 0.31% decrease in SOx by 2030). 8 of 25 stakeholders have said they expect provision of this information will lead to a small or large decrease in the level of air pollutants.

Information on taxes and QR code are also expected to contribute to decreasing emissions of air pollutant emissions, but to a lower extend. Stakeholders, in general, do not expect the air pollution to change as a result of this measure.

As discussed earlier, provision of TCO has relatively low effectiveness in short and medium terms, if compared to other information elements, and is expected to become more effective in the longer term. We observe that provision of TCO helps consumers to make more rational choices, which leads to a different mix of powertrains and improvements in fuel efficiency. According to the SULTAN TCO scenario, provision of TCO is expected to lead to about 0.22% of decrease in NOx, 0.16% decrease in PM and 0.18% decrease in SOx from passenger cars by 2025 (and up to 1.3% decrease in NOx, 0.66% decrease in PM, and 0.86% decrease in SOx by 2030). 9 of 25 stakeholders have said they expect provision of this information will lead to a small or large decrease in the level of air pollutants.

Measures that specify methodological aspects on how certain values are calculated: Provision of WTW emissions also leads to improvements in terms of NOx and PM but worth outcomes in terms of SOx. According to the SULTAN WTW scenario, provision of WTW is expected to lead to about 0.45% of decrease in NOx, 0.11% decrease in PM and 0.23% increase in Sox from passenger cars by 2025 (and up to 0.69% decrease in NOx, 0.17% decrease in PM, and 0.55% increase in SOx by 2030). These results are in line with the view expressed by stakeholders; where 11 out of 25 stakeholders have stated that they expect this measure to lead to a decrease in air pollution, while 4 of 25 expected it

would lead to an increase. Stakeholders, in general, do not expect the air pollution to change as a result of this measure.

Real-world methodology is not expected to lead to significant differences, with respect to BAU scenario, although 11 of 25 stakeholders have said they expect provision of this information will lead to a small or large decrease in the level of air pollutants.

Table 3-22: Overall impacts of measures related to information elements on air quality

Policy measure	Impact on air quality
IE0: Include information on taxes	✓ Not assessed quantitatively. Impacts expected similar to running costs, but of a lower magnitude.
IE1: Include WTW emissions	? Unclear, although improvements in terms of NOx and PM but worth outcomes for SOx
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	✓✓ On the basis of NewLabel scenario, strong positive impacts are expected.
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	✓✓ On the basis of NewLabel scenario, strong positive impacts are expected. Our results also indicate that with respect to provision of information on air pollutants, the impacts on choices do not differ significantly for used and new vehicles.
IE4: Include Total Cost of Ownership	✓✓ On the basis of TCO scenario, strong positive impacts are expected.
IE5: Include running costs	✓✓ On the basis of NewLabel scenario, strong positive impacts are expected.
IE6: Include information on type approved electric range	✓✓ On the basis of NewLabel scenario, strong positive impacts are expected.
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	O No impact expected
IE8: Include real-world CO_2 emissions and fuel consumption	O No impact expected
IE9: Include information on real-world electric range	O No impact expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	✓ Not assessed quantitatively but positive impacts are expected.
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No impact expected

Measures extending the scope of the Directive

Similarly to the impact on energy use and GHG emissions in Section 3.3.2.1, impacts on air quality pollutants were assessed with SULTAN for extending potential new requirements to vans (S1). As we can see from **Error! Reference source not found.**, NOx is expected to reduce in 5.5% in the NewLabel scenario. Smaller reductions are expected with the other new additional requirements tested. Similar results are expected for PM and SOx but change is expected to be lower.

The above analysis is supported by the views provided by the stakeholders that participated in the consultation for this study, where 13 out of 23 stakeholders supported a small reduction in air quality pollutants from this measure.

Table 3-23: Calculated change in the air quality pollutants (vans only, kt pollutant)

NOx externalities	2020	2025	2030
Baseline (BAU)	127	110	99
NewLabel (vs BAU)	*0.00%*	*-5.48%*	*-6.05%*
WTW (vs BAU)	*0.00%*	*3.20%*	*3.01%*
TCO (vs BAU)	*0.00%*	*1.11%*	*-0.78%*
Custom (vs BAU)	*0.00%*	*-1.79%*	*-1.92%*

PM externalities	2020	2025	2030
Baseline (BAU)	147	129	115
NewLabel (vs BAU)	*0.00%*	*-0.67%*	*-1.74%*
WTW (vs BAU)	*0.00%*	*0.18%*	*0.39%*
TCO (vs BAU)	*0.00%*	*-0.05%*	*-0.44%*
Custom (vs BAU)	*0.00%*	*0.00%*	*-0.02%*

SOx externalities	2020	2025	2030
Baseline (BAU)	138	122	108
NewLabel (vs BAU)	*0.00%*	*-1.23%*	*-3.14%*
WTW (vs BAU)	*0.00%*	*0.54%*	*1.26%*
TCO (vs BAU)	*0.00%*	*0.08%*	*-0.23%*
Custom (vs BAU)	*0.00%*	*-0.28%*	*-0.71%*

In line with the impacts described for energy use and level of GHG emissions we expect positive impacts on air quality associated with changes in vehicles sales and parc composition from extending the requirements to used vehicles (S2). However, it is not possible to quantify the impact on air quality, and it is likely to depend on which vehicles are available in the used car market. Only a third[42] of the interviewed stakeholders suggested reductions in air pollutants from this measure, where the majority expected only

[42] 8 out of 23 stakeholders

a small reduction. However, around a quarter[43] suggested no changes and a few[44] stakeholders suggested an increase in emissions.

Extending the requirements to rental vehicles is expected to have small to negligible impacts on vehicle sales and parc composition, thus we do not anticipate significant impacts on air pollutant levels from this measure.

The overall impacts of the measures related to extending the scope are summarised in Table 3-24.

Table 3-24: Overall impacts of measures related to extending the scope of the Directive on air quality

Policy measure	Impact on air pollutants
S1: Extend requirements to [new] vans	✓✓ Significant improvements in air quality expected: on the basis of the NewLabel scenario, emission reductions of up to 6.05% of NOx, 1.74% of PM and 3.14% of SOx compared to the baseline in 2030
S2: Extend requirements to used vehicles	o Minimal impacts are expected
S3: Extend requirements to rental vehicles	o Small to negligible impact expected

Measures increasing the level of harmonisation of implementation in the Member States

Similarly to the impacts described for energy use and level of GHG emissions, it is anticipated that an increase in the level of harmonisation across all EU Member States on measures to raise consumer awareness (H1) will lead to positive impacts on improving air quality associated with changes in vehicle sales/composition. It is not possible to quantify the impacts of the measure on air quality, and it is likely to vary, depending on the way in which the measure is implemented (i.e. design and methodological aspects specified and affected MSs).

Overall, the stakeholder input supports the view that increasing the level of harmonisation across EU Member States will lead to a decrease in air pollutant emissions. Similarly to reductions in energy use and GHG emissions, aspects that are considered by stakeholders to be particularly effective when harmonised contributing to this decrease include adopting the label style used in the Energy Labelling Regulation (10 out of 23 respondents anticipated that there would be either a small or a large decrease in air pollutant emissions); specifying the method underlying the way in which cars are assigned to a category (e.g. relative/absolute) (9 out of 22 respondents), and specifying the emissions values used that determine the way in which cars are assigned to a category (e.g. CO_2 emissions relating to each band) (10 out of 22 respondents). However, there are also approximately a quarter of respondents that believe there will be no change. The overall impacts of measures related to harmonisation are summarised in Table 3-25.

Table 3-25: Overall impacts of measures related to harmonisation on air quality

Policy measure	Impact on air pollutants
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/methodological elements specified and extent to which MSs are

[43] 5 out of 23 stakeholders

[44] 4 out of 23 stakeholders

Policy measure	Impact on air pollutants
	affected by implemented changes. Potential for positive impact on improving air quality.

3.3.3. Economic impacts

The assessment of economic impacts is undertaken for the following categories of impacts:

- Costs to consumers and households;
- Costs to professional vehicle users;
- Costs to businesses;
- Impacts on public budgets; and
- Impacts on the functioning of the internal market and competition.

3.3.3.1. Costs to consumers and households

Changes in vehicle choices arising from the policy measures can have an impact on the costs that consumers incur for personal travel to the extent that they will lead to a shift to different powertrains or more efficient vehicle classes (i.e., leading to higher upfront costs and/or lower running costs). These impacts may be smaller or greater as a result of the effectiveness of the different measures, which was covered in Section 3.2 above.

Results from SULTAN show that the NewLabel is expected to lower total fleet costs by 0.05% in 2025 and 0.16% in 2030. The lower costs can be associated to the increase in xEVs sales in this scenario, as shown in Section 3.3.1. As seen in Figure 3-12, costs reductions are observed in running costs (i.e. fuel/electricity costs and O&M) but upfront costs increase, as well as EV cost infrastructure. Costs reductions are higher by 2030 mainly as costs for EV infrastructure are expected to decrease over time.

Similarly, the TCO scenario also showed to be effective in increasing sales of xEVs as assessed in Section 3.3.1, however to a lesser extent than in the NewLabel scenario. Reductions in total fleet costs expected in this scenario are thus smaller of 0.02% in 2025 and 0.08% in 2030. Costs reductions in this scenario are explained by slightly lower costs of fuel/electricity. However, reduction is small as increases in EV infrastructure costs are expected.

On the other hand, reductions in costs to first end consumers from WTW scenario is expected to be minor. As seen in Section 3.3.1, this scenario does not lead to increases in xEVs sales.

Results for the Custom scenario suggest minor increases in costs to consumers. This scenario is expected to have a small impact in increasing sales of xEVs, however reduction in running costs are more than compensated by increased capital costs and EV infrastructure.

Figure 3-12: Calculated change in average total cost of ownership (TCO) for first end-users for different options, breakdown by component for 2025 and 2030

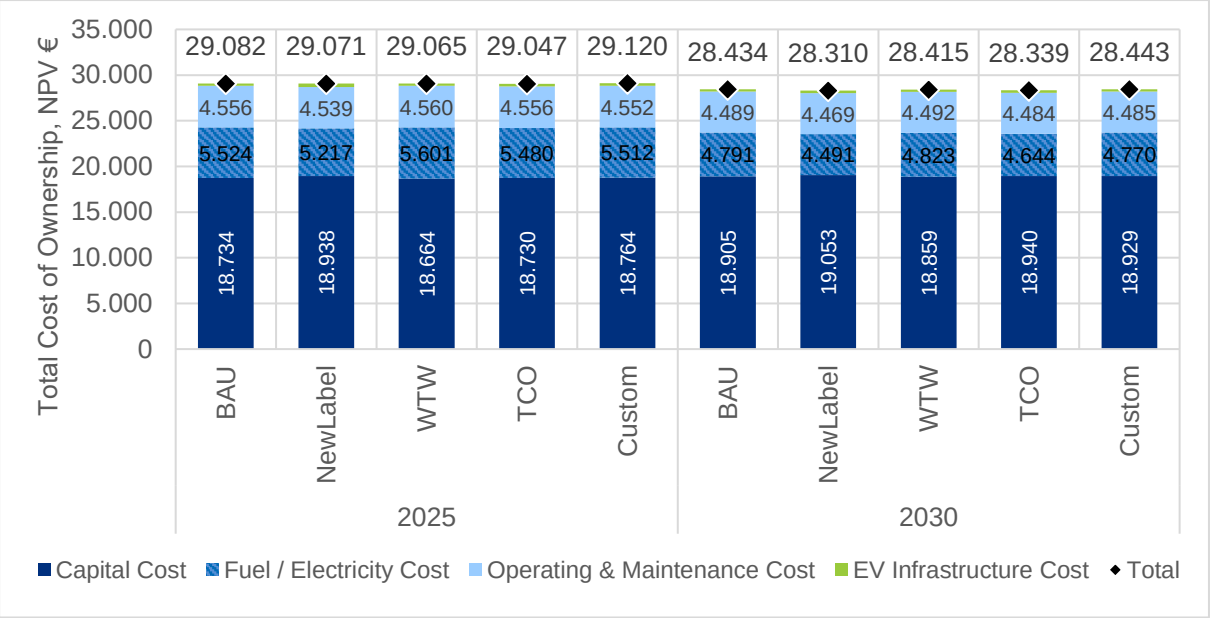


Table 3-26: Calculated change in total fleet cost for the consumer for different options (passenger cars only, € bn)

	2020	2025	2030
Baseline (BAU)	1,264	1,443	1,540
NewLabel (vs BAU)	0.00%	-0.05%	-0.16%
WTW (vs BAU)	0.00%	-0.01%	-0.03%
TCO (vs BAU)	0.00%	-0.02%	-0.08%
Custom (vs BAU)	0.00%	0.03%	0.05%

Table 3-27 Absolute change in total fleet cost for the consumer for different options compared to the baseline (passenger cars only € bn)

	2020	2025	2030
Baseline (BAU)	1,264	1,443	1,540
NewLabel (vs BAU)	-	0.74	2.41
WTW (vs BAU)	-	0.13	0.42
TCO (vs BAU)	-	0.32	1.26
Custom (vs BAU)	-	- 0.48	- 0.76

Measures implementing changes to the information channels through which information is communicated

Overall, the largest changes in the costs which consumers could face for personal travel, compared to the baseline, could arise from the adoption of the measure which proposes

the provision of a web-platform to facilitate vehicle comparison (IC6) and the provision of an online label (IC1). This is demonstrated by the results of the NewLabel scenario.

The provision of information in a tailored manner through an interactive display (IC2) and through a quote (IC7) could also lead to increased sales of more efficient powertrains and vehicle classes but to a lesser extent. As such, the results from the Custom scenario and the TCO scenario in the SULTAN model, respectively, suggest that total cost of ownership remains similar to that of the baseline.

The provision of information in dynamic advertising (IC5) could also have an impact on costs to consumers. As indicated earlier, this measure could also increase the sales of more efficient vehicles and thus lead to changes in costs but especially if enhancing the effectiveness of other measures such as the provision of information through an online label.

All other measures are not expected to have significant impacts on costs to consumers, just smaller to negligible impacts on vehicle sales.

The overall impacts of measures related to information channels are summarised in Table 3-28, including the upper bound[45] of the expected changes in average TCO on the basis of the relevant scenarios modelled in SULTAN.

Table 3-28: Overall impacts of measures related to information channels on costs to consumers and households

Policy measure	Impact on costs to consumers
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓ On the basis of the NewLabel scenario, decrease in average TCO of up to €124 in 2030 compared to the baseline (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	O Minimal increase in average TCO in 2030 compared to the baseline
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	O Small to negligible impact expected
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Small to negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	O Small to negligible impact expected
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓ On the basis of the NewLabel scenario, decrease in average TCO of up to €124 in 2030 compared to the baseline
IC7: Car manufacturers/ dealers to present information of interest in a quote provided	O

[45] As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform) and/or it is not possible to disentangle the effects of measures assessed together in the consumer experiments.

Policy measure	Impact on costs to consumers
(including online e.g. car configurators where an estimate of the price is provided)	Minimal average decrease in TCO in 2030 compared to the baseline
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O Small to negligible impact expected
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Small to negligible impact expected

Measures implementing changes to the information elements that are communicated

This section reports on the changes in terms of the costs to consumers and households, expressed in terms of TCO, as estimated by SULTAN model. We also use additional results from our consumer experiment to shed light on the possible underlying mechanisms of that impacts. In this additional analysis of consumer experiment, we do not perform an exhaustive analysis of each of TCO components but focus on two main components of TCO instead: purchase price and running costs.

The overall impacts of measures related to information elements, including those not tested in consumer experiment, are summarised as follows.

Making provision of certain information elements obligatory: Consistent with our findings in terms of powertrain mix, provision of information on running costs and TCO is expected to lead to a decrease in the total costs paid by consumers and households.

SULTAN estimates that the average TCO will decrease by €9 in 2025 and by €124 in 2030 in the NewLabel scenario (fleet costs are expected to go down by 0.05% in 2025 and by 0.16% in 2030). This scenario includes addition of running costs, information on air pollutants, electric range; but also introduces changes on how early the information on CO_2 emissions is displayed. So, all these **information elements together** can be expected to contribute up to €124 in TCO reduction by 2030.

Additional analysis of the consumer experiment shows that those participants who indicated running costs as one of most useful information elements have chosen, on average, a car with 3.7% lower TCO compared to those who did not consider running costs useful. Interestingly, this impact is related to price aspects and not through running costs: those who said running costs were useful have chosen cars with purchase price, on average, 5.7% lower than the rest of participants.

With respect to information on air pollutants, our analysis shows that the choices of those participants in our behavioural experiment, who indicated air pollutants as one of most useful information elements, were not different from the rest, in terms of TCO. We did observe a small impact on running costs: those who indicated air pollutants as one of most useful information elements have chosen, on average, cars with 6.2% lower running costs.

On electric range, our analysis shows that those participants in our behavioural experiment, who indicated electric range as one of most useful information elements, have chosen, on average, a car with 2.2% higher TCO than those who did not consider electric range useful. Not surprisingly, this impact is coming through lower running costs (9.8% lower on average) and higher price (5.6% higher) for alternative powertrains. Those who said electric range were, on average, 9.5% more likely to choose electric or hybrid car.

This negative impact should be reduced or even reversed in the future, when TCO for alternative powertrains falls below the TCO for conventional powertrains.

SULTAN estimates that the average TCO will decrease by €35 in 2025 and by €95 in 2030 in the TCO scenario (fleet costs are expected to go down by 0.02% in 2025 and by 0.08% in 2030). We have not observed statistically significant differences in terms of TCO in our experiment, which would be consistent with hypothesis that participants had a "budget" in

mind, and the differences manifested themselves through the mix of powertrains, as those who observed TCO were more likely to select a petrol vehicles. We do, however, expect to see more important impacts in the future, especially for TCO scenario, if TCO signal becomes stronger.

Information on taxes and QR code are also expected to contribute to a decrease in TCO, but to a lower extend.

Measures that specify methodological aspects on how certain values are calculated: Provision of WTW or real-world methodology are not expected to lead to significant differences with respect to BAU scenario.

In the WTW scenario, SULTAN estimates that the average TCO will decrease by €17 in 2025 and by €19 in 2030 (fleet costs are expected to go down by 0.01% in 2025 and by 0.03% in 2030).

Table 3-29: Overall impacts of measures related to information elements on costs to consumers and households

Policy measure	Impact on costs to consumers
IE0: Include information on taxes	✓ Not assessed quantitatively. Impacts expected similar to running costs, but of a lower magnitude.
IE1: Include WTW emissions	O No or negligible impacts expected
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	O No or negligible impacts expected
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	O No or negligible impacts expected
IE4: Include Total Cost of Ownership	✓ On the basis of TCO scenario, positive impacts expected
IE5: Include running costs	✓✓ On the basis of NewLabel scenario, strong positive impacts expected.
IE6: Include information on type approved electric range	× On the basis of NewLabel scenario, negative impacts are expected
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	O No impact expected
IE8: Include real-world CO_2 emissions and fuel consumption	O No impact expected
IE9: Include information on real-world electric range	O No impact expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	✓ Not assessed quantitatively but positive impacts are expected.

Policy measure	Impact on costs to consumers
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No impact expected

Measures extending the scope of the Directive

As the largest proportion of van buyers are commercial, extending the requirements for new vans (S1) will be assessed in the next section, which focuses on the costs to professional vehicle users.

We cannot quantify the impact of extending the requirements of the Directive to used cars (S2) on costs. However, this measure is expected to decrease costs to used car consumers as this measure could lead to increased sales of more fuel-efficient vehicles in the second-hand market. As suggested in Section 3.3.1, by encouraging the purchase of more fuel-efficient second-hand vehicles the residual value of more efficient models is expected to increase. In turn, the purchase of new more efficient models may increase reducing costs to consumers in general.

Extending the requirements to rental vehicles is expected to have smaller to negligible impacts on vehicle sales, thus it is not expected to have significant impacts on costs to consumers.

The overall impacts of the measures related to extending the scope are summarised in Table 3-30 below:

Table 3-30: Overall impacts of measures related to extending the scope of the Directive on costs to consumers and households

Policy measure	Impact on costs to consumers
S2: Extend requirements to used vehicles	✓ Not assessed quantitatively but cost savings are expected from increased sales of more fuel-efficient vehicles in the second-hand market.
S3: Extend requirements to rental vehicles	o Small to negligible impact

Measures increasing the level of harmonisation of implementation in the Member States

For the measures increasing the level of harmonisation across EU Member States (H1), there are likely to be resulting varying impacts for consumers and households depending on the design or methodological aspects specified in future legislation and the difference between the current design or methodological aspects used in each EU Member State.

Although it cannot be quantified, based on the assumption that increased harmonisation could lead to increased sales of more efficient power trains and vehicle classes, it can be anticipated that consumers and households in those Member States where the greatest changes are implemented (in comparison to the current implementation of the legislation) could benefit from a reduction in vehicle-related costs. The overall impacts of measures related to harmonisation are summarised in Table 3-31.

Table 3-31: Overall impacts of measures related to harmonisation on costs to consumers and households

Policy measure	Impact on costs to consumers
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/methodological elements specified and extent to which MSs are affected by implemented

Policy measure	Impact on costs to consumers
	changes. Potential for positive impact on reducing costs for consumers and households.

3.3.3.2. Costs to professional vehicle users

This impact is mainly related with the measure proposing the potential extension of the Directive to cover vans (S1)[46]. A small reduction on total fleet costs is expected, of €0.25 billion in 2025 and €0.63 billion in 2030 compared to the baseline in 2025 (Table 3-33). Expected impacts on costs to professional vehicle users are smaller than expected impacts on passenger car consumers as there are less vans sold annually.

Table 3-32: Calculated change in total fleet cost for the consumer for different options (vans only, € bn)

	2020	2025	2030
Baseline (BAU)	210	225	245
NewLabel (vs BAU)	0.00%	-0.11%	-0.26%
WTW (vs BAU)	0.00%	0.04%	0.05%
TCO (vs BAU)	0.00%	0.00%	-0.08%
Custom (vs BAU)	0.00%	-0.02%	-0.03%

Table 3-33: Absolute change in total fleet cost for the consumer for different options compared to the Baseline (vans only, € bn)

Scenario	2020	2025	2030
BAU-a	210	225	245
NewLabel-LDVs	0	- 0.25	- 0.63
WTW-LDVs	0	0.08	0.13
TCO-LDVs	0	- 0.01	- 0.19
Custom-LDVs	0	- 0.04	- 0.06

The overall impact of this measures related to extending the scope to new vans is summarised in Table 3-34.

Table 3-34: Overall impacts of measures related to extending the scope of the Directive on costs to consumers

Policy measure	Impact on costs to consumers
S1: Extend requirements to new vans	✓ On the basis of the NewLabel scenario, decrease in total fleet costs of €0.63 bn in 2030 compared to the baseline

3.3.3.3. Costs to businesses

A broad range of measures considered are expected to result in additional compliance or administrative costs, cost savings or lost revenues for the business sectors affected (e.g., dealers, manufacturers, publishing and/or advertising companies).

[46] Although it might also be relevant for other measures targeting passenger cars (i.e. company cars and small businesses that purchase vehicles from the same channels as final consumers), it has not been possible to assess this.

The analysis is based on a combination of logical analysis of how costs might arise (based on assumptions on the affected stakeholders and on the split of responsibility for taking further action, compared to the baseline) as well as stakeholder inputs and desk research. Where possible, estimates of costs are included.

We note that changes in the costs that business could face also depend on the assumptions on the stakeholders expected to take further action, which could differ depending on the implementation approach of each Member State. Indeed, the evaluation study on the Car Labelling Directive (Ricardo and TEPR, 2016) also found that costs related to the implementation of the Directive provisions depended very much on the way the Directive was operating at a practice level in each country. As such, certain assumptions made below on how stakeholders could be required to change their operations (with a resulting effect on costs) might differ for some Member States.

Measures implementing changes to the information channels through which information is communicated

Measures related to changes to information channels (both existing information channels established in the Directive and new information channels) can result in direct costs related to compliance with the new provisions for dealers, manufacturers and those responsible for relevant third-party websites involved in the sale/lease of new cars, whereas the advertising industry could also be affected due to specific measures. In addition, removing requirements to use certain information channels might lead to cost savings or lost revenues for certain stakeholders.

Table 3-35 identifies the affected stakeholders and how/why they may incur in additional costs or savings. Overall, the analysis suggests that the different businesses could face an increase in costs or loss of revenues:

- For **dealers, vehicle manufacturers and those responsible for relevant third-party websites**, there is a potential for an increase in one-off and ongoing costs arising from the provision of the online label (IC1), and the provision of information of interest in a quote (IC7).
    - For manufacturers only, there is also a potential for an increase in one-off costs arising from the provision of information in dynamic advertisement (IC5).
    - For dealers only, there is also a potential for an increase in one-off costs arising from the need to show the label in interactive displays (IC2), and the potential for a decrease in one-off costs as there would be no need to print the poster (IC4).
- For the **publishing industry**, there could be a loss of revenues if the production of a printed guide is made optional (IC3).
- For the **advertising industry**, there is also a potential for an increase in one-off costs arising from the provision of information in dynamic advertisement (IC5).

Table 3-35: Expected cost implications for businesses from the measures implementing changes to the information channels through which information is communicated

Measure	Who is affected and required actions	Cost or savings implications
IC1: Label to be shown online	**Dealers, vehicle manufacturers and those responsible for relevant third-party websites** to display the label on their websites.	Potential **increase in one-off and ongoing costs** for dealers, manufacturers and those responsible for relevant third-party websites associated with updating the systems and continue making the label available online
IC2: Label to be shown in interactive displays (fixed or	**Dealers** to provide at least one interactive display.	Potential **increase in one-off costs** for dealers

Measure	Who is affected and required actions	Cost or savings implications
mobile) where cars are made available for sale or lease		associated with the purchase of the interactive display
IC3: Guide to be made available in electronic format and the production of a printed guide to be made optional	**Dealers** would no longer have to provide a printed guide. **Publishers** would no longer have to print guides.	No cost changes for dealers – assume to receive printed guides from authorities (this could vary with the approach of each Member State). In turn, **publishers might lose revenues** from printing.
IC4: Remove the requirement to present a poster/electronic display in the showroom	**Dealers** would no longer have to show a poster/electronic display.	Potential **decrease in one-off costs** for dealers that no longer need to print the poster
IC5: Information on CO_2 emissions and fuel consumption to be shown in dynamic promotional material (e.g. TV/online) in addition to printed promotional material (e.g. brochures, billboards)	Those responsible – both **vehicle manufacturers** and in external **advertising companies** – would need to ensure that they display the relevant information. Those displaying the dynamic content (i.e., TV companies, cinemas, those responsible for dynamic billboards and online sites) would need to show material containing this information.	Potential **increase in one-off costs** for manufacturers and advertising companies associated with updating the systems to ensure display of information. There could also be a **loss of revenues for advertising companies**
IC6: Make a platform available - on the web and/or via a mobile app -containing the information on all models to facilitate their comparison	Businesses are not expected to be affected as it is assumed that national ministries or agencies will develop – or commission the development of – a platform to enable comparisons.	No cost changes for businesses.
IC7: Car manufacturers/ dealers to present information of interest in a quote provided to consumers (including online e.g. car configurators) where an estimate of the price is provided.	**Vehicle manufacturers and operators of third-party websites** to display the relevant information on the quote next to the price of respective vehicles on their websites. **Dealers** to display the quote next to both physical and electronic indications of the price of vehicles.	**Potential increase in one-off and ongoing costs** for dealers, manufacturers and those responsible for relevant third-party websites associated with updating the systems and continue making the relevant information available next to the price of respective vehicles.
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	Businesses are not expected to be affected as it is assumed that national ministries or associations will organise these campaigns.	No cost changes for businesses.
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	Businesses are not expected to be affected as it is assumed that national ministries or associations will organise these campaigns.	No cost changes for businesses.

The limited **input provided by stakeholders** consulted for this study suggest that, if any, cost changes are expected to be small for the majority of the measures under consideration.

In line with analysis in Table 3-35 above, the two stakeholders from the automotive sector that took part in the consultation for this study identified the potential for one-off cost increases arising from the provision of the online label (IC1), but only one of these stakeholders suggested an increase in ongoing costs. Regarding the provision of information in dynamic advertisement (IC5), both stakeholders suggested the potential for not only one-off cost increases (as identified in Table 3-35) but also ongoing cost increases. ACEA also commented on this measure in particular, explaining that they do not expect significant costs arising from it for vehicle manufacturers. In addition, only one of these stakeholders suggested an increase in one-off and ongoing costs from the provision of information of interest in a quote (IC7); the other stakeholder commented that this is in practice already today, so no cost changes are expected.

Conversely, the two automotive sector stakeholders indicated the potential for additional costs not envisioned in Table 3-35 for vehicle manufacturers necessarily, but which affect dealers. We did not receive any input from dealers so their input is important to understand the type and size of costs that could arise for stakeholders that have cars for sale/lease. Both suggested a one-off cost increase associated to the provision of label information in an interactive display (IC2) and one of these also suggested recurring additional costs. In addition, one of the stakeholders also identified a one-off cost increase but a recurring cost decrease if the guide is made available in electronic format and the production of a printed guide is made optional (IC3). Similarly, the same stakeholder suggested a recurring cost decrease due to the removal of the requirement to present a poster/electronic display in the showroom (IC4).

In their comments, one stakeholder clarified that the magnitude of the costs depends on the lead time – if short, costs increase. They also noted that providing the interactive display and poster in the showroom are expected to generate the highest costs. The other stakeholder explained that the cost impact also depends on the information and its complexity. If this is not harmonised, there could be an increase in costs. On the other hand, ACEA suggested that the proposed measures are appropriate to limit costs.

For the advertising and publishing industry, the participating stakeholders suggested the potential for not only one-off cost increases (three of four stakeholders in this industry) (as identified in Table 3-35) but also ongoing cost increases (all four stakeholders) arising from the provision of information in dynamic advertisement (IC5). According to the comments of EGTA, this requirement would lead to an increase in the production costs of advertisements (linked to the need for broadcasters to monitor this obligation and coordinate with the advertiser on the wording) thereby decreasing the advertising budget available to the media. There could also be an increase in costs due to the need to discuss with authorities how to provide information as well as deal with consumer complaints. For the Advertising Association, the cost implications can arise from longer advertising time or larger advertising displays, however it is unclear how this would raise costs for the advertising industry. The European Magazine Media Association and European Newspaper Publishers' Association noted that the requirements currently in place in the Directive for printed media already created extra costs for the magazine and newspaper publication industry and expanding the provision of information to online media advertising could negatively affect advertising revenues which are very important for the financial health of the newspaper and magazine sector.

Overall, no specific estimates were provided by the participating stakeholders, but the available evidence suggests that the provision of the interactive display (IC2) could be associated with higher costs for dealers. This cost was indicated by not only the affected stakeholders but also other groups as a potential challenge to the implementation of this measure (according to Irish and Estonian authorities, ACEA, ZPS).

In addition, for the publishing industry, the loss of revenues from printing guides might represent up to €60,000 per year and per country as indicated by the cost savings for authorities, calculated in the following section. This would only apply to countries which still print the guide.

Other measures are expected to have smaller cost impacts, if any. In the case of the provision of the online label, as already concluded in the earlier evaluation study (Ricardo and TEPR, 2016), the labelling of products online involves little effort and thus the provision of information online was considered to represent a negligible cost. In total, however, the costs of the different measures might add up.

The overall impacts of measures related to information channels are summarised in Table 3-36.

Table 3-36: Overall impacts of measures related to information channels on costs to businesses

Policy measure	Impact on costs to businesses
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	O Small to negligible impact expected
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	× More significant costs for dealers expected
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	× Loss of revenues for publishing industry (up to €60,000 per year and per country)
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Small to negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	× Potential loss of revenues for advertising companies
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	O No cost impact for businesses.
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	O Small to negligible impact expected
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O No cost impact for businesses.
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O No cost impact for businesses.

Measures implementing changes to the information elements that are communicated

In general, in the case of measures related to changes to the **information elements**, no significant costs would be expected to arise for businesses since most of these elements

would be made available in the Certificate of Conformity (CoC) or a database which businesses could directly use to comply with the new information provision requirements.

