Environmental potential of the collaborative economy

Final Report

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Acknowledgments

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Abstract

Collaborative platforms, such as Airbnb, Blablacar and Peerby, have changed the ways in which goods and services are offered and consumed in the economy. There has been a recent growth in studies analysing the drivers, impacts and scope of the collaborative economy. Some of them point to positive environmental impacts of such platforms. However, none of the studies so far have provided a systematic, qualitative and quantitative analysis of the impacts. This study fills this gap by answering two questions:

(1) What is the environmental impact of the collaborative economy today and in the future?

(2) Under which conditions will the collaborative economy contribute to a shift to a more sustainable development of the EU economy?

This study developed five in-depth case studies, applied a Life-Cycle Assessment to analyse in detail the environmental impacts per platform and used a macro-econometric model to analyse the potential economic, employment and environmental impacts towards 2030. The results show that the way in which the collaborative economy creates environmental (and socio-economic) impacts is complex and can differ strongly per business model. In general, though, by increasing the utilisation of existing assets in the economy, the environmental impact of collaborative consumption is typically lower than traditional alternatives. Yet, as collaborative consumption allows consumers to save money, the extra consumption could offset these direct environmental gains.

Abstrait

Les plateformes collaboratives, telles qu'Airbnb, Blablacar et Peerby, ont modifié la façon dont les biens et les services sont offerts et consommés dans l'économie. Il y a eu une croissance récente des études analysant les moteurs, les impacts et la portée de l'économie collaborative. Certains d'entre eux soulignent les impacts environnementaux positifs de ces plateformes. Cependant, aucune des études à ce jour n'a fourni une analyse systématique, qualitative et quantitative des impacts. Cette étude comble cette lacune en répondant à deux questions:

(1) Quel est l'impact environnemental de l'économie collaborative aujourd'hui et dans le futur?

(2) Dans quelles conditions l'économie collaborative contribuera-t-elle à un passage à un développement plus durable de l'économie de l'UE?

Cette étude développe cinq études de cas approfondies, applique une analyse de cycle de vie pour analyser en détail les impacts environnementaux par plateforme et utilise un modèle macro-économétrique pour analyser les impacts économiques, sociaux et environnementaux potentiels à l'horizon 2030. Les résultats montrent que la manière dont l'économie collaborative crée des impacts environnementaux (et socio-économiques) est complexe et diffère fortement selon le modèle économique. En général, cependant, en augmentant l'utilisation des actifs existants dans l'économie, l'impact environnemental de la consommation collaborative est généralement plus faible que les alternatives traditionnelles. Cependant, comme la consommation collaborative permet aux consommateurs d'économiser de l'argent, la consommation supplémentaire pourrait compenser ces gains environnementaux directs.

Executive Summary

This study provides an analysis of the environmental potential of the collaborative economy in the EU. This study focused on answering two main questions:

1. What is the environmental impact of the collaborative economy and how is the environmental impact expected to develop in the future (the environmental potential)?
2. Under which conditions will the collaborative economy contribute to a sustainable development of the EU economy?

This study goes beyond desk research and case study data provided by platforms, which have been the main source of information on this topic to date. This study used objectively derived assumptions and data available on collaborative economy transactions to quantify environmental and socio-economic impacts through Life-Cycle Assessments (LCAs) and a large-scale macro-economic model (E3ME).

Current literature has generally shown positive environmental and social impacts of the collaborative economy, as the analyses often focused on case studies provided by the platforms themselves. This study explains that the way in which the collaborative economy creates environmental (and socio-economic) impacts is complex and that there are different both positive and negative drivers which effect the sustainable development of the EU economy.

This study focused on three markets in which collaborative platforms are particularly active: transport, tourist accommodation and consumer durables. From the (limited) data obtained, the environmental impact of the collaborative economy was evaluated at business model and sector level using the LCAs, which has been a unique contribution of this study. Moreover, to assess the impacts in the medium-long term, scenarios on how those sectors *might develop* towards 2030 were developed. This means that the scenarios reflect *possible futures* for the collaborative economy: they should not be interpreted as a prediction for how the collaborative economy will develop.

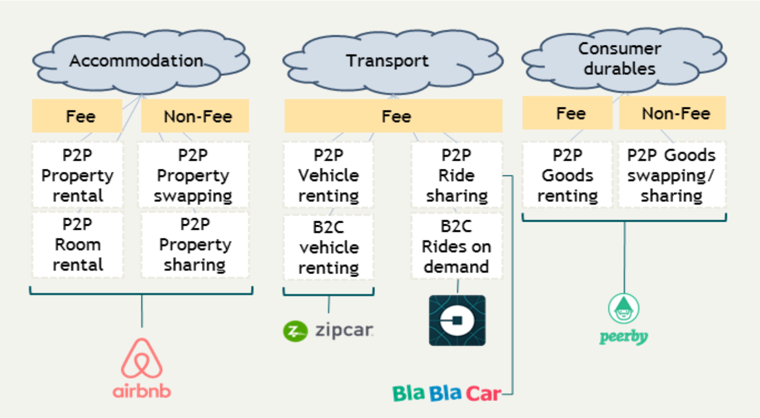
What is the collaborative economy?

There exist many definitions and interpretations of the collaborative economy. It is an evolving concept, referring also to the 'sharing economy' or 'gig economy'. The scope of this definition also varies greatly across different studies. Building on the recent contributions in literature, for the purpose of this study, collaborative business models were defined as:

> *Business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals. Transactions do not involve a change of ownership and can be carried out on a profit or non-for profit basis. The collaborative economy involves three categories of actors: 1. Providers – who share assets, resources, time or skills (peers or professional services providers); 2. Users; and 3. Intermediaries that connect via an online platform providers and users.*

Figure 1 Typology of business models and representative platforms that were selected as case studies

This definition was operationalised further by defining inclusion criteria to judge whether activities of digital platforms are considered inside or outside the scope of the collaborative economy in this study.



Legend: P2P – peer-to-peer, B2C – business-to-consumer

These inclusion criteria led to the identification of ten different business models in the three sectors. In order to get a more in-depth understanding of these business models, five selected representative platforms were studied in more detail. These case studies served as inputs for the LCA and the scenarios.

What is the current size of the collaborative economy?

Generally, the size of the collaborative economy in Europe is still quite limited, despite the rapid growth of some of the most known platforms. The case studies estimated the current market shares of the five selected platforms and their number of users in EU.

The tourist accommodation sector is the only sector where collaborative economy transactions are estimated to have a considerable market share. Airbnb alone is estimated to be responsible for around 4.7% of all the stays in the sector, with 27.8 million guests in 2016. In contrast, in the transport sector, sharing cars (or vehicle renting) account for only 0.02% of the entire car fleet in Europe and the 9 million successful ridesharing rides correspond to approximately 0.1% of the total person-kilometres travelled by car. Rides on demand is the only business model in the transport sector where the collaborative economy has a significant impact as there are around 120,000 UBER drivers registered in the EU. The market for sharing and renting of consumer durables is also small, as the largest platform in the market – Peerby - has only 250,000 users worldwide, of whom only 60% are active on the platform. This means that a maximum of around 1.35% of the EU population actively shares or rents goods via Peerby.

What is the socio-economic impact of the collaborative economy today?

For the consumer, the collaborative economy has the potential of delivering concrete benefits. The use of smartphones and digital platforms leads to a reduction in transaction costs to match supply and demand compared to 'traditional economy' transactions. The digital interface reduces the need for 'offline infrastructure', such as retail outlets or sales agents. Therefore, collaborative economy platforms have the potential to offer services at a lower price, leading to potential cost savings for consumers.

The net social and economic impacts of the collaborative economy at sector and macrolevel are less clear. On one hand, positive impacts are generated in terms of job creation, cost savings or revenue generation for peers, whereas on the other hand, negative impacts can be incurred on the traditional economy (reduced income and job losses). These impacts are hard to quantify. For example, Airbnb created around 700 platform jobs in the EU, but host employment and its impact on traditional economy is difficult to estimate. In the transport sector, the ride-sharing and car-sharing activities hardly produce any employment, apart from some jobs at headquarters of the platforms. However, there might be some direct social benefits, such as visiting family and friends (reported by 60% of Blablacar users). The latter platform is based on cost sharing rather than profit making activities, hence generating less extra income and consumption. Sharing and renting of consumer durables does not have substantial employment impacts either, it provides a few jobs at platform headquarters. As an example, Peerby, the largest platform operating in the market employs twenty people. Currently, the scale of good sharing and renting is too small to have an impact on employment in the production of consumer durables.

The rebound effects, i.e. impacts created on the wider economy from spending the money saved and earned due to the collaborative economy transaction, can compensate for the economic and employment losses at macro-level. However, this additional spending might happen in sectors not primarily affected by collaborative economy. Moreover, a certain hybridisation of collaborative and traditional economies is already occurring. For example, many smaller business suppliers sell their services through so-called collaborative platforms, and private suppliers are offering their services on platforms such as booking.com. Such ambiguity creates difficulties in assessing and quantifying the actual impacts the collaborative economy creates.

What are the environmental impacts of the collaborative economy today?

The environmental impacts of the traditional and collaborative economy today are assessed through a Life Cycle Assessment (LCA) to show the environmental footprint per functional unit of both the collaborative and traditional economies. This is done per business model as well as for the entire sector to show the contribution of the collaborative business models to the overall environmental impact of the sector. Data on the behaviour of consumers in the collaborative economy is scarce, which results in an analysis partly based on assumptions of the most likely behaviour.

Accommodation

The environmental impact of collaborative accommodation is assessed at the level of a person staying for one night in a peer-to-peer rented property (a private residence) compared to a one night at a hotel (traditional economy model). **The results show that the current environmental impact of staying one night at a collaborative economy accommodation is comparable to staying at a budget hotel.** Staying for two nights at a peer-to-peer accommodation leads to a similar carbon footprint as staying for one night at a midscale hotel. The main factor behind the lower environmental impact of collaborative accommodation is the electricity use, which is higher for midscale and luxury hotels than for example a private residence or a budget hotel. Another important factor is the type of the building (from which materials, energy efficiency, lifetime), as this alters the environmental impacts (such as climate change or resource depletion) differently.

With regard to the sectoral impacts, the market share of collaborative accommodation platforms is small (estimated around 5%), and its environmental impact is generally even smaller (due to the positive environmental impact on several environmental impact categories). The luxury hotels account for a large share in the environmental impact of the tourist accommodation (about 40%), while the number of person-nights spent at such hotels is relatively small (18%). Budget hotels have an approximate market share of 13% while their environmental impact accounts for only around 7% for most of the impact categories.

Transport

The environmental impact of car sharing (vehicle-renting), ride-sharing and rides on demand is analysed by calculating the environmental impact of a kilometre travelled with those platforms. The environmental impact of a kilometre travelled using a collaborative platform is compared with the average environmental footprint of the current mix of transport modes in the EU (the share that people travel by car, motor bike, bicycle, bus, train, airplane, ship and walking). As the share of collaborative economy transport is very small, so are its environmental impacts. The contribution of the currently active platforms in overall environmental impacts created by the transport sector is minimal (<1%). However, since the share of traditional car transport is very large (>60%), there is also a significant improvement potential for switching from personal to collaborative car transport and reducing the environmental impact.

The current environmental impact of travelling with collaborative economy transport is generally smaller than or equal to travelling with the traditional transport mix. Ride-sharing generally has the lowest environmental impact. This can be attributed to the increasing car occupancy rate and the subsequent reduction of overall per person-km impacts related to car use. Ride-sharing is the only type of collaborative economy transport for which a reduction of the carbon footprint is achieved (compared to the traditional transport mix). Car-sharing and rides on demand do not perform better than the traditional transport mix for climate change, because the traditional mix includes transport types with a low to very low carbon footprint, such as trains, trams, bicycles and walking. **When compared with the impact of a kilometre travelled in your personal car (the most common alternative), the collaborative business models typically have a significantly lower environmental impact**. To realise the environmental potential of collaborative transport, it is very important to create a shift from personal car use to collaborative car use, and to avoid that users of public transport, bike users or pedestrians shift towards collaborative transport (i.e. the use of a car).

Consumer durables

Two specific products were selected as durable goods for the environmental impact assessment: the cordless power drill and a ladder. These are products widely used by households and popular on sharing platform Peerby. Moreover, in this way the impact of a product with or without a relevant energy consumption during the use phase is compared.

Power drill

In a collaborative economy, consumers can choose to borrow a power drill using PeerbyClassic or PeerbyGo. A key factor for assessing the environmental impact is the transport scenario that is considered in the analysis. **The results show that both collaborative economy scenarios score significantly better on all environmental impact categories**. The contribution of transport is lower for the collaborative scenario as it is assumed that goods are available in a smaller radius and more transport takes place by bike (in countries like The Netherlands) or on foot instead of by car. This outweighs the fact that more transport trips are necessary in the collaborative scenario, and accounts for the share of renting of the equipment in the traditional scenario, but not for the share where the power drill is bought. The environmental impact of transport is thus a key determinant for the overall results.

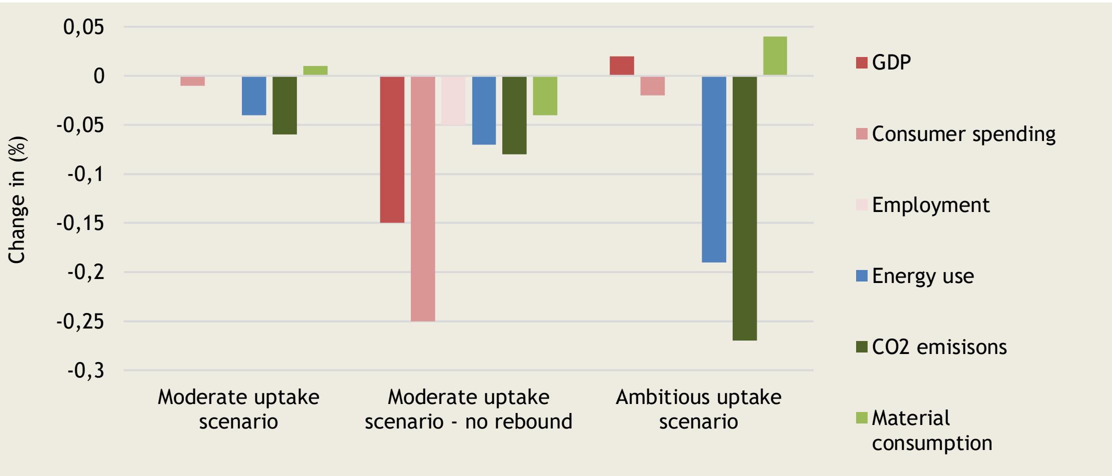
Ladder

In a traditional economy, consumers either buy a ladder or borrow one from neighbours. Additionally, it is assumed that consumers pay for a service which requires a ladder, rather than buying a ladder and doing it themselves. When a ladder is provided for by a service it is intensively used. Therefore, the environmental impacts related to the production of the ladder per hour of use is considered negligible. Again, the transport scenario is a determining factor for the environmental impact of the collaborative economy. A ladder has no environmental impact during use. Environmental impact during the life cycle of a ladder only occurs during production and transport.

What are the likely impacts of the collaborative economy towards 2030?

The future environmental impacts of the collaborative economy are in general likely to be small when compared to the overall economy. The scale of effects is partly due to the fact that the scenarios deal with isolated sectors of the economy and relatively low market shares of collaborative economy (a maximum of 10% market share). More importantly, the small net effects also reflect rebounds associated with the income and savings generated from collaborative activities. In the main scenarios, it was assumed that this additional income is spent by consumers on other goods and services, according to the standard consumption patterns. This additional spending had its own environmental, economic and social impacts. By using a complete modelling framework such as E3ME, the study captured direct, indirect and rebound interactions between the economy, energy system and the environment. The results clearly show a trade-off between economic activities and environmental impacts.

Figure 2 Trade-off between economic impacts (orange) and environmental impacts (green) for the three combined scenarios compared to the baseline.



In the combined ambitious scenario (assuming around 10% of market share for collaborative economy in the three sectors) with rebound effects, GDP is expected to increase by around €4.7 billion (or 0.02%) compared to the baseline. The net employment is expected to increase by around 16,000 jobs (which is almost no different from the baseline). These small net impacts are a result of looking at the economy as a whole, where winners in some sectors will imply losers in other sectors, while the overall impacts will balance themselves out. This scenario also has the largest positive environmental impact as the uptake of collaborative transactions increases. However, if there were no rebound effects of consumer spending on the wider economy, the environmental impacts would be even more positive.

The theoretical scenario without rebound effects (meaning the income generated is not spent on other services and goods but saved) shows the approximate magnitude of the effects of collaborative activities on the economy and the trade-off between economic impacts and environmental benefits. The GDP impact is a reduction of around €31 billion (in particular in the traditional economy sectors as the money is taken out of the economy), and the employment impact is around 107,000 jobs lost (in particular in the traditional economy sectors). Although the % changes to the baseline are still very small, the negative effects on the economy are much more dramatic than for the moderate uptake scenario with rebound (Figure 2), which assumed the same level of collaborative economy transactions. It also shows that the total environmental benefits are larger when there is no rebound effect.

The potential to reduce energy and emissions is largest in the transport case, where car and ride sharing would lead to reduction in the number of cars and the distance travelled. The study assumptions were conservative on efficient engine and electric car assumption. If higher share of electric cars was assumed, further environmental benefits could be expected.

The market shares may be larger in the future, however, the study findings would still be applicable, albeit at greater magnitudes, as the same interactions within economy and between economy, energy and environment are expected.

How can the collaborative economy contribute to sustainable growth of the EU economy?

The results of this study indicate that many collaborative business models can simply be seen as more efficient versions of their direct 'traditional' competitors, with their borders and differences likely to become blurred in the future. This is due to collaborative business models becoming more mature and traditional business models becoming more dynamic and adaptive to some of the collaborative economy practices. Therefore, the collaborative economy should not be a specific target of policy action, but rather all activities in the sector should be targeted with the aim to ensure fair and equal competition between traditional and collaborative business models. This is further supported by the apparent hybridisation of the platform and traditional economy.

Secondly, the lack of data on collaborative consumption and platform business activity, in particular at EU level, restricts a proper analysis of the environmental and socio-economic impacts. Further measures should be taken to increase data collection from platforms at Member State and EU level in line with reporting requirements for other businesses in the same sector, in particularly for the for-profit platforms.

Specific implications for the transport sector

As the environmental impact of lower car production is smaller than the overall environmental impact of fuel use in the use-phase of cars, the environmental potential of increased utilisation in cars is high. Ride-sharing and car-sharing that lead to a higher utilisation of cars therefore contribute to less environmental impacts. As collaborative transport options make travelling by car more attractive and affordable, this does sometimes come at the cost of the use of public transport or cycling options, which from an environmental point of view are better options than car driving. Therefore, the negative environmental rebound effects of increased car use should be limited by discouraging car use in general and by promoting cleaner types of car use. As collaborative transport options are often the more efficient options within car travel, such measures might stimulate the use of car-sharing and ride-sharing schemes instead of personal car travel.

Specific implications for the acommodation sector

Since the environmental impacts of peer-to-peer rented properties are lower with higher occupancy rates, policies that restrict the type of listings offered on collaborative platforms to properties where the host has main residence should be encouraged. By restricting the maximum number of days for which a property can be rented out via the collaborative economy, this would also discourage property renters who buy a property only to rent it out, and encourage only those who also reside in the property to increase the occupancy rate of their residence. The environmental impact of the collaborative accommodation is also lower if the building and residence itself have better energy efficiency and use more sustainable materials. The study also showed that rebound effects from increased travelling might have a negative environmental impact, which could be mitigated through promotion of cleaner ways of travelling.

Specific implications regarding goods sharing and renting

Sharing and renting goods make better use of the (typically long) technical life that consumer durables have. Therefore, goods sharing and renting can help the EU economy develop in a sustainable manner. Sharing and renting of goods can be facilitated by implementing design requirements that increase the durability and sharing ability of consumer durables, such as modular design and high quality standards. Most importantly, though, is that the environmental impact of the logistics behind the sharing or renting transaction itself remain low. Therefore, clean transport solutions for the logistics behind sharing and renting goods should be promoted.

In conclusion, the study highlighted the environmental potential that can be garnered from the collaborative economy business models. Such a dynamic transition could create opportunities to green the economy via innovation from platforms (for example using cleaner cars in carsharing), policy makers (by promoting sustainable and energy efficient buildings, clean transport) or by consumers (by making choices on how to consume and behave). Such conditions can facilitate a shift to a more sustainable development of the EU economy.

Résumé

Cette étude fournit une analyse du potentiel environnemental de l'économie collaborative dans l'UE. Cette étude visait à répondre à deux questions principales:

1. Quel est l'impact environnemental de l'économie collaborative et comment l'impact environnemental devrait-il évoluer à l'avenir (potentiel environnemental)?

2. Dans quelles conditions l'économie collaborative contribuera-t-elle au développement durable de l'économie de l'UE?

Cette étude va au-delà de la recherche documentaire et des études de cas fournies par les plateformes, qui ont été la principale source d'information sur ce sujet à ce jour. Cette étude utilise des hypothèses objectivement dérivées et des données disponibles sur les transactions de l'économie collaborative pour quantifier les impacts environnementaux et socio-économiques à travers des analyse du cycle du vie (ACV) et un modèle macro-économique à grande échelle (E3ME).

La littérature actuelle a généralement montré des impacts environnementaux et sociaux positifs de l'économie collaborative, car les analyses se sont souvent concentrées sur des études de cas fournies par les plateformes elles-mêmes. Cette étude explique que la manière dont l'économie collaborative crée des impacts environnementaux (et socio-économiques) est complexe et qu'il existe différents facteurs positifs et négatifs qui affectent le développement durable de l'économie de l'UE.

Cette étude s'est concentrée sur trois marchés dans lesquels les plateformes collaboratives sont particulièrement actives : le transport, le logement touristique et les biens de consommation. À partir des données (limitées) obtenues, l'impact environnemental de l'économie collaborative a été évalué au niveau du modèle économique et sectoriel en utilisant les ACV, ce qui constitue une contribution unique de cette étude. De plus, pour évaluer les impacts à moyen et long terme, des scénarios sur la manière dont ces secteurs pourraient se développer vers 2030 ont été développés. Cela signifie que les scénarios reflètent les futurs possibles pour l'économie collaborative : ils ne devraient pas être interprétés comme une prédiction de la façon dont l'économie collaborative se développera.

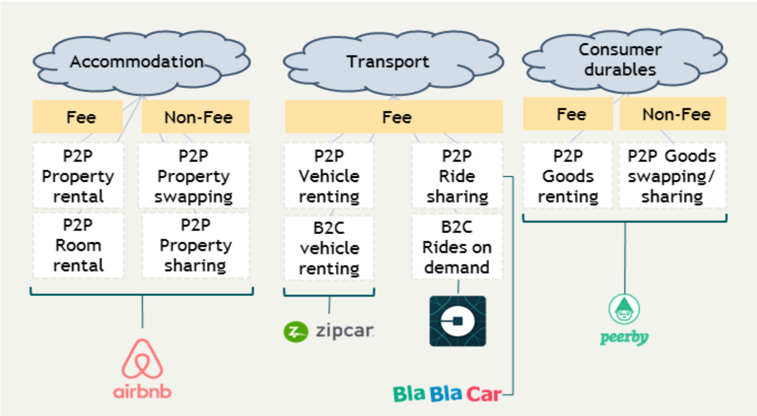
Qu'est-ce que l'économie collaborative ?

Il existe de nombreuses définitions et interprétations de l'économie collaborative. C'est un concept qui évolue et qui fait également référence à « l'économie du partage » ou à «l'économie du concert» (*gig economy*). La portée de cette définition varie également considérablement d'une étude à l'autre. Sur la base des contributions récentes dans la littérature scientifique et pour les besoins de cette étude, les modèles de gestion collaborative ont été définis comme suit :

> *Modèles d'affaires où les activités sont facilitées par des plateformes collaboratives qui créent un marché ouvert pour l'utilisation temporaire de biens ou de services souvent fournis par des particuliers. Les transactions n'impliquent pas de changement de propriété et peuvent être réalisées sur une base à but lucratif ou non. L'économie collaborative implique trois catégories d'acteurs : 1. Les fournisseurs - qui partagent des actifs, des ressources, du temps ou des compétences (pairs ou fournisseurs de services professionnels); 2. les utilisateurs; et 3. Intermédiaires qui se connectent via un fournisseur de plateforme en ligne et les utilisateurs.*

Cette définition a été opérationnalisée davantage en définissant des critères d'inclusion pour juger si les activités des plateformes numériques sont considérées à l'intérieur ou à l'extérieur de la portée de l'économie collaborative dans cette étude.

Figure 1 : Typologie des modèles économiques et des plateformes représentatives sélectionnées comme études de cas



Ces critères d'inclusion ont permis d'identifier dix modèles d'affaires différents dans les trois secteurs. Afin d'obtenir une compréhension plus approfondie de ces modèles d'affaires, cinq plates-formes représentatives ont été étudiées plus en détail. Ces études de cas ont été utilisées pour l'analyse du cycle de vie et les scénarios.

Légende : P2P - peer-to-peer, B2C - business-to-consumer

Quelle est la taille actuelle de l'économie collaborative ?

En général, la taille de l'économie collaborative en Europe est encore assez limitée, malgré la croissance rapide de certaines des plateformes les plus connues. Les études de cas ont estimé les parts de marché actuelles des cinq plateformes sélectionnées et leur nombre d'utilisateurs dans l'UE.

Le secteur de logement touristique est le seul secteur où les transactions de l'économie collaborative sont estimées avoir une part de marché considérable. Airbnb à lui seul, représente environ 4,7% de tous les séjours dans le secteur, avec 27,8 millions de visiteurs en 2016. En revanche, dans le secteur des transports, le partage de voitures (ou la location de véhicules) ne représente que 0,02% de la flotte des voiture en Europe et les 9 millions de trajets de covoiturage réussis correspondent à environ 0,1% du nombre total de personnes-kilomètres parcourus en voiture. Les trajets à la demande (*Rides on demand*) est le seul modèle d'entreprise dans le secteur des transports où l'économie collaborative a un impact significatif car il y a environ 120 000 conducteurs UBER enregistrés dans l'UE. Le marché du partage et de la location de biens de consommation durables est également réduit, la plus grande plateforme du marché, Peerby, ne compte que 250 000 utilisateurs dans le monde, dont seulement 60% sont actifs sur la plateforme. Cela signifie qu'un maximum d'environ 1,35% de la population de l'UE partage ou loue activement des biens via Peerby.

Quel est l'impact socio-économique de l'économie collaborative aujourd'hui ?

Pour le consommateur, l'économie collaborative a le potentiel de fournir des avantages concrets. L'utilisation des smartphones et des plateformes numériques entraîne une réduction des coûts de transaction pour faire correspondre l'offre et la demande par rapport aux transactions « traditionnelles». L'interface numérique réduit le besoin d'une « infrastructure hors ligne », comme les points de vente au détail ou les agents de vente.

Par conséquent, les plates-formes d'économie collaborative ont le potentiel d'offrir des services à un prix inférieur, ce qui peut entraîner des épargnes directes pour les consommateurs.

Les impacts sociaux et économiques nets de l'économie collaborative au niveau du secteur et au niveau macro sont moins clairs. D'une part, des impacts positifs sont générés en termes de création d'emplois, d'économies de coûts ou de génération de revenus pour les pairs, alors que d'autre part, des impacts négatifs peuvent être encourus sur l'économie traditionnelle (revenus réduits et pertes d'emplois). Ces impacts sont difficiles à quantifier. Par exemple, Airbnb a créé environ 700 emplois sur des plateformes dans l'UE, mais il est difficile d'estimer l'emploi d'hôtes et son impact sur l'économie traditionnelle. Dans le secteur de transport, les activités de covoiturage et d'autopartage ne génèrent pratiquement aucun emploi, à l'exception de certains emplois au siège des plateformes. Cependant, il pourrait y avoir des avantages sociaux directs, comme rendre visite à la famille et aux amis (rapporté par 60% des utilisateurs de Blablacar). Cette dernière plateforme est basée sur le partage des coûts plutôt que sur des activités lucratives, générant ainsi moins de revenus et de consommation supplémentaires. Le partage et la location de biens de consommation durables n'ont pas non plus d'impact significatif sur l'emploi, mais fournissent quelques emplois au siège de la plate-forme. À titre d'exemple, Peerby, la plus grande plateforme opérant sur le marché emploie une vingtaine de personnes. Actuellement, l'ampleur du partage et de la location est trop faible pour avoir un impact sur l'emploi dans la production de biens de consommation durables.

Les effets de rebondissement, c'est-à-dire les impacts créés sur l'économie en général par l'argent économisé et gagné grâce à la transaction d'économie collaborative, peuvent compenser les pertes économiques et d'emploi au niveau macro. Cependant, ces dépenses supplémentaires pourraient se produire dans des secteurs qui ne sont pas principalement touchés par l'économie collaborative. De plus, une certaine hybridation des économies collaborative et traditionnelle est déjà en cours. Par exemple, de nombreux fournisseurs de petites entreprises vendent leurs services par le biais de plateformes dites collaboratives, et les fournisseurs privés offrent leurs services sur des plateformes telles que booking.com. Une telle ambiguïté crée des difficultés pour évaluer et quantifier les impacts réels de l'économie collaborative.

Quels sont les impacts environnementaux de l'économie collaborative aujourd'hui ?

Les impacts environnementaux de l'économie traditionnelle et collaborative d'aujourd'hui sont évalués au moyen d'une analyse du cycle de vie (ACV) afin de montrer le cout environnemental à la fois des économies collaboratives et traditionnelles. Ceci est fait par le modèle d'affaires pour l'ensemble du secteur pour montrer la contribution des modèles d'affaires collaboratifs à l'impact environnemental global du secteur. Les données sur le comportement des consommateurs dans l'économie collaborative sont rares, ce qui conduit à une analyse basée sur le comportement le plus probable.

Logement

L'impact environnemental de logement en collaboration est évalué au niveau d'une personne séjournant une nuit dans une propriété louée entre particuliers (une résidence privée) par rapport à une nuit dans un hôtel (modèle d'économie traditionnelle). Les résultats montrent que l'impact environnemental actuel de rester une nuit dans un logement d'économie collaborative est comparable à séjourner dans un hôtel économique. Séjourner deux nuits dans un logement peer-to-peer conduit à une empreinte carbone similaire à rester une nuit dans un hôtel milieu de gamme. Le facteur principal expliquant le faible impact environnemental de logement collaboratif est la consommation d'électricité, qui est plus élevée pour les hôtels milieu de gamme et de luxe que par exemple une résidence privée ou un hôtel économique. Un autre facteur important est le type de bâtiment (à partir duquel les matériaux, l'efficacité énergétique, la durée de vie), car cela modifie les impacts environnementaux (tels que le changement climatique ou l'épuisement des ressources) différemment.

En ce qui concerne les impacts sectoriels, la part de marché des plateformes de logement collaboratif est faible (estimée à environ 5%) et son impact environnemental est généralement encore plus faible (impact environnemental positif sur plusieurs catégories d'impacts environnementaux). Les hôtels de luxe représentent une part importante de l'impact environnemental de logements touristique (environ 40%), tandis que le nombre de nuitées passées dans ces hôtels est relativement faible (18%). Les hôtels économiques ont une part de marché approximative de 13% alors que leur impact environnemental ne représente qu'environ 7% pour la plupart des catégories d'impact.

Transport

L'impact environnemental de l'autopartage (location de véhicules), du covoiturage et des trajets à la demande est analysé en calculant l'impact environnemental d'un kilomètre parcouru avec ces plateformes. L'impact environnemental d'un kilomètre parcouru en utilisant une plate-forme collaborative est comparé à l'empreinte environnementale moyenne de la combinaison actuelle de modes de transport dans l'UE (la part que les gens voyagent en voiture, moto, vélo, bus, train, avion, bateau, en marchant). Comme la part du transport en économie collaborative est très faible, ses impacts environnementaux le sont aussi. La contribution des plateformes actuellement actives aux impacts environnementaux globaux créés par le secteur des transports est minime (<1%). Cependant, étant donné que la part du transport automobile traditionnel est très importante (> 60%), il existe également un potentiel d'amélioration significatif pour passer du transport individuel au transport collaboratif et réduire l'impact sur l'environnement.

L'impact environnemental actuel du voyage avec le transport économique collaboratif est généralement inférieur ou égal à voyager avec le mélange de transport traditionnel. Le covoiturage a généralement l'impact environnemental le plus faible. Cela peut être attribué à l'augmentation du taux d'occupation des voitures et à la réduction subséquente des impacts globaux par personne-km liés à l'utilisation de la voiture. Le covoiturage est le seul type de transport en économie collaborative pour lequel une réduction de l'empreinte carbone est obtenue (par rapport à la combinaison de transport traditionnelle). L'autopartage et les trajets à la demande ne sont pas plus performants que les transports traditionnels pour le changement climatique, car le mélange traditionnel inclut des types de transport à faible ou très faible empreinte carbone, comme les trains, les tramways, les bicyclettes et la marche. En comparaison avec l'impact d'un kilomètre parcouru dans votre voiture personnelle (l'alternative la plus courante), les modèles d'entreprise collaborative ont généralement un impact environnemental nettement plus faible. Pour réaliser le potentiel environnemental du transport collaboratif, il est très important de passer de l'utilisation personnelle de la voiture à la voiture collaborative et d'éviter que les usagers des transports publics, des cyclistes ou des piétons ne se tournent vers le transport collaboratif.).

Biens de consommation

Deux produits spécifiques ont été sélectionnés en tant que biens durables pour l'étude d'impact sur l’environnement : la perceuse électrique sans fil et une échelle. Ce sont des produits largement utilisés par les ménages et populaires sur la plate-forme de partage

Peerby. De plus, on compare ainsi l'impact d'un produit avec ou sans consommation d'énergie pertinente pendant la phase d'utilisation.

Perceuse électrique

Dans une économie collaborative, les consommateurs peuvent choisir d'emprunter une perceuse électrique en utilisant PeerbyClassic ou PeerbyGo. Un facteur clé pour évaluer l'impact environnemental est le scénario de transport considéré dans l'analyse. **Les résultats montrent que les deux scénarios d'économie collaborative obtiennent de meilleurs résultats dans toutes les catégories d'impact environnemental.** La contribution du transport est plus faible pour le scénario collaboratif car il est supposé que les marchandises sont disponibles dans un rayon plus proche de consommateur et la majorité des voyages se fait à vélo (dans des pays comme les Pays-Bas) ou à pied plutôt qu'en voiture. Cela l'emporte sur le fait que plus de voyages sont nécessaires dans le scénario de collaboration, et représente la part de la location de l'équipement dans le scénario traditionnel, mais pas pour la part où la perceuse électrique est achetée. L'impact environnemental du transport est donc un déterminant clé pour les résultats globaux.

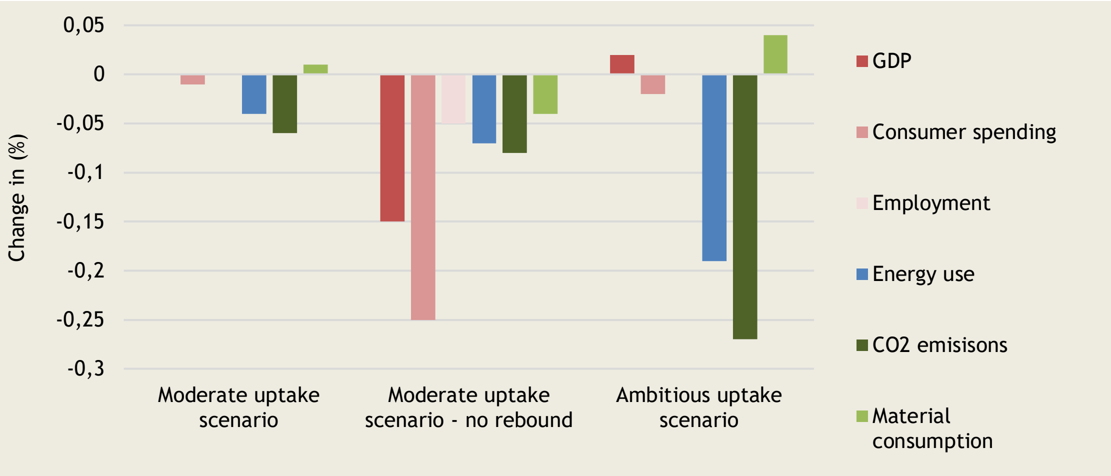
Échelle

Dans une économie traditionnelle, les consommateurs achètent une échelle ou en empruntent une à leurs voisins. En outre, il est supposé que les consommateurs paient pour un service qui nécessite une échelle, plutôt que d'acheter une échelle et de le faire eux-mêmes. Lorsqu'une échelle est fournie pour un service, elle est utilisée de manière intensive. Par conséquent, les impacts environnementaux liés à la production de l'échelle sont considérés comme négligeables. Encore une fois, le scénario de transport est un facteur déterminant pour l'impact environnemental de l'économie collaborative. Une échelle n'a aucun impact sur l'environnement pendant l'utilisation. L'impact environnemental pendant le cycle de vie d'un film ne se produit que pendant la production et le transport.

Quels sont les impacts probables de l'économie collaborative vers 2030?

Les impacts environnementaux futurs de l'économie collaborative sont en général susceptibles d'être faibles par rapport à l'ensemble de l'économie. L'ampleur des effets est en partie due au fait que les scénarios traitent de secteurs isolés de l'économie et de parts de marché relativement faibles de l'économie collaborative (une part de marché maximale de 10%). Plus important encore, les petits effets nets reflètent également les rebonds associés aux revenus et aux économies générés par les activités de collaboration. Dans les scénarios principaux, il a été supposé que ce revenu supplémentaire soit dépensé par les consommateurs sur d'autres biens et services, selon les modèles de consommation standard. Ces dépenses supplémentaires ont eu leurs propres impacts environnementaux, économiques et sociaux. En utilisant un cadre de modélisation complet tel que E3ME, l'étude a analysé les interactions directes, indirectes et de rebond entre l'économie, le système énergétique et l'environnement. Les résultats montrent clairement un compromis entre les activités économiques et les impacts environnementaux.

Figure 2 : Échange entre les impacts économiques (orange) et les impacts environnementaux (vert) pour les trois scénarios combinés par rapport au scénario de référence.



Dans le scénario ambitieux combiné (supposant environ 10% de parts de marché pour l'économie collaborative dans les trois secteurs) avec des effets de rebond, le PIB devrait augmenter d'environ 4,7 milliards d'euros (ou 0,02%) par rapport au scénario de référence. L'emploi net devrait augmenter d'environ 16 000 emplois (ce qui n'est presque pas différent de la base de référence). Ces petits impacts nets sont le résultat de l'analyse de l'économie dans son ensemble, où les gagnants dans certains secteurs impliqueront des perdants dans d'autres secteurs, tandis que les impacts globaux s'équilibreront. Ce scénario a également l'impact environnemental positif le plus important à mesure que l'adoption des transactions collaboratives augmente. Cependant, s'il n'y avait pas d'effet de rebond des dépenses de consommation sur l'ensemble de l'économie, les impacts environnementaux seraient encore plus positifs.

Le scénario théorique sans effets de rebond (ce qui signifie que les revenus générés ne sont pas dépensés pour d'autres services et biens mais sauvegardés) montre l'ampleur approximative des effets des activités de collaboration sur l'économie et l'arbitrage entre impacts économiques et avantages environnementaux. L'impact sur le PIB est une réduction d'environ 31 milliards d'euros (en particulier dans les secteurs de l'économie traditionnelle lorsque l'argent est retiré de l'économie) et l'impact sur l'emploi de 107 000 emplois perdus (en particulier dans les secteurs économiques traditionnels). Bien que les pourcentages de variation par rapport au scénario de référence demeurent très faibles, les effets négatifs sur l'économie sont beaucoup plus dramatiques que dans le scénario de reprise modérée avec rebond (figure 1), qui suppose le même niveau de transactions économiques collaboratives. Cela montre également que les avantages environnementaux totaux sont plus importants lorsqu'il n'y a pas d'effet de rebond.

Le potentiel de réduction de l'énergie et des émissions est le plus important dans le cas du transport, où le partage de voitures et de véhicules entraînerait une réduction du nombre de voitures et de la distance parcourue. Les hypothèses de l'étude étaient prudentes sur l'hypothèse d'un moteur et d'une voiture électrique efficaces. Si l'on suppose une part plus élevée de voitures électriques, on peut s'attendre à d'autres avantages environnementaux.

Les parts de marché pourraient être plus importantes à l'avenir, mais les conclusions de l'étude seraient toujours applicables, même si elles sont plus importantes, étant donné que les mêmes interactions au sein de l'économie et entre l'économie, l'énergie et l'environnement sont attendues.

Comment l'économie collaborative peut-elle contribuer à la croissance durable de l'économie de l'UE?

Les résultats de cette étude indiquent que de nombreux modèles d'entreprise collaborative peuvent simplement être considérés comme des versions plus efficaces de leurs concurrents directs « traditionnels », avec leurs frontières et leurs différences susceptibles de s'estomper à l'avenir. Cela est dû au fait que les modèles d'affaires collaboratifs deviennent plus matures et que les modèles d'affaires traditionnels deviennent plus dynamiques et adaptatifs à certaines des pratiques de l'économie collaborative. Par conséquent, l'économie collaborative ne devrait pas être une cible spécifique de l'action politique, mais plutôt toutes les activités dans le secteur devraient être ciblées dans le but d'assurer une concurrence juste et équitable entre les modèles commerciaux traditionnels et collaboratifs. Ceci est encore soutenu par l'hybridation apparente de la plate-forme et de l'économie traditionnelle.

Deuxièmement, le manque de données sur la consommation collaborative et l'activité des plates-formes, en particulier au niveau de l'UE, limite une analyse appropriée des impacts environnementaux et socio-économiques. D'autres mesures devraient être prises pour accroître la collecte de données à partir des plates-formes au niveau des États membres et de l'UE, conformément aux exigences de déclaration pour les autres entreprises du même secteur, en particulier pour les plates-formes à but lucratif.

Implications spécifiques pour le secteur des transports

Comme l'impact environnemental de la réduction de la production automobile est plus faible que l'impact environnemental global de l'utilisation de carburant dans la phase d'utilisation des voitures, le potentiel environnemental d'une utilisation accrue dans les voitures est élevé. Le covoiturage et l'auto-partage qui conduisent à une meilleure utilisation des voitures contribuent donc à réduire les impacts environnementaux. Comme les options de transport collaboratif rendent les déplacements en voiture plus attrayants et abordables, cela se fait parfois au détriment de l'utilisation des transports en commun ou des options de cyclisme qui, du point de vue de l'environnement, offrent de meilleures options que la conduite automobile. Par conséquent, les effets néfastes sur l'environnement de l'augmentation de l'utilisation de la voiture devraient être limités en décourageant l'utilisation de la voiture en général et en promouvant des modes d'utilisation plus propres de la voiture. Étant donné que les options de transport collaboratif sont souvent les options les plus efficaces en matière de déplacements en voiture, de telles mesures pourraient encourager l'utilisation de systèmes d'autopartage et de covoiturage au lieu des déplacements en voiture personnelle.

Implications spécifiques pour le secteur de logement

Étant donné que les impacts environnementaux des locations louées par des pairs sont plus faibles avec des taux d'occupation plus élevés, les politiques qui limitent le type de listes proposées sur les plateformes collaboratives aux propriétés où l'hôte a sa résidence principale devraient être encouragées. En limitant le nombre maximum de jours pour lesquels une propriété peut être louée via l'économie collaborative, cela découragerait également les locataires qui achètent une propriété uniquement de la louer, et encouragerait seulement ceux qui résident également dans la propriété à augmenter l'occupation taux de leur résidence. L'impact environnemental de logement collaboratif est également moindre si le bâtiment et la résidence ont une meilleure efficacité énergétique et utilisent des matériaux plus durables. L'étude a également montré que les effets de rebond de l'augmentation des déplacements pourraient avoir un impact négatif sur l'environnement, qui pourrait être atténué par la promotion de moyens de transport plus propres.

Implications spécifiques concernant le partage et la location de biens

Le partage et la location de biens font un meilleur usage de la vie technique (généralement longue) que possèdent les biens de consommation durables. Par conséquent, le partage et la location de biens peuvent aider l'économie de l'UE à se développer de manière durable. Le partage et la location de biens peuvent être facilités par la mise en œuvre d'exigences de conception qui augmentent la durabilité et la capacité de partage des biens de consommation durables, tels que la conception modulaire et les normes de qualité élevées. Le plus important, cependant, est que l'impact environnemental de la logistique derrière la transaction de partage ou de location elle-même reste faible. Par conséquent, des solutions de transport propres pour la logistique du partage et de la location de biens devraient être promues.

En conclusion, l'étude mis en évidence le potentiel environnemental qui peut être tiré des modèles économiques de l'économie collaborative. Une telle transition pourrait créer des opportunités d'écologisation de l'économie via des plateformes innovantes (par exemple en utilisant des voitures plus propres), des décideurs (en promouvant des bâtiments durables et économes en énergie, des transports propres) ou des consommateurs (en faisant des choix). et se comporter). De telles conditions peuvent faciliter le passage à un développement plus durable de l'économie de l'UE.

1 Introduction

1.1 Context

Collaborative platforms, such as Airbnb, Blablacar and Peerby, have changed the ways in which people organise their modes of travel accommodation, transport, professional services or temporary use of tools and equipment. In recent years, collaborative economy platforms have seen tremendous growth from unknown websites to very important market players. Airbnb for example grew from 1 million bookings in 2011 to 52 million bookings in 2016 (CNBC, 2017). Similarly, Blablacar has grown from 1 million users in 2011 to 20 million users in 2015 (Blablacar, 2016). This rise of collaborative economy platforms has sparked widespread interest among policymakers, businesses, and civil society in the future and the potential impact of the collaborative economy.

These new peer-to-peer (P2P) business models are able to offer goods and services that have greater variety, higher availability and lower costs compared to alternatives offered by traditional industry. For example, the world's largest hotel chain, Intercontinental, has only two thirds of Airbnb's capacity, placing the P2P platform in an excellent position to satisfy consumer choice. Similarly, Uber's dynamic pricing strategy is seen as accelerating economic efficiency by providing a highly innovative way for equilibrating demand and supply (Allen and Berg, 2014). Such innovation has led to *Time* magazine including the sharing and collaborative economy as one of the 10 ideas that will change the world (Walsh, 2011). According to scholars in the field, 'the sector will have the biggest impact on society since the Industrial Revolution' (The People Who Share, 2013). Yet, there is clearly a certain 'hype' character in the use of the term 'collaborative economy' too. Facts and realistic trends therefore need to be identified and distinguished from over-optimistic narratives largely based on wishful thinking or marketing motives. Although, 'sharing' of assets seems to create social, economic and environmental benefits on a micro-scale, the macro-level consequences of the collaborative consumption on the economy and the environment are largely unknown.

1.2 The objectives and scope of the study

This study has two key overall objectives:

1. Assess the environmental impact and potential of the collaborative economy by studying its environmental impacts from a life-cycle perspective and
2. Identify the conditions under which the collaborative economy will contribute to sustainable development.

In other words, the study focuses on what the environmental implications of the developments in the collaborative economy are (for both the situation today as well as what the environmental implications might be in the future) and on understanding under which conditions the collaborative economy activities could lead to environmental benefits. Even though the causal chain that leads from more efficient use of productive assets to environmental benefits seems plausible, actual impacts depend on a wide range of factors and assumptions regarding consumer behaviour and the use of assets. Therefore, it is of critical importance that the study takes a broad, life cycle approach to the topic as overall environmental impacts do not just depend on the direct effects from switching between the traditional economic sector and collaborative platforms, but also on direct and indirect rebound effects, e.g. which effects are triggered by the money earned and saved through the changed consumption pattern. For example, if Airbnb makes travel less expensive, then the money saved could be spent on more travel than previously affordable. This could potentially result in the environmental impact from increased travel outweighing other possible environmental savings.

These trade-offs and drivers will become a focal point of this study. This study contributes to filling the knowledge gap regarding the environmental and resource efficiency impacts of newly emerging collaborative economy models. The study identifies where and how the largest resource efficiency gains can be achieved but should also present estimates for employment and economic impacts in order to be able to compare overall environmental effects with potential economic and employment trade-offs.

Ultimately, giving insights on the environmental potential of the collaborative economy and its trade-offs with economic and employment effects should help policy makers define the most appropriate policy action in this rapidly expanding and developing field.

