CO_2 reductions in the transport sector in the EU28

The need for renewable fuels to achieve 2030-targets

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Key Findings

In this analysis we have explored the energy use development in the transport sector in the EU28 and the emission reductions pathways towards 2030. Based on our calculations and the literature sources used we have found the following:

- To achieve the 2030 CO2 emission reduction targets that are in line with the Effort Sharing Regulation (ESR)[1], fossil energy use will have to be capped to 9,023 PJ[2].
  To put this in context: the fossil energy consumption in transport in 2017 amounted to 12,674 PJ.
- Under a scenario of existing and adopted policies, the total energy consumption in intra-EU transport would rise to 14,235 PJ by 2030. Achieving the 14% RED-II target for renewables in transport (equaling to 1,993 PJ of renewable energy deployment) is not enough to get below the maximum of 9,023 PJ of fossil energy use aimed by the ESR. With 14% renewable energy, fossil energy use would still be of 12,242 PJ[3], resulting in higher than allowed CO_2 emissions. A fossil energy use of 12,242 PJ will result in 918 Mtonne CO_2 emissions, 241 Mtonne more than the ESR cap.
- Thus, in order to achieve the 2030 CO2 targets in line with the ESR, fossil energy consumption should decrease with an additional amount of 3,219 PJ. This can be done through various measures:
- Accelerating the market deployment of electric mobility. With a market share of 23% of EV's in passenger cars in 2030 (see section Assumptions at end of document), 538 PJ of electricity will be used in electric mobility, thereby replacing fossil fuel. In addition to that, 807 PJ of fossil fuel would be avoided due to higher energy efficiency. In this analysis it is assumed that all electricity in vehicles will come from renewable resources.
- Energy efficiency improvements will result in approximately 100 PJ of avoided fossil energy use. Measures are e.g. lower speed limits at highways and optimization of (urban) distribution logistics of goods.
- Increased use of public transport. A modal shift effort to give preference to public transport and cycling may result in 450 PJ of electricity used in rail public transport.
- Introduction of renewable fuels: in addition to these three measures, a further replacement of 1,323 PJ of fossil fuels by renewable fuels is needed to achieve CO_2-emission levels in line with the ESR 2030 targets. Therefore, to achieve the 2030 targets, a total of 3,316 PJ (1,993 PJ already planned and 1,323 PJ extra required) of renewable fuels will need to be deployed.

[1] https://ec.europa.eu/clima/policies/effort/regulation_en

[2] The ESR states a 30% cut in emissions by 2030 compared to 2005 levels (966,8 Mtonne CO_2). That means that emissions will be capped at 677 Mtonne CO_2 which is equivalent to a maximum of 9,023 PJ of fossil energy use.

[3] 14,235 PJ final energy consumption - 1,993 PJ renewable energy.

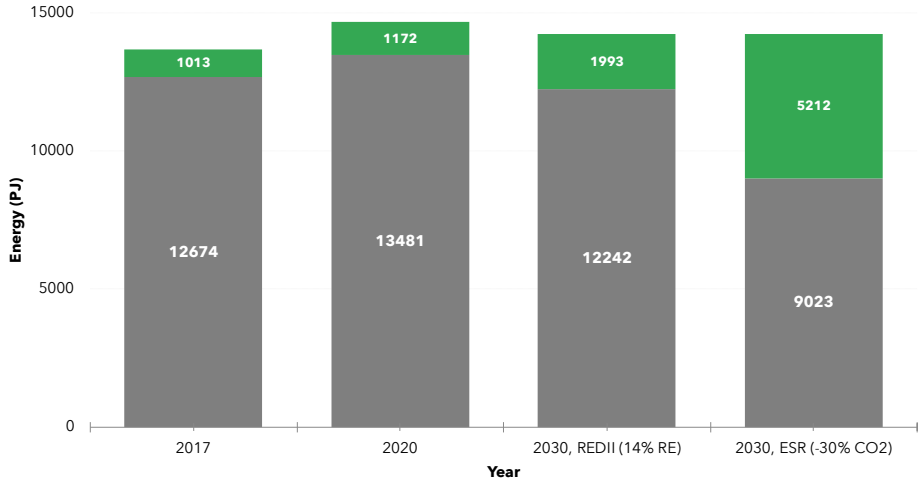

Figure 1 Share of fossil and renewable energy for the years 2017, 2020 and the expected share of renewable energy in 2030 with a 14% share of renewables under the RED II and for 2030 for the achievement of the ESR of a 30% reduction in CO_2 from 2005 levels.