Some stakeholders pointed out that costs for businesses associated to this group of measures will depend directly on the complexity of calculations and distribution of responsibilities. There will be significant costs for the automotive industry associated with those elements where the manufacturers, dealers and/ or third parties are in charge of the calculations.

Therefore, there are two information elements that will potentially require responsibility in industry:

- **IE4: Include Total Cost of Ownership.** As prices for the same vehicle differ across different points of sale, it is likely that the businesses/ retailers themselves would need to calculate and update it according to the current quote. One of stakeholders provided an example of Belgium, where currently dealers are required to produce a different label for each region as taxation varies between regions. However, the methodology and other assumptions are expected to be provided by the Commission or National Authorities.
- **IE1: Include WTW emissions.** In case the EU legislation allows using Renewable Energy certificates to be used to offset emissions in transport sector, WTW emissions will depend directly on the extend these certificates are used for each particular car. In this case, costs associated to calculation and provision of this information element will need to be paid by the businesses (e.g. manufacturers or dealers).

For the rest of the elements, the information required for the label can be derived from information already gathered in the course of vehicle type approval and testing – as formally required in the Directive itself, the figures should be based on the "official fuel consumption" and "official specific CO_2 emissions" derived from these tests. A review of the available literature indicates that labelling products online involves little effort, hence information provided online was considered to incur a negligible cost. The information required for the label is derived from information already gathered in the course of vehicle type approval and testing – as formally required in the Directive itself, the figures should be based on the "official fuel consumption" and "official specific CO_2 emissions" derived from these tests. Hence, no additional costs are associated with the need to gather information required. A review of the available literature indicates that labelling products online involves little effort, hence information provided online was considered to incur a negligible cost.

Table 3-37: Overall impacts of measures related to information elements on costs to businesses

Policy measure	Impact on costs to businesses
IE0: Include information on taxes	O No impact expected
IE1: Include WTW emissions	× Possible negative impacts
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	O No impact expected
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	O No impact expected
IE4: Include Total Cost of Ownership	×

Policy measure	Impact on costs to businesses
	Possible negative impacts
IE5: Include running costs	O No impact expected
IE6: Include information on type approved electric range	O No impact expected
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	O No impact expected
IE8: Include real-world CO_2 emissions and fuel consumption	O No impact expected
IE9: Include information on real-world electric range	O No impact expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	O No impact expected
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No impact expected

Measures extending the scope of the Directive

Measures related to extending the scope of the Directive are expected to result in direct costs related to compliance with the new provisions for dealers, manufacturers and those responsible for relevant third-party websites involved in the sale/lease of vans, used vehicles and/or rental cars as well as newly affected stakeholders (e.g. rental companies).

Error! Reference source not found. identifies the affected stakeholders and how/why they may incur additional costs or savings. Overall, the analysis indicates that the businesses that could have an increase in costs are:

- **Manufacturers and dealers:** there is a potential for an increase in one-off costs associated with the introduction of more vehicles to the system and information material for all three measures (S1, S2 and S3).
- **Car/van rental companies**: there is also a potential for an increase in one-off costs arising from introduction to the system and information material (S3).

Table 3-38: : Expected cost implications for businesses from the measures related to extending the scope of the Directive

Measure	Who is affected	Cost or savings implications
S1: Extend requirements to new vans	**Dealers/manufacturers** would have to set up a similar system to that which they have put in place for new cars under the current Directive in order to collate and disseminate the information about new vans (in some MS, these costs could be associated to national authorities). The inclusion of any additional communication channels or pieces of information that are currently not required by the Directive would	Potential increase in **one-off administrative costs for manufacturers and dealers** associated with the introduction to the system and information material. Potential **increase in ongoing costs** from adding and updating the information.

Measure	Who is affected	Cost or savings implications
	have similar implications to those for new cars. Dealers and manufacturers that solely sell or lease vans would be subject to the legislation for the first time.	
S2: Extend requirements to used vehicles	For most used cars, the information that is currently required by the Directive will already be in the relevant databases of **manufacturers and dealers** (i.e. databases from previous years) but the systems would have to be adapted to collate and produce the relevant information (e.g. the label) for used cars. For used vans, the relevant information may not have been collated already (as noted above for new vans), hence collating this information for used vans might prove to be a challenge. **Dealers** that solely sell used vehicles would be subject to the legislation for the first time.	Potential **increase in one-off costs** associated with introduction to the system, data collection and checking for missing information. Potential **increase in ongoing costs** from adding and updating the information.
S3: Extend requirements to [new] rental vehicles	**Car/van rental companies** would be subject to the legislation for the first time and would need to amend their own systems to ensure that the necessary information is accessed and appropriately communicated to those renting cars/vans. For rental cars, the information to be communicated would be the same as that which is currently communicated to those buying or leasing new cars, so the same source and templates can be used (as amended). For rental vans, newly systems/databases (for S1) set up by manufacturers/dealers (depends on existing responsibilities in Member States, could be responsibility of national authorities) would be used.	Potential increase in **one-off administrative costs for car/van rental companies** associated with the introduction to the system and information material.

Evidence from extending the requirements to used cars (S2) in the UK suggests that the only cost to dealers was printing the label that was free to download and displaying it. Interviewed dealers in this study suggested the scheme was very easy to administer and the website from where labels were downloaded was also very easy to use. However, this study indicated that any additional costs in the future could have a significantly negative impact on the willingness of dealers to engage with the scheme on a voluntary basis (LowCVP, 2010).

The limited input provided by manufacturer representatives consulted for this study suggest that cost changes are expected to be low for manufacturers and dealers. One of

the manufacturers consulted and ACEA indicated cost increase for them from adopting S1. ACEA suggested costs are not expected to be significant for manufacturers. Two of the manufacturers interviewed supported one off and recurring costs increase from S2. One of them highlighted that the main costs that could be expected would arise if different IT standards are used for data supply for new and used cars. For S3, only one of the consulted manufacturers indicated an increase in costs. For all measures, costs would depend on existing responsibilities in Member States, as they could be faced by national authorities.

The overall impacts of measures related to extending the scope of the Directive are summarised in Table 3-39.

Table 3-39: Overall impacts of measures related to extending the scope of the Directive on costs to businesses

Policy measure	Impact on energy use and GHG emissions
S1: Extend requirements to [new] vans	× Potentially small increase in one-off and ongoing costs
S2: Extend requirements to used cars	× Potentially small increase in one-off and ongoing costs, but additional costs can be expected if different IT standards are operated for data supply
S3: Extend requirements to rental vehicles	× Potentially small increase in one-off

Measures increasing the level of harmonisation of implementation in the Member States

Legislative changes relating to the specification of the design and methodological aspects associated with increased level of harmonisation across EU Member States (H1) are likely to lead to one-off compliance and administrative costs for **vehicle manufacturers** in the form of changes to the collection and presentation of vehicle model data (inputs to labels) and updates to associated databases. However, it is recognised that there are also potential cost savings due to reduced complexity of data provision in the longer-term (harmonised data for all EU Member States

The limited input provided by stakeholders consulted for this study suggested that, if any, cost changes are expected to be small. One vehicle manufacturer welcomed the potential for harmonised data provided for all Member States – a positive change from the current situation where varying data are required depending on the Member State which is also likely to reduce complexity and subsequently costs. Another vehicle manufacturer explained that although there are likely to be one-off costs in the short term associated with updates to databases, it is again anticipated that there will be cost savings in the long term.

Although there was no feedback from **publishing and/or advertising companies**, it could be assumed that where publications are distributed in multiple Member States, small cost savings could be anticipated due to the simplification of information presented. It is not anticipated that there will be any costs/savings for dealers, who will be required to continue to display the latest label/information for each model, as obtained from the relevant authority.

The overall impacts of measures related to harmonisation are summarised in Table 3-40.

Table 3-40: Overall impacts of measures related to harmonisation on costs to businesses

Policy measure	Impact on costs to businesses
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/methodological elements specified and extent to of changes required in supplying

Policy measure	Impact on costs to businesses
	and maintaining data. One-off costs expected with potential for longer term cost savings for manufacturers.

3.3.3.4. Impacts on public budgets

Most of the measures, across all areas, are expected to have some **impact on administrative and enforcement costs** for public authorities. The size of these costs will depend on the measure, the difficulty to implement it and the associated enforcement effort. The main data source is the consultation activities, complemented by evidence on the costs of specific measures already implemented in some Member States, where data is available. The analysis is provided below for each group of measures under consideration.

As is the case for the costs that businesses could face, the costs to authorities also depend on the assumptions on which stakeholders are expected to take further action, which could differ depending on the implementation approach of each Member State.

To the extent that the proposed measures lead to a shift towards alternative powertrains, there will also be an **impact on revenues** from vehicle/fuel taxation under the current taxation regimes where clean vehicles are often exempted. The SULTAN model is used to quantify the impacts on levels of tax revenue for the constructed scenarios as a result of the proposed measures alone. As explained in Section 3.3.1, the effects are determined by the average vehicle choices observed in the consumer experiments which are used as a proxy for potential new vehicle sales.

SULTAN results in Figure 3-13 and Table 3-42 show expected decreases in annual fiscal revenue of €1 billion for the NewLabel in 2025 and €4 billion for 2030. This scenario is expected to increase the sale of xEVs significantly which can explain the reduction in fiscal revenues from the higher share of cleaner vehicles which are subject to lower (or even exempt of) vehicle/fuel taxation.

In line with the conclusions on impacts in the sale of xEVs assessed in Section 3.3.1, more limited reductions in annual fiscal revenues are expected for TCO and Custom scenario and an increase in revenues is expected for the WTW scenario.

Figure 3-13: Net fiscal revenue vs the baseline (cars only)

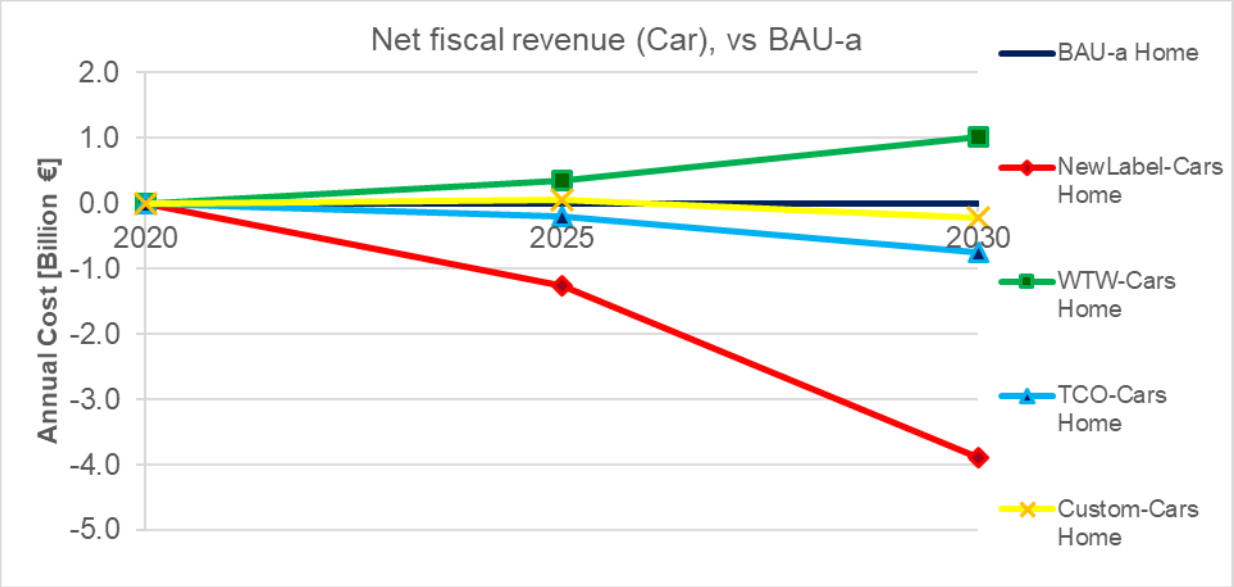


Table 3-41: Annual net fiscal revenue per scenario (cars only, € bn)

Scenario	2020	2025	2030
BAU-a	312	311	286
NewLabel-Cars	312	310	282
WTW-Cars	312	312	287
TCO-Cars	312	311	285
Custom-Cars	312	311	286

Measures implementing changes to the information channels through which information is communicated

This group of measures can give rise to **additional costs** for public authorities related to the implementation, monitoring and enforcement of the provisions.

Overall, the measures with the potential for leading to more substantial implementation costs for authorities are those which require specific actions from these stakeholders, namely:

- The guide to be made available in electronic format and the production of a printed guide to be made optional (IC3) since authorities could achieve **ongoing cost savings** from no longer having to print the guide but they could incur in **additional one-off and ongoing costs** to develop and continue making available an electronic version of the guide.
- Make a platform available - on the web and/or via a mobile app -containing the information on all models to facilitate their comparison (IC6) since authorities would have to develop – or commission the development of – a platform to enable comparisons, incurring in **additional one-off and ongoing costs.**

All measures are also likely to require additional efforts with monitoring and enforcement.

The input provided by stakeholders provides further insights into these cost changes. Of the 16 authorities responding, only three (BE, AT, SI) identified the potential for a change in costs arising from the provision of an online guide and the removal of the requirement to provide a printed version. We note that some of the responding authorities are from countries which already provide an online version of the guide (including AT, BE, EE, SE, SK).

No specific estimates have been provided by the consulted stakeholders on the potential savings from the removal of the requirement to print the guide but the evaluation study (Ricardo and TEPR, 2016) found that the cost could represent up to €60,000 per year. As such, this could be the maximum savings that could be achieved for the authorities that still print guides.

Regarding the provision of a web-platform for vehicle comparisons, seven authorities (IE, BE, AT, SI, EE, DK, SE) identified a potential change in costs (six suggested a change in recurring costs and five suggested a change in one-off costs). In their comments, authorities also indicated that this platform should be developed at the EU-level (IE, HR, AT, FR, SI, EE) or by OEMs (FI) which could explain why some of these authorities did not identify the potential for a cost increase. In addition, one authority (SE) noted that resources would be needed for keeping the platform up-to-date.

The findings from the evaluation support study (Ricardo and TEPR, 2016) suggest that the development of a website allowing for detailed comparison of vehicles could result in costs between €20,000 to €35,000 (one-off costs). Its annual maintenance could vary between €19,000 and €217,000 (annual recurring costs).

According to two authorities (BE, DK), they already have such a platform in place. In particular, in Denmark, the authority indicated that it costs between €10,000 to €15,000 to maintain this platform which includes data which they purchase from importer organisations and the label which they also purchase from another party. According to them, the involvement of these parties makes this platform more expensive. For Belgium, which responded to the data request for this study, the one-off cost is unrealistic and ongoing costs could be €14,550. Three other authorities responded to the data request

(AT, EL, FI), all confirming the range of estimates suggested. In particular, the Finnish authority indicated that they have developed such a platform, with a one-off cost of €30,000 was incurred and annual maintenance is between €50,000-100,000 depending on the year. They also contracted this service to an external company and expect the cost could be lower if this was done in-house.

Moreover, the additional costs from providing an electronic version of the guide are expected to be lower than the costs of developing the web-platform.

In terms of the **impact on revenues**, the results from the SULTAN model suggest that the provision of information through a web-platform (IC6) and the provision of an online label (IC1) could result in more substantial revenue losses due to the increase in sales of xEVs for which taxes are lower/none. This is demonstrated by the NewLabel scenario.

The use of interactive displays in showrooms (IC2) and a quote to provide relevant information (IC7) have smaller impacts on the sales of xEVs and thus are expected to have a more limited impact on fiscal revenues, as captured by the Custom scenario and TCO scenario, respectively.

The overall impacts of measures related to information channels are summarised in Table 3-42, including the upper bound[47] of the expected change in fiscal revenues on the basis of the relevant scenarios modelled in SULTAN.

Table 3-42: Overall impacts of measures related to information channels on public budgets

Policy measure	Impact on public budgets
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	×× On the basis of the NewLabel scenario, significant reduction in fiscal revenues expected (up to €4 bn in 2030, compared to baseline)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	× Reduction in fiscal revenues expected
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	? Unclear. Cost savings expected from no longer having to print the guide but increased costs from providing the electronic version
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Small to negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	O Small to negligible impact expected
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	×× More substantial costs expected related to the development and maintenance of the website: up to €35,000 (one-off costs) and €217,000 (annual recurring costs). Accompanied by a loss of fiscal revenues (up to €4 bn in 2030, compared to baseline), as represented by the NewLabel scenario.

[47] As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform) and/or it is not possible to disentangle the effects of measures assessed together in the consumer experiments.

Policy measure	Impact on public budgets
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	* Reduction in fiscal revenues expected
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O Small to negligible impact expected
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Small to negligible impact expected

Measures implementing changes to the information elements that are communicated

Provision of some of the information elements is expected to lead to significant costs for authorities, in terms of costs of implementation and enforcement.

According to the SULTAN analysis, implementation of the new label, which includes provision of information on running costs, air pollutants and electric range, and obligation of displaying it online, leads to €1 billion lower net fiscal revenue in 2025 and €4 billion lower net fiscal revenue in 2030. Parts of this fiscal revenue reduction can be attributed to the provision of individual information elements, through their relative influence on the choice of different powertrains.

Provision of the information on costs is expected to lead to an increase in costs for authorities, as approximately half (7 of 16) of National Authorities indicated in their response to our questionnaire. These are, in general, expected to be both, one-off and recurring costs. More stakeholders indicated that the provision of TCO is likely to cause significant costs for authorities, compared to provision of running costs.

According to SULTAN analysis of TCO scenario, net fiscal revenues would stay unchanged in 2020 but would decrease by €1 billion in 2030, explained by differences in mix of powertrains and fuel consumption.

National authorities also expect to see cost increases associated with the **provision of the information on air pollutants**, with approximately half of stakeholders expecting to see a one-off and recurring costs. Less severe cost burden is expected with respect to used cars, compared to new ones. The main complication of this information element is a potential need to take into account local air quality restrictions and reflect them on the label. This would need to be done at the Member State level or at the level of local authorities.

With respect to provision of **information specific to PHEV and BEV**, a lower share of National Authority stakeholders (5 out of 16) indicated that they expect to see significant costs (mostly one-off costs). Provision of charge time is expected to lead to more burden that provision of the information on electric range.

Some National Authority stakeholders (6 out of 16) have indicated they expect to see a cost increase associated with **provision of additional information in the form of QR code**, in terms of likely resource and cost implications to develop and maintain the electronic resources accesses through QR code.

Half of the stakeholders indicated that they expect a cost increase associated to **provision of real-world values**, referring to the costs of establishing a real-world testing regime, calibration of the equipment, staffing and equipment resources. In addition, some stakeholders mentioned costs of collection and regular updates of this information.

Finally, according to SULTAN analysis of WTW scenario, net fiscal revenues would go up €1 billion in 2025 and 2030, explained by lower penetration of alternative powertrains and higher fuel consumption.

The majority of National Authority stakeholders (9 out of 16) coincide that **provision of WTW emissions** will have significant costs associated to it. Establishing a methodology, collating and updating the data regularly and communication effort were listed as cost sub-categories in this case.

Table 3-43: Overall impacts of measures related to information elements on public budgets

Policy measure	Impact on public budgets
IE0: Include information on taxes	× Some negative impacts are expected according to the inputs from stakeholders
IE1: Include WTW emissions	? Unclear. According to the stakeholders, some positive impacts are expected in terms of net fiscal revenue, but these might be offset by the costs for national authorities associated to the collection of this information, its implementation and update.
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	×× According to the stakeholders, strong negative impacts are expected
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	× According to the stakeholders, some negative impacts are expected
IE4: Include Total Cost of Ownership	× According to the stakeholders, some negative impacts are expected
IE5: Include running costs	×× According to the stakeholders, strong negative impacts are expected
IE6: Include information on type approved electric range	×× According to the stakeholders, strong negative impacts are expected
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	× According to the stakeholders, some negative impacts are expected
IE8: Include real-world CO_2 emissions and fuel consumption	× According to the stakeholders, some negative impacts are expected
IE9: Include information on real-world electric range	× According to the stakeholders, some negative impacts are expected

Policy measure	Impact on public budgets
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	* According to the stakeholders, some negative impacts are expected
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	* According to the stakeholders, some negative impacts are expected

Measures extending the scope of the Directive

The impact on annual fiscal revenues from extending potential new requirements to new vans was assessed in SULTAN. As seen in Figure 3-14 and Table 3-44, €0.3 billion are expected to be lost in revenue in 2025 and €0.6 billion in 2030 in the NewLabel scenario compared to the baseline. This scenario is expected to increase the sale of xEVs significantly which can explain the reduction in fiscal revenues from the higher share of cleaner vehicles which are assumed to be exempt of vehicle/fuel taxation. These effects are only quantified as a result of the proposed measures. Expected impacts from the other scenarios modelled are in line with the conclusions on sales of electric vans in Section 3.3.1. Loss of revenue from considering other new measures are expected to be lower, as their impact on increasing vehicle sales is expected to be lower.

Figure 3-14: Net fiscal revenue vs the baseline (vans only)

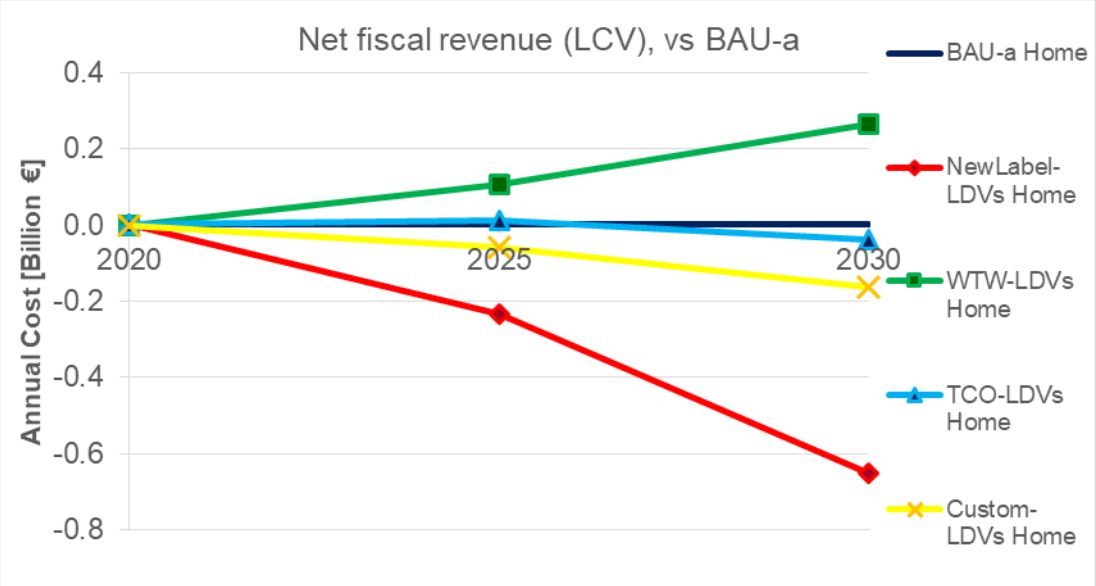


Table 3-44: Annual net fiscal revenue per scenario (vans only, € bn)

Scenario	2020	2025	2030
BAU-a	48.6	48.4	48.4
NewLabel-LDVs	48.6	48.1	47.8
WTW-LDVs	48.6	48.5	48.7
TCO-LDVs	48.6	48.4	48.4
Custom-LDVs	48.6	48.3	48.3

Extending the scope to new vans (S1) is expected to increase costs to public authorities in terms of implementation, enforcement and monitoring of the provisions. Half[48] of the

[48] 7 out of 14 consulted national authorities.

national authority stakeholders that took part of the consultation identified increases in one-off costs. Additional one-off costs for authorities are associated with the need to collect and add data on new vans to set up a similar system to that which they have put in place for new cars. Previous evidence from the evaluation support study (Ricardo, 2016) suggests that current collection of data on new passenger cars can cost from €72,000 and €90,000 per year. A Greek, Austrian, Belgian and Finnish national authorities agreed that collection of data costs would increase by 5-25% with the adoption of this measure.

This measure is also expected to result in additional ongoing costs for monitoring and enforcement of the provisions covering new vans, as suggested by 5 stakeholders. There were varied estimates for ongoing costs associated to monitoring and enforcement provided by the consulted national authorities. The Belgian and Finnish authorities suggested a cost of €1,000-10,000. The Finnish authority suggested costs would much difference in enforcement and monitoring costs for dealership as they sell both passenger cars and vans. The Austrian authority suggested costs of less than €1,000, but indicated this low cost is expected as Austria already implemented a "collaborative" approach with the car industry and no real enforcement is implemented. Only the Greek authority indicated higher costs of €10,000-100,000.

Extending the scope to used cars (S2), could result in significant one-off costs for authorities associated with database adaptation (i.e., redesign of IT platform) and the collation of data on used cars. This is based on the expectation that, for most used cars, the information that is currently required by the Directive will already be in the relevant databases of the National Authorities and/or manufacturers and dealers (i.e. databases from previous years) but the systems would have to be adapted to collate and produce the relevant information (e.g. the label) for used cars. 6 of the 14 national authority stakeholders consulted identified one-off costs. Consulted national authorities estimated these costs at €10,000-100,000, except for the Belgian authority that estimated it at €1,000-10,000. The Greek and Austrian authority suggested these increases would represent a large additional cost, whereas the Finnish and Belgian authority suggested these would represent only a small additional cost. According to the Finnish authority costs can be lower based on the original design of the database and its interfaces. Most cars are marketed and sold through internet-sites, which already have and use their own interfaces for external information to be added to the site.

This measure is also expected to result in ongoing costs associated with the monitoring and enforcement of the provisions of the Directive over a larger number of vehicles. The Greek, Austrian and Finnish authority estimate monitoring and enforcement costs of €10,000-100,000. The Finnish authority suggested these costs would depend on how the measure is supposed to be monitored and enforced. Most of the cars are sold through the internet, so there is no need for 'on-site enforcement', leading to lower costs.

The Finnish authority already has an interface system in place with costs between €72,000 and €90,000 per year. Adding a new car dealership or internet-service selling cars in Finland, which joins the interface, costs only €300 (to the private company operating the platform on their behalf) per interface. So, no 'significant costs' from this interface service. In Finland, the vehicle national agency's data-systems are built and designed for interface-use, through which they relay information to private sector inspection stations and other users. They also receive vehicle information through interfaces from the vehicle importers, inspections stations and vehicle insurance companies.

For both measures, S1 and S2, the Finish national authority identified additional costs may arise from the WLTP-measurements and the adaptation of electronic CoC, since the relevant information for the energy label moves even closer to the manufacturers and manufacturer's representatives/importers. Because of this, Finland has a contract with a private company, which supplies part of the information to the service, which they cannot get from their own agency's registers. Information is received directly from the Finnish car importers.

Costs for national authorities from extending the requirements to new rental vehicles (S3) are expected to be lower as information to be communicated would be the same as that which is currently communicated to those buying or leasing new cars, so the same source and templates could be used. This measure is assumed to be implemented for vans only if extending the requirements to new vans (S1) was implemented, thus no further data

collection costs would be needed from S3 for rental vans. Half of the national authority stakeholders consulted suggested that there would be costs for national authorities from adopting S3. These costs were mainly related to enforcing the new legislation to car/van rental companies.

However, the costs to national authorities depend on existing responsibilities in MS, where some of the costs identified in this section may be faced by manufacturer/dealers/rental companies. This is reflected by a few[49] national authorities indicating no costs were applicable for them from measures S1, S2 and S3.

Table 3-45: Overall impacts of measures related to extending the scope of the Directive on public budgets

Policy measure	Impact on public budgets
S1: Extend requirements to [new] vans	× On the basis of the NewLabel scenario, small reduction in fiscal revenues expected (up to €0.6 bn in 2030, compared to baseline). Additional one-off costs of €3,750-€22,500 (5-25% increase in current costs), and ongoing costs for monitoring and enforcement of €1,000-100,000
S2: Extend requirements to used vehicles	×× Higher additional one-off costs of €10,000-€100,000 and ongoing costs for monitoring and enforcement of €10,000-100,000
S3: Extend requirements to [new] rental vehicles	o Small to negligible costs expected

Measures increasing the level of harmonisation of implementation in the Member States

Measures increasing the level of harmonisation across EU Member States (H1) are likely to incur legislative changes relating to the specification of design and methodological aspects. It is therefore expected that there will be compliance and administration costs for public authorities at the Member State level, most likely one-off costs. One-off costs are likely to be related to making changes to the label and methodologies that contribute to data displayed in the label; updating databases prepared and maintained by public authorities (e.g. as inputs to the production of labels to be displayed in dealerships); costs associated with any internet-based services that use new data/methodologies; and any costs associated with promotional material that attempts to communicate the changes that have been implemented.

Due to the extent of changes to design and methodological aspects being unknown, it is not possible to quantify the potential costs to public authorities. Limited stakeholder input from national authorities revealed that less than half of respondents anticipate costs (either one-off, recurring or one-off and recurring costs) as a result of increase in the level of harmonisation across the EU Member States (H1)[50]. One Member State[51] suggested that adaptations to the label could result on one-off costs of around €5,000 associated with making changes to the label, and €2-5,000 associated with database changes.

Some Member States pointed out few costs may be incurred when making changes to the label/approach depending on the design features already adopted in their national approach, i.e. if it is specified that an absolute approach should be taken, and it is

[49] Two national authorities from Slovakia and Belgium said costs are not applicable to them from adopting S1, S2 or S3.

[50] Between 6 and 9 out of 19 respondents indicated that they expect one-off, recurring or one-off and recurring costs depending on design aspect/methodological approach specified.

[51] DK

consistent with the approach currently used within the Member State, then no costs would be expected in this case. However, due to the know variation in the design aspects and methodological approaches used by Member States across the EU, it is anticipated that costs will be incurred by some Member States, but to a varying degree.

It is also possible that where a large shift to cleaner vehicles is realised in selected Member States as a result of harmonisation, costs may also be incurred relating to a reduction in revenues from vehicle/fuel taxation under current taxation regimes, where clean vehicles are often exempted. The overall impacts of measures related to harmonisation are summarised as follows:

Table 3-46: Overall impacts of measures related to harmonisation on public budgets

Policy measure	Impact on public budgets
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	× Small, one-off costs for public authorities associated with making updates to databases and potential loss of revenue under due to increases in clean vehicles.

3.3.3.5. Impacts on the functioning of the internal market and competition

A number of measures are expected to have an impact on the functioning of the internal market and levels of competition. The assessment of impacts on vehicle sales and parc composition (Section 3.3.1) already identified a number of policy measures that are expected to significantly enhance consumer awareness.

In particular, measures related to the increase in the level of harmonisation (H1) are expected to impact the functioning of the internal market. In fact, differences in the implementation of the Directive leading to lack of consistent information across Member States is one of the problem drivers identified that, in turn, leads to both consumers making sub-optimal vehicle purchase choices and manufacturers having inconsistent incentives to produce cleaner vehicles. It follows that any measures found to facilitate fair comparisons across different vehicles and increase the level of harmonisation of information provision across the EU can contribute to an improved functioning of the internal transport market.

The majority of stakeholders (14 out of 21) agreed that the functioning of the internal market and competition would increase as a result of harmonisation of the label based on the design used for the Energy Labelling Regulation. The harmonisation of other aspects were also considered to have a positive impact, including harmonising the method underlying the way in which cars are assigned to a category (absolute/relative); and establishing methodological approaches (all 13 out of 21).

In interviews ANEC & BEUC express their support for harmonisation of key elements of the Directive in order to create synergies between Member States. They recommend that a balance is found between enabling Member States to enforce legislation that is appropriate in the context of national culture, whilst also being consistent with the requirements of the internal market. Other stakeholders agreed that increased understanding and trust that could be gained through harmonisation cold assist in informing consumers and brining clarity in the single market (BEUC, FIA, AK Wein).

Provision of cost information, in particular running costs and especially TCO, as well as provision of battery range are expected to positively affects competition between manufacturers (in terms of efficiency and price) and dealers (in terms of price), as it becomes easier for consumers to compare across options from different providers. 16 out of 33 stakeholders expected an increase for level of competition on the market if TCO is provided and 15 out of 33 – if running costs or battery range are provided.