Specific objectives

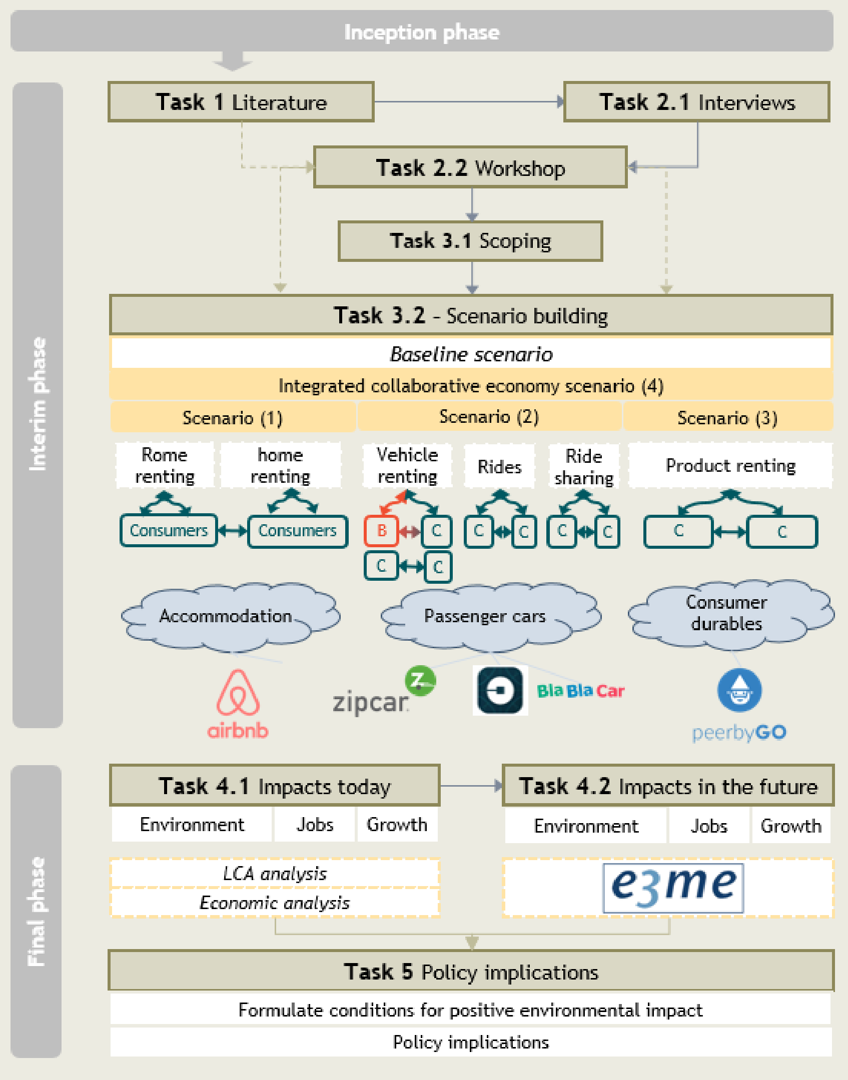
In order to achieve these overall objectives, the research activities in our study are jointly designed to:

1) Gather evidence on the impact of the collaborative economy on consumption
2) Quantify and assess the direct and indirect environmental and rebound effects on micro and macro level
3) Derive the corresponding effects on employment (number of jobs) and economic growth of the collaborative economy
4) Based on these insights, explain under which conditions and in which cases the collaborative economy could yield positive environmental impacts and how EU policy could further strengthen these impacts. In addition, propose policy action to mitigate possible negative impacts.

1.3 Overview of the overall approach to the study

Figure 1-1 illustrates the overall approach to the study and the tasks that were performed. The study started with a thorough literature review of the existing information on the definitions, scope and overview of the environmental, economic and social impacts of the collaborative economy. The project team also conducted 10 interviews with stakeholders in the field. Using these findings, the scope of the collaborative economy for the purpose of this study was defined and analysed. Five detailed case studies were developed for the most important platforms in three sectors (accommodation, transport and consumer durables): Airbnb, Uber, Blablacar, Zipcar and Peerby. In addition, the project team further elaborated on the expected impacts of the collaborative economy on these case studies by developing three sector-specific scenarios. This allowed an illustration of the expected impacts of the collaborative economy towards 2030, and the main differences between an economy with and without further growth of the collaborative economy towards 2030. These findings and the scenario assumptions were discussed and validated at a workshop with stakeholders. The three scenarios serve as input to the Life Cycle Assessments of the collaborative economy business models, which is used to determine and analyse in detail the environmental impacts of the collaborative economy today. The E3ME model was then used to assess the medium-term environmental, social and economic impacts of the collaborative economy. The findings of these are presented in section 4 and 5 of this report. Section 6 will present conclusions and policy implications.

Figure 1-1 Schematic overview of the study approach



Legend: B = business, C = consumer

1.4 Study limitations and challenges

The main challenge faced in the study has been the lack of data on collaborative economy on EU level. To date, most of the studies on this topic relied on literature predominantly discussing the different business models, the definition and scope, and on scarce data provided by the platforms themselves. However, no systematic data collection on platforms' activities in the EU have taken place yet. The market is very young and dynamic, which contributes to this challenge. As such, the study relied on this limited data to derive estimates and make assumptions.

Another important factor has been the difficulty in defining and scoping the collaborative economy as even with the Commission's definition, there is a scope for interpretation. The collaborative economy is part of the larger platform economy, which aggravates the problem of defining the 'collaborative' part of it. Moreover, the collaborative economy as well as the traditional economy business models are evolving, which makes defining and scoping them increasingly difficult.

Lastly, the results of the LCA and macro-econometric modelling relied on study's estimates and assumptions with respect to the scope of the collaborative economy (the choice of platforms), the current and future market size in terms of revenues and market shares, and what shifts drive the economic changes. The macro-econometric modelling further relied on assumptions on consumer behaviour – how do they spend the income they generate from providing services on the platforms, as well as on the limitations of such a macro-econometric model to model peer to peer activities. As such, the results of this study might not be always comparable with results of other studies.

Nevertheless, the study methodology was transparent and sufficiently robust to answer the question of the environmental potential of the collaborative economy in the EU.

2 The scope and definition of the collaborative economy

In order to determine the environmental potential of the collaborative economy and its socio-economic impacts that it triggers, it is very important that we define what we mean with the collaborative economy: What are collaborative business activities? What are collaborative business models and what type of economic activities fall under the umbrella of the collaborative economy? This section provides the definition and the scope of the collaborative economy that we applied for this study.

Section 2.1 prepares a working definition of the collaborative economy for this study. Section 2.2 takes this definition further and aims to operationalise it by developing criteria to determine whether economic activities can be classified as 'collaborative' or not. Section 2.3 then prepares a typology of most common collaborative business models that will be used in the remainder of the study as case studies to determine the environmental potential of the collaborative economy. Using this developed scope, Section 2.4 determines the size of these business models in the EU currently and the collaborative economy as a whole. To summarise, Section 2.5 outlines which activities are therefore *excluded* from our definition of the collaborative economy.

2.1 What is the collaborative economy?

Ever since platforms like Uber and Airbnb have made it into the lives of the general public, the attention from scholars and institutions to get a grip on consumption models based on 'sharing' assets (your car, your home, your tools) has been increasing. The popularity and uptake of these new consumption models is rising rapidly and so are the numbers of activities emerging across a variety of sectors (accommodation, travel, finance, education, consumer goods, etc.). Sharing is, however, not new. Humans have always shared. The new activities are therefore by some (including the European Commission) referred to as 'the collaborative economy' instead of the sharing economy. Others call it the peer-to-peer economy or the on-demand economy. According to Schor (2014), it is namely 'stranger sharing' that defines the new type of activities that are emerging lately. Facilitated by online digital platforms, we can now share assets with people we did not know before.

2.1.1 Defining collaborative economy in this study

Still, due to the large variety in emerging online platforms and their activities scholars and experts struggle to agree on the common denominators that underpin the transactions that these platforms facilitate. As a result, many of them develop their own definitions to describe broadly similar models or a framework encompassing them. These are broadly similar conceptually, but can often entail the inclusion of very different business models. Notable definitions of the term include:

- **Collaborative Economy** (an online portal on the topic): "*an economic system of decentralized networks and marketplaces that unlock the value of underused assets by matching needs and haves, in ways that bypass traditional institutions*" (Collaborative Lab (NESTA), Oxford University and ShareNL)
- **European Parliament**: "*the use of digital platforms or portals to reduce the scale for viable hiring transactions or viable participation in consumer hiring markets (i.e. 'sharing' in the sense of hiring an asset) and thereby reduce the extent to which assets are under-utilised" (European Parliament, 2016)*

- **European Commission**: "*Business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals" (European Commission, 2016)*
- **Rachel Botsman**: "*an economy built on distributed networks of connected individuals and communities versus centralized institutions, transforming how we can produce, consume, finance, and learn*" (Botsman, 2013)

A common thread across the definitions is the inclusion of **transactions facilitated by digital platforms** aiming to make use of **underutilised assets**. Consumption in the collaborative economy is based on access, rather than ownership. ShareNL, a Dutch sharing economy think-tank, highlights that ownership is the key determinant for distinguishing between the collaborative and traditional economy (ShareNL, 2015). In the collaborative economy, they argue, **assets are owned by individuals** and therefore create peer-to-peer (P2P) and consumer to business (C2B) transactions. Outside the scope of the collaborative economy, businesses facilitate B2C and B2B type transactions. This leaves a grey area of, for example, vehicle sharing companies (such as Car2Go) that are based on B2C transactions but with a certain collaborative nature of sharing an asset to increase its utilisation. Some parties therefore place it within the collaborative economy scope, whereas others do not. Section 2.2 details this discussion further. Compared to the traditional economy, the matching of supply and demand is also done predominantly **online** compared with 'offline' in the traditional economy.

This study follows the European Commission's definition of the collaborative economy and uses the distinction highlighted by ShareNL to classify different business models (see section 2.2.2). According to the Communication, *A European Agenda for the collaborative economy (2016)* the collaborative economy encompasses (European Commission, 2016):

Business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals. Transactions do not involve a change of ownership and be carried out on a profit or non-for profit basis. The collaborative economy involves three categories of actors:

1. Providers – *who share assets, resources, time or skills (peers or professional services providers)*

2. Users

3. Intermediaries that connect via an online platform providers and users

Even though this definition provides a useful anchor to the remainder of the study, there are still various dimensions to the definition that can be interpreted in a number of ways (e.g. "often provided by private individuals" and how long is "temporary") and includes a wide range of platforms (involving both goods and services). Frenken & Schor (2017) also rightfully note that: "*we will be unable to come up with coherent answers [about the entity called the sharing economy] if the object itself is inconsistent" (Frenken and Schor, 2017).* Therefore, rather than aiming to develop a coherent and all-encompassing definition, we first illustrate the different types of transactions and business models that can be distinguished as part of this collaborative economy definition. We then make our own choices as regards to what is included and excluded in our definition of the collaborative economy on the basis of a number of inclusion criteria for platforms. We also develop the characteristics of 'representative' business models that jointly cover the variety of different collaborative economy activities, so that the environmental potential of these can be established.

2.1.2 Different business models, sectors and activities

Just like the definitions for the sharing economy and the collaborative economy differ in the literature, so do the categorisations of the different activities and business models that used to cluster the variety of different platforms active in the collaborative economy. Based on the review of the literature, we define a number of defining characteristics for the different business models of collaborative economy transactions:

1. Market or sector and underlying assets
2. Transaction relation
3. Transaction mode.

1) Market or sector and underlying assets - there are collaborative business models and activities across a wide variety of sectors, for example visually mapped by Owyang (2016) who identifies collaborative consumption in the goods, money, accommodation, travel, health, food, utilities and many other sectors. ShareNL (2015) classified the sectors into: goods, space, mobility, energy, money, knowledge and services. **Sector-specific differentiations** can render collaborative economy models more specific and help distinguish between platform characteristics. Further specifying the **underlying underutilised asset** within each sector helps to further distinguish the different business models. For instance, accommodation models are often divided between rentals of living spaces (e.g. AirBnB), sharing of living spaces (e.g. CouchSurfing), sharing of workspaces (e.g. Studiomates), sharing of storage space (SharemyStorage) or others. In **transport models**, distinctions are made between vehicle hiring (e.g. DriveNow, Cambio), car sharing (e.g. Uber, Taxify) and ride sharing (e.g. BlaBlaCar, UberPop, EasyCarClub).

2) Transaction relation - another defining feature of the different business models active in the collaborative economy is the **transaction relation** between the three key actors in the collaborative economy (as mentioned in the EC definition noted on the previous page: users, providers and platforms). In the 'traditional' economy, the providers of goods and services are often businesses, whereas the users can be businesses and consumers. Therefore, in the traditional economy we observe mostly **business-to-business (B2B)** and **business-to-consumer (B2C)** transactions. Transactions in the collaborative economy on the other hand are "predominantly provided by individuals" (EC definition) and therefore focus on **peer-to-peer (P2P)** transactions. According to some, certain **business-to-consumer (B2C)** transactions (e.g. DriveNow or Cambio in the transport sector) can also be considered the collaborative economy (but not the sharing economy), whereas for others (such as ShareNL, 2015) the collaborative economy should only encompass P2P transactions. In any case, business models based on P2P relations (e.g. ZipCar, SnappCar, WhipCar) are substantially different from B2C models (e.g. DriveNow, Cambio), even though both involve the 'sharing' of cars. The transaction relation is therefore very defining for the type of business model.

ShareNL (2015) also specifies the **'peer-to-business-to-peer'** transaction relation as capturing the latest trend within the collaborative economy of platforms providing more services to both users and providers and providing more trust to the transaction. This trend acknowledges that certain transactions in the collaborative domain are not "about sharing at all" (Bardhi and Eckhardt, 2012). For the sake of simplicity, we classify these activities also in the P2P group, but it does lay bare the different roles that the platforms can have. The EC communication already explains that platforms can act as mere intermediaries and information providers to users and providers as well as offer additional services (such as insurances). In other instances, the platforms are also the providers (e.g. Cambio). In order to keep the distinction clear, we consider the role of platforms in the collaborative economy to be intermediaries. As a result, unlike traditional business models, collaborative platforms themselves do not own the goods or services they provide, but merely act as intermediaries. There is also certain similar overlap on the side of providers. Depending on the sector, goods or service providers are required to be registered as micro-entrepreneurs (e.g. Uber drivers, AirBnB accommodation providers in certain cities), and therefore act as businesses. Even though these providers might have a different legal status as workers, we consider them still to be consumer/peer providers rather than classifying them in the B2C category.

3) Transaction mode - the *way in which* the three parties engage with each other is another defining aspect of the different business models in the collaborative economy (monetary based or non-monetary based). Schor and Fitzmaurice (2015), as well as Owyang (2013) offer concrete conceptual classifications of types of activities, such as **renting, sharing, lending and swapping**. Belk (2010) also makes a valuable contribution by distinguishing sharing from gift giving and commodity exchange, the latter resembling true market exchanges and the first resembling social interactions (often non-monetary based). Buying and donating might also be possible exchange modes, but we do not consider these as part of the collaborative economy as they lead to a transfer of ownership, whereas collaborative consumption is based on non-ownership based consumption. These transaction modes resemble transactions involving physical goods that one can physically exchange, either involving a payment or not involving a payment. However, the collaborative economy also includes **services** of many forms for which the above transaction modes do not apply. These can relate to true labour services (e.g. TaskRabbit), but also services using 'under-utilised' assets, such as Uber.

2.2 Inclusion criteria to define collaborative economy activities

The technical specifications to this study limited the scope of this study to the collaborative activities in three markets: **accommodation**, **transport** and **consumer durables**. But even with the definition of the collaborative economy included in the EC Communication of 2016 in mind and this focus on these three focus markets, there are a wide range of activities in these sectors that should either be classified as part of the 'collaborative economy' or the 'traditional economy'. Some activities clearly fit in either category, but there is also a grey area of activities in all of the markets that could either fall in or out of the scope of this study.

First, we take our working definition of the collaborative economy (the definition of the collaborative economy included in the EC Communication on the collaborative economy of 2016) as a starting point. Second, we take the criteria included in the technical specifications of this study (that already defined the scope of the study) to define the transactions involved in the collaborative economy as:

1. From peer to peer (P2P) and business to consumer (B2C);
2. Where consumers get temporary access to a, in particular, under-utilised good as opposed to the permanent transfer of ownership of that good;
3. Regarding/including physical assets;
4. Facilitated by a digital platform;
5. For cost-sharing or profit seeking purposes, mainly employing a (short term) rental model;

We develop these criteria further in order to be able to more distinctly tell which activities in the three focus markets are regarded as part of the collaborative economy and which are regarded part of the traditional economy. The collaborative economy in this study includes transactions:

1. **That are predominantly from Peer-to-Peer (P2P) and exceptionally[1] from Business to Consumer (B2C)**
    a. The EC definition of the collaborative economy mentions "temporary usage of goods and services, often provided by private individuals", which implies a focus on transactions where peers/consumers own assets. As illustrated in section 2.1, many of the existing contributions also note that in the collaborative economy, (under-utilised) assets should be owned by individuals.
    b. B2B and C2B transactions are excluded, because of criteria number (1)
2. **That aim to increase utilisation of underutilised goods/physical assets**
    a. This criterion is taken directly from the criteria included in the technical specifications. It´s an important building block for the collaborative economy: using digital platforms to create easier access to otherwise underutilised goods for consumers.
    b. This criterion implies an explicit **exclusion** of **services-based transactions** (e.g. Taskrabbit, Spotify or Netflix) and collaborative production, education and finance business models from the Botsman (2010) classification.
3. **Which facilitate temporary access to a good as opposed to the permanent transfer of ownership of that good**
    a. This criterion is also taken directly from the criteria included in the technical specifications of this study and forms the second important building block of the collaborative economy: using digital platforms to create access to goods (and services) without the need to own the underlying good or asset. One of the most important drivers of the collaborative economy is the possibility to access, rather than own items.
    b. This criterion also implies that this study does not include "redistribution" or second-hand markets (such as eBay and GumTree) as collaborative economy.
    c. "Temporary access" is meant to imply a maximum use of 90 days per year (common term used in literature and some cities have adopted this term for Airbnb hosts).
4. **Which are facilitated by a digital platform that acts as intermediary**
    a. Collaborative economy activities must take place on an online platform that facilitates the transaction. In line with the European Commission's (2016) Communication, such platforms must be distinct legal entities from both the providers and the consumers transacting on it. In case the platform facilitates P2P transactions, the platform itself does not own the items provided on it, but increases the interaction between providers and consumers through services such as geolocation, advanced search criteria, trust-building mechanisms, provision of online payment systems, etc.

[1] There is much discussion in the literature whether B2C business models should be considered part of the collaborative economy as they often lean towards traditional service suppliers (e.g. zipcar that is almost a traditional rental car company). The focus in this study is on P2P business models – like in the EC definition – but will include B2C models depending on the market and the type of B2C platforms in question (assessed in a pragmatic and ad-hoc basis).

b. In case the collaborative transactions concern a B2C relation, the platform often fulfils the role of both 'provider' and 'intermediary'. For example, for the B2C vehicle rental model in the transport sector both the provider and the platform are the same entity (that owns the assets), such as ZipCar and Cambio. These models are a grey area for the collaborative economy as they aim to increase utilisation of assets, but can also be seen as innovations of traditional car rental models (such as Avis) and do not involve many collaborative or sharing characteristics (as demonstrated by Belk, 2010). This study has decided on a case-by-case basis whether these B2C models are in- or excluded from the scope (see subsection 2.3).

5. That occur for cost-sharing or profit-seeking reasons, mainly by employing a (short term) rental model

a. Collaborative economy transactions must be profit-driven or at least driven by the need to share the costs of use between peers (cost-sharing). The European Commission (2016) Communication extends the scope of the collaborative economy to profit and not-for-profit activities, but in practice the difference is difficult to make. Even transactions that do not involve a monetary transaction to gain short term access (e.g. CouchSurfing or Peerby) are done with a 'cost-sharing' motive in mind: the user saves on having to buy the asset and the provider can get more 'utility' and often some favours from the user from the transaction. Therefore, both non-monetary and monetary transactions are included in the scope of our study, also because the environmental impact from non-monetary based collaborative activities might be significant.

b. This criterion refers solely to the collaborative economy transaction and not to the business model of the platforms, which can ask fees in a variety of ways to cover their costs. It therefore assumed that the platforms within the scope of this study, which are gathered in the database described below, are financially sustainable.

c. The study considers mainly renting as transaction mode, but in line with the literature findings also considers other possible modes of exchange for assets: lending, sharing and swapping, but not buying or donating as these represent a transfer of ownership.

6. That are facilitated by a platform with a market presence in the EU

2.2.1 Collaborative economy areas excluded from this study's scope

Following the description of the collaborative economy included in the EC Communication on the collaborative economy of 2016, some online platforms are immediately out of the scope of the collaborative economy. Thus, we have excluded them from this study:

- **B2B online platforms** - B2B platforms offer traditional organisations with all functions that businesses use to run or are running in house under different departments.
- **B2C and P2P platforms facilitating the transfer of ownership** - Second hand goods resale platforms are directly excluded from the definition we have considered for this study. However, in other definition of the sharing economy include re(sale) goods platforms. In our platform database 22.7% of platform operate in this sector. Additionally, other online platforms that could be considered part of the collaborative

economy platforms have been excluded as they host activities that have a small environmental impact

- **Platforms operating in other sectors –** such as on-demand household services, on-demand professional services, collaborative finance and collaborative education.

The next subsection introduces a typology of representative business models that illustrate the implied scope of the collaborative economy using these inclusion criteria.

2.3 Representative business models in each of the markets

Given our working definition and the inclusion criteria developed above, what characterises the different collaborative economy activities in these markets? And how are they different from one another? This section develops a few representative business models that should jointly cover the vast majority of collaborative economy activities that fall within the scope of this study.

2.3.1 Defining characteristics of collaborative economy business models

The review of literature found that there is an extensive range of business models used by collaborative economy platforms. However, no generally-agreed framework for classifying these platforms exists. For this study, it is most useful to describe the differences between collaborative economy activities based on the three defining characteristics that we introduced in Section 2.1. They namely trigger the largest differences in environmental potential between the different business models. We formulated these dimensions on the basis of our understanding of the literature and initial interviews with experts. Each unique combination of these defining characteristics can be seen as a representative business model:

1. Market or sector and underlying assets

a. The market to which the transaction refers is defined by the scope as either accommodation, transport or consumer durables
b. The underlying asset on which the transaction is based (e.g. rooms or homes, cars, selected consumer durable goods)
c. For accommodation, we focus on entire homes and rooms as underlying assets
d. In the transport market, we focus on passenger cars as underlying assets, for example leaving out platform matching car owners with nearby parking spaces.
e. In the consumer durables market, we focus on 'shareable' and 'durable' consumer goods. The case study on the consumer durables market for the scenario building (on Peerby – see Annex 7) presents these type shareable and durable consumer goods in more detail. For the life cycle assessments, two representative products are selected.

2. Transaction relation

a. As defined by the scope in this study as P2P and exceptionally as B2C (case by case basis). The case of Uber is considered a B2C transaction as in the EU, Uber drivers are licensed taxi drivers representing a micro business. Also, the

B2C vehicle sharing case is considered even though it is a 'border-case' of being included in the collaborative economy scenario.

3. Transaction mode

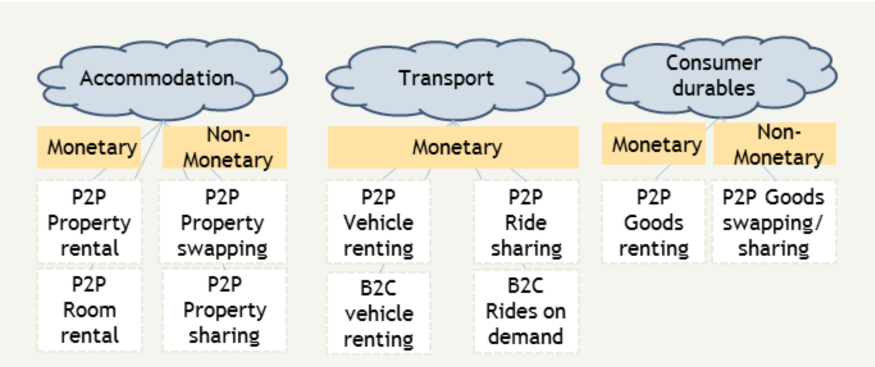
a. As presented in the literature review (Annex 1) and in the scope above, all transaction modes that facilitate non-ownership based consumption of a good are considered and can each be viewed as leading to a unique business model: **swapping**, **renting** and **sharing**. Sharing transactions can involve a monetary exchange but not necessarily. Both options are included in this study as either in principle involves underlying 'cost-sharing' motives. Renting includes all short-term access to a good for involving a monetary exchange (therefore also 'pseudo'-sharing activities like AirBnB that are based on 'sharing your home', whereas one actually rents out a room). Swapping is often non-monetary and involves temporary access to a good or service in exchange for your own good or service.

b. When the transaction involves a physical good, but the transaction is actually about a service (such as for Uber), we denote the transaction mode as a '**service**'.

2.3.2 Representative business models

Using the above mentioned three defining characteristics of business models and the scope of our study, we are able to develop a business model typology that reflects the collaborative economy in scope of this study. Figure 2-1 illustrates this typology. Each of the representative business models contains a unique combination of each of the three defining characteristics that are applicable in that market: Underlying asset, transaction relation (P2P or B2C) and transaction mode (renting, sharing, swapping or a service).

Figure 2-1 Collaborative economy business model typology



Source: Own illustration

Accommodation sector

Collaborative economy in the accommodation sector could be four types of business models, namely home rental, room rental, home sharing and home swapping. Their characteristics based on the classification developed above and using findings from empirical observations in existing literature are presented in Table 2-1.

Table 2-1 Business models in the accommodation sector

	Assets		Transaction type		Activity			Matchmaking		Revenues	
	Rooms	Homes	B2C	P2P	Rent	Share	Swap	Demand	Supply	For-profit	Cost-sharing
Room renting											
Home renting											
Home sharing											
Home swapping											

Room renting models are peer to peer transactions, where personal providers rent out their spare rooms to other people looking for affordable accommodation. These transactions are for-profit' in the sense that they are based on a monetary exchange for the rental. Platforms match peers according to supply and demand, i.e. platforms list a range of available rooms, which peer consumers can choose from and platforms list of listings in which people are looking for a room. Examples include StudentFlat.cz (both demand and supply matchmaking) and BedyCasa, as well as property rental platforms that also offer property sharing such as Airbnb.

Home renting models are P2P transactions, where personal providers rent out entire properties. These transactions are 'for-profit' in the sense that they are based on a monetary exchange for the rental. Platforms match peers according to supply, i.e. platforms list a range of available properties for short-term rent, which peer consumers can choose from. Examples include Wimdu, AirBnB and Homeaway.

Home sharing models are largely non-monetary, P2P transactions, where personal providers offer a space (a couch) in existing properties to share with other peers. They are based on cost-sharing principles (guests might compensate owners in-kind or with a small fee), where no monetary transaction is expected. Platforms match peers according to supply and demand, platforms list a range of personal providers looking for shared accommodation which peer providers can choose from or platform list a range of personal providers offering shared accommodation which peer consumers can choose from. Examples include Couchsurfing (supply matchmaking).

Home swapping models are peer-to-peer and cost-sharing transactions, where peers can swap their properties thereby significantly reducing costs for holidays or travel as they do not pay for housing. The transaction is non-monetary based as the exchange is in-kind (a house swap). Platforms match peers according to the supply, i.e. list of peers offering their properties for a short-term swap, which other peers can choose from. Examples include Trompolinn, GuesttoGuest and NightSwapping.

2.3.3 Transport sector

Table 2-2 illustrates the characteristics of the three unique business models considered as part of collaborative economy in the transport sector in this study.

Table 2-2 Business models in the transport sector

	Assets	Type		Activity				Matchmaking		Revenues	
	Cars	B2C	P2P	Rent	Share	Swap	Service	Demand	Supply	For-profit	Cost-sharing
P2P Vehicle rental											
B2C Vehicle rental											
Ride sharing											
Rides on demand											

P2P Vehicle renting models are for-profit (monetary-based) transactions, where personal providers can rent out their cars and consumers can rent cars by subscribing to the car rental service in the platform (e.g. membership fee). Platforms match according to supply, i.e. platforms list a range of available cars being supplied personal providers, where peer consumers can choose from.

B2C Vehicle renting models are for-profit (monetary-based) transactions, where consumers can rent cars by subscribing to the car rental service in the platform (e.g. membership fee) or renting the car instantly on the platform. Platforms match according to supply, i.e. platforms list a range of available cars being supplied, which peer consumers can choose from, but also on the basis of demand. Platforms will acquire more cars when the demand for the service is rising.

Ride sharing models are peer-to-peer and cost-sharing transactions (monetary-based), where peers can share rides. Platforms match according to supply or demand, i.e. platforms list a range of available car rides being offered by other peers, which peer consumers can choose from. BlablaCar is one of the most popular car sharing platforms worldwide, the platform matches according to supply. Some other local platforms, such as Jojob match according to both demand and supply.

Ride on demand models are for-profit transactions (monetary-based), where professionals or personal providers can offer to pick up peers that want to go to a specific place in a concrete time or in other words, professionals or personal providers offering taxi services. Platforms match according to demand, i.e. platforms will match a service request with an available driver nearby. Uber provides this demand matchmaking services as well as other platforms such as Taxify, Hailo and Taxibeat. It could be argued that these business models fall out of the scope of the collaborative economy as there are few sharing or collaborative characteristics in the UberX, Uberblack and UberPoP business models and those business models can be viewed as process innovations in the taxi-sector that make the industry more efficient (increase utilisation of vehicles). However, since these business models fall match the inclusion criteria developed for this study (notably the platform does not own the assets, transactions are facilitated by a digital platform and concern underutilised vehicles), there are considered inside the scope of the collaborative economy.

Consumer durables

Table 2-3 illustrates the characteristics of the two unique business models considered as part of collaborative economy in the consumer durables sector in this study.

Table 2-3 Business models in the consumer durables sector

	Transaction type		Activity				Matchmaking		Revenues	
	B2C	P2P	Rent	Share	Swap	Service	Demand	Supply	For-profit	Cost-sharing
Goods renting		■	■				■	■	■	■
Goods sharing		■		■	■		■	■		■

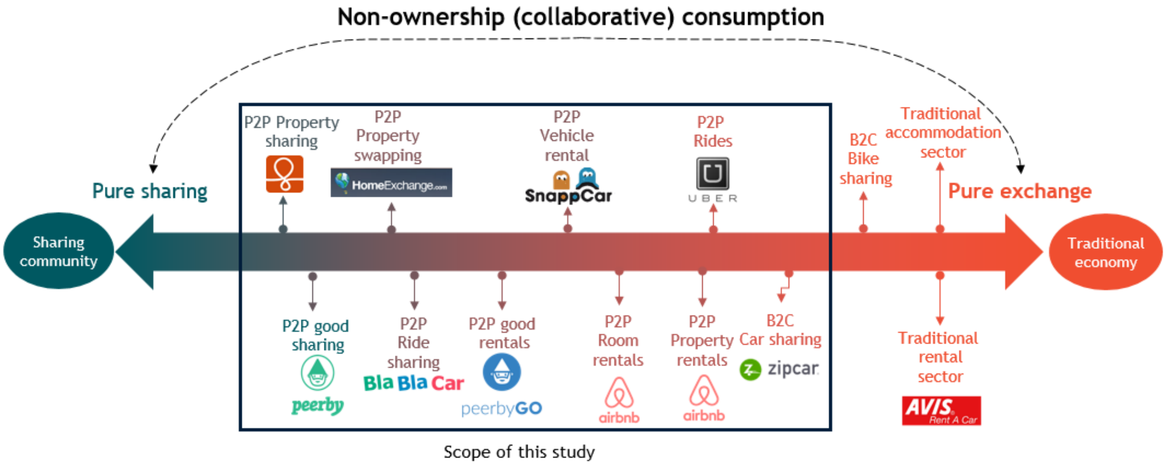
Good renting models are for-profit or cost-sharing transactions involving a monetary exchange, where personal providers can offer goods that are underutilised. P2P platforms match according to demand, i.e. platforms will match a request with peers offering the requested good (e.g. Peerby). According to a research by the European Parliament (2016), the most important Classification of Individual Consumption According to Purpose (COCOIP) categories where collaborative economy platforms operate are: **clothing and footwear** (EUR 800 per person per year), **recreational items** (EUR 300/person/year), **goods for routine household maintenance** (EUR 200/person/year). In addition, the five most rented products on Peerby Go, arguably the largest consumer durables collaborative platform in the EU, were the following in August 2016: cargo bike, projector, party tent, pressure cleaner, laminate cutter, wheelchairs, folding tables, steam cleaners and hoisting ropes. It is worth noting thought that Peerby has by far its largest user based in the Netherlands, explaining the dominance of certain product categories in this list.

Good swapping and sharing models are cost-sharing and P2P transactions without involving a monetary exchange, where peers can swap/share goods depending on their needs. Platforms can match according to demand, i.e. platforms will match sharing requests with peers willing to share (e.g. Peerby Classic) or supply-driven, where peer providers post a listing advertising a good they own. Goods sharing and swapping platforms, such as Vinted, SwapStyle.com or Swapz combine demand- and supply-models.

Synthesis of the business model typology

The representative business models identified and described in this section will form the units of analyses studying the environmental implications of the collaborative economy. Even though this typology distinguishes the business models according to some key defining features, the collaborative economy is home to many different variants and combinations of these business models, such that there are platforms and activities that represent a combination of business models. The literature review also found that certain collaborative economy activities are much more like true 'sharing' than others (Bardhi and Eckhardt, 2012). In a recent contribution, Habibi, Kim and Laroche (2016) consolidate the differences in collaborative economy activities in a dynamic framework that illustrates well how certain collaborative economy activities can be characterised and whether they should be considered as part of the collaborative economy or not. They introduce a continuum ranging from pure sharing activities and pure (transactional) exchange activities (in the traditional economy, like offline car rentals). We have adapted this continuum to our study and placed the representative business models introduced above on the continuum. See Figure 2-2.

Figure 2-2 Classification of business models along the sharing-exchange continuum



Source: Own illustration based on Habibi, Kim and Laroche (2016)

The defining characteristics introduced at the start of this section determine to a large extent where business models are located on the continuum. Sharing activities are typically non-monetary based, from peer to peer, conducted for cost-sharing reasons and include sharing and swapping exchanges also to realise social interaction. On the right, the more market exchange type business models are located, those where there are more business to consumer transactions, often based on monetary rental exchanges without a strong social element.

2.4 The size of the collaborative economy today

To determine the size of the collaborative economy today, this study created a database of 749 collaborative economy platforms of various types. The database builds upon an earlier database used in the DG JUST exploratory study on consumer issues in the sharing economy (European Commission, 2017). The DG JUST database has been revised in this study to cover business models which were not in the scope in the exploratory project but are included in this study. The database developed in this study assesses the business model characteristics of the 749 collaborative platforms identified in the EU, according to the inclusion criteria specified in Section 2.2. The following platform characteristics were assessed, for each:

- **Origin**: Country of origin, as well as countries of operation;
- **Identification**: Website and year of establishment;
- **Size**: Number of daily unique website visitors, and where available also the number of registered consumers and providers, as well as the number of listings;
- **Availability**: whether the platform is available via a mobile app;
- **Scope relevance**: whether the platform is within the scope of this study or not;
- **Business model characteristics**: we evaluated seven business model themes, and a total of 30 indicators describing them.

Based on our database, 27% of the identified collaborative economy platforms in the three sectors fall within the scope of this study, according to the inclusion criteria specified in section 2.2. Of the 204 platforms that fall within this study's scope, 53% are from the transport sector, while 29% and 20% belong to the accommodation and consumer durables sectors, respectively.

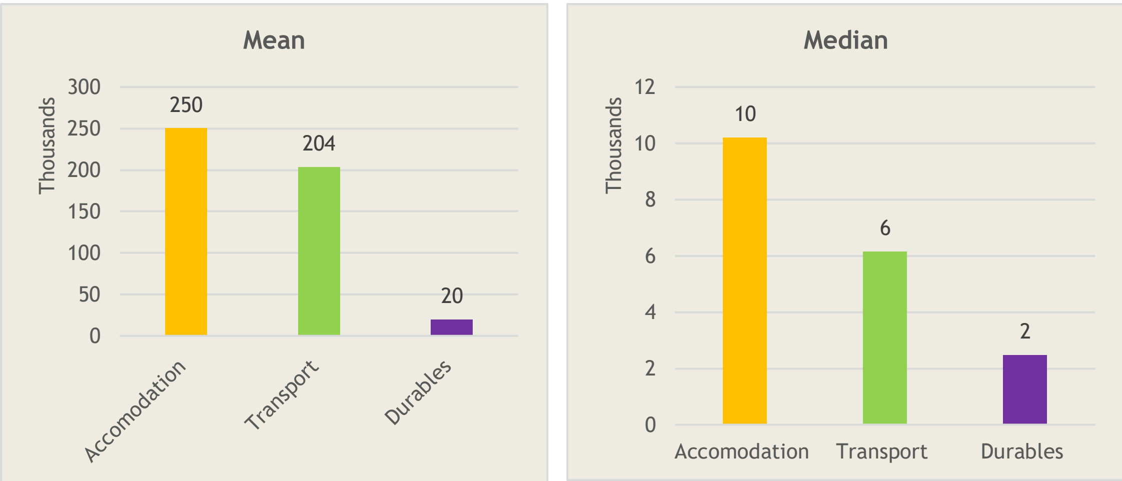
The study's database allows us to observe the prevalence of the various business model characteristics identified in sub-section 2.3.1. In terms of **sub-markets**, rental business models tend to dominate, especially in the accommodation and consumer durables sectors, where about 80% of platforms operate this way. Sharing is prevalent especially in transportation, but also in accommodation, as Table 2-4 shows. It is important to note that a platform may belong to more than one sub-market. This is the case for 23 platforms (14% of the eligible sample).

Table 2-4 Prevalence of the identified sub-markets among the platforms within each main market

Accommodation	
- Property rental	61%
- Property sharing	45%
- Property swapping	20%
Transport	
- Vehicle rental	38%
- Ride sharing/carpooling	54%
- Ride on demand	6%
Consumer durables	
- Durable goods renting	77%
- Durable goods swapping	22%

In terms of size, the vast majority of platforms that are within scope (165, or 80%) do not give details on the number of registered peers. A more reliable indicator of popularity can be given by the number of monthly unique website visitors, using freely-available website traffic counters such as HypeStat.com. Based on this metric, we could retrieve information for 181 platforms. Based on this information, we find that accommodation platforms are the most popular and durables having the least visitors.

Figure 2-3 Mean and median number of monthly unique website visitors on accommodation, transport and consumer durables platforms in the database[2]



The cross-sector comparison by monthly unique website visitors should be interpreted with caution, as not all collaborative economy platforms solely operate via websites. Indeed, 80 platforms (39% of the sample of platforms within scope) also feature online apps,

[2] Information on monthly unique website visitors was retrieved from the website HypeStat.com as of March 20th, 2017.

particularly in the transport sector (56% of platforms). In the accommodation sector, only 20% of eligible platforms have apps and 22% of the transport in the consumer durables sector have an app.

In terms of **transaction relation**, most of the collaborative economy platforms in this study's samples, in each of the three sectors considered, tend to facilitate P2P, rather than B2C transactions. However, 13% of the platforms within the scope of this study facilitate both types of transactions.

Table 2-5 Prevalence of P2P and B2C transaction relations within this study's platform sample, per main sectors

Sector	P2P prevalence	B2C prevalence
Accommodation	91%	23%
Transport	76%	27%
Consumer Durables	87%	15%

Transaction modes follow a similar trend as hinted by the sub-markets presented in Table 2-5. As observed in Table 2-6, most accommodation and consumer durables platforms in our sample feature renting transactions among peers, while sharing transaction are more prevalent on transport platforms.

Table 2-6 Types of transaction modes prevalent within this study's platform sample, per main sectors

Sector	Sharing	Renting	Swapping
Accommodation	45%	73%	3%
Transport	56%	44%	0%
Consumer durables	7%	72%	20%

Most of the in-scope platforms identified in this study's sample are local, while under 40% of them are international. The sector with most international platforms is the accommodation sector with 39% of such platforms having an international reach. By contrast, only 19% of consumer durables platforms are international.

Table 2-7 Types of reach within this study's platform sample, per main sectors[3]

Sector	Local	International
Accommodation	56%	43%
Transport	78%	21%
Consumer durables	82%	17%

[3] In the case of certain platforms in the consumer durables sector, it was impossible to assign one dimension or the other, as there is not enough publicly-available information to determine the correct attributes.

In terms of the geographical coverage, most platforms from the study's scope operate in Spain (71 or 34.8%), France (57 or 28%) and Germany (55 or 27%). On the contrary, the smallest number of platforms operate in Cyprus (17 or 8%), Latvia (18 or 8.8%) and Malta (19, or 9%). As can be seen in figure 2-4, all of the Member states have been represented in terms of platforms within the scope fairly proportionally taking into consideration their population. On average, the number of countries in which an accommodation platform operates is 9.42, 2.51 countries per transport platform and 1.73 country per durables.

Figure 2-4 Geographical coverage

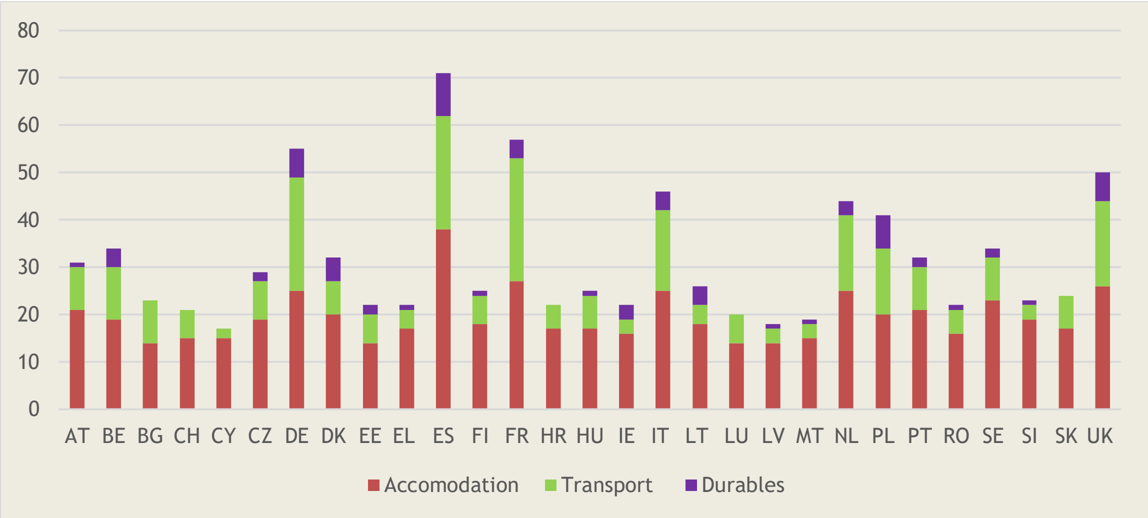
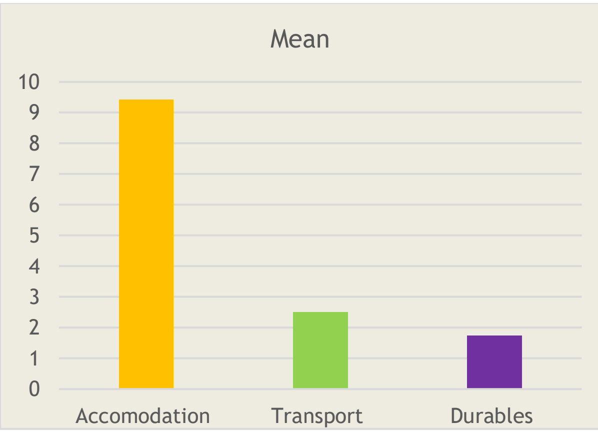


Figure 2-5 Mean number of countries per platform in a sector



2.4.1 Spending and revenues on collaborative economy platforms

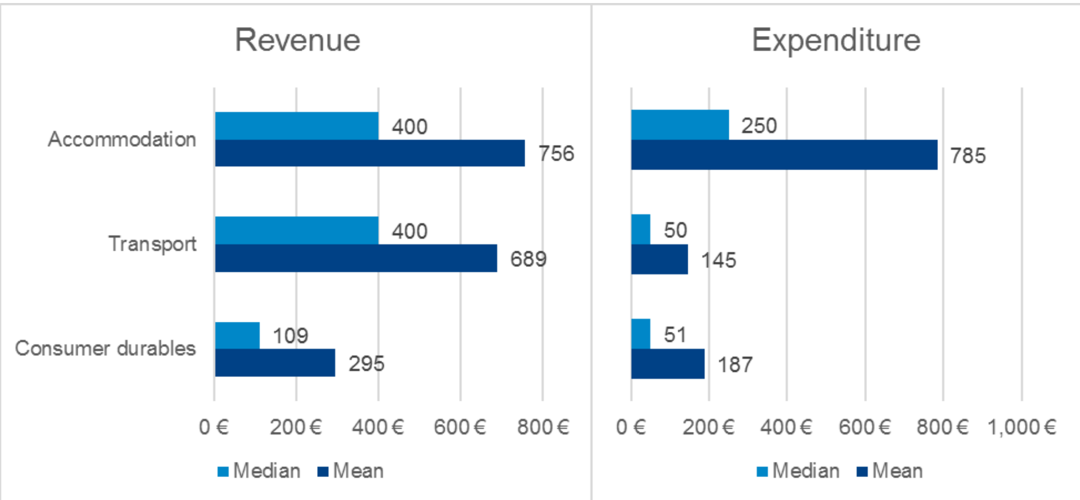
In terms of market share, or market size, it is difficult to retrieve financial information for many platforms, due to several reasons. Firstly, it might be because many platforms are start-ups, they belong to larger companies in which it is impossible to isolate the economic activity attributable to the platform, or simply many firms do not make their financial records public. Despite the limitations, this study relies on earlier findings from an ongoing study for DG JUST, where the three sectors under study were considered, along with two other sectors of the "sharing" economy (namely (re)sale of goods and odd jobs). Using data from a survey conducted in 10 EU Member States with 9,998 valid responses, the study finds that peers spend and earn most in the accommodation sector, and the least in the transport sector. The figure below displays these trends, also showing a large variation between median and mean spending.

There are several limitations to interpreting the survey's data, however:

- **First** is that the survey is based on respondents from 10 MS, and not all EU28. The selection of 10 EU MS includes six EU MS where P2P transactions have reached a certain critical mass, and/or where relevant research has been or is being conducted (e.g. Netherlands, UK, Denmark, Spain, France, Germany). In addition, four additional EU MS (Bulgaria, Italy, Poland, Slovenia) were chosen given their high potential for collaborative economy initiatives (Nielsen, 2014) and available international surveys (ING, 2015) on the topic. Their results have been extrapolated to EU-level.
- **Second**, only EU citizens aged 18 or over were considered for estimating the EU population. Even though most platforms do not allow it, peers younger than 16 (or 18, depending on the platform) could be actively engaged in P2P transactions (Mila blog, 2015). This study does not account for them.
- **Third**, it is possible that respondents may have interpreted the question about "money received through the platform" differently. In particular, some peer providers may have deducted costs from the money they report to have "received through the platform", thus reporting only real or net earnings. Such costs may be higher or lower depending on the sector, or the type of service provided. For instance, in the case of the sharing/hiring rides sector, some peer providers may deduct fuel costs or in the accommodation sector cleaning costs. In the case of the sharing/hiring of rides costs may vary between car-sharing, ride hiring and ride-sharing platforms.

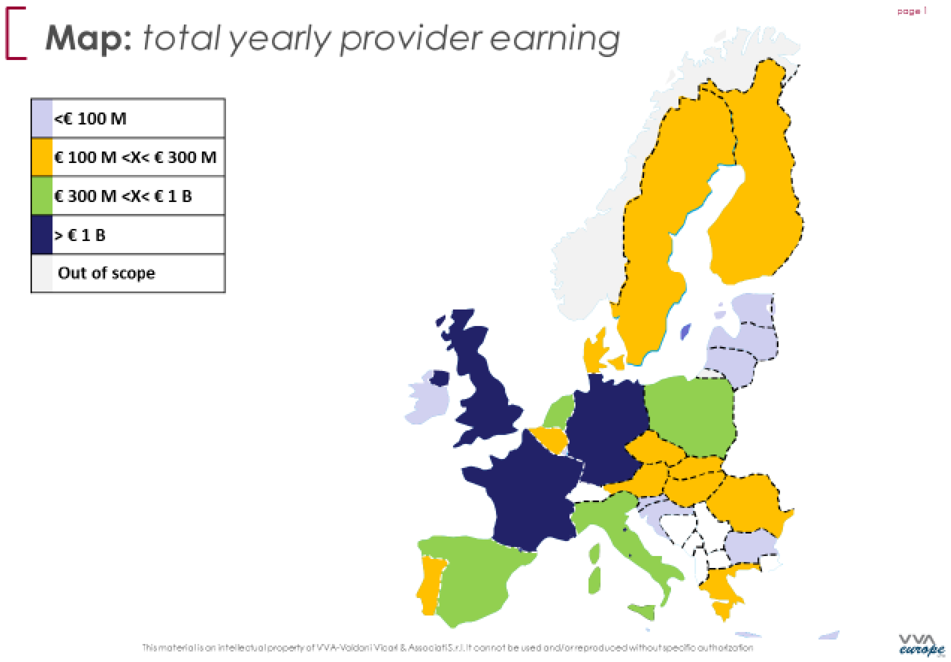
In terms of earnings, the DG JUST study reveals similar proportions among the three sectors considered: accommodation accounts for EUR 4.1 billion of peer provider earnings per year, consumer durables accounts for about EUR 0.82 billion, while peers providing services on transport platforms earn collectively EUR 0.79 billion per year. These numbers are for EU28 based on extrapolation.

Figure 2-6 Mean and median P2P peer expenditure and revenue per respondent in the last 12 months in the respondent's country, per sector in the 10 MS under study, in EUR



Based on median expenditure reported by survey respondents, the total expenditure by peer consumers is estimated at EUR 13.5 billion. The figure is computed by multiplying the median earnings/expenditure with the incidence rate of consumers/providers in a certain sector, and with the incidence rate of internet use among people aged 18 or over. The total peer expenditure is estimated at Member State-level considering each Member State's internet penetration rate.[4] Figure 2-7 visualises the estimates of peer consumer expenditure in each EU MS.

Figure 2-7: Yearly provider earning



[4] The study compiled an EU-level estimate of median expenditure and median earnings for each sector. Based on the internet penetration rate specific to each country, as well as on the EU-level rates for the incidence of peer providers and peer consumers, the study mapped earnings and expenditure. Note that the differences between Member States are solely given by their population and internet penetration rates, while the estimate on the number of peers providing/consuming on platforms, as well as their incidence rate in various sectors is assumed the same at EU-level.