Reader's guide

This analysis will explore the development of the energy use in the transport sector in the EU 28. It will start by showing the current levels of energy consumption and how they compare with the energy and CO_2 reduction targets for 2030.

The first section looks at the energy consumption levels in the transport sector in the EU-28 from 1990 and compares it with the EU emissions' reductions targets.

The second section focuses on the energy use development in the EU. It looks at the energy consumption levels in 2017, 2020 and 2030 and the shares of renewable energy in each year. The aim of this section is to show how energy consumption is predicted to developed and then put these values in perspective with the 2030 targets.

The third section identifies the reductions in energy consumption that are needed in order to achieve the 2030 targets. Specifically, it is shown that a total of 3,219 PJ of fossil energy will have to be reduced to stay within the maximum CO_2 emissions allowed.

The fourth section ends up showing how the targets can be achieved. It looks into four measures (electric mobility, sustainable logistics, a modal shift in personal mobility and renewable energy carriers). It concludes that all four measures are necessary to stay below the 9,023 PJ limit of fossil energy use. It is argued that even when the volumes of renewable fuels for 2030 would conform with the RED-II targets, the actual deployment of renewable fuels will need to be nearly doubled to achieve CO_2 -emission levels that are in line with the Effort Sharing Directive for 2030.

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1 Energy use targets

As part of the efforts to curb the effects from climate change, the EU Commission set binding emission reductions targets. EU leaders agreed to an economy-wide emissions' reductions target of 40% by 2030, compared to 1990 levels.[4]

As part of the Effort Sharing Regulation (ESR), sectors not covered by the EU-ETS must reduce emissions by 30% by 2030, compared to the levels in 2005[5]. That includes the transport sector. Other sectors regulated by the ESR are agriculture, built environment, waste management and industrial activities not covered by the EU-ETS system. As shown in Figure 2, the emission level in intra-EU transport in 2005 was of 967 Mtonne CO_2. By 2030, the CO_2 emission levels should be down by 30%, which equals a maximum of 677 Mtonne CO_2 or 9,023 PJ of fossil energy.[6]

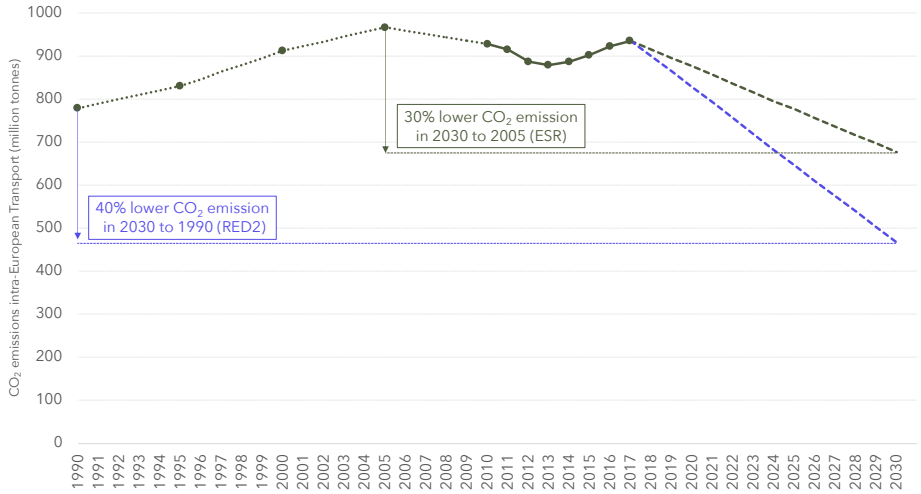

Figure 2 CO_2 emissions development showing the targets for 2030 with a 30% emissions reduction under the ESR and a 40% reduction from 1990 levels