WTW emissions and information on air pollutants have been indicated as another measure with relatively large impacts on internal market and competition, as indicated by stakeholders (15 out of 33 stakeholders expected an increase in competition).

The overall impacts of measures related to harmonisation are summarised as follows:

Policy measure	Impact on functioning of the internal market and competition
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	✓ Ensures consistent information is provided to consumers across EU MS, increasing understanding and trust.

3.3.4. Social impacts

Two types of social impacts are examined in this section: impacts on income distribution and social inclusion, and on public health. Similar to the assessment of environmental impacts, these are indirect impacts potentially arising from changes in vehicle choices and purchase decisions. The SULTAN model is used to quantify these impacts, together with other relevant input from the field and desk research.

3.3.4.1. Impacts on income distribution and social inclusion

This impact category considers the effects of the proposed measures on lower income consumers, as an indirect impact of the choices that new vehicle buyers make. If new vehicle buyers choose more efficient vehicles, these will eventually move into the second-hand car market, where lower income consumers are more likely to purchase them. The rapid depreciation of car values in the first few years is likely to ensure that second-hand owners can reap the fuel savings without the fuel efficiency being fully reflected in the prices they pay for used cars.

Results from SULTAN model show that the NewLabel scenario is expected to lower cost to second end consumers by 0.19% in 2025 and 0.67% in 2030. The lower costs can be associated to the increase in new xEVs sales in this scenario shown in Section 3.3.1, which will become available in the used car market. Similarly, the TCO scenario is also expected to lower costs to second end consumers by 0.12% in 2025 and 0.41% in 2030. Similar to reductions in costs for first car users assessed in Section 3.3.3.1, costs reductions are observed in running costs.

On the other hand, the WTW scenario is not expected to have a significant impact on costs for second end consumers, whereas the Custom scenario is expected to result in small cost increases. In the latter, reductions in running costs are more than compensated by increased capital costs and EV infrastructure.

Figure 3-15: Calculated change in average total cost of ownership (TCO) for second end-users for different options, breakdown by component for 2025 and 2030

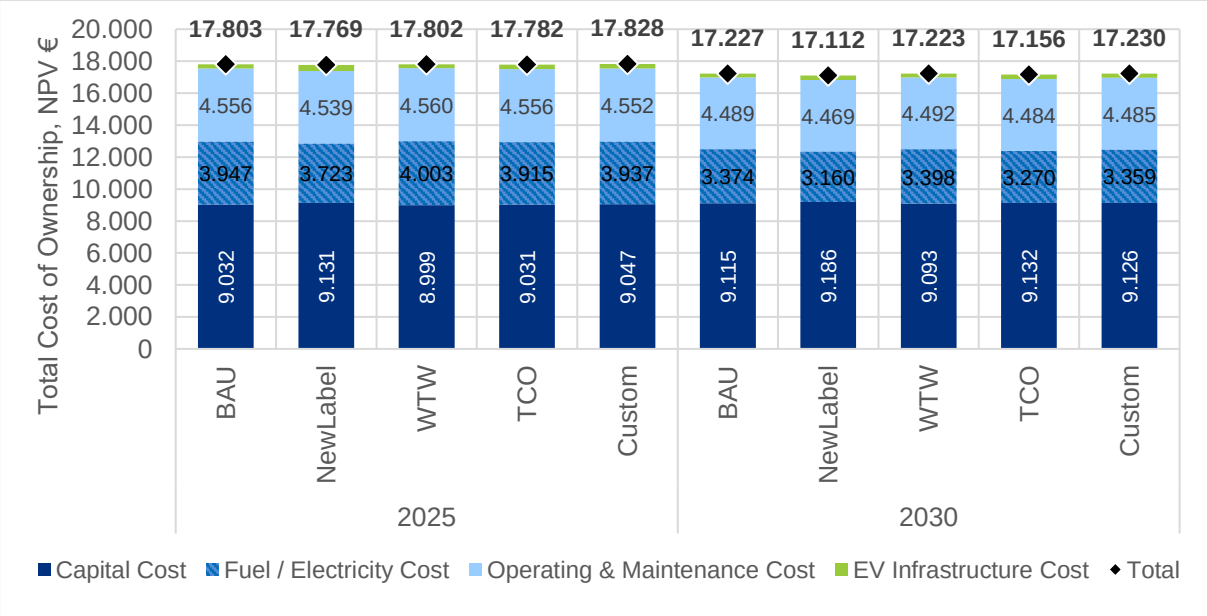


Table 3-47: Calculated change in average total cost of ownership (TCO) for second end-users for different options (passenger cars only, €)

	2020	2025	2030
Baseline (BAU)	18,318	17,803	17,227
NewLabel (vs BAU)	*0*	*-0.19%*	*-0.67%*
WTW (vs BAU)	*0*	*-0.01%*	*-0.03%*
TCO (vs BAU)	*0*	*-0.12%*	*-0.41%*
Custom (vs BAU)	*0*	*0.14%*	*0.01%*

In addition, improvements in the provision of information that result in an increased level of understanding of the information provided could also be more beneficial for the most vulnerable and less educated segments of the population. Other segments are likely to already be more informed and/or familiar with the trade-offs in vehicle purchase decisions. On the basis of the demographic information collected from the consumer experiment and information on the budget segment selected by the participants, we can explore whether the effectiveness of the various treatments would be different across demographic groups.

Measures implementing changes to the information channels through which information is communicated

On the basis of the above analysis that concluded that measures such as the provision of information through a web-platform (IC6) and the provision of an online label (IC1) can have an effect on vehicle sales, it follows that buyers of second-hand vehicles will also be indirectly affected by having access to a pool of more efficient vehicles that will become available in the second-hand market eventually. As a result, the average TCO for second end-users could decrease as represented by the NewLabel scenario.

On the other hand, the use of interactive displays in showrooms (IC2) as captured by the Custom scenario, and the use of a quote to provide relevant information (IC7), as captured by the TCO scenario, have smaller effects on the costs which used car buyers face.

As described earlier, the provision of information in dynamic advertising (IC5) is only expected to have an impact on vehicle sales indirectly and, thus, the impact on the costs to second-hand car buyers would be smaller than other measures such as the provision of information through an online label.

It is also important to consider whether there are differences in the way that the channels proposed reach the different population segments. As concluded earlier in Section 3.2, there is a risk for those which have lower digital skills to be negatively affected by the removal of more traditional channels to communicate information in the showroom: printed guides (IC3) and present a poster/electronic display (IC4). This risk was raised by BEUC, T&E, and the Belgian[52] and Austrian[53] authorities that commented that the tools used should be fair, and accessibility to information should be maintained for all consumers. As a result, the removal of the requirements associated with the use more traditional channels in the showroom could potentially decrease access to relevant information.

To the extent that awareness campaigns and training events can contribute to enhance the understanding of the information provided (in general, including via the new channels proposed), they could also be more important for certain segments of the population that are less informed and/or familiar with the trade-offs in vehicle purchase decisions. These

[52] FPS public health

[53] Environment Agency Austria

groups can therefore benefit more from improved access and use of relevant information for their decisions.

The overall impacts of measures related to information channels are summarised in Table 3-48, including the upper bound[54] of the expected changes in the average TCO on the basis of the relevant scenarios modelled in SULTAN.

Table 3-48: Overall impacts of measures related to information channels on income distribution and social inclusion

Policy measure	Impact on income distribution and social inclusion
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓ On the basis of the NewLabel scenario, decrease in average TCO of up to €115 in 2030 compared to the baseline (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	O Minimal increase in TCO in 2030 compared to the baseline
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	× Potential risk of excluding population with lower digital skills
IC4: Remove the requirement to present a poster/electronic display in the showroom	× Potential risk of excluding population with lower digital skills
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	O Small to negligible impact expected
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓ On the basis of the NewLabel scenario, decrease in average TCO of up to €115 in 2030 compared to the baseline
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	O Minimal decrease in TCO in 2030 compared to the baseline
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O Small to negligible impact expected
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Small to negligible impact expected

[54] As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform) and/or it is not possible to disentangle the effects of measures assessed together in the consumer experiments.

Measures implementing changes to the information elements that are communicated

The provision of some of the information elements is expected to favour more vulnerable households. While we find that most information elements with important impacts as described in previous sections have some implications for lower-income households, our analysis shows that cost information is most valuable.

Provision of information on running costs is expected to contribute to decisions that lead to more TCO savings for lower-income households. In our experiment, lower income households indicated that all information elements are less useful than higher-income households, although 29% of lower-income participants indicated running costs as useful (only TCO has a higher score). On average, they did save up to 8.7% in terms of TCO in our New Label treatment.

Provision of TCO could to contribute to decisions that lead to more TCO savings for lower-income households, although we do not observe statistically significant differences in our experiment, despite of the fact that 30% of lower income participants indicated TCO as useful (the highest score among information elements).

No significant impacts are expected for air pollutants, as only 16% of lower income participants indicated information on air pollutants as useful. Moderate impacts expected for used cars, higher than for new cars, as lower-income households are 10% more likely to be interested in a used car.

Provision of electric range is expected to contribute to the decisions that lead to more TCO savings for lower-income households. In our experiment 19% of lower-income participants indicated electric range as useful. On average, they did save up to 8.7% in terms of TCO in our New Label treatment.

Table 3-49: Overall impacts of measures related to information elements on income distribution and social inclusion

Policy measure	Impact on income distribution and social inclusion
IE0: Include information on taxes	✓ In line with other cost categories, this measure is expected to benefit lower-income households more.
IE1: Include WTW emissions	O No significant impacts expected.
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	O No significant impacts expected.
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	✓ Moderate impacts expected
IE4: Include Total Cost of Ownership	✓ Moderate impacts expected
IE5: Include running costs	✓✓ Strong positive impacts expected
IE6: Include information on type approved electric range	✓ Moderate impacts expected
IE7: Include the information on charge time, including details on the	O

Policy measure	Impact on income distribution and social inclusion
power of the charger that was assumed in the calculations	No significant impacts expected.
IE8: Include real-world CO_2 emissions and fuel consumption	O No significant impacts expected.
IE9: Include information on real-world electric range	O No significant impacts expected.
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	O No significant impacts expected.
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No significant impacts expected.

Measures extending the scope of the Directive

Similar to new cars, extending the requirements to new vans is expected to impact the sales of more fuel efficient/economical vans, which will eventually move into the second-hand car market, where lower income consumers are more likely to purchase them (Ricardo-AEA and TEPR, 2011; Norris et al, 2019). Results from SULTAN suggest that encouraging the sales of more efficient new vans by adopting the potential new requirements of the Directive tested in this study could lead to a 0.8% reduction in the average TCO for used van users (Table 3-50).

Table 3-50: Calculated change in average total cost of ownership (TCO) for second end-users for different options (vans only, €)

	2020	2025	2030
Baseline (BAU)	22,342	21,906	21,473
NewLabel (vs BAU)	*0*	*-0.80%*	*-0.90%*
WTW	*0*	*0.37%*	*0.30%*
TCO	*0*	*0.04%*	*-0.25%*
Custom (vs BAU)	*0*	*-0.12%*	*-0.13%*

As presented in Section 3.3.1 extending the requirements to used cars (S2) can have an impact in increasing the sale of more efficient used cars. Thus, this measure is expected to directly benefit lower income consumers that are more likely to buy used cars.

Extending the requirements to rental vehicles (S3) is expected to have smaller to negligible impacts on vehicle sales, thus it is not expected to have significant impacts on income distribution and social inclusion.

Table 3-51: Overall impacts of measures related to extending the scope of the Directive on income distribution and social inclusion

Policy measure	Impact on income distribution and social inclusion
S1: Extend requirements to [new] vans	✓ On the basis of the NewLabel scenario, decrease in average TCO of up to €193 in 2030 compared to the baseline from more efficient/economic vans entering the second-hand car market benefiting lower income consumers purchasing these vans.
S2: Extend requirements to used vehicles	✓

Policy measure	Impact on income distribution and social inclusion
	Not assessed quantitatively but positive impacts are expected.
S3: Extend requirements to rental vehicles	o Small to negligible impact expected

Measures increasing the level of harmonisation of implementation in the Member States

As increased specification of the design/methodological aspects can have an effect on vehicle sales, it follows that buyers of second-hand vehicles will also be indirectly affected by having access to a pool of more efficient vehicles that will become available in the second-hand market eventually. Therefore increased harmonisation across EU Member States can be expected to see positive impacts for income distribution and social inclusion in those Member States where the greatest changes are realised.

Table 3-52: Overall impacts of measures related to harmonisation on income distribution and social inclusion

Policy measure	Impact on income distribution and social inclusion
S1: Extend requirements to [new] vans	? Unclear, will depend on design/methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on income and social inclusion.

3.3.4.2. Impacts on public health

The potential improvements in air quality discussed above can also be assessed in terms of impacts on public health. The SULTAN model is used to estimate the external costs of air pollution.

Table 3-53 shows that both the NewLabel scenario and the TCO scenario are expected to lead to lower externalities, compared to the baseline scenario, in line with the conclusions on their impacts on the level of NOx, PM and SOx emissions. The effects of the Custom and WTW scenarios are smaller, compared to the baseline.

Table 3-53: Calculated change in the air quality pollutant externalities (passenger cars only, € Bn)

	2020	2025	2030
Baseline (BAU)	51	45	39
NewLabel (vs BAU)	*0.00%*	*-1.56%*	*-3.31%*
WTW (vs BAU)	*0.00%*	*-0.03%*	*0.01%*
TCO (vs BAU)	*0.00%*	*-0.17%*	*-0.81%*
Custom (vs BAU)	*0.00%*	*0.00%*	*-0.09%*

Measures implementing changes to the information channels through which information is communicated

Overall, the analysis described in the earlier Section 0 demonstrates that measures such as the use of a web-platform to facilitate vehicle comparisons (IC6) and the use of online label (IC1) are expected to have more substantial impacts on air quality which translate into important benefits in terms of public health. These are evidenced by the results from SULTAN for the NewLabel scenario (in which relevant information is made available online) in particular. The use of a quote to provide relevant information (IC7) can also lead to improvements in public health as captured by the TCO scenario results. On the other hand,

the benefits for public health due to the use of the interactive display in the showroom (IC2) are smaller, as evidenced by the Custom scenario results.

In addition, showing relevant information on dynamic advertisement (IC5) could also have an impact on air quality, leading to benefits in terms of public health. Although these cannot be quantified, the measure is expected to be effective in encouraging the sales of cleaner vehicles, albeit only indirectly. If combined with the use of the online label, it could improve the consistency of the message and enhance its effectiveness and thus the impacts of that channel.

In line with the analysis of the air quality impacts in earlier Section 0, the remaining measures are expected to have quite small impacts, if any.

The overall impacts of measures related to information channels are summarised in Table 3-54, including the upper bound[55] of the expected change in external costs on the basis of the relevant scenarios modelled in SULTAN.

Table 3-54: Overall impacts of measures related to information channels on public health

Policy measure	Impact on public health
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓✓ On the basis of the NewLabel scenario, significant improvements in public health expected: reduction in external costs of air pollution up to 3.31% compared to the baseline in 2030 (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC2: Label information to be provided in interactive displays (fixed or mobile) where cars are made available for sale or lease	✓ On the basis of the Custom scenario, improvements in public health expected: reduction in external costs of air pollution up to 0.09% compared to the baseline in 2030
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	O Negligible impact expected
IC4: Remove the requirement to present a poster/electronic display in the showroom	O Negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	✓ Small improvements in public health expected by enhancing the effectiveness of other channels
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓✓ On the basis of the NewLabel and Custom scenarios, significant improvements in public health expected: reduction in external costs of air pollution up to 3.40% compared to the baseline in 2030
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car	✓

[55] As described earlier, the SULTAN model results provide a proxy for the expected impacts of these measures and represent the upper bound of the expected effects since some Member States have already implemented some of the measures under consideration (e.g., web-platform) and/or it is not possible to disentangle the effects of measures assessed together in the consumer experiments.

Policy measure	Impact on public health
configurators where an estimate of the price is provided)	On the basis of the TCO scenario, small improvements in public health expected: reduction in external costs of air pollution up to 0.81% compared to the baseline in 2030 (however, it was not possible to disentangle the effects of this measure from the effects of the information elements communicated by this new channel)
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O Negligible impact expected
IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	O Negligible impact expected

Measures implementing changes to the information elements that are communicated

Following our analysis of the impacts on air quality, the following table summarises the impacts on public health derived from this analysis.

Table 3-55: Overall impacts of measures related to information elements on public health

Policy measure	Impact on public health
IE0: Include information on taxes	✓ Not assessed quantitatively. Impacts expected similar to running costs, but of a lower magnitude
IE1: Include WTW emissions	✓ Moderate impacts expected, following air quality improvements
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	✓✓ Significant impacts, following air quality improvements
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)	✓✓ Significant impacts, following air quality improvements
IE4: Include Total Cost of Ownership	✓✓ Significant impacts, following air quality improvements
IE5: Include running costs	✓✓ Significant impacts, following air quality improvements
IE6: Include information on type approved electric range	✓✓ Significant impacts, following air quality improvements
IE7: Include the information on charge time, including details on the power of the	O

Policy measure	Impact on public health
charger that was assumed in the calculations	No impact expected
IE8: Include real-world CO_2 emissions and fuel economy	O No impact expected
IE9: Include information on real-world electric range	O No impact expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	✓ Not assessed quantitatively but positive impacts are expected
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No impact expected

Measures extending the scope of the Directive

The quantitative and qualitative analysis in Section 0 demonstrates that extending the new requirements of the Directive to new vans can have a small impact on air quality. We anticipate this impact will translate into small benefits in public health. SULTAN results for air quality externalities evidence the benefits in public health from this measure, suggesting a decrease in air quality negative externalities of 1.7% for the NewLabel scenario in 2025 compared to the baseline, that is expected to decrease even further in 2030. Expected impacts from the other scenarios modelled are in line with the conclusions on impacts in air quality, as shown in **Error! Reference source not found.**.

Table 3-: Calculated change in the air quality pollutant externalities (vans only, € Bn)

	2020	2025	2030
Baseline (BAU)	13	12	11
NewLabel (vs BAU)	*0.00%*	*-1.68%*	*-3.14%*
WTW (vs BAU)	*0.00%*	*0.83%*	*1.28%*
TCO (vs BAU)	*0.00%*	*0.20%*	*-0.33%*
Custom (vs BAU)	*0.00%*	*-0.44%*	*-0.71%*

Qualitative analysis for the impact on air quality pollutants suggests that there would be minimal reductions from extending the requirements of the current Directive to used cars (S2). Thus, we assume minimal impacts on public health from this measure where air pollutants are expected to decrease.

Extending the requirements to rental vehicles (S3) is expected to have small to negligible impacts on vehicle sales and parc composition, thus we do not anticipate significant impacts on air pollutant levels from this measure. The overall impacts of the measures related to extending the scope are summarised in **Table 3-56**.

Table 3-56: Overall impacts of measures related to extending the scope of the Directive on public health

Policy measure	Impact on public health
S1: Extend requirements to [new] vans	✓✓ On the basis of the NewLabel scenario, significant improvements in public health expected: reduction in external costs of air pollution of 3.14% compared to the baseline in 2030

Policy measure	Impact on public health
S2: Extend requirements to used vehicles	o Not assessed quantitatively but only minimal impacts are expected
S3: Extend requirements to rental vehicles	o Small to negligible impact expected

Measures increasing the level of harmonisation of implementation in the Member States

The qualitative analysis for the assessment of impacts on air quality (see Section 3.3.2.2) suggests that there would be a small positive effect on improving air quality as a result of implementing the measure to increase the level of harmonisation across all EU Member States on the measures to raise consumer awareness (H1). It is therefore anticipated that where improvements in air quality are realised (expected to vary across EU Member States due to the current differences in the implementation of the Directive) benefits in terms of public health can also be realised. The overall impacts of measures related to harmonisation are summarised in Table 3-57.

Table 3-57: Overall impacts of measures related to harmonisation on public health

Policy measure	Impact on public health
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on public health.

4. Consideration of design and methodological elements

There are a number of design and methodological aspects, interlinked with the provision of various information elements across the different channels, which are also important to consider as they can increase consumers' understanding and trust in the information provided. Many of these have been described to some extent in Section 3.2 concerning measures to increase harmonisation across EU Member States and have informed design choices for the consumer behaviour experiment (see Annex G).

These design and methodological aspects had already been identified in the long-list of policy measures but were not screened nor short-listed since they included proposals that require a more in-depth analysis in the context of the measures they target (related to the information elements and channels), i.e., design and standardisation considerations cannot be disassociated from the aspects they concern. This section therefore considers the most relevant design elements and methodological aspects/approaches in more detail for the information elements and channels assess above, drawing upon evidence from the literature and stakeholder input.

4.1. Design elements for information provided

The potential design aspects that could be considered for further specification include the following:

- The style/design of the label; and
- The representation of relevant information on energy consumption and emissions, e.g. relative versus absolute approach, drive cycles used to communicate CO_2 emissions and energy consumption information.

For these, there appears to be a consensus in the literature and/or among stakeholders as to the preferred option.

4.1.1. Style/design of the label

The most frequent style/design of the label currently used in Member States is one similar in appearance to that used in the Energy Labelling Regulation (2017/1369). This approach uses an A to G scale, is coloured green to red and categorised based on CO_2 emissions of the vehicle. Those Member States that have already taken this approach when transposing the Directive include Denmark, France, Finland, Germany, Ireland, Netherlands, Romania and Spain. However, although they have all opted to take this approach, there are still variations, including the number of coloured CO_2 bands/categories used, and either a relative or absolute approach taken to assigning vehicles to a category (see below for further discussion on these aspects). Alternative approaches to presenting the information in the label include a scaled colour-coded comparison (e.g. Austria), continuous comparative label (e.g. Belgium), a list format (e.g. Hungary, Italy and Sweden) or no specified format (e.g. Czech Republic, Poland).

The number of categories used is also an important consideration, as the experience with the EU Energy Label demonstrates. Over time, the EU energy label moved from a 7-class A to G system to a 10 category system (including A+, A++ and A+++ categories). Whereas the majority of products started off in the E, F and G categories, developments in technologies and energy efficiency meant that more of the newer models deserved to be placed in the top classes, with new classes being created. However, with such a positive result, it was difficult for consumers to distinguish the best performing products. For example, through purchasing an A+ rated product, the consumer may think that they are buying one of the most efficient on the market, whereas in fact it is potentially an average or one of the least efficient products. A revised energy labelling system was adopted in 2017 which returned to the A to G class system, which includes a process for rescaling existing labels overtime as efficiency improves. This approach has been taken to improve understanding and coherence, enabling consumers to identify the most efficient products (European Commission, 2019a).

Overall, the literature findings suggest that the EU Energy Label style is the most appropriate and that the use of A+++, A++ and A+ categories should be avoided. The evaluation study for the Directive (Ricardo and TEPR, 2016) concluded that the use of colour-coded categories similar to the EU Energy Label, as applied in some Member States,

is well recognised and understood by consumers. This is especially the case for categories using A-G (or A-M) range compared to A+++, A++ and A+ range. (AIRUSE, 2016) echoes this finding, suggesting that a simple 'eco-label' using an A to G rating system based on the Energy Labelling approach would be the most successful (with additional information on vehicle running costs). (Haq and Weiss, 2016) also recommend that one standardised label design should be introduced that mirrors the EU energy label. They also recommended that 7-scale labelling is used, denoted by A to G, which is implemented uniformly across the EU, avoiding the use of A+, A++ categories which denote high efficiency. This is also supported by BEUC (BEUC, 2019) which suggests that in order for consumers to easily identify which vehicle performs best in terms of CO_2 emissions, the label should be presented as a colour-coded comparative rating scale, ranging from class A to G. It is considered that this approach is easy to understand, and as it is based on the label used for the Energy Labelling Regulation, it is very well known among consumers.

Consultation with stakeholders for this study also revealed a high level of support (23 out of 29 respondents) for basing the design of the label/presentation of vehicle CO_2 emissions on the Energy Labelling Regulation (2017/1369), i.e. A to G scale using colours green to red.

4.1.2. Representation of relevant information on energy consumption and emissions

Regarding the format/presentation of the information, CO_2 emissions could be presented using the absolute approach (where a comparison and categorisation of each car is made against all cars) or the relative (categorised according to a comparison against cars in a similar class). According to the evaluation of the Directive (Ricardo and TEPR, 2016), ten Member States used the absolute approach[56], with three using the relative approach[57] and a further 14 which did not use a categorisation (e.g. stated emissions)[58].

The available evidence suggests that the absolute approach is the most appropriate. The evaluation of the Directive concluded that "absolute scaling is more transparent and easier to understand for consumers than relative scaling" (Ricardo and TEPR, 2016). It identified generally supportive evidence towards the higher effectiveness of an absolute scaling approach compared to a relative one in terms of influence on consumer understanding and purchasing behaviour. The absolute approach provides very clear and transparent information to consumers. However, it is acknowledged that its main challenge is in remaining relevant (also potentially a challenge for relative labels). Categories used need to be updated periodically to reflect the gradual shift of vehicles towards lower emissions otherwise there will be too many vehicles in the A-C categories, which would make it difficult for consumers to differentiate between vehicles (Ricardo and TEPR, 2016).

A 2018 study (Hille, Geiger, Loock, & Peloza, 2018) concluded that the absolute approach is the most direct form of information regarding a vehicles performance, and does not create consumer misinterpretation of a vehicles environmentally friendliness. Of the relative approach, the authors conclude that it can mislead and confuse consumers, with consumers placing low-emitting vehicles in low-emitting vehicles in lower rating classes than high-emitting vehicles (based on consumer experiments). The study also suggested that an absolute approach may also motivate manufacturers to develop more fuel-efficient fleets, with those manufacturers taking technological leadership in this area will give them a competitive advantage and the ability to differentiate themselves on the basis of their vehicle fleets' environmental performance (Hille, Geiger, Loock, & Peloza, 2018).

BEUC (BEUC, 2019) calls for a label that indicates CO_2 emissions in absolute terms, enabling consumers to easily compare cars based on their environmental performance. BEUC points out that the absolute approach can enable useful comparisons between model versions of a vehicle model (i.e. to see the effect of optional equipment on emissions), and could also be more easily linked to fiscal measures, which are commonly based on absolute CO_2 emissions in many Member States. In their opinion, the relative approach is not well

[56] AT, BE, BG, DK, EE, FI, FR, IE, PT, SI

[57] DE, NL, ES

[58] HR, CY, CZ, EL, HU, IT, LT, MT, PL, LV, LU, RO, SE, SK

understood by consumers. In addition, the use of mass as a parameter to assign cars to efficiency classes leads to less incentive for manufacturers to invest in light-weighting, which is considered to be an efficient way to achieve CO_2 emission reductions.

An assessment of various car models (in ten segments) was undertaken that revealed that the application of a relative labelling metric (compared to an absolute one) can cause substantial discrepancies in the classification of a particular car in two given Member States (Haq and Weiss, 2016). The discrepancies identified were typically small for cars with low distance-specific CO_2 emissions (e.g. mini- and small- cars and plug-in hybrids). However, they were found to be potentially substantial for large and heavy cars that are equipped with high-efficient to medium-efficient engines. (AIRUSE, 2016) agrees that the absolute system is 'simpler to implement and administer and is generally easier for consumers to understand'.

The majority of stakeholders consulted for this study agreed that a vehicle's CO_2 performance should be based on an 'absolute' approach (18 out of 29 respondents). Justifying their answers, some stakeholders suggested that the relative approach used in Germany, the Netherlands and Spain can be confusing for consumers, and ultimately does not encourage consumers to purchase the lower emitting vehicles (just the lower 'in class')[59]. The use of absolute CO_2 is also considered to be a key factor in terms of decarbonisation of the transport sector[60]. 6 out of 29 respondents support the use of a relative approach, citing the fact that consumers shop for vehicles within a certain class, thus making it relevant. However, it was also suggested that the relative approach could be presented in addition to the absolute approach, as secondary information, to fully inform consumers vehicle choices[61].

In addition, it is also important to consider which drive cycle to use to communicate WLTP figures. From 1 January 2019, Member States were required to ensure that only WLTP fuel consumption and CO_2 emission values are used for consumer information purposes. Member States were also required to ensure that the official fuel consumption and official specific CO_2 emission values include at least the 'combined' values. For vehicles type-approved in accordance with the WLTP, values are provided for low speed (representing city driving); medium speed (representing town driving); high speed (representing rural driving); extra high speed (representing motorway driving); combined (representing a mix of the cycles above); and weighted combined (for plug-in hybrid vehicles only, representing operation on both the battery and the internal combustion engine, taking into account the utility factor for electric operation). In the case of pure electric vehicles, WLTP electricity consumption and electric range values are provided for combined (representing a mix of low, medium, high and extra-high cycles); and city (representing a combination of the low and medium cycles).

The provision of the 'combined' drive cycle value seems appropriate, at least according to stakeholder input. In the consultation for this study, stakeholders were asked what the driving cycle information should be based on[62]. The most popular response was a 'combined' approach (25 responses), largely due to its simplicity, ease of understanding by consumers, and ability to portray a more realistic scenario for vehicle use. This was followed by low speed (11 responses) – relevant in urban areas, and city (only relevant for electric vehicles – 9 responses).

4.2. Methodological aspects/approaches used

In addition to the design of the label, there are potential methodological aspects that could be considered for further specification, including:

- Rules relating to categorisation, e.g. assigning vehicles to A to G vehicle categories based on their CO_2 emissions;

[59] T&E, NGO (anon), BEUC

[60] MS (anon) x 2

[61] FIA, leasing representatives (anon)

[62] 29 stakeholders responded and they could indicate more than one response.

- Rules for communicating fuel consumption and CO_2 emissions under WLTP, e.g. all models versus basic models; and
- Rules on how assumptions for calculations should be made and adjusted (e.g. fuel prices, average distance travelled, etc.)

Whilst the proposal of such rules is outside the scope of this study, the analysis provided below highlights the most important issues for future consideration.

4.2.1. Categorisation rules

There isn't currently an agreed approach to the ***emissions values used that determine the way in which cars are assigned to a category (e.g. CO_2 emissions relating to each band) nor how often they should be updated***. Where they are used in Member State labels, they can differ significantly, with some being defined through alignment with vehicle taxation processes (e.g. UK).

The recently revised EU Energy Efficiency Regulation intends to reallocate products to a scaled-down A to G class system, and includes a process for rescaling existing the labels in the future as products become more energy efficient (European Commission, 2019a). The process of both defining the categories and allocating products to them is clearly defined and harmonised across the EU for each product type[63]. The process for each product type involves a detailed preparatory study; extensive stakeholder consultation; assessment of the impacts on the environment, industry and consumers followed by expert discussion/Member State voting; and European Parliament and Council final scrutiny.

BEUC (BEUC, 2019) suggests that the classes (A to G) should be initially distributed to allow a clear distinction between a similar approach is taken between zero and low emission vehicles and other vehicles. It is recommended that enough leeway is left at the top of the scale to accommodate future technological developments, whilst the criteria for achieving the energy classes is periodically tightened to keep up with technological advances. They agree that the "plus class" approach (A+, A++, A+++) should not be allowed, which tends to confuse consumers. The (AIRUSE, 2016) study recommends that any label must be periodically adjusted and updated to reflect technological improvements and to prevent it becoming out of date. It is suggested that this could be achieved through allocating a fixed percentage of the models year into each of the classes, e.g. the top 10% of models allocated to the A class; 10% to B; 20% to C; 20% to D; 20% to E; 10% to F and 10% to G.

When asked how the 7 CO_2 band ranges should be defined in the consultation for this study, a range of answers were provided. A number of stakeholders[64] supported reserving 'A' for zero emission vehicles, and in some cases very low emission vehicles (i.e. a set percentage). After vehicles are initially assigned to categories, stakeholders also indicated that it will be important to review and update the categorisation regularly (but not too regularly) as technological advances are made and more vehicles enter the higher tiers[65]. It was also pointed out that the inclusion of hybrids add further complexities to the categorisation, as it is not known how much time they will be using the battery versus internal combustion engine.