3 Scenario building

The collaborative economy is a nascent market with a high speed of development and dynamism. It is uncertain how the collaborative economy is going to develop in the future and, in turn, which environmental implications the collaborative activities might have. Based on the information we have to date about the development of the various collaborative economy business models, this section builds a number of scenarios reflecting the different ways in which the collaborative economy in the accommodation, transport and consumer durables market could develop in the future. Data on a number of key variables in the scenarios are then used to model the development of the collaborative economy towards 2030 in the E3ME model (section 5) to understand what the macro-level economic, environmental and social impacts of the different scenarios could be in the future. In short, we:

1. Present the number and type of scenarios to be developed **[Section 3.1];**
2. Present our approach to building scenarios **[Section 3.2];**
3. Present the final developed scenarios **[Section 3.3]**.

3.1 Type of scenarios considered

Scenario development concerns the art of predicting the future in a stylised and simplified manner. Since nobody knows what the future will bring, this is a difficult exercise and is based on taking assumptions around uncertainties. Our findings from the literature review, interviews with stakeholders and the organised workshop show that uncertainties with respect to the development of the collaborative economy are especially large since there are many factors that influence the development of the collaborative economy. Moreover, other external factors will influence the development of the traditional economy at the same time, such as automation, increase in use of renewable energy sources, the rise of electric vehicles, etc. Another challenge to capture the developments is the fact that there is some blurring already occurring between the services provided by the collaborative economy market participants and the related traditional alternatives. Such blurring might be more and more the case when moving towards the future. As one participant in the workshop organised for this study pointed out, ‘we are trying to shoot at a moving target’.

Despite trying to stay as close as possible to what might be expected in the future, the scenarios we have developed for this study reflect ***possible*** **futures rather than the most** ***realistic*** **future.** These ‘possible futures’ reflect the changes in the economy towards 2030 if the collaborative economy in the three focus markets would develop further in a specific way. Regardless of whether they will actually develop in that way, the scenarios illustrate the impacts that the collaborative economy *could have* if it were to develop in the way we assume in the scenarios.

The scenarios are used to provide a narrative on a possible future as well as to study the economic, environmental and social impacts of the development of the collaborative economy towards 2030. Impacts can however only be assessed when two situations are compared. To estimate impacts of the collaborative economy in the future we are interested to know what the economy would look like in case the collaborative economy further develops compared to the situation in which the economy develops without the presence of the collaborative economy. To estimate the impacts of the collaborative economy now, we ‘only’ have to compare the effects of transactions in the collaborative economy with transactions in the traditional economy today. Studying the impacts of the collaborative economy today (section 4) is therefore relatively straightforward as we compare the current collaborative practices in the three focus markets against their traditional alternatives now. In order to estimate the impacts of the collaborative economy in 2030, though, we establish a baseline scenario that captures the most likely development of the economy without the collaborative economy towards the future. We then define collaborative economy scenarios that represent the changes in the future with respect to this regular (business-as-usual) development of the economy.

3.1.1 Baseline scenario

The baseline scenario used in the E3ME model to model future impacts can be viewed as an 'uncontroversial yet timely projection' of the future path of the EU-28 that embodies accepted trends. In similar policy impact work for the EC this is taken to be based on the long-term trends and assumptions published in DG Energy publication *EU Reference Scenario 2016, Energy, transport and GHG emissions: Trends to 2050* (published in 2016), with more current assumptions for particular variables where available. For this study we use demographic trends that are consistent with the most recent Eurostat population projections (European Commission, 2015) and economic projections that are consistent with the latest labour market trends, i.e. those developed for Cedefop (Cedefop, 2016). In summary it includes the most realistic and likely business-as-usual developments for:

- Macro-economic indicators – GDP, investment, ex- and imports, employment, household income;
- sectoral disaggregation of key indicators – value added, employment, exports, imports, investment;
- energy use by fuel user and fuel type;
- CO_2 emissions by fuel user and fuel type; and
- Seven categories of materials used.
- Data/projections for each MS;

The baseline scenario makes the explicit assumption on no further development of collaborative economy towards 2020 and 2030. Of course, there is some collaborative economy activity already ongoing at this moment, but the data used for the baseline scenario already capture this activity and cannot easily be separated from economic activity from the traditional sector. Therefore, the baseline reflects no *further development* of the collaborative economy compared to now. In this way, the collaborative economy scenarios (see below) demonstrate the potential impact of more collaborative economy versus the current situation in terms of both macroeconomic and environmental indicators.

3.1.2 Collaborative economy scenarios

The scope of the collaborative economy in this study is defined around three key markets. We chose to develop three separate scenarios reflecting the developments in each of the three key markets in order to capture the impacts of the collaborative economy in each market separately. In this way, we can distinguish between impacts from the collaborative economy in the accommodation, transport and consumer durables market. If we only defined scenarios in terms of ambition levels (higher/ lower uptake of collaborative economy) for all three markets jointly, we would not have been able to separate the effects of one market from another.

We also define a fourth scenario that models the joint development of the collaborative economy in all three markets together (a combined scenario). This scenario is compiled by aggregating the three market scenarios, while taking the cross-linkages between the indirect and rebound effects from the three markets adequately into account. For each of the four scenarios, we model a moderate uptake of the collaborative economy (a moderate scenario), but conduct a sensitivity analysis on an ambitious uptake of the collaborative economy in the sector, showing how the results would change if the collaborative economy grew faster than predicted in the moderate growth scenario. Lastly, in order to illustrate the impact of the rebound effect (which is assumed to occur in the moderate scenario) we also conduct a sensitivity analysis without modelling a rebound effect, simulating the situation in which the money earned and saved from engaging in the collaborative economy would not be spent and generate more consumption. Sensitivity analysis means that the magnitudes of existing modelling inputs in the moderate scenarios are changed. There are no new modelling inputs introduced in the sensitivity analyses. Table 3-1 summarises the type of scenarios and sensitivity analyses considered.

Table 3-1 Type of scenarios and sensitivity analyses

Scenarios	Accommodation	Transport	Consumer durables
Accommodation moderate scenario	Moderate uptake collaborative economy	*(baseline)*	*(baseline)*
Sensitivity 1	Ambitious uptake		
Sensitivity 2	No rebound effect		
Transport moderate scenario	*(baseline)*	Moderate uptake collaborative economy	*(baseline)*
Sensitivity 1		Ambitious uptake	
Sensitivity 2		No rebound effect	
Consumer durables moderate scenario	*(baseline)*	*(baseline)*	Moderate uptake collaborative economy
Sensitivity 1			Ambitious uptake
Sensitivity 2			No rebound effect
Combined moderate scenario	**Accommodation, transport and consumer durables moderate scenarios combined**		
Sensitivity 1	**Accommodation, transport and consumer durables ambitious scenarios combined**		
Sensitivity 2	**Accommodation, transport and consumer durables moderate scenarios with no rebounds combined**		
Baseline			

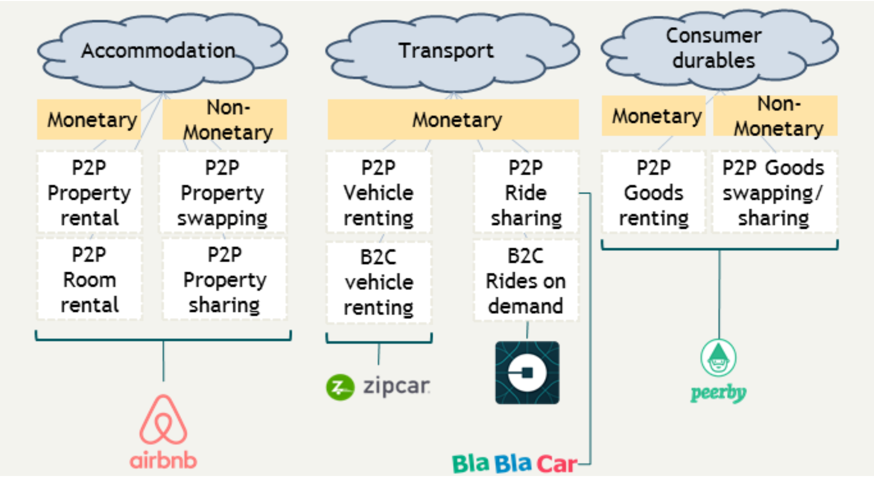
3.2 Development of the scenarios and case studies

We have developed the scenarios in a bottom-up manner. We explain how we have built the scenarios (section 3.2.1), how each scenario is structured (section 3.2.2) and how the case studies are conducted (section 3.2.3).

3.2.1 Building scenarios bottom-up

The scenarios are built in a bottom-up manner in order to reflect what happens in the three collaborative economy markets at platform level by looking at their transactions. In this way, the scenarios reflect what actually happens (what impacts are created when somebody stays in an Airbnb versus staying in a hotel) in the collaborative economy. However, analysing all collaborative activity in the three selected markets is virtually impossible due to the many different type of activities in the markets. Therefore, five case studies on specific collaborative platforms have been selected for an in-depth study. The case studies have been selected based on their representativeness of the defining business models in each of the three markets (see the section on scope) and their size (covering a large part of the collaborative activity in the market). In this way, studying the activity of the platform can be seen as representative for the collaborative economy in the entire market. We used case studies to help build the collaborative economy scenarios. Figure 3-1 shows the selected cases as representative platforms for the business models and markets in this study's focus. The analysis conducted for the case studies follows the same structure and develops assumptions and information on the key indicators that are also needed for the development of scenarios. As such, the information from the case studies can be directly used to extrapolate the assumptions and information to a market-level.

Figure 3-1 Selected case studies



Source: Own illustration

3.2.2 Structure of the scenarios

In essence, there are three different scenarios: one for each market. Each of these scenarios has a common structure and consists of information about the likely development of the collaborative economy in that particular market. The scenarios are developed to assess overall economic, social and particularly environmental effects. Each scenario contains information on two elements that determine the overall impact of the collaborative economy in a particular market now and in the future:

1. **The (relative) market size of the collaborative economy in the market** – the more important the collaborative business models are in a market, the more impact the collaborative economy will create. This relative importance is assessed through the market share of the collaborative business models versus the traditional alternatives in a market (e.g. the share of Airbnb stays versus hotel stays).
2. **Factors that influence the sustainability of the collaborative economy in that market** – next to the size of the collaborative economy (the volume impact), it is important to identify and analyse the factors that have an influence on the sustainability of the collaborative economy transactions. Whereas the Life Cycle Assessment (LCA) analyses the environmental impact of the collaborative business models in the three markets in detail, in this task, each market scenario identifies possible factors (technological, regulatory, behavioural, etc.) that could affect the

environmental impact per transaction in the future. Such '**sustainability triggers'**, such as the potential for full electrification of the Uber vehicle stock, could change the environmental impact of the collaborative economy in the future.

To assess the aforementioned two elements, each scenario description includes four sections covering both of the elements:

1. **Key developments shaping the development of the collaborative economy** – a narrative on the possible future developments in the market, its key drivers and challenges in relation to the size of the collaborative market as well as the factors influencing its sustainability;
2. **Relative size of the collaborative economy now** – Information on the relative size of the collaborative economy and its different business models compared to its traditional alternatives in the market now;
3. **Relative size of the collaborative economy in the future** – Information on the relative size of the collaborative economy and its different business models compared to its traditional alternatives in the future;
4. **Direct impacts as modelling inputs for the E3ME model and the Life Cycle Assessments – T**he scenarios include developed assumptions and estimates from the case studies to model the impacts of the collaborative economy towards 2030 in the E3ME model and to provide some inputs to calculate the comparative direct environmental impact between the traditional and the collaborative business models now (in the LCA). The latter takes the factors influencing the sustainability of the collaborative economy into account.

The developed scenarios for the three markets are presented in Section 3.3.

3.2.3 Role and structure of the case studies

The study assesses the overall environmental, economic and social impacts as well as identifies the way in which these impacts are created. We therefore distinguish three channels in which economic, environmental and social impacts can be created:

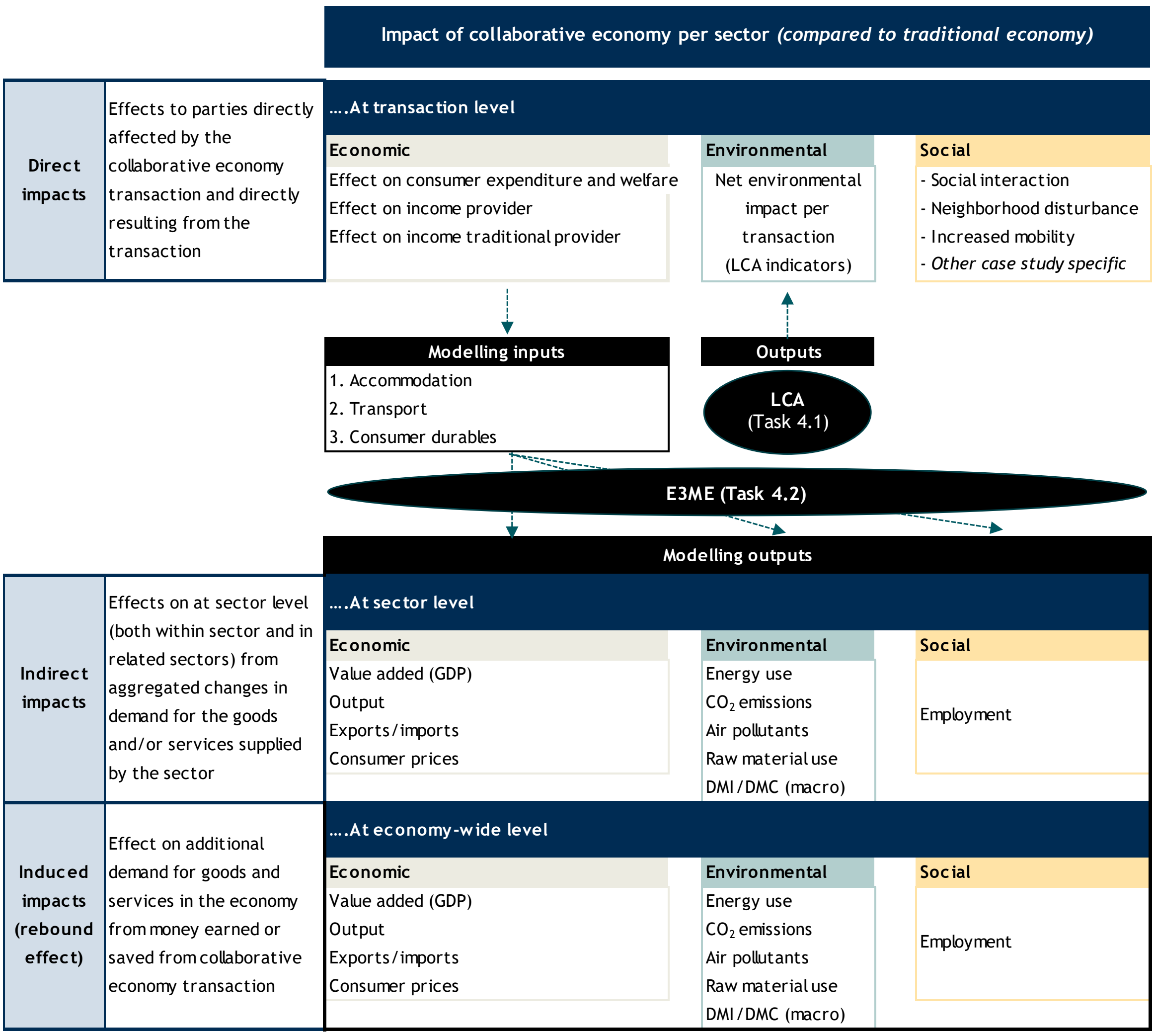
1. **Direct economic/social/environmental impacts** – impacts created directly from the collaborative economy transaction itself to the actors involved.
2. **Indirect economic/social/environmental impacts** – impacts created at sector-level from the aggregated changes in demand (all collaborative transactions together).
3. **Rebound economic/social/environmental effects (induced impacts)** – Impacts created on the wider economy from spending the money saved and earned due to the collaborative economy transaction (rebound effects) and other impacts created from behavioural changes induced by the collaborative economy.

By combining different research tools, we create insights into all three possible channels of impacts. As the case studies focus on digital platforms and the transactions they realise, the most significant direct impacts are illustrated in the case studies. Moreover, the LCAs perform a detailed analysis of the direct environmental impact at transaction level. The expected direct impacts are used to generate modelling inputs for the E3ME model in the scenarios. Through the established economic, environmental and social interconnections in the E3ME model, indirect and rebound effects impacts come out of the model without being explicitly modelled. The link between research tools and impacts considered is also visually presented in Figure 3-2.

The goal of the five selected case studies is therefore to provide evidence from a bottom-up platform perspective on the critical scenario elements as well as on expected direct impacts and the relevant modelling inputs for the E3ME model and the LCA. The cases also illustrate the expected possible indirect and induced impacts. All five case studies therefore have the following structure:

1. Introduction of the platform and the business model(s) it represents
2. Description of the current size and characteristics of the platform
3. Outlook towards 2030
4. Assessment of direct impacts (and modelling inputs for LCA and E3ME)
5. Assessment of indirect impacts
6. Assessment of rebound effects (induced impacts)

Figure 3-2 Relation between research tools and impacts



3.3 Collaborative economy scenarios

In this section, we present the three collaborative economy scenarios for the accommodation, transport and consumer durables markets. First, though, some important trends that generally affect the development of the collaborative economy in all markets is presented.

3.3.1 Relevant general trends for the collaborative economy

There are several general trends observed for the future of the collaborative economy as such. With the increased regulatory fragmentation with respect to the collaborative economy observed across EU Member States, there is a call for greater harmonisation. Some Member States are setting up rules that are promoting, or on contrary, hindering the development of collaborative business models, and as such there is no balanced development. The European Commission, in turn, is actively monitoring and assessing adequate regulatory responses (if at all) in the various sectors of the collaborative economy and with respect to the functioning of the Single Market, the environmental potential of the business models (by means of this study), the legal status of service providers etc.

What is also apparent from the literature, interviews and the workshop, participation rate in the sharing/collaborative economy is likely to increase in the near future (ING, 2015; Belk, 2014; Burnett, 2014; Vision Critical and Crowd Companies, 2014; interviews; workshop). However, no one can provide the magnitude of this growth (even though the Business Innovation Observatory predicts a growth potential of 25% (2013)). The interviewed expert from Ouishare confirms that it is difficult to predict something beyond 2-3 years. For example, the collaborative economy can be a hype in travelling today, but might disappear in 5 to 7 years (Skift, 2013).

3.3.2 Accommodation sector scenario

The collaborative accommodation scenario builds upon the analysis of the Airbnb case study, the results of the interviews, literature review and the workshop (which took place in May 2017).

Key developments shaping the future of the collaborative economy in the accommodation market

There are several factors that will influence the development of the collaborative accommodation market. **The platforms themselves and the services they provide change rapidly** – platforms in the accommodation sector are diversifying their portfolio of services to for example, luxury trips and business travel (The Economist, 27 May 2017). While initially the idea was to provide P2P accommodation, it is becoming apparent that more and more businesses list their properties on the platforms as well. This is creating a blurring between the collaborative accommodation and the ‘traditional’ tourist accommodation. Some listed properties on Airbnb (and most likely on other platforms as well) are the same as those offered by the ‘traditional’ holiday & short-stay tourist accommodation. To go even a step further, it was also pointed out during the same workshop that Airbnb might move out of the accommodation sector and operate as a big data company in another sector. The data that Airbnb collects is already one of their most valuable assets. Regarding the predicted future growth of the tourist accommodation market, there are a lot of factors that will influence the tourist arrivals which makes a prediction very difficult. This will impact not only Airbnb and the remainder of the collaborative economy market, but also the ‘traditional’ hospitality sector.

From the workshop and expert interviews, a common observation and agreement with that Airbnb will resemble traditional accommodation businesses more and more, and vice-versa. Airbnb is expected to add more services in its service offering (which is already happening) and it might either push out or buy competing platforms. We might therefore expect a tendency towards **centralization of the market**.

Hotels are also already accommodation services that resemble Airbnb. There will be a further need to change their services to create new products and attract millennials (e.g. accommodations that are between a hotel and a youth hotel, with opportunities for people to socialize more). Therefore, **some convergence between the two is expected in the future**. Nevertheless, hotels are expected to keep some of their services unique and as such remain attractive to customers. During the workshop, an analogy was made to the introduction of low-cost airlines in the airline industry, where we can now observe a closer integration of the service offerings of both low-cost and full-service carriers in the market.

Regulation will be another major driving force behind the future development of the market. In the future, the regulatory framework might catch up with collaborative platforms operating in the sector, which can create a level playing field with the traditional accommodation sector. This lack of regulation led to a proliferation of growth of collaborative accommodation but also to an unfair competition according to some stakeholders. There are already some cities regulating accommodation platforms, and this trend is expected to grow in the future.

Size of the collaborative accommodation today

A summary overview of the key scenario elements for the accommodation market can be found in figure 3-3. In order to estimate the market size of collaborative accommodation today in the EU, we calculate three main indicators: (1) the total demand for person-nights in the hotel and short-term holiday tourist accommodation sector, including accommodation offered by service providers on the platforms, and (2) the estimated share that the collaborative economy has in supplying these person nights today, and (3) the estimate for EU-wide turnover of collaborative accommodation.

i. Total demand for person-nights in tourist accommodation in the EU

To estimate the total demand for person nights in tourist accommodation in the EU for today (i.e. by mid-2016), we relied on Eurostat monthly tourism statistics.[5] Between July 2015 and June 2016, the demand for person-nights in tourist accommodation in the EU totals 2.44 billion. This includes hotels and holiday & short-stay accommodation. We exclude camping as this is a very different accommodation category than Airbnb or other similar platforms. Out of these 2.44 billion person-nights, 1.83 billion person-nights belong to hotels, and 612 million person-nights to holiday & other short stay accommodation. During the workshop organised for this study, the expert group on the accommodation market stated that Airbnb and similar platforms form part of the holiday & other short stay accommodation. However, it was also noted that the person-nights in this sub-market might be significantly underestimated. This is because a study by PwC for the European Holiday Home Association has shown that there are 20 million beds in Europe. According to the official statistics from Eurostat, only 7 million beds are registered. A similar underestimate might apply to the person-nights indicator. This shows that most of these properties rent out illegally (i.e. do not register the guests) and that the official statistics

[5] Eurostat Tourism statistics – Monthly data on tourism industries- Nights spent at tourist accommodation establishments by residents/non-residents URL: http://ec.europa.eu/eurostat/web/tourism/data/main-tables

must be considered carefully because they do not always reflect the reality. However, it was also pointed out by stakeholders at the workshop that there are no alternative statistics. Hence, we rely on Eurostat data for further estimations.

ii. Market share of collaborative accommodation in the EU today

For this scenario, we made a simple assumption: collaborative accommodation sector equals to Airbnb, as this is by far the largest platform on this market. To estimate the market share of Airbnb, we used the latest available data provided by Airbnb themselves. Airbnb reported on a number of economic indicators for the entire EU market and several Member States with strong presence of Airbnb. According to the latest Airbnb report on the EU market, between July 2015 and July 2016, 27.8 million guests stayed in Airbnb accommodation in the EU (Airbnb, 2016a). We estimated the total person-nights booked on Airbnb during this period by multiplying the number of guests in the EU (= 27.8 million) by the average number of nights per booking (= 4.1 nights per booking (from Airbnb country reports)), totalling to 114 million person-nights during that one year. This would imply that **the overall market share of Airbnb in the relevant accommodation sector** (including hotels), **is calculated to be 4.7%** (114M out of 2.44 billion person-nights) for the period between 2015-2016. We assume that this rate is more or less representative for the entire collaborative accommodation market in Europe as Airbnb is by far the largest platform.

iii. Collaborative accommodation EU-wide turnover

Similarly, as for the market share, we assume that the turnover calculated for Airbnb is representative of the entire collaborative accommodation market in Europe. Using the Airbnb data and data from a web scraping tool (insideairbnb), we are able to estimate the total turnover generated by Airbnb in Europe. First, we calculate the total number of bookings for Airbnb in the EU, by dividing the total number of inbound guests by the average number of guests per booking. Subsequently, one can multiply the total number of bookings with the average number of nights per booking and the average price per night[6] to arrive at the total turnover created by Airbnb bookings. This total turnover is a sum of host income (= revenue generated by the service providers) and the platform revenue generated from host and guest fees for the use of the platform. For more details, see the Airbnb case study (Annex 3).

Table 3-2 shows the results of our estimations for the EU28 and for some specific Member States for which Airbnb published economic impact reports. The **total turnover for Airbnb in the EU28** between July 2015 and July 2016 was calculated to be **€4.56 billion** (calculated as total number of nights booked on Airbnb multiplied by the average price per night). From this total turnover 6-12% goes directly to Airbnb as a guest fee, which corresponds to €273 million - 547 million. Additionally, Airbnb hosts pay a host fee of 3% of the booking value to Airbnb, which corresponds to €137 million. The remainder of the turnover **is additional income for hosts**, totalling **€3.88 billion - 4.15 billion**.

[6] The average price per night was calculated based on the data from insideairbnb.com presented in the Airbnb case study.

Table 3-2 Calculation of economic indicators for Airbnb

Parameter	A. Total # of guests *	B. Average # guests per booking	C. Total number of bookings (A/B)	D. # nights per guest	E. Total # of nights booked (CxD)	F. Total person-nights (AxD)	G. Average price per night (€)	H. Total turnover (€) (ExG)
EU28 2016	27.8 M	2.5	*11.2 M*	4.1	*45.6 M*	*114.0 M*	*100*	*4.56 bn*
FR 2016	8.3 M	2.5	*3.3 M*	3.6	*12.0 M*	*29.9 M*	95 (Paris)	*1.14 bn*
NL 2016	1.4 M	2.5	*0.56 M*	3.5	*2.0 M*	*4.9 M*	133 (Amsterdam)	*266 M*
DE 2016	2 M	2.5	*0.8 M*	3.5	*2.9 M*	*7.2 M*	60 (Berlin)	*174 M*
IT 2015	3.6 M	2.6	*1.4 M*	3.6	*5.0 M*	*13.0 M*	135 (Venice)	*675 M*
(Source)	*1, 2, 3, 4,5*	*3, 6*	*Calculated*	*1*	*Calculated*	*Calculated*	*7, Calculated*	*Calculated*

Sources: 1. Airbnb (2016). Overview of the Airbnb community in the European Union. **2.** Airbnb (2017). La communauté Airbnb en France en 2016 **3.** Airbnb (2017). The Airbnb Community: The Netherlands – based on 2016 data; **4.** Airbnbcitizen.com (2017). Germany. URL: https://germany.airbnbcitizen.com/ **5**. Airbnb (2016). Overview of the Airbnb Community in Italy. **6.** Airbnb (2016). Overview of the Airbnb Community in Denmark – based on 2015 data; **7.** Based on listing data from http://insideairbnb.com/ for London, Edinburgh, Paris, Berlin, Madrid, Barcelona, Mallorca, Venice, Amsterdam, Brussels, Vienna and Copenhagen (206,121 listings in total). retrieved on 03-03-2017.

* For the total number of guests only the inbound guests, i.e. EU-residents and non-EU residents staying in Airbnb accommodations on EU territory. Stays of EU-residents outside EU territory were not included in this calculation.

Red figures are assumed figures based on country reports, whereas black figures are based on reported data. Figures in italics represent calculated figures as opposed to reported data.

Size of the collaborative accommodation in 2030

The size of the collaborative accommodation market in 2030 can be estimated using a similar approach as for the current size. We applied three levels of market shares: (a) 4.7% in the baseline (the same as the market share today), (b) 10% in the moderate scenario, which corresponds to the predictions that the size of the collaborative accommodation will increase, and (c) 15% in the ambitious scenario (applying a sensitivity analysis). These estimates are pure assumptions given the fact that there is no evidence on how the market will evolve in the future. We calculated the number of person nights in collaborative accommodation by first estimating the total size of the market in 2030 and applying these three assumptions on the level of market uptake. It is important to estimate the number of person-nights in collaborative accommodation in order to calculate approximate turnover of such platforms in 2030. This is in turn an important modelling input.

We estimated the size of the tourist accommodation market in 2030 in terms of person-nights using two approaches:

1. Extrapolating the growth in demand for person-nights in the EU based on historical trends according to Eurostat, at 1.3% p.a.
2. The overall demand for person nights will grow at an equal rate as the number of expected international tourist arrivals in Europe, at 2.3% p.a. (UNWTO, 2011).

Table 3-3 presents the demand for person-nights in Airbnb for the three market uptakes in 2030, the expected turnover, platform revenue and service providers revenue (hosts), using a growth rate of 1.3% and 2.3%.

Table 3-3 Projecting the size of Accommodation sector and Airbnb in 2030

Parameter	Projected person-nights total accommodation	Market share Airbnb (*assumed*)	Projected person-nights Airbnb (M)	Projected person-nights traditional accommodation (bn)	Projected turnover Airbnb (€ bn)	Minimal income Airbnb platform (€ M)	Maximal income Airbnb platform (€ M)	Minimal total host income (€ bn)	Maximal total host income (€ bn)
Approach 1 - Extrapolation of traditional accommodation demand at 1.3% p.a.	2.93 billion	*4.7 % (BAU)*	137.8	2.79	5.5	496	827	4.7	5.0
		10% (moderate)	293.1	2.64	11.7	1,055	1,759	10.0	10.7
		15% (ambitious)	439.6	2.49	17.6	1,583	2,638	14.9	16.0
		20%	586.2	2.34	23.4	2,110	3,517	19.9	21.3
Parameter	**Projected nights total accommodation (Trad. +Airbnb)**	**Market share Airbnb (*assumed*)**	**Projected person-nights Airbnb (M)**	**Projected person-nights traditional accommodation (bn)**	**Projected turnover Airbnb (€ bn)**	**Minimal income Airbnb platform (€ M)**	**Maximal income Airbnb platform (€ M)**	**Minimal total host income (€ bn)**	**Maximal total host income (€ bn)**
Approach 2 - Projected growth inbound tourism WTO (+2.3% p.a)	3.30 billion	4.7 % (BAU)	155.2	3.15	6.2	559	931	5.3	5.6
		10% (moderate)	*330.1*	2.97	13.2	1,189	1,981	11.2	12.0
		15% (ambitious)	*495.2*	2.81	19.8	1,783	2,971	16.8	18.0
		20%	*660.3*	2.64	26.4	2,377	3,962	22.5	24.0

Source: own calculation

Direct impacts as modelling inputs for the E3ME model and the Life Cycle Assessments

Modelling inputs for the E3ME model

Collaborative accommodation will have direct economic impacts, which can be translated into modelling inputs for the E3ME model. We have used the case study of Airbnb to represent the entire collaborative accommodation market, as mentioned above. There is one key direct economic impact which serves as modelling input into the E3ME model: **turnover of Airbnb**.

- It is estimated that 60% of transactions on Airbnb are P2P (as 40% of hosts offer multiple accommodation spaces) (EC, 2016b), the Airbnb turnover can be modelled as additional income for households.
- This means that there will be no additional shift of income from households to the tourist accommodation sector (= businesses) in the E3ME model corresponding to a % market uptake of collaborative accommodation (4.7% in baseline, 10% in moderate scenario or 15% in the ambitious sensitivity scenario) and 60% of Airbnb turnover for these market uptakes.

- This will have an indirect effect on investments made by the (business) accommodation sector in the model, which translate into other second level impacts on for example ancillary services of hotels.
- Next to increased income for hosts, the income for Airbnb as a platform will increase from to €273 million -547million today to €496 million to 3,962 million in 2030, again depending on the assumptions. This can be modelled as additional income for the sector computer programming and info services in NACE classification. This will also have knock-on indirect effects in the model on other sectors.

We have investigated the possibility to explicitly model rebound effects. However, there is a lack of comprehensive data showing the complete distribution of goods and services on which hosts spend their generated income through platforms such as Airbnb. Therefore, we will assume the general spending pattern for a host in our model. With regard to income 'saved' by a guest, there is data provided by Airbnb (see the case study) for France, but it is not clear from the evidence to what extent these are 'savings', for example during a business trip where otherwise a hotel would have been booked (substitution), and where guests would not travel otherwise (additional demand). We will also assume the general spending pattern in our model. We have also investigated if there is any 'sustainability trigger' that can be modelled, i.e. if there are any direct impacts which would make collaborative accommodation more sustainable. One identified sustainability trigger has been the decrease of construction of new hotels and holiday apartments as a result of more 'Airbnb' type platforms. However, this impact is indirect and will be determined in the model through the decreased income for tourist (business) accommodation sector.

Modelling inputs for the LCAs (factors that influence the sustainability of the platforms)

Next to the mere size of the collaborative accommodation market, the environmental impact will depend on the environmental impact per stay (bottom part Figure 3-3), which in turn depends, amongst other things, on the type of Airbnb listing and traditional accommodation alternative that Airbnb is compared to. The estimated current market size indicators for Airbnb and other relevant economic data on the type of listings, the length of stay and price can be used in the LCA analysis as input data to compare a person-night stay in Airbnb type accommodation with a person-night stay in alternative traditional accommodation. However, as the collaborative accommodation and traditional accommodation sector develop over time, the environmental impact per stay might also change. Such changes could be shifts in the relative share of the different listing types or changes on collaborative accommodation platforms, which might occur for example, because of stricter regulations regarding the rental of entire properties. Similarly, the traditional accommodation sector might be subject to stricter environmental legislation and targets than private homes, which might also change the environmental impact per stay over time.

Figure 3-3 Summary overview of the variables, indicators and estimates to build scenarios for the collaborative accommodation market

Business model/sector	Key scenario variables	Corresponding indicator	Situation today	Growth assumptions	Situation 2030 (baseline)	Direct impacts	Modelling input E3ME
Accommodation (P2P Property and Room rentals)	**Total market size** tourist accommodation	*# of person-nights*	2.44 bn in the EU by mid-2016	*1.3% growth p.a. in demand for person-nights*	2.93 bn	Reduced demand for tourist accommodation in hotels and other holiday & short-stay accommodation	Part of household expenditure (equal to 60% of Airbnb host income) not spent on business accommodation sector but remains in the household income category[7]
				2.3% growth p.a. in tourist arrivals	3.30 bn		
	Market share collaborative economy	*% of total person-nights spent*	4.7% in the EU by mid-2016	*AirBnB market share constant*	138 - 155 M person-nights spent in Airbnb	Additional household income (hosts)	€ 4.7-16.8 bn
				AirBnB market share to 15%	440 - 495 M person-nights spent in Airbnb	Income for the collaborative platforms	Additional Income *Retail/ marketing* sector €827 M - 2.97 bn
	Factors that influence the sustainability of the collaborative business model	*Listing types in Airbnb and their relative share in total # person nights*	69% entire homes 30% private rooms 1% shared rooms	*No change in relative shares different listing types*	69% entire homes 30% private rooms 1% shared rooms	**Life Cycle Assessment and policy recommendations**	
		Difference in regulating traditional sector and Airbnb	Status quo	*No change*	No change		
				e.g. stricter environmental regulation for traditional sector	Lower environmental impact per unit for traditional alternative		

[7] This does not mean that there is no financial transfer from the guest to the host, but since the transfer happens from a peer to peer, in the model the transaction does not have an impact as it remains in the same household income category.

3.3.3 Transport sector scenario

The scenario of the development of the collaborative economy in the transport sector builds upon the analyses of the Zipcar, Uber and BlaBlaCar case studies, the results of the interviews, literature review and the workshop (which took place in May 2017). The three case studies cover the three main, yet distinctly different, business models in the transport sector and are integrated in this transport scenario in order to reflect a joint growth of these three business models in the transport sector alongside the traditional mobility solutions. This scenario first describes qualitatively which type of major effects are expected from the three business models towards the future and what the most likely net total effect on a number of key variables is. Secondly, it presents the key direct impacts that are used as modelling inputs for the E3ME model and the LCA (sections 4 and 5). The assumptions and growth calculations used to calculate the main direct effects of the collaborative business models in the transport sector are largely based on the case study findings, additional literature cited in this section as well as 'guesstimates' (clearly indicated).

Key developments shaping the future of the collaborative economy in the transport market

Findings from the transport case studies, additional interviews and the stakeholder workshop conclude that the rate of transformation in the transport market is high, arguably the highest across the three focus markets in this study. The impact of technological advancements is high in this sector, with electrification of vehicles increasing and the likelihood of automation of vehicles a realistic possibility in the future. Moreover, the optimisation of the use of cars through big data combined with the consistent increase in demand for mobility in the EU give rise to significant adjustments and changes in the sector that are likely to continue. As in the other markets, the future of the transport market towards 2030 is uncertain and depends of the development in such factors. The overall environmental impact of future mobility solutions involving passenger cars will depend on a number of key factors:

1. **The cost of mobility by car** (what does it cost to travel by car for European citizens) – lower costs for car travelling will *ceteris paribus* increase person-kilometres travelled by car and the associated economic, environmental and social impacts.
2. **How many kilometres will European citizens travel by car in the future –** Depending on the need for travelling and the cost of available travel options, the number of kilometres travelled per person by car (**person-kilometres**) will determine how much demand for travelling by car there will be in the future.
3. **How many kilometres will all cars in the EU travel in total in the future –** depending on the occupancy rate of cars (number of people in a car for a ride), the number of person-kilometres travelled will determine how many vehicle kilometres all cars in the EU will travel (**vehicle-kilometres**). Environmental impacts from energy use and emissions are proportionally to this.

These factors can have a critical indirect effect on the size of the car fleet in the future (how many cars will need to be produced in the future). In addition, as a result of potential changes in the cost of travelling by car and the number of options that European citizens might have in the future to travel by car (that will increase due to the collaborative economy), there could also be important indirect effects on how much and for how long citizens travel by public transport.

Quantitative determination of the precise impact of the collaborative economy business models on these key drivers is very complex due to the uncertainty about the success of each collaborative business model, the way in which traditional transport options will adjust and what the intermodal effects between the collaborative business models will be as well as their interaction with public transport and individual car use alternatives. In order to build a hypothetical transport scenario that illustrates a useful possible future, we have triangulated the findings from the predicted impacts of the three business models from the case studies and the additional interview and literature findings on this market. Using these findings, we have identified the most significant drivers of impacts for each business model and determined the most likely direction of impact for each of the key impacts mentioned above. Table 3-4 presents an overview of the likely direction of impacts expected from the collaborative economy business models in the transport market. After introducing the likely direction of these effects, the following sub-section estimates the likely magnitude of these effects and translates these into modelling inputs for the E3ME model and the LCA. As explained in more detail in the next subsection, four of these five variables are actually modelled in the E3ME model[8].

Table 3-4 Expected direction of impacts of collaborative economy in the transport market on key indicators

Business models	Key impact drivers	Impacts				
		(1) Cost of mobility by car	(2) p-kms travelled in passenger car	(3) Vehicle kilometers	Car sales/size of car fleet	Effect on p-kms in public transport
Car-sharing (Zipcar)	Car sharers travel less by car (behavioural shift)	Decrease	Decrease	Decrease	Decrease	Increase
	Increased utilisation-rate of cars	Decrease	No effect	No effect	Decrease	No effect
Ride-sharing (BlaBlaCar)	Shift as driver from own car to ride-sharing	Decrease	No effect	No effect	No effect	No effect
	Shift as passenger from own car to ride-sharing	Decrease	No effect	Decrease	Decrease	No effect
	Shift from public transport to ride-sharing	Decrease	Increase	Increase	No effect	Decrease
	Additional car travel due to ride-sharing	Decrease	Increase	Increase	Increase	No effect
Ride-hailing (Uber)	Shift from conventional taxi to ride-hailing	Decrease	No effect	No effect	Decrease	No effect
	Shift from public transport to ride-hailing	Increase	Increase	Increase	Increase	Decrease
	Additional car travel due to ride-hailing	Increase	Increase	Increase	Increase	No effect
	Behavioural shift away from car use	Decrease	Decrease	Decrease	No effect	Increase
Overall		**Small decrease**	**Small increase**	**Small decrease**	**Decrease**	**Small decrease**

E3ME modelling input

The key impacts of P2P vehicle sharing/renting (**car-sharing**) is the fact that instead of using personal cars or public transport, users can drive a car without owning it. The ZipCar case showed this has created two major effects. First, most car-sharers decide not to own a personal car anymore and due to not having the convenience of having a car at disposal anytime, become more aware about their trips and travel on average less by car (fewer person-kms by car). Secondly, the fact that one car is used by more than one person (or household) means an increased utilisation rate of the car-fleet (personal cars are replaced by cars used by more people). The cost of travelling by car decreased as a result of these effects (shared cars reduce costs per kilometres due to increased utilisation of the cars), but due to the fact that typical car-sharers do not own their own car anymore, the likely effect on person-kms in cars is negative. Similarly, by assuming an unchanged occupancy

[8] As we focus on the environmental impact of the collaborative economy, it is relatively more important to understand the impact of the collaborative economy on vehicle kilometres, rather than on person kilometres as the aggregate number of vehicles driving around deliver the most significant environmental and economic impacts.

rate in cars, vehicle-kilometres in the EU also decrease. The knock-on effect on public transport use is positive as car-sharers without a car will look for alternative travel options.

The key impacts of P2P **ride-sharing** (BlaBlaCar) originate from the fact that driving by car becomes more economical for long distance travellers due to the possibility to share a ride. Costs of travelling by car therefore decrease and the total amount of vehicle kilometres in the EU decrease as a result of only one car traveling (instead of two) to a similar destination. However, this is only the case for 16% of passengers that drive with a BlaBlaCar driver (ADEME, 2015). Most of the time (>70%), they would have taken public transport (train). ADEME (2015) also finds that BlaBlaCar drivers also drive more due to the possibility to share their ride for trips they would have taken by train or not have made in general. Therefore, the overall effect on vehicle kilometres in the EU from ride-sharing seems (counter-intuitively) negative. Ride sharing will thus also reduce kilometres travelled in public transport.

Lastly, the case study and other findings in this study conclude that the **ride-hailing (or rides on demand)** collaborative business model (Uber) mainly creates a competition effect in the taxi/ride-hailing market by making rides cheaper and more easily accessible. It reduces the cost of travelling by car as compared to its most common alternative (taxi), but this substitution effect does not create an effect on vehicle kilometres or person-kms in cars. Due to the increase in efficiency and utilisation of ride-hailing vehicles, there might be a small decrease in the size of the ride-hailing car fleet as under constant demand, there would be less ride-hailing vehicles needed. However, the cost competitive effect in this market also makes it more attractive as alternative to public transport or even as additional demand for which walking, cycling or no trip at all was considered. This increases the money spent on travelling by car, on person-kms in passenger cars, on total vehicle kilometres driven in the EU and on demand for cars. There might be a small offsetting negative effect on these impacts due to the fact that an increase in the availability of quick and cheap rides might make city inhabitants decide to get rid of their car and use Uber instead.

As the table 3-4 shows, we can therefore expect multiple impacts in opposite directions from the collaborative business models on. Overall though, we expect the three collaborative business models to **increase competition in this market and lower the cost of travelling by car** (all business models make travelling by car more attractive). They also commonly **increase the occupancy and utilisation of cars,** while at the same time the lower cost of mobility for travelling by passenger car (due to increased utilisation and occupancy rates) also makes car travel more attractive (efficiency effect) and increases the number of vehicle kilometres (scale effect). **The higher efficiency effect is likely offsetting the scale effect and therefore is likely to decrease the number of vehicle kilometres driven by passenger cars in the EU, while at the same time more people will travel by car**. By increasing the occupancy and utilisation rates, the **size of the car fleet is likely to decrease** in the future when these collaborative business models grow larger. The overall impact on **the use of public transport, though, is likely to be negative** as the options of taking shared rides, hiring a car or hailing a ride become more attractive. In the next section, we translate these general findings to inputs for the E3ME model.

Direct impacts as modelling inputs for the E3ME model

As mentioned in the previous section, we expect five factors will determine the environmental and economic impacts of the collaborative economy in the transport market most significantly. As the effect on person-kilometres is mainly an 'intermediary' effect (on 'vehicle kilometres and indirectly on the demand for public transport), we aim to model the changes brought about by the collaborative economy in the E3ME model by calculating the expected changes in the following indicators:

1. Demand for cars (size of car fleet)
2. Vehicle kilometres driven
3. Cost of travelling by car (cost of car mobility)
4. Demand for public and other transport solutions

As for the other markets, we define a **moderate growth scenario** and an **ambitious growth scenario** for the predicted growth of the collaborative economy. The baseline scenario in the E3ME model and our calculations for the baseline are based on the predicted trends in demand for passenger transport by passenger car, energy use by passenger cars and demand for public rail and road transport made in the PRIMES 2016 Reference scenario (European Commission, 2016d). Other critical assumptions we have made for the calculation of the transport-wide effects of the collaborative economy are presented in Table 3-5, most of which are based on the findings from the respective case studies presented in the Annexes.

Table 3-5 Assumptions for the transport sector in 2030, for the baseline and growth scenarios

Business model		Baseline scenario	Moderate growth	Ambitious growth
Car-sharing	Users	2.7 million (no growth)	**9.3 million users** (10% p.a.)	**29 million users** (20% p.a.)
	Cars/person	0.491 cars per person[9]	**0.442 cars per person** (-10% in car ownership)	**0.246 cars per person** (-50% in car ownership)
Ride-sharing	Users	30 million users (no growth)[10]	**60 million users**	**120 million users**
	No. of trips	1.33 rides per person/year	**1.33 rides per person/year**	**1.33 rides per person/year**
	Person/trip	Average 2.8 people per trip	**Average 2.8 people per trip**	**Average 2.8 people per trip**
	Avg. trip length	Average trip 360 km[11]	**Average trip 360 km[12]**	**Average trip 360 km[13]**
Ride-hailing		5% of taxi rides replaced by ride-hailing	**20% of taxi rides replaced by ride-hailing apps**	**50% of taxi rides replaced by ride-hailing apps**
Person-kms car		11,000 p-km/capita/year		
Energy use (vehicle kms)		63.3 toe/million vehicle kms		
Person-kms public transport (bus + taxi)		1,171 pkm/capita/year		
Person-kms rail		1,343 pkm/capita/year		

[9] EURF (2016).
[10]Estimate based on total number of 40M users worldwide. https://www.forbes.com/sites/rawnshah/2016/02/21/driving-ridesharing-success-at-blablacar-with-online-community/#26c5b1073b51
[11]BlaBlacar (2017**)**. Average trip length of Blablacar trips in the UK. URL: https://www.blablacar.co.uk/blablalife/going-places/womens-day-at-blablacar
[12]BlaBlacar (2017**)**. Average trip length of Blablacar trips in the UK. URL: https://www.blablacar.co.uk/blablalife/going-places/womens-day-at-blablacar
[13]BlaBlacar (2017**)**. Average trip length of Blablacar trips in the UK. URL: https://www.blablacar.co.uk/blablalife/going-places/womens-day-at-blablacar

On the basis of the growth assumptions assumed in the table above and the predicted qualitative effects illustrated in the previous section, we estimate the quantitative effects for the four indicators that will form the modelling input for the E3ME model:

1) Demand for cars

Although all of the three collaborative economy business models in the transport sector in theory might contribute to a reduction in the number of cars on the road, the modelling inputs are based on the car-sharing case because this business model is believed to trigger the most significant impact on overall demand for cars. We model an expected reduction in the number of cars needed for the share of the EU population that is expected to engage in car-sharing schemes in the EU in 2030. In a moderate growth scenario, we predict that 10% of the car-sharers would let go of their own car and in an ambitious scenario we predict that 50% of the car-sharers would let go of their car. See for detailed calculations Table 9-1 in Annex 9:

a) In a **moderate growth** scenario this results in a **reduction in the overall demand for new passenger cars with 0.46 million units by 2030**, which corresponds to reducing the size of the current EU passenger car fleet by 0.2%.
b) In the **ambitious scenario** this results in a **reduction in the overall demand for new passenger cars of 7.1 million units by 2030**, which corresponds to reducing the size of the current EU passenger car fleet by 2.8%.

2) Vehicle-kilometers travelled by passenger car

As explained in the previous section, we expect both a small increase in the number of vehicle kilometres in the EU due to the decreased costs of mobility by passenger car (compared to trips that otherwise would have made by train) as well as a larger decrease due to the presence of car-sharing schemes (and people getting rid of their own car and therefore driving less). Table 9-2 in Annex 9 shows the detailed calculations for the decrease in vehicle kilometres expected from the car-sharing effect. Tables 9-3 and 9-4 in this Annex show the increase in vehicle kilometres expected from the ride-sharing effect. As expected, the first effect dominates the second, proving our initial assumptions correct. We assume no major effect on vehicle kilometres due to ride-hailing (as most of the rides substitute traditional taxis):

a) In a **moderate growth** scenario these effects result in:
   i) **A total reduction of 15.3 bn** vehicle-kilometres in the EU due to car-sharing
   ii) **A total increase of 9.9 bn** vehicle-kilometres due to ride-sharing
      a. **Net effect = overall decrease of 5.4 bn vehicle-kilometres.**
         Using an average energy use of 63.3 ktoe/bn vehicle-kilometres (from PRIMES), we obtain a **343 ktoe decrease in energy use** by passenger cars (0.2% reduction of total energy demand for passenger cars in 2030).
b) In an **ambitious growth** scenario these effects result in:
   i) **A total reduction of 47.9 bn** vehicle-kilometres due to car-sharing
   ii) **A total increase of 19.8 bn** vehicle-kilometres due to ride-sharing
      a. **Net effect = overall decrease of 28.1 bn vehicle kilometres by passenger cars.**
         This results in an overall decrease in energy use by passenger cars of **1,773 ktoe** (1% reduction in energy use of passenger cars in 2030).