For 2050, the European Commission has set a target of at least 80% greenhouse gas reductions compared to 1990 levels. In 1990, the total intra EU emissions of the transport sector were of 779 Mtonne. This means that CO_2 emissions will be limited to 156 Mtonne CO_2, which equals a maximum of 2,076 PJ of fossil fuels[7]. If a more ambitious target of 95% reductions compared to 1990 levels is set for 2050, CO_2 emissions will be limited to a maximum of 39 Mtonne CO_2 or 519 PJ of fossil fuels.

In the graph below, the development of energy consumption from 1990 to 2017 is shown, together with the predictions for 2020.

The two bars on the right present the resulting maximum volumes of fossil fuels under the overall 40% reduction target and the 30% reduction target (Effort Sharing Regulation, the non-EU ETS sectors).

In the EU energy consumption data used in this analysis, intra-European aviation was included as part of the transport sector. Therefore, the total energy consumption in transport

[4] https://ec.europa.eu/clima/policies/strategies/2030_en
[5] https://ec.europa.eu/clima/policies/effort/regulation_en
[6] Assuming an equal reduction of 30% in all ESR-regulated sectors. In reality differences may be expected but transport and built environment are the sectors in ESR with the largest absolute CO_2-emissions and hence need to provide most reductions.
[7] Based on 75 gCO_2-eq/MJ tank-to-wheel emissions.

(including intra-EU aviation) will be analysed for compliance with the targets of the non EU-ETS sector (30% reductions compared to 2005).

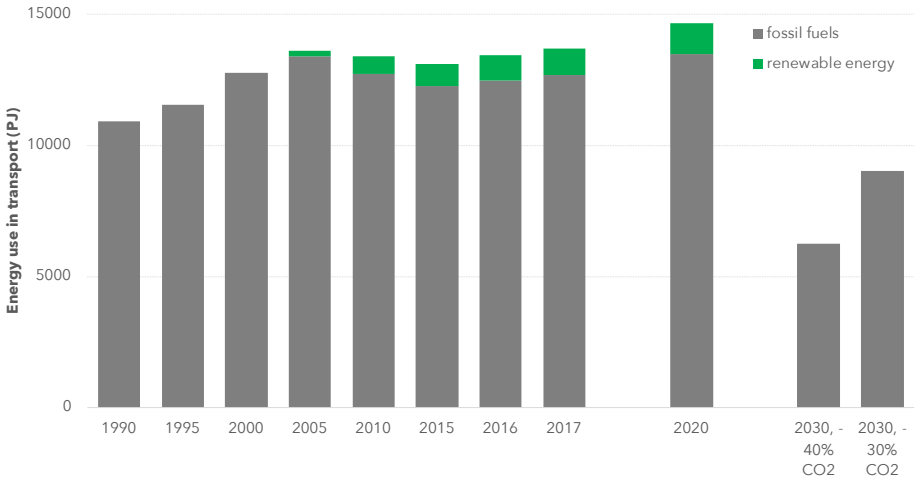

Figure 3 Development of energy consumption from 1990 to 2017, predictions for 2020 as well as the maximum volume for fossil in 2030 under overall 40% CO_2-reduction target (from 1900 levels) and 30% CO_2 reduction Effort Sharing Regulation target

2 Energy use development

In 2017, energy consumption in the transport sector in the EU-28 amounted to 13,687 PJ. From these, 1,013 PJ were from renewable energy. 12,674 PJ came from fossil fuels.

In 2020, 1,172 PJ of renewable energy are expected to be used in transport, from a total of 14,653 PJ of expected final energy use in transport.

It is expected that by 2030, the total energy consumption from the transport sector will be of 14,235 PJ (340 Mtoe), from which 1,993 PJ will be renewable energy (based on the 14% target in RED-II).