4.2.2. Rules for communicating fuel consumption and CO_2 emissions under WLTP

As discussed above regarding channels that increase the relevant or understanding of the message, there is potentially a need to ***establish rules for communicating CO_2 emissions under WLTP values (e.g. all models versus basic models)***. Whilst CO_2 emissions under WLTP values may be presented for the 'basic model', what is considered to be the 'basic model' may differ between manufacturers (e.g. in some cases there are more 'extras' on selected basic models compared with others, meaning models are not

[63] Separate defined energy efficiency categories for each of the five products: Dishwashers, washing machines and driers; refrigerators; lamps; and electronic displays (television monitors, digital signage displays etc).

[64] AVERE, T&E, Verbraucherzentrale Bundesverband, ZPS - Zveza potroÅinikov Slovenije, BEUC, OEM (anon), FR, anon national authority x 2

[65] ZPS - Zveza potroÅinikov Slovenije (Slovene Consumers' Association, BEUC, OEM (anon)

strictly comparable). Additionally, it may be more appropriate to provide CO_2 emissions under WLTP values for all models, e.g. taking into account the specification of the model that the consumer is considering purchasing. This latter approach would enable better comparison between specific vehicle models.

For this study, stakeholders were asked whether rules should be established for communicating CO_2 emissions under WLTP values - 24 out of 29 stakeholders agreed that they should (two disagreed and three did not know).

4.2.3. Calculation rules and assumptions

If it is agreed that additional information should be included on the label, then the Commission may wish to decide whether to ***establish (specify) methodologies/rules determining how assumptions for the calculations should be made and adjusted***. This may include calculations/assumptions relating to fuel prices, average distanced travelled etc. According to our stakeholder survey and the interviews, cost information, including running costs and TCO, as well as WTW emission rules are the most polemic ones.

First, the EC would need to decide which of the values will be common and which will be specific to Member States. Second, precise rules will need to be determined, at least for the following parameters:

- Running costs: period (monthly, yearly, etc.), assumed distance driven and energy prices, frequency of update.
- TCO: same as for running costs plus additional components (maintenance costs, subsidies, insurance, etc.), discount rate, length of period under consideration, frequency of update.
- WTW: emission factors (current or future), frequency of update.

As for running costs, the majority of our stakeholders (16 of 25 respondents) suggested they should be presented as yearly running costs. However, other preferences were expressed, including expressing running costs as price per km.

With respect to TCO, stakeholders have expressed a very wide range of period length, from 2 to 16 years, but the majority said a number between 6 and 10 years.

Most stakeholder coincide that WTW emissions, if introduced as a measure, should be provided taking into account national circumstances. Many also coincide that a wide discussion among stakeholders will be needed to agree on the approach.

5. Comparison of policy measures and synergies

This section brings together the analysis of impacts and draws conclusions on the extent to which the different policy measures generate benefits compared to their costs and/or negative impacts. It also considers any interactions between the different policy measures, as relevant.

On the basis of the above analysis, we have mapped the positive and negative impacts against each of the identified impact categories (see Table 5-1 to Table 5-4). Overall, they show that measures which are expected to have a more significant impact on vehicle sales, introducing more xEVs or efficient vehicles in the fleet, compared to the baseline, are associated with positive impacts on the environment. In addition, costs to consumers, in terms of total costs of ownership, could be lower due to the use of xEVs and more efficient vehicle models, especially in the future when the upfront cost of these powertrain types is expected to decrease. On the other hand, there is a loss of revenues for authorities associated with the lower taxation of these powertrains. Social impacts, capturing effects on lower-income households, vulnerable population and public health, also demonstrate that those measures leading to higher sales of xEVs could bring societal benefits but there are also measures for which population with lower digital skills might be negatively affected. Costs to businesses and authorities, associated with the implementation of these measures, is dependent on the type of actions required of each stakeholder group and could differ depending on the implementation approach of each Member State.

Limitations of the analysis

The quantitative analysis on the impacts of the measures is based on the consumer responses in the behavioural experiment. There is uncertainty on the conversion of the consumer response findings into actual real-world purchase decisions, which could not be quantified as part of this project's research.

The analysis also assumes that there are no restrictions in the supply of efficient vehicle models as these are strongly driven by the CO_2 regulation targets. In other words, it assumes that the models chosen by the consumers will be effectively available for lease/purchase. The consumer information (e.g. label) is thus not to be understood as triggering an increase of the supply of ZEV, but rather as orienting consumers in their choices amongst vehicle types and models available on the market.

For **information channels**, Table 5-1: shows that the provision of an online label (IC1) and the web-platform for vehicle comparisons (IC6) are expected to bring about the most benefits. However, there is a more substantial cost associated with the development and maintenance of the websites as well as more significant losses of fiscal revenues arising from both measures.

In particular, the use of the online label that includes a number of the proposed information elements is likely to achieve the highest benefits. These additional **information elements** (Table 3-4) include: the inclusion of information on running costs (IE5), air pollutants (IE2), and electric range (IE9). The analysis shows that they are all relevant and can bring important benefits, so should be included in online and physical label too.

For websites, in addition to the above information elements, the TCO (IE4) could also be provided, where prices are displayed. Table 3-4 shows that this information element can deliver important benefits. However, this information element is more difficult to implement in practice (development of a specific methodology would be required to ensure comparability).

In addition, the following information elements could also be provided in these websites: fuel economy and CO_2 emissions for different drive cycles, charge time, customised cost measures (e.g. running costs or TCO tailored to a user-defined time period, location), additional information (e.g. map of charging points). This is in line with stakeholder views which suggested that detailed cost information would be of importance, but also highlighted that alternative ways to express emissions (e.g. WTW, lifecycle) might be interesting to include too.

The removal of the requirements to use more traditional channels that are only provided in the showroom such as the printed guide (IC3) and the poster (IC4) is anticipated to have little effects, apart from the risk of excluding certain population segments. To minimise any adverse effects of their removal, the provision of the printed version of the guide could still be mandated when requested by the consumer, as suggested by one stakeholder interviewed.

In addition, the provision of the interactive display (IC2) could also in part replace the use of the poster, although it seems that the benefits it can bring in terms of the provision of more tailored information could be outweighed by the costs to dealers of providing these devices.

The use of the quote (IC7) is also expected to deliver positive impacts with little/no costs. It makes sense that the type of information which could be communicated via this channel should be seller-specific, because otherwise it can be provided elsewhere. TCO (IE4) is a potential candidate in this case, as it directly depends on purchase price not controlled by the EU or the Member States, which can vary significantly across different points of sale.

The measure related to the provision of information in dynamic advertising (IC5), on the other hand, is expected to generate less benefits as it affects choices indirectly but could be important to enhance the benefits of other channels at a low cost, although stakeholders from the advertising industry have identified a potential loss of revenues for their sector.

As described above, it is more difficult to communicate technical information through this channel, so it would make sense to have a simplified information standard for this channel (e.g. only colour band for CO_2 emissions but not the values). The literature and stakeholder views on this are scarce, but this measure has been already implemented in several Member States already, either because of regulation (e.g. DK) or on voluntary basis following demand of car manufacturers and dealers, who wish to advertise that their offering complies with local air quality restrictions (e.g. ES).

The use of information campaigns (IC8) and training events (IC9) was found to bring little benefits but also at a small cost.

The overall benefits and costs of **extending the requirements of the Directive beyond the sale of new cars** depends on the vehicle categories considered (Table 5-3:). Extending the requirements to new vans (S1) is expected to bring the most environmental, economic and social benefits at a low cost. However, we cannot quantify the expected benefits from extending the current requirements of the Directive.

Considering the new requirements tested in the consumer experiment, the highest benefits are expected when the **following measures are considered in combination**: the provision of an online label (IC1), including information on real world emissions of NOx and particulates (IE2), including information on the Euro standard for second-hand vehicles (IE3), including information on running costs (IE5), information on type-approved electric range (IE6) and QR code (IE10 and IE11). Including TCO information (IE4) can also result in positive benefits from S1.

Extending the requirements to used cars (S2) is also expected to result in positive benefits. Including information on costs (IE5) is assumed to lead to higher benefits as purchasers of used cars are likely to be more sensitive to fuel price. Small environmental benefits are expected mainly due to the smaller choice of more efficient cars in the second-hand market. Higher costs are expected for monitoring and enforcement due to the private sale of used cars and the relatively unregulated industry. This second issue would be minimised if S2 is only made mandatory for the formal market.

Extending the requirements to rental vehicles (S3) is not expected to result in significant benefits as its impact on influencing vehicle sale and parc composition are limited.

Table 5-4: outlines the expected impacts for **increasing the level of harmonisation across all EU Member States on the measures to raise consumer awareness** (H1). For the majority of impact categories, the impacts of harmonisation have been assessed as being currently unclear. However, this is largely due to two key issues.

Firstly, there are a **range of design and methodological aspects that could be specified** as part of action to increase harmonisation across EU Member States. When

assessing potential impacts, it should be noted that the actual design and methodological aspects to be harmonised are not known, and subsequent impacts associated with the way they are specified and implemented will vary. Support for harmonising a range of aspects and their potential effectiveness in terms of affecting consumer awareness have been considered.

Those aspects that have the most support from stakeholders in terms of harmonisation and are expected to be the most effective in increasing consumer awareness include:

- Harmonising the design of the label, through taking a similar approach to label design to that used in the EU Energy Labelling Directive (2017/1369) (e.g. using coloured band representation with letters signifying each band, usually A to G);
- Specifying the method underlying the way in which are assigned to a category (e.g. absolute, relative);
- Specifying emission values that determine the way in which cars are assigned to assigned to a category (e.g. CO_2 emissions relating to each band); and
- Establishing methodologies/rules determining how assumptions for the calculations should be made and adjusted.

The second issue relates to the **existing flexibility in the Directive and the variations in the way it has currently been implemented in EU Member States**. It is thus anticipated that the **extent of impacts realised in each MS will also vary depending on their respective baseline position** (i.e. the difference between current label/measures and those proposed under any action to harmonise the approach).

If the baseline design/methodology at individual Member State level differs greatly from that proposed by revised legislation (i.e. basic/minimal information is currently provided), then it could be reasonably expected that more significant impacts are realised. Conversely, if a minimum common denominator approach is taken to harmonisation across EU Member States, then impacts on affecting consumer awareness are unlikely to be achieved.

Assuming that more effective label design/methodologies are specified, impacts are likely to be positive for environmental and social impacts, leading to changes in the sales of xEVs and the composition of the vehicle parc. Positive economic impacts could also be expected for both consumers, businesses and functioning of the internal market. As with all changes to legislation, costs are expected for national authorises relating to implementation and administration, but these are expected to be small.

It is possible that some Member States will experience negligible/no impacts as a result of harmonisation, largely due to the fact that few changes are implemented (i.e. their baseline is in line with changes being proposed). However, it is anticipated at a Member State level, there is the potential for positive impacts to be achieved across all impact categories (with the exception of costs to authorities).

The harmonisation (H1) measure was not explicitly tested within the consumer experiment. However, some degree of harmonisation was considered as a new label was created and tested with participants in all three countries, displaying those information elements and design features that are expected to be the most effective in affecting consumer awareness. We find that the effects of the information elements are generally consistent across the three countries (Germany, Spain and Poland), with effect sizes observed to be largest in the German subgroup, and weakest in Poland, explained by difference in the mechanism of these effects – through higher share of alternative powertrains in Germany and bigger concern for fuel efficiency in Poland.

Table 5-1: Summary of the expected impacts arising from measures implementing changes to the information channels through which information is communicated

Measures	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
IC1: Label/information to be shown online (for manufacturers and dealers - purchase and lease-related sites, second-hand vehicle apps, etc.)	✓✓ Increase in sales of new xEVs (up to 5 percentage points in 2030, compared to the baseline), leading to a higher share of these powertrains in the fleet over time	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 3.3% of GHG, 4.25% of NOx, 2.35% of PM and 4.13% of SOx compared to the baseline in 2030)	✓ Reduction in average costs expected (up to €124 in 2030 compared to the baseline)	O Minimal additional costs expected (if any)	×× Limited additional costs expected due to monitoring and enforcement activities Loss of revenues expected (up to €4 bn in 2030, compared to baseline) due to increase in sales of xEVs	O Minimal impact expected	✓ Positive effect expected for second-hand car buyers arising from access to a pool of more efficient vehicles (up to €115 decrease in average TCO in 2030 compared to the baseline) ✓✓ Expected improvements in public health due to reduction in air pollutant emissions (reduction in external costs of air pollution up to 3.31% in 2030 compared to the baseline)
IC2: Label information to be provided in	✓ Increase in sales of new xEVs (up to	Unclear	O	× More significant	× Limited additional costs expected	O	✓

[66] Impacts are assessed in terms of lifecycle greenhouse gas emissions and WTW air pollutant emissions (Tables 5.1 to 5.4)

Measures	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
interactive displays (fixed or mobile) where cars are made available for sale or lease	1.5 percentage points in 2030, compared to the baseline), leading to a higher share of these powertrains in the fleet over time	Reduction in GHG, NOx, SOx emissions compared to the baseline (up to 0.17% of GHG, 0.09% of NOx and 0.22% of SOx compared to the baseline in 2030) Increase in PM emissions of up to 0.07% in 2030 compared to the baseline	Minimal impacts expected	costs for dealers expected	due to monitoring and enforcement activities Reduction in fiscal revenues expected	Minimal impact expected	Minimal impacts on second-hand car users expected Small improvements in public health expected (reduction in external costs of air pollution up to 0.09% compared to the baseline in 2030
IC3: Guide to be made available in electronic format and production of a printed guide to be made optional	O No/negligible impact expected	O No/negligible impact expected	O No/negligible impact expected	× Loss of revenues for publishing industry (up to €60,000 per year and per country)	Unclear: cost savings expected from no longer having to print the guide but increased costs from providing the electronic version No/negligible impact expected on fiscal revenues	O Minimal impact expected	O Minimal impacts on second-hand car users expected Negligible improvements in public health expected
IC4: Remove the requirement to present a	O	O	O	O Minimal cost savings	O	O	O

Measures	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
poster/electronic display in the showroom	No/negligible impact expected	No/negligible impact expected	No/negligible impact expected	expected (if any)	No cost impacts expected No/negligible impact on fiscal revenues	Minimal impact expected	No/negligible impact expected
IC5: Relevant information to be to be shown on dynamic (e.g. TV/ online) in addition to printed (e.g. brochure, billboard) advertisement	✓ Increase in sales of xEVs expected by increasing the effectiveness of other channels	✓ Further reduction in GHG emissions expected by increasing the effectiveness of other channels	O Minimal impacts expected	× Potential loss of revenues for advertising companies	O Limited additional costs expected due to monitoring and enforcement activities No/negligible impact on fiscal revenues	O Minimal impact expected	✓ Minimal impacts on second-hand car users expected Small improvements in public health expected
IC6: Make a platform available - in web version or mobile app - containing the information on all models and facilitate their comparison	✓✓ Increase in sales of new xEVs (up to 1.5 percentage points in 2030, compared to the baseline), leading to a higher share of these powertrains in the fleet over time	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 3.53% of GHG, 4.34% of NOx, 2.28% of PM and 4.35% of SOx compared to the baseline in 2030)	✓ Reduction in average costs expected (up to €124 in 2030 compared to the baseline)	O No costs expected	×× More substantial costs expected related to the development and maintenance of the website: up to €35,000 (one-off costs) and €217,000 (annual recurring costs). Loss of revenues expected (up to €4 bn in 2030, compared to	O Minimal impact	✓ Positive effect expected for second-hand car buyers arising from access to a pool of more efficient vehicles (up to €115 decrease in average TCO in 2030 compared to the baseline) ✓✓ Expected improvements in

Measures	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
					baseline) due to increase in sales of xEVs		public health due to reduction in air pollutant emissions (reduction in external costs of air pollution up to 3.40% in 2030 compared to the baseline)
IC7: Car manufacturers/ dealers to present information of interest in a quote provided (including online e.g. car configurators where an estimate of the price is provided)	✓ Increase in sales of new xEVs (up to 2 percentage points in 2030, compared to the baseline), leading to a progressively higher share of these powertrains in the fleet over time	✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 0.66% of GHG, 1.30% of NOx, 0.66% of PM and 0.86% of SOx compared to the baseline in 2030)	O Minimal impacts expected	O Minimal additional costs expected (if any)	× Limited additional costs expected due to monitoring and enforcement activities Reduction in fiscal revenues expected	O Minimal impact expected	✓ Minimal impacts on second-hand car users expected Small improvements in public health expected (reduction in external costs of air pollution up to 0.81% compared to the baseline in 2030)
IC8: Awareness campaigns to highlight changes made to the legislation via media (e.g. TV, printed, billboards, social media)	O No/negligible impact expected	O No/negligible impact expected	O No impact expected	O No impact expected	O No impact expected	O Minimal impact expected	O Minimal impacts on second-hand car users expected Negligible improvements in public health expected
IC9: Training for new drivers, such	O	O	O	O	O	O	O

Measures	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
as providing information on emissions to eco-driving requirements in the driving licence Directive (e.g. CO_2, air pollution)	No/negligible impact expected	No/negligible impact expected	No impact expected	No impact expected	No impact expected	Minimal impact expected	Minimal impacts on second-hand car users expected Negligible improvements in public health expected

Table 5-2: Summary of the expected impacts arising from measures implementing changes to the information elements

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
IE0: Include information on taxes	✓ Small increase in sales of xEVs (not assessed quantitatively but lower impact on sales is expected compared to running costs).	✓ Small positive impacts are expected from increased sales of more efficient used vehicles (not assessed quantitatively but lower impact is expected compared to running costs).	✓ Small reduction in average costs is expected (not assessed quantitatively but lower impact is expected compared to running costs).	O No impact expected	× Small additional costs expected (if any)	O Minimal impact expected	✓ Small impact on lower-income households, in line with other costs elements. ✓ Small improvements in public health expected due to reduction in air pollutant emissions (not assessed quantitatively but lower impact is expected compared to running costs).
IE1: Include WTW emissions	×× Reduction in sales of xEVs (up to 1 percentage points in 2030, compared to the baseline), associated to the lower dispersion of emission bands.	× Rise in GHG and SOx emissions compared to the baseline (up to 0.54% of GHG, and 0.55% of SOx compared to the baseline in 2030)	O No/negligible impact expected	× Small additional costs expected (if any)	? Unclear. Additional costs associated to collection and update of data and implementation. Increase in revenues expected	O Minimal impact expected	O No significant impacts expected on second-hand car users. ✓ Small improvement in public health

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
		Reduction in NOx and PM (up to 0.69%of NOx, 0.17% of PM in 2030 compared to baseline)			due to increase in sales of xEVs		expected due to reduction in air pollutant emissions (NOx and PM)
IE2: For new vehicles, include the information on real world emissions of NOx and particulates on the label and when information is presented online	✓✓ Increase in sales of xEVs (up to 0.1-0.2 percentage points in 2030, compared to the baseline), rising share of these powertrains in the fleet over time.	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 0.23% of GHG, 0.29% of NOx, 0.16% of PM and 0.28% of SOx compared to the baseline in 2030)	O No/negligible impact expected	O No impact expected	×× Large additional costs expected, at least for some MS	O Minimal impact expected	O No/negligible impact expected on second-hand car users. ✓✓ Significant improvements in public health expected due to reduction in air pollutant emissions
IE3: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and a comparison of the emissions	✓✓ Increase in sales of xEVs (similar magnitude as for new cars), rising share of these powertrains in the fleet over time.	✓✓ Large positive impacts are expected from increased sales of more efficient used vehicles (not assessed quantitatively).	O No/negligible impact expected	O No impact expected	× Small additional costs expected (if any)	O Minimal impact expected	✓ Moderate impacts expected on second-hand car users. ✓✓

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
limit values with those of a newer car (e.g. the next Euro emission level/ new vehicle)							Significant improvements in public health expected due to reduction in air pollutant emissions
IE4: Include Total Cost of Ownership	✓✓ ✓ Increase in sales of xEVs (up to 2 percentage points in 2030, compared to the baseline)	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 0.66% of GHG, 1.3% of NOx, 0.66% of PM and 0.86% of SOx compared to the baseline in 2030)	✓ Reduction in average costs expected (up to €95 in 2030 compared to the baseline)	× Small additional costs expected (if any)	× Small additional costs expected (if any)	O Minimal impact expected	✓ Moderate impacts expected on second-hand car users. ✓✓ Significant improvements in public health expected due to reduction in air pollutant emissions
IE5: Include running costs	✓✓ Increase in sales of xEVs (up to 0.2 percentage points in 2030, compared to the baseline). Impact on choices is stronger for used vehicles,	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 0.28% of GHG, 0.36% of NOx, 0.19% of PM and 0.35% of SOx	✓✓ Strongly positive impacts expected. Those participants, who indicated running costs as one of most useful information elements, have chosen, on	O No impact expected	×× Large additional costs expected, at least for some MS	O Minimal impact expected	✓✓ Significant impacts expected on second-hand car users. ✓✓ Significant improvements in public health expected due to

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
	compared to new vehicles	compared to the baseline in 2030)	average, a car with 3.7% lower TCO than those who did not consider running costs useful				reduction in air pollutant emissions
IE6: Include information on type approved electric range	✓✓ Increase in sales of xEVs (up to 0.1-0.2 percentage points in 2030, compared to the baseline)	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 0.26% of GHG, 0.31% of NOx, 0.17% of PM and 0.31% of SOx compared to the baseline in 2030)	× Negative impacts are expected. This negative impact should be attenuated or even reversed in the future, when TCO for alternative powertrains will below the TCO for conventional powertrains.	O No impact expected	×× Large additional costs expected (reduction in fiscal revenues due to lower consumption of fossil fuels)	O Minimal impact expected	✓ Moderate impacts expected on second-hand car users ✓✓ Significant improvements in public health expected due to reduction in air pollutant emissions
IE7: Include the information on charge time, including details on the power of the charger that was assumed in the calculations	O No/negligible impact expected	O No impact expected	O No impact expected	O No impact expected	× Small additional costs expected (if any)	O Minimal impact expected	O No/negligible impact expected
IE8: Include real-world CO_2	O	O	O	O	×	O	O

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
emissions and fuel consumption	No or negligible impacts expected	No impact expected	No impact expected	No impact expected	Small additional costs expected (if any)	Minimal impact expected	No/negligible impact expected
IE9: Include information on real-world electric range	O No or negligible impacts expected	O No impact expected	O No impact expected	O No impact expected	× Small additional costs expected (if any)	O Minimal impact expected	O No/negligible impact expected
IE10: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	✓ Not assessed quantitatively but positive impacts are expected	✓ Not assessed quantitatively but positive impacts are expected.	✓ Not assessed quantitatively but positive impacts are expected.	O No impact expected	× Small additional costs expected (if any)	O Minimal impact expected	O No/negligible impact expected ✓ Small impacts expected on second-hand car users
IE11: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	O No or negligible impacts expected	O No impact expected	O No impact expected	O No impact expected	× Small additional costs expected (if any)	O Minimal impact expected	O No/negligible impact expected

Table 5-3: Summary of the expected impacts arising from measures extending the scope of the Directive

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
S1: Extend requirements to [new] vans	✓✓ Increase in sales of electric vans (up to 2 percentage points in 2030, compared to the baseline), rising share of these powertrains in the fleet over time*	✓✓ Reduction in GHG, NOx, PM, SOx emissions compared to the baseline (up to 2.4% of GHG, 6.0% of NOx, 1.7% of PM and 3.1% of SOx compared to the baseline in 2030) *	✓ Decrease in total fleet costs of €0.63 bn in 2030 compared to the baseline *	× Potentially small additional costs expected (if any)	× Small additional costs expected due to data collection, monitoring and enforcement activities Small loss of revenues expected (up to €0.6 bn in 2030, compared to baseline) due	O Minimal impact expected	✓ Positive effect expected for second-hand van buyers arising from access to a pool of more efficient vans (up to €193 decrease in average TCO in 2030 compared to the baseline) *

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
					to increase in sales of xEVs *		✓✓ Significant improvements in public health are expected due to reduction in air pollutant emissions*
S2: Extend requirements to used vehicles	✓ Not assessed quantitatively, but small increase in sales of more efficient used cars is expected based on evidence	✓ Small positive impacts are expected from increased sales of more efficient used vehicles (not assessed quantitatively).	✓ Small cost savings are expected from increased sales of more fuel-efficient vehicles in the second-hand market (not assessed quantitatively).	× Small additional costs expected (if any)	×× Significant additional costs expected due to data collection, monitoring and enforcement activities	O Minimal impact expected	✓ Direct positive effect expected for second-hand car buyers arising from increasing the sale of more efficient used cars (not assessed quantitatively). O Minimal improvements

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
							are expected in public health due to minimal impact on air pollutant emissions (not assessed quantitatively).
S3: Extend requirements to rental vehicles	O Small or negligible impact	O Small or negligible impact	O Small or negligible impact	× Small additional costs expected (if any)	O Minimal additional costs expected for rental cars and small costs expected for rental vans	O Minimal impact expected	O Small or negligible impact

* These effects are from extending the new requirements to new vans (considered in the NewLabel scenario). We cannot quantify the effects of extending the current requirements to new vans in SULTAN.

Table 5-4: Summary of the expected impacts arising from measures increasing the level of harmonisation across all EU Member States

Measure	Impact on vehicle sales and parc composition	Environmental impacts[66]	Economic impacts				Social impacts
			Consumers	Businesses	Authorities	Functioning of the internal market and competition	
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	? Unclear, will depend on design/ methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on sales of xEVs and composition of the vehicle parc.	? Unclear, will depend on design/ methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on reducing GHG emissions and improving air quality.	? Unclear, will depend on design/ methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on reducing costs for consumers and households.	? Unclear, will depend on design/ methodological elements specified and extent to of changes required in supplying and maintaining data. One-off costs expected with potential for longer term cost savings for manufacturers.	× Small, one-off costs for public authorities associated with making updates to databases and potential loss of revenue under due to increases in clean vehicles.	✓ Positive impacts, consistent information provided to consumers across EU MS, increasing understanding and trust.	? Unclear, will depend on design/ methodological elements specified and extent to which MSs are affected by implemented changes. Potential for positive impact on income and social inclusion and public health.

6. Conclusions and Recommendations

An overview of our conclusions and recommendations are presented below.

Information channels

Of all the measures considered related to information channels, the provision of information through online channels (such as the label to be shown online and the use of web-platforms for vehicle comparisons) are expected to deliver the most environmental and social benefits. This reflects both the increased importance of online sources when searching for a car and the fact the online medium allows the provision of more/complementary information that can be kept up-to-date. However, there is a more substantial cost associated with the development and maintenance of the websites, although a number of Member States[67] have already implemented similar solutions. In addition, some Member States (IE, HR, AT, FR, SI, EE) have also suggested that this solution should be centralised and provided at the EU-level, which would minimise costs for authorities.

The use of the quote to provide relevant information is an additional channel not currently considered by the Directive, but which was found to have the potential to deliver positive impacts with little/no costs. However, the type of information to be provided through this channel is an important consideration. The results presented in this report are based on the assumption that TCO information is provided via this channel.

The provision of information in dynamic advertising would extend current requirements of the Directive on promotional literature. Although not possible to quantify, this channel is expected to generate less benefits (than the provision of information through other channels) as it affects choices indirectly by enhancing familiarity and consequently increasing the use of information provided by other information channels during the purchase stage. The information that can be communicated via this channel is also more limited. There are also differences between mediums, with the provision of information in online promotional materials expected to be more effective. In addition, some backlash is expected from stakeholders from the advertising industry which have identified a potential loss of revenues for their sector.

The removal of the requirements to use more traditional channels that are only provided in the showroom such as the printed guide and the poster is found to have little to no impacts. Indeed, some Member States have moved to the exclusive provision of the electronic version of the guide[68]. There is however a risk of excluding certain population segments with lower digital skills which could be minimised by requiring the provision of the printed version of the guide when requested by the consumer. Moreover, the provision of an interactive display could also in part replace the use of the poster and is shown to deliver important benefits by allowing vehicle configuration that will provide more relevant and tailored information to consumers. However, there is an associated cost to dealers of providing these devices which should not be neglected. The number of devices available in the showroom is also important to determine their use and thus impacts.

Evidence that supports the adoption of other channels to communicate information such as the use of information campaigns and training events is limited: these channels are anticipated to bring small benefits but also at a small cost.

Information elements

In addition to the provision of information on fuel consumption and CO_2 emissions, additional information elements were found to be relevant for consumers' purchasing decision process, which are, at the same time, difficult and/or time-consuming to obtain if not provided. They also help correct for the biases and/or misperceptions the consumers might have.

Provision of cost information, in particular, is found to bring the most significant benefits. Costs are the most important and effective driver of decisions relating to vehicle purchases and fuel economy is considered to be better communicated through running costs. There

[67] Including DK, FR, ES, BE, FI, EE, SE, AT according to (Ricardo and TEPR, 2016)

[68] Including AT, IT, BE, EE, FI, NL, PT, SE, SK according to (Ricardo and TEPR, 2016).

are also benefits associated with the provision of running costs, as they are expected to contribute to the decisions that lead to more TCO savings for lower-income households.

TCO information can also be important to deliver positive impacts, especially in the longer term. Because the TCO information is expected to facilitate comparisons between powertrains, their benefits in terms of the choice of cleaner/low carbon vehicles are higher when prices and TCO of xEVs decrease and the gap between conventional powertrains and alternative ones narrows down. However, not all information channels are viewed as appropriate for provision of this information.

For the label, the most relevant elements are information on running costs, air pollutants, and electric range. In general, the analysis shows that consumers understand, trust and value these elements when making choices. A number of Member States have also implemented the provision of some of these elements in the label: vehicle running costs (UK, DE, IE, FI, DK, EE, FI), air pollutant emissions (FI, SI). Associated with these, there are important design and methodological considerations to make which can further improve their effectiveness. The information on air pollutants is better understood when presented in the context of local air quality restrictions, due to its direct practical value to the consumers.

Moreover, no significant costs would be expected to arise for businesses since most of these elements would be made available in the Certificate of Conformity (CoC) or a database in which businesses could directly use to comply with the new information provision requirements. In some cases, however, it depends directly on the complexity of calculations and distribution of responsibilities. There will be costs for the automotive industry associated to those elements if and where they are in charge of the calculations.

For authorities, on the other hand, the provision of TCO information and air pollutant emissions is likely to cause more significant costs. For the latter, there is a potential need to take into account local air quality restrictions and reflect them on the label which could be challenging.

Regarding the other information elements, more limited impacts are expected. Tax information is expected to be relevant, but only if appropriate fiscal incentives are in place. The provision of a QR code with a link to a comparison website could deliver benefits by providing additional information whilst avoiding information overload. However, there could be a cost increase for authorities in terms of likely resource and cost implications to develop and maintain the electronic resources accessed through a QR code.

Provision of real-world values, on the other hand, is not anticipated to lead to significant impacts in terms of awareness or choices, although there is a possibility to contribute positively through trust.

Despite of raising awareness, the provision of WTW CO_2 emissions information is expected to lead to less sustainable choices. This is explained by less apparent difference between powertrains in the eyes of consumers. In addition, authorities found that the provision of WTW emissions will lead to significant costs associated with the need to establish a methodology, collate and update the data regularly and the communication.

Scope of the requirements

The analysis has shown that extending requirements (including some of the information channels and information elements described above) to new vans is expected to bring important environmental, economic and social benefits at a low cost. Vans represent around 15% of all new vehicle sales which has been increasing over time. The most benefits would arise from small commercial organisations and private buyers which are likely to be less aware of this relevant information. An aspect to consider is that vans are sold in a different way compared to passenger cars and thus the most effective channels might differ (e.g. online channel more important than the physical label in the showroom). Nevertheless, labelling for new vans has already been introduced in some countries, such as Denmark, Spain, Poland, Sweden and Austria.

Extending the requirements to used cars is also expected to result in positive benefits, especially considering that, in some European countries, the used car market is three times larger than the new car market. Finland has also extended the requirements of the Directive to used cars.

Message consistency can be particularly improved by targeting used and new cars. To a certain extent, used car buyers can benefit more from the information provided than new car buyers as the first value more the information on fuel economy, being a significant proportion of vehicle operating costs. In particular, it can directly benefit lower income consumers that are more likely to buy used cars. However, environmental benefits are likely to be smaller given the smaller choice of more efficient cars in the second-hand market.