3) Cost of car mobility

The cost of mobility by passenger cars is expected to go down due to the increased efficiency and utilisation of passenger cars in the collaborative economy, particularly from the car-sharing and ride-sharing business models. The potential cost savings effect from the ride-hailing business model is modelled as part of the effects on ‘public transport and other transport’ as this is where taxi rides are included in the E3ME model (see point 4 below). For the car-sharing model, we assume an annual cost saving per car-sharing user of €300 (see Zipcar case). For Blablacar we assume that € 0.10 is saved for each vehicle kilometre that is replacing a trip that would have been made in a passenger car anyway (ADEME, 2015). Detailed calculations to estimate the total reduction in the costs of car use due to car-sharing and ride-sharing can be found in Annex 9 Table 9-9:

a. In the **moderate growth** scenario these effects result in:
   - » **A cost reduction of € 2.79 bn** because of car-sharing
   - » **A cost reduction of € 1.35 bn** because of ride-sharing
     - **A total reduction in expenditure on the operation of cars of € 4.14 bn**

b. In the **ambitious growth** scenario these effects result in:
   - » **A cost reduction of € 8.70 bn** because of car-sharing
   - » **A cost reduction of € 2.69 bn** because of ride-sharing
     - **A total reduction in expenditure on the operation of cars of € 11.39 bn**

4) Effects on public transport and other transport

Lastly, the indirect effects on the demand for public transport and traditional taxi rides (‘other transport’ in E3ME) matter for the overall environmental and economic impacts created by the collaborative economy. We showed that the **car-sharing** business model triggers a decrease in kilometres driven by passenger cars by its users and that they increase their use of public transport as a result: two-thirds of the reduction in car travel shifts to public transport (guesstimate), specifically one-third to additional rail transport and one-third to additional demand for other transport (e.g. buses). The remaining part of reduced car travelling is assumed not to be replaced by other means of transport. **Ride-sharing** results in a number of modal shifts, which are described in Annex 9 table 9-3. Ride-sharing will primarily result in a decrease in rail transport, because this is the main alternative to the long-distance trips made via ride-sharing (ADEME, 2015). The calculation of the total effects that car-sharing and ridesharing have on person-kms travelled in public transport can be found in Annex 9 Table 9-7. The net outcome of the calculations is given below. **Ride-hailing** is also expected to result in a decrease in the use of public transport, but due to a lack of data we will assume that ride-hailing only replaces conventional taxi rides (and therefore does not have an effect on public transport). Therefore, for ride-hailing, only a reduction in household expenditure on ‘other transport’[14] will be modelled (due to savings on cheaper taxi rides, see Annex 9 Table 9-6 for detailed calculation):

a. In a **moderate growth** scenario, the net effects described above result in:
   - » Demand for rail transport increases with 10.2 bn person-kilometres (1.5% of total passenger rail travel in 2030) **due to car-sharing**
   - » Demand for rail transport decreases with 34.9 bn person-kilometres (5% of total passenger rail travel in 2030) **due to ride-sharing**
     - **Total reduction in rail transport: 24.7 bn person-kilometres (3.6% of total)**

[14] EC 2016e. 21% of expenditures on 'other transport' go to taxis.

- » Demand for other transport increases with 10.2 bn person-kilometres (1.7% of demand for public road transport in 2030) **due to car-sharing**
- » **Ridesharing** replaces 20% of the taxi rides, resulting in a 0.8% overall reduction in expenditures on 'other transport' (for calculation see Annex 9 - Table 9-4).
  - **Total effect on expenditures on 'other transport': [+1.7% - 0.8%] = +0.9% in expenditure on other transport** (Annex 9 Table 8).

b. In an **ambitious growth** scenario, the net effects described above result in:

- » Demand for rail transport increases with 31.9 bn person-kilometres (4.6% of total passenger rail travel in 2030) **due to car-sharing**
- » Demand for rail transport decreases with 69.8 bn person-kilometres (10.1% of total passenger rail travel in 2030) **due to ride-sharing**
  - **Total reduction in rail transport: 37.9 bn person-kilometres (5.5% of total)**
- » Demand for other transport increases with 31.9 bn person-kilometres (5.3% of demand for public road transport in 2030) **due to car-sharing**
- » **Ridesharing** replaces 20% of the taxi rides, resulting in a 4.2% overall reduction in expenditures on 'other transport' (for calculation see Annex 9 - Table 9-4).
  - **Total effect on expenditures on 'other transport': [+5.3% - 4.2%] = +0.9% in expenditure on other transport** (Annex 9 Table 9-7).

Overview of direct impacts & E3ME modelling inputs

Tables 3-6 and 3-7 summarise the net results on the four indicators that will be modelled in the E3ME for the transport scenario. Table 3-6 focuses on the overall effects modelled in E3ME per indicator, whereas Table 3-7 also summarises the main assumptions taken to calculate these effects. Largely as predicted at the start of this section, we model a **decrease in cost of mobility by car** by 2030, a **decrease in the total number of vehicle kilometres driven** in 2030, **a reduction in the size of the car fleet** by 2030, a **decrease in the use rail transport** and an **increase in the use of other transport** (taxis/Ubers). The effects of collaborative business models on costs of car mobility are modelled by adjusting the expenditures of households on operation of cars. The reduction in car travelling will be taken into account by reducing the energy demand by passenger cars. The reduction of the total car fleet can be modelled either by reducing household expenditures on vehicles or by directly reducing the demand for cars. Lastly, the changes in demand for public transport can be modelled by adjusting household expenditures on rail and other transport. Additionally, the revenues for car-sharing, ride-sharing and ride-hailing platforms were calculated. In the moderate scenario the revenues in 2030 of car-sharing, ride-sharing and ride-hailing will be € 5.06 bn, € 306m, and 1.1% of consumer expenditures on 'other transport', respectively. In the ambitious scenario car sharing will generate € 15.8 bn in revenues, ride-sharing € 611m and the income of ride-hailing platforms will correspond to 2.6% of all consumer expenditures on 'other transport'.

Table 3-6 Overview of the direct impacts that will be modelled and the relevant E3ME variables

Business models	Impacts: (1) Cost of mobility by car (annual)	(2) p-kms travelled in passenger car (annual)	(3) Vehicle kilometres (annual)	(4) Car sales/size of car fleet	(5) Effect on p-kms in public transport
Car-sharing (Zipcar)	**- [€ 2.8 - 8.7 bn]**	**- [€30.7 - 95.7 bn]**	**- [€15.3 - 47.9 bn]**	**- [0.46 -7.1m] units**	**Rail transport: + [1.5 - 4.6%] Other transport: + [1.7 - 5.3%]**
Ride-sharing (BlaBlaCar)	**- [€ 1.4- 2.7 bn]**	**+[€27.8 - 55.6 bn]**	**+ [€9.9 - 19.8 bn]**	*No effect modelled*	**Rail transport: -[5.0-10.1%]**
Ride-hailing (Uber)	*No effect modelled*	*No effect modelled*	*No effect modelled*	*No effect modelled*	**Expenditures on other transport: -[0.8 - 2.1%]**
Overall	**- [€4.1 - 11.4 bn]**	**- [€ 2.9 - 40.1 bn]**	**- [€ 5.4 - 28.0 bn]**	**- [0.46 - 7.1m] units**	**Expenditure on rail transport: [-3.6 - +5.5%] Expenditures on other transport: + [0.8 - 3.1%]**
E3ME input variables	Household expenditure on operation of cars (petrol etc.)	Reduction in energy use in passenger car transport with [344 -1773] ktoe (0.2-1.0% of total energy demand for passenger cars)		Household expenditure on vehicles *or* change demand for passenger cars	Household expenditure on rail transport & household expenditure on 'other transport'

Table 3-7 Summary assumptions and results for the transport scenario on four main dimensions and E3ME variables modeling inputs

	Demand for cars	Vehicle kilometres	Cost of car mobility	Public transport & other transport
Car-sharing	[9.3 - 29 M] car-sharing users[1] [10-50%] reduction in car ownership among users [2] [2.3-4.1] persons/shared car	30% less travelling in cars by users [3]	[€ 2.79 - 8.70 bn] cost savings on usage of cars[4]	pkms rail transport increase by [1.5-4.6%] [5] pkms other transport increase by [1.7-5.3%] [5]
Ride-sharing	*No significant effect modelled*	[60-120 M] users in 2030 [6] Average trip length of 360km [7] 65% increase in car occupancy [8] 1.33 tips per ride-sharing user per year [9]	€ 0.10 cost savings per km for the driver and for passengers that would have used private car otherwise → [€ 1.35-2.69 bn for all users) [10]	pkms rail transport is decreased by [5.0-10.1%] [11]
Ride-hailing	*No significant effect modelled*	*No effect modelled*	*No effect modelled*	21% of expenditures on 'other transport' go to taxis [12] 20-100% of the taxis will be replaced by ride-hailing [13] Cost savings compared to taxis are 20% [14]
Overall effect	Decrease	Decrease	Decrease	Decrease

	Variable	Input	Variable	Input	Variable	Input	Variable	Input
E3ME model	Demand for vehicles automotive sector	**Passenger car sales reduced with [0.5-7.0] M units**	Energy use by passenger cars	Car sharing reduces energy demand with [972 - 3029] ktoe Ridesharing increases energy demand with [628 -1256] ktoe Overall energy change in passenger cars is between - [344 and -1773] ktoe ([0.2 - 1%] of total energy use of passenger cars in 2030)	Household expenditure on operation of cars (petrol etc.)	- [€ 4.14-11.39 bn]	Household expenditure on rail transport	[3.6-5.5]% reduction [15]
					Household expenditure on rail transport	Modelled as effect on 'public transport' (right)	Household expenditure on other transport	0.9% increase[15]
							Energy use in public transport	Decreases

1. Extrapolation of estimate of car-sharing users today (2.7 M), for explanation see Zipcar case-study. **2.** Actual number of cars per capita in the EU (0.491), based on data from the EURF road statistics yearbook 2016. According to Chen & Kockmann (2016), car-sharing can reduce car ownership with 10-49%, so a reduction rate of 10-50% was assumed. Chen, T.D. & Kockelmann, K.M. (2016). Car sharing's life-cycle impacts on energy use and greenhouse gas emissions. **3.** Car sharing reduces number of vehicle-kilometers with 27-67% according to Chen, T.D. & Kockelmann, K.M. (2016), 30% was chosen as a conservative estimate (see Zipcar case). **4.** Assumption annual cost savings of € 300 per user (see Zipcar case) **5.** Assuming that 2/3 of the 30% decrease in car-travelling translates into increased travel in public transport, with 1/3 of the person-kms going to rail transport and the other 1/3 going to other transport. **6.** Based on current number of BlaBlacar users (40M worldwide) **7**. Average trip length of Blablacar trips in the UK. BlaBlacar (2017**)** URL: https://www.blablacar.co.uk/blablalife/going-places/womens-day-at-blablacar**. 8**. Average car occupancy in BlaBlacar is 2.8 according to information from the platform compared to an average car occupancy in EU of 1.7 (EEA, 2017). **9.** Based on 30M members in 2015 (see Blablacar case) making 10 M trips every quarter. Forbes (2016) URL: https://www.forbes.com/sites/rawnshah/2016/02/21/driving-ridesharing-success-at-blablacar-with-online-community/#26c5b1073b51 Retrieved on 14-06-2017. **11**. ADEME (2015). Enquête aupres de utilisateurs du covoiturage longue distance.**12**. EC (2016). Study on passenger transport by taxi, hire car with driver and ridesharing in the EU. **14**.See UBER case.**15**. For calculations see Annex 9

3.3.4 Consumer durables sector scenario

A third particular modelling scenario is devoted to the collaborative economy in the consumer durables market. This scenario is developed on the basis of the case study analysis of Peerby (and similar platforms) in Annex 7. A summary of the information from the case study on the defining elements of the scenario for this market is visually presented in Figure 3-4.

Key developments shaping the future of the collaborative economy in the consumer durables market

The sharing and renting of consumer durables among peers is the smallest among the three collaborative economy markets, with relatively few active platforms in the EU and not yet one very dominant model. Experiences from Peerby show (case study) that for a share of the EU population, sharing goods is a hobby and a nice thing to do and that economics do not drive the transactions. The social interaction is for them a pleasant characteristic, but many also see it as a barrier to engage in sharing. The P2P renting model therefore seems to serve a larger share of consumers and has grown most quickly lately. It is the expectation that this business model will grow faster than the sharing model in the future too. In general, though, both business models are expected to grow larger in the future from the insignificant role they currently play. A number of key factors will play an important role in determining the extent of growth of the collaborative economy in this market, including:

- The development in the **price levels of durable consumer goods**: the higher, the more sharing/renting.
- **Degree of urbanisation**. More and more people have started living in cities in the EU, a trend that is believed to continue towards 2050 (EC, 2014). As the P2P goods sharing and renting business model works best when transactions are realised on a small scale, the scope for a growing number of transactions increases when more and more people live in cities.
- **Technological developments in transport and distribution solutions.** When revolutionary transport solutions could arrive in the mass market in the future (e.g. drone deliveries), sharing and renting transactions could become cheaper and more convenient, increasing their role in the life of consumers in the future.

1) Size of P2P goods sharing/renting today

The P2P goods sharing and renting business models are in an infancy stage today. There are currently relatively few people actively involved in sharing and renting goods from peers. Based on a large survey from Statista (2017) in the Netherlands, **1.4% of the Dutch population was active on Peerby in 2016**, compared with for example 51% of people active on second-hand trading websites. Across the EU, there are multiple P2P goods renting and sharing platforms active but all with small user bases. Most of the larger platforms are engaged in P2P renting activities. Based on our research, there are P2P renting/sharing platforms in 17/28 Member States. Based on Peerby's user statistics (believed to be the largest/most commonly known platform in this market), approximately **5% of the population in larger cities** in the Netherlands are a member of the platform. If that were true for all platforms active in those 17/28 Member States, some **1.4% of the EU population is engaged** in P2P goods sharing/renting. The relative environmental impact of a P2P goods sharing/renting transaction is assessed through the LCA in section 4 for two representative products.

2) Size of P2P goods sharing/renting in 2030

Due to the nascent stage of the collaborative economy in the sector at the moment, it is very uncertain what the consumer durables market would look like in 2030, but it is likely safest to assume that the importance of P2P sharing and renting will increase. A number of important exogenous societal developments will influence the speed of uptake of P2P goods sharing and renting models (see 'key developments' section before). Three potential speeds of growth of the sector are assumed:

- No further growth of the collaborative activities employed now (*baseline* – max 1.4% of EU population engaged)
- When the current penetration of Peerby users in the Netherlands (1.4% / 5% of core city population), reaches the entire EU-28 (not only the 17/28 as it is now). Then **2.1% of all EU citizens would be engaged in P2P goods sharing/renting.**
- When twice as many inhabitants of cities participate in P2P goods sharing/renting activities than do now in the Netherlands (Peerby) in the entire EU. This implies a city penetration of 10% in all core cities in the EU. This would imply 4.2% of all EU citizens engaged.

One potential significant exogenous factors that would affect the overall sustainability of the business model in 2030 was identified. Radical changes in logistical solutions for the transport of shared/rented goods (such as potential drone deliveries or a significant increase in the electrification of transport modes of city inhabitants) could be adopted until 2030 which would bring the environmental impact per collaborative transaction in the sector down. The potential relative impact of this sustainability trigger is estimated as part of the LCAs conducted and presented in section 4.

3) Direct impacts as modelling inputs for the E3ME model and the Life Cycle Assessments

In order to define this expected development towards 2030 in the E3ME model, we translate the key direct economic impacts that the collaborative business models in this sector bring about in changes in selected E3ME parameters. The main macro-economic impact of P2P goods sharing/renting originates from different consumer behaviour: Goods sharing models could trigger economic savings for receiving peers and some additional income for peers renting out goods. Lastly, the digital platform (Peerby) earns some money from the rental transactions. Therefore, the following aspects can be modelled as part of the consumer durables scenario:

1. **Reductions in household expenditures for selected product categories** that contain durable and shareable consumer good products. An estimate of the share of total average EU household spending (in 2015) on the maximum potentially shareable and durable consumer goods is 2.2% (€185 per capita per year) (contributing 1.2% to GDP). If all EU citizens would engage in P2P sharing and renting and forgo of buying new products for the shared/rented products, we could observe a decrease in consumer spending on these products in the future. However, we already know that potential economic savings are not the key driver for consumers to engage in sharing/renting and that the spread of sharing/renting will reach at most 4.2% of EU citizens in 2030 in the most ambitious scenario. Therefore, potential consumer spending on durable and shareable goods will not go down by the full 2.2%, but only a fraction of that. Therefore, we can expect the macroeconomic impacts from sharing and renting to be marginal. The case study on Peerby (see

Annex 7) found that 2.2% of current household expenditure is on shareable and durable goods as illustrated again in Table 3-8. In our collaborative economy scenarios, we take however more realistic assumptions and assume that 5% (moderate) and 10% (ambitious) of the maximum potential of cost savings would be realised by 2030.

Table 3-8 Potential savings in household expenditure from sharing/renting consumer durables

Category	Current expenditure[A]	% shareable & durable[B]	Potential savings[C] - 100% shared	Reference scenario - 5% shared	Ambitious scenario - 10% shared
Clothing	4%	0.25%	**6%**	**0.3%**	**6%**
Footwear	0.9%	0%	-	-	-
Furniture and furnishings, carpets	1.8%	0.15%	**8%**	**0.4%**	**0.8%**
Household textiles	0.4%	0.05%	**13%**	**0.65%**	**0.13%**
Household appliances	0.8%	0.4%	**50%**	**2.5%**	**5%**
Glassware, tableware and household utensils	0.5%	0.06%	**12%**	**0.6%**	**1.2%**
Tools and equipment for house and garden	0.4%	0.3%	**75%**	**3.75%**	**7.5%**
Goods/services for routine household maintenance	1.5%	0%	-	-	-
Audio-visual, photographic and information processing equipment	1.3%	0.46%	**35%**	**1.75%**	**3.5%**
Other major durables for recreation/culture	0.4%	0.2%	**50%**	**2.5%**	**5%**
Other recreational items and equipment, gardens and pets	2.0%	0.2%	**10%**	**0.5%**	**1%**
Recreational and cultural services	3.1%	0%	-	-	-
Newspapers, books and stationery	1.1%	0.14%	**13%**	**0.65%**	**1.3%**
Package holidays	0.6%	0%	-	-	-
Total	**18.8%**	**2.2%**			

[A] = Share of household expenditures on the respective item in the annual total of household expenditures for an average EU household in 2015, sourced from the Eurostat Household Budget Survey

[B] = The estimated share of expenditure on products in the respective expenditure category that are durable and can be shared – for detailed calculated see Annex 7

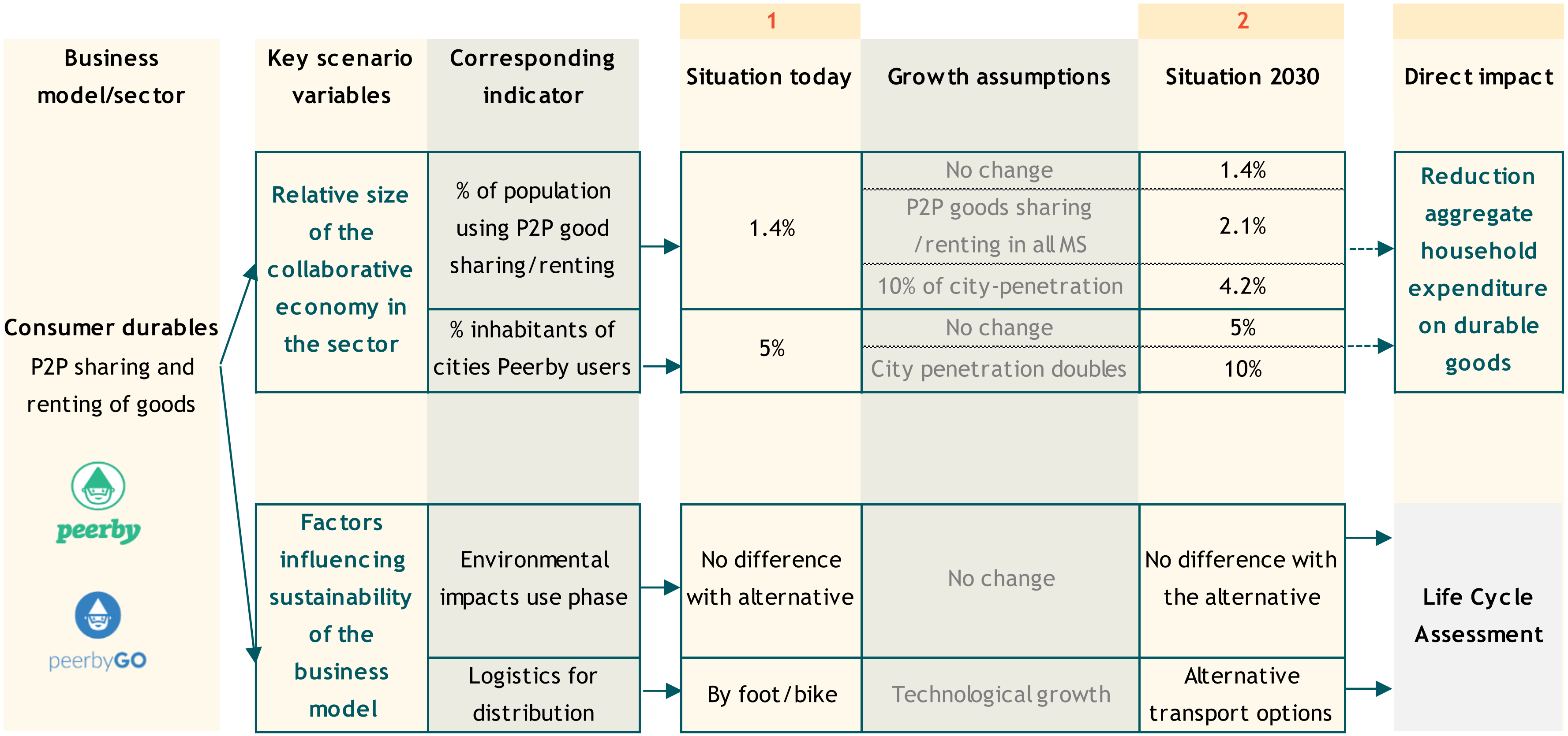
[C] = Calculated as (% shareable and durable / current expenditure)

These assumptions do not imply that we think that this business model will not grow strongly until 2030, but rather that the economic savings from this business model are likely to be moderate. P2P renting, which still costs money, is namely expected to be the dominant business model by 2030 and the total savings from using this business model (compared to P2P sharing for free) are expected to be moderate.

2. Secondly, an **increase in household income** from engaging in P2P renting with a maximum of €942m (ambitious scenario) in case the Peerby growth targets are reached throughout the EU (by Peerby-like platforms) and half of that target (€471m) in the moderate scenario.
3. Thirdly, an **increase in turnover for the 'computer programming & information services' sector** (E3ME sector 43), reflecting the increase in economic activity for that sector of a maximum of €318m (most ambitious scenario) when projected Peerby growth targets are met by 2030 and half of that (€159m) in the moderate scenario.

The LCAs conducted on the collaborative economy in the consumer durable goods market will compare the life cycle impact of P2P sharing/renting durable goods with the most common alternative of buying the same good. Since the life cycle impact of consumer durable goods can strongly differ depending on the type of good considered and the resources involved in conducting a LCA for one products significant, two representative shareable and durable products will be chosen.

Figure 3-4 Scenario diagram consumer durables



4 Environmental and socio-economic impacts of the collaborative economy today

The section starts with an overview of the literature on environmental impacts of the collaborative economy (section 4.1). However, this section focuses predominantly on assessing the environmental impacts using an LCA approach (sections 4.2 – 4.5). The section concludes with a short section on the socio-economic impacts (section 4.6). The socio-economic impacts have been analysed in detail in the literature review and the five case studies (in Annexes).

4.1 Results from the literature on environmental impacts

The literature review showed that most of the reviewed sources discuss potential environmental impacts at a theoretical level and very few empirical studies have been carried out to date. These are analysed below. This is in line with what the JRC (2016) concludes in their Science for Policy Report 'The Passions and the Interests: Unpacking the 'Sharing Economy' (JRC, 2016a).

Impacts on the collaborative economy in general

Many collaborative economy platforms promote themselves as environmentally friendly. This is often based on the intuition that sharing, and thus the optimisation of the use of goods and facilities, should be less resource intensive and better for the environment (IDDRI, 2014; Schor, 2014; Schor and Wengronowitz, 2017). In reality, however, the environmental effects of the collaborative economy are more complex. Not only the direct effects (e.g. reduction of the number of cars produced due to sharing, or reduction of the hotels constructed due to renting rooms in private homes) should be taken into account, but also the less visible changes that are set in motion as a result of the new practices (Frenken and Schor, 2017).

One of the changes that may increase the environmental footprint is the "rebound effect", the consumption of additional goods through the gain of purchasing power, in this case resulting from sharing/ renting goods. Many authors distinguish between two types of effect (Verboven and Vanherck, 2016):

- The **direct rebound effect** occurs when efficiency improvements and the associated decrease of costs result in increased consumption of the same product or service. This way, more of the same economic activity is created that would not have existed otherwise—more travel, more automobile rides (Schor, 2014).
- The **indirect rebound effect** takes place when the savings are used for the consumption of other products or services.

Although the rebound effect is negative from an environmental perspective, it is positive from an economic and social perspective (IDDRI, 2014). When the rebound effect is larger than 100%, it is called 'backfire' (Jenkins et al., 2011). According to Verboven and Vanherck (2016), there is a lack of structured proof for the rebound effect, due to a wide span of areas that could be impacted by new, sustainable business models, such as transportation and product life span.

At the moment, very few comprehensive studies are available that provide quantitative evidence on the lower environmental impact of the sharing economy (IDDRI, 2014; Frenken and Schor, 2017). Only for car sharing, there are indications that reductions in CO_2 emissions are realized (Chen and Kockelman, 2015; Nijland and Van Meerkerk, 2015; Frenken and Schor, 2017). Furthermore, papers on the environmental impact of the collaborative economy generally focus on climate change only, not on other environmental effects. A notable exception is a study of the collaborative economy in Germany (Gsell et al., 2015) which models the environmental impacts of car sharing not only in terms of greenhouse gas emissions, but also acidification, eutrophication, and resource use (total energy consumption and raw materials).

IDDRI (2014) discusses the conditions for improving the sustainability of the sharing economy. According to the authors, the most important requirement for the environmental sustainability is the quality of the shared good. Goods with a long lifespan and a high recyclability (and actual recycling) should be prioritized. Sustainability would be further improved if companies (in the case of business to consumer models) could bring goods to the market that are designed for being shared. The next key condition for the sustainability of sharing models is the optimization of transportation. Transport is needed to make shared goods available, whether rented or resold. For some models, especially peer-to peer ones, the impact is limited, since they are based on the geographic proximity of users. The last key condition relates to consumption patterns. Changes in habits may have either negative or positive effects on the environment. Consumption may increase if new models of a good become more easily available, or on the other hand distancing users from a good through changes in the way we consider property may allow for more ecological consumption patterns. The authors take car sharing as an example. Indeed, many studies show that individuals using car sharing services tend to drive less and use public transports more, therefore changing their habits to more sustainable one (see table 2-1).

Another aspect that could contribute to the environmental impact of collaborative economy business models are resource intensive telecommunication networks. For example, the computer resources (including Sharing Economy platforms) may be highly energy intensive (DG ENV, 2011; Maxwell et al. 2011; Pargman et al., 2016).

Transport

The approach taken in the reviewed studies on the environmental impacts of collaborative economy models within the transport sector varies widely. Many of the quantitative studies collect data through surveys (e.g. Loose, 2010; Martin and Shaheen, 2010 and 2011; Firnkorn and Müller, 2011), others are based on literature review only (e.g. Chen and Kockelman, 2016) or develop their own scenarios based on assumptions (e.g. Gsell et al., 2015; Carranza et al., 2016). Transport emission models such as COPERT are sometimes used to calculate vehicle emissions (e.g. Baptista et al., 2013). Not only physical data is used, some studies are (partially) based on cost data, using Input-Output databases to translate them into environmental impacts (e.g. Briceno et al., 2005; Gsell et al., 2015; Carranza et al., 2016). The quantitative studies focus on a specific region, ranging from a city to a continent, while the qualitative studies are generally on a continental or global level.

Within the transport sector, car sharing is the most studied collaborative economy business model. Research shows that the environmental improvements related to car sharing include not only the potential optimization of vehicle usage, but also the additional benefit that car sharers travel a smaller distance by car, favouring public transport options instead (IDDRI, 2014).

A study commissioned by the German Ministry of Environment (Gsell et al., 2015) concludes that the avoided environmental costs associated with increased market penetration of flexible car sharing in Germany would be in the range of EUR 940-950 million per year, in a scenario where the increase in car sharing is accompanied by improvements to public transport and cycling infrastructure (as rebound effects). However, in models based on a scenario with unchanged framework conditions, the environmental impacts are only marginal, suggesting that measures supporting public transport and cycling are the main drivers of the positive environmental impacts revealed by the study, and not the increase in car sharing in isolation (without rebound effects explicitly considered).

Chen and Kockelman (2016) list the factors that contribute to the environmental consequences of car sharing. First, the number of vehicles owned per person generally falls with car sharing membership, generating environmental benefits from avoided vehicle and parking infrastructure production. Next, car sharing tends to decrease the kilometres travelled and thus fuel consumption. Finally, car sharing causes a shift from private cars to public and non-motorized transport (as well as a shift from non-auto modes to shared cars). The table below gives an overview of the variables that influence the environmental savings that may result from car sharing.

Table 4-1: Variables influencing the environmental consequences of car sharing.

Variable	Key figures	Sector/ Platform	Geography	Source
Market potential for car sharing	10% of adults 21 and older	car sharing in general	North America	Shaheen et al. (2006)
	exploitable potential estimated at 16.2% of the total number of routes	car sharing in general	Germany	Gsell et al. (2015)
Vehicle ownership impacts	each car sharing vehicle replaces at least 4 to 8 personal cars	car sharing in general	Europe	Loose (2010)
	vehicle ownership reduced by 49%	car sharing in general	US	Martin and Shaheen (2011)
	each car sharing vehicle replaces 23 private vehicles	PhillyCarShare	Philadelphia	Lane (2005)
	each car sharing vehicle replaces 15,3 private vehicles	PhillyCarShare	Philadelphia	Econsult (2010)
	each car sharing vehicle replaces 15,3 private vehicles	car sharing in a university setting	Ithaca, NY	Stasko et al. (2013)
	net reduction of 1995 cars for 17,000 members	car2go	Ulm	Firnkorn and Müller (2011)
	each car sharing vehicle replaces 6 private vehicles	MobCar sharing	Lisbon	Baptista, Melo, Rolim (2013)
Vehicle kilometres travelled	decreased 27% after joining car sharing (from 6468 to 4729 km/year)	car sharing in general	North America	Martin and Shaheen (2011)
	31% reduction	car sharing in general	North America	Frost and Sullivan (2010)
	67% reduction	City CarShare	San Francisco	Cervero et al. (2007)
	72% reduction	Mobility Car sharing	Switzerland	Muheim (1998)
	33% reduction	car sharing in general	The Netherlands	Meijkamp (1998)
	45% reduction	car sharing in general	Bremen	Ryden and Morin (2005)
	28% reduction	car sharing in general	Brussels	Ryden and Morin (2005)
Fuel efficiency vehicles	car sharing fleets register up to 15 to 20 percent lower specific CO2 emissions, in some cases up to 25 percent lower	car sharing in general	Europe	Loose (2010)
	shared cars are approximately 24% more fuel efficient than the average car	car sharing in general	The Netherlands	Meijkamp (1998)
	car sharing fleet averaging 13.9 km per liter and vehicles replaced averaging 9.8 km per liter	car sharing in general	North America	Martin and Shaheen (2011)
	average car sharing vehicle is 17% more fuel efficient than the average private vehicle	car sharing in general	Germany and Belgium	Ryden and Morin (2005)

Parking infrastructure demand	parking needs fall by 26–30%	car sharing in a university setting	Ithaca, NY	Stasko et al. (2013)
Influence on other modes of transportation	14% increase in bicycling, 36% increase in rail transit use, and 34% increase in bus transit use among car sharing members	car sharing in general	The Netherlands	Meijkamp (1998)
	car sharing members use public transportation 35–47% more during weekdays	car sharing in general	Germany and Belgium	Ryden and Morin (2005)
	net use of walking, biking, and carpooling modes increased 2%, 7%, and 3%, respectively (statistically insignificant)	car sharing in general	North America	Martin and Shaheen (2011)
	25% increase in walking, 10% increase in bicycling, and a 14% increase in public transit use	Car sharing Portland, Inc.	Portland	Cooper et al. (2000)
	Assuming unchanged framework conditions (i.e. no improvements in public transport and cycling infrastructure), increased market penetration of car sharing does not lead to significant changes in the modal split for car owners. For passengers without an own vehicle, biking decreases from 23.7% to 19.4%, while the share of walking and public transport remain unchanged.	car sharing in general	Germany	Gsell et al. (2015)

Source: Based on literature overview of Chen and Kockelman (2016), additional references added.

It is much more difficult to find data on other collaborative economy business models within the transport market. A limited number of studies have been performed on bikesharing (e.g. Shaheen et al., 2011 and Roland Berger, 2014). Some statements of environmental impact reduction from ride sharing can be found on platforms and in papers (e.g. according to the BlaBlaCar platform, over the past two years, their global community has saved 1 million tons of CO_2), but actual data to endorse these claims are generally missing.

Accommodation

Some LCA studies on traditional hotels, focussing mainly on energy use, are available. For example, Filimonau et al. (2011) list and quantify the different types of energy use of two hotels. Furthermore, several hotel chains publish outcomes of their sustainability assessments (e.g. AccorHotels, Hilton, NH Hotel Group); however, background reports are not publicly available.

Most papers on the environmental impact of collaborative economy models for accommodation are limited to qualitative information. Accommodation sharing platforms allow using space more efficiently, and could lead to a decrease of new hotel buildings. However, collaborative property rentals such as provided by Airbnb are often entire homes/apartments, in Europe over two-thirds of the Airbnb listings are entire homes/apartments (Insideairbnb, 2017). This in contrast to the traditional accommodation sector that mostly rents out rooms. This might have large impacts on the relative environmental impact of stays in accommodation provided by collaborative business models as opposed traditional accommodation.

In the accommodation sector, rebound effects are also an essential factor affecting the overall environmental impact. Availability of inexpensive lodging may increase the carbon footprint due to an increase of trips and (air) travel (Schor, 2014; Pargman and Eriksson, 2016; Tussyadiah and Pesonen, 2016). However, a survey of users of accommodation sharing platforms done by Zvolska (2015) indicated that 92% of the guests would have travelled to the same destination if the sharing platform had not been available. Nearly 70% would have stayed in the destination for the same time and the rest would have stayed for a shorter period, thus accommodation sharing platforms allow people to prolong their holidays. Since transportation is the most important contributor of tourism to climate change, it is important to know whether there is a rebound effect that leads to tourists traveling more often or further away from their homes. Zvolska concludes that accommodation sharing platforms do not lead to a significant increase of greenhouse gas emissions generated by travel to the destination as they substitute the traditional accommodation. Since the accommodation that can be booked through the platforms was found to be less resource intensive than hotels, booking a trip through an accommodation sharing platform leads to a decrease in environmental impact.

As far as studies on the environmental impact of specific platforms are concerned, only some on Airbnb are found (Cleantech Group, 2014; Howe and Kudo, 2016). According to Howe and Kudo (2016), on a per-square foot basis Airbnb leads to lower greenhouse gas emissions, energy consumption, and water usage than hotels. Their analysis is based on costs and estimates of the environmental impacts with data from an input-output database. The authors could not conclude whether demand for hotel construction has decreased due to Airbnb's prevalence in the area.

Consumer durables

According to IDDRI (2014), savings of up to 20%[15] in terms of household waste could be achieved if sharing models could be operated under the most favourable conditions, such as high durability of the shared goods and the adaption of sustainable consumption patterns. This would also lead to a lower need for industrial production, since fewer goods need to be produced to replace the discarded ones. For products where the environmental impact occurs mainly during the use phase, the extension of their lifespan may delay the spread of technological advances that enable lower consumption. The authors list the conditions for short-term renting and lending to be positive from an environmental perspective. The first condition is that the borrower does not buy a product himself. Secondly, the lender needs to provide a high quality good resistant to intensive usage. And thirdly, the rental should occur at a local scale to minimize transport. Les Pionniers du Collaboratif (2016) also mention transport as a potential rebound effect. Furthermore, they list two others: 1) the demand-side rebound effect - buyers and borrowers of goods may use these platforms to acquire additional goods that they would otherwise not have bought and 2) the supply-side rebound effect - sellers and renters may use the profit of these platforms to acquire more new goods.

Most literature on sharing of consumer durables is qualitative rather than quantitative. ShareNL qualitatively discusses the potential environmental effects the sharing of various goods may have. Intlekofer et al. (2010) investigate whether the shorter product life cycles, leasing and renting may lead to are positive for overall energy use. They quantitatively test this for household appliances and computers. The results show that products with high use impacts and improving technology can benefit from reduced life cycles (allowing them to be replaced sooner by more efficient ones), whereas products with high manufacturing impacts and no improving technology do not.

4.2 Life-Cycle Approach

The environmental impacts of the traditional and collaborative economy today are assessed by a screening Life Cycle Assessment (LCA)[16] and, as such, encompass a static analysis of the current situation. The LCA methodology as described in the ILCD handbook and ISO 14040/44 is used as a basis/guidance. The analysis is built up in different steps. First, the environmental impact of the specific collaborative economy business models is assessed on a functional unit level. This is done for the representative traditional economic model(s) in each sector as well. In a next step, this information is extrapolated to the sector level, which is a mixture of the main collaborative economy business models and the traditional business models. This leads to the picture for the economy as a whole, according to today's situation. Due to lack of data this last step was not feasible for the consumer goods market.

Specific data that follow from the previous tasks are used as much as possible. Background data (e.g. for electricity production) are taken from the Ecoinvent (v3.3) database. In case data are lacking, assumptions have been made. All data and assumptions are reported in the following paragraphs and in

[15] Rough estimate based on the estimated increase in the usage duration of goods in sharing models.

[16] An attributional approach is used, which attempts to provide information on what portion of global burdens can be associated with a system (in this case a business model or sector).

The ILCD environmental impact assessment methodology is used, except for water depletion (which is based on Recipe[17]). All impact categories as defined by ILCD are assessed and reported. If focus is necessary, the following impact categories are acknowledged as the most relevant by policy (e.g. ecolabels) and by applying normalization and weighting[18]:

- Climate change;
- Resource depletion: mineral and fossil resources;
- Water depletion.

4.3 Environmental impacts in the accommodation sector

4.3.1 Parameters

The environmental impact of a person staying for one night at a hotel (traditional economy model) is compared to the environmental impact of one night at a peer-to-peer rented property, such as Airbnb (collaborative economy model). It is assumed that the needs of the consumer are equal in both situations, only differences linked to the different accommodation types (facilities offered, and the materials used in construction) are taken into account. Impacts that are assumed to be very similar (e.g. the impact of food consumed in both situations) are left out. Included are the energy use (electricity and fuels), the water use, the use of toiletries (soap and toilet paper) and the waste created (waste water, packaging and excess products for guests) and the infrastructure itself (production, maintenance and end of life of hotels and houses[19]). The difference between budget, mid-scale and luxury hotels is quite large; therefore, their impacts are calculated separately.

The energy and water use of the hotels is based on different sources (IMPIVA, 1995; Onut and Soner, 2006; Beccali et al., 2009; Filimonau et al., 2011 and ACCOR, 2012) which show a large variation, even within each class of hotels. As no specific data on the energy and water use in collaborative economy accommodation is available, it is assumed that people staying at a collaborative accommodation use the same amount of energy and water as when they stay at home. These residential consumption data are available in Eurostat. As far as the toiletries are considered, it is assumed that they differ according to the hotel type, and that their use in collaborative accommodation is generally (in 75% of the cases, own assumption) equal to budget hotels and sometimes (25% of the cases, own assumption) to midscale hotels.

In reality, the impact of infrastructure differs according to the region, construction age, budget, personal preferences etc. However, due to the strict timing of this study, only one specific type of building is considered to be representative for the hotels, and one type for the collaborative accommodations. To relate a share of the building to the stay a guest for one night, the lifetime and occupancy rate of the building are needed. Both thus have a

[17] The ILCD method takes into account the local scarcity of water. In the Ecoinvent background data in our software, however, water is sometimes accounted for as "local" water in a specific region and sometimes as average water (with an average scarcity) without referring to the region of consumption. This leads to inconsistent results when using the ILCD method for water depletion combined with the Ecoinvent v3.3 database. Therefore, this impact category is calculated with the ReCiPe method, which results in an absolute water use (in m^3), without considering local scarcity.

[18] Based on normalization and weighting as defined in Recipe

[19] Since about 70% of the listing types for Airbnb from 12 large cities in Europe are entire homes/apartments (source: insideairbnb.com, 2017), an entire home (with an average occupancy) is considered for the infrastructure in the collaborative economy scenario.

large influence on the environmental impact of infrastructure. Since most LCA studies consider a service life of buildings of 50 years, this is also assumed here. For hotels, an occupancy rate of bed places of 44,4% is considered (Eurostat, 2017[20]). For Airbnb, the occupancy rate used is 30% (Coyle and Yeung, 2017). However, this may be an underestimation of the overall occupancy over the lifetime of the building, since it may well be that it is fully occupied during most of its lifetime and rented through the collaborative economy platform only for a few years. Therefore, a 100% occupancy rate is also considered.

The detailed inventory of data used to calculate the environmental impacts of the accommodation sector at business model and sector level can be found in Annex 10.

4.3.2 Results – business model level

The analysis is first performed on the business model level, per person-night (= functional unit). Figure 4-1 compares the impact, for different environmental impact categories, of the traditional midscale hotel (line) and both collaborative economy scenarios. The grey zone represents the uncertainty/ insignificance interval.

The figure shows that the current environmental impact of staying for one night at a collaborative economy accommodation is generally smaller than or equal to staying at a traditional midscale hotel. For example, staying for 2 nights at a peer-to-peer accommodation leads to a similar carbon footprint as staying for 1 night at a midscale hotel. Only for ozone depletion, the impact of the collaborative accommodation with a 30% occupancy rate is larger. The next paragraph focuses on the reasons for the differences. Figure 4-2 shows the environmental impacts of all hotel categories and collaborative scenarios, relative to those of the luxury hotel (since this accommodation has the highest impact in all categories). The impact of the budget hotel is about 1/3rd smaller than that of the midscale hotel, and for most impact categories rather close to that of the collaborative accommodation with a 30% occupancy rate. The environmental impact of the luxury hotel is almost three times larger than that of the midscale hotel.

Thus, staying at an average collaborative economy accommodation currently has a lower environmental impact than staying at a luxury hotel and often even a midscale hotel. However, if staying at a collaborative economy accommodation implies that a more luxury type of accommodation becomes available with the same budget (direct rebound effect), the environmental impact may increase.

[20] Occupancy data for 2015

Figure 4-1: Comparative environmental profile – accommodation

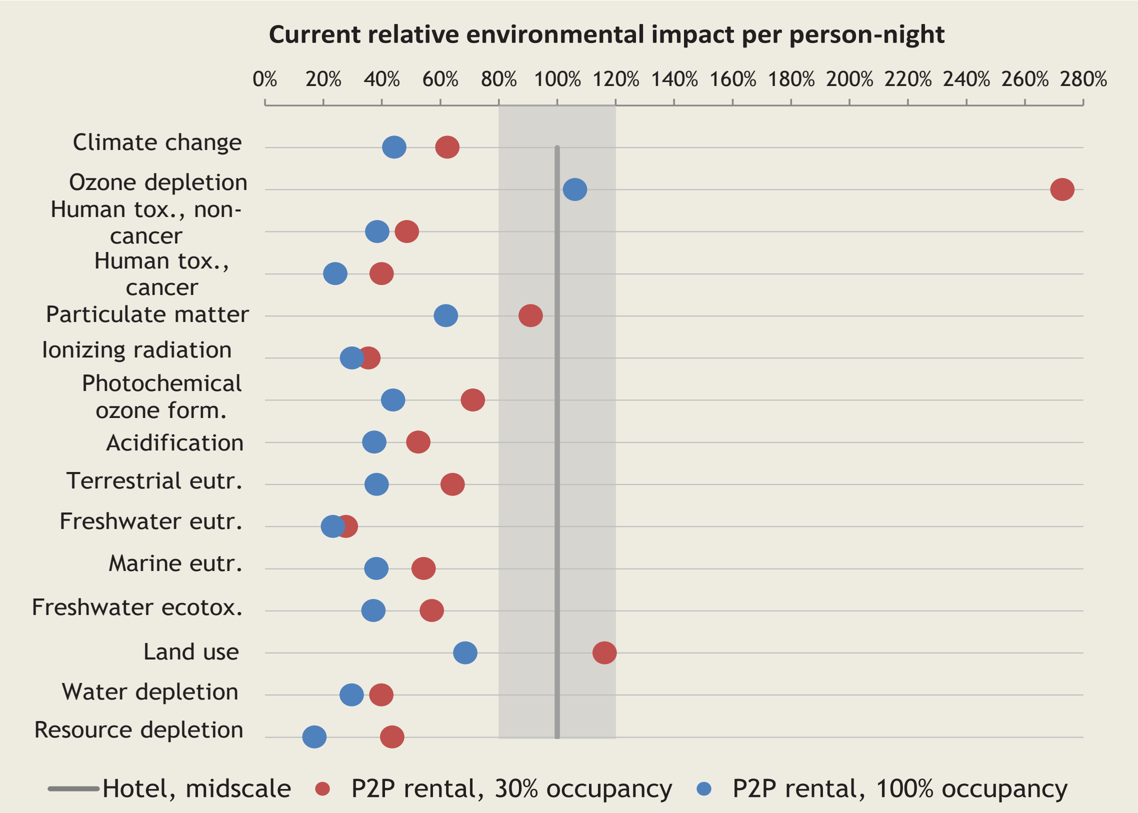
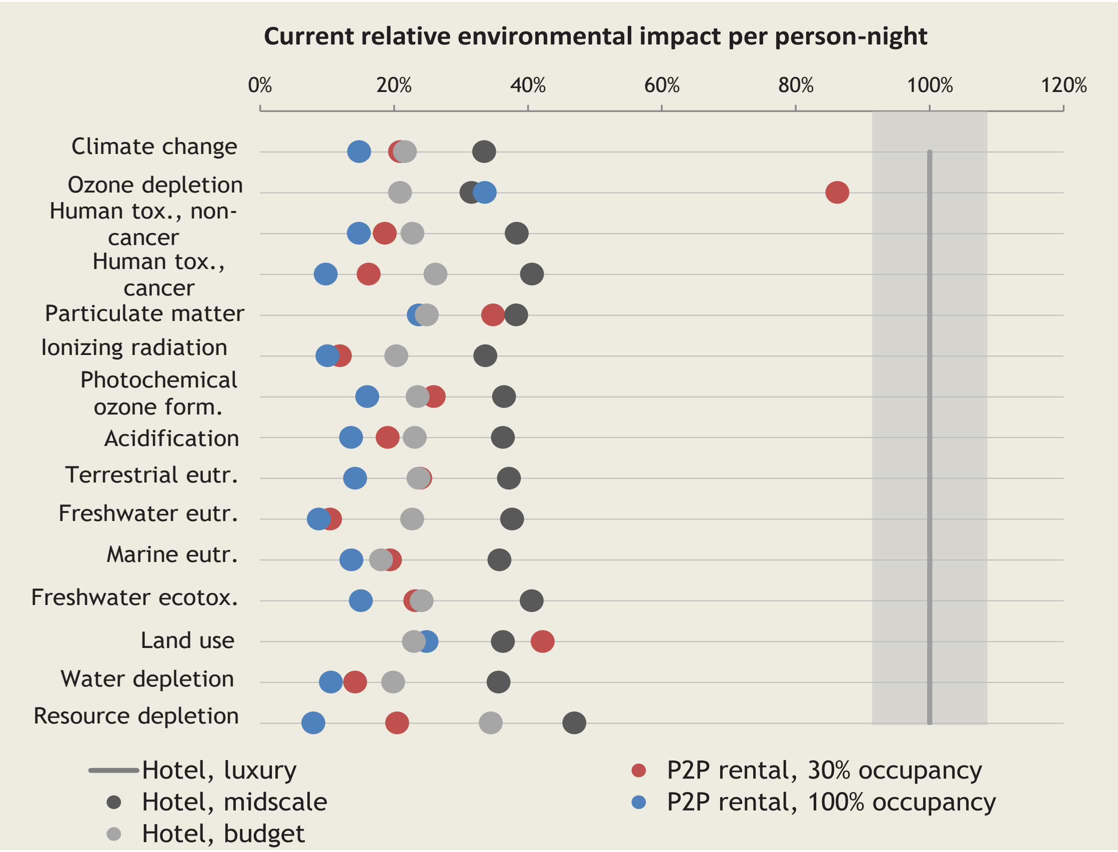


Figure 4-2: Comparative environmental profile – accommodation, including 3 categories of hotels



The contribution of the different factors to the environmental impact can be seen in Figure 4-3 and Figure 4-4. The energy use (both electricity and heating) is a major contributor to the impact of both the midscale hotel and the collaborative accommodation with 30% occupancy. The difference in electricity use is the main cause of the difference in impact between traditional and collaborative accommodation. The impact of the building depends on the impact category considered. The extreme differences between the traditional and collaborative building in some impact categories are due to the fact that only one building type was selected to represent each category. The collaborative building has a high contribution to ozone depletion due to the use of extruded polystyrene insulation, while the hotel has a high impact on resource depletion because of the zinc coating used for ventilation ducts. Water consumption and waste water treatment has a relevant impact on human toxicity, marine and freshwater eutrophication, freshwater ecotoxicity and water depletion. The impact of the use of toiletries is generally limited, for freshwater ecotoxicity it is a bit larger due to the production of soap.