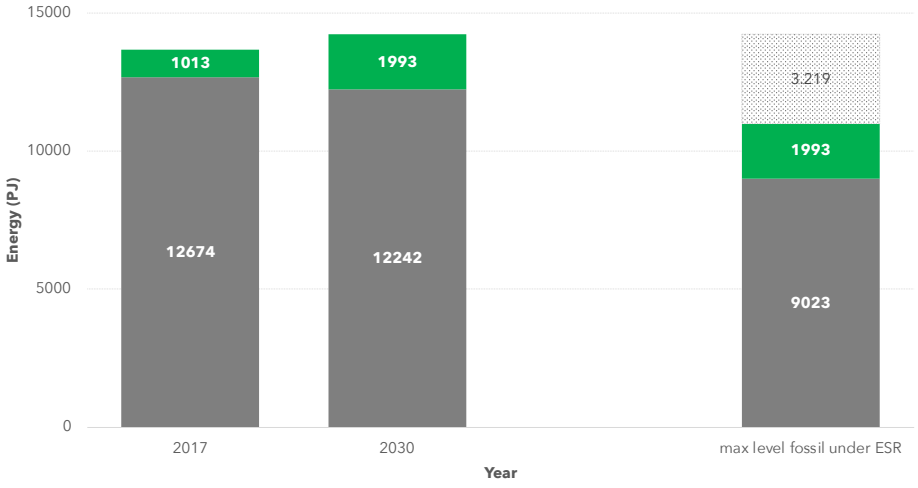

Figure 4 Energy use development for 2017, 2020 and 2030

The goal is to achieve a 30% reduction in CO_2 emissions from 2005 levels. That limits emissions to a maximum of 677 Mtonne CO_2 by 2030. This translates into a maximum of 9,023 PJ of fossil fuels that can be used in the transport sector.

To comply with this number, fossil energy use will have to be reduced.

2.1 Target achievement

Given the expected energy consumption levels and the expected renewable energy used in 2030, there will have to be an extra reduction in fossil energy use of 3,219 PJ to remain within the maximum of 9,023 PJ of fossil energy use.

This will have to be achieved through a combination of energy efficiency improvements and renewable energy.

The total of 3,219 PJ of energy that needs to be reduced is equivalent to around a fifth of the total final energy consumption expected in 2030.

2.2 Emission reduction measures

There are several ways to reduce CO_2-emissions in transport. In the analyses in this report we have not included the option of less mobility or avoided mobility, while this might be an option to further elaborate on. As a result the following options to lower the amount of energy, and hence fossil energy are identified:

1. Electric mobility
2. Energy efficiency
3. Modal shift in personal mobility
4. Renewable energy carriers

Electric mobility

It is assumed here that the total EU passenger car fleet will remain up to 2030 at 260 million cars in 2030. According to a forecast by the International Energy Agency[8], the market share of EVs in Europe would be around 23% in 2030. Therefore, the number of EVs in 2030 would be around 60 million cars. That amount of passenger cars results in 538 PJ energy consumption in electric mobility in 2030[9] (see the blue section in the bar at the right of Figure 5). Due to the higher energy efficiency, another 807 PJ of fossil fuel is avoided by the use of electric vehicles (see the white section in the bar at the right of Figure 5).

Energy efficiency

Improvements in energy efficiency and logistics optimization (e.g. speed reduction, optimized city distribution logistics etc.) are estimated to avoid another 100 PJ of fossil fuel use (see Figure 5).

Modal shift in personal mobility

Various options exist to shift mobility to less energy intense modes. In cities people can be promoted to use public transport or car or bike sharing services. City design can impact citizens to choose walking to nearby services. It is also assumed that the total railway utilization in transport could be intensified. As a result it has been estimated that 450 PJ will result from increased use of rail public transport and other modal shift options (see Figure 5).

[8] See http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637895/EPRS_BRI(2019)637895_EN.pdf

[9] Based on EV's energy consumption of 6 km/kWh (6km/ 3.6 MJ) and annual milage of 15,000 km in a year.