In addition, extending the scope to used cars could result in significant one-off costs for authorities associated with database adaptation (i.e., redesign of IT platform) and the collation of data on used cars. There are also significant challenges associated with implementing the requirements to used cars that can limit its effectiveness:

- There is a risk for information reliability for used cars as the emission performance of older cars can get worse and the running costs/TCO can be hard to predict, depending of the age of the used cars. One solution could be to limit the inclusion of used cars up to a certain age.
- Monitoring and enforcement are difficult due to the private sale of used cars. A large part of this market is informal as used cars are often sold by private sellers. This would be minimised if only the formal market would be covered.

Extending the requirements to rental vehicles is not expected to result in significant benefits as consumers which rent these vehicles tend to base their choice of car on vehicle class and price, whereas fuel economy and environmental considerations are less relevant.

Harmonisation

Increasing the level of harmonisation across all EU Member States could lead to positive impacts for the environment and society, by increasing familiarity, understanding and trust on the information provided and channels used to communicate it. However, this depends on the design and/or methodological specification made. It is also likely to vary from Member State to Member State, with the most significant impacts likely to be realised in those countries where the existing approach to implementation of the Directive differs the most to the harmonised approach being proposed.

In particular, harmonisation is expected to positively impact the functioning of the internal market but balance is needed. The flexibility to adapt the requirements to national circumstances is also important.

At the same time, there will be compliance and administration costs for public authorities at the Member State level, related to the need to make changes to the label and methodologies that contribute to data displayed in the label; updating databases; internet-based services that use new data/methodologies; and promotional material that attempts to communicate the changes that have been implemented.

Aspects that are more likely to be benefit from harmonisation at the EU level include:

- Harmonising the design of the label, through taking a similar approach to label design to that used in the EU Energy Labelling Directive (2017/1369) (e.g. using coloured band representation with letters signifying each band, usually A to G);
- Specifying the method underlying the way in which are assigned to a category (e.g. absolute, relative);
- Specifying emission values that determine the way in which cars are assigned to assigned to a category (e.g. CO_2 emissions relating to each band); and
- Establishing methodologies/rules determining how assumptions for the calculations should be made and adjusted.

Recommendations on the preferred combination of policy measures

Overall, the following recommendations can be made:

- Provision of the following **additional information elements: running costs, air pollutants, and electric range** whenever the label is displayed (physical or online)**.**

- The **provision of the label online** which includes additional information elements (running costs, air pollutants, and electric range, as identified above).
- The **harmonisation of certain design elements, style of the label and methodological aspects**. In particular, the use of a similar style to that of the EU Energy Label seems appropriate. However, flexibility should be retained in other areas to enable Member States to reflect national circumstances.
- Additionally, it is recommended that the guide is made available in electronic format and that the production of a printed guide to be made optional (although made available on request). Also, the requirement to present a poster in the showroom could be replaced with the provision of an interactive display that enables configuration of vehicle models.

The following measures could also generate benefits and their implementation should be considered provided the challenges identified can be resolved:

- **Websites that allow vehicle comparisons** are expected to bring additional benefits if they enable customisation of the information to the consumers' circumstances and where additional information is able to be provided. In addition to the provision of the new label (with the additional information elements described above), the provision of the following information elements should also be considered: fuel economy and CO_2 emissions for different drive cycles, charge time, customised cost measures (e.g. running costs or TCO tailored to a user-defined time period, location), additional information (e.g. map of charging points). However, there is a more significant cost associated with the development of these websites and thus there is a need to consider whether it should be implemented at the EU or Member State level;
- Requiring the **provision of TCO whenever the price of the vehicle is displayed** could also generate positive impacts, especially in the long-term. However, the calculation methodology should be defined to ensure comparability.
- Extending the requirements on promotional literature to **dynamic advertising**, and in particular, online advertising could also have an impact, although benefits are smaller. If adopted, further consideration of the information elements to include is important. A simplified information standard (e.g. only colour band for CO_2 emissions but not the values) seems more appropriate for this channel.
- **Extending the scope of these requirements to vans and used cars** could also deliver benefits to a smaller extent and thus it should be considered. For these vehicle categories, it is particularly important that information on costs is provided through the relevant channels. However, there are challenges associated with implementing the requirements to used cars which would need to be addressed to ensure that these benefits are indeed realised (e.g. only include the formal market).

7. Abbreviations

BEV	Battery Electric Vehicle
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CoC	Certificate of Conformity
ETS	Emissions Trading Scheme
EV	Electric Vehicle
GHG	Greenhouse Gas
HEV	Hybrid Electric Vehicle
ICEV	Internal Combustion Engine Vehicle
FCEV	Fuel Cell Electric Vehicle
gCO_2e	Grams of Carbon Dioxide equivalent
LCE	Life Cycle Emissions
LCV	Light Commercial Vehicle
LDV	Light Duty Vehicles
LPG	Liquefied Natural Gas
LowC	Low carbon fuels, i.e. biofuels and low carbon synthetic fuels.
NEDC	New European Driving Cycle
NOx	Nitrogen Oxides
PHEV	Plug-in Hybrid Electric Vehicle
PM	Particulate Matter
QR	Quick Response [code]
SOx	Sulphur Oxides
SULTAN	SUtainabLe TrANsport model
TCO	Total Cost of Ownership
tCO_2e	Tonnes CO_2 equivalent
vkm	Vehicle Kilometers
WLTP	Worldwide harmonised Light-Duty Test Procedure
WTW / W2W	Well to Wheels
xEV	Electric vehicles – including BEVs and PHEVs

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Annexes

A Annex A: Approach to evidence collection

A.1 Desk research and data collection

Desk research and a review of the literature were undertaken to collect data and evidence for this study.

The review of the existing literature focussed on identifying potential policy measures to improve consumer awareness of fuel economy and emissions from LDVs, and on collecting evidence to support the screening of the long-list of measures with the view of short-listing the most appropriate measures to be taken forward (see Section **Error! Reference source not found.**). Furthermore, this task has also informed the short-listing of measures (see Section **Error! Reference source not found.**), providing information and evidence to support the development of the detailed design of the short-listed measures. Literature included:

- *Existing legislation on vehicle labelling and information disclosure*: these sources set the current legal framework;
- *Supporting legislative documentation and implementation reports*: these sources contribute to the understanding of the current issues and provide recommendations on how to address them. We have also reviewed studies focusing on other countries (e.g. US) which offer comparative examples of other countries' approaches to vehicle information disclosure. These studies provide examples of measures and design elements to deal with similar issues;
- *Behavioural economics / consumer experiment studies:* these sources provide a quantitative assessment of the impact of information disclosure elements on consumer choices, focusing on how they affect individual decision-making.
- *Econometric studies:* these sources provide a quantitative assessment of the impact of information disclosure elements on consumer choices, helping disentangle their effects from other developments.
- *Documents on eco-labelling and information disclosure approaches for other products:* these sources provide information on similar eco-labelling initiatives for other products and provide information on best practices and learnings from other sectors.

A.2 Field research / Stakeholder consultation

The field research, incorporating stakeholder engagement, played a broad role within the study. The field research was thus broken down into a number of different consultation tools that were used as inputs to various stages of the project. These tools are summarised in Table A1 below and described in more detail in the subsequent sub-sections.

Table A1: Overview of stakeholder engagement methods used

Activity	Stakeholders involved	Role within the study
Engagement with a panel of key stakeholders	EU level representatives of key stakeholder groups	Involvement throughout the entire study to provide guidance, advice and review of the proposed methods and produced results

Activity	Stakeholders involved	Role within the study
Targeted survey of national authorities	Competent authorities responsible for the implementation of the policy measures, which vary among Member States (e.g. Ministries of Environment, Ministries of Transport, Ministries of Economy).	Used to gather information about the expected costs and effectiveness implementation of alternative policy provisions.
Targeted interviews	Covering the full range of affected stakeholders, from industry to consumer organisations	The targeted interviews were conducted on the basis of tailored interview checklists that allowed us to explore the relevant topics for each stakeholder group in depth.
Data requests	Targeted data requests to gap-fill specific information	Data requests were sent to Member States who responded to the survey of national authorities. The requests attempted to obtain further information on costs relating to specific policy measures to fill gaps identified in the data collection and other field research tasks.
Consumer survey / experiment	8,000 representative consumers (up to 2,700 across each of three EU countries).	The online behavioural experiment was developed to enable us to draw robust statistical conclusions as to the effectiveness of different options, which has fed into the quantitative analysis.

A.2.1 Engagement with panel of key stakeholders

A stakeholder panel was formed with the aim of bringing together a group of carefully selected key stakeholders to engage with them throughout the duration of the study to provide guidance, advice and review the proposed methods and preliminary results. The panel was made up of two stakeholders – one representing vehicle manufacturers, and a second representing consumers.

Table A2 outlines a summary of the engagement that took place with the stakeholder panel during the study.

Table A2: Engagement with stakeholder panel

Stage	Timing	Purpose
1. Exploratory interviews	January 2020	Exploratory interviews were undertaken to: • discuss the relevant issues that require a policy response; • gather views on potential policy measures that could be part of a future intervention; and

Stage	Timing	Purpose
		• obtain suggestions on relevant literature and data sources for this study.
2. Written feedback	Early February 2020	• Written feedback was received from the stakeholder panel following a review of the draft screening of the long list of measures produced by the study team, validating the screening process. The screening was subsequently updated. See Section **Error! Reference source not found.** for further details on the short-listing of measures
3. Interim interviews	April 2020	• Interviews were undertaken to review and comment on the proposed detailed design of the shortlisted measures to be tested in the consumer experiments. See Section G.1.3 for further details on the detailed definition and design of the elements to be tested with consumers.
4. Final interviews	July/August 2020	Interviews were undertaken to: • Provide input on the expected impacts of the shortlisted measures; and • Discuss the effectiveness and feasibility of the measures.

A.2.2 Survey of national authorities

A survey of national authorities was undertaken to support the testing of short-listed policy elements to assess their effectiveness to incentivise sustainable consumers' choices towards more efficient vehicles, and identify the impacts and any challenges associated to their implementation. The questions survey asked national authorities to provide input on: A survey of national authorities was undertaken to support the testing of short-listed policy elements to assess their effectiveness to incentivise sustainable consumers' choices towards more efficient vehicles, and identify the impacts and any challenges associated to their implementation. The questions survey asked national authorities to provide input on:

- The expected effectiveness and impacts of the short list of policy measures;
- The expected costs for the authorities for implementing the policy measures;
- Their views on practical implications or any potential issues/problems that may arise; and
- Other specific questions on policy measures and their implementation.

The full set of survey questions can be viewed in Annex B.

The national authorities of interest were those competent authorities that are responsible for implementing the Car Labelling Directive and who are typically directly involved in the implementation and enforcement of any new policy measures. Competent authorities vary among Member States but are usually the ministries responsible for environmental, economic or transport policy. Other authorities may also be involved in the implementation or enforcement of the measures, depending on the exact measures adopted (e.g. ministries responsible for consumer protection and/or press/media).

The survey was made available to national authorities in an online format (Survey Gizmo) and was launched on the 19 June 2020 and was live for a period of 6 weeks (with a two-week extension). Sixteen responses to the survey were received, from 13 Member States[69].

A.2.3 Targeted interviews

Similarly to the survey, the purpose of the targeted interviews was to support the testing of short-listed policy elements with a wider group of EU-level and national level stakeholders to identify which are the most effective to incentivise consumers to make sustainable choices towards more efficient vehicles as well as to assess their impacts and other considerations resulting from their implementation. A range of stakeholders were targeted, including the following:

Similarly to the survey, the purpose of the targeted interviews was to support the testing of short-listed policy elements with a wider group of EU-level and national level stakeholders to identify which are the most effective to incentivise consumers to make sustainable choices towards more efficient vehicles as well as to assess their impacts and other considerations resulting from their implementation. A range of stakeholders were targeted, including the following:

EU level stakeholders

- Automotive industry, associations;
- Advertising and publishing;
- Fuel industry and alternative fuels representatives;
- Consumer and driver organisations, & professional vehicle users; and
- Non-Governmental Organisations (NGOs).

National-level stakeholders

- National competent authorities or authorities implementing legislation in this area; and
- National consumer organisations and national industry or association representatives.

The interview programme began in June 2020 and concluded in early September 2020. The final list of stakeholders who participated in interviews is provided in Table A3.

[69] AT (x2), BE (x2), DK, IE, EE. ES, FI, FR, GR, HR, SE, SK (x2), SL

Table A3: Stakeholder interview programme

	Stakeholder group	Interviews (proposed in brackets)	Stakeholders participating in interviews	
EU Level	Automotive industry, associations	2 (6)	Dealers/Traders	*Did not take place*
			Large manufacturer	2 x Anon
	Stakeholder panel	3 (3)		Panel member: ACEA (manufacturer)
	Advertising and publishing organisations	4 (3)	Advertising and marketing	EGTA UK Advertising (EASA) Anon – national advertising association
			Publishing	ENPA/EMMA
	Fuel industry and alternative fuels representatives	2 (3)	Petrol/Diesel	FuelsEurope
			Electric	Anon
			Hydrogen	*Did not take place*
	Consumer and driver organisations, & professional vehicle users	2 (3)	Leasing representative	Anon
			Professional/commercial vehicle users	*Did not take place*
			Vehicle users	Federation of International Automobiles (FIA)
	Stakeholder panel	3 (3)		Panel member: BEUC (consumers)
	NGOs	2 (2)	Transport-specific NGO	T&E
			Electric vehicle-specific NGO	Anon
	Stakeholder panel	0 (3)	-	-
National Level	National competent authorities/Authorities implementing regulations	3 (3)	Selected following receipt and review of national authority surveys from Member States	Anon
				Belgium
				Anon
	National consumer organisations	3 (3)	Selected national consumer organisations	VZBZ (German consumer organisation)
				ZPS (Slovenian consumers association)
				Anon - national consumer organisation
	National industry or association representatives	0 (3)	Selected national industry associations, representatives, incl. dealers/manufacturer assoc.	*Did not take place*
Total (EU + national)		**24 (32)**		

A.2.4 Data requests

Ad hoc targeted data requests were used to fill data gaps identified following completion of the interview and survey programmes. Gaps were identified regarding one-off and ongoing costs associated, in particular, with three measures:

Ad hoc targeted data requests were used to fill data gaps identified following completion of the interview and survey programmes. Gaps were identified regarding one-off and ongoing costs associated, in particular, with three measures:

- IC6: Make platform available – on web and/;or via a mobile add containing the information on all modes to facilitate their comparison;
- S1: Extend requirements to new vans; and
- S2: Extend requirement to used vehicles.

Requests were sent out to all national authorities who responded to the national authority survey in November 2020, and they were given two weeks to respond. Five responses were received and used in the assessment of impacts.

A.2.5 Consumers survey

The consumer survey (or consumer experiment) was used in this study to assess the extent to which selected short-listed policy measures may influence consumers' purchase and leasing decisions towards more efficient vehicles.

The consumer survey (or consumer experiment) was used in this study to assess the extent to which selected short-listed policy measures may influence consumers' purchase and leasing decisions towards more efficient vehicles.

An online experiment was designed simulating a third-party website where consumers get information before they decide on which passenger car to buy or lease in three EU Member States (Spain, Germany and Poland). This online simulation reflects the real-world situation in which consumers use third-party websites to compare cars before visiting a local dealership.

The consumer experiment tested each selected country's business-as-usual (BAU) scenario and alternative variants of information on fuel economy and emissions, aiming to answer the following questions:

- Which of the proposed variants are most effective in influencing consumers' purchase/leasing decisions towards more efficient vehicles/vehicles?
- Which information channels and elements are most effective?

The selection of variants of information on fuel economy and emissions focused on those information elements for which existing research and evidence of effectiveness is limited, while implementation is challenging, due to technical or administrative difficulties. Annex G.1.1 described the selection of measures that were tested.

Results from the experiment were used as inputs in SULTAN model, described below, where they are translated to the implications for new car sales and serve as primary inputs for the assessment of the overall effectiveness of the analysed measures. Annex G.2.6 describes our approach to the assessment of impacts of policy measures, using the results of the experiment. In addition, the results obtained from the experiment were used to test whether the design of the measures and elements embedded in the experiment were adequate. These results informed the most effective design of the measures.

The experiment was launched in Summer 2020 and achieved participation from 8,730 participants. Annexes G and H describe the consumer survey in detail.

A.3 Modelling

A.3.1 Overview of SULTAN model

The SUtainabLe TrANsport (SULTAN) model developed by Ricardo has been used to develop the baseline scenario and quantify the impacts of the shortlisted policy measures. This model runs between 2005 and 2050 and covers all modes of transport at an EU level. It was originally developed for the European Commission DG CLIMA across a range of projects. As part of this project the existing model baseline (based on the Commission's 2016 Reference scenario) has been updated/calibrated to be consistent with the Commission's baseline scenario from the 2018 EU Long Term Strategy for the EU27 countries (European Commission, 2018). An overview of the model and the modelling process is provided in Figure A1 **Error! Reference source not found.**below.

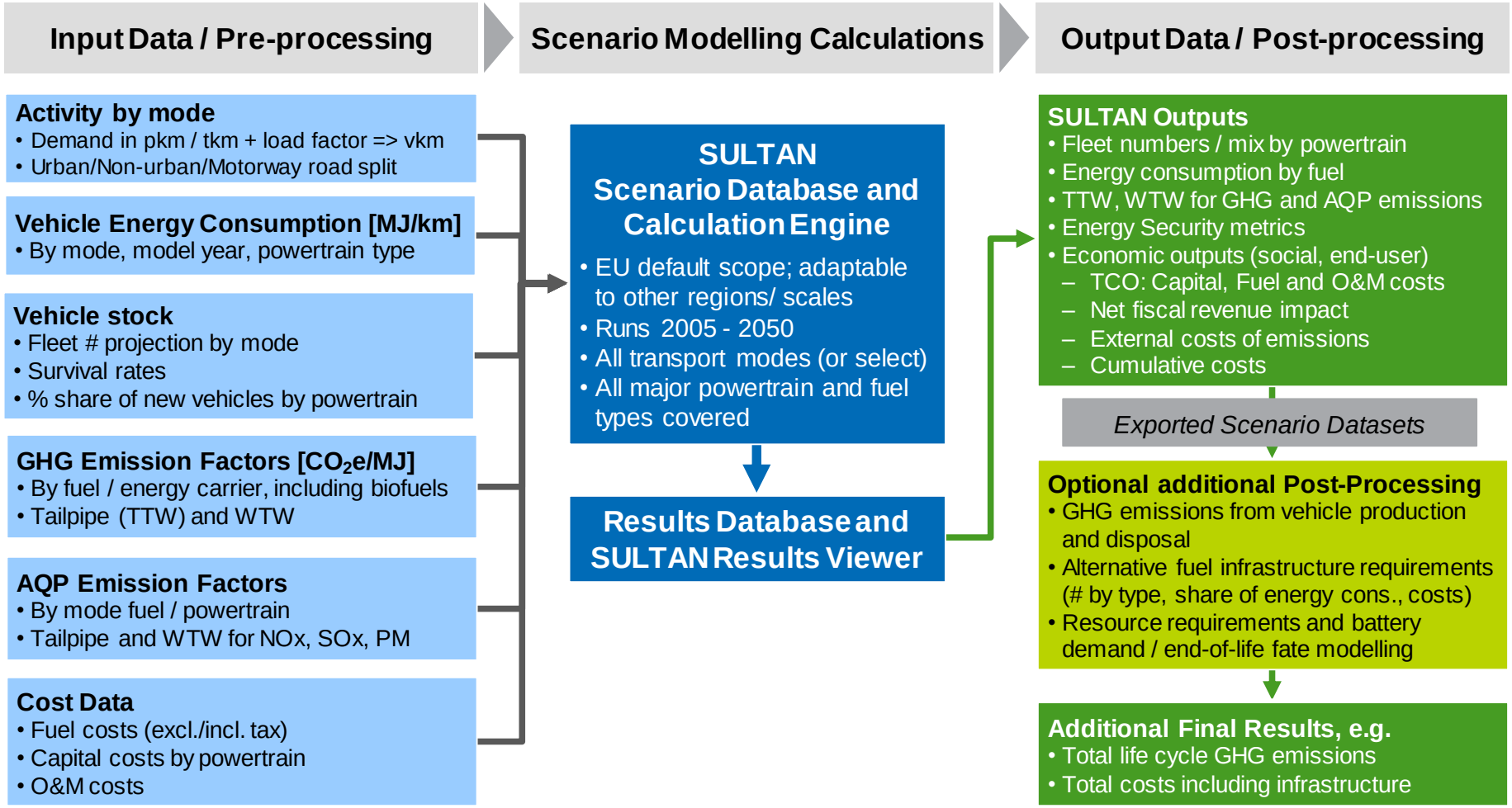
Table A4**Error! Reference source not found.Error! Reference source not found.** below summarises the key impact categories that have been quantified using the SULTAN model, based on the outputs from the consumer experiment (see Annex G for further information).

Table A4: Key impacts quantified using SULTAN for baseline and policy scenarios

Impact category	Indicator	Units	Scope/Level of detail
Primary direct impact			
Impact on sales of (clean) vehicles	Fleet numbers / mix by powertrain	#	Numbers of new vehicles and total parc by mode and powertrain type
Economic impacts			
Cost to consumers /businesses	Fleet and vehicle-level costs - Total Cost of Ownership (TCO): Vehicle capital costs, fuel costs, O&M costs, (AFV infrastructure costs via additional module)	€ €Billion	Total per average vehicle (also by powertrain or per km) Total annual costs for entire fleet Both on societal (excl. tax) and end-user perspective (incl. tax). TCO can be provided as total lifetime average and also for first owners and second owners.
Public authorities	Net fiscal revenue impact	€Billion	Difference between societal costs (excl. taxes) and end-user costs (incl. tax).
Environmental impacts			
Transport and the use of energy	Energy consumption by fuel	PJ	For all major fuel types, including accounting for biofuel/low carbon fuel use/substitution.
The climate: GHG emissions	Lifecycle GHG emissions (fuel TTW, WTW, vehicle production and disposal)	$MtCO_2e$ Lifecycle tCO_2e /vehicle gCO_2e /vkm	TTW and WTW emissions from vehicle energy consumption. Vehicle production and disposal emissions

Impact category	Indicator	Units	Scope/Level of detail
			calculated in post-processing module. Results are available for average vehicle/powertrain types and fleet total.
Air quality	Air quality emissions (NOx, SOx, PM)	ktonnes	Includes both tailpipe and upstream WTT emissions
Social impacts			
Public health	External costs of emissions	€Billion	For GHG, NOx, SOx, PM (for both tailpipe and upstream WTT emissions)
Impacts on lower income consumers	Total cost of ownership	€	TCO can be provided as total lifetime average for second owners, who are more likely to be lower income

Figure A1: Overview of SULTAN scenario modelling analysis process



A.3.2 Using SULTAN model to develop the baseline scenario

In order to assess the impact of the policy measures, a baseline scenario is needed that describes the expected evolution in the case of no changes to the existing Car labelling Directive 1999/94, and other important measures that are expected to have an impact on the vehicle market (e.g. the post-2020 car and van CO_2 standards).

During this project, the SULTAN model baseline has been updated to be more consistent with the Commission's baseline scenario for the EU Long Term Strategy for the EU27 countries (European Commission, 2018). This entailed:

- Re-calibration of the model to capture the expected impacts of the recently adopted policies, in particular the recently adopted post-2020 CO_2 standards for light duty vehicles (European Commission, 2019a) and the change in regulatory testing requirements for light duty vehicles from NEDC to WLTP. Other key policies that underline the EC modelling baseline scenario and are reflected in the SULTAN baseline scenario include the Clean Vehicles Directive; the Directive on the Deployment of Alternative Fuels Infrastructure; the Renewable Energy Directive; and the Fuel Quality Directive.
- Updating the model to output results for EU27.
- Updating the calculation of tailpipe emissions of NO_x, PM and SO_x to more closely align with the COPERT-based methodologies used in international emissions inventories and in the PRIMES-TREMOVE model.
- Updating of the model to align with more recent projections in fuel and electricity prices.
- Updating of the life-cycle emissions module to align with the underlying (and output) datasets from the vehicle LCA project recently completed for DG Climate Action (Ricardo et al., 2020).

The scenario does not take into account the current and potential future impacts of the global COVID-19 pandemic.

A summary of the outputs from the update to the SULTAN baseline scenario are provided in Section 3.1.3 of the main report.

A.3.3 Modelling the findings from the consumer experiment using SULTAN

The following Table A5: provides a summary of the scenarios defined in SULTAN, based on the outputs from the consumer experiments (see also Table 3-7, Section 3.3 of the main report). For each of these scenarios, two variants were modelled, summarised in Table A6:.

We have analysed a total of 17,460 choices altogether from our consumer experiment, including both, first and second choices of each participant. Doing so is equivalent to assigning equal weights to each choice. We have treated our sample as representative at the EU level.

For each of our experimental treatments, we have calculated **the shares of each powertrain** (petrol, diesel, hybrid petrol, hybrid plug-in, electric) and their **average energy consumption** (petrol, diesel or electricity). We have done this calculation for three car segments included in our experiment (small, medium and large) separately and then calculated weighted averages, using the weights from our control treatment. This re-balancing was needed as, due to the fact that segment choice was done by the participants, after they were assigned to one of the treatments, the number of participants choosing different segments varies slightly across treatments.

We then have calculated the percentage point deviations between policy scenarios and corresponding BAU: TR1 – TR0 for NewLabel scenario, TR2 – TR1 for WTW scenario, TR3

– TR1 for TCO scenario and TR4 – TR3 for Custom scenario (see description of scenarios in Table A5:).

The outputs from the analysis of the consumer experiment data were implemented in SULTAN via percentage point changes in the shares of different powertrain types for new vehicles, and changes in the energy consumption (in MJ/km) of different powertrain types. A summary of the specific inputs to the SULTAN model scenarios is provided in Table A7: below; earlier Table A4 also summarises which outputs from the modelling have been used in the assessment of different economic, environmental and social impacts in the main report (Section 3.3).

Table A5: Summary of the scenarios defined in SULTAN, based on the outputs from the consumer experiments

Scenario	Scenario description
BAU	No policy changes, current labels continue being used by the Member States with no further changes. No new channels are added.
NewLabel	Implementation of a new label based on EU energy-efficiency design (including provision of information on running costs, air pollutants, tailpipe CO_2 emissions, fuel economy for combined cycle, electric range and QR code leading to additional information). New label to be shown in the point of sale and online on web resources of car manufacturers, dealers and third parties.
WTW	Implementations of changes to current label to contain information on WTW emissions instead of tailpipe CO_2 emissions. Results have been adjusted for the period after 2020 to reflect changes in the relative WTW emissions of conventional and electric vehicles due to significant decarbonisation of electricity. We assume that by 2050 all vehicles fall in the same colour/ letter bands as they are for tailpipe CO_2 emissions, and interpolate linearly the intermediate years.
TCO	Maintenance of the current labels but implementation of an obligation to provide information on TCO in the point of sale and exposition. Results from the consumer experiment have been adjusted in the period after 2020 to reflect changes in the relative TCO of different powertrain types in the BAU scenario. We rank changes in share of each powertrain according to current average TCO and observe monotonous relationship: powertrains with lowest TCO increase their share in this treatment, while powertrains with lowest TCO decrease their share. We develop the new TCO ranking for future years, according to the models maintained by Ricardo. We then apply the share changes observed in the experiment to these new rankings, to approximate expected changes in the future.
Custom	Maintenance of the current label but addition of a flexibility to adjust information on running costs and TCO according to consumer driving behaviour in the point of sale and exposition (annual mileage and urban/ extra-urban driving).

Notes: Two scenario variants were run, one for cars only, and one for all LDVs – see Table A6:.

Table A6: Summary of the scenario variants/sensitivities defined in SULTAN

Variant	Scenario variant/sensitivity description
Cars	This is the basic variant, which assumes the new label is only applied to passenger cars, and not also to vans
LDVs	This is the scenario sensitivity, which assumes a new label is also applied to vans. The impacts of the label for vans have been estimated by restricting our sample only to those individuals who described themselves as "When choosing a car, I focus mainly on economic aspects (price, fuel economy, and other costs)". We believe choices of these

Variant	Scenario variant/sensitivity description
	participants are closer to potential choices of businesses and can be used as a proxy for those interested to purchase/ lease vans.

Notes: Scenario variants are alternative versions of a common similar scenario; in this case the variants assume the new labels are applied to different groupings of the light-duty vehicle fleet.

Table A7: Summary of the scenario inputs defined in SULTAN for cars and vans

			Percentage point Change in new vehicle market share		% Change in new vehicle MJ/km	
Scenario	Mode	Powertrain	2025	2030	2025	2030
NewLabel	Cars	Gasoline ICEV	-4.28%	-4.28%	-0.44%	-0.44%
		Diesel ICEV	-3.20%	-3.20%	-0.66%	-0.66%
		Hybrid (HEV)	1.38%	1.38%	-1.23%	-1.23%
		PHEV	1.70%	1.70%	-0.43%	-0.43%
		BEV	4.40%	4.40%	-0.25%	-0.25%
	LCVs	Gasoline ICEV	0.00%	0.00%	-1.63%	-1.63%
		Diesel ICEV	-6.25%	-6.25%	-1.76%	-1.76%
		Hybrid (HEV)	0.88%	0.88%	-1.21%	-1.21%
		PHEV	2.26%	2.26%	0.79%	0.79%
		BEV	3.11%	3.11%	-1.15%	-1.15%
WTW	Cars	Gasoline ICEV	2.06%	2.06%	-0.05%	-0.05%
		Diesel ICEV	-0.58%	-0.58%	-0.85%	-0.85%
		Hybrid (HEV)	0.64%	0.07%	0.91%	0.91%
		PHEV	-0.87%	-0.64%	-0.42%	-0.42%
		BEV	-1.26%	-0.92%	-1.24%	-1.24%
	LCVs	Gasoline ICEV	0.00%	0.00%	1.08%	1.08%
		Diesel ICEV	3.80%	3.80%	-0.20%	-0.20%
		Hybrid (HEV)	-0.80%	-1.60%	2.48%	2.48%
		PHEV	-1.14%	-0.84%	-3.00%	-3.00%
		BEV	-1.86%	-1.36%	0.03%	0.03%
TCO	Cars	Gasoline ICEV	0.59%	-0.71%	-0.28%	-0.28%
		Diesel ICEV	-0.17%	-1.08%	-0.41%	-0.41%
		Hybrid (HEV)	-0.96%	-0.83%	0.48%	0.48%
		PHEV	0.58%	1.88%	-1.01%	-1.01%
		BEV	-0.05%	0.74%	-0.54%	-0.54%
	LCVs	Gasoline ICEV	0.00%	0.00%	0.32%	0.32%
		Diesel ICEV	1.67%	-0.03%	0.26%	0.26%
		Hybrid (HEV)	-1.17%	-1.18%	0.97%	0.97%
		PHEV	0.11%	1.24%	-3.00%	-3.00%

Scenario	Mode	Powertrain	Percentage point Change in new vehicle market share		% Change in new vehicle MJ/km	
			2025	2030	2025	2030
		BEV	-0.61%	-0.03%	0.03%	0.03%
Custom	Cars	Gasoline ICEV	-0.87%	-0.87%	1.04%	1.04%
		Diesel ICEV	-0.24%	-0.24%	0.86%	0.86%
		Hybrid (HEV)	-0.06%	-0.06%	0.05%	0.05%
		PHEV	0.32%	0.32%	0.22%	0.22%
		BEV	0.85%	0.85%	0.05%	0.05%
	LCVs	Gasoline ICEV	0.00%	0.00%	0.23%	0.23%
		Diesel ICEV	-2.05%	-2.05%	-0.32%	-0.32%
		Hybrid (HEV)	-0.17%	-0.17%	0.22%	0.22%
		PHEV	0.47%	0.47%	1.59%	1.59%
		BEV	1.75%	1.75%	0.40%	0.40%

Notes: For the periods after 2030, the percentage point changes were assumed to remain ~constant for both market share by powertrain and for vehicle efficiency, with the exception of the WTW powertrain shares. For the WTW scenario the proportion of PHEVs and BEVs increase as the grid emissions decrease, with the share reducing from HEVs.

B Annex B: Questions for surveys and interviews

The survey and interview questions can be accessed in the accompanying annex.