Figure 4-3: Comparative environmental profile – accommodation, results split up in contributing factors

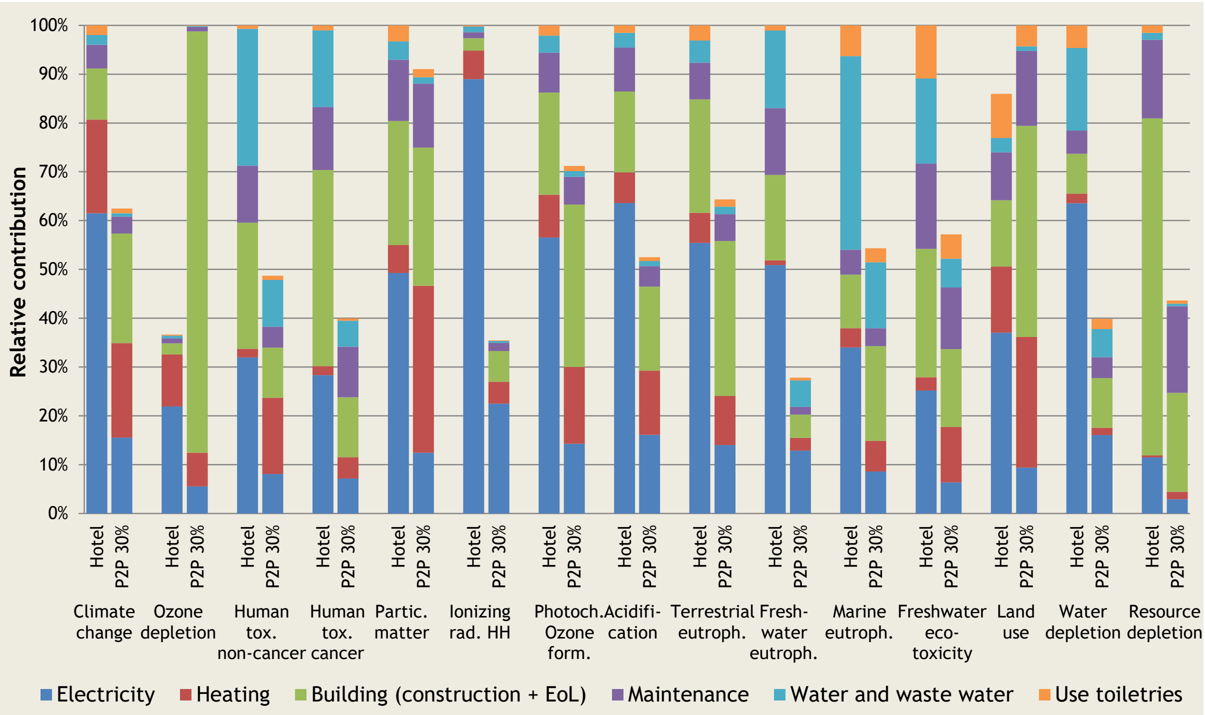


Figure 4-4: Individual environmental profiles – accommodation

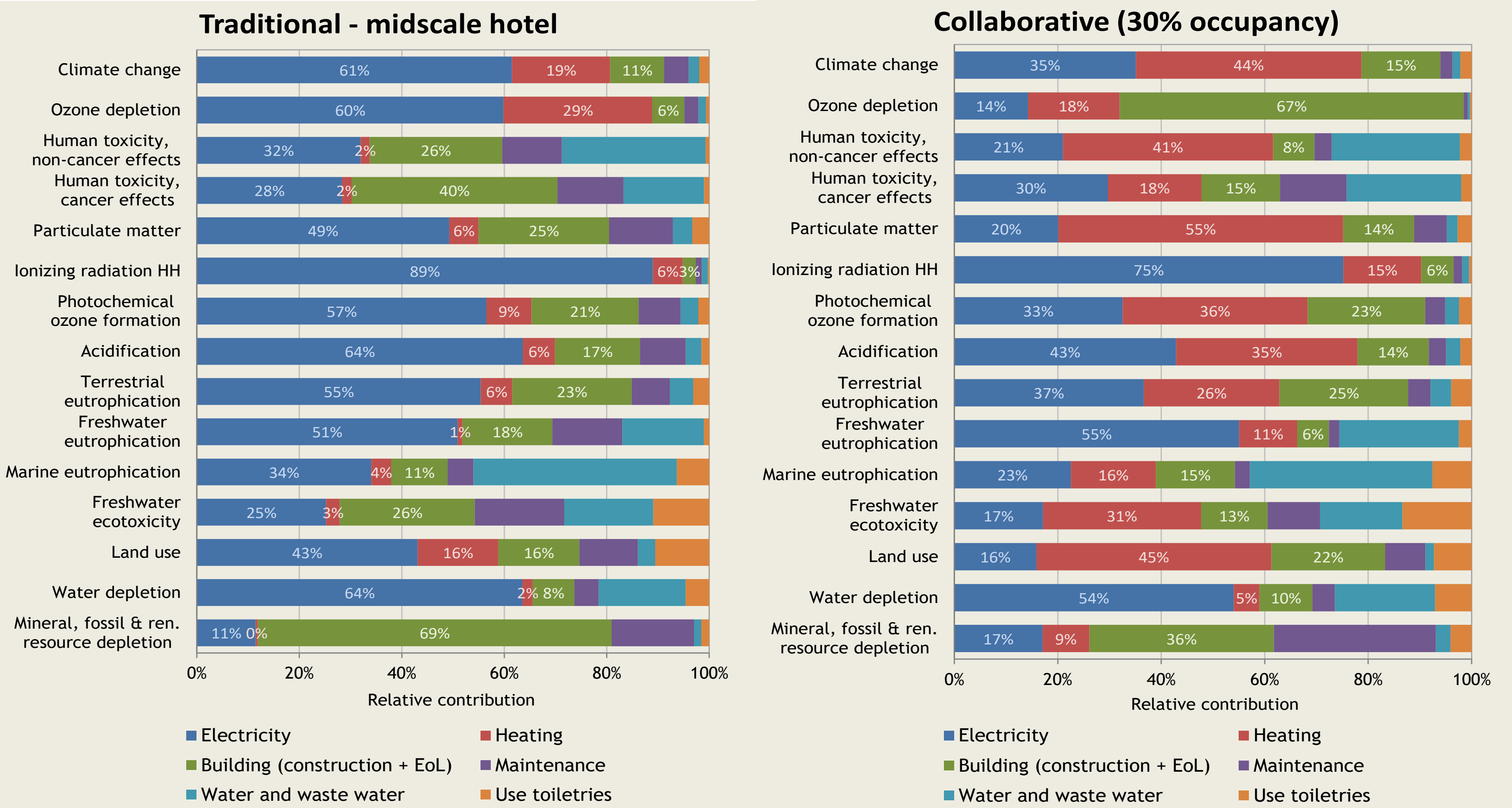
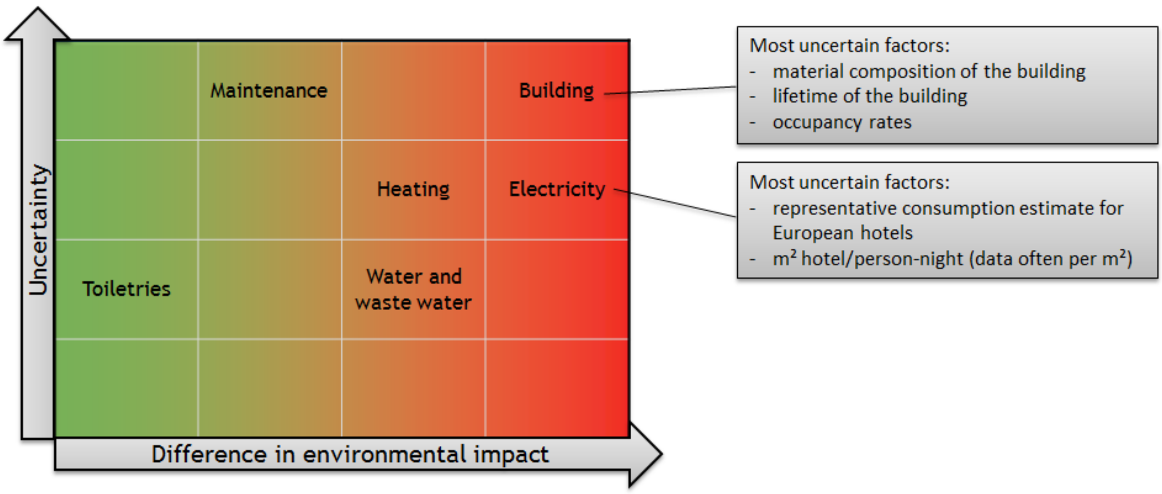


Figure 4-5 gives an overview of the most uncertain factors for the environmental impact of accommodation and their contribution to the difference in environmental impact between the traditional and collaborative scenario of today. The construction of the buildings and the electricity use have a large influence on the difference in environmental impact, and both have a high uncertainty. In the case of the buildings this is due to the selection of one type of building to represent the average for Europe, the uncertainty on the service life of the building for both the collaborative and traditional accommodation and occupancy rates, especially for the collaborative economy business models. The impact of electricity is uncertain because of the difficulty to find data on the average energy consumption of European hotels per person-night. Furthermore, for the collaborative economy it is assumed that people use the same amount of energy when they are on holiday as they do at home. The same is true for heating of buildings. The uncertainty in the environmental impact of maintenance is also high; however, the contribution to the difference in impact of collaborative and traditional business models is limited.

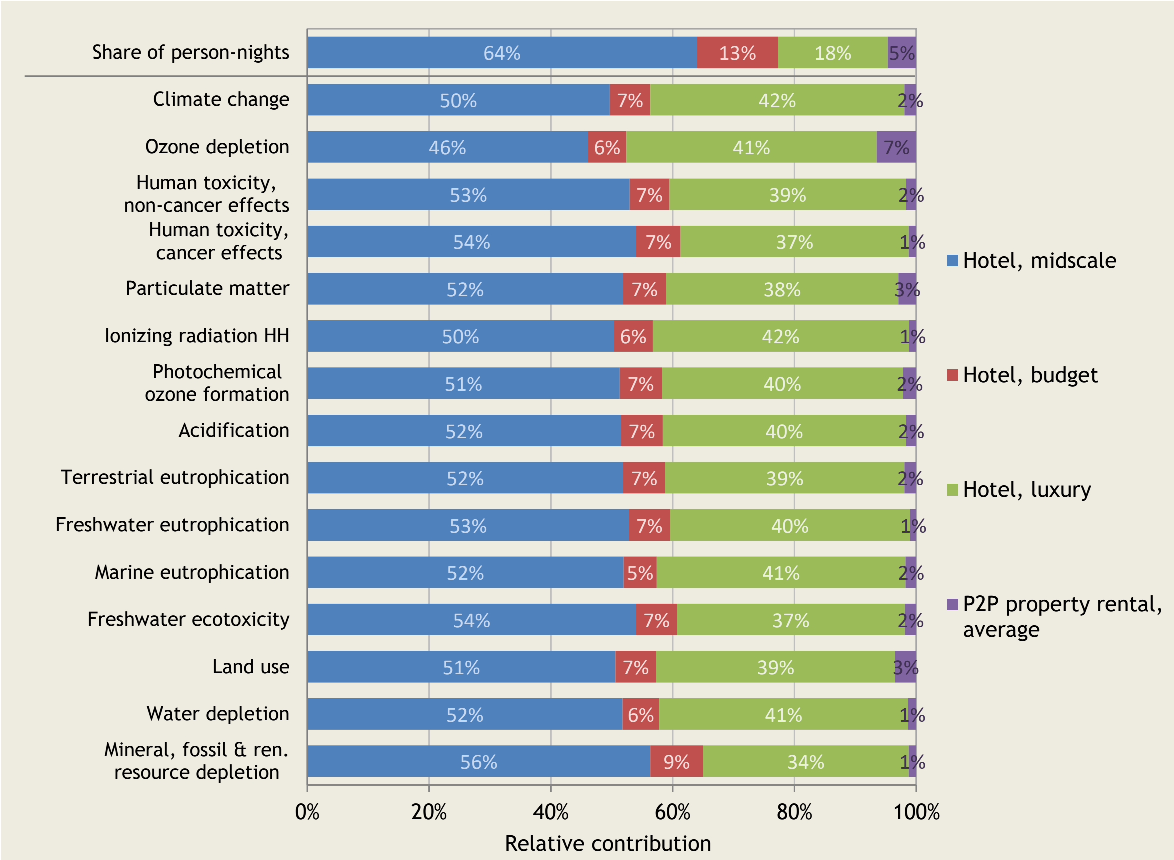
Figure 4-5: Uncertainty matrix – accommodation



4.3.3 Results – sector level

The next analysis is performed on sector level, estimating the contributions of different traditional and collaborative tourist accommodation models to the environmental impact of tourist accommodation in Europe today. Figure 4-6 shows the share of different types of hotels and collaborative economy accommodation in the total tourist accommodation use in Europe, and their relative environmental impact. The share of collaborative economy accommodation is small, and its impact is generally even smaller. The luxury hotels account for a large share in the environmental impact of the tourist accommodation (about 40%), while the number of person-nights spend at this type of hotels is not that large (18%). There is thus a large variability in the environmental impact of different types of hotels. This is probably also the case for the collaborative economy accommodation; however, more data need to become available to be able to evaluate this.

Figure 4-6: Environmental profile on sector level – accommodation



4.4 Environmental impacts in the transport sector

4.4.1 Parameters

To analyse the environmental impact of transport today, the transport of one person over one kilometre is compared for traditional transport and three collaborative transport business models (ride-sharing, ride-hailing and car-sharing). For the traditional economy transport, a mix of all transport modes that are currently used is considered, including transport by car, motor bike, bicycle, bus, train, airplane, ship and walking. This mix is obtained from EU Transport in figures (European Commission, 2016), complemented by walking and cycling figure (from European Environment Agency, 2003). Additionally, the results for traditional car transport only are shown. For all collaborative economy transport models, car transport only is taken into account. The variables that are included are the infrastructure (production, maintenance and end of life of vehicles and roads) and the energy use and direct emissions during operation. To relate a share of the environmental impact of (driving) a vehicle to the impact of one person-km, the service life and the average occupancy rate of the vehicle are needed. For cars, the average occupancy rate in Europe for traditional transport is assumed to be 1,6 persons per car. The service life of the car is assumed to be 150000 km (Ecoinvent). For ride-sharing models, such as BlaBlaCar, average EU car transport with an average car mix and an average service life of the cars (150000 km) is assumed. The occupancy rate is 2,8 according to the BlaBlaCar platform. For ride-hailing services, such as Uber, newer cars are used since their maximum age is strictly regulated. Their service life (in km) is also larger, as they are used more intensively. An average service life of 300000 km is assumed, similar to that of taxis (NYC Taxi and Limousine Commission, 2014). The more intensive use of the vehicles also results in a lower use of road infrastructure per km driven (7 times lower). The reason for this is that it is assumed that the use of infrastructure is equal regardless whether the car is driving or parked. The same occupancy rate as for traditional car transport is considered (1,6 persons per car[21]). Car-sharing models, such as ZipCar, generally also use newer cars. According to ZipCar, the average age of their vehicles is eleven months. ZipCar does not provide data on the service life (in km) of their vehicles, but it is expected that the distance driven can be extended by at least 50% compared to average cars. Thus, an average service life of 225000 km is assumed. Due to the more intensive use of the cars, a lower use of road infrastructure per km driven is assumed (17 times lower). The occupancy rate is assumed not to differ from the average (1,6 persons per car), because this model is actually a type of car rental.

The detailed inventory of data used to calculate the environmental impacts of the transport sector at business model and sector level can be found in Annex 10.

4.4.2 Results – business model level

The analysis is first performed on business model level, per person-kilometre (= functional unit). Figure 4-7 compares the impact, for different environmental impact categories, of the traditional transport mix, traditional car transport and the collaborative economy transport models. The grey zone represents the uncertainty/insignificance interval. The figure shows that the current environmental impact of travelling with collaborative economy transport is generally smaller than or equal to travelling with the traditional transport mix. Only for resource depletion, the impact of car-sharing and ride-hailing is larger. The result for collaborative economy transport is less environmentally damaging when comparing to traditional car transport only. Ride-sharing generally has the lowest environmental impact. This can be attributed to when increasing the car occupancy rate, all per person-km impacts related to car use are reduced accordingly (fuel consumption, direct emissions from cars and vehicle and road production, maintenance and end of life). Ride-sharing is the only type of collaborative economy transport for which a reduction of the carbon footprint (impact category climate change) is achieved compared to the traditional mix. When choosing ride-sharing instead of traditional car driving, 1,75 km can be driven rather than 1 km, with the same effect on climate change. Ride-sharing and ride-hailing don't perform better than the traditional mix for climate change because the traditional mix includes transport types with a low to very low carbon footprint, such as train and tram, bicycle and walking. To realize the environmental potential of collaborative transport, it is thus very important to create a shift from personal car use to collaborative car use, and to avoid users of public transport, bike users or pedestrians to shift towards collaborative transport. For the impact categories terrestrial and marine eutrophication, car-sharing has the lowest impact. In these categories, the NO_X emissions of the car have the largest contribution to the environmental impact. For car-sharing, new EURO 6 cars are assumed to be used; therefore, NO_X emissions to air are the lowest for this business model. Ride-hailing has the lowest impact on "human toxicity – cancer", due to the lower need for car production (which causes emissions of chromium to be released from the landfill of slag from steel furnaces).

The collaborative economy transport models can thus help to reduce the impact of car transport by increasing the occupancy rate of the car or accelerating the uptake of newer, more fuel-efficient cars. However, other traditional transport modes (e.g. train, tram and bicycle) have a lower impact, since they use less energy to transport one person over one km.

[21] The Uber driver is not counted in the occupancy rate, as the purpose of the trip is to transport customers.

Figure 4-7: Comparative environmental profile – transport

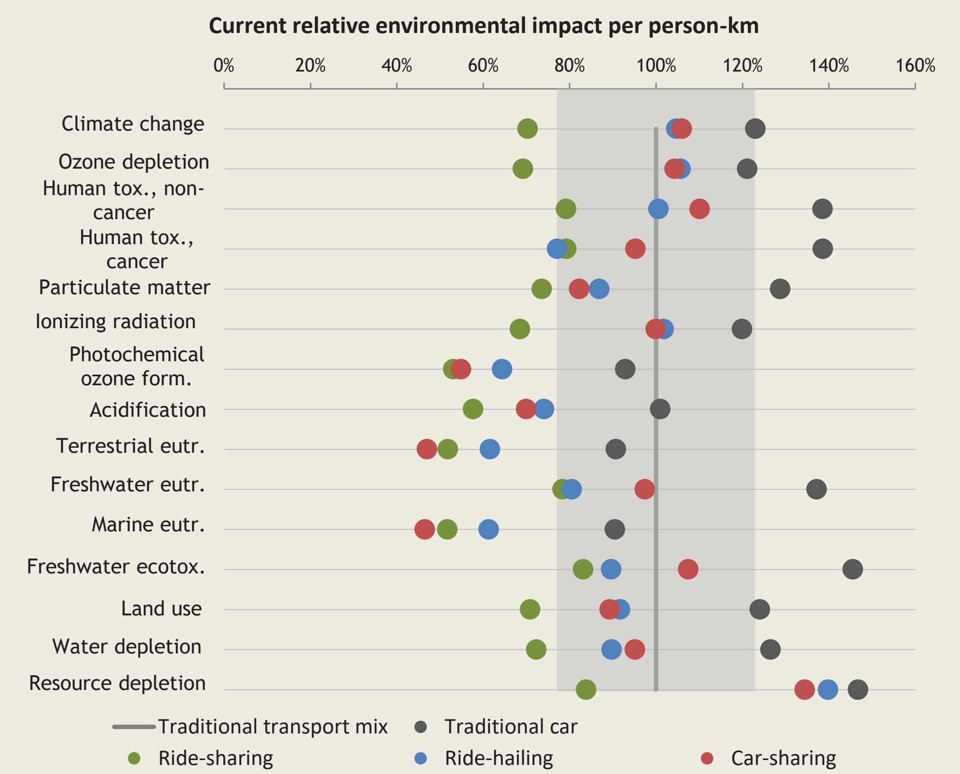
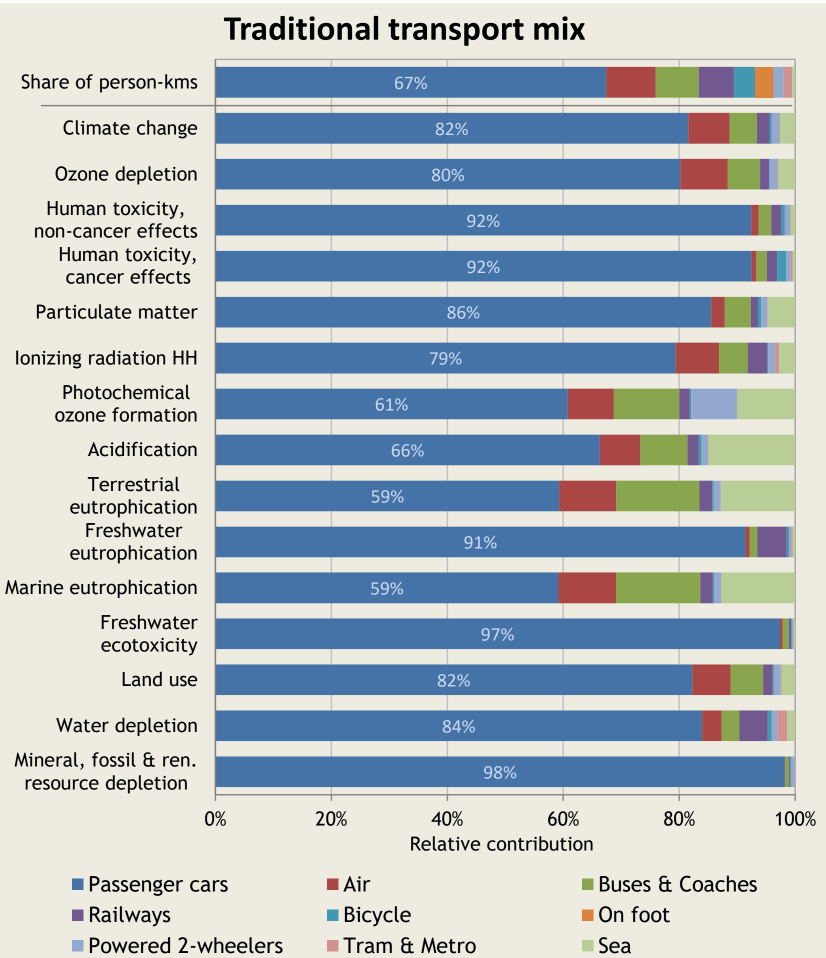
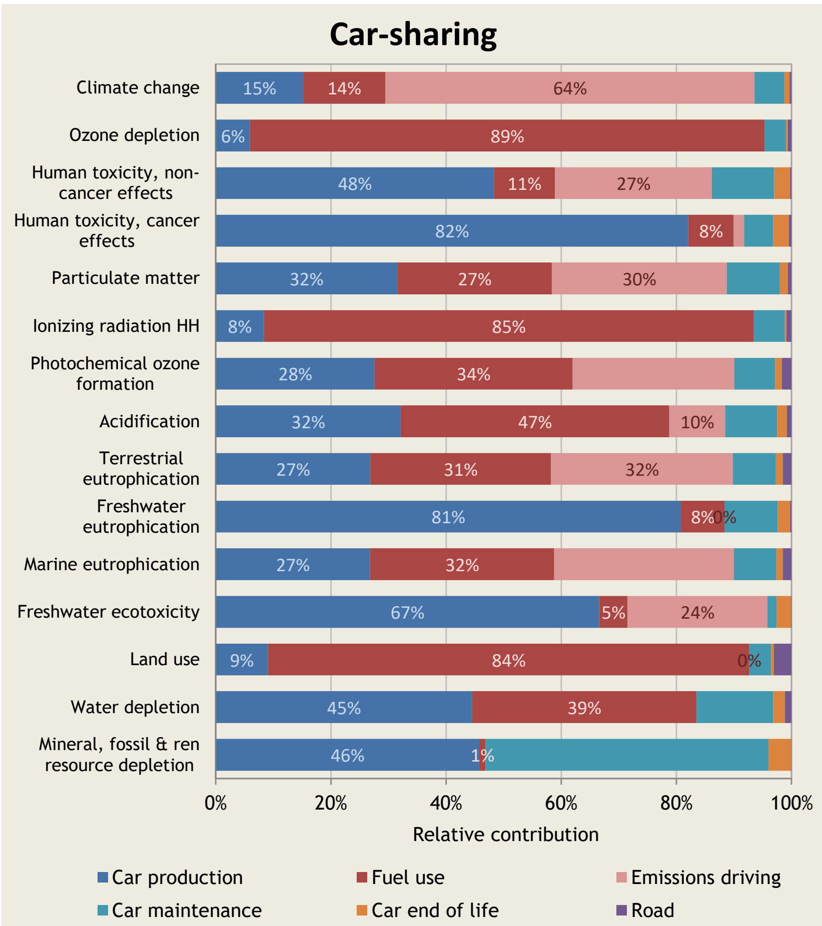


Figure 4-8: Individual environmental profiles – transport – traditional economy



The contribution of the different factors to the environmental impact of car-sharing can be seen in Figure 4-9. As for all car transport, the fuel and the emissions when driving have the largest contribution to most of the environmental impact categories considered. The impact of the fuel is related to its extraction (e.g. emissions released during extraction, waste produced, energy needed), processing (mainly due to the energy use) and distribution (materials needed to produce infrastructure). The fuel-related emissions when driving have an impact on climate change (principally CO_2 emissions), particulate matter formation (mostly PM 2,5[22], NO_X and SO_2), photochemical ozone formation (mainly NMVOC[23] and NO_X) and terrestrial and marine eutrophication (predominantly NO_X). The tyre and brake wear emissions, on the other hand, have an effect on "human toxicity – non-cancer" (mostly due to zinc emissions) and freshwater ecotoxicity (mainly copper, zinc and antimony). Furthermore, the car production has a major contribution to some impact categories, such as "human toxicity – cancer" (emissions of chromium are released from the landfill of slag from steel production) and freshwater eutrophication (emissions of phosphate are released from sulfidic tailings from mining of metals needed for the electronic equipment of the car). The impact of car maintenance on resource depletion is due to the use of lead. The relative environmental impact of the end-of-life of the car and the road is very limited. The factors that contribute most to the environmental impact of the car-sharing business model are also the most relevant for the other business models. There are some differences, such as the impact of the road, which is higher for the other models due to the less efficient use of road infrastructure.

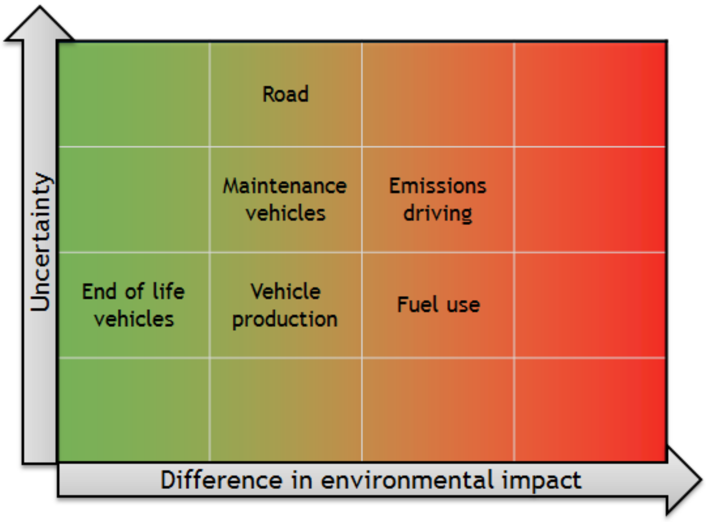
Figure 4-9: Individual environmental profiles – transport – collaborative economy model car-sharing



[22] particulates with a diameter smaller than or equal to 2,5 micrometres
[23] non-methane volatile organic compounds

Figure 4-10 gives an overview of the most uncertain contributors for the environmental impact of transport and their contribution to the difference in environmental impact between the traditional and collaborative scenarios of today. The uncertainty of the contributors is related to the underlying uncertainty in the occupancy rates, the service life of vehicles and the mix of vehicles used in the different business models. For example, the emissions from driving have a high influence on the difference in environmental impact between the different business models and a high uncertainty. A large part of this uncertainty is caused by the variance in the mix of vehicles used and their occupancy rates.

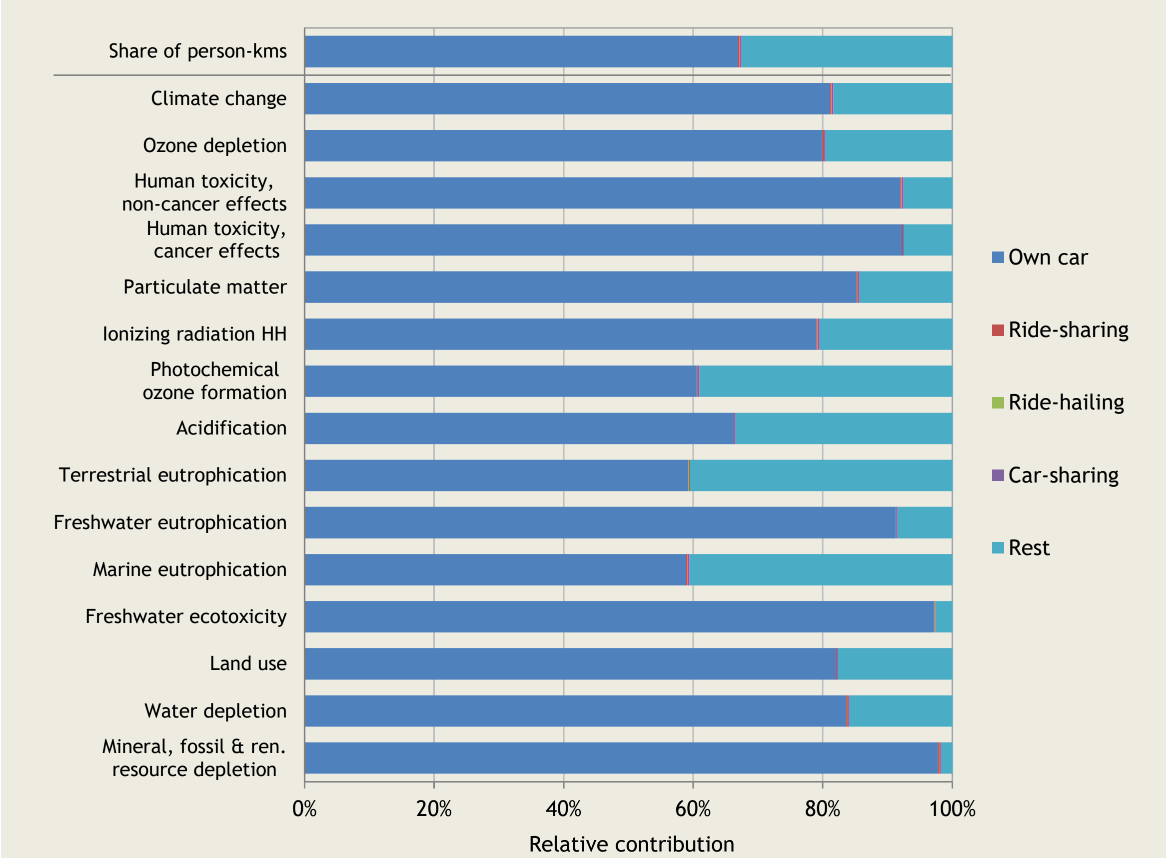
Figure 4-10: Uncertainty matrix – transport



4.4.3 Results – sector level

The next analysis is performed on sector level, estimating the contributions of different traditional and collaborative business models to the environmental impact of person transport in Europe today. Figure 4-11 shows the share of different types of business models in the person transport in Europe, and their relative environmental impact. The traditional transport is spilt up into car transport (own car) and the other transport modes. The share of collaborative economy transport is very small, and thus so are its environmental impacts.

Figure 4-11: Environmental profile on sector level – transport



4.5 Environmental impacts in the consumer durables sector

As durable goods comprise a wide range of products with very different life cycles, functionality and characteristics, it is not possible to select one product that is representative for the whole sector of durable goods. Instead, two specific products are selected for the environmental impact assessment of today: the cordless power drill[24] and the ladder. These are products widely used by households, chosen to be representative of consumer durables with or without a relevant energy consumption during the use phase. During the workshop Peerby stakeholders indicated these products belong to the most frequently shared goods. For consumer durables no results are available on sector level, because such an assessment cannot be based on two products only. Thus, results are only presented and discussed on business model level.

4.5.1 Power drill

The scenarios represent an estimated distribution of the acquisition/use of goods in the traditional market on the one hand and the collaborative economy on the other hand. No exact data are available on this distribution. It is assumed that in a traditional economy, consumers either buy (70%) or rent (30%) a power drill. In a collaborative economy, consumers can choose to borrow a power drill using PeerbyClassic or PeerbyGo. The collaborative economy scenario in this analysis assumes that in 30% of the cases PeerbyClassic is used, in 70% PeerbyGo.

It is known that business models that enable sharing of goods (renting, Peerby) increase the use rate of the good over its useful life and thus reduce the number of goods to be

[24] The cordless power drill is selected as consumer durables evolve to more battery-powered and wireless durable consumer goods.

produced to offer the same functionality to consumers. When for example four households share their 'drill-needs' through Peerby, the drill's use over its useful life increases, while saving the production of three drills, assuming that all households use the drill as much as they would have when they own the drill themselves. This analysis is based on a power drill with a useful life of 300 hours, which is used for 15% of its useful life in case of ownership and for 60% in a sharing model (Leismann et al. 2013). The production and end-of-life of the power drill per working hour is as such reduced with a factor 4. The bill of materials for an average power drill is taken from a publication from EPTA (European Power Tool Association)[25].

An important factor for assessing the environmental impact is the transport scenario that is considered in the analysis. It is assumed that on average consumers drive 15km back and forth by car to *buy* a power drill in the shop. As shops usually sell and rent tools the same transport scenario is considered for *renting*. PeerbyGo resembles a renting business model (paid service), for that reason we assume that transport is also done by car but over a shorter distance (7,5km back and forth), as PeerbyGo typically targets households in city centres as 'users' and 'providers' of tools and thus require transport over a shorter distance. Consumers that use PeerbyClassic to borrow a power drill are assumed to go on foot or by bike in a radius of max. 5km. Peerby encourages trade by bike or on foot, so in a sensitivity scenario the effect of going by bike or on foot when using PeerbyGo is assessed. It is taken into account that for each transaction in a sharing business model (renting and Peerby) transport is necessary[26].

It is assumed that on average the power drill is used for 30 minutes per borrowing turn. The assumption is made that the same type of power drill is used in both the traditional and the collaborative scenario. Therefore, the energy consumption per hour of use is the same in both scenarios. It can be argued that collaborative platforms tend to offer more recent (and thus more energy-efficient) power drill types due to more frequent use and thus necessary replacement, but this is not taken into account in the environmental impact analysis because there are not data to back this claim.

The analysis is performed on business model level and related to a functional unit (= 1 working hour). The figure below compares the impact, for different environmental impact categories, of the traditional scenario (line) and 2 collaborative economy scenarios: PeerbyGo with transport by car (A), and PeerbyGo with non-motorized transport (by bike or on foot) (B). The grey zone represents the uncertainty/insignificance interval.

Results – business model level

Both collaborative economy scenarios score significantly better on all environmental impact categories. The collaborative scenario A is considered a more realistic scenario, while scenario B can be regarded as an 'ideal' scenario where transport is only performed by bike or on foot. The difference between the environmental impact of collaborative scenario A and B, which is significant, is only related to the replacement of car transport by non-motorized transport. The environmental impact of transport is thus a key determinant for the overall results.

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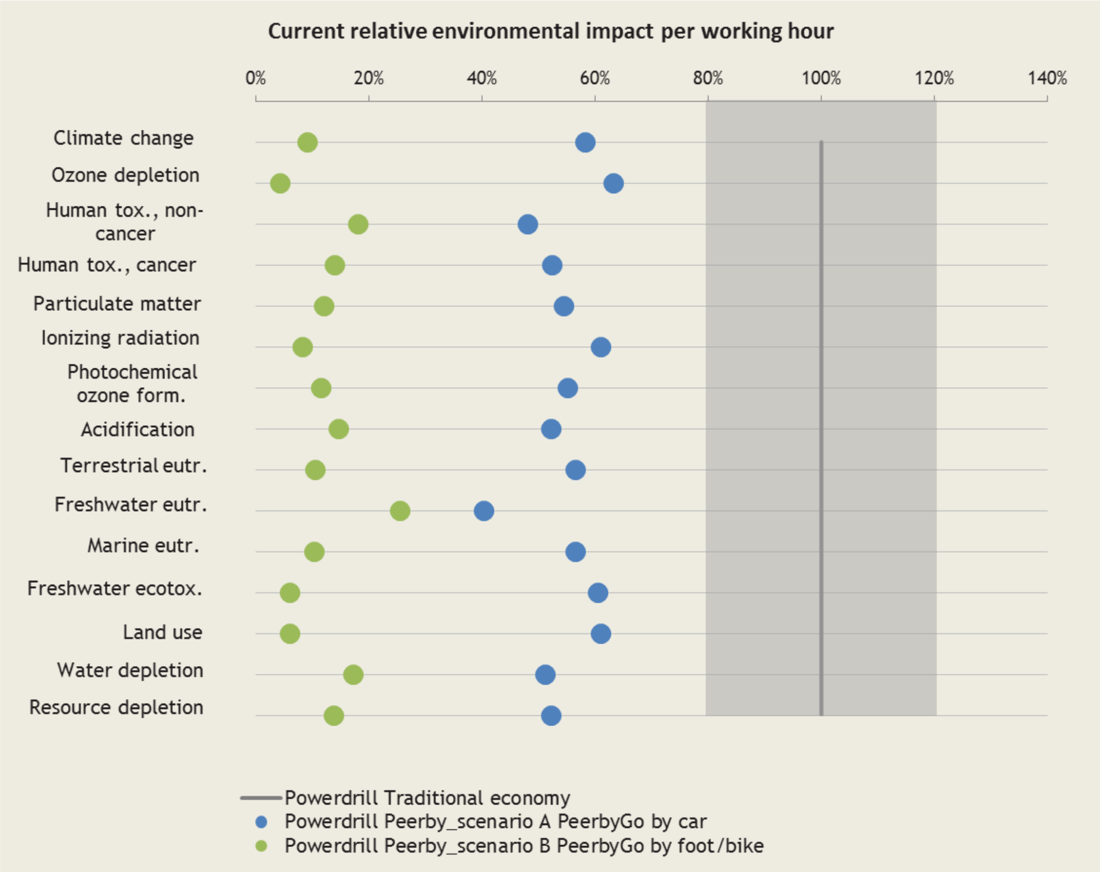
[25] Hand held power tools (HHPT) – European market, Input to the Ecodesign working plan 2015-2017 http://www.epta.eu/images/pdf/summary%20for%20ecodesign%20working%20plan%202015%202017%20v4.pdf

[26] It is assumed that a power drill is used on average 30 minutes per lending turn. In combination with the assumption that a power drill is used for 60% of its useful life (300 working hours) in a sharing business model, the number of turns and transport trips are calculated and related to the functional unit (1 working hour).

Figure 4-12: Comparative environmental profile – power drill



The transport by car required to buy or rent (in the traditional economy) or borrow (in the collaborative economy) the power drill is the highest contributor to nearly all environmental impact categories (except for human toxicity non-cancer and freshwater eutrophication where the production contributes the most) (see Figure 4-13). The lower contribution of transport for the collaborative scenario comes from the fact that goods are available in a smaller radius (and thus require a shorter transport distance) and more transport takes place by bike or on foot instead of by car. This outweighs the fact that more transport trips are necessary in the collaborative scenario, as a transport step is required every time a person needs a power drill. This is also relevant in the traditional scenario where a power drill is rented, but not when the power drill is bought.

The production of the power drill is responsible for the remainder of the environmental impact. The high contribution to freshwater eutrophication is caused by emissions occurring in the production chain of the charger and battery. The high contribution to "human toxicity non-cancer" relates to the emissions during the life cycle of the switch, motor, charger and battery. Overall, the components contributing the most to the environmental impact of production are the charger and Li-ion battery. Together they are responsible for more than 60% of the environmental impact of production. As less power drills need to be produced in a collaborative scenario it is logical that the environmental impact of production is reduced. We assume the same type of power drill to be representative for both the collaborative and the traditional economy, so the reduced number of goods to be produced is the only factor influencing the environmental impact of production.

The contribution of the use and end-of-life phase is negligible and mainly related to the impact of the electricity production (ionizing radiation, water depletion).

Figure 4-13: Comparative environmental profile – power drill, results split up in contributing factors

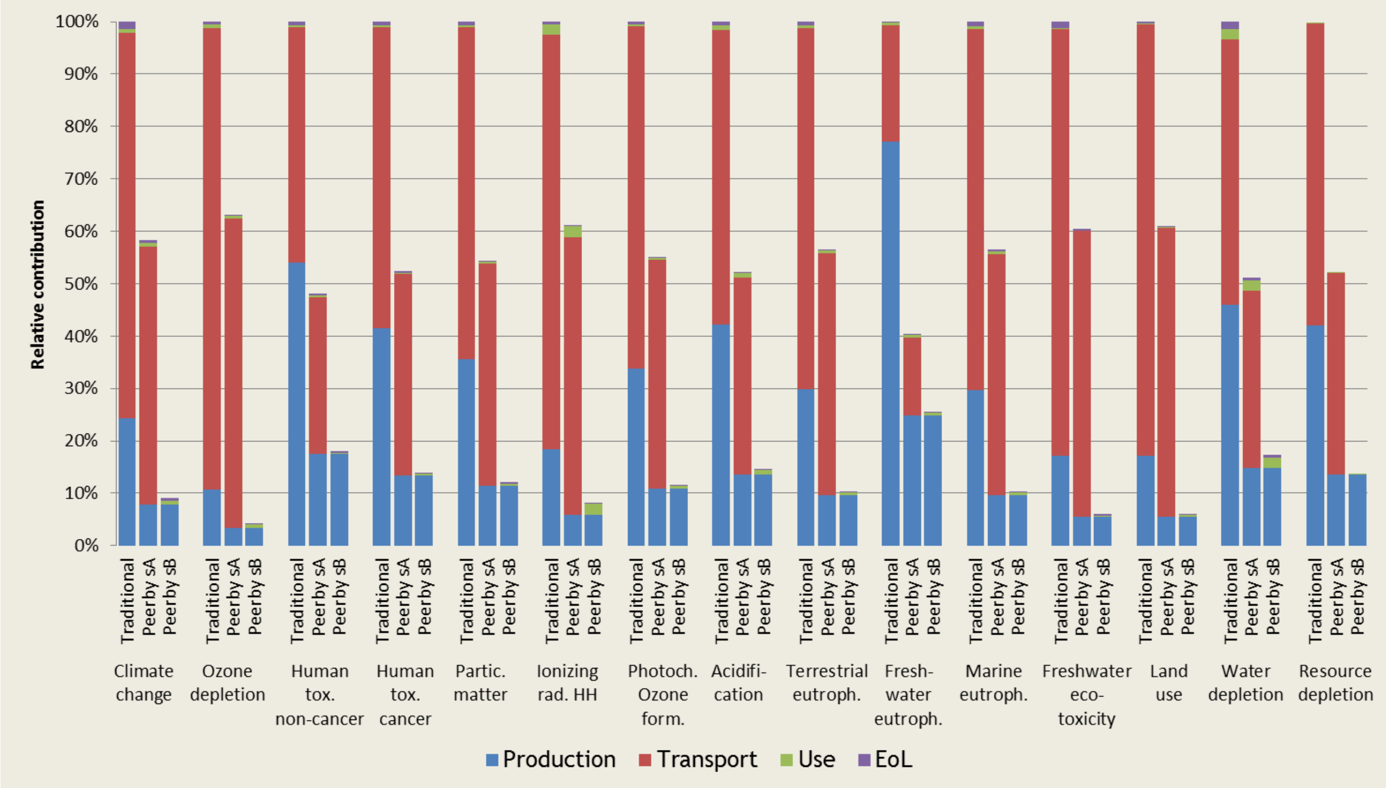
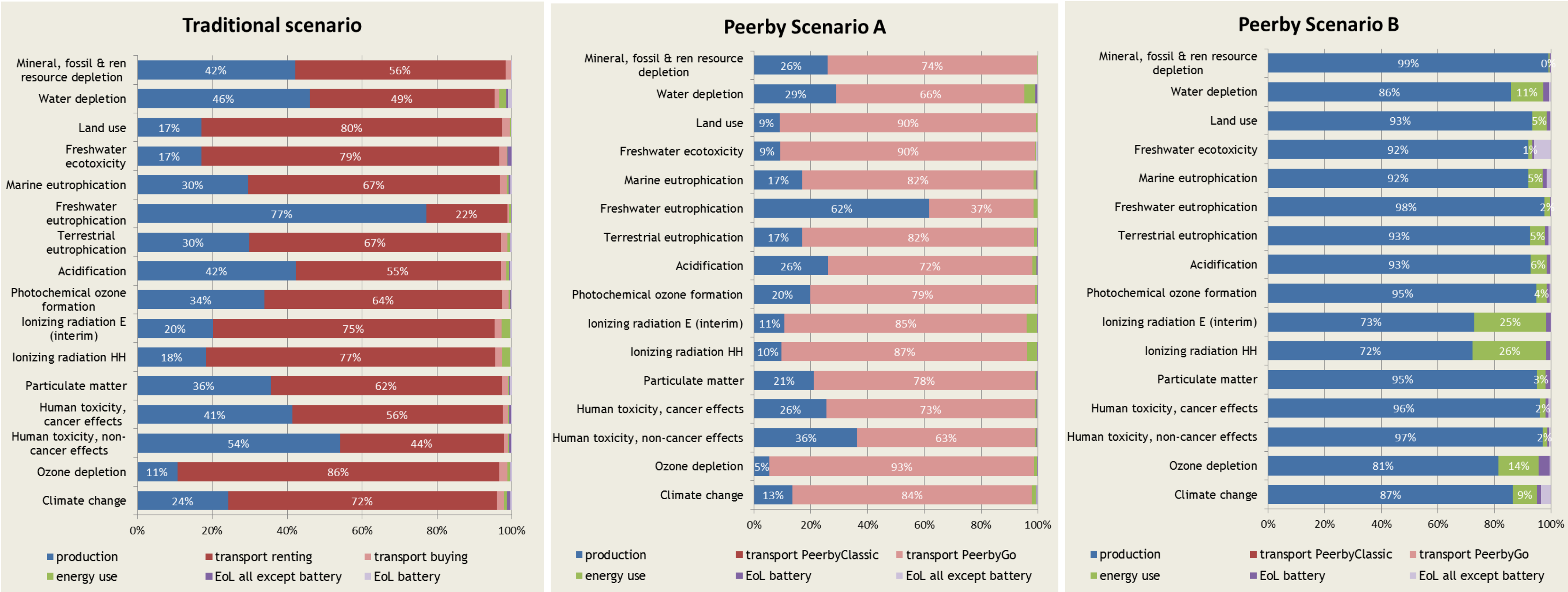


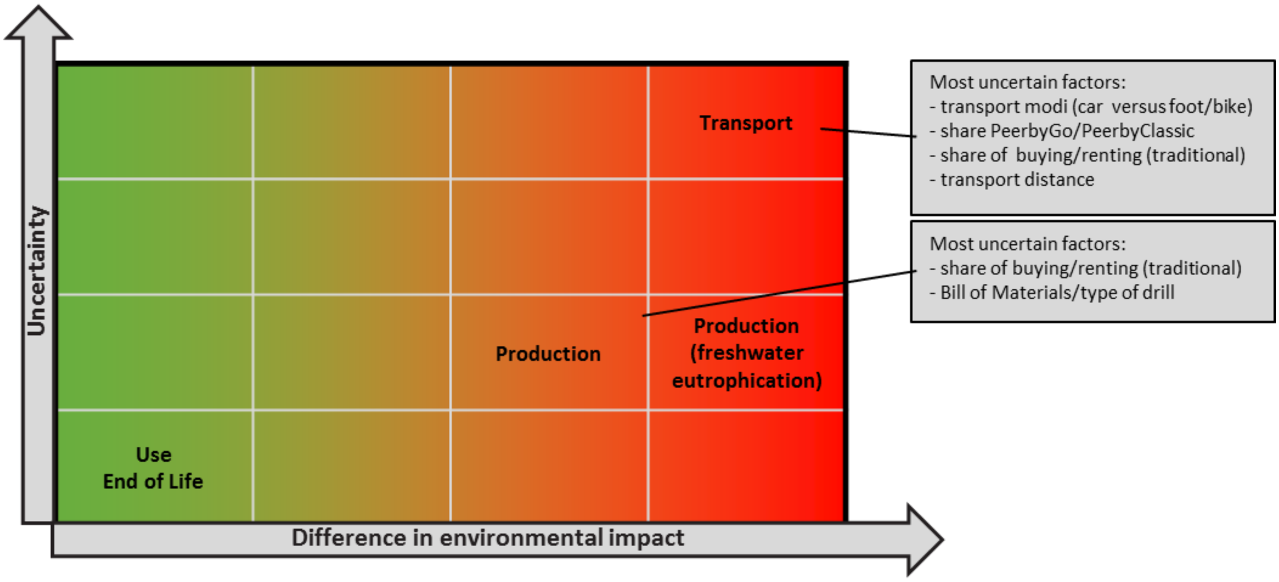
Figure 4-14: Detailed individual environmental profiles for the 3 power drill scenarios



The comparative environmental profile as presented above clearly shows the huge impact of the transport scenario for both the traditional and collaborative economy. The graphs below shows how the different transportation steps contribute to the total impact of transportation in each scenario. When transport is done by bike or on foot, the transport-related impact is zero. But when transport takes place by car, buying a powerdrill creates a negligible transport related environmental impact compared to renting or borrowing a drill. For this assessment, this implies that the choice of the transport parameters (which is mainly built on assumptions) determines the environmental impact of the traditional and the collaborative scenario, and it is possible that results are completely different or even reverse depending on the transport scenario that is chosen. But it implies also that both the transport mode (motorized or non-motorized) as well as the type of motorized transport (e.g. electric versus diesel engines – not analysed in this study) used to transport the goods between users determine the environmental potential of the collaborative economy for consumer durable goods, and should be taken into account when deploying collaborative models at a larger scale.