Renewable fuels

On top of the other To fully achieve the 3,219 PJ fossil avoidance, an additional amount of 1,323 PJ of renewable fuels is needed to achieve the 2030 targets (see the top green section in Figure 5).

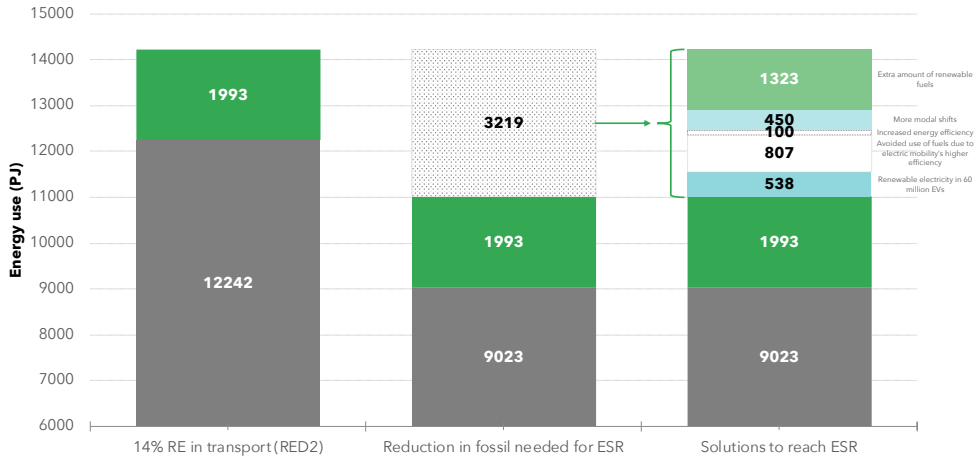

Figure 5 Emission reduction options to achieve ESR in 2030.

By re-ranking the options for replacing the 3,219 PJ of fossil fuels, it can be seen that a wide mix of options is needed to achieve the CO_2 emissions reductions target set under the Effort Sharing Regulation of the European Commission.

Total fuel consumption will be lower in 2030, given the efficiency gains from electric mobility (807 PJ) and other measures (100 PJ).

Furthermore, increased numbers of electric vehicles and more rail traffic will give high shares of renewable electricity (538 PJ + 450 PJ).

Next to the envisaged 1,993 PJ of renewable fuels under RED-II, an additional amount of 1,323 PJ of renewable fuels will be necessary to replace fossil. This means that by 2030, a total of 3,316 PJ of renewable fuels should be deployed in the market.