C Annex C: Problem tree and policy objectives

C.1 Problem tree

A clear understanding of the problem is important for the development of policy measures that are both relevant and proportionate to the issues at hand. For this purpose, a problem tree was developed to outline the drivers, problems and consequences that warrant a policy response or that need addressing to increase consumer awareness of fuel economy and emissions from road vehicles (**Error! Reference source not found.**).

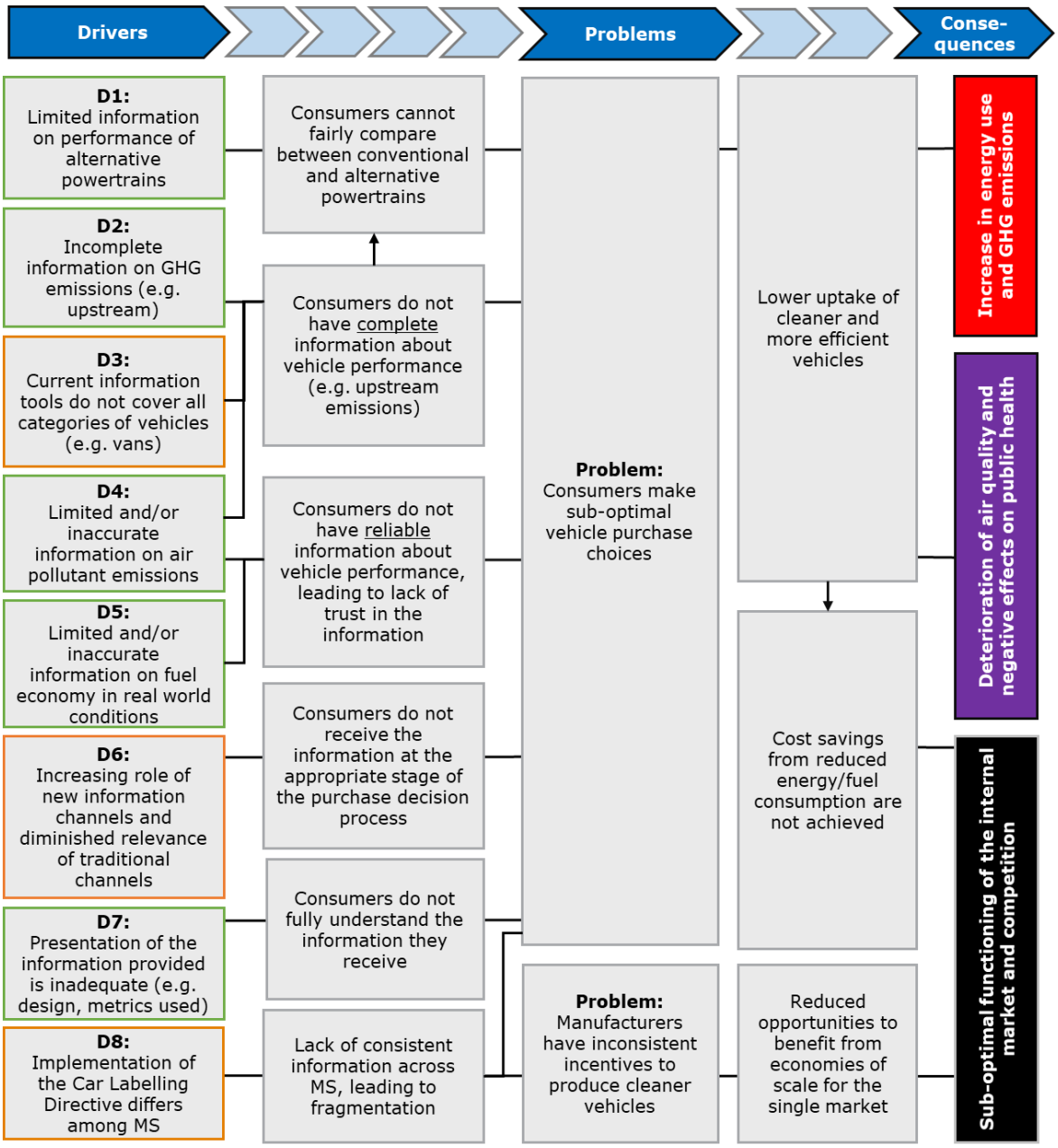
Two main problems associated with the lack of/limited consumer awareness of fuel economy and emissions from road vehicles were identified:

1. Consumers make sub-optimal vehicle purchase choices; and
2. Manufacturers have inconsistent incentives to produce cleaner vehicles.

The main drivers of these problems have been categorised into two main groups:

- The drivers in **green** represent those where the policy response directly concerns the **provision of information elements to consumers**. These include the (lack of) information on alternative powertrains, on upstream/end-of-life GHG emissions and on air pollutant emissions. The lack of reliable information on fuel economy, GHG and air pollutant emissions is also a recent aspect that warrants consideration, although the new WLTP data should help improve the accuracy of the fuel economy and GHG emission figures.
- For the other drivers represented in **orange**, the policy responses might require changes to the **overall scope and implementation elements of the Directive**. These include the lack of coverage of certain vehicle categories, changes in the role of information channels (e.g. uptake of new technologies and media has been changing the way consumers obtain information; existing tools might have become less relevant and redundant), and issues with the implementation of the current legal framework.

Figure C1: Problem tree



C.2 Policy objectives

The definition of policy objectives is important to establish the level of ambition of the policy interventions, provide a benchmark against which to assess their effectiveness, and clarify any interactions with other EU legislation.

Two main objectives have been identified by DG CLIMA:

1. To raise consumer awareness of the fuel consumption and emissions of vehicles
2. To promote the use of more fuel-efficient vehicles.

These should be understood in the context of the recently adopted European Green Deal which proposes to decarbonise transport and protect the environment, and the existing EU legal framework regulating the CO_2 emissions from LDVs (i.e., the recently adopted Regulation (EU) 2019/631) that sets out measures to stimulate the supply of more fuel efficient cars.

D Annex D: Long list of policy measures to raise awareness of emissions and fuel consumption

A comprehensive list of policy measures was compiled based on the literature review and inputs from the stakeholder panel. The list intended to identify potential improvements to provisions of the Car Labelling Directive, as well as other measures to raise consumer awareness (both at EU and Member State level) that would address the problems and the drivers previously identified.

The review of relevant literature was used to support the identification all possible measures (including econometric studies, policy papers, consumer surveys and behavioural experiments). The labels currently in use across different Member States were also reviewed. Subsequently, measures were identified based on:

- Findings of the evaluation of the car labelling Directive;
- New issues and issues for which information is scarce (e.g. air pollutant emissions, electric and other alternative powertrains);
- Evidence and findings from around the world;
- Evidence and findings from transport and other sectors (e.g. energy label); and
- Exploratory interviews with the panel of key stakeholders.

Through this process, 91 measures were identified. Measures were grouped into the topics that they address, reflecting different policy elements, and are further described in the following sections:

- Changes to the information channels through which information is communicated;
- Changes to the information elements that are communicated;
- Extension of the scope of the Directive;
- Increase in the level of harmonisation of implementation in the Member States;
- Definition of methodological approaches; and
- Improvements to the design and presentation of the information provided.

D.1 Changes to the information channels through which information is communicated

The problem driver associated with the growing importance of new information channels and the diminished relevance of more traditional channels suggests the need for a revision of the information tools mandated by the current Directive (i.e., the label, guide, promotional material, poster) as well as the use of new channels or mediums to communicate information to vehicle buyers. In total, 30 measures related to changes to information channels were identified (see long-list of policy measures).

The communication channels preferred by consumers before making a purchasing decision have changed significantly since the Directive was adopted in 1999. Now, the internet has gained a major relevance as an information channel. Consumers undertake more research on vehicles before visiting a car showroom, and in this way visit the showroom with less frequency. Hence, the showroom has become less important as a means of communicating information to consumers, whereas the internet has become much more important (LowCVP, 2018).

For this reason, the **display of the label online** is proposed. This measure is supported by several studies (Ricardo and TEPR, 2016; Lane and Banks, 2010). In addition, other energy labels already have to be displayed online - e.g. the 2017 Energy Labelling

Regulation, which governs *inter alia* household appliance labelling, requires dealers to display the energy label when selling appliances online[70].

Given the relevance of the internet, it is also suggested that the **guide is provided in an electronic format and the production of a printed guide is made optional.** The printed guide was the original means of enabling consumers to compare the models of different manufacturers. As the internet is increasingly preferred as a means to research new cars before visiting the showroom, the printed guide has arguably lost its relevance. Several studies have concluded that online versions of the printed guide are more widely used, whereas the printed guide is not well-used by consumers (LowCVP and TEPR, 2018; Ricardo and TEPR, 2016). Many countries (AT, IT, BE, EE, FI, NL, PT, SE, SK) have already moved to the exclusive provision of electronic copies of the guide (Ricardo and TEPR, 2016).

In addition, it is recommended to **remove the requirement to present the poster/electronic display in its current form** as it brings little in the way of added value (LowCVP and TEPR, 2018; Ricardo and TEPR, 2016). As suggested by (LowCVP and TEPR, 2018), **presenting the information in a mobile interactive display**, perhaps on a tablet, might be preferred as it can better communicate the complexity of the WLTP information to consumers, particularly the way in which the inclusion of different options affects a new car's CO_2 performance.

Moreover, the Directive currently defines promotional material as all printed material used in the marketing, advertising and promotion of vehicles, whereas a lot of adverts for new cars are dynamic, e.g. on TV, in cinemas or in online adverts. Thus, it is recommended to **include the relevant information in audio-visual promotional material** (ANEC and BEUC, 2014; BEUC, 2019).

Besides measures related to changes to the current channels used by the Directive, we also identified **new information channels** that could be of use. These include presenting relevant information on manufacturers or dealers' quotes, on bills or invoices (e.g. fuel bills or car insurance bills) or making a platform for easy comparisons of different vehicles/ models (e.g. fuel economy calculator). Also, measures to **raise overall awareness** were proposed. Some examples include developing awareness campaigns, training material and promoting public events.

D.2 Changes to the information elements that are communicated

The problem drivers associated with the provision of limited information on the performance of alternative powertrains, incomplete information on CO_2 emissions, and limited or inaccurate information on air pollutant emissions and fuel economy in real world conditions suggest there is a need to review the information elements that are communicated in the context of the Directive. We identified 21 measures to improve and/or include information elements based on five key areas of focus: alternative powertrains, CO_2 emissions, fuel consumption under real world conditions, air pollutant emissions and costs (see long-list of policy measures).

When the Directive was adopted in 1999, it sought to address the existing market situation, which resulted in a focus on the provision of information that was of most relevance to cars using internal combustion engines (ICEs), i.e. petrol and diesel cars. With the increasing uptake of electric cars (in response to the need to move towards decarbonisation in the transport sector as set out in the European Green Deal and strengthened by the broader aim to achieve climate neutrality), the lack of the provision of relevant information for such vehicles has been highlighted as a gap that needs to be addressed (Ricardo and TEPR, 2016; BEUC, 2019). Including **specific information for alternative powertrains** is recommended. Two information elements that were identified as relevant to Battery Electric Vehicles (BEV) and Plug-in Hybrid Electric (PHEV) consumers are: electric range

[70] Regulation (EU) 2017/1369 setting a framework for energy labelling

and charging time (BEUC, 2019; LowCVP and TEPR, 2018).Thus, including this information may potentially raise awareness and interest in these powertrains.

To improve information on alternative powertrains and enable more accurate comparisons with internal combustion engine (ICE) vehicles, **CO_2 emissions associated with the production of fuel and electricity, so-called well-to-wheel (WTW) emissions** need to be considered. As the CO_2 emissions associated with the production of petrol and diesel are similar, there was no need to consider presenting this information as part of the original Directive. However, a more realistic comparison between ICEs and alternative powertrains such as BEVs and Fuel Cell Electric Vehicles (FCEVs) can be gained when presenting well-to-wheel emissions, which consider the CO_2 emissions associated with the production of the electricity and hydrogen Several studies have highlighted the importance of presenting WTW CO_2 emissions in order to make vehicles using different powertrains more comparable (Haq and Weiss, 2016; ANEC and BEUC, 2014; BEUC, 2019)

Moreover, it has been identified that inadequate information is currently provided on fuel economy in real world conditions. Given the differences between real-world and laboratory fuel consumption/CO_2 performance (despite the replacement of NEDC by the more representative WLTP), **using correction factors to adjust laboratory values to provide realistic on-the-road figures** was considered (BEUC, 2019).

In recent years, the public has also become increasingly aware of air pollution, including the misleading portrayal of vehicle emissions by some manufacturers, the EU taking infringement action against various Member States and increased awareness of the links between air pollution and human health. This information is already provided in a few countries (e.g. FI, SI). Thus, including **information on air pollutant emissions** is also recommended.

In addition, **providing cost information** (e.g. running costs, total cost of ownership, tax incentives) is suggested as research indicates consumers value this information. It will add to the consumer's interest and receptiveness to the label/information and it may contribute to increasing awareness and interest in clean vehicles by showing their cost and benefits (ANEC and BEUC, 2014; Codagnone et al, 2016; BEUC, 2019; LowCVP and TEPR, 2018; Ricardo-AEA and TEPR, 2011; APEC, 2015). Some countries have already included information on costs (DE, IE, FI, DK, EE, FI).

Some studies have also identified that adding information on the label could lead to information overload (Haq and Weiss, 2016), and thus providing **access to additional information and/or additional tools** could be useful for those consumers that are eager to have extra information besides what is show in the label (AIRUSE, 2016).

D.3 Extension of the scope of the Directive

Currently the Directive applies only to new cars that are made available for sale or lease. The literature has suggested extending the scope of the Directive in various directions, including to other types of vehicle and beyond the sale of new vehicles. We identified 6 measures related to the extension of the scope of the Directive (see long-list of policy measures).

This study has explored **extending the scope of the Directive to other vehicle classes, including vans** (AIRUSE, 2016; Ricardo and TEPR, 2016; BEUC, 2019) **and L categories vehicles** (ANEC and BEUC, 2014; BEUC, 2019), as well as **including used and rental vehicles** (ANEC and BEUC, 2014; Ricardo and TEPR, 2016). The rationale behind extending the scope in these directions is to allow a higher number of consumers to be exposed to fuel economy and emissions information and because a more comprehensive vehicle scope is expected to make the underlying message/signal to consumers more consistent. In addition, only considering the sale of new vehicles within the scope of the Directive is seen as a factor that potentially limits the effectiveness of the Directive.

D.4 Increase in the level of harmonisation of implementation in the Member States

Eight specific measures for **increasing the level of harmonisation of implementation in the Member States** were identified (see long-list of policy measures). The current implementation of the car labelling Directive differs among Member States. Beyond high level parameters set by the Directive, there is scope for customisation. Variations can be found in how the information is presented in the label, information elements included, metrics and methodologies in place and in the vehicle scope.

In previous studies, the information channel that has been raised as potentially being most in need of harmonisation has been the label (BEUC, 2019). It is recommended to increase the level of harmonisation of implementation as it may increase the quality and quantity of information presented in some Member States, it may potentially increase effectiveness cumulatively and it may contribute to the fairness to consumers across EU Member States. However, some degree of flexibility is preferred for some measures as their effectiveness may be hindered due to cultural and fiscal differences in some Member States. Thus, as suggested in the literature it is recommended to increase the level of harmonisation while leaving some degree of flexibility (Ricardo and TEPR, 2016).

D.5 Definition of methodological approaches

There is a need **to establish the methodological approaches to improve the presentation and adequacy of relevant information**, which may increase consumers' understanding and trust in the information provided. We identified four broad measures to improve overall methodologies (see long-list of policy measures).

Areas that could benefit from standardisation include the categorisation of vehicles into ranges of gCO_2/km (i.e., to characterise CO_2 bands) as well as the schedule to update these ranges over time. The adoption of a standardised approach could be important as some categorisations may prove to be more effective for consumers' understanding or in providing an ambition towards the deployment of more efficient vehicles (e.g., establishing category A as 0 gCO_2/km). In addition, assumptions used for relevant figures (e.g. fuel prices, average distance travelled) are also not defined. Setting specific rules on how assumptions for calculations should be made and adjusted could also help provide more consistent information to consumers.

D.6 Improvements to the design and presentation of the information provided

The problem driver related to inadequate presentation of information suggests a need to **improve the design of the information provided**. 22 design measures were identified, including measures to improve the presentation of elements for the four current information channels of the Directive as well as measures that propose alternative presentation approaches to increase overall consumer awareness (see long-list of policy measures).

Evidence from the literature suggests that the **layout of the new car label should be designed so that it is similar to the existing EU energy labels used for domestic appliances**, with the use of colour-coded CO_2 bands. As this layout is familiar to European consumers it has the potential to improve understanding of the information presented (BEUC, 2019). Moreover, we identified a **preference for absolute performance data** over relative performance data to be provided to consumers, as the latter can be misleading.

Some studies also address other design elements that could be improved, however there is no consensus on those elements (e.g. metrics for fuel consumption). Measures identified for which there is no clear conclusions in the literature could be further explored in the consumer experiment or through interviews with the wider stakeholder group.

Other measures were also identified, which have the potential to increase overall awareness. These measures include requiring relevant information to be customisable according to a set of characteristics (e.g. mileage, drive cycle, price), communicating information on air pollutant emissions through impacts on the probability of human health impacts and comparing relevant information to a certain target (e.g. country/EU target for emissions of new cars) or to an average for a certain group (e.g. country average).

E Annex E: Screening of policy measures

An initial screening of the long list of measures was conducted by the project team and later validated by the stakeholder panel and DG CLIMA. The objective of the screening exercise was to narrow down the long list in a sensible manner so that less preferable measures are discarded. The assessment at this stage was qualitative (detailed quantitative assessment will be performed for short-listed measures only) based on the findings from the literature and judgement from the experts in the project team.

E.1 Preparing the long-list of measures for screening

Measures identified in the long list were reviewed and refined to be further explored in the screening exercise. Of the total 91 measures identified, the measures proposing improvements on design elements of the information to be provided, methodological approaches and other detailed implementation considerations were not included in the screening exercise since they include proposals that require a more in-depth analysis in the context of the measures they target (i.e., related to the information elements and channels), i.e., design and standardisation considerations cannot be disassociated from the aspects they concern. As such, these elements were first considered when developing the detailed design of the short-listed measures (see Annexes D.5 and D.6) and were discussed with stakeholders in this context as part of the survey and interview programme.

E.2 Screening approach and outcomes

The criteria used for the screening of measures include: (1) effectiveness, (2) efficiency, (3) technical feasibility, (4) subsidiarity and proportionality, and (5) administrative feasibility. Each measure was assessed based on these five criteria and assigned a colour-coding (either green, amber or red). The descriptions of each criterion as well as the decisions on how the colour-coding was assigned to each measure is explained in Table E1 below.

Table E1: Criteria and colour-coding explained for screening

Criteria	Description	Colour-coding assigned		
		Green	Amber	Red
Effectiveness	The contribution of the measure to addressing the specific problem and/or meeting the objectives that it is targeted to address.	High direct impact on raising awareness objectives and influencing purchasing decision	Potentially limited direct impact, indirect impact or partial impact (e.g. it targets only a small share of the market or only addressed one aspect of the action proposed)	Very limited impact
Efficiency	The (qualitative) cost burden or savings that could be achieved with the adoption of the measure.	Minor or no costs incurred, and/or high cost-effectiveness	Substantial costs are incurred and/or relative cost-effectiveness	Very high costs are incurred, and/or low cost-effectiveness
Technical feasibility	The presence of any technical barriers to the adoption and enforcement of a measure. This is particularly important for new measures that require the disclosure of new types of information for which standardised metrics do not yet exist (e.g. life cycle emissions) and would require the development of legislation in other areas.	Limited or no additional effort is needed; methodology and information required are available	Moderate effort needed; methodology and/or information required are not available	Substantial effort is needed; methodology and information required are not available and they are difficult to define and implement
Subsidiarity and proportionality	To ensure that the principles of subsidiarity and proportionality are respected.	Principles are satisfied with no potential conflicts	Potential problems may arise with these principles (e.g. potential problems with regulations imposed by MS)	Conflicts with MS competencies are likely to arise
Administrative feasibility	Availability of information and extent to which option is workable in the EU context.	Low implementation and enforcement effort are required	Significant implementation or enforcement effort is required, there is a need for coordination among multiple agents, potential acceptability difficulties and/or there is a need to involve new stakeholder groups	Conflicts arise to implement or enforce measures and/or there is a great opposition from agents involved

To facilitate the comparison of measures, each colour-rating was assigned a numerical value: 5 (high score) for green, 3 (medium score) for amber and 1 (low score) for red. These values have been used to calculate an average of the ratings of each criterion for each specific measure to determine whether the measure should proceed or not proceed to the short-list:

>4.5	Proceed to short-list
>4 to ≤4.5	Potentially proceed to short-list
≤4	Not proceed to short-list

Measures that ranked 4.2 or above where selected to be further analysed. This high threshold was selected to retain only a manageable number of measures for further analysis.

Several iterations of the initial screening were conducted among different experts in the project team. Following the initial exploratory interviews, the key stakeholder panel was asked to review the project team's screening analysis and provide feedback in writing. Once the written feedback was received, the views of the stakeholders were considered and the ranking and screening of options were adjusted as needed. The final screening matrix was then confirmed with the Commission, and on the basis of the scores, the most promising options were selected for the shortlist (Section 2).

F Annex F: Detailed design of short-listed policy measures

This annex presents more detail on the design of the measures that were taken forward. Each measure is presented in turn, with the details being developed on the basis of evidence from the literature review and, where this is lacking, the judgement of the team. The measures are grouped into the topics that they address, i.e.:

- Changes to the information channels through which information is communicated.
- Changes to the information elements that are communicated.
- Extension of the scope of the Directive.
- Increase in the level of harmonisation of implementation in the Member States.

All of the short-listed measures, with the exception of awareness campaigns and driver training (IC8 and IC9 respectively) were tested with wider stakeholders. IC8 and IC9 were instead reviewed by the study team using expert judgement.

F.1 Changes to the information channels through which information is communicated

Seven measures were taken forward that would entail changes to the information channels through which information is communicated. These are described in more detail in Table .

For each of these, we assume that the way in which the information would be collated and shared within each Member State for the purpose of its communication to consumers would be the same as is currently the case. In other words, we assume that any expansion of the information channels through which the information is communicated to consumers would use the same source of information as is currently used to identify the information that needs to be included on the current label, on the poster/electronic display, in the guide and in promotional material. This might be a central database, which could be maintained by a national ministry or agency, that is used for the purpose of vehicle registrations, or manufacturers' own databases; the information in these databases is extracted from the respective certificates of conformity.

Similarly, we assume that the format of the label that would be used in any additional information channels would be the same as is currently used in the Member State. Hence, any stakeholder that is required to use the Member State's label as a result of the expansion in the communication channels used would obtain the template from the same source as the dealers do at the moment, e.g. a template developed and maintained by a national ministry or agency.

Table F1: Detailed description of measures – changes to the information channels through which information is communicated

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
IC1: Label to be shown online	This measure would require the label to be prominently displayed online when new cars are made available for sale or lease, in line with the scope of the current Directive (and potential extensions to the scope of the Directive), or where information on new cars is displayed for the benefit of consumers. This would include the websites of car manufacturers and car dealers, as well as the various third-party websites that enable consumers to compare the vehicles of different manufacturers.	From the perspective of dealers, who already have to display the label, this measure would require dealers to also display the label online when a consumer is viewing a specific vehicle model. For manufacturers and third party websites, the template of the label, and the information used to fill it, would be obtained from the same source as that used by the dealers for accessing the information, assuming that this is an accessible source. If not, this information would need to be made available by a relevant Member State authority.	Dealers, manufacturers and those responsible for relevant third-party websites would need to ensure that they display the label as required on their websites.	An alternative to showing the label would be to provide the same required information on a new car using figures, rather than the label.
IC2: Label to be shown in interactive displays (fixed or mobile) where cars are made available for sale or lease	This measure would require dealers to use interactive displays to demonstrate, inter alia, the way in which the inclusion of different options affects a car's fuel economy and CO_2 emissions, and consequently its label, as the car is configured to the needs of the consumer. Such an interactive display	Dealers would be required to have interactive displays in which it is clear how changes to the way in which the car is configured affects the car's label. For example, as the consumer adds or removes options to/from their preferred	Each dealer would need to have at least one interactive display, which shows the label, and which enables the label to be updated as the user adds/removes options from the vehicle.	Where dealers use configurators (either their own or those provided by OEMs on their websites) to demonstrate the implications of the addition/removal of different options, this requirement would apply to those configurators, rather than require additional interactive displays.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
	in the showroom would be analogous to the process that consumers would follow online when selecting a new car for which they want to see more detail, e.g. being able to see the impact of various options on CO_2 emissions performance.	model, the vehicle's label changes as a result. The label's template and the source of the information that it contains would be the same as is currently the case with the label that is fixed to the vehicle.		
IC3: Guide to be made available in electronic format and the production of a printed guide to be made optional	This measure would remove the requirement for the guide to be printed, and in turn require that it is made available electronically.	A national ministry or agency would have to develop an electronic version of the guide, which contains all of the information contained in the printed version of the guide (which would no longer be required). The source of the information for the electronic guide would be the same as that for the printed guide.	The requirement on the national authority and dealer changes from the provision of a printed guide to the provision of an electronic guide.	This measure would not go as far as actively enabling comparisons, which is the subject of an additional measure (see IC6, below).
IC4: Remove the requirement to present a poster/electronic display in the showroom	The current poster/electronic display would no longer be required.	This requirement would be removed from the legislation.	Dealers would no longer have to display the poster/electronic display.	The interactive display (IC2 above) would effectively replace the poster or electronic display.
IC5: Information on CO_2 emissions and fuel consumption to be to be shown in dynamic promotional material (e.g. TV/online) in addition to printed promotional	This measure would require the information that is currently required to be shown in printed promotional material to be shown in dynamic promotional material, e.g.	Those involved with the production and display of dynamic promotional material would need to incorporate the relevant	Those responsible – both within manufacturers and in external advertising companies – would need to ensure that they display the relevant information. Those displaying the dynamic	Alternatively, instead of the information on CO_2 emissions and fuel economy, the label could be presented instead on all dynamic promotional material. For those Member

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
material (e.g. brochures, billboards).	advertising on TV, cinema and in dynamic material online and dynamic billboards.	information within this material. The source of the information would be the same as is currently the case for printed promotional material.	content, so TV companies, cinemas, those responsible for dynamic billboards and online sites, would need to show material containing this information.	States that have a colour-coded label, a further alternative could be to display only the relevant colour-coded bar.
IC6: Make a platform available - on the web **and/or via a mobile app - containing the information on all models to facilitate their comparison**	This measure would require the development of a platform that can provide updated information at all times and allow comparisons between vehicles.	This measure would effectively further develop the requirement to make the guide available electronically by requiring a national ministry or agency to develop a platform to enable consumers to easily compare different models, including those from different manufacturers. The source of the information for the platform would be the same as that for the current printed guide.	The national authority would need to develop – or commission the development of – such a platform.	
IC7: Car manufacturers/ dealers to present information of interest in a quote provided to consumers (including online e.g. car configurators) where an estimate of the price is provided.	This measure would require relevant information to appear in a quote when the price of a vehicle is displayed. It aims to inform potential purchasers of the key information alongside the price.	The quote would need to appear wherever the price was displayed. In the showroom, this would be on the vehicle next to the price, as well as presented next to the price when this is generated on the configurator or interactive display. The quote would	Dealers would need to ensure that they display the quote next to both physical and electronic indications of the price of vehicles. Dealers, manufacturers and operators of third-party websites would need to ensure that they display the quote next to the price of	The information to be presented in this quote – and its format – will be explored with stakeholders. A reference to fuel costs or fuel economy is probably the most appropriate subject of the quote.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
		also appear online next to the price of any specific vehicle that a consumer is looking at, or has effectively configured. This would include the websites of dealers, manufacturers and third parties. The information used in the quote would be taken from the same source as the information for the other channels of communication.	respective vehicles on their websites.	

F.2 Changes to the information elements that are communicated

This section considers measures that would change the information elements that are communicated to consumers, in each case by requiring additional information to be presented, which the literature suggests would be useful for consumers. Table F2 provides a detailed description of the measures related to changes to the information elements that are communicated.

One of the elements covered in this table is the information that should be included for cars that use alternative powertrains. For battery electric cars, as well as for plug-in hybrid electric cars, a relevant parameter that is important for consumers is the distance that the car can travel using its electric motor, i.e. its electric range. Of course, plug-in hybrid electric cars will also have emissions in the same way that cars that only have an internal combustion engine (ICE) will have, hence similar information to that supplied for ICE vehicles will also be relevant for plug-in hybrid electric vehicles.

For hydrogen fuel cell vehicles, it is less clear what any additional relevant information might be, not least as the certificate of conformity for such vehicles only differs from those of ICE vehicles in terms of the metric in which the fuel consumption is presented. While information on the range that a hydrogen fuel cell vehicle could travel on a tank of hydrogen might be relevant to a consumer, given the that the hydrogen refuelling network is currently limited, this information is not provided on the certificate of conformity. Similarly, information on the energy (rather than the fuel) consumption of a hydrogen fuel cell vehicle could be a useful means of directly comparing these vehicles to battery electric and ICE vehicles, if similar information was identified (and presented) for these vehicles. However, this is also not presented on the certificate of conformity. Hence, if additional information for hydrogen fuel cell vehicles is to be communicated on the label, or via any other communication channel, this will need to be measured separately and then collated and disseminated, accordingly. However, as it is not clear what this information should be, we have not included a measure for hydrogen fuel cell vehicles at this stage, although what to communicate about these vehicles was explored with stakeholders.