Figure 4-15 gives an overview of the most uncertain factors for the environmental impact of the power drill and their contribution to the difference in environmental impact between the traditional and collaborative scenario of today. It is obvious that the difference in environmental impact is mainly related to the difference in transport. This means that the choice of the transport parameters (which is mainly built on assumptions) is determining for the results and conclusions that follow from this analysis. Different factors play a role: distance and transport modes, but also the share of buying versus renting in a traditional economy and PeerbyGo versus PeerbyClassic in a collaborative economy.

Figure 4-15: Uncertainty matrix – Durable goods, power drill



4.5.2 Ladder

Parameters

As for the powerdrill, it is assumed that the same type of ladder is used in both the traditional and collaborative economy model. This seems realistic since a ladder is a less complex product than a powerdrill. In a traditional economy consumers either buy a ladder or borrow one from neighbours, and additionally it is assumed that for specific work (e.g. guttering) a service is bought that uses a ladder instead of doing it yourself. No specific data on these different use modes are available, so it is assumed that the 3 alternatives are equally applied in a traditional economy scenario A (each for 1/3rd). As the use of services can be discussed as a representative traditional alternative for the collaborative economy in the case of a ladder, an additional scenario for the traditional economy only assumes that ladders are bought (50%) or borrowed from neighbours (50%) (scenario B). In the collaborative economy scenario it is assumed that consumers more often opt for PeerbyClassic (70%) than for PeerbyGo (30%) because a ladder is not easy to transport over a longer distance (by bike or on foot) and consumers prefer to borrow a ladder for free from their neighbours than having the pay for a shared one. In a sharing model less ladders are required and thus need to be produced to offer the same functionality. This analysis is based on a ladder with a useful life of 50 years[27], which is used for 600 hours in case the ladder is owned (1 hour per month on average) and for 1200 hours in case the ladder is borrowed (both in the traditional and collaborative scenario). This implies a reduction by a factor 2 for the production and end-of-life of the ladder. When a ladder is provided by a service it is intensively used, for that reason the environmental impacts related to the production of the ladder per hour of use is considered negligible. The analysis is based on a ladder made of aluminium and rubber support. Again the transport scenario that is considered in the analysis is a determining factor for the environmental impact. It is assumed that consumers drive on average 15 km (back and forth) to buy a ladder in a shop. This is similar to the power drill, as usually both tools are available in the same shops. The same distance is considered for services using ladders, but transport is assumed to take place by van. In case the ladder is borrowed from neighbours it is transported on foot, which is possible because of the short distance. The same applies for PeerbyClassic. In case PeerbyGo is used, a transport step of 7,5 km by car (back and forth) is taken into account. It is assumed that a ladder is used on average for 2 hours per borrowing turn (and for services). A ladder has no environmental impact during use.

Results – business model level

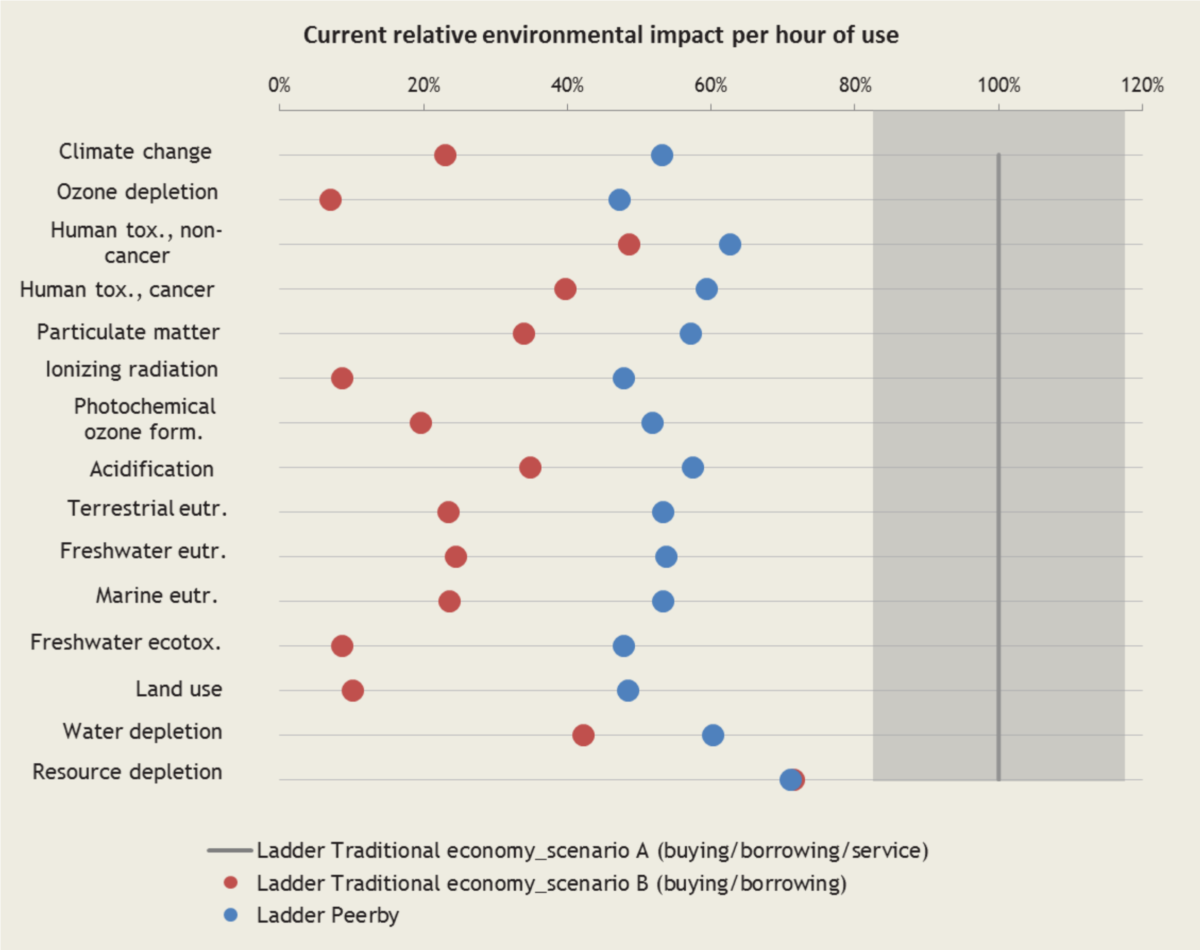
The analysis is performed on business model level and related to a functional unit (= 1 hour of use). The figure below compares the impact, for different environmental impact categories, of the traditional (line) and collaborative economy scenario. The grey zone represents the uncertainty/insignificance interval.

The environmental impact of the traditional economy scenario B (without services) is significantly lower than the impact of scenario A (with services). This shows the huge environmental impact of the services, and the importance of drawing conclusions in relation to the assumptions. The traditional economy scenario B also scores significantly better than the collaborative scenario as defined for a ladder, which in his turn has a significantly lower impact than the traditional economy scenario A (with services). Only

[27] Conservative estimate based on 100-year life time of a ladder as predicted in http://www.atdhomeinspection.com/advice/average-product-life/

for resource depletion the traditional scenario B has a comparable environmental impact as the collaborative economy scenario.

Figure 4-16: Comparative environmental profile – ladder



Environmental impact during the life cycle of a ladder only occurs during production and transport. Due to the assumptions for both the traditional and the collaborative economy scenario, the impact of the production phase per hour of use of a ladder is equal for the traditional economy scenario A and the collaborative economy scenario. The impact of the production of a ladder in the traditional scenario B is higher for all environmental impacts, which is directly related to the fact that ladders are less frequently used in case of borrowing or buying than in case of the use of services and as such the production impact per hour of use is higher.

The differences in environmental impact between the scenarios are mainly related to the transport. As explained in the analysis of the powerdrill, transport by bike or on foot has no (or negligible) environmental impact. Transport by car (as is assumed in case of buying and PeerbyGo) and by van (in case a service is bought) do have environmental impacts. The impact of the transport in the traditional economy scenario A is almost entirely caused by the transport for the service, which follows from the assumption that borrowing does not require motorized transport and buying requires only 1 trip for 600 hours of use. This can be seen in Figure 4-17. In the collaborative economy scenario only the transport for PeerbyGo causes environmental impact, which is lower compared to the service transport in the traditional economy due to a smaller radius (7,5 km instead of 15km). In the traditional scenario A only motorized transport is needed in case the ladder is bought, the impact of which is negligible per hour of use.

Figure 4-17: Comparative environmental profile – ladder, results split up in contributing factors

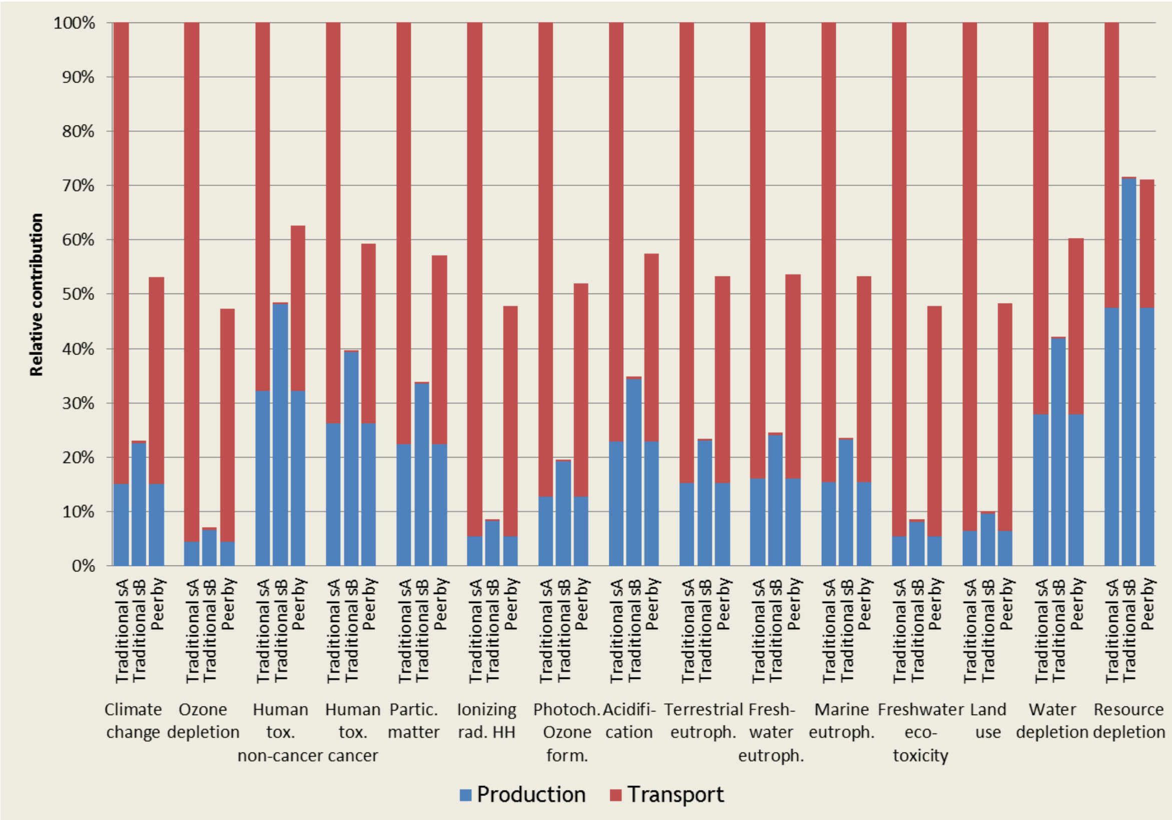


Figure 4-18: Detailed individual environmental profiles for the ladder scenarios

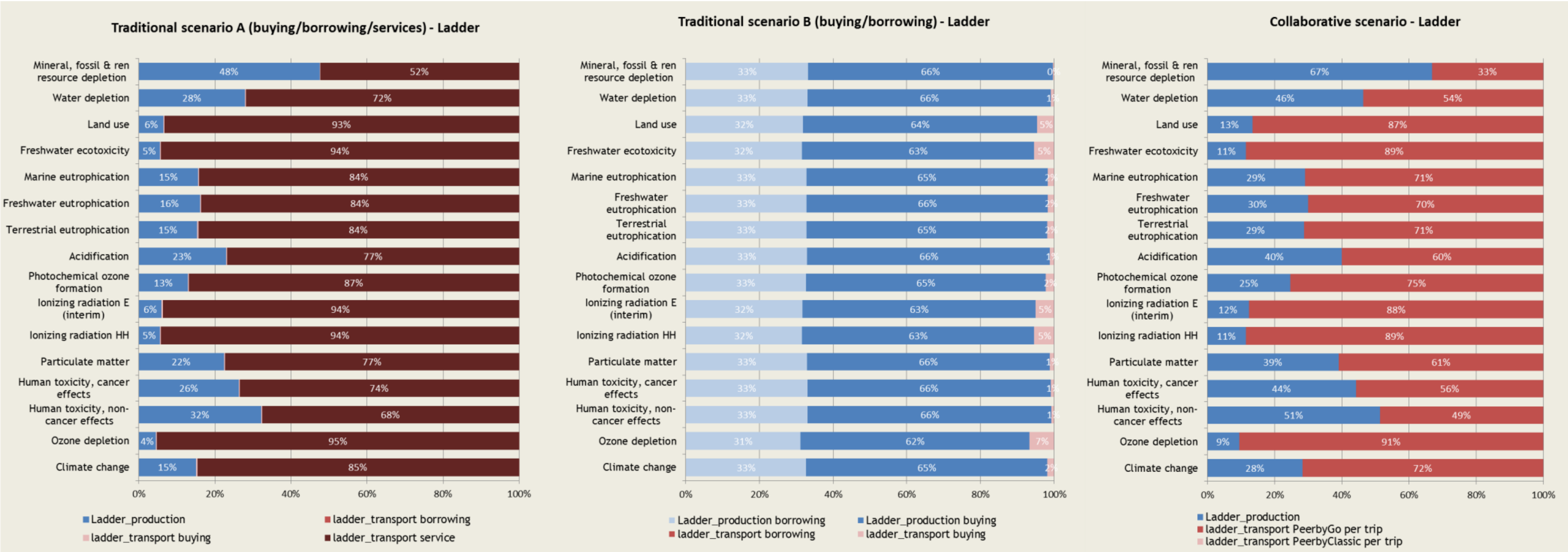
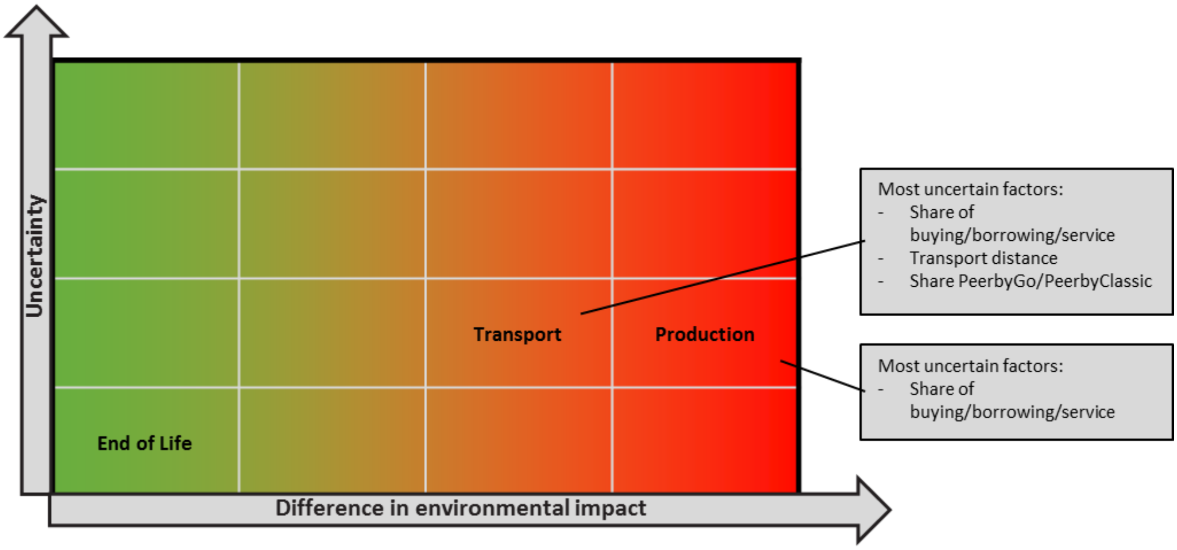


Figure 4-19 gives an overview of the most uncertain factors for the environmental impact of the ladder and their contribution to the difference in environmental impact between the traditional and collaborative scenarios of today. If services are considered as a representative alternative in the traditional economy, they have a large influence on the environmental impact (reduced impact for production, huge impact for transport) and as such on the conclusions regarding the difference in environmental impact between the traditional and collaborative economy. The production of the ladder is considered negligible per hour of use for services, as ladders are intensively used. On the other hand, the transport of the ladder has a large environmental impact due to the radius of 15 km and the fact that transport usually takes place by van. So the share of buying versus borrowing versus services in a traditional economy is an important factor that significantly affects the results and for which no information is available. The importance of this is proven by the low impact of the traditional economy scenario B when only bying or borrowing are considered as relevant alternatives. In the collaborative economy scenario the share of PeerbyGo and PeerbyClassic is also determining for the environmental impact. Another factor that has a significant effect on the results and conclusions and a high degree of uncertainty is the transport distance in those cases where motorized transport is necessary.

Figure 4-19: Uncertainty matrix – Durable goods, ladder



4.6 Socio-economic impacts

In this section the main economic and social impacts of the collaborative economy today, which have been identified during the literature review, are summarised. First the overall direct and indirect economic impacts will be discussed, followed by the current size of the collaborative economy in the three focus markets (accommodation, transport and consumer durables). Secondly, the social impacts of the collaborative economy will be discussed, but only in terms of impacts on the labour market.

4.6.1 Economic Impacts

Direct economic benefit to the parties involved

It is undisputed that there is a direct economic benefit to the parties involved in collaborative transactions, as otherwise such transactions would not take place. The main direct economic benefits include:

- **Price reductions** for services offered by these platforms – accommodation and travel became cheaper compared to the 'traditional' providers such as hotels, house rentals, buses, train, taxis, as such providing greater access to these services;
- **Savings and revenues** generated by users and providers, respectively – savings generated due to price reductions of such services, and additional revenues generated by offering an under-utilised good or service (a spare room, house/ apartment while away, ride sharing, unused car or products);
- **Low transaction costs** to exchange goods and provide services – this relates to the search costs and contractual costs, including online payment;
- **Greater purchasing power to consumers** – because of all the elements listed above, consumers end up with a greater purchasing power, which might lead to over-consumption or to different type of consumption.

Direct and indirect economic effects on external parties are less clear cut

Collaborative platforms affect other industries within the same market, such as incumbent ('traditional') industries – **hotels, rail, bus, taxi services**, etc., which can observe declining demand, and as such declining revenues for their services. The collaborative services and goods can be in certain situations and locations complementary to the 'traditional' goods and services, while in others they act as substitutes. There are also indirect impacts on related industries and sectors. The literature shows evidence in both directions. For example:

- Accommodation - Airbnb substitutes hotels in some locations but accommodation offered through collaborative platforms works also as a complement to overbooked locations and more expensive hotels. There is an indirect impact on local economies where, on the one hand, shared accommodation is expected to have a positive impact on local shops and areas, while hotels claim shared accommodation negatively affects ancillary services, such as bars and restaurants.
- **Transport** - BlaBlaCar works as a substitute for bus and train rides, Uber for taxi rides, but bike sharing acts as a complement to bus and train rides
- **Consumer durables** – renting/ sharing consumer durables is a substitute for buying these goods.

4.6.2 Current economic impact of the collaborative economy in the three focus markets

In this study we have estimated the current economic impacts in particular, the market size of the collaborative economy in the three sectors. The available data is very limited. This study did provide some estimates, in particular in the literature review (Annex 1) and case studies (Annexes 3- 7). Estimation of economic indicators such as revenue per Member State is being done in a parallel study for DG Grow.

Accommodation

Current economic impact of the collaborative economy in the accommodation sector has been detailed in the Airbnb case study (Annex 3). Using the available data, we are able to estimate the total turnover generated by the use of Airbnb in Europe. This includes the revenue generated by services providers, i.e. hosts, and the revenue generated by Airbnb themselves from the guest and host fees. First, we calculate the total number of bookings for Airbnb in the EU, by dividing the total number of inbound guests by the average number of guests per booking. Subsequently, one can multiply the total number of bookings with the average number of nights per booking and the average price per night[28] to arrive at the total revenue turnover generated by Airbnb bookings.

Table 4-2 shows the results for the EU28 and for some specific Member States for which Airbnb published economic impact reports. The **total turnover for Airbnb in the EU28** between July 2015 and July 2016 was estimated to be **€4.56 billion**. From this total revenue 6-12% goes directly to Airbnb as a guest fee, which corresponds to € 273 million - 547 million. Additionally, Airbnb hosts pay a host fee of 3% of the booking value to Airbnb, which corresponds to € 137 million. The remainder of the turnover **is additional income for hosts**, totalling **€ 3.88 billion - 4.15 billion**.

Table 4-2 Calculation of economic indicators for Airbnb

Parameter	A. Total # of guests *	B. Average # guests per booking	C. Total number of bookings (A/B)	D. # nights per guest	E. Total # of nights booked (CxD)	F. Total person-nights (AxD)	G. Average price per night (€)	H. Total turnover (€) (ExG)
EU28 2016	27.8 M	2.5	*11.2 M*	4.1	*45.6 M*	*114.0 M*	*100*	*4.56 bn*
FR 2016	8.3 M	2.5	*3.3 M*	3.6	*12.0 M*	*29.9 M*	95 (Paris)	*1.14 bn*
NL 2016	1.4 M	2.5	*0.56 M*	3.5	*2.0 M*	*4.9 M*	133 (Amsterdam)	*266 M*
DE 2016	2 M	2.5	*0.8 M*	3.5	*2.9 M*	*7.2 M*	60 (Berlin)	*174 M*
IT 2015	3.6 M	2.6	*1.4 M*	3.6	*5.0 M*	*13.0 M*	135 (Venice)	*675 M*
(Source)	*1, 2, 3, 4,5*	*3, 6*	*Calculated*	*1*	*Calculated*	*Calculated*	*7, Calculated*	*Calculated*

Source: 1. Airbnb (2016a). Overview of the Airbnb community in the European Union. **2.** Airbnb (2017a). La communauté Airbnb en France en 2016 **3.** Airbnb (2017b). The Airbnb Community: The Netherlands – based on 2016 data; **4.** Airbnbcitizen.com (2017). Germany. URL: https://germany.airbnbcitizen.com/ **5**. Airbnb (2016). Overview of the Airbnb Community in Italy. **6.** Airbnb (2016b). Overview of the Airbnb Community in Denmark – based on 2015 data; **7.** Based on listing data from http://insideairbnb.com/ for London, Edinburgh, Paris, Berlin, Madrid, Barcelona, Mallorca, Venice, Amsterdam, Brussels, Vienna and Copenhagen (206,121 listings in total). Retrieved on 03-03-2017.

***** For the total number of guests only the inbound guests, i.e. EU-residents and non-EU residents staying in Airbnb accommodations on EU territory. Stays of EU-residents outside EU territory were not included in this calculation.

Red figures are assumed figures based on country reports, whereas black figures are based on reported data. Figures in italics represent calculated figures as opposed to reported data.

[28] The average price per night was calculated based on the data from insideairbnb.com presented in Table 6-3.

Transport

Between January and April 2017, more than 7.5 million people hailed Uber rides in the 21 EU Member States where the platform operates, a five-fold growth compared to the same period in 2015 (Reuters, 2017). In the US in July 2016, the number of Uber trips was 62 million trips, an increase of 15% compared to the previous month, according to Business Insider (2016[B]).

Uber had over **120,000 active drivers in Europe in April 2017**, according to the firm. The platform started to facilitate transport services by licensed operators with Private Hire Vehicle (PHV) licenses, in line with local regulations that also govern traditional taxi services. However, the firm's efficiency gains are reflected in the lower prices charged to consumers: licensed PHV services cost around 20% less than regulated taxi services, while peer-to-peer services (e.g. UberPop) cost around 35% less than regulated (traditional) taxi services.

The market size for the car-sharing business model is quite hard to estimate, although there are some company and- country-specific figures. In 2016, Zipcar had 1 million members and 12,000 vehicles in 500 cities across Austria, Belgium, Canada, France, Germany, Spain, Turkey, the United Kingdom and the United States (Zipcar Press Kit Belgium, 2016), but no data were available on the number of Zipcar users in Europe only. More generally, it is estimated that in 2014, B2C car-sharing activities taking place in 33 countries and 1,531 cities and counted for approximately 4.8 million members sharing over 104,000 vehicles (Shaheen and Cohen, 2016).

In Europe, there were 2,206,884 Zipcar members and 57,947 vehicles in 2014, which accounts for 46% of worldwide membership and 56% of the global car-sharing fleet (Shaheen and Cohen, 2016). The Boston Consulting Group (2016) estimates a slightly lower number of users (2.1 million in Europe, including Turkey and Russia) and a much lower number of vehicles (31,000) in 2015. More recent national-level estimates are available for Germany and the UK, which suggest that the overall market size in the EU today is likely to be higher than the 2.1-2.2 million mentioned above. In Germany alone, 1,715,000 members of car-sharing platforms and 17,200 vehicles were counted at the start of 2017 (Bundesverband CarSharing, 2017a). The Carplus Annual Survey of Car Club Members shows that there were over 245,000 members and over 4,000 vehicles in the UK in 2016/2017 (Carplus, 2017). A recent nation-wide study on the sharing mobility in Italy counts 695,650 members of car-sharing platforms, but less than half of these actually used the service at least twice during 2015 (Ciuffini et al., 2017). Since B2C car-sharing services are also present (to different degrees) in other EU countries, we assume that there are at least 2.7 million users in the EU at present (i.e. members of car-sharing platforms who actually use the service). The total size of the European car-sharing fleet is more difficult to estimate, as reflected in the large difference between the two EU-level estimates as well as the large range of estimates that exist for the average number of users per shared car, which ranges from 38-100.

In Europe, the car-sharing market size was estimated to amount to $ 260.3 million in 2013 and $324.2 million in 2014 (Global Market Insights, 2017). For comparison, the entire car rental industry worldwide (including the 'traditional' vehicle renting market) was worth approximately USD 51 billion in 2014, with the European market accounting for about a quarter of this (Nedrelid Corporate Advisory, 2016).

In the ridesharing market, Blablacar is the largest player being responsible for 90% of ride-sharing service market in France, Germany and Spain and 15% of the ride-sharing market worldwide. In 2016, 10 million trips every quarter took place through the BlaBlaCar platform, about four times more than the total distance travelled using the Eurostar high speed train, which equalled to 5 billion kilometres (only considering the completed rides). Similarly, more than 10 billion kilometres were travelled in Europe over the period 2012-2017. Blablacar informed us during a personal communication that in 2016 9.6 million trips were booked within 13 EU countries[29].

Goods sharing

The collaborative economy within the consumer durables market is still in its infancy. **Peerby** is the largest and most well-known platform active in this market and is therefore used as case study for the scenario analysis of the consumer durables market. Other similar active platforms are Zilok (mainly France), Fatlama (mainly UK, London) and Reborrowo (P2P goods renting, Spain).

Peerby is mainly active in cities in four EU Member States (The Netherlands, the UK, Belgium and Germany). Next to that, they have active communities in many other capital cities, but the size of these communities is small. Precise data on the number of users is confidential due to the nascent stage of Peerby, but according to an interview with the platform they currently have approximately 250,000 registered users worldwide. Most of its registered users are based in the Netherlands, (some 150,000 in 2015 according to ShareNL, 2015) a number that might have grown to ~175,000 by now (Peerby did not want to reveal the precise number of users in the Netherlands). A portion of these users are also active on Peerby Go. According to Peerby, some 5% of its registered users are very active and realise up to 20 sharing or renting transactions a day ("super-peers"). Overall, some 60% of its user base is estimated to be using the platform actively (at least once a month) (ShareNL, 2015).

To get an impression of the share of the population using Peerby, we assume that Peerby has 175,000 users in the Netherlands who are registered in one of 14 active Peerby Go cities. Table 4-3 shows the number of inhabitants for these 14 cities. Based on the total, we could assume that approximately 5% of city residents in the Netherlands are currently using Peerby (of which ~60% actively). Based on a population of 16.8m (2014), Peerby was used by approximately 1% of the Dutch population.

Table 4-3 -Estimated city-penetration of Peerby users in the Netherlands

	Amsterdam	Utrecht	Rotterdam	Den Haag	Amersfoort	Arnhem	Delft	Eindhoven	Groningen	Haarlem	Leiden	Nijmegen
Inhabitants ('000)	811	328	618	509	151	151	100	221	198	155	121	168
Total inhabitants ('000)	3,531											
Peerby users ('000)	175											
"City-penetration"	**5.0%**											

Source: Eurostat, urb_cpop1

[29] These countries are: Belgium, Czech republic, Germany, Spain, France, Hungary, Italy, The Netherlands, Poland, Portugal, Romania and Slovakia.

According to Eurostat's Urban Audit data[30], an estimated 42% of EU citizens (~200m) live in core cities and approximately 72% in built-up areas (cities, towns and suburbs). If we assume that the 41 platforms identified in 18/28 Member States would jointly also reach the 5% core city-penetration in their Member States, **some 1.35% of the total EU-28 population could currently be using P2P sharing and renting platforms**. This estimate is however extremely rough and based on many assumptions for which no data is available. It is also likely to be overestimated because according to Peerby, their platform is the largest known platform in the EU and this estimate is based on an estimation of the user penetration of the Netherlands (Peerby's biggest market) in the other 18/28 Member States. But, by means of a large consumer survey, **Statista (2017) also finds that 1.4% of the Dutch population used Peerby in 2016** (see Figure 7-2 in Annex 7)**.** On the other hand, ShareNL (2015) corroborates this estimate mentioning that according to their research **1% of demand for the services delivered by consumer durable products (e.g. hole in the wall, clean garden) is at the moment filled by P2P sharing and renting.** and therefore, we continue to assume a market share of **1.4%** for the situation today.

The economic importance in terms of jobs or turnover generated of Peerby, Peerby Go or Peerby-like platforms in the EU is estimated to be low at the moment. The classic Peerby does not directly create economic value as the transaction does not involve a monetary fee for the borrowing of the product, but could indirectly contribute to economic savings as borrowing from a peer might be an alternative to renting (see direct impacts). The turnover of Peerby Go is confidential, though according to the crowdfunding website where Peerby sourced its financing, it was supposed to reach €75,000 in 2015 and should grow to €177m in 2020. but not expected to be significant yet as the service started operations in 2015, but this rental version of Peerby is growing faster and faster than the classic Peerby did. As of December 2016, 120,000 products were offered on Peerby Go in the Netherlands (within 1.5 years of existence).[31] In the same time, Peerby classic offered 30,000 products, though these two numbers cannot directly be compared as Peerby classic is more of a demand-driven platform than Peerby Go.

4.6.3 Social impacts

A more detailed review of social impacts has been carried out by literature review (Annex 1). In this short section, we focus on employment impacts only and do not mention other social impacts, such as for example racial discrimination, social inclusions, etc. It is evident from the available evidence that employment impacts in particular have not yet been fully researched or quantified for the European market. This is being done in another parallel study for DG Grow.

Overall impact of the collaborative economy on employment is still unclear

Similarly, to the discussion about the overall contribution of the collaborative economy to value added and economic growth, it is hard to make firm statements about the employment effects of the collaborative economy. On the one hand, the collaborative economy creates additional direct employment in terms of jobs at platforms and generates income for people who work as a service provider, but on the other hand it causes a loss of employment in 'traditional' industries (e.g. traditional accommodation

[30] http://ec.europa.eu/eurostat/statistics-explained/index.php/Statistics_on_European_cities

[31] Donk, R., 2016, Oprichter Peerby: Wil je innoveren? Ga klantonderzoek doen', available at: https://www.mt.nl/business/oprichter-peerby-wil-je-innoveren-ga-klantonderzoek-doen/529151

sector or taxi rides). Additionally, there can be indirect employment impacts in related sectors. For the collaborative services sector, there are concerns that the collaborative economy might replace jobs in the existing economy, while offering worse working conditions and security for its platform workers (Verboven and Verherck, 2016). Collaborative labour services are, however, outside the scope of this study. For the three markets covered in our study, there are some rough estimates on employment effects, but many of these studies have limited geographical coverage, poor methodologies (i.e. very rough estimations) or are self-reported figures by the platforms themselves, which might cause concerns on their reliability. Below we discuss the available estimates of employment impacts for the transport and accommodation sector. For the consumer durables sector, no relevant estimates were found.

Direct and indirect employment impacts in the transport sector

For the transport sector, there are three main types of employment impacts according to existing literature. First of all, P2P ride-hailing services compete with traditional taxi services and might create job losses in that sector. This would be a negative direct employment impact. In New York, it was estimated that 65% of the rides with Uber replaced a ride with the conventional yellow cab (The Economist, 2015). A study from the UCLA Labour Center estimated that these services might have resulted in a loss of 319 jobs in the entire U.S. up to 2014 (UCLA labor center, 2015). However, this number is relatively small compared to the number of people that earn additional income through these ride services. These ride services create additional direct employment among drivers in addition to the direct jobs they create at platforms. By that time, Uber had over 160,000 active drivers working via its platform, of which a large part worked in the U.S (Uber, 2015). Uber drivers have a more stable income than traditional taxi drivers, because the app is very efficient in matching drivers and customers, which reduces the idle time in-between rides (Hall and Krueger, 2015). However, if all rides are managed in such an efficient way, it is likely that less drivers will be required.

Secondly, increased use car-sharing, ride-sharing and ride-hailing can lead to a reduction in private car ownership and therefore demand for new passenger cars in the long run. This decreased demand will lead to a decrease in production and a corresponding loss in employment in the automotive sector and in related sectors through a knock-on effect from its input and output linkages, and as such to a loss of direct and indirectly related jobs. These effects have not been quantitatively estimated yet. Similarly, low-cost bike sharing systems might threaten conventional bike rental businesses and as such lead to direct employment losses.

Finally, all collaborative business models operating in the collaborative transport sector make car use more attractive by lowering the costs of car use. As a consequence, people may use public transport less, which might negatively impact employment in that sector. On the contrary, A German study made a scenario where car-sharing is combined with large investments in public transport, resulting in a doubling of transport use (Gsell et al., 2015). This would generate an additional 109,000 jobs in the public transport sector. However, with regard to environmental and economic impacts, the main drivers of the results in this German study are the investments in the public transport system, and not the growth of car sharing *per se.* However, up to now collaborative transport options have primarily lowered the demand for public transport. For example, 25% of the Blablacar drivers and 72% of the Blablacar passengers in France would have used the train otherwise (ADEME, 2015).

Direct and indirect employment in the accommodation sector

In the accommodation there are also direct and indirect employment impacts, which are mainly related to the provision of short-term rentals. The direct employment impact refers to the jobs created by platforms running such services, which is little compared to the amount of work created for providers of such services – the hosts, although this work is officially not counted as employment. There might be some direct job losses in traditional accommodation companies such as hotels.

The hotel association in New York City claims that $ 451m of revenues that were missed by the hotel industry, through bookings via Airbnb (Hotel Association of New York City, 2015). Furthermore, hotels missed about $136m of revenues from ancillary services, of which the largest part are lost sales in food ($88.9m) and drinks ($20.5m) (see Table 4-4). As a consequence, the study estimates a loss of approximately 2,042 jobs. Additionally, there are losses in revenue and employment in sectors that provide inputs to the hotel sector. These indirect effects were estimated to result in a job loss of 508 jobs. Additionally, induced losses in revenues were forecasted to result in a loss of 693 jobs.

Table 4-4 Estimated effects of Airbnb on the traditional accommodation sector in New York

Estimated losses for hotel industry and related economic activities in New York		
	Economic losses ($US)	**Jobs lost***
Direct Loss	451,426,000	2042
Ancillary Loss		
Food	88,880,636	
Beverage	20,537,467	
Other Operated Departments	11,850,752	
Miscellaneous Income	14,669,620	
Total	**135,938,475**	
Construction Loss	**1,088,746,711**	
Indirect Effect - Loss $	**101,616,132**	508
Induced Effect – Loss $	**114,665,277**	693

Source: Hotel Association of New York city, 2015.

*The report does not define whether the job losses concern full-time jobs or head-count numbers.

On the other hand, tourists staying in collaborative accommodation also spend their money in local shops and restaurants, just like they would have done in a traditional hotel or bed & breakfast. Airbnb states that its guests stay longer than average hotel guests and therefore spend more money, 42% of which is spent in the surroundings of the place they stay (Airbnb, 2017). This spending in the local economy supports local jobs, as stated above. For several cities and countries, Airbnb has estimated its impact on local jobs, based on spending of its guests (Table 4-5). However, the methodology for calculating these employment effects are not given by Airbnb. Moreover, the net employment impact of Airbnb should take into account the local jobs created/ lost by the traditional accommodation services.

Table 4-5 Airbnb estimates for the number of local jobs that are supported because of Airbnb guests

London & Edinburgh	Paris	San Francisco	Sydney	Barcelona	France	Italy
11600	1100	430	1600	4000	13300	98400

Source: Airbnb (2017). https://www.airbnbcitizen.com/

Consumer durables sector

There has been no literature found on social impacts of the consumer durables sector.

5 The impacts of the collaborative economy towards 2030

5.1 Future collaborative economy scenarios summary

Table 5-1 provides a summary of the future collaborative economy scenarios in this part of analysis. For each of the three collaborative economy sectors, there are three scenarios: moderate take up of collaborative economy activities, ambitious take up of collaborative economy activities and a sensitivity to test what would happen if we assumed that the additional revenues generated to households through shifting from P2B to P2P is saved rather than spent.

Table 5-1 Future collaborative economy scenarios summary

Scenario	Descriptions
Baseline	No additional growth in the collaborative economy from the last year of historical data (2016)
Accommodation moderate case	Moderate take up of collaborative economy activities in the accommodation sector
Accommodation ambitious case	Ambitious take up of collaborative economy activities in the accommodation sector
Accommodation moderate case with no rebound	Moderate take up with additional revenues generated to households being saved rather than spent
Transport moderate case	Moderate take up of collaborative economy activities in the transport sector
Transport ambitious case	Ambitious take up of collaborative economy activities in the transport sector
Transport moderate case with no rebound	Moderate take up with additional revenues generated to households being saved rather than spent
Consumer durables moderate case	Moderate take up of collaborative economy activities in the consumer durables sectors
Consumer durables ambitious case	Ambitious take up of collaborative economy activities in the consumer durables sectors
Consumer durables moderate case with no rebound	Moderate take up with additional revenues generated to households being saved rather than spent
Combined moderate case	Moderate take up of collaborative economy activities in the accommodation, transport and consumer durables sectors combined
Combined ambitious case	Ambitious take up of collaborative economy activities in the accommodation, transport and consumer durables sectors combined
Combined moderate case with no rebound	Moderate take up with additional revenues generated to households being saved rather than spent

In the last set of scenarios, we combined all three sectors of the collaborative economy together. The model results are compared to the baseline where we assumed there is no additional growth in the collaborative economy from the last year of historical data (in 2016).

The following sections describe our modelling approach and findings for each sector.

5.2 Modelling approach

In order to work out the future environmental impacts of the collaborative economy, we need to first introduce modelling inputs that reflect the way collaborative economy operates and include assumptions on how we see the collaborative economy developing in the future. The modelling information for each of the collaborative economy sectors is taken directly from our own analysis of scenario building (see section 3). The model used for this exercise is the E3ME model, which captures the linkages between economy, energy and environment. Please refer to the separate sheet with the description of the model or the E3ME model manual[32] for a full description of the E3ME model.

5.2.1 How do we model the collaborative economy?

One fundamental difference between the collaborative economy and the traditional economy is the way consumers purchase goods and services. In a traditional economy, consumers pay businesses to produce goods and services. This consumer spending generates demand for industry output, resulting in additional demand through a sector's supply chain. This process generates employment, material demand and energy demands that are requirements to a sector's production. In a collaborative economy, consumers no longer make these purchases from traditional businesses. Instead, they pay other households to 'borrow' the goods or services that they provide. In the modelling, we do not distinguish between households that are 'buyers' and households that provide the goods and services. Instead the money that would otherwise get spent and transferred to traditional businesses stays within the household sector.

Rebound effects

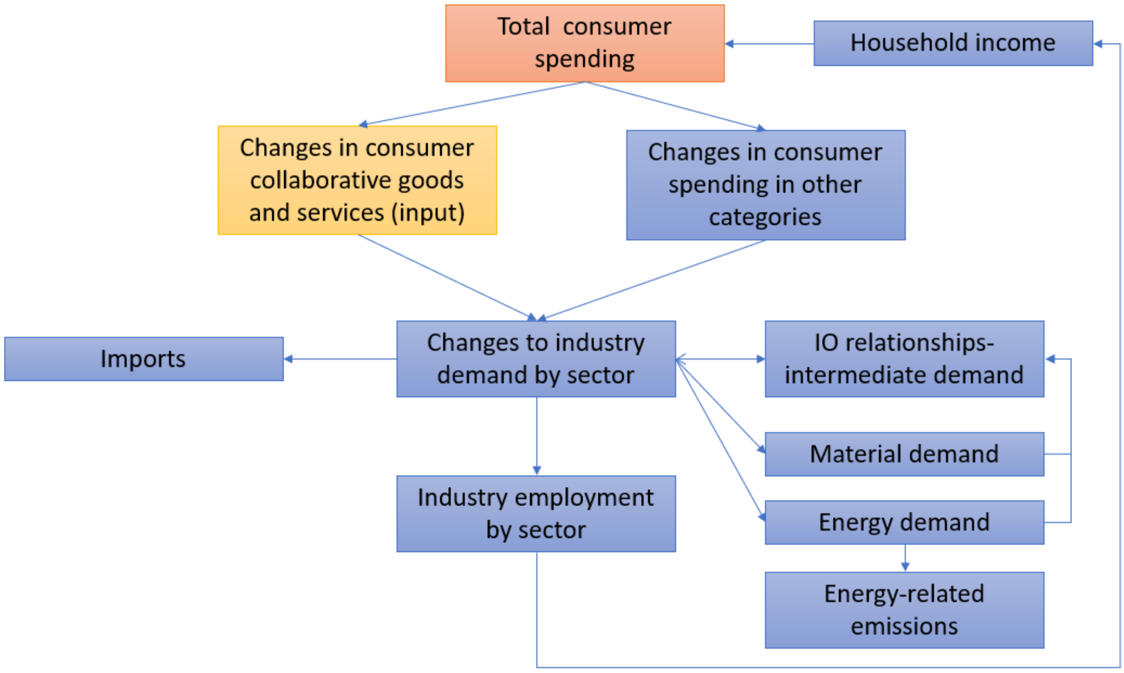
The above method raises a question of how this additional money received by the households that provide goods and services is used. It is not an unrealistic assumption to assume that households (e.g. an Airbnb host) will spend this money in the same way as his or her income from traditional employment. This assumption, however, has an important implication on the environmental impacts of a collaborative economy because, although the collaborative economy reduces demand for traditional businesses (and their energy and material consumption), it generates additional income that gets spent elsewhere in the economy. This causes a 'rebound effect' for the environment from additional consumer demand.

The E3ME model

The E3ME model has 43 consumer spending categories, 70 economic sectors, 23 fuel users of 12 fuels and 15 users of 7 raw materials. It also covers each Member State individually (and 31 other world regions). The model captures the indirect and rebound effects through its linkages between sectors, labour, energy and material. Figure 5-1 summarises how a collaborative economy is modelled in E3ME.

[32] www.e3me.com

Figure 5-1 Modelling the collaborative economy in E3ME



For each collaborative sector, we first introduce the change to consumer spending, from traditional businesses (P2B) to transfers between households or person-to-person (P2P). These changes in consumer spending behaviour get reflected in changes to industry demand and supply chains, as well as changes to employment level and household incomes. The model also captures any additional spending by households that provide the collaborative goods and services. For this we assume that any additional income is spent in line with current household spending. Although shifting spending from P2B (taking money away from traditional businesses) to P2P (adding to household income to be spent on other goods and services) should result in a net change of zero to total consumer spending, the modelling results may show changes in net total consumer spending because of secondary impacts through employment and income that result from a reallocation of resources within the economy. Throughout all of the scenarios government revenue and expenditure is assumed to be exogenous to the model and is therefore assumed to remain fixed.

In summary the modelling inputs to our collaborative economy scenarios are

- Spending transferred from P2B to P2P
- Payment to collaborative economy platforms[33] (e.g. Airbnb, ZipCar or Peerby)
- In the case of road transport – a reduction in energy demand and changes to other modes of transport.

[33] These are modelled as additional consumer spending on 'miscellaneous services' which are related to services sectors such as IT, marketing, and agencies.

Links between LCA, direct impacts and E3ME modelling

The life cycle analysis (LCA) carried out in the previous section provides an analysis at a product level as of 'today' to highlight the environmental impacts of the two different products: 'traditional' vs. 'collaborative'. In this part of analysis, we look at the 'future' environmental impacts of the collaborative economy from a macroeconomic perspective. The modelling inputs are 'direct impacts' of the collaborative economy, e.g. how much money is diverted from business to the sharing economy, and how much is paid to a collaborative sharing platform. The environmental impacts from the modelling exercise therefore include not only changes at product level but also other indirect effects from changes in consumer spending. Moreover, it is important to note that the size of the collaborative economy in our future scenarios is still relatively small compared to the traditional economy. Although, the findings from LCA may suggest significant environmental impacts at product level, at macro level the environmental impacts can be relatively small, once account for relative size, plus the indirect and rebound effects. In the following table, we describe further how LCA impacts are embedded in the modelling results.

Table 5-2 LCA and E3ME comparison

Description of impacts	LCA	E3ME	E3ME (note)
Accommodation			
Less hotels being built	X	✓	through shift in demand P2B to P2P - input to E3ME modelling
Hotels use more steel than a traditional home	✓	✓	through shift in IO coefficient of how much steel is demanded by the hotel sector
Home improvement, residential construction	x	✓	through secondary impacts (some will go toward dwelling investment)
Payment to collaborative platform	x	✓	input to E3ME modelling
Electricity used per one person per night	✓	✓	through shift from hotel use of electricity to residential use of electricity
Other energy used per person night	✓	✓	through shift from hotel use of other energy to residential use of other energy
Water used per person night	✓	✓	through shift from hotel use of water to residential use of water
Toiletry used per person night	✓	✓	through shift from hotel use of toiletry (supply chain) to residential use of toiletry
Food consumption	*	*	* in both cases assume no changes but in E3ME there is a shift from spending at hotels to eating at home or in restaurants (based on standard consumer spending pattern)
Indirect effects	x	✓	Knock-on effects on supply chains, employment and investment demand
Rebound effects	x	✓	Additional spending from income generated from P2P
Transport			
Less car demand, more sharing	x	✓	through reduction in car sales - input to E3ME modelling (take account of

Description of impacts	LCA	E3ME	E3ME (note)
			occupancy rate and service life already)
Materials used in car production per unit, collaborative vs traditional model	✓	x	different car mix but no changes in production phase e.g. still use similar material mix to produce EURO6 cars compared to EURO3 cars. No adjustment to type of material demand by car manufacturing is required in the modelling
Payment to collaborative platform	x	✓	input to E3ME modelling
Spending on petrol and maintenance due to more sharing (quantity)	x	✓	input to E3ME modelling
Car mix - more efficient engines	✓	✓	through energy demand reduction – input to E3ME modelling
Car mix – more electric cars	x	x	LCA only includes today's mix; in the modelling electric car use falls outside the scope of the analysis
Changes in other modes of transport	✓	✓	input to E3ME modelling
Car service life	✓	✓	reflected in car purchases – input to E3ME modelling
Indirect effects	x	✓	knock-on effects on supply chains, employment and investment demand
Rebound effects	x	✓	additional spending from income generated from P2P
Consumer durables			
Less durable goods demand, more sharing	x	✓	LCA only compares drills and ladders, E3ME includes all potential goods that can be shared
Differences in production methods and inputs	x	x	not included, the same materials are used to produce durable goods
Payment to collaborative platform	x	✓	input to E3ME modelling
Distance and mode of transport to shop	✓	x	LCA assumes a higher use rate in the case of the collaborative economy, which leads to more than double the number of trips being required in the lifespan of a shared good compared to buying. However, once the mode of transport is taken into account (car, bike, foot) there is not much difference between the collaborative or traditional models.
Indirect effects	x	✓	knock-on effects on supply chains, employment and investment demand
Rebound effects	x	✓	additional spending from income generated from P2P

5.3 Accommodation sector

5.3.1 Modelling inputs

The modelling inputs for the accommodation sector scenarios are given in Table 5-3. These inputs are taken from the findings of direct impacts of the accommodation sector as described in Section 3.3.2: Scenario Building.