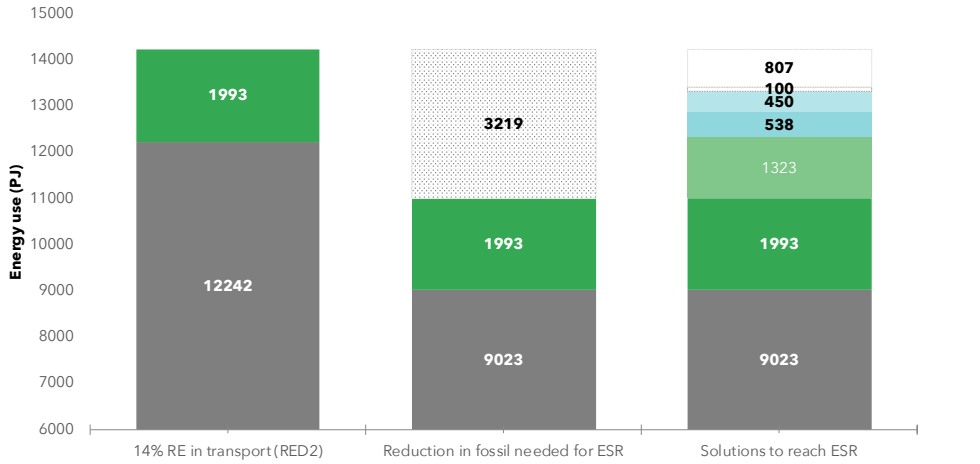

Figure 6 Reranking of emission reduction options

3 Conclusions

The effort sharing regulation (ESR) stipulates that sectors not covered by the EU-ETS must reduce emissions by 30% by 2030 compared to the levels in 2005. That includes the transport sector. To achieve the ESR targets in 2030, CO_2 emissions levels would have to **be capped to 677 Mtonne CO_2 or 9,023 PJ** of fossil energy. To put this in context: the 2017 fossil energy consumption in transport amounted to 12,674 PJ and is predicted to be 12,242 PJ in 2030.

Achieving the RED-II target for renewables in transport (14%, equaling to 1,993 PJ) is not enough to get below the maximum of 9,023 PJ necessary to comply with the ESR. The analysis also looked into the role of electric mobility, energy efficiency improvements and a modal shift in personal mobility in reducing fossil energy use. After accounting for these three measures and with 14% renewable energy, fossil energy use would still be 10,346 PJ, resulting in higher than allowed CO_2 emissions. To achieve the ESR targets, a further reduction of 1,323 PJ of fossil energy use are necessary. Therefore, to achieve the 2030 targets, **a total of 3,316 PJ** (1,993 PJ already planned and 1,323 PJ extra required) of renewable fuels will need to be deployed.

The EU is therefore faced with the challenge of increasing the deployment of renewable fuels in the transport sector. This would require an adequate policy framework that would support and incentivize the production and use of biofuels in the transport sector. Since the transport sector is responsible from most emissions of the non EU-ETS sector, its contribution for decarbonization of the energy system will have a major effect and would facilitate the achievement of the Paris Agreement goals.

Reflective points

A fossil cap makes it possible to keep CO_2 emissions in the transport sector below 677 Mtonne by 2030. It would also facilitate the achievement of climate neutrality for the transport sector in 2050, or possibly earlier. With a cap in place, the market will have to focus on alternatives to fossil energy and thus provide the necessary investments in alternative energy sources.

The limit aimed by the European Commission emphasizes the need for a fossil reduction pathway. It highlights the need to switch to renewable energy carriers and renewable energy mobility services in the upcoming decade. As such, it is a clear signal to fuel and energy suppliers, as well as to other parties in the transport sector, of the need to adapt. It provides an incentive for innovation and encourages investments in climate-neutral options. A fossil limit ensures cooperation and at the same time encourages a healthy competition between all existing market players and new entrants to come up with cost-effective solutions.

A cap on fossil energy ensures that its use cannot grow, and it shifts the market perspective towards a greater focus on other alternative options. These include electrification, increasing efficiency, renewable fuels, public transport, sharing options and avoiding mobility all together. To achieve a decreasing use of fossil energy in the system, an increase in the current deployment of renewable energy will be necessary. Some of the actions that can be taken are:

- Expanding public transport: rail traffic and other public transport should grow by at least 50% compared to 2017. Great amounts of energy consumption can be avoided if there is a switch done between personal car mobility towards the use of train, metro and bus.
- Investing on efficiency improvements.
- Basing all required liquid and gaseous fuels on a larger share of renewable components, to which fossil fuels may be added up to a given maximum. This is to ensure that the CO_2 intensity of the fuel is sufficiently low.
- Making sure that the share of electric vehicles will grow as predicted (60 million vehicles in 2030), which becomes easier if the models meet the functional needs and financial possibilities of most car users.

There is also a need for more stable and long-term policies incentivizing the production and use of renewable fuels so that they can achieve real economies of scale. Policies favoring low or zero carbon fuels should be in place as well as policies putting a cost to carbon. More and better accessibility to fueling facilities will also increase the use of renewable fuels. Public acceptance of renewable fuels also needs to be improved. This requires, among others, a harmonization of sustainability criteria and clarity of its implications. Advanced renewable fuels need special attention because (1) they face less sustainability risks due to the type of feedstock they use and (2) because most of them can be added as drop-