Table F2: Detailed description of measures – changes to the information elements that are communicated

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
IE1: Include real-world CO_2 emissions	This measure would require the provision of information on real world, tailpipe CO_2 emissions.	From 2021, the monitoring of real-world CO_2 emissions from new cars (and vans) is required by the LDV CO_2 Regulation. This information would be the basis of the real-world CO_2 emission values to be communicated. If it were to be included on the label, the Commission would have to comprehensively collate the information and ensure that it was made accessible to Member States.	Member States would need to ensure that their databases, from which information for the purpose of the Directive is extracted, contains a field for this information. Label templates would have to be updated accordingly, and the information would need to be included in the (printed or electronic) guide, as well as in any platforms that are developed. Dealers would need to ensure that this data was contained in and displayed on their interactive displays.	The implementation of this measure could only begin once the data on real-world CO_2 emissions are being collected. The way in which this information is communicated in the various communication channels, e.g. where and how on the label, could be set by the EU legislation.
IE2: Include WTW emissions	This measure would require the provision of information on CO_2/GHG emissions associated with the production of fuel and/or electricity in addition to tailpipe CO_2 emissions.	The Commission would need to decide how WTW emissions should be measured, and the extent to which they should reflect national circumstances (e.g. the GHG intensity of the Member State's electricity generation). Guidance would need to be produced (or requirements set) on how this information should be communicated on the various communication channels.	As above, Member States would need to ensure that their databases and label templates are amended, accordingly, so that the relevant communication channels can contain these data, while dealers would need to ensure that their interactive displays contain and display this information.	WTW factors for different fuels and energy sources, probably differentiated by Member State, might be the best way forward.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
IE3: For new vehicles, include the information on real world emissions of NOx and particulates	This measure would require the provision of information on air pollutant emissions.	Information on a new car's emission of NOx and particles is presented on the car's certificate of conformity. This information will need to be collated and presented on the label and all relevant communication channels. The means of doing the latter, and the location of the information on the label, could be set within the EU legislation.	As above, Member States would need to amend their databases and label templates so that the relevant communication channels can contain these data, while dealers would need to make sure that it was present and displayed in their interactive displays.	It would be important to find a simple way of displaying this information in order to ensure that the label or other information channels are not overloaded and becomes confusing for consumers. An alternative is to include a symbol on the label indicating whether or not the vehicle can be used in relevant clean air zones.
IE4: For second-hand vehicles, include the information on the Euro emission standard of the vehicle and/or a comparison of the emissions limit values with those of a newer car (e.g. the next Euro emission level).	This measure would require the provision of information on the Euro emissions standard of the vehicle.	This information should be presented on the label and all relevant communication channels. The way in which this should be done should be set in EU legislation, while also taking account of national rules that already exist. Hence, if there are national rules, e.g. for urban vehicle access restrictions, that already present a vehicle's Euro emissions standard, then this could be used instead of a common EU approach.	As above, this information would need to be included in the relevant databases, templates and interactive displays so that the relevant communication channels can contain these data. There might be a challenge – particularly for those Member States that have not previously collected this information for cars when they were new – to retrospectively identify each vehicle's Euro emission class. An approximation could be the year that the car was first registered, although this will not be completely accurate.	This measure assumes that the scope of the legislation has been extended to cover used cars (see Table F3, below). As an alternative (or additional to) to presenting the Euro class, a scale might be used instead, e.g. to compare the car with the next most stringent Euro standard to inform buyers how much cleaner a slightly newer car might be.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
IE5: Include Total Cost of Ownership	This measure would require the provision of information on the Total Cost of Ownership (TCO).	The way in which total cost of ownership is defined should be set out in the EU legislation. This could take account of national circumstances to some extent, e.g. in relation to the price of the respective fuels, which will differ between Member States. In which communication channels this information should be presented, and how this should be presented (e.g. if it is to be presented on the label), should be set out in the EU legislation.	Member States would need to amend their label templates, if appropriate. However, this information should not be included in any database, rather it should be calculated at the point of inclusion in the communication channel on the basis of the approach set out in the EU legislation, taking account of any national circumstances, as appropriate. Dealers would similarly need to ensure that this information was included in their interactive displays.	The most appropriate way of defining, and communicating, the total cost of ownership will need to be investigated with stakeholders. It will need to be ensured that the information is communicated in a way that does not overwhelm or confuse consumers.
IE6: Include running costs	This measure would require the provision of information on the running costs of a vehicle.	As with the total cost of ownership, the way in which running costs are calculated, and where and how they should be presented, should be set out in the EU legislation.	As with total cost of ownership, the value should be calculated at the point of inclusion in a communication channel, according to the approach set out in the EU legislation, while dealers should also include this information in any interactive displays.	The most appropriate way of defining, and communicating, running costs will need to be investigated with stakeholders. It will need to be ensured that the information is communicated in a way that does not overwhelm or confuse consumers.
IE8: For battery electric vehicles and plug-in hybrid electric vehicles, include information on type approved electric range	This measure would require the provision of information on the driving range of these vehicles based on type-approved values.	Information on a new battery electric car's (and a new plug-in hybrid car's) electric range is presented on the car's certificate of conformity. This information will need to be collated and	As above (e.g. for air pollutant emissions for new cars), Member States would need to amend their databases and label templates so that the relevant communication	It will need to be decided whether the information that is presented is the maximum type-approved electric range or the combined value.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
		presented on the label and other relevant communication channels. The means of doing the latter, and the location of the information, could be set within the legislation.	channels can contain these data, while dealers would need to make sure that it was present in their interactive displays.	
IE9: For battery electric vehicles and plug-in hybrid electric vehicles, include information on real-world electric range	This measure would require the provision of information on the driving range of these vehicles based on real-world conditions.	This information would need to be measured consistently (as it is not one of the real-world elements that the Commission has to make available under the LDV CO_2 Regulation) and then collated and disseminated.	The Commission would either have to monitor and make available this information available in addition to the other real-world elements that it has to cover under the LDV CO_2 Regulation, or identify or commission an organisation to do this. Then, as above, Member States would need to amend their databases and label templates so that the relevant communication channels can contain these data, while dealers would need to make sure that it was present in their interactive displays.	The means of doing this could be explored with stakeholders, as would the means of communicating this and the location of the information, where appropriate.
IE10: For battery electric vehicles, include the information on charge time, including details on the power of the charger that was assumed in the calculations	This measure would require the provision of information on the battery recharging times for electric vehicles.	The most appropriate approach would seem to be to present some form of 'typical charging time' for recharging a car's battery to a certain level (e.g. 80% is typically used). However, different types of electric vehicle chargers have	As above (e.g. for air pollutant emissions for new cars), Member States would need to amend their databases and label templates so that the relevant communication channels can contain these data, while dealers would	Given the way in which recharging technology is improving for rapid charging, it would also be important for this measure to be updated regularly to ensure that 'typical' values are still being presented to consumers. Information

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
		significantly different charging times, ranging from 7 hours to 15 minutes, so identifying a typical value could be challenging. This should be done at the EU level and set in the legislation in order to ensure that the same approach is taken across the EU.	need to make sure that it was present in their interactive displays.	about the charging times for the range of chargers available could be given separately. How to define a 'typical' recharging time could be explored with consumers.
IE11: Include QR code/ barcode/ link to other tools (e.g. fuel economy calculator)	This measure would require a QR code/barcode/link to comparative tools (e.g. fuel calculator) to provide additional comparative information to consumers.	This would include a link to relevant comparative tools. An indicative list of the type of tools that might be considered could be included in the EU legislation. A QR code or barcode would be included on printed documentation; a link would be included on electronic information.	Member States would have to ensure that the relevant information is contained and maintained on a relevant online site. Dealers and manufacturers need to ensure that a QR code or barcode appears prominently on their printed material relating to the car and its purchase. Dealers, manufacturers and those responsible for relevant third-party websites would need to ensure that they include a suitable link at in a prominent position where information about the vehicle is displayed on websites.	
IE12: Include QR code/ barcode/ link to more details (e.g. other driving cycles, other price assumptions)	This measure would require a QR code/barcode/link to additional information and calculations to provide	This would include information on separate drive cycles, different fuels and the (range of) charging times for electric vehicles. An indicative list of the	Member States would have to ensure that the relevant information is contained and maintained on a relevant online site. Dealers and manufacturers	

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
	additional relevant information to consumers.	information that might be included here could be included in the EU legislation. A QR code or barcode would be included on printed documentation; a link would be included on electronic information.	would need to ensure that a QR code or barcode appears prominently on their printed material relating to the car and its purchase. Dealers, manufacturers and those responsible for relevant third-party websites would need to ensure that they include a suitable link at in a prominent position where information about the vehicle is displayed on websites.	

F.3 Extension of the scope of the Directive

Currently the Directive applies only to new cars that are made available for sale or lease. The literature has suggested extending the scope of the Directive in various directions, including to other types of vehicle (specifically vans), to second-hand vehicles and to rental vehicles. These measures will each be explored in more detail with stakeholders (described in Table F3).

Table F3: Detailed description of measures - extension of the scope of the Directive

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
S1: Extend requirements to new vans	Under this measure, the requirements of the Directive would be extended to new vans. The same communication channels (as amended) that would be used for new cars would also be used for communicating information about new vans. Similarly, the same (amended) information that would be communicated for new cars would also be communicated for new vans.	Member States would need to set up a similar system to that which they put in place for new cars under the current Directive in order to collate and disseminate the information about new vans. Manufacturers and dealers would similarly have to set up relevant systems. The extent of the work needed depends on the way in which each stakeholder has set up its relevant systems and databases. (The inclusion of any additional communication channels or pieces of information that are currently not required by the Directive would have similar implications to those for new cars, as covered in Table and Table F2).	Member States, manufacturers and dealers would need to set up systems for communicating the information about vans. Dealers that solely sell or lease vans would be subject to the legislation for the first time.	It was explored with stakeholders whether it is appropriate to use the same communication channels and to communicate the same information for new vans as for new cars.
S2: Extend requirements to used vehicles	Under this measure, the requirements of the Directive would be extended to used cars (and vans, if relevant). The same communication channels (as amended) that would be used for new cars (and vans, if relevant) would also be used for communicating information	For used cars that have been put on the market since the early 2000s (which will include most cars still in use), the information that is currently required by the Directive will already be in the relevant databases of the Member State, manufacturers and dealers.	As with extending the legislation to new vans, Member States, manufacturers and dealers would need to set up systems for communicating the information about used vehicles, which might be challenging for new vans (as mentioned in the previous column). Dealers	It was explored with stakeholders whether it is appropriate to use the same communication channels and to communicate the same information (in addition to that on air pollutant emissions) for used vehicles as for new vehicles.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
	about used cars (and vans, if relevant). Similarly, the same (amended) information that would be communicated for new vehicles would also be communicated for used vehicles (with the exception of air pollutant emissions – see Table F2).	However, the systems would have to be adapted to collate and produce the relevant information (e.g. the label) for used cars. For used vans, the relevant information may not have been collated already (as noted above for new vans), hence collating this information for used vans might prove to be a challenge. (As with extending the provisions to new vans, extending the requirements to any additional communication channels or pieces of information that are currently not required by the Directive would have similar implications to those for new cars, as covered in Table and Table F2).	that solely sell used vehicles would be subject to the legislation for the first time, so Member States would need to make their data collation systems, which currently apply to new cars, accessible to used vehicle dealers.	Given the potential challenges of operationalising this measure and of extending the legislation to used vehicle dealers, the extension to used vehicles could be voluntary (at least for vans).
S3: Extend requirements to rental vehicles	Under this measure, the requirements of the legislation (as amended) would be extended to rental cars (and vans, if relevant). The target of this extension would be the consumers who rent vehicles, rather than the operators buying the vehicles.	For rental cars, the information to be communicated would be the same as that which is currently communicated to those buying or leasing new cars, so the same source and templates can be used (as amended). Car rental companies would need to amend their own systems to ensure that the necessary	Vehicle rental companies would be subject to the legislation for the first time. Member States would need to make their data collation systems, which currently apply to new cars, accessible to vehicle rental companies.	It will be explored with stakeholders whether it is appropriate to use the same communication channels and to communicate the same information for rental vehicles as it is for vehicles made available for sale or lease.

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
		information is accessed and appropriately communicated to those renting cars. For rental vans, the challenges are the same as for extending the legislation to cover new vans (see above); indeed, it would probably not be worth considering extending the legislation to cover rental vans unless the legislation was also extended to cover new vans. If the legislation was extended to cover new vans, the same considerations that are relevant for rental cars (as mentioned above) would be relevant for rental vans. (As with extending the provisions to new vans or used vehicles, the inclusion of any additional communication channels or pieces of information that are currently not required by the Directive would have similar implications to those for new cars, as covered in Table and Table F2).		The extension to rental vehicles could be voluntary.

F.4 Increase in the level of harmonisation of implementation in the Member States

The final measure that has been taken forward is to increase the level of harmonisation of the implementation in the Member States (see Table F41). The challenge of this measure is what information should be harmonised. The Directive sets out high level parameters for each of the four current information channels of the Directive, with which Member States must comply. Beyond these high-level parameters, there is scope for customising the various channels.

Table F41: Detailed description of measures – increase in the level of harmonisation of implementation in the Member States

Measure	Detailed description of the measure	Operationalising the measure	Stakeholders affected	Other considerations
H1: Increase the level of harmonisation across all EU MS on the measures to raise consumer awareness	Possible approaches include harmonising the following: • Common label design across the EU based on the format set out in the Energy Labelling Regulation; • Common label design across the EU based on another design; • The method underlying the way in which cars are assigned to a category; • The emission values that determine the way in which cars are assigned to a category.	The extent of the harmonisation would be set in the EU legislation. Member States would have to amend their respective approaches, accordingly.	Member States would have to amend their systems and templates, accordingly, as would manufacturers if they have their own systems in a particular country. Dealers would simply use the new label.	The extent of the harmonisation that is appropriate was explored with stakeholders. Where a Member State's system changes significantly, this would need to be clearly communicated within the country concerned.

G Annex G: Consumer survey

G.1 Detailed design of aspects for the consumer survey

The consumer survey (or consumer experiment) was used in this study to assess the extent to which different policy measures may influence consumers' purchase and leasing decisions. The main advantage of the experimental research is its ability to provide specific and accurate conclusions on causal effects of different options considered.

As conducting experimental research is costly, only a limited number of different options can be tested. Our consumer experiment covers five different variations of the information presented to the consumers. Following the terminology of experimental research, we call them experimental treatments. One of these treatments represents the business as usual scenario, with no deviations from the information available to consumers visiting dealerships currently. The remaining four treatments aim at covering different variations of both: **what information** is presented and **how it is presented**.

To cover and assess the impacts of all policy measures considered in this study, this experimental research has been complemented by information from stakeholders and approximations. The latter is especially important for the options that cannot be tested with consumers.

This section covers the process of selection of the measures to be tested experimentally and describes the design of five treatments in detail. Experimental environment, protocol, outcomes and analytical strategy are covered in Annex G.2.

Having reviewed a number of econometric studies, consumer surveys and behavioural experiments, as well as views of our stakeholders, we have documented aspects which are already well-understood and for which a consensus exists (e.g. recommendations to use EU energy efficiency style colour ratings already familiar to the consumers, to rely on absolute performance classification, or to include information on air pollutants). We do not consider it would be an effective use of resources to explore these issues again using the consumer experiment.

We have also produced a list of the aspects where the evidence is scarce, or the consensus has not been reached in the literature and among stakeholders. **Our selection of treatments focuses on those information elements for which existing research and evidence of effectiveness is limited, while implementation is challenging,** due to technical or administrative difficulties, as the screening exercise for measures taken forward suggests.

We have developed the initial variants of those designs based on team's expert judgement and drawing upon the results of the literature where available. We have also discussed with DG CLIMA the outcomes of this exercise and agreed on the design.

G.1.1 Selection of measures to be tested with consumers

To define experimental treatments, we first classified the short-listed measures identified at the previous stages of work into three categories:

1. **The measures, which are not possible or not appropriate to test experimentally.** These are the measures related to specific information channels (e.g. poster or TV advertisement) or implementation aspects (e.g. the measures related to enforcement or the level of harmonisation across all EU Member States). In addition to the recommendations of the literature, these measures will be explored in depth during stakeholder engagement.
2. **The measures or elements** appropriate for testing in an online experiment, but which are **extensively covered by the literature and there exists a consensus** between different sources. These measures and elements will be taken forward on the basis of the recommendations in the literature and will be sense-checked and

confirmed with stakeholders during the stakeholder engagement and in panel interviews.

3. **The measures or elements** appropriate for testing in an online consumer experiment, but **with limited coverage in the literature or in the absence of consensus** reached between different sources. This group has formed the set of candidates to be tested with the consumer experiment.

The subset of potential candidates has been analysed further, identifying as priority the measures or elements with potentially high but uncertain impacts and/ or those that would be difficult or costly to implement, due to high costs of implementation, technical or administrative feasibility.

Table G1 **Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**below contains the list of policy design elements in this subset. Note that the design elements are not included in this list as they did not form part of the screening exercise. Due to a limited number of treatments that can be tested in the experiment, there are some aspects of policy elements included in the experimental design that have been based on the literature findings and sense-checked with stakeholders (e.g. the way information on air pollutants is presented or the number and width of bands on colour-coded ratings).

Table G1: Policy elements candidates for testing in online consumer experiment

Policy design element	Measure	Comments	Priority (H: high, M: medium, L: low)
Vehicle scope	S2: Extend requirements to used vehicles	Broad support in the literature, as it is seen as a factor potentially limiting the effectiveness of the Directive (ANEC and BEUC, 2014; Ricardo, 2016; BEUC, 2019). Studies are supported by consumer and trade associations, as well as MS stakeholders	L - (impact emissions only indirectly)
Vehicle scope	S3: Extend requirements to [new] leased/ rental vehicles	Not frequently addressed. Some studies highlight the relevance of including leased/ rental vehicles (ANEC and BEUC, 2014; BEUC, 2019)	M - (increasingly important)
Information channel	IC2: Label information to be provided in interactive displays where cars are made available for sale or lease	Some studies suggest that displays are available at a later stage in the decision-making (Ricardo, 2016), however there are no clear or strong conclusions regarding their relevance as an information channel	M - (high cost of measure)
Information channel	IC6: Make a platform available containing the information on all models and facilitate their comparison	Several studies agree on the relevance of online platforms with a database of all the relevant information (e.g., EC FIA, 2017). Many MS have created fully searchable online databases (AT, BE, DK, FI, FR, EE, ES, NL, SE and UK). Some doubted as to how widely consumers used this compared to other independent sites, and the extent to which they were aware of the database's existence (e.g., DfT, 2018)	M - (helps to understand importance)

Policy design element	Measure	Comments	Priority (H: high, M: medium, L: low)
Information channel	IC7: Car manufacturers/ dealers to present information of interest in a quote provided	Not fully studied and not really addressed by literature	H - (new actors)
Information channel	IC9: Training for new drivers, such as providing information on emissions to eco-driving requirements in the driving licence Directive	Not fully studied, however training currently includes information on fuel economy	L - (no trade-offs)
Information elements	IE2: Include WTW emissions	Several studies highlight the importance of WTW CO_2 emissions to make all vehicle types comparable (ANEC, BEUC, 2014; HAG and WEISS, 2016, BEUC, 2019). AIRUSE (2016) suggested using the WTW as in the Belgium Ecoscore system. Understanding issue is not extensively addressed	H - (impacts are uncertain, no methodology)
Information elements	IE3: For new vehicles, include information on NOx and particulates	Although several studies agree on the relevance of including air pollutant emissions and this information is already provided in FI and SI, some suggest there is a risk that the label will be less clear if this information is included alongside other information (Weiss, 2016).	M - (no consensus in the literature)
Information elements	IE4: For second-hand vehicles, include the Euro emission standard and a comparison of the emissions limit values with newer car	Not highlighted in literature	M - (same as above)
Information elements	IE5: Include Total Cost of Ownership on the quote	There is agreement in the literature on the importance of cost information, however there are no clear conclusions on which type of	H - (potentially high impact, not extensively tested)

Policy design element	Measure	Comments	Priority (H: high, M: medium, L: low)
		costs to include. Some favour TCO (DURMORTIER et al, 2015, 2019_LOWCvp) whereas others favour running costs (ANEC, BEUC, etc). This is a lack of agreement on where these costs should be presented, e.g. on promotional material or on the label (DURMORTIER et al., 2015)	
Information elements	IE6: Include running costs	No clear conclusions on which types of costs to include. Several studies recommend including running costs (e.g., ANEC and BEUC, 2014; Carroll et al, 2014; Codagnone et al, 2013; Ricardo, 2011; DfT, 2018; BEUC, 2019; APEC, 2015). Currently, UK, DE, IE, FI, DK, EE, FI include these costs	L - (no trade-offs)
Information elements	IE7: Include information on taxes	Several studies agree on the relevance of including taxes when applicable (ANEC, BEUC, 2014, APEC, 2015, LOWCvp, 2019 and BEUC, 2019). Some MS (UK, DE, IE, FI, DK) provide it.	L - (no trade-offs)
Information elements	IE8: Include information on type approved electric range	Some studies agree on the relevance of electric range for xEV[71] customers and that consumers don't feel informed of about this aspect of electric vehicles (BEUC, 2019; DfT, 2018)	M - (impacts uncertain)

[71] xEV refers to all electromotive vehicles, including hybrid electric vehicles, plug-in hybrid electric vehicles and fuel-cell electric vehicles

Policy design element	Measure	Comments	Priority (H: high, M: medium, L: low)
Information elements	IE10: Include the information on charge time	Some studies agree on the relevance of battery recharging times for BEV and PHEV customers (DfT, 2018)	M - (impacts uncertain)
Information elements	IE11: Include QR code/ barcode/ link to more details	Some studies agree on the inclusion of a QR code/link to access further information (e.g. AIRUSE, 2016). The issue is only addressed by some studies. Also, there are no clear conclusions on what information to be included	M - (impacts uncertain)
Information elements	IE12: Include QR code/ barcode/ link to other tools	As above	M - (as above)

G.1.2 Experiment treatments

According to the prioritisation criteria outlined in the table above, we have developed four treatments to be tested in the experiment, along with the control group. We have aimed at covering as many aspects as possible that are of high and medium importance, without compromising the possibility of interpreting separate results from the experiment. To detect casual effects of the proposed measures in a precise way, the treatments can only differ in one element at a time. This will guarantee that we can quantify effects of each measure separately.

In some cases, different measures must be combined, and this was done in one of the treatments (TR1). Although it is possible to assess precisely the relative importance of each label element on consumer choices, we do not consider this to be a problem, as all the elements are recommended by the literature and will need to be present on the label simultaneously directly or indirectly[72]. That is, we measure the impact of the new label design as a whole.

Table G2 below describes our suggested treatments in detail. We discuss separately the design of each of the following information elements: fuel economy, CO_2 emissions, air pollutants, costs, EV range and QR code in Annex G.1.3 below.

Table G2: Description of five experimental treatments

Element	Control Group (TR0)	New label (TR1)	WTW emissions (TR2)	TCO on quote (TR3)	Customised label (TR4)
	TR0	**TR1**	**TR2**	**TR3**	**TR4**
Fuel economy	Number (no comparison), combined cycle, mixed fuels, l/100km	Number (no comparison), combined cycle, mixed fuels, l/100km	Number (no comparison), combined cycle, mixed fuels, l/100km	Number (no comparison), combined cycle, mixed fuels, l/100km	Number (no comparison), combined cycle, mixed fuels, l/100km, **customised**
CO_2 emissions	Tailpipe, energy label style, combined cycle and mixed fuels, compared to best in class, gCO_2/km	Tailpipe, energy label style, combined cycle and mixed fuels, **compared to best**[73], gCO_2/km	**WTW**, energy label style, combined cycle and mixed fuels, compared to best, gCO_2/km	Tailpipe, energy label style, combined cycle and mixed fuels, compared to best, gCO_2/km	Tailpipe, energy label style, combined cycle and mixed fuels, compared to best, gCO_2/km, **customised**
Air pollutants	No	**Yes, Euro standard and/or local AQ compliance, iconographic for values**	Yes, Euro standard and/or local AQ compliance, iconographic for values	Yes, Euro standard and/or local AQ compliance, iconographic for values	Yes, Euro standard and/or local AQ compliance, iconographic for values
Costs	No	**Running costs on label, per month, nothing on quote**	Running costs on label, per month, nothing on quote	Running costs on label, per month, **TCO on quote, per 5 years**	Running costs on label, per month, TCO on quote, per 5 years, **customised**

[72] Some of the elements will be available through other means, e.g. info in QR code, online platform.

[73] Comparison to best refers to all vehicles being considered in a single pool, regardless of segments. Information on emissions will be shown in Energy-Efficiency label style using absolute format.

Element	Control Group (TR0)	New label (TR1)	WTW emissions (TR2)	TCO on quote (TR3)	Customised label (TR4)
EV range	No	**Yes, range, number, km**	Yes, range, number, km	Yes, range, number, km	Yes, range, number, km
QR code	No	**Yes, separate drive cycles, separate fuels, charge time, link to other tools**	Yes, separate drive cycles, separate fuels, charge time, link to other tools	Yes, separate drive cycles, separate fuels, charge time, link to other tools	Yes, separate drive cycles, separate fuels, charge time, link to other tools

The **Control Group (TR0)** is the only treatment that varies across three Member States included in the experiment (more details on the experiment can be found in Annex G.1.3). The design of the label will **mimic current conditions the consumers would face in each Member States' dealerships**, adapted for online channels as required. The corresponding column in the table above includes an example for Germany.

The **New Label (TR1)** treatment incorporates **all the recommendations where there was a consensus in the literature**. The new label consolidates all the improvements to the current one by including new information and changing the way it is presented. The impact of the new label on consumer choices is obtained by comparing average choices in this treatment with the ones in TR0. TR1 represents the minimum change expected for the information that consumers get on the label. It also serves as the basis for all subsequent treatments.

The **Well to Wheel (TR2)** treatment relies on **WTW CO_2 emissions, instead of tailpipe emissions**. This methodological difference with respect to how CO_2 emissions are calculated is the only change with respect to TR1. This way we can assess the magnitude of changes that introduction of WTW methodology would bring, by comparing average choices of consumers in TR2 to those in TR1. We anticipate that the development of a WTW methodology would be a challenging task, and that is why we suggest including this treatment in the experiment – only if significant benefits are observed would such a task be worth undertaking.

The **Total Cost of Ownership (TCO) on Quote (TR3)** treatment does not change the label with respect to TR1 but **incorporates the 5-year TCO on quote**, next to the retail price or monthly lease rate. This information is aimed at making comparisons between different vehicles and powertrains easier. It is also expected to increase attractiveness of xEVs, as the difference in TCOs between EV and ICE vehicles becomes smaller, when lower EV's running costs compensate partially for higher upfront price or lease rate. To quantify the impact of this new information element (TCO) and channel (quote), the choices in this treatment will be compared to TR1.

The customised Label (TR4) treatment shows the same information as in TR3, but **in a personalised way**. That is, fuel consumption, emissions and costs are adjusted according to the driving habits and unit costs specified by the user. This treatment helps to illustrate the potential impacts that online comparison tools might have. It will also give an insight on the usefulness of labels provided on interactive displays. To quantify the impact of customisation, the choices in this treatment are compared to TR3.

G.1.3 Detailed definition and design of the elements to be tested with consumers

Based on the experiment treatments defined above, a range of information elements were tested with consumers:

- IE1: including WTW emissions
- IE2: including information on real world emissions of NOx and particulates
- IE3: including information on the Euro standard for second-hand vehicles

- IE4: including TCO information
- IE5: including information on running costs
- IE6: information on type-approved electric range
- IE10 and IE11: QR code to additional tools/information

These proposed information elements were added to the current mandatory information regulated in the Directive to create two labels. Label 1 to be used for TR1, TR3 and TR4, and Label 2 to be used for TR2. Figure shows an example of the new labels presented to consumers for electric vehicles, where all the new elements (indicated in blue) and existing elements (indicated in purple) are presented. Figure presents an example of Label 2 to be used for TR2 for a conventional fuel car model, where WTW emissions were included.

Figure G1: Example of Label 1

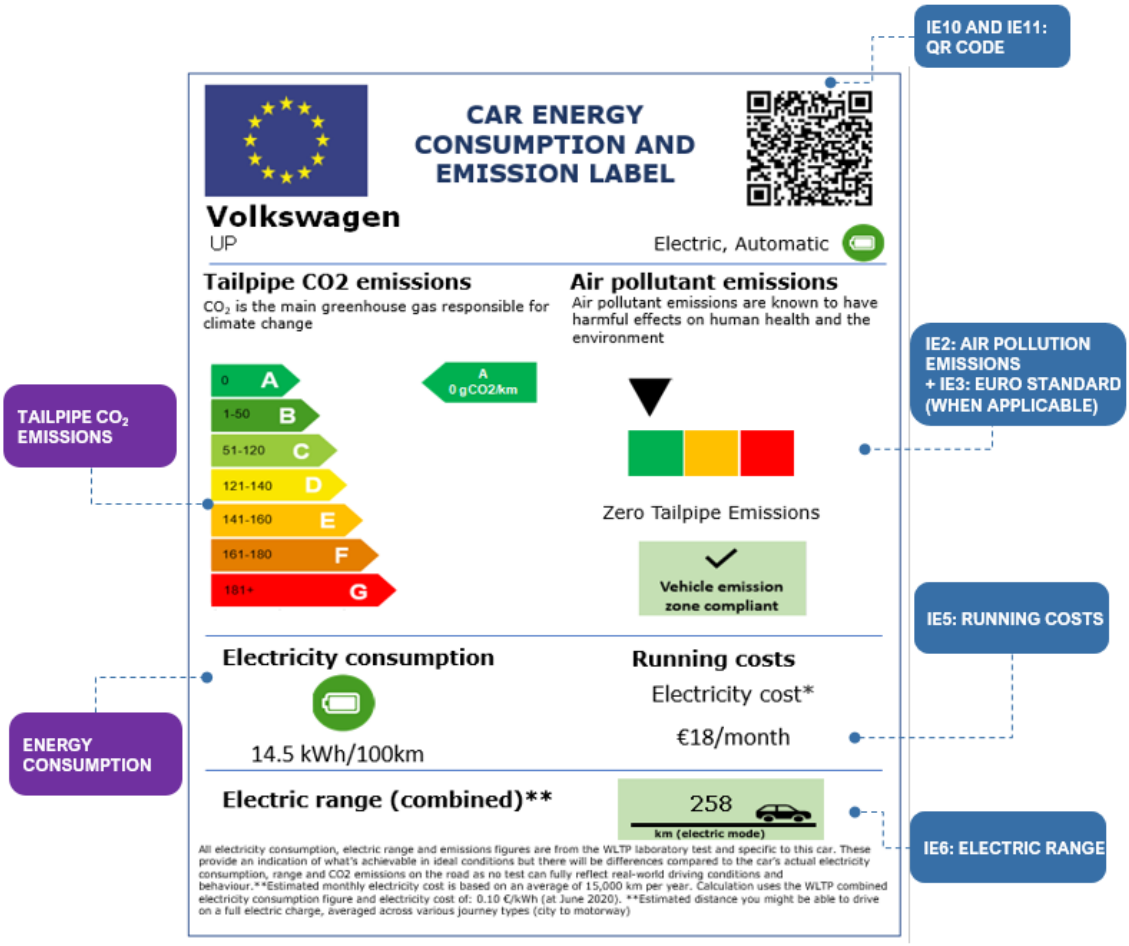
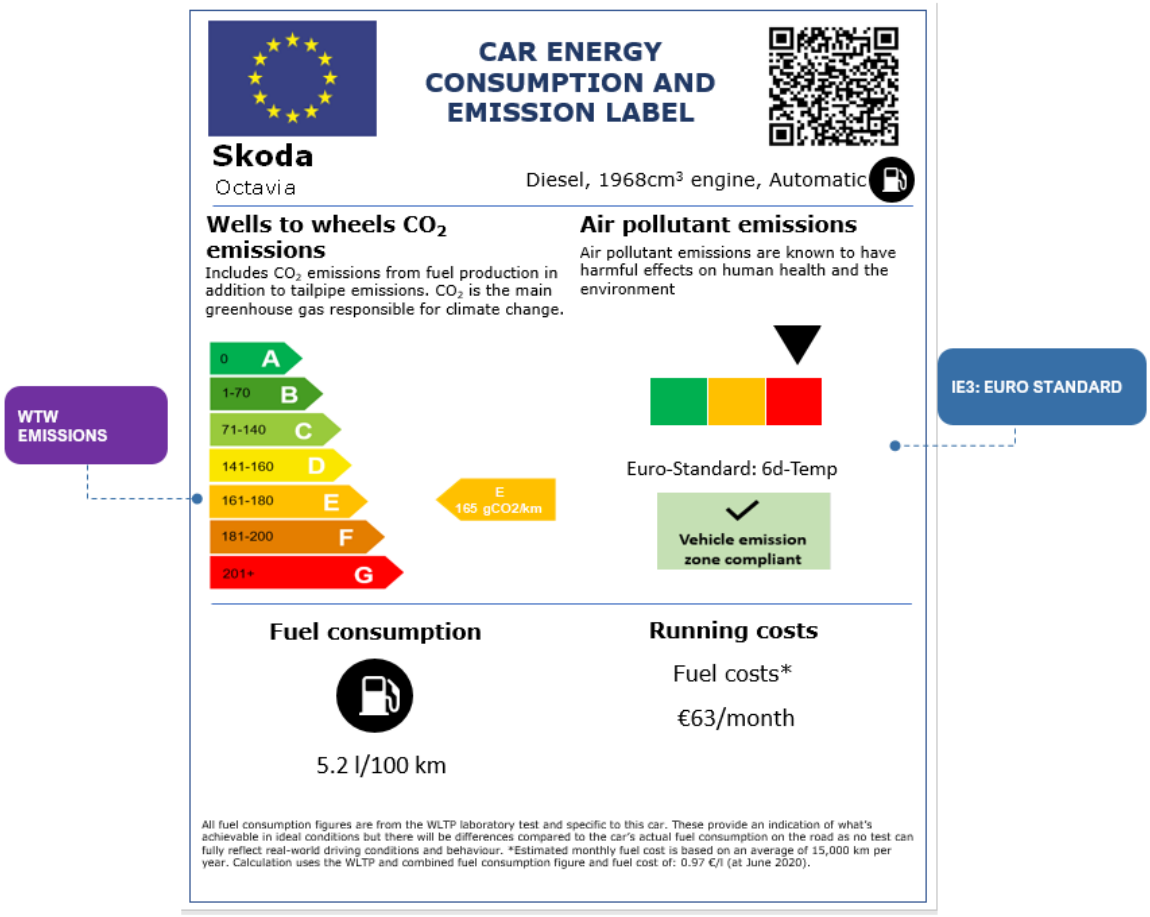


Figure G2: Example of Label 2



A detailed description of elements design is presented below:

Energy consumption was presented using an icon indicating the corresponding consumption value. A fuel pump was used for fuel consumption and a battery for electricity consumption. Figures were shown in l/100 km for petrol/diesel and kWh/100km for electricity consumption, both reflecting WLTP performance. In the case of PHEVs, both figures were presented (i.e., the weighted fuel consumption and weighted electricity consumption) to reflect the fact that this powertrain uses both fuel and electricity. To prevent information overload, we only showed fuel economy for the combined cycle.