Table 5-3 Accommodation scenario inputs (from using Approach 2 in Table 3-3 – differences to baseline)

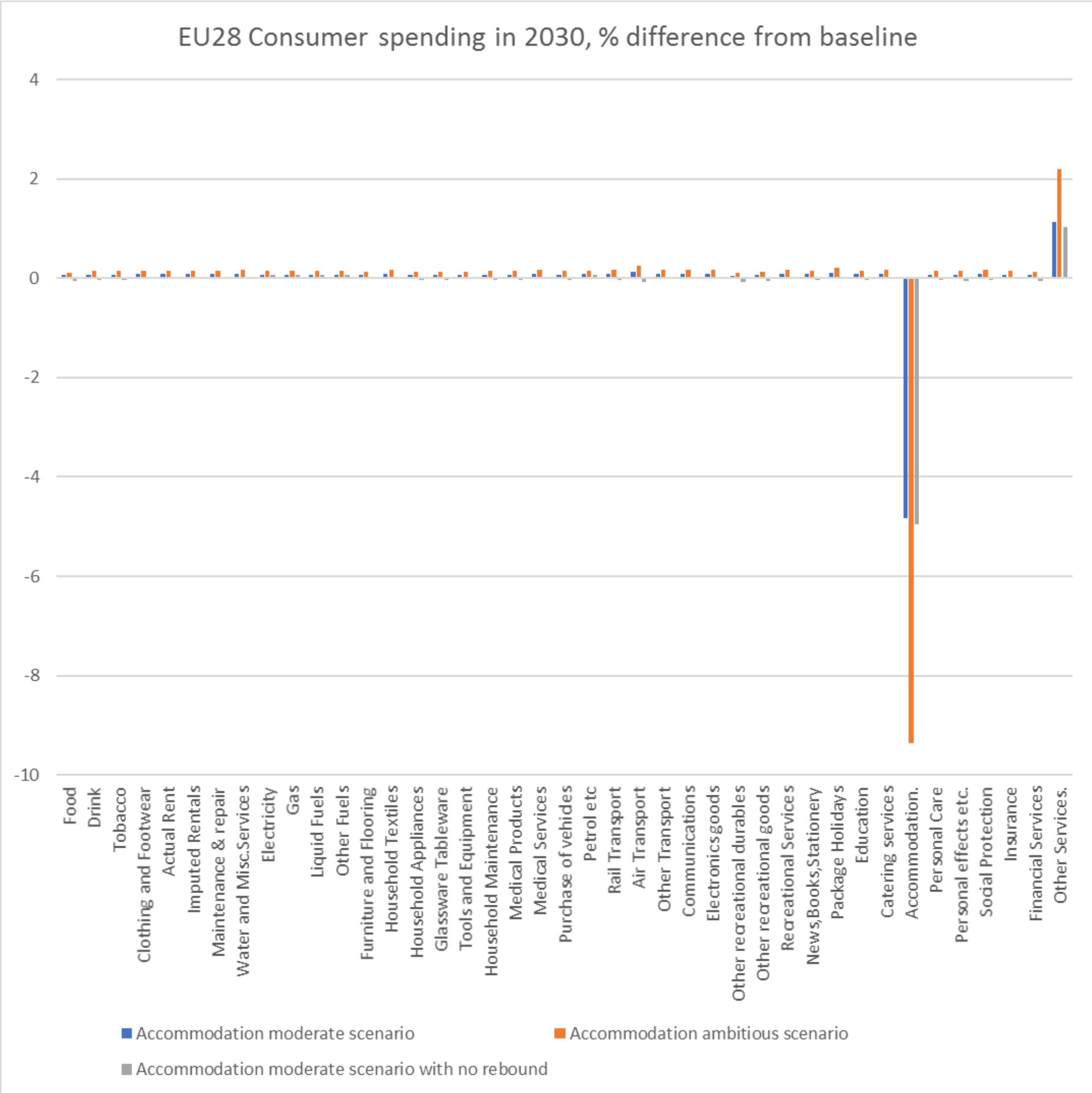
input(s)	Level(s)	Rationale(s)
Moderate scenario		
Consumer spending on traditional model of accommodation	reduce by €6.4bn*	this is the money that would otherwise be spent on traditional hotels and instead remains in the household sector (P2B to P2P)
Consumer spending on sharing platform (misc.services)	increase by €1.05bn	hosts payment to Airbnb platform
Ambitious scenario		
Consumer spending on traditional model of accommodation	reduce by €18.4bn**	as above but more ambitious
Consumer spending on sharing platform (misc.services)	increase by €3.03bn	as above but more ambitious
Moderate scenario with no rebounds		
Same as moderate scenario but assume additional income from P2P is saved rather than spent		
*The reduction in consumer spending in the moderate scenario is calculated as the difference between maximal total host income in the moderate growth projection and the business as usual growth projection (as shown in the final column for Approach 2 in Table 3-3). This income is assumed to equate to an equal reduction in consumer spending in the 'traditional' economy. ** The reduction in consumer spending in the ambitious scenario is calculated as the difference between maximal total host income in the ambitious 15% growth projection and the business as usual growth projection (as shown in the final column for Approach 2 in Table 3-3). This income is assumed to equate to an equal reduction in consumer spending in the 'traditional' economy.		

The above direct impacts are for 2030 and for the EU28 as a whole. We split out the changes over time (2017-2030) using a simple interpolation method and convert the figures from current to constant price euros. We also split out the direct impacts across Member States using the current share of consumer spending on accommodation.

5.3.2 Economic impacts

Figure 5-2 summarises the changes in consumer spending as a result of collaborative economy in the accommodation sector. In the accommodation ambitious case, the reduction in consumer spending in the traditional accommodation sector compared to the baseline is close to 10%. There is around a 2% increase in the spending category 'Other services', which represents commission or service payments to collaborative digital platforms such as Airbnb in this case. There are also increases in other consumer spending categories in the accommodation moderate scenario ambitious scenario due to the additional income generated from P2P activities. In the moderate and ambitious scenarios, we have assumed that households who receive money for 'renting' their accommodation go on to spend this additional income on other goods and services elsewhere in the economy. In the accommodation moderate case with no rebounds, we assumed additional incomes are not spent. Instead, households increase savings. In the E3ME modelling, increased savings are treated as leakages from the economy.

Figure 5-2 EU28 consumer spending in 2030 by categories, percentage differences from baseline



Source(s): E3ME, Cambridge Econometrics.

The differences in industry output by sector are very small. However, it can be seen that within the accommodation scenarios the sectors that see a reduction in output include the 'hotels and catering' sector (-0.8% reduction in output compared to the baseline in the moderate scenario and -1.5% reduction in the ambitious scenario). This is not surprising since demand for the services provided by this sector are directly impacted by collaborative activities. Other sectors that suffer a knock-on effect from a decline in demand for accommodation from the 'traditional' economy include 'food, drink and tobacco', which sees a -0.07% decline in output in the moderate scenario and a -0.1% decline in the ambitious scenario. This is due to consumers making more use of self-catering options and choosing to 'stay in' rather than 'go out' while staying in accommodation rented through collaborative platforms. Industries that are then linked to this via supply chains, such as 'fishing' and 'crop production' also see some of the larger falls in output. Conversely, the sectors that see the largest increases in output within the accommodation moderate and ambitious scenarios include sectors such as 'arts and entertainment activities', 'sports activities' and 'other personal services'. In these scenarios consumers are spending the additional income generated from collaborative activities on leisure activities such as those offered by these sectors. In the moderate scenario with no rebounds most sectors see a fall in output since the additional income generated from collaborative activities is assumed to be saved and not spent in other sectors. Under this scenario, similar to the moderate and ambitious scenarios, 'hotels and catering' and 'food and drink' experience the biggest falls in output as a direct result of less demand for these services.

At macro level, the economic impacts are very small (<0.01% of EU28 GDP in the moderate and ambitious scenarios and approximately -0.05% in the no rebound sensitivity scenario). In the table below, we present the absolute differences from the baseline. The model results show negative impacts on employment (just over 10,000 jobs across Europe in the moderate scenario), mainly as a result of reduction in demand for hotels which is a labour-intensive sector. However, the reduction in employment does not equate to lower real disposable incomes in the accommodation scenarios because of the falls in average consumer prices (as a result of lower costs of accommodation and traditional hotels lowering their prices to compete). Overall, there are slight increases in consumer spending which lead to a (very) small increase in GDP in the accommodation moderate and ambitious cases. In the accommodation moderate case with no rebounds, in the absence of additional spending from incomes generated from collaborative activities, there is a net reduction in consumer spending, which has further knock-on effects on jobs and the other components of GDP. Consumers are purchasing less from the 'traditional' accommodation sector and instead 'renting' accommodation from other households, but the income that is generated by these households is now saved instead of being spent elsewhere in the economy, and is treated as a leakage from the economy. This, along with negative multiplier effects, leads to an overall reduction in GDP in this scenario.

Table 5-4: Accommodation scenarios EU28 macroeconomic impacts in 2030

EU28 Macroeconomic impacts in 2030, absolute differences from baseline, €2015 bn (% difference from baseline)			
Indicator	**Accommodation moderate case**	**Accommodation ambitious case**	**Accommodation moderate case with no rebounds**
GDP	0.7 (0.00)	1.2 (0.01)	-8.2 (-0.05)
Consumer spending	0.5 (0.01)	1.1 (0.01)	-7.2 (-0.08)
Extra-EU imports	0.3 (0.01)	0.5 (0.02)	-0.4 (-0.01)
Extra-EU exports	0.1 (0.00)	0 (0.00)	-0.3 (-0.01)
Investment	0.4 (0.01)	0.8 (0.02)	-1.1 (-0.03)
Real disposable income	0.9 (0.01)	1.7 (0.01)	-1.5 (-0.01)
Employment (000s)	-10.3 (-0.00)	-10.7 (-0.00)	-48.7 (-0.02)

Source(S): E3ME, Cambridge Econometrics.

5.3.3 Environmental impacts

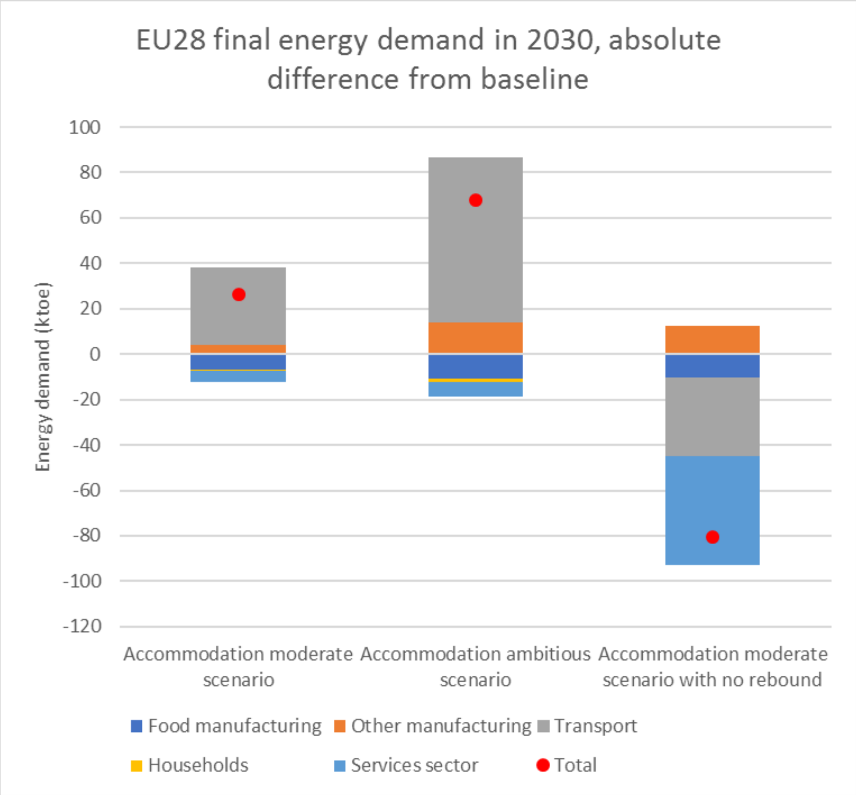
Energy demand

Figure 5-3 shows impacts on final energy demand for selected energy users. Despite the reduction in energy demand from the 'other services' user (which includes the traditional accommodation sector), we can clearly see that there is a much bigger increase in transport demand (air and road transport mainly). Although we have not specifically allocated additional income from P2P accommodation to a particular consumer category, the model results show that savings due to switching from more energy-intensive traditional hotels to less energy-intensive residential accommodation are compensated by higher energy used in transport as a result of more frequent trips and travels.

Final energy demand from the food manufacturing industry decreases slightly in the accommodation scenarios. This reflects the supply chains of the hotel sector. While tourists are still expecting to eat regardless of the type of accommodation they are in, it could be that by staying in residential accommodation with kitchen facilities, home cooking is encouraged. Eating at home is often seen as more energy and resource efficient comparing to eating out, having inclusive board options or ordering room services. The increase in home cooking is reflected in higher demand for retail (supermarkets) and agriculture (local farmers) which are embedded in the energy demand results of the 'other services' sector.

Energy demand in other sectors reflects rebounds in consumer spending from additional P2P incomes. Overall the net increases in final energy demand are 30 and 70 kilotonnes of oil-equivalent (ktoe) in the moderate and ambitious scenarios respectively. In the no-rebound sensitivity, total final energy demand falls by 80 ktoe.

Figure 5-3 Accommodation scenarios EU28 final energy demand in 2030, absolute differences from baseline in thousands tonne of oil-equivalent



Source(s): E3ME, Cambridge Econometrics

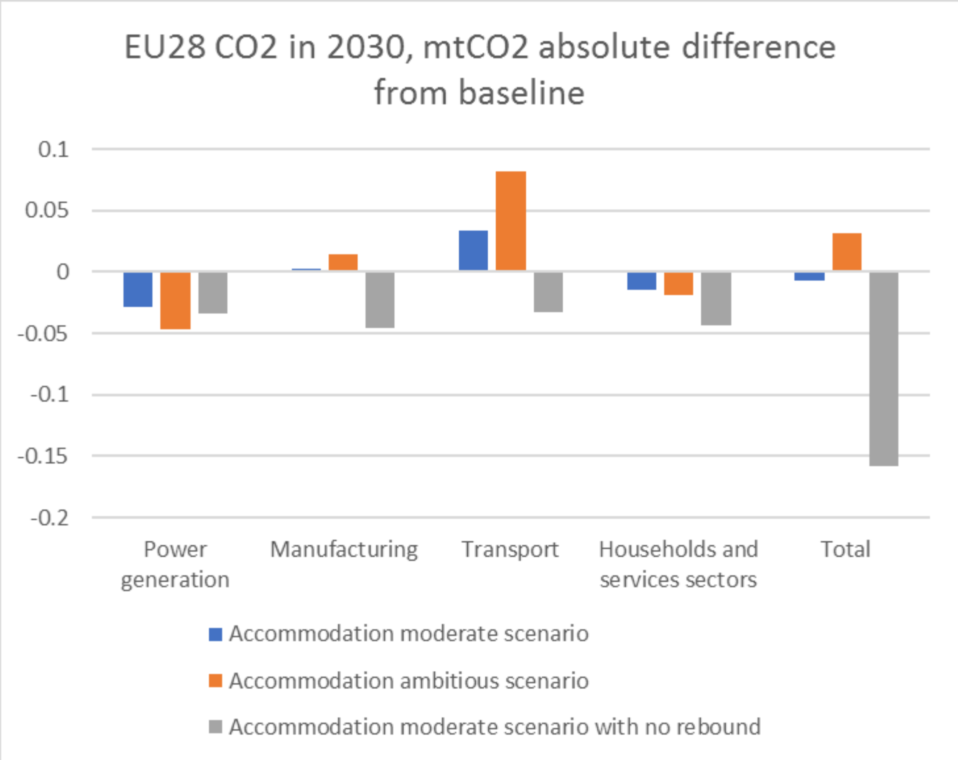
Emission results

Despite the overall increase in final energy demand, CO_2 impacts are minimal (less than +/-0.01% compared to baseline). This equates to an increase of 0.018mt CO_2 in the moderate scenario and a reduction of 0.022mt CO_2 in the ambitious scenario. The increase in final energy use in the moderate and ambitious scenarios comes mostly from oil demand used in transport. This is greater within the ambitious scenario where the rebound effects are more pronounced. In this case the positive environmental impacts from collaborative economy activities are outweighed by the rebound in spending and subsequent increase in energy demand and emissions in other sectors. The model results suggest demand for other fuels (electricity, gas and solid) either remain stable or decrease slightly.

Lower final demand for electricity results in lower primary demand for the fuels used to generate electricity. As a result, we see lower CO_2 emissions from the power sector, which overall offsets some of the increase in CO_2 emissions from the transport sectors. Emissions from other users remain largely unchanged from the moderate case.

In the moderate scenario with no rebound, where additional income from P2P is saved rather than spent, there are no rebounds in energy demand and there is a net reduction in CO_2 emissions.

Figure 5-4 Accommodation scenarios EU28 CO_2 in 2030, absolute differences from baseline in $mtCO_2$



Source(s): E3ME, Cambridge Econometrics.

Material demand

The demand for raw materials follows changes in economic activity. The table below shows the impacts on material demand, in domestic material input (DMI), as a percentage difference from baseline. Results in absolute terms are not comparable because of the relative weight of the different categories. Shifting from traditional hotels to shared accommodation, where tourists have more tendency to home cook, could reduce the food waste associated with eating out at restaurants and/or provisions at hotels. The changes in demand for other raw materials reflect increases in demand for other goods and services from P2P incomes. Raw material consumption falls in the case of no rebound effects from additional P2P incomes.

Table 5-5 Accommodation scenarios EU28 material demand (DMI) in 2030, % difference from baseline

EU28 Material demand (DMI) in 2030, percentage difference from baseline			
	Accommodation moderate scenario	Accommodation ambitious scenario	Accommodation moderate scenario with no rebounds
1 Food	-0.01	-0.03	-0.04
2 Feed	-0.02	-0.02	-0.03
3 Forestry	0.01	0.01	-0.02
4 Construction Minerals	0.01	0.01	-0.02
5 Industrial Minerals	0.01	0.02	-0.01
6 Ferrous metals	0.02	0.03	-0.01
7 Non-ferrous metals	0.01	0.02	-0.01

Source(s): E3ME, Cambridge Econometrics.

5.4 Transport sector

5.4.1 Modelling inputs

The modelling inputs for the transport sector scenarios are given in Table 5-6. These inputs are taken from the findings of direct impacts of the transport sector as described in Section 3.3.3.

Table 5-6 Transport scenario inputs

input(s)	Level(s)	Rationale(s)
Moderate scenario		
Consumer spending on cars	reduce by 0.5m cars at an average cost of €25,000[34] per car*	In a collaborative economy there is more sharing of cars and therefore fewer cars are purchased. Money that would otherwise have been spent on new cars instead remains in the household sector (P2B to P2P).
Road transport energy demand	Reduction in energy demand from the road transport sector (-0.2% compared to BAU)	Total distance travelled is reduced as trips are combined in one vehicle due to ridesharing.
Consumer spending on fuel and car maintenance	Links automatically to the reduction in energy demand. Together with other maintenance the reduction is €4.14bn.	The cost of mobility by car is reduced as consumers share the cost of maintaining and fuelling a car when they car-share or ride-share.
Consumer spending on rail and other transport	Rail: 3.6% reduction from baseline expenditure Other transport: 0.9% increase from baseline expenditure	Changes to other forms of transport can be positive or negative. A collaborative economy in the transport sector could lead to a general behavioural shift away from car use and car ownership, leading to an increase in public transport use.

[34] We assumed average price of a new car in the EU is €25,000 https://www.statista.com/statistics/425095/eu-car-sales-average-prices-in-by-country.

input(s)	Level(s)	Rationale(s)
		On the other hand, consumers may now use car/ ride-sharing methods as an alternative to public transport.
Consumer spending on sharing platform (misc.services)	€5,064m car sharing, €306m for ride sharing and 1.1% of other transport spending for ride hailing	Payments are made to agencies such as UBER, Zipcars, BlaBlaCar etc.
Ambitious scenario		
Consumer spending on cars	Reduce by 7m cars at an average cost of €25,000 per car*	as above but more ambitious
Road transport energy demand	Reduction in energy demand from the road transport sector (-1.0% compared to BAU)	as above but more ambitious
Consumer spending on fuel and car maintenance	See above. Together with other maintenance the reduction is €11.4bn.	as above but more ambitious
Consumer spending on rail and other transport	Rail: 5.5% reduction from baseline expenditure Other transport: 0.9% increase from baseline expenditure	as above but more ambitious
Consumer spending on sharing platform (misc.services)	€15.8bn car sharing, €0.6bn for ride sharing and 2.6% of other transport spending for ride hailing	as above but more ambitious
Moderate scenario with no rebounds		
Same as moderate scenario but assume the additional income from P2P is saved rather than spent.		
*The reduction in the number of cars purchased is based on calculations detailed in section 3.3.3.		

The above direct impacts are for 2030 and for the EU28 as a whole. We split out the changes over time (2017-2030) using a simple interpolation method and convert the figure from current to constant price euros. We also split out the direct impacts across Member States using current shares of consumer spending on cars.

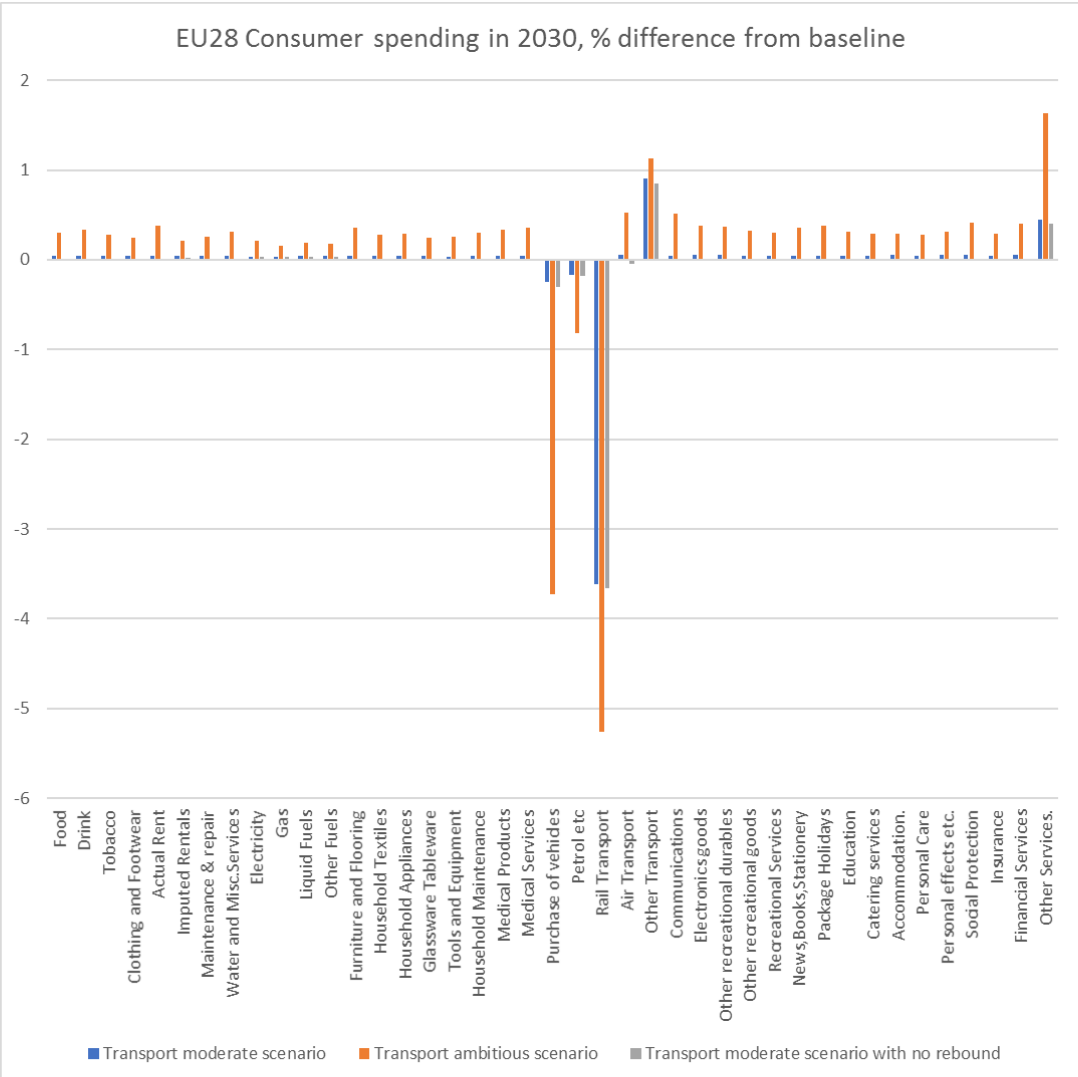
5.4.2 Economic impacts

Figure 5-5 summarises the changes in consumer spending as a result of the collaborative economy in the transport sector. In the transport ambitious scenario, the reduction in consumer spending on cars is close to 4% compared to the baseline, while spending on petrol is reduced by almost 1%. Ride or car sharing schemes may be a better, cheaper, more convenient and comfortable option for travellers who may have otherwise used public transport (e.g. rail). This is reflected in our modelling input of a greater than 5% reduction in consumer spending on rail transport compared to the baseline.

In all scenarios, consumers enjoy the same level of consumption of transport overall, but instead of purchasing services from the 'traditional' economy, they now use collaborative economy platforms to share with other consumers. Aside from the spending to collaborative platforms such as Zipcar, these transactions are no longer recorded within the consumer spending part of GDP, however, households who earn income from transport related collaborative activities spend this on other goods and services within the economy. In the ambitious scenario, consumer spending is increased by 1.6% in the 'Other services' category, reflecting payments made to ride or car-sharing agencies such as UBER, Zipcar and BlaBlaCar. There are increases in other consumer spending categories in the transport moderate scenario and ambitious scenario due to the additional disposable income households have to spend as a result of their collaborative economy activities. In the transport moderate scenario with no rebounds we assume that this additional income is not spent on alternative goods and services but instead households increase savings.

It should be noted that changes in the ambitious scenario for the transport sector are much larger than in the transport moderate case. For example, in the transport moderate scenario there are 0.5m fewer cars purchased while in the transport ambitious scenario 7m fewer cars are purchased.

Figure 5-5 EU28 consumer spending in 2030 by categories, percentage differences from baseline



Source(S): E3ME, Cambridge Econometrics.

Similar to the results of the accommodation scenarios, the sectors that benefit the most in the moderate and ambitious transport scenarios, and have the largest, albeit still small, increases in output, are 'arts and entertainment' (0.11% increase in the moderate scenario, 0.6% increase in the ambitious scenario), sports activities (0.07% increase in the moderate scenario, 0.5% increase in the ambitious scenario) and 'other personal services' (0.06% increase in the moderate scenario, 0.4% increase in the ambitious scenario). These are all linked to the rebound in consumer spending resulting from increased household income from collaborative activities; these results suggest an increase in spending on leisure activities. The sectors that are directly affected by the decline in demand within the 'traditional' economy for transport-related goods and services experience the biggest falls in output, although again, these are still relatively small. In these scenarios output falls within 'travel agencies' (-0.2% fall in the moderate scenario and -0.3% fall in the ambitious scenario), 'land transport' (-0.1% fall in the moderate scenario and -0.2% fall in the ambitious scenario), 'sale of cars' (-0.06% fall in the moderate scenario and -0.2% fall in the ambitious scenario) and 'motor vehicles' (-0.03% fall in the moderate scenario and -0.3% fall in the ambitious scenario). Falls in output within these sectors also occur in the moderate scenario with no rebounds, in which additional income is assumed to be saved. However, unlike in the other scenarios, sectors do not benefit from additional consumer spending. 'Other personal services' sees a very small 0.03% increase in output, as a result of payments made to collaborative platforms such as Uber or ZipCar.

At macro level, as in the accommodation sector, the impacts are quite small (€0.8bn increase in EU28 GDP in the moderate scenario, approximately €20bn in the ambitious scenario and approximately -€5 in the no rebound sensitivity). In the table below, we present absolute differences from baseline since in percentage terms these are very small.

The model results show positive impacts on employment and real disposable incomes in the moderate and ambitious scenarios, when rebound effects are considered (about 17,000 jobs across Europe in the moderate scenario and 145,000 jobs in the ambitious scenario). There are job losses in the car manufacturing and car sales sector, but these are compensated by employment in other sectors due to increased demand and consumer spending elsewhere (since consumers have more disposable income, generated from their collaborative economy activities). Secondary increases occur because of multiplier effects stimulating further rounds of employment, higher incomes and spending.

However, in the transport moderate scenario with no rebounds, where we assume that there are no rebound effects since additional income is saved rather than spent, there is a reduction in consumer spending. Consumers are purchasing less from the 'traditional' transport sector and instead transfers are being made between households, but the income that is generated by these households is now saved instead of being spent elsewhere in the economy, and this is treated as a leakage from the economy. This, along with further negative knock-on effects to employment and other components of GDP, leads to a decrease in GDP of almost €5bn.

Table 5-7: Transport scenarios EU28 macroeconomic impacts in 2030

EU28 Macroeconomic impacts in 2030, absolute differences from baseline €2015 bn (% difference from baseline)			
Indicator	**Transport moderate scenario**	**Transport ambitious scenario**	**Transport moderate scenario with no rebounds**
GDP	0.8 (0.00)	20.1 (0.10)	-4.8 (-0.02)
Consumer spending	0.4 (0.00)	9.1 (0.08)	-4.5 (-0.04)
Extra-EU imports	-0.2 (-0.00)	-0.5 (-0.02)	-0.6 (-0.02)
Extra-EU exports	-0.2 (-0.00)	-1.5 (-0.04)	-0.3 (-0.00)
Investment	0.3 (0.00)	11.2 (0.23)	-0.6 (-0.01)
Real disposable income	0.6 (0.00)	7.6 (0.06)	-0.9 (-0.00)
Employment (000s)	17.2 (0.00)	144.9 (0.06)	-3 (-0.00)

Source(S): E3ME, Cambridge Econometrics.

5.4.3 Environmental impacts

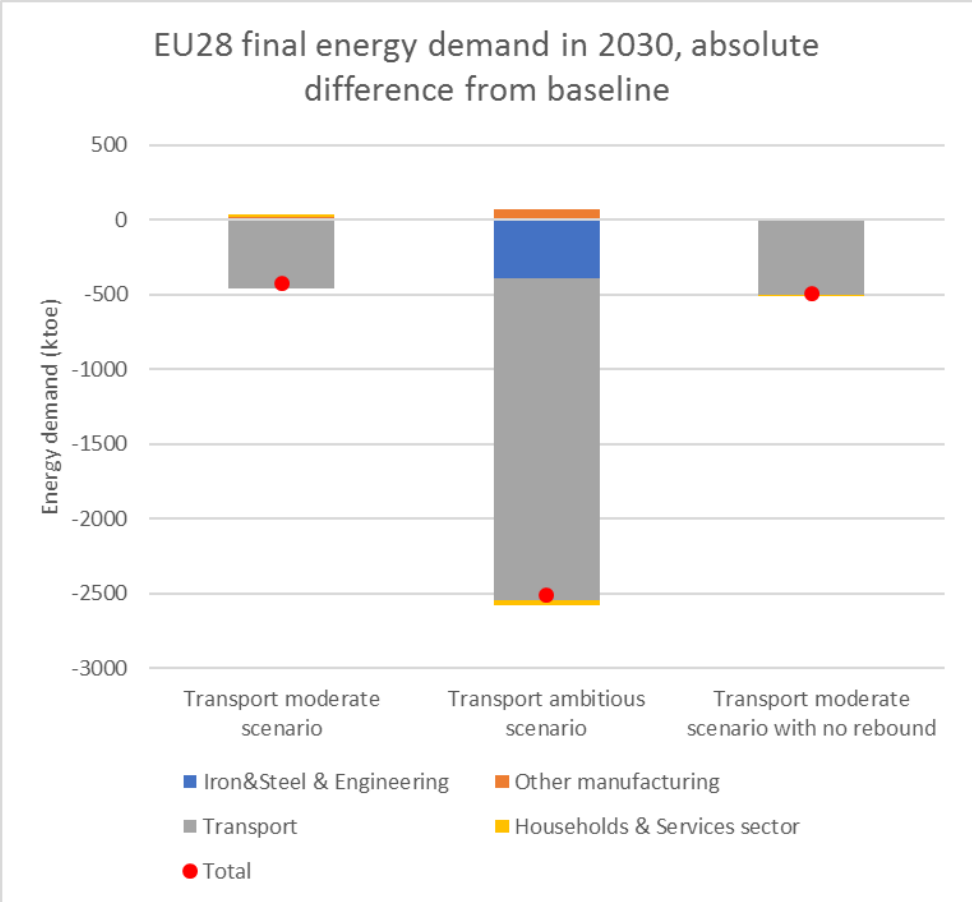
Energy demand

Figure 5-6 shows the differences in final energy demand in 2030 compared to the baseline, as absolute differences for selected energy users. In all scenarios there is an overall decrease in energy demand, mainly driven by reduced energy demand from the transport sector. Although there are some rebound effects, the overall trend is negative. Within the transport sector, the biggest reduction in energy demand is in the road transport sector. This is a direct effect of reducing the use of road transport in the modelling, to represent the impact of less distance travelled per car as trips are combined to one vehicle as people share rides.

In the transport moderate and ambitious scenarios there are small increases in energy demand from 'other manufacturing' due to the rebound effect of increased consumer spending due to higher household income and the demand this places on the manufacturing industries. Increased consumer spending also leads to small increases in energy demand in the 'iron, steel and engineering 'and 'households and services' sectors in the moderate scenario. However, in the more ambitious scenario, energy demand from 'iron and steel and engineering' is in fact reduced as a result of the decline in car sales and therefore activity in this sector, which is closely linked to car manufacturing. A decrease in emissions is also seen in the 'households and services' sector in the more ambitious scenario, as the reduction in demand for, and emissions from, services related to purchasing and maintaining cars outstrips any increase in emissions from rebound effects.

In the transport moderate scenario with no rebound, where we assume no rebound in spending, with additional income instead being saved, energy demand from these sectors falls as a result of reduced economic activity.

Figure 5-6 Transport scenarios EU28 final energy demand in 2030, absolute differences from baseline in thousands tonne of oil equivalent



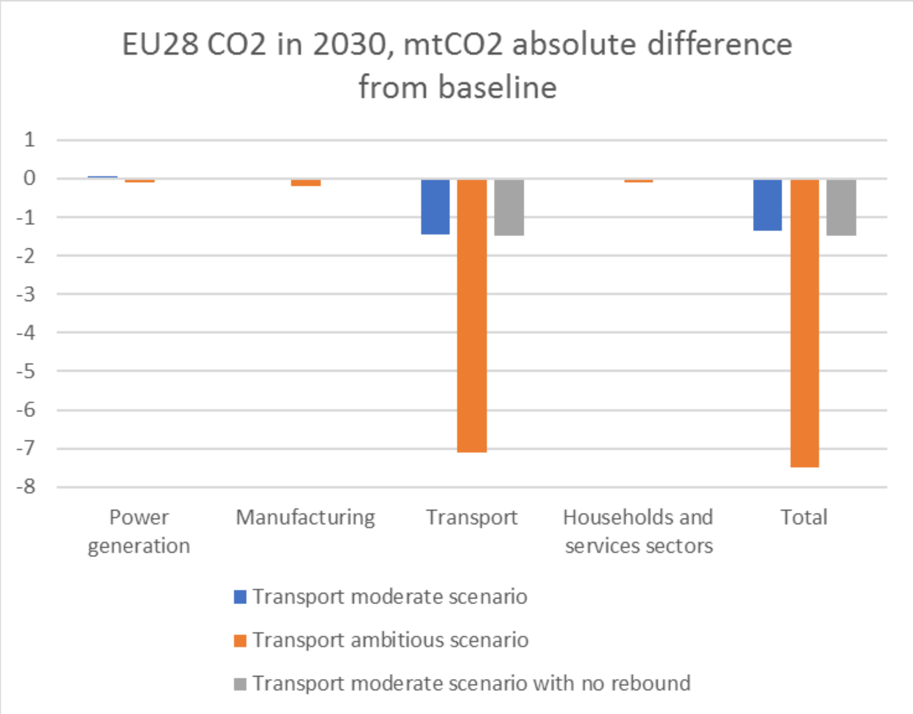
Source(s): E3ME, Cambridge Econometrics

Emission results

Figure 5-7 shows the impact of the scenarios on CO_2 emissions for selected sectors. In the transport sector the impact of collaborative economy activities leads to reductions in total CO_2 emissions for all scenarios, with the majority of the reductions coming from the transport sector. This is because of fewer cars on the road and less distance travelled per car. As with energy demand, any increases in emissions caused by rebound effects are cancelled out by the reductions resulting from decreased car-use or distance travelled.

In the transport ambitious scenario there are also reductions in emissions from other sectors, particularly from iron and steel and power generation (a knock-on effect from the decreased activities in the power-intensive iron and steel sector). This sector's position in the supply chain for car manufacturing means that activity is reduced as a result of fewer car sales in a collaborative economy.

Figure 5-7 Transport scenarios EU28 CO_2 in 2030, absolute differences from baseline in $mtCO_2$



Source(s): E3ME, Cambridge Econometrics.

Material demand

Changes in economic activity are reflected in changes in demand for raw materials. The impacts on raw material demand are very small in the transport sector scenarios, as shown in Table 5-8. In our moderate and ambitious scenarios there is a shift in consumer spending away from new cars, which is reflected as a reduction of 0.07% in demand for ferrous metals in the ambitious scenario compared to the baseline. Demand for all other raw materials is increased by very small amounts as a result of increased consumer spending from higher household incomes. When we assume that additional income is saved and there are no rebound effects from the collaborative economy (transport moderate scenario with no rebound), raw material consumption of minerals falls slightly.

Table 5-8 Transport scenarios EU28 material demand (DMI) in 2030, % difference from baseline

EU28 Material demand (DMI) in 2030, percentage difference from baseline			
Indicator	**Transport moderate case**	**Transport ambitious case**	**Transport moderate case with no rebound**
1 Food	0.01	0.05	0.00
2 Feed	0.01	0.00	0.00
3 Forestry	0.01	0.07	0.00
4 Construction Minerals	0.00	0.00	-0.01
5 Industrial Minerals	0.00	0.00	0.00
6 Ferrous metals	0.00	-0.07	-0.01
7 Non-ferrous metals	0.00	0.05	-0.01

Source(s): E3ME, Cambridge Econometrics.

5.5 Consumer durables sector

5.5.1 Modelling inputs

The modelling inputs for the consumer durables sector scenarios are given in Table 5-9. These inputs are taken from the findings of direct impacts of consumer durables sectors, as described in Section 3.3.4.

Table 5-9 Consumer durables scenario inputs

input(s)	Level(s)	Rationale(s)
Moderate scenario – 5% cost savings through sharing shareable and durable goods		
Consumer spending on sharable durable goods	Numbers are potential savings compared to baseline*: • Clothing 0.3% • Furniture and furnishing, carpets 0.4% • Households textiles 0.65% • Households appliances 2.5% • Glassware, tableware and household utensils 0.6% • Tools and equipment for house and garden 3.75% • Audio-visual, photographic and information processing equipment 1.75% • Other major durables for recreation or culture 2.5% • Other recreational items and equipment, gardens and pets 0.5% • Newspaper, books and stationery 0.65%	This is what would otherwise be spent on buying these durables and instead remains in the household sector (P2B to P2P)
Consumer spending on sharing platform (misc.services)	25% fee of total sharable spending paid to sharing platform	Admin fee payment to sharing platform like Peerby
Ambitious scenario - 10% cost savings through sharing shareable and durable goods		
Consumer spending on sharable durables goods	Numbers are potential savings compared to baseline: • Clothing 0.6% • Furniture and furnishing, carpets 0.8% • Households textiles 1.3% • Households appliances 5% • Glassware, tableware and households utensils 1.2% • Tools and equipment for house and garden 7.5% • Audio-visual, photographic and information processing equipment 3.5% • Other major durables for recreation or culture 5% • Other recreational items and equipment, gardens and pets 1% • Newspaper, books and stationery 1.3%	as above but more ambitious
Consumer spending on sharing platform (misc.services)	25% fee of total sharable spending paid to sharing platform	Admin fee payment to sharing platform like Peerby
Moderate scenario with no rebounds		
Same as moderate scenario but assume additional income from P2P is saved rather than spent.		
*See Table 3-8 for the potential savings in household expenditure from sharing/renting consumer durables. The reduction in consumer spending in the moderate scenario is calculated based on the assumption that 5% of potential sharing in each respective category is realised. *** See Table 3-8 for the potential savings in household expenditure from sharing/renting consumer durables. The reduction in consumer spending in the ambitious scenario is calculated based on the assumption that 10% of potential sharing in each respective category is realised.		

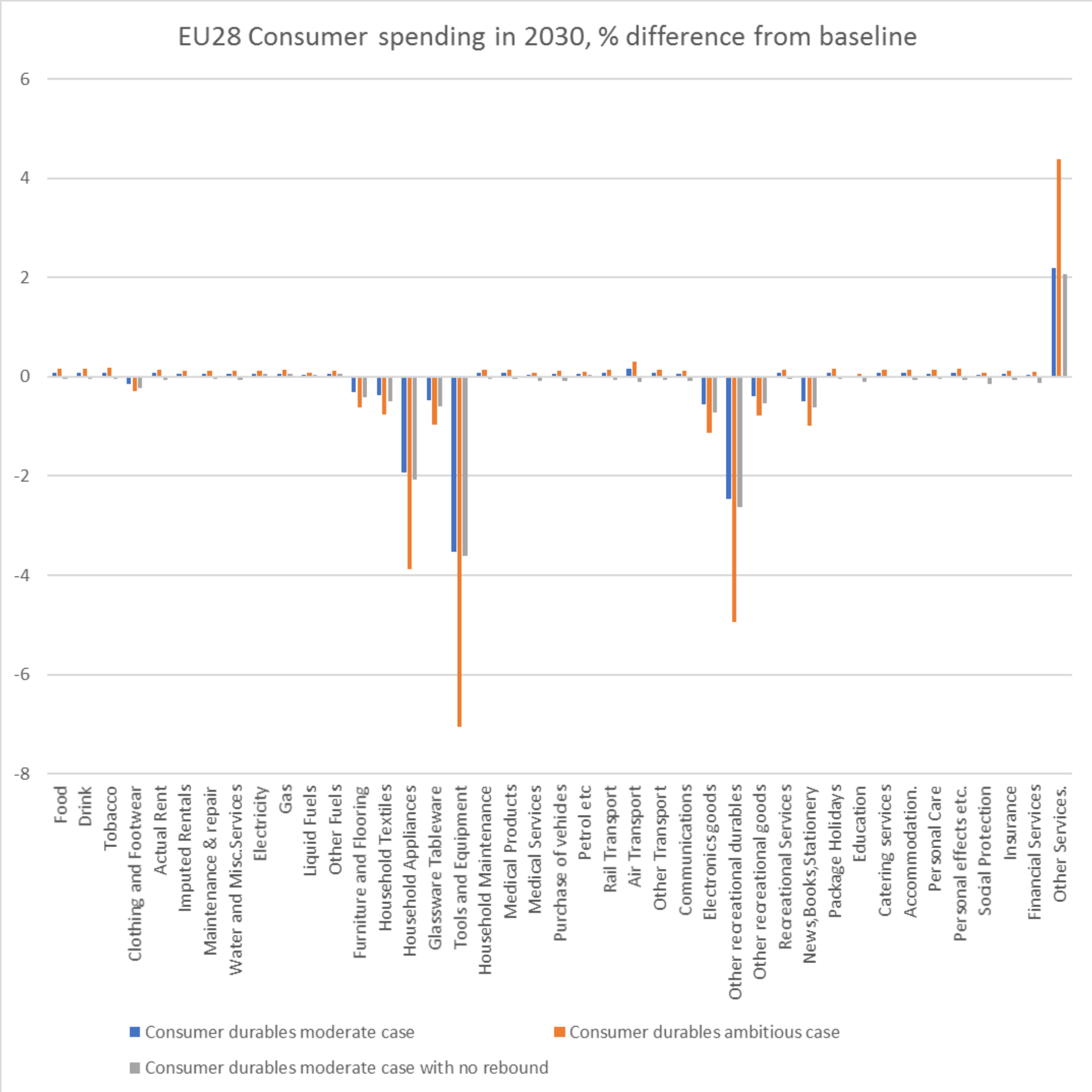
5.5.2 Economic impacts

Figure 5-8 summarises the changes in consumer spending as a result of the collaborative economy for consumer durables.

In both the consumer durables moderate and ambitious scenarios, consumer spending is reduced overall in all the sectors listed in Table 5-9, since consumers spend less on goods with the 'traditional' economic sectors and instead 'borrow' items from other households. The same level of consumption occurs overall, but aside from the money paid to sharing platforms such as Peerby, these transactions are no longer recorded within the consumer spending element of GDP. However, the reduction is partially offset by some increases in spending that occur as a result of higher net household incomes that come from collaborative economic activity. The higher net incomes result from both households that lend items and earn an income, and from households that borrow items at reduced cost from their peers. Consumer spending across all other sectors where we have not modelled collaborative economy activities is increased in both the moderate and ambitious scenarios as a result of higher household incomes.

When we assume that no rebound effects occur, and additional income is instead saved by households rather than spent, there is a reduction in consumer spending across all sectors. 'Other services' still sees an increase in consumer spending, similarly to the consumer durables moderate and ambitious scenarios, due to the payments made to sharing platforms that facilitate the collaborative economy for consumer durables.

Figure 5-8 EU28 consumer spending in 2030 by categories, percentage difference from baseline



Source(S): E3ME, Cambridge Econometrics.

Once again, main 'winners' within the consumer durables scenarios in terms of sectoral output include sectors that benefit from the rebound in consumer spending that occurs in the moderate and ambitious scenarios. These include 'arts and entertainment' (0.4% increase in output in the moderate scenario, 0.8% increase in the ambitious scenario), 'sports activities' (0.2% increase in output in the moderate scenario, 0.4% increase in the ambitious scenario) and 'other personal services' (0.2% increase in output in the moderate scenario, 0.4% increase in the ambitious scenario). Output from 'other personal services' is also directly affected by demand for collaborative platforms such as Peerby. The main 'losers' in all the consumer durables scenarios are those sectors that are directly affected by the slow-down in demand for certain goods within the 'traditional' economy, as these goods are now borrowed from other households instead, and sectors that link to their supply chains. This includes 'other retail', 'printing', 'paper and paper products' and 'textiles and leather'. In all cases the reductions in output are very small, ranging from -0.1% - -0.4%.

The macroeconomic impacts of the collaborative economy for consumer durables are shown in Table 5-10. The GDP results are negative in all runs and opposite to the GDP results in the accommodation and transport sectors. There is a small GDP reduction even when rebounds in spending from additional savings and incomes generated from P2P activities are factored in.

The explanations can be found at Member State level. The GDP reductions are biggest in countries such as Germany, Italy and the UK, which produce and export electronic and durable goods (results below show only extra-EU trade). Under a collaborative model for durable goods, these countries see their production and exports to other EU countries fall. Although these losses are compensated for by increases in consumer spending elsewhere, the compensation is not enough to make up for the loss of value added from these large sectors. The same can be explained for employment and income. The additional employment created is in consumer sectors such as restaurants and food. These sectors are more labour-intensive, and wages are lower than in the engineering sectors. As a result, there is a net increase in employment but lower real income at macro level.

Table 5-10: Consumer durables scenarios EU28 macro-economic impacts in 2030

EU28 Macroeconomic impacts in 2030, absolute differences from baseline €2015 bn (% difference from baseline)			
	Consumer durables moderate case	Consumer durables ambitious case	Consumer durables moderate case with no rebound
GDP	-0.8 (-0.00)	-1.6 (-0.01)	-15.3 (-0.07)
Consumer spending	-2.2 (-0.02)	-4.4 (-0.04)	-15.1 (-0.13)
Extra-EU imports	-0.2 (-0.01)	-0.5 (-0.02)	-1.5 (-0.04)
Extra-EU exports	-0.1 (-0.00)	-0.2 (-0.01)	-0.5 (-0.01)
Investment	1.2 (0.03)	2.5 (0.05)	-1.3 (-0.03)
Real disposable income	-2.9 (-0.02)	-5.8 (-0.04)	-6.9 (-0.05)
Employment (000s)	6.4 (0.00)	14.7 (0.00)	-43.4 (-0.02)

Source(S): E3ME, Cambridge Econometrics.

In the consumer durables moderate case with no rebound, where we assume no rebounds in consumer spending, the GDP impact is more negative and there is no longer the increase in employment that occurred in consumer-related sectors associated with rebounds in consumer spending.

5.5.3 Environmental impacts

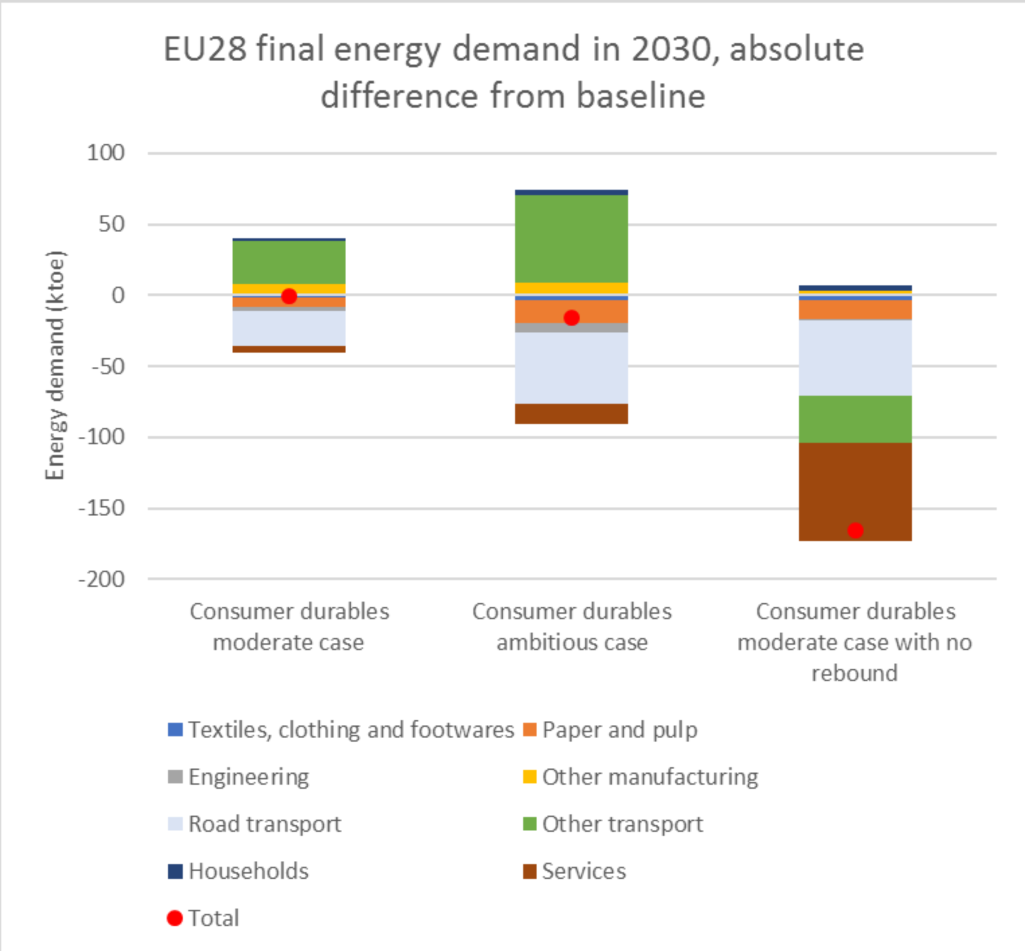
Energy demand

The difference in final energy demand in 2030 compared to the baseline is shown in Figure 5-9 for key energy users. Reductions in energy demand can be seen from users that are key to the supply chain for consumer spending categories where spending is reduced as a result of the collaborative economy. For example, energy demand from the 'textiles, clothing and footwears' sector is reduced as a result of less spending on 'clothing' and 'household textiles'. Energy demand from the 'paper and pulp' sector is reduced as a result of less consumer spending on 'newspapers, books and stationery'. The effects on supply chains extend to retailing and distribution of durable goods. As a result, we see a reduction in energy demand from 'road transport' and 'other services' users.

'Other manufacturing' and 'other transport' see increases in energy demand as consumer spending is increased across other spending categories due to income effects. However, overall there is a reduction in total energy demand in both the moderate scenario (0.8 ktoe reduction) and the more ambitious scenario (16 ktoe reduction).

When we assume that there are no rebound effects and additional income from P2P is saved rather than spent, the overall reduction in total energy demand is much higher than the previous scenarios (166 ktoe reduction), reflecting the significant decrease in demand for consumer durables and therefore economic activity across all sectors.

Figure 5-9 Consumer durables scenarios EU28 final energy demand in 2030, absolute differences from baseline in thousand tonnes of oil-equivalent



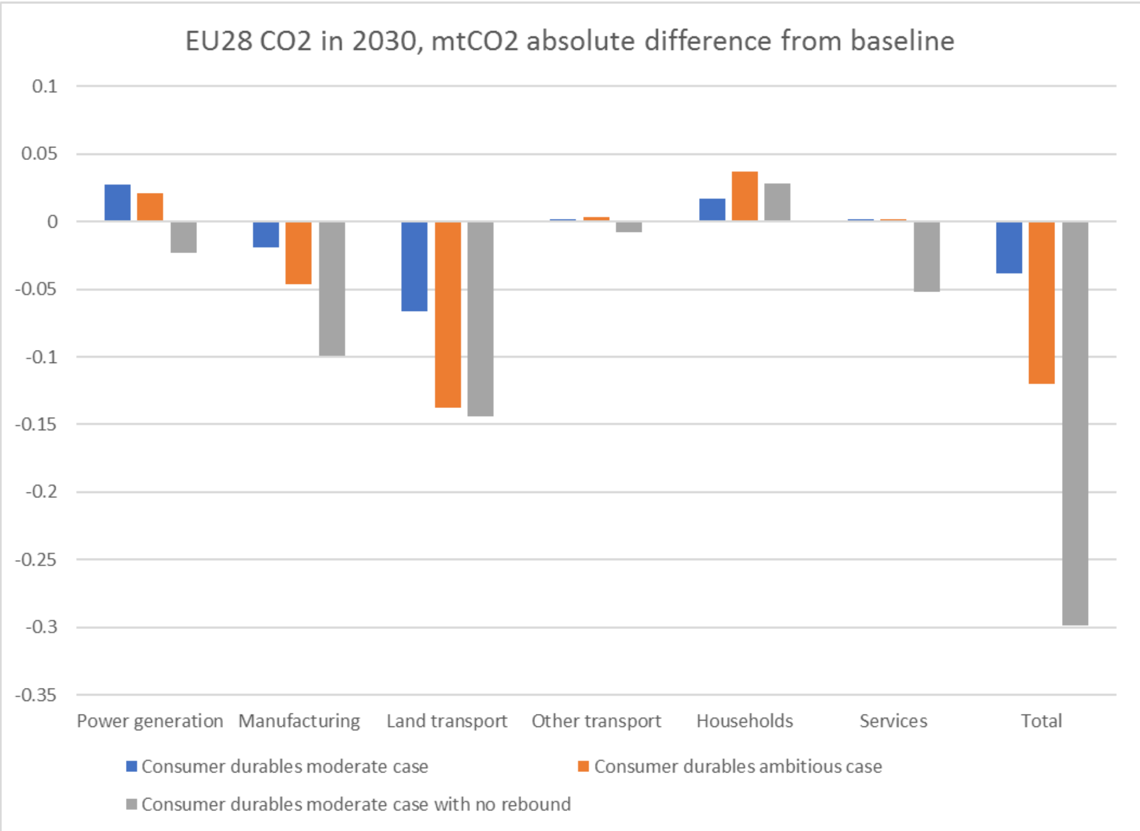
Source(s): E3ME, Cambridge Econometrics

Emission results

Compared to the baseline, total emissions are reduced for key sectors in all the consumer durables scenarios, as shown in Figure 5-10. This reduction is mainly driven by reductions in emissions from 'land transport' and 'other manufacturing'. The decline in consumer spending in those sectors where the collaborative economy can take place leads to a reduction in the distribution of wholesale goods and therefore a reduction in emissions coming from the 'land transport' sector. Similarly, activity in the 'other manufacturing' sector is reduced due to decreased demand for new consumer durables, leading to a reduction in emissions in this sector too. In the moderate and ambitious scenarios emissions are increased from the 'households and services' sector as economic activity increases in this sector as a result of the collaborative economy. Emissions from households increase as their energy demand increases with higher income in the moderate and ambitious scenarios. Despite a reduction in its energy demand, emissions from the services sector remain unchanged because most energy savings related to electricity consumption.

In the consumer durables moderate case with no rebound, where no rebound effects are assumed, and additional income is saved rather than spent, there is a reduction in emissions from all these key sectors, as a result of decreased economic activity.

Figure 5-10 Consumer durables scenarios EU28 CO_2 in 2030, absolute differences from baseline in $mtCO_2$



Source(s): E3ME, Cambridge Econometrics.

Material demand

The impact on raw material demand as a result of the collaborative economy for consumer durables is shown in Table 5-11 for key sectors. In the moderate and ambitious scenarios there is an increase in the demand for 'food', 'feed' and 'construction minerals', while all other key sectors see a decline in material demand. This is caused by the shift in consumer spending away from some consumer durables that are now shared rather than purchased new (for example, reduction in demand for 'furniture' and 'newspaper, books and stationery' leads to less material demand from the 'forestry' sector), to spending on other goods and services such as eating out at restaurants (which places greater material demand on the 'food' and 'feed' sectors).

Table 5-11 Consumer durables scenarios EU28 material demand (DMI) in 2030, % difference from baseline

EU28 Material demand (DMI) in 2030, percentage difference from baseline			
	Consumer durables moderate scenario	**Consumer durables ambitious scenario**	**Consumer durables moderate scenario with rebound**
1 Food	0.02	0.04	-0.01
2 Feed	0.01	0.02	-0.02
3 Forestry	-0.04	-0.07	-0.07
4 Construction Minerals	0.01	0.03	-0.01
5 Industrial Minerals	-0.01	-0.01	-0.02
6 Ferrous metals	-0.01	-0.02	-0.03
7 Non-ferrous metals	-0.01	-0.02	-0.04

Source(s): E3ME, Cambridge Econometrics.

5.6 Combined scenario

5.6.1 Modelling inputs

The combined scenarios model the joint development of the collaborative economy in all three markets – accommodation, transport and consumer durables. These scenarios are compiled by aggregating the three market scenarios and all the modelling inputs defined in the sections above, while taking the cross-linkages between the indirect and rebound effects from the three markets adequately into account.

5.6.2 Economic impacts

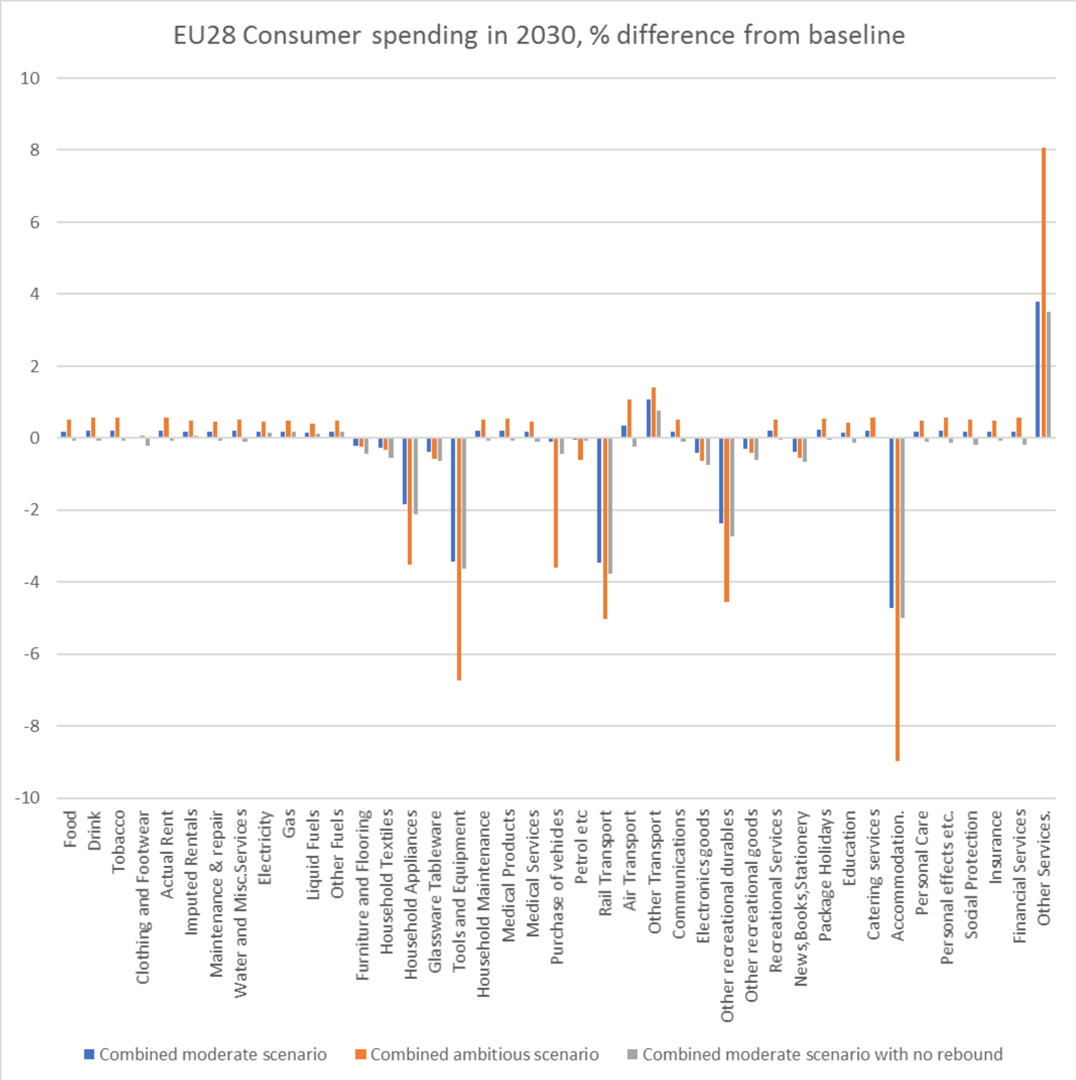
Figure 5-11 shows the change in consumer spending in 2030 as percentage difference from the baseline for the combined scenarios. In all the combined scenarios consumers spend less on goods and services in the 'traditional' economy, therefore consumer spending is reduced in some sectors. However, all collaborative activities require a payment to a collaborative economy platform, and furthermore, in the moderate and ambitious scenarios we assume there are rebounds in spending on other goods and services within the economy. In the combined moderate and combined ambitious scenarios the biggest increase in consumer spending is seen in the 'other services' category, because consumers are spending more on payments to agencies that facilitate collaborative economy activities in our three markets (e.g. Airbnb, UBER and Peerby).

Other sectors that see the largest increases in spending include 'other transport', 'air transport', 'package holidays', 'catering', 'food', and 'drink', reflecting the higher disposable incomes (generated from P2P payments) that households can now enjoy spending on leisure activities. The sectors that see the greatest decrease in spending include 'accommodation', due to less visits to traditional hotels, 'rail transport', since car and ride-sharing present an attractive alternative, and 'tools and equipment' and 'household appliances' since these types of goods can now be shared rather than bought new.

In the combined moderate scenario with no rebound, where no rebounds in spending occur, there is a decrease in consumer spending across all categories except for 'other services' and 'other transport'. Other services benefit directly from the collaborative economy through the payments made to sharing platforms. The increase in the 'other transport' sector comes from our assumptions on additional demand for other modes of transport as a result of higher ride and car sharing.

The combined scenarios lead to some reductions in output from sectors that are directly or indirectly linked (via supply chains) to changes in consumer demand for goods and services from the 'traditional' economy. The sectors with the largest falls in output include 'hotels and catering', 'travel agency and tours' (as a result of collaborative activities in the accommodation sector), 'warehousing' (as a result of collaborative activities in the consumer durables sectors) and 'land transport' and 'sale of cars' (as a result of collaborative activities in the transport sectors). Reductions in output within these sectors range from -0.1% - -0.7% in the combined moderate scenario, -0.1% - -1.1% in the combined ambitious scenario and -0.2% - -0.9% in the combined moderate scenario with no rebounds. In the combined moderate and combined ambitious scenarios there are rebounds in consumer spending that increase demand for, and therefore output from, certain sectors. These include 'arts and entertainment', 'sports activities' and 'other personal services', as consumers spend their additional income on more leisure activities. The increase in output from these sectors ranges from 0.4% - 0.8% in the combined moderate scenario and 0.9% - 1.7% in the combined ambitious scenario.

Figure 5-11 EU28 consumer spending in 2030 by categories, percentage difference from baseline



Source(S): E3ME, Cambridge Econometrics.

Table 5-12 provides the macroeconomic impacts in 2030 of the combined scenarios. Results are shown as absolute differences from the baseline since the impacts at the macroeconomic level are small.

Table 5-12: EU28 macroeconomic & environmental impacts in 2030 for the combined scenarios in comparison to the baseline scenario

EU28 Macroeconomic impacts in 2030						
	1. Combined moderate uptake scenario		2. Combined ambitious uptake scenario		3. Combined moderate uptake scenario with no rebound	
Indicator	Impact in € bn (2015€)	Relative Impact (%)	Impact in € bn (2015€)	Relative Impact (%)	Impact in € bn (2015€)	Relative Impact (%)
GDP	0.9	0.00	4.7	0.02	-31.4	-0.15

EU28 Macroeconomic impacts in 2030						
Consumer spending	-1	-0.01	-1.7	-0.02	-29.7	-0.25
Extra-EU imports	0	0.00	-0.9	-0.03	-2.7	-0.08
Extra-EU exports	-0.1	-0.00	0.2	0.01	-1	-0.02
Investment	2.1	0.04	5.5	0.11	-3.5	-0.07
Real disposable income	-1.2	-0.01	-2.1	-0.02	-10	-0.07
Employment (*thousands*)	9.4	0.00	16.1	0.0	-107.3	-0.05

Source(S): E3ME, Cambridge Econometrics.
Note: red numbers show negative impact

The impact on GDP in the moderate and ambitious scenarios is positive – in the combined moderate scenario an increase of €0.9bn is seen in 2030 compared to the baseline, while in the more ambitious combined scenario there is a €4.7bn increase. The positive economic benefits of the collaborative economy are also seen in employment, where the moderate scenario leads to an increase in jobs of 9,400, while in the more ambitious scenario, where more of the collaborative economy potential is realised, the increase in jobs is over 16,000. As explained in the consumer durable case, these additional jobs are associated with consumer sectors which tend to be labour-intensive and low paid, while job losses in the sectors associated with durable goods (e.g. electronics and engineering) tend to be higher paid. As a result, there is a net increase in employment but overall lower real income in the moderate and ambitious scenarios.

In the combined moderate scenario with no rebound, where we assume no rebound effects in consumer spending, the impact of the collaborative economy is negative and relatively large. While consumers are still consuming the same level of goods and services overall, payments are now made between households rather than within the 'traditional' economy, and activity (aside from payments made to collaborative platforms) is therefore no longer recorded within GDP. Furthermore, negative multiplier effects and the lack of rebound spending in this scenario leads to an overall reduction in GDP of over €31bn. This has a knock-on effect on employment, with a loss of over 107,000 jobs, and other components of GDP.

5.6.3 Environmental impacts

Table 5-13 gives an overview of the main environmental impacts discussed below.

Table 5-13: EU28 macroeconomic & environmental impacts in 2030 for the combined scenarios in comparison to the baseline scenario

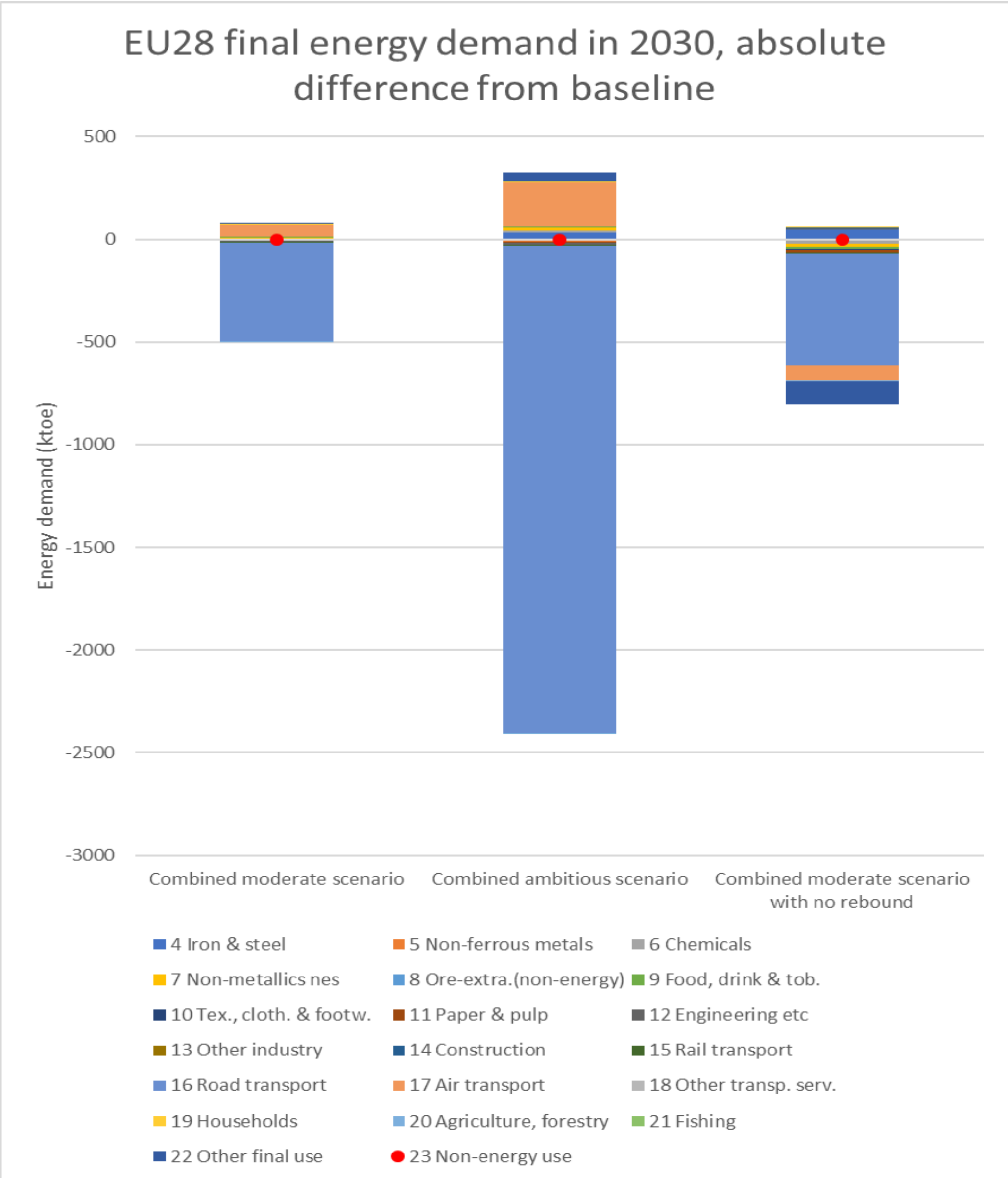
EU28 environmental impacts in 2030						
	1. Combined moderate uptake scenario		2. Combined ambitious uptake scenario		3. Combined moderate uptake scenario with no rebound	
	Absolute impact	Relative impact (%)	Absolute impact	Relative impact (%)	Absolute impact	Relative impact (%)
Final Energy demand (Mtoe)	-0.4	-0.04	-2.1	-0.19	-0.8	-0.07

EU28 environmental impacts in 2030						
CO2 emissions (Mt CO_2-eq.)	-1.5	-0.06	-6.9	-0.27	-2.2	-0.08
Material consumptions (DMI, M tonnes)	1.6	0.01	3.9	0.04	-4.4	-0.04

Source(S): E3ME, Cambridge Econometrics.
Note: red numbers show negative impact

Energy demand

Figure 5-12 Combined scenarios EU28 final energy demand in 2030, absolute difference from baseline in thousand tonnes of oil-equivalent



Source(S): E3ME, Cambridge Econometrics.

When combining the collaborative economy across the accommodation, transport and consumer durables sectors there is an overall reduction in energy demand in all scenarios. This reduction is mainly attributed to decreases in energy demand in the 'road transport' sector in the combined moderate and combined ambitious scenarios, as a direct result of car and ride-sharing and the effect that this has on total distance travelled and number of cars on the road. Other sectors closely linked to car manufacturing and consumer durables, such as 'engineering' and 'non-ferrous metals', also see some of the largest declines in energy demand as consumers opt not to purchase a new car and instead make use of collaborative alternatives. In the moderate and ambitious scenarios there are increases in energy demand in some sectors as consumers use their additional income from P2P payments, most notably in the 'air transport' sector, to engage in more leisure activities such as holidays abroad.

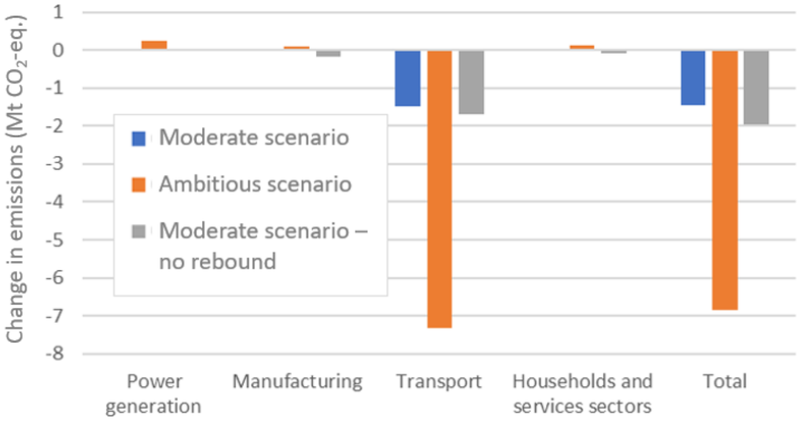
When households save their addition P2P incomes rather than spend it, as in the combined moderate scenario with no rebound, the overall reduction in energy demand is also negative and less energy is demanded overall compared to the moderate case since there is no additional economic activity from rebound effects. The only exception is higher energy demand in 'other final use' which includes a proxy for collaborative payment platform.

Emission results

The following chart shows the impact on emissions for key sectors in the combined scenarios. In all of the combined scenarios there is a reduction in total emissions, and this is most evident in the ambitious scenario where there is expected to be a decrease of almost 7 mtCO2 by 2030 compared to the baseline[35]. In all cases the reduction in emissions is mainly made up of reductions in the 'transport' sector, as a direct result of collaborative activities within this sector such as ride-sharing and car-sharing, reducing the total number of cars and distance travelled, and therefore harmful emissions produced. In the combined moderate and combined ambitious scenarios there are small increases in emissions in all other key sectors including 'manufacturing' and 'households and services'. The increase in emissions from 'households and services' is a direct impact of the greater economic activity in this sector from higher income from P2P and as a result of payments to sharing platforms/ agencies. 'Manufacturing' produces more emissions in these scenarios as a result of the rebound effects in consumer spending and the increase in demand for manufactured goods.

[35] For comparison, EU28 CO_2 emissions in 2013 is approximately 3,000 $mtCO_2$.

Figure 5-13 Combined scenarios EU28 CO2 in 2030, absolute differences from baseline in $MtCO_2$



Source(s): E3ME, Cambridge Econometrics.

Material results

Material demand results are shown in Table 5-14. As in previous sector scenarios, the impacts on material demand are small due to rebounds in consumer spending on other goods and services as a result of additional incomes or savings generated from collaborative activities. The savings on materials only occur when we assumed that these additional incomes are not spent.

Table 5-14 Consumer durables scenarios EU28 material demand (DMI) in 2030, % difference from baseline

EU28 Material demand (DMI) in 2030, percentage difference from baseline			
Material	**Combined moderate scenario**	**Combined ambitious scenario**	**Combined moderate scenario with rebound**
1 Food	0.02	0.06	-0.05
2 Feed	0.01	0.05	-0.05
3 Forestry	-0.02	-0.03	-0.10
4 Construction Minerals	0.02	0.05	-0.03
5 Industrial Minerals	0.01	0.05	-0.03
6 Ferrous metals	0.01	-0.02	-0.05
7 Non-ferrous metals	0.00	-0.03	-0.06

Source(s): E3ME, Cambridge Econometrics.

5.7 Summary - impacts of the collaborative economy towards 2030

In this section we show that the future environmental impacts of the collaborative economy are in general quite small. The scale of effects is partly because the scenarios deal with isolated sectors of the economy and relatively low rates of collaborative activity, but also reflect rebounds in energy and environmental demand associated with the income and savings generated from collaborative activities. By using a complete modelling framework such as E3ME, we are able to capture direct, indirect and rebound interactions between the economy, energy system and the environment. There is a clear trade-off between economic activities and environmental impacts. The results from this activity provide a useful comparison to the life-cycle analysis that yield positive environmental impacts of a collaborative activity at a product level.

In the sensitivity runs where we relaxed assumption of rebounds effects, the modelling results show greater benefits to the environment from collaborative economy. However, it is unrealistic to assume that any additional household income generated from P2P would all be saved rather than spent. In reality, households are likely to save some and spend the rest, suggesting that the true impacts could lie somewhere between our results from the different scenarios.

The potential to reduce energy and emissions is largest in the transport case, where car and ride sharing would lead to reduction in the number of cars and the distance travelled. In our analysis, we were conservative on efficient engine and electric car assumption. If instead we assume higher share of electric cars, then further environmental benefits could be expected.

It should be noted that our scenario assumptions reflect the potential of collaborative activities based on the current situation. Even in the ambitious cases, share of collaborative activities of a sector is still less than 10%. These potentials may be larger in the future, but our findings would still be applicable, albeit at greater magnitudes, as we expected the same interactions within economy and between economy, energy and environment.

In summary, although the impacts shown in our analysis are quite small, they could be expected to grow in future if the collaborative economy takes off across a wider range of sectors. The ultimate impacts appear to be highly dependent on the scale of any rebound effect and how households spend any extra income or savings from sharing products.

6 Conclusions and policy implications

6.1 General conclusions

6.1.1 Collaborative economy definition is a "moving target"

The literature review conducted as part of this study showed that there is no single definition of what collaborative economy actually means. Different studies define it by using contrasting terminology, for example, sharing economy, gig economy, etc. or the same term is used but the scope of platforms included in the definition varies. The European Commission adopted its own definition of collaborative economy, which we fall back to, however, even this definition is open for interpretation. Despite having a strong working definition and inclusion criteria in this study, challenges remain to define and scope the collaborative economy precisely. It is however not relevant for the purpose of this study to develop the definition further as the collaborative economy and the 'traditional economy' will continue to evolve. With this evolution, the impacts of the collaborative and traditional economies will continue to develop along with it.

6.1.2 The future trend shows a potential for convergence of collaborative and traditional business models

Moreover, the collaborative economy and the traditional sectors can become so interrelated that they actually merge into a 'new normal'. This is already visible today as several collaborative economy platforms already have many professionalised providers, and vice-versa. This is resulting in traditional sectors becoming more and more digitalised and 'collaborative'. This has an impact on how we analyse and regulate the sector, as a clear separation between the collaborative (less regulated) and traditional (more regulated) economy will no longer be there. Due to this converging trend, it could be more advantageous for future studies to analyse (environmental) impacts of all types of business models (collaborative and traditional) on a sector level, instead of studying the impacts of collaborative platforms in isolation.

6.1.3 Collaborative business models often have positive environmental impacts at transaction level

From our LCA analysis we find that if we compare collaborative economy transactions directly with their traditional alternatives (staying a night in Airbnb vs. staying at a hotel, or driving a kilometre in a shared car versus your own car, etc.), without further considering indirect or rebound effects of the transaction, the collaborative alternative generally creates less environmental impact than the traditional alternative. However, substantial differences between different business models exist and the magnitude of the environmental impact depends very strongly on the 'traditional economy' alternative that the transaction is compared to. The generally positive environmental impact stems from increasing the utilisation rate of the physical assets and the generally more modern (energy and resource efficient) assets used. The potential to reduce energy use and emissions is the largest in the transport sector, where car and ride-sharing would lead to reduction in the number of cars on the road and also the total distance travelled. For example, ride-sharing trips can reduce the environmental impact of travelling by car by half if the passenger had taken his or her own car for the same trip.

6.1.4 There is a trade off between environmental and socio-economic impacts

It should be noted though, that while this immediate impact of collaborative economy at the transaction level is largely positive for the environment, the economic and employment impacts of the collaborative economy are negative. Consumers potentially save money by engaging in collaborative transactions with other consumers, resulting in the same level of welfare for consumers for less money.[36] Satisfying demand with an existing physical asset instead of buying a new one reduces demand for new products, lowering economic growth and consequently employment. The macro-economic modelling results (see section 5 of this report) confirm this finding: the 'no rebound' scenarios show that the overall impact on GDP and employment is negative for all considered collaborative business models, while the environmental impacts are positive.

6.1.5 Rebound effects can potentially cancel out positive environmental impacts

The immediate effects described above however do not tell the full story. As the collaborative economy leads to cost savings for the same volume of demand, consumers save money overall, which can either be spent or saved. Although some consumers might engage in collaborative transactions driven by environmental or social motives, most users seem to do so because of the economic benefits that collaborative transactions offer (Bucher E. et al. 2016). This means that in general, consumers will spend the money saved through collaborative transactions on purchasing of more goods and services, either on more goods and services in the same sector (e.g. money saved by AirBnB is spent on making more holidays) or in other sectors. This additional demand created causes further environmental, social and economic impacts, which are called the 'rebound effects' of the collaborative economy. One of the important findings from this study is that the rebound effect can potentially cancel out positive environmental or even lead to net negative overall environmental impacts, as can be seen in the results of the accommodation sector ambitious scenario. At the same time, this rebound effect creates additional demand for goods and services, therefore stimulating economic growth and employment.

Another important aspect to note is that the environmental impact of the rebound effect depends strongly on how the saved consumer income is spent, as some expenditure categories lead to much higher environmental impacts than others. In the macroeconomic modelling task of this study we assumed that the income saved is spent on all household expenditure categories in equal shares according to a standard spending pattern, because of a lack of empirical data on how users of collaborative platforms spend their saved money. However, this assumption might not hold in reality as people tend to spend their additional income on more luxury goods such as travelling or consumer electronics rather than on basic needs, such as food or maintenance costs. As an example, one could intuitively expect that cheaper accommodation will probably primarily lead to more travelling and perhaps to a lesser extent to more spending on other goods and services. Furthermore, the spending patterns will differ between different income groups and Member States.

[36] However, this is not always the case, since for profit platforms use dynamic price-setting mechanisms which adapt prices to demand and supply in local markets.

6.1.6 Overall economic and environmental impacts are quite limited

Overall, the results of this study indicate that the economic and environmental impacts of the collaborative economy in 2030 are in general quite small. The limited scale of effects is primarily explained by the fact that the scenarios deal with isolated sectors of the economy and relatively low rates of collaborative activity. In the combined ambitious scenario (assuming around 10% of market share for collaborative economy in the three sectors) with rebound effects, the GDP is expected to increase by around €4.7 billion (or 0.02%) compared to the baseline, which is a small net impact but still positive. The net employment is expected to increase by around 16,000 jobs (which is almost no different from the baseline). By using a complete modelling framework such as E3ME, we were able to capture direct, indirect and rebound interactions between the economy, energy system and the environment. Although the impacts shown in our analysis are quite small, they could potentially grow in future if the collaborative economy takes off across a wider range of sectors. The market shares may be larger in the future, however, the study findings would still be applicable, albeit at greater magnitudes, as the same interactions within economy and between economy, energy and environment are expected.

6.2 Environmental impacts at a sector and business model level

This section concludes on the assessment of environmental impacts in each of the analysed sectors. The business model analysis has shown that different types of business models (e.g. renting, sharing, lending, swapping, etc) are likely to have different environmental implications. In addition, within each sector there are large differences with regard to environmental implications based on the specific market niche (e.g. luxury versus budget accommodation). Thus, apart from the development of the collaborative economy as a whole, or that of a particular sector, it is the mix of business models and the relative success of these models which is likely to have the biggest impact on the environment. Such developments are demand driven, they will vary by country and across different socio-demographics, making future projections difficult.

Before going into more detail on the environmental impacts per business model it is important to note that very little data is available on the environmental impact of collaborative economy transactions. For the 'traditional economy' data are available for specific cases, but upscaling these data to European level is not always straightforward (e.g. for accommodation). Because of this lack of data, assumptions had to be made to compare the environmental impact of collaborative economy transactions with their traditional economy counterparts. Therefore, the results give an insightful illustration of how collaborative business models affect environmental impacts, but the magnitude of the effects should be handled with care.

6.2.1 Accommodation

Currently, a stay in a collaborative economy accommodation has in general a lower environmental impact than a stay in at a luxury or even a midscale hotel. The impact of a budget hotel is close to that of the average collaborative economy accommodation. However, if staying at a collaborative economy accommodation implies that a more luxury type of accommodation becomes available with the same budget, the environmental impact per transaction may increase.

When it comes to future environmental impacts of the collaborative economy in the accommodation sector, we see that the rebound effect leads to an overall negative environmental impact in the accommodation sector. This is primarily caused by increased transport use from investing saved money into more trips. It is interesting that this result already appeared when the saved income was spread equally over all expenditure categories. This means that if a higher share of the saved money would have been allocated to expenditures on travelling, which is likely when tourist accommodation becomes cheaper, the rebound effect would probably have been even larger.

6.2.2 Transport

In the transport sector, collaborative economy business models can help to reduce the impact of car transport by increasing the occupancy rate of the car or accelerating the uptake of newer, more fuel-efficient cars. In other words, collaborative car use is better for the environment than personal car use (when travelling an equal distance by car), but the best transport options from an environmental viewpoint are still walking, cycling or using public transport. This means that the kind of transport mode that the collaborative economy business model is compared to has a major impact on the net positive or negative environmental impact. Ride-sharing is the only business model that leads to an overall reduction of the environmental impacts on a person-km level compared to the traditional transport mix, as by increasing the occupancy rate of the car, all impacts (such as fuel consumption and emissions) are reduced accordingly. The other collaborative economy business models have a more limited effect, since it is more difficult to accomplish the same by improving the (per km) performance of the cars.

The macroeconomic modelling exercise shows reduced CO_2 emissions due to collaborative business models in the transport sector for all scenarios. In the ambitious case, CO_2 emissions are reduced with approximately 7 Mtons, which is equivalent to a bit more than 3% of the total emissions from the entire transport sector in 2030. This is almost solely caused by reduced energy consumption in the use phase (reduced fuel use). It should be noted though, that these results rely primarily on the optimistic assumptions on the penetration of carsharing and the assumption that carsharing reduces the overall number of pkms travelled by car. If the latter assumption holds when carsharing is adopted by a large share of car users remains to be seen. The results do not indicate a significant reduction in the use of natural resources, but this might be due to the rebound effect.

6.2.3 Consumer durables

The sharing of durable goods is not per se a more environmentally friendly option for all consumer goods. For goods that consume energy during use, collaborative business models have a higher potential for reducing the environmental impact than goods that typically have no energy consumption. An important parameter that determines the environmental impact reduction potential is the transport (distance and transport mode) for picking up the goods at the sharing point. As opposed to the transport and accommodation sectors, reduced environmental impacts in the consumer durables sectors originate from reduced impact in the production phase, not the use phase.

The consumer durables sector is the only sector for which both the ambitious scenario without rebound as well as the scenario with rebound show a reduction in GDP, as people buy less products and services which also results in a reduction in the overall environmental impact in both scenarios. This can be explained by the fact that the sharing of consumer durables affects many expenditure categories simultaneously and also by the ambitious assumptions regarding the number of good sharing users.

6.3 Policy implications

This section explores the conditions under which the collaborative economy could lead to more sustainable collaborative economy. The collaborative economy has the potential to bring about positive environmental and social impacts, but there is no guarantee that these positive impacts will happen automatically. On the contrary, recent developments in the collaborative economy seem to shift sustainability paradigms to paradigms of economic opportunity (Martin, C. J., 2016). Therefore, in order to ensure that the collaborative economy aids the development of more sustainable consumption patterns, policy guidance is essential. The collaborative economy is not a natural phenomenon that we can only undergo, it is something that can be shaped through policies. From this study we distilled a set of general and specific policy implications that are outlined below.

6.3.1 General policy implications

The collaborative economy should not be addressed by policies in isolation, but should be included in policies that address the sustainability of an entire sector the specific platforms operate in, thereby affecting both collaborative and 'traditional' businesses.

Already today, the boundaries between the collaborative economy and the 'traditional' economy are very blurry. Collaborative platforms are becoming more and more professionalised, while the traditional service providers are trying to diversify their service portfolios to include more digital and user-friendly services, as well as more 'experience' sharing. This is in particular visible in the accommodation and transport sectors. For example, many smaller business suppliers sell their services through so-called collaborative platforms, and private suppliers are also offering their services on platforms such as booking.com. The same hybridisation occurs in taxi markets as professional taxi drivers register and use the Uber app in addition to other dispatching services. Moreover, in the transport sector, the regulatory environment is requiring more and more professionalisation from for example Uber, while taxi services and car-renting services are going more and more into the direction of using a digital platform to manage their services. In the future, the collaborative economy and the traditional sectors could become so interrelated that they actually merge into a 'new normal'. Therefore, it might be more useful to analyse and target policy action at sectoral level, in order to include all types of business models to be addressed by policies in a fair and equal manner.

The lack of data on collaborative activities, in particular on EU level, prevents a proper analysis of the environmental and other impacts. Further measures should be taken to increase data collection on such businesses and their activities at Member State and European levels.

This study is a clear example of the extent of data gaps on environmental impacts of the collaborative economy, but also on socio-economic impacts, in particular for the EU. Currently, there is no systematic data collection on activities of these platforms, nor on the activities of the service providers using these platforms. This comes with no surprise, as the platforms have seen their prolific rise only in the last one-two years. In addition, they fall between the private and professional economy and have not yet been as fully regulated as other traditional businesses, and as such do not have established reporting requirements. Moreover, collecting information on for example non-profit platforms might not be justified as they directly do not contribute to economic activities generating profits and revenues. This has led to this study, and other studies in this field, relying on anecdotal evidence, self-reported evidence by platforms, or assumptions. There would be a large role for the Eurostat, as an EU level body, to collect such data but also to include processes to ensure comparability between the data across Member States. However, since the sector is very dynamic and fast moving, the processes set up to collect such data also needs to respond to these characteristics. There is a potential to collect data from consumer or platform surveys, however, from our experience, there needs to be a legal basis for such data collection in order to have a high response rate and reliable statistics.

Further research needs on studying indirect and rebound effects to understand consumer and service provider behaviour.

Due to lack of empirical evidence, the study had to rely on a number of important assumptions, one of them being the way service providers spend their revenue generated on the platforms. In order to be able to guide the collaborative consumption towards the best environmental outcome it is important to improve our understanding on a number of collaborative consumption aspects:

- Factors that influence consumers in choosing between a collaborative economy transaction or a traditional one.
- The exact products and services that are replaced by the collaborative economy. For example, what kind of accommodation would a traveller choose if an entire apartment on Airbnb would not have been available? Would they have chosen a smaller hotel room or B&B or would they have spent more to achieve a similar level of comfort? Are taxi services actually replaced by platforms such as Uber?
- The rebound effect. How do people spend their saved money? On which kind of products and services do they spend most of their money and how does this differ between different income groups? How do the service providers spend their generated revenue?
- The willingness of consumers to share their underutilised assets. How can we improve this willingness?
- The social impacts of the use of collaborative economy platforms on social cohesion in neighbourhoods and income inequality.

The main link with the EU Circular Economy and resource efficiency policy is the fact that collaborative economy increases the utilisation of assets under certain conditions, which potentially leads to less goods being produced and lower energy consumption.

The analysis in this study showed that not all aspects of collaborative activities lead to positive environmental impacts. Rather, there are sector specific conditions under which the environmental impact can be positive. In overall, the main condition across the three sectors is the increased utilisation of an asset, be it a home, car or consumer durable. This increased utilisation contributes to the optimisation of the good during its lifetime. This may decrease the production of that good, and as such lead to resource efficiency gains by requiring less resources. However, there are indirect and rebound effects which might counter balance the positive impact of this increased utilisation. Another important environmental aspect which came out of the analysis is the energy use. In particular collaborative transport offers opportunities for energy savings.

The next section on sector specific policy implications outlines the conditions under which collaborative economy fosters more sustainability, and the measures which could be taken.

6.3.2 Sector-specific policy implications

Transport

In collaborative transport, the environmental impact of lower car production is much less important than the impact of lower fuel use in the use phase.

Unlike what is generally pointed out in the existing literature that the main environmental benefit of collaborative transport is coming from decreased need for the production of new cars, our study finds out that it is the lower energy consumption during use phase which makes the significant difference. In particular, car-sharing and ride-sharing contribute to this environmental benefit as less person-kilometres and less kilometres are driven by cars.

Stimulate car-sharing and ride-sharing to reduce the environmental impacts of car travelling

Compared to travelling in a personal passenger car, car-sharing and ride-sharing have reduced the environmental impacts, by reducing the person-kilometres driven by car and total distance travelled by cars, respectively. Hence, if car-sharing or ride-sharing replace trips travelled in an own car, these business models provide environmental benefits. Car sharing can be promoted by for example prioritising shared cars for access to parking spaces in areas where parking space is limited, e.g. through the creation of shared-cars-only parking lots; or by creating more car-pooling lanes (this applies to promoting sustainable transport in general). The main condition under which these business models create positive environmental impacts is the increased occupancy rate of a car, which as a result decreases the number of person-kilometres driven and total distance travelled by cars.

Stimulation of car-sharing and ride-sharing should be combined with better connections and access to public transport options, and facilitation of walking and cycling.

The potential of car-sharing and ride-sharing to reduce the distance that people travel by car overall will only be fulfilled if stimulation of these business models is combined with better connections to other transport modes. A highly flexible multimodal system makes it easier for people to switch from their (shared) cars to other transport modes during a trip. Measures that can help car-sharing and ride-sharing users to reduce their overall car travelling include:

- The provision of cheap (or free) parking spaces for shared cars near train stations and other public transport hubs. In this way, car-sharing can really serve to travel 'the last mile' or travelling to remote areas.
- The provision of a dense public transport network, with frequent services and affordable prices.
- Stimulation of cycling through construction of safe and fast bicycle lanes and high availability of shared bikes throughout cities.

Limit the negative environmental rebound effects of car-sharing through discouragement of car use in general and by promoting cleaner types of car use.

The largest negative environmental impact from collaborative business models in the transport sector is the risk of increased travelling by car because of reduced costs for car use. Mitigation of such risks synergize well with an overall promotion of less and cleaner car use. As the environmental impacts of car use occur primarily in the use phase, it makes sense to implement taxation schemes that tax car use per kilometre driven, or even better, in function of the emissions generated. Such a measure will reduce the overall attractiveness of car use, but will simultaneously encourage ride-sharing as this will reduce the costs per kilometre travelled. Additional measures to minimise the overall negative impact of both private and shared cars include:

- Discouragement of car use in city centres through the creation of car free zones/pedestrian zones and by limiting access for cars
- Stimulation of using clean cars in cities, either through financial incentives or by limiting access to highly pollutive cars.

Accommodation

Restrict the type of listings offered on collaborative platforms to properties where the host has main residence.

Airbnb started off with sharing air mattresses and rooms in someone's apartment. It has since evolved into renting out entire properties of hosts who were travelling or hosts with secondary homes which were empty most of the time of the year, to hosts and investors buying properties for the purpose of renting them out on Airbnb. According to current data, only 1% of Airbnb listings from 12 large European cities concerns a shared room, around 30% renting out a private room and close to 70% renting out entire homes and apartments (Insideairbnb.com, 2017). Approximately 40% of providers on Airbnb have multiple listings, hence there is a large % of providers who are businesses. One of the main factors that determine the environmental impact of collaborative accommodation is the occupancy rate of the property. The LCA analysis showed that a 100% occupancy rate has a lower environmental impact per person-night than a 30% occupancy rate on all environmental impact categories. The more properties listed on collaborative platforms which come closer to this 100% occupancy rate, result in better environmental impacts these properties will have in general. This could be achieved by promoting renting out properties only when the resident is not there, or when the resident is there but has an empty room. It might be the case that a 100% occupancy rate is achieved also by renting out renting out entire homes even if this is not the main residence of the host, in particular in very touristic areas or seasons. In this case, a policy would need to distinguish between those residences that are frequently rented out (and hence close to the 100% occupancy rate) from those that are not, rather than targeting renting out entire homes in a fair and equal manner.

Limit the maximum amount of days for which a property can be rented out via collaborative Platforms.

By restricting the maximum number of days for which a property can be rented out via the collaborative economy, this would also discourage property renters who buy a property only to rent it out, and encourage only those who also reside in the property to increase the occupancy rate of their residence. This will ensure that properties are not bought to solely rent out for business/ economic gains, which is not fully in line with the environmental benefit of increasing the utilisation rate (= occupancy rate) of the property. Besides limiting negative environmental outcomes, such a limitation also prevents:

- Unfair competition with regular short- and long-term room and apartment rentals and ‘traditional’ holiday accommodation businesses.
- Aggravation of scarcity of affordable housing in cities that are popular tourist destinations.

The environmental impact of the collaborative accommodation is also lower if the building and residence itself have better energy efficiency and use more sustainable materials.

The LCA analysis has shown that the type of building and its lifetime also has an environmental impact on some of the environmental impact categories, for example, ozone depletion. Electricity and heating were among key factors contributing to the environmental impacts across a number of impact categories. Moreover, the electricity use is the most important factor distinguishing a traditional tourist accommodation from P2P rented property, assuming the electricity use in the latter is similar as in a private residence. The policy should target these factors in a more general way, i.e. applied to the entire sector rather than distinguishing collaborative accommodation from other tourist rented properties. This is already being done as part of the sustainable buildings policy and energy efficiency in buildings policy.

Prevent potential negative environmental rebounds due to increased travelling through promotion of cleaner ways of travelling.

As for all collaborative business models, the largest environmental impact in the accommodation sector comes from rebound effects as income generated or saved through selling/ renting on the platforms is spent elsewhere and not saved. Although empirical evidence is still lacking, it is not unrealistic to assume that a large share of money saved through collaborative accommodation will be spent on more travelling. In the accommodation sector, literature points to this evidence. As transport to and from the holiday location comprises a large share of the total environmental impact of holiday travelling (especially when travelling by airplane) it is important that the negative environmental impacts of travelling are minimised, as they are indirectly linked to tourist accommodation. This can be done through stimulation of cleaner transport modes and through proper taxation of pollutive transport modes. Aviation deserves particular attention in this respect, as the person-kilometres travelled by airplane are increasing at an alarming rate and decarbonisation of this sector is challenging.

Goods sharing

Promote shareability of goods by implementing design requirements that increase the durability and shareability of consumer durables.

The sharing of consumer durables can reduce the environmental impacts resulting from the production of such goods. However, this only holds if sharing does not decrease the lifetime of products to such an extent that the environmental benefits are cancelled out. Therefore, extending the lifetime of consumer durables would contribute to environmental benefits of good sharing.

Promotion of clean transport modes improves the environmental potential of good sharing.

The results from our Lifecycle Assessment show that the logistics behind the good sharing transaction are the most important determinant of the environmental impact. Therefore, promotion of transport modes with less environmental impacts can contribute to the environmental gains made through sharing of goods.

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