For **tailpipe CO_2 emissions**, we used the colour bands and A-G categorisation as used in the EU Energy Efficiency Label, given that consumers are more familiar with this categorisation. Regarding the size of the CO_2 emission bands ranges, we set the top band to 0 g/km and defined ambitious upper bands. We presented the (WLTP) CO_2 emission band ranges as follows (all g/km): A=0, B = 1-50, C =51 - 120, D = 121-140, E= 141-160, F = 161-180, G= 181+. The rationale for defining band A as 0 g/km and more ambitious upper bands was to account for the expected market changes, i.e., a higher share of xEVs and more efficient internal combustion engine cars. Thus, there is scope in this approach for technological development/ambition over the coming years as more vehicles begin to populate the higher bands.

Emissions were shown in absolute values and in gCO_2/km measured in WLTP given that CO_2 emissions were defined only on the basis of their WLTP performance from 2021. For PHEVs, the information was provided in terms of the weighted value which combines both energy sources. As is the case for energy consumption information, emissions were shown for combined cycle to avoid information overload. In addition, the information provided was compared to best.

The design elements specified for the provision of information on tailpipe emissions above was applied equally to the provision of information on **WTW emissions** for TR2,

except the upper and lower bounds of the bands which will need to be adapted as needed. CO_2 emission band ranges for TR2 were defined as follows (all g/km): A=0, B = 1-70, C =71 - 140, D = 141-160, E= 161-180, F = 181-200, G= 201+.

Regarding **air quality pollutants**, we included this information in two formats to aid interpretations. We linked the car models presented to consumers to air quality zones, to the level of NOx emissions and Euro standard.

Consumers are typically aware of active air quality zones in their country. Therefore, understanding whether a vehicle would meet entry requirements for such zones could be relevant when making a purchase decision. However, some countries have adopted different criteria to define access to different cities, making the reference to specific air quality zones hard to implement. To facilitate implementation for the purposes of the experiments, we included an icon/visual representation to indicate whether a vehicle is "vehicle emission zone compliant" in general (most stringent case within the Member State), rather than specifying all the zones/cities in the Member State to which the vehicle would have access. In this way, information on the most restrictive access/zones in operation at the national level within a Member State will be displayed acting as benchmark for assessing vehicle compliance in the country. For those Member States in which there are ultra-low emission zones in place, it is possible that only zero emission vehicles will be marked as "vehicle emission zone compliant". In practice, this approach will need to be adapted to the specific situation of each Member State regarding air quality zones and therefore it might not be possible to harmonise across the EU.

Information on specific zones (within cities) that can be accessed could be showed as additional information through a QR code/link/barcode. In this way, additional information is provided to consumers whilst it becomes easier to keep the information up to date on local/national air quality policies.

We also presented information on air pollutants emissions using a simple relative scale for NOx, where red in high emissions, amber is medium, and green is lower emissions. We also included information on the Euro Standards.

For **cost information**, we included monthly running costs in the label. Running costs were based on a stated estimated annual mileage that was indicated on the label. We proposed a harmonised approach across Member States, using the same 15,000 km annual mileage, which represents the average annual mileage in the EU (BEUC, 2019).

For IE4, we tested 5-year Total Cost of Ownership (TCO) in a quote (i.e. next to the price of the vehicle). The quote showed the TCO next to the price of the vehicle as associating relevant information with prices could be of potential interest to consumers. The annual mileage was set equal to the mileage used for the running costs calculation, for consistency. A 5-year timeframe was selected for experimental purposes to allow consumers to see more significant changes between the TCO of different powertrains. In practice, this timeframe is likely not to represent the average length of new car ownership or lease agreement. For leased cars, it represents the upper bound of a contract duration typically set between two to five years (Leaseurope, 2018). However, the length could be potentially higher. If tax elements are included in the TCO, then shorter time periods could be very relevant, especially for company cars. TR4 will accommodate the possibility of participants setting the TCO for shorter (e.g. 2 years) or longer (e.g. 9 years) ownership lengths, while the rest of the treatments will use the static 5-year TCO estimate.

Combined **electric range** was presented to consumers based on the inputs from the stakeholder panel and Ricardo's expert team, as it captures the variety of technologies and driving styles.

A **QR code** was selected to offer access to additional tools and information that could potentially help prevent information overload while providing all relevant information to consumers. The EU Energy Efficiency label design uses a QR code as a means to enable consumers to access additional (non-mandatory) information, thus this method of accessing further information was chosen.

Additional information was not available via the QR code in the consumer experiments, however we recommend the below additional information to be included:

- information on separate drive cycles
- information on separate fuels
- air quality zones information in the form of a database for different access regimes for different zones in Europe
- charge time for electric vehicles
- additional information on electric cars, as shown in French website (https://www.je-roule-en-electrique.fr/#)
- link to other comparative tools

This information would be provided by public authorities to prevent this tool to be used for marketing purposes.

Table G3 summarises the design of the different information elements presented to consumers.

Table G3: Summary of definition and design of information elements presented to consumers

	Energy consumption	CO_2 emissions	Air pollutants	Costs	Electric range
Variants tested in the experiment	1	2: tailpipe and WTW emissions	1	2: Running costs, TCO	1
Visual representation / design considerations	Icon with information	Colour bands Number of categories: 7 (A-G) Size of ranges (in gCO_2/km, WLTP) for tailpipe emissions: A=0, B = 1-50, C =51 - 120, D = 121-140, E= 141-160, F = 161-180, G= 181+ Size of ranges (in gCO_2/km, WLTP) for WTW emissions: A=0, B = 1-70, C =71 - 140, D = 141-160, E= 161-180, F = 181-200, G= 201+	Linked to **air quality zones** (if relevant to the Member State): include air quality zone icon + information or air quality zone icon only Linked to **level of emissions/Euro standard**: include reference to the Euro standard and/or use a simple scale to reflect level of emissions	Icon with information	Icon with information
Metrics	Petrol/diesel: l/100 km (WLTP) Electricity: kWh/100km (WLTP)	gCO_2/km (WLTP)	None – iconography only	**Running costs:** € per month by assumed annual mileage **TCO:** € per 5 years by assumed mileage, except in TR4 where participants will be allowed to set the timeframe for calculation of TCO	Km (combined)

	Energy consumption	CO_2 emissions	Air pollutants	Costs	Electric range
Other	To avoid information overload, present only for mixed fuels and combined cycle	To avoid information overload, present only for mixed fuels and combined cycle Absolute values Compared to best	None	None	None

G.2 Approach to the consumer survey

The consumer survey tested each selected country's business-as-usual (BAU) scenario and four alternative variants of information on fuel economy and emissions (in three EU Member States), aiming to answer the following questions:

- Which of the proposed variants are most effective in influencing consumers' purchase/leasing decisions towards more efficient vehicles/vehicles with lower CO_2 emissions/powertrains/segments?
- Which information channels and elements are most effective?

The survey was conducted via an online experiment using the Predictiv platform. Predictiv (www.predictiv.co.uk) is an online platform for running behavioural experiments built by the Behavioural Insights Team. It enables governments and other organisations to run randomised controlled trials (RCTs) with an online population of participants, and to experiment whether new policies and interventions work before they are deployed in the real world. It provides access to a large international panel, with access to tens of thousands of participants across dozens of countries, as well as the functionality to run a range of online experiments.

The following sections describe the approach to the consumer survey, including:

- The environment of the experiment;
- The participant pool and eligibility;
- Implementation and sample distribution (initial and final);
- The design of the experiment;
- The outcome measures;
- analytical strategy; and
- The use of the results.

The description of treatments and how they were derived from short-listed measures is covered in Annex G.1.

G.2.1 Experiment environment

The experiment has been designed as a simulated third-party website where consumers get information before they decide on which passenger car to buy or lease. The participants were shown a selection of cars displayed with one of five information variants (see Annex G.1). Participants were asked to shortlist two cars for test-driving. The performance of each variant has been assessed with the choices of participants, measured as the average energy and emission efficiencies, as well as powertrain of choices of their two shortlisted cars.

This online simulation reflects the real-world situation in which consumers use third-party websites to compare cars before visiting a local dealership. According to Car Buyer Journey Survey, online research accounts for 70% of pre-purchase time (Cox Automotive, 2019). We chose to simulate a third-party website, rather than a dealership website, so as to include car options across different brands.

The menu of choices or the set of vehicle models included in the experiment was based on the top-selling models in the EU and corresponding Member State in particular, as well as their alternative powertrains. The final selection of models took into account the following:

- Our selection includes popular vehicle models, that is, those that are very attractive to the consumers. We have included top selling models EU-wide and in the three selected Member States in particular.
- It represents a sufficient amount of choice for different budgets and segments. This has been achieved by including top selling models for each segment and budget range.

- We include new and used cars. To make the analysis of the experimental data more robust, we kept constant the model offering in each segment, for new and used cars and assumed all used cars are 5 years old. In this sense, we study the situation where the cars that are being sold now are expected to be in the used car market in the next 5 years.
- We include a good variety of popular brands and include Price/ TCO trade-offs that the consumers face (e.g. some models are less attractive than others from price perspective but more attractive from TCO perspective due to their efficiency) and also include alternative powertrains for the top selling models, to consider possible brand loyalty.
- We include a wide range of fuel consumption and emissions performance, to make statistical comparisons meaningful.

All models were presented for sale and for lease too, to attend to the flexibility of choice of the mode of ownership. The same set of models have been used in both cases, but prices/ lease rates have been adjusted accordingly.

G.2.2 Participant pool and eligibility

The consumer survey was conducted in three EU Member States. Germany, Poland, and Spain were selected in order to cover the largest car markets, obtain a balance between East and Western countries and to cover a range of different existing information provision approaches.

Spain, Germany and Poland were considered to be good candidates to include, forming an EU-representative sample in terms of economic development, car market, implementation of the Directive and driving habits. **Error! Reference source not found.** provides an overview of the selected Member States compared with the EU average.

Table G4: Overview of key characteristics of countries included in the consumer experiment

	EU	Spain	Germany	Poland
Geography	n/a	South	Centre	East
Population ('000)	446,410	46,937	83,019	37,972
Economy (EUR mln)	13,483,857	1,202,193	3,344,370	496,360
New car sales 2018	12,791,727	1,321,438	3,435,778	531,889
Alternative powertrain sales 2018	969,869	110,000	180,000	28,334
Fuel price 2020 (gasoline EUR/l)	1.27	1.3	1.43	1.15
Distance per year	12,000	12,000	14,000	9,000
GDP per capita	30,205	25,613	40,284	13,072
Car sales per capita	29	28	41	14
Share alt powertrains	7.6%	8.3%	5.2%	5.3%
Year of fuel/ GDP per capita	50%	61%	50%	79%
Label type		EU Energy Labelling style	EU Energy Labelling style	No specified format
Number of bands		7 (A to G)	8 (A+ to G)	NA

	EU	Spain	Germany	Poland
Relative/ absolute		Relative	Relative	NA
Running costs		No	Yes	NA
Other info		No	Fuel consumption for different drive cycle Tax info Electricity consumption of xEV	No

It was intended to recruit 8,000 participants split evenly between the three countries. The participants in the Predictiv Panel were limited to car drivers who have or are planning to purchase a car. Eligibility will be determined using several screening criteria as shown in Table .

Table G5: **Screening criteria to determine participant eligibility**

Question	Eligible answers	Ineligible answers
C1. Do you currently have a valid car driving licence?	Yes	No
C2. Have you chosen, or helped to choose, a car to buy or lease in the last five years?	Yes	No (unless C3 is "Yes")
C3. Are you planning to choose, or to help to choose, a car to buy or lease in the next five years?	Yes	No (unless C2 is "Yes")

G.2.3 Implementation and sample distribution

The trial was launched on August 7th, 2020 and was closed on September 23rd, 2020. The final sample size was 8,730 participants (2,915 from Germany; 2,901 from Spain; 2914 from Poland).

In total, 11,319 participants entered the survey, 4,070 from Germany, 3,752 from Spain, and 3,497 from Poland. After data cleaning, accounting for missing and/or duplicated respondent IDs, IP addresses and referrer URLs, 11,036 entries remained. Of those, 2,614 did not complete the experiment and were excluded from analysis, leaving an available sample of 8,730. There was no evidence of differential drop-out between treatments (F-stat = 1.541, p-value = 0.1886).

The final sample of 8,730 participants was sufficiently balanced across experimental treatments for standard covariates: age ($\square^2$ = 9.536, df = 8, p-value = 0.2991), gender ($\square^2$=2.1277, df = 4, p-value = 0.7123), location ($\square^2$ = 61.522, df = 60, p-value = 0.4213), and income ($\square^2$ = 13.727, df = 8, p-value = 0.08917). Furthermore, the sample was balanced across experimental treatments for custom covariates: household size; number of cars owned; main car type; car registration year; car ownership status; car purchase year; planned replacement year; main car use; annual mileage; proportion of urban mileage; preferred car size; preferred car purchase type (new/used, and buy/lease).

Power calculations were run to assess whether we could be sufficiently confident in detecting a difference between the intervention and the control material. This is based on the number of individuals participating in each of the test conditions, the variance in responses, and insights from academic literature and previous studies on the impact of the intervention tested.

The power calculations aim to have sufficient statistical power to detect an effect in the

primary analysis, should it exist, with 80% confidence. This follows standard practice[74] by adopting a significance threshold for the *p*-value of the statistical tests of 5%. We have initially adopted a design with different sample sizes in each treatment, since the minimum economic effect is different for different treatments. In particular, we wanted to reserve most of the power for comparing the first treatment to the control.

Table G6 Summary of initial power calculation assumptions and inputs

Alpha (significance level)	5% after adjusting for multiple comparisons
Power	80%
Total planned sample size	8,000
Number of trial arms	5 — of sizes 2,500/2,500/1,000/1,000/1,000 respectively. Comparisons are TR1 vs TR0; TR2 vs TR1; TR3 vs TR1; TR4 vs TR3. The most important comparison is TR1 vs TR0.
Base rate or SD	We expect the SD of the outcome to be around 30 gCO_2/km, which we can reduce to around 22 gCO_2/km with knowledge of covariates (in particular the participant's previous car and budget range)
What is the planned MDES for this trial?	For TR1, a decrease of 1.5 gCO_2/km units of emission relative to control. For the other comparisons, a decrease of 2 gCO_2/km. (The other interventions are more expensive to develop, so they need to have a higher effect to be economical.) For the comparison between TR4 and TR3, the MDES is 2.4 gCO_2/km.
Anticipated *statistical effect size* of the intervention?	For the key comparison (TR0 vs TR1), Cohen's d is estimated to be 0.067, which is far lower than the historical average of BIT trials (~.2).
Anticipated *substantive* effect of the intervention?	According to the EC (2019), the average emissions of new passenger cars registered in the EU and Iceland in 2018 was 120.4 gCO_2/km. The treatment effect would be equivalent to a decrease of a little over 1% in emissions. The MDES for our primary outcome is lower than the economically meaningful effect size, meaning we are sufficiently powered.
Is the planned MDES the same as or smaller than the anticipated effect of the intervention?	Yes in all cases except TR4 vs TR3. This is still a "primary outcome" but the comparison is only material when TR1 "works" and TR3 is an incremental improvement.
Have you corrected for multiple comparisons?	Yes, 4 comparisons (one primary outcome x 4 treatment arms)

[74] List, J. A., Sadoff, S., & Wagner, M. (2011). So you want to run an experiment, now what? Some simple rules of thumb for optimal experimental design. *Experimental Economics*, *14*(4), 439.

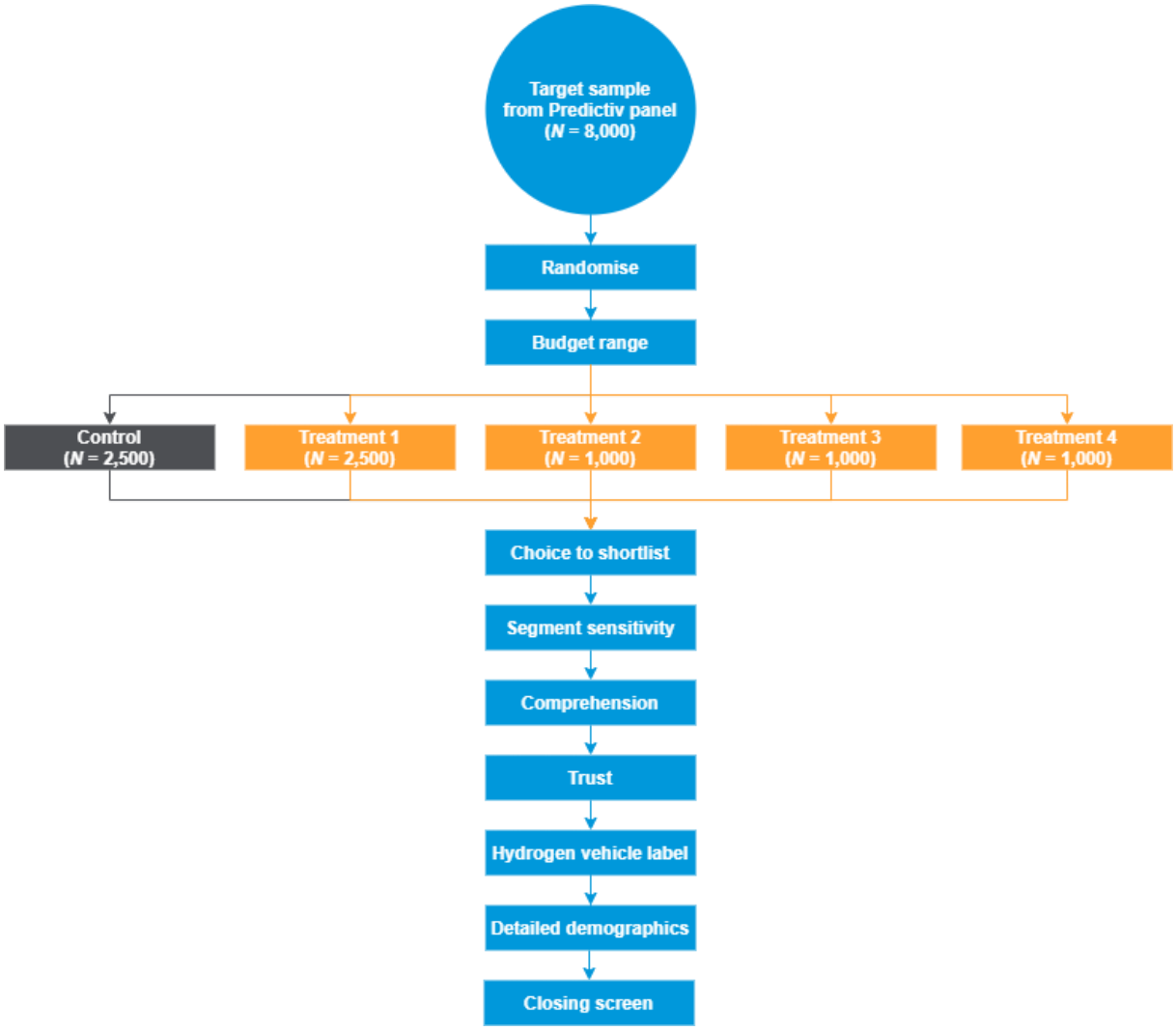
The distribution of the outcomes were monitored after 400 participants completed the experiment, in order to update power assumptions/calculations. It was observed that average emissions of shortlisted cars had a lower variance than expected, after controlling for covariates. For this reason, it was decided that it was more optimal from a power perspective to adjust the treatment assignment mechanism such that we ended up now aiming for 1,600 in each treatment (previous specification was a planned allocation scheme of (2,500, 2,500, 1,000, 1,000, 1,000) for the five treatments). With this more even distribution of sample across treatments, we are better able to precisely test differences between the alternative interventions, whilst still being able to very comfortably detect policy-relevant differences between the BAU label and TR1, which was of priority in this trial.

Following the decision to adjust the planned sample sizes in each of the experimental treatments after the pre-test, the control group (BAU label) had 1,954 participants; TR1 had 1,817; TR2 had 1,663; TR3 had 1,629; and TR4 had 1,667 participants. Importantly, the sample composition was also balanced across trial arms for each country (Germany: 2,915; Spain: 2,901; Poland: 2,914).

G.2.4 Experimental design

The experimental design is shown Figure **Error! Reference source not found.**.

Figure G3: Experimental design flow



This experiment has been conducted entirely online using the Predictiv platform. Participants in the study could select to participate in this experiment through the panel

survey website on which they are registered. They were then taken through several stages:

- **Instructions**: Participants were first shown instructions on the task. They could spend as much time as they wish viewing the instructions.
- **Modality choice:** Participants were shown the simulated third-party website. We have asked them to select if they would like to view options for new or used cars, according to their personal preferences and needs.
    - **Buy/ lease choice:** Those who chose the new car option were then asked if they would prefer to view purchase or leasing options.
    - **Segment choice**: Participants were asked to select the size/segment of their next car. This was to reduce the standard deviation on the primary outcome variable (average fuel and emission efficiency of shortlisted cars), thus allowing us to detect a smaller effect size.
- **Completion of the task**: Participants were randomly allocated to one of the five treatments. They were shown a selection of cars matching their preferences. The cars were displayed with the information according to the treatment they were assigned to. Participants were asked to shortlist two of the cars for test-driving.
- **Segment sensitivity**: Next, participants were presented with an alternative car that is similar to one of their shortlisted cars in terms of observable characteristics but from a different segment (small are offered to switch to medium, medium – to small and large – to medium segment). They were shown the alternative with its information in the same manner as displayed in the third-party website. Participants were then asked to decide if they would like to switch their shortlisted cars.
- **Comprehension questions**: Participants then answered a series of questions to gauge their understanding of the information presented in the labels. Both general and treatment-specific questions were included. The performance of different treatments was assessed with the number of the general questions answered correctly compared to the other treatments.
- **Trust questions**: Next, participants answered questions to elicit whether they believe the information presented to them is accurate and whether they trust the source of the information. These questions considered each information element on the label/quote. The best-performing treatment was defined as that with the highest scores on accuracy and trust relative to the other treatments.
- **Hydrogen fuel cell vehicle label**: Participants were shown a hydrogen fuel cell vehicle with its label in the same variation as displayed in the third-party website. They answered a series of comprehension and trust questions about the label. The answers to these questions were used to test the labels' effectiveness at translating information on these vehicles. Hydrogen fuel cell vehicles were excluded from the main task due to their small market share and low likelihood that participants would shortlist them (e.g. due to the lack of available infrastructure for these cars).
- **Detailed demographic questions**: Finally, participants answered questions related to their personal characteristics (e.g. age, gender, household income, location, education level, household size, year obtained first driving licence); current main car (e.g. type, registration year, owned or leased, new or used, purchase year, planned replacement year); and current driving habits (e.g. annual mileage, proportions of mileage in urban areas and on highways). This information was used in our statistical models to understand whether it is associated with the efficiency of the shortlisted cars. This information was also used in calculating the possible impact of different short-listed measures using the SULTAN model.

When the participant completed the stages outlined above, they were thanked for taking part and the experiment concluded.

Annex H provides the list of the detailed demographics measured in the experiment. Potential survey fatigue was considered, where participants may drop out if the survey becomes too long.

G.2.5 Outcome measures and analytical strategy

Table G7 lists the selection of outcome measures and covariates used in the experiment. The second column explains how each variable is constructed, and the third column details the coding.

Table G7: List of experimental outcomes analysed

Primary		
Measure	**Definition**	**Coding**
Emissions performance	Average emissions performance (in units of gCO_2/km) of participants' two shortlisted cars.	Continuous variable.
Secondary		
Measure	**Definition**	**Coding**
Fuel economy	Average fuel economy (in units of l/100km or equivalent) of participants' two shortlisted cars.	Continuous variable.
Powertrain	Type of powertrains shortlisted.	Binary variable. 0 → Both petrol / diesel cars 1 → At least one car is electric / plug-in hybrid
Segment sensitivity	Whether participants choose to switch one of their shortlisted cars for an alternative car that is similar in terms of budget range and other characteristics, but is from a different segment.	Binary variable. 0 → Doesn't switch 1 → Switches
Comprehension	Sum of correct answers to 5 questions (Appendix 1).	Continuous variable.
Trustworthiness	Question: "Looking at this label again, do you think it is... ... trustworthy? [Not at all / A little / Moderately / Very]	Continuous variable.
Perceived usefulness	Question: "Looking at this label again, do you think it is... ... useful for shortlisting cars? [Not at all / A little / Moderately / Very]	Continuous variable
Hydrogen fuel cell vehicle label: Comprehension	Whether participants correctly identify the vehicle with the lowest CO_2 emissions, other air pollutant emissions, and running costs from the labels (Appendix 1).	Binary variable. 0 → Incorrect 1 → Correct
Hydrogen fuel cell vehicle label: Trust	Question: "Looking at this label again, do you think it is trustworthy?" [Not at all / A little / Moderately / Very]	Continuous variable.

In our analyses, the samples from the three countries were pooled together, using them as a proxy for the EU. Recognising that the business-as-usual labels from the three countries are not identical, we also performed some within-country analysis, when needed.

We used a linear regression to test the effect of our treatments on the average emissions and fuel economy of participants' two shortlisted cars. We then used a stepwise approach, as follows:

- Run the model, including the outcome and treatment variables only;
- Run the model with outcome, treatment, and standard covariates; and
- Run the model with outcome, treatment, standard covariates, and custom covariates.

This approach helped us select the model with the best fit to the data, which in turn minimised uncertainty associated with the treatment coefficient, thus increasing power and the precision of our estimate.

We also tested the effect of treatment labels on the likelihood that participants shortlist a certain powertrain. We specified a set of logistic regressions with the same model-covariates selection procedure, first including the outcome and treatment variables only; then a model with outcome, treatment, and standard covariates; and finally, a model with outcome, treatment, standard covariates, and custom covariates.

We tested whether the treatment labels change the propensity of participants to be willing to switch car 'segments' when shown a vehicle that was excluded by their initial search criteria. We looked for treatment effects using a logistic regression model.

We were also interested in testing the overall understanding of the information in the labels. As we are dealing with a bounded count outcome, we specified a quasibinomial regression model to test the effect of treatment arms on associated comprehension scores. We also tested the trustworthiness of the label variants using a linear regression.

Finally, we tested whether the labels are effective at communicating information about emissions and fuel economy specific to hydrogen fuel cell vehicles. This is due to being interested in discerning whether this information should be presented completely differently. We used a logistic regression model to estimate associated treatment effects.

G.2.6 Use of the results

The information collected in the experiment has been used to determine which of the proposed treatments (i.e. information elements and channels via which these are delivered) are most effective in influencing consumers' purchase/leasing decisions towards more efficient vehicles/vehicles with lower CO_2 emissions/powertrains/segments.

The choices of consumers have been characterised in terms of fuel economy, CO_2 emissions, powertrain choices and strength of segment preferences, for each treatment. These parameters were then be used as inputs in SULTAN, where they are translated to the implications for new car sales and serve as primary inputs for the assessment of the overall effectiveness of the analysed measures.

In addition, the results obtained from the experiment were used to test whether **the design of the measures and elements embedded in the experiment were adequate**. This information has fed into the conclusions of this study regarding the most effective design of the measures. According to the literature and problem drivers covered in Section 3.2, to be most effective, the information not only needs to be delivered to the consumers, but also understood and trusted.

H Annex H: Overview of demographics measured in the consumer experiment

Table H1: Overview of detailed demographics measured in the consumer experiment

Treatment			
Measure	**Vector**	**Definition**	**Coding**
Treatment		Treatment assignment	Categorical variable: *Control → 0* *Treatment 1 → 1* *Treatment 2 → 2* *Treatment 3 → 3* *Treatment 4 → 4*
Personal characteristics			
Measure	**Vector**	**Definition**	**Coding**
Gender	*A*	"What is your gender?" *	Binary variable: *Male → 0* *Female → 1*
Age	*A*	"What is your age?" *	Categorical variable: *18–24 → 1* *25–54 → 2* *55+ → 3*
Household income	*A*	"What is your current annual household income before taxes?" * Original variable is country-specific.	Binary variable based on median income in each country: *Below median income → 1* *At or above median income → 2*
Location	*A*	"In which region do you live?" * Original variable uses NUTS1.	Categorical variable specific to each country.
Education	*A*	"What is your education level?"	Categorical variable specific to each country.
Household size	*A*	"How many people live in your household including yourself?"	Categorical variable. Responses: • *1 person* • *2 persons* • *3 persons* • *4 persons* • *5 persons* • *More than 5 persons* • *Prefer not to answer*
Car segment			
Measure	**Vector**	**Definition**	**Coding**
Car size	A	The size of car pre-selected by the	Categorical variable:

		participant on the simulated website	• *Small* • *Medium* • *Large*
Type of purchase	A	Whether the participant would want to buy or lease a car when replacing their existing car.	Categorical variable: • *Buy* • *Lease*
New or used car	A	The participant's choice between searching for new or used cars.	Categorical variable: • *New* • *Used*
Current car			
Measure	**Vector**	**Definition**	**Coding**
Number of cars in household	C	"How many cars does your household currently have?"	Categorical variable. Responses: • *None* • *1 car* • *2 cars* • *3 cars* • *More than 3 cars*
Type	C	"Thinking about the main car you currently use, what type is it?"	Categorical variable. Responses: • *Petrol* • *Petrol hybrid* • *Petrol plug-in hybrid* • *Diesel* • *Diesel hybrid* • *Diesel plug-in hybrid* • *(All-)electric vehicle* • *Natural gas* • *Hydrogen fuel cell*
Registration year	C	"In what year was your main car first registered?"	Categorical variable. Responses: • *Before 2000* • *2000* • *2001* • *(etc.)* • *2020*
Ownership status	*C*	"Is your main car owned (and if so, did you buy it) or leased?"	Categorical variable. Responses: • *Owned and bought* • *Owned but not bought* • *Leased* • *Don't know*
Decision-maker	*C*	"Who was responsible for making the decision to purchase your main car?"	Categorical variable. Responses: • *I was primarily responsible* • *Someone else in my household was primarily responsible* • *It was a joint decision* • *No decision made (e.g. inherited)*
New or used [if main car is not	*C*	"Did you buy your main car new or used?"	Categorical variable.

leased]			Responses: • *New* • *Used* • *Don't know*
Purchase year	*C*	"In which year did you buy/lease your main car?"	Categorical variable. Responses: • *Before 2000* • *2000* • *2001* • *(etc.)* • *2020*
Replacement year	*C*	"Approximately how long are you planning to own/lease your main car before you will replace it?"	Categorical variable. Responses: *I am planning to replace it…* • *This year* • *In the next 2 to 3 years* • *In the next 4 to 5 years* • *In the next 5 to 10 years* • *After the next 10 years*
Driving habits			
Measure	**Vector**	**Definition**	**Coding**
Annual mileage	*C*	"What do you estimate is the average annual mileage for your main car?"	Categorical variable. Responses: • *Less than 5,000km/year* • *5,000 to 5,999 km/year* • *6,000 to 6,999 km/year* • *(etc.)* • *19,000 to 19,999 km/year* • *20,000km/year and above*
Mileage in urban areas	*C*	"Approximately what proportion of this mileage takes place in the city or urban areas?"	Categorical variable. Responses: • *100% urban; 0% highways* • *90% urban; 10% highways* • *(etc.)* • *10% urban; 90% highways* • *0% urban; 100% highways*
Use of car	*C*	"What do you primarily use your main car for?"	Categorical variable. Responses: • *Work* • *Commuting to work* • *General household use* • *Occasional use* • *Other*
* Participants are automatically profiled on standard demographic characteristics (age, gender, household income, location), which means that this information does not need to be solicited in the experiment.			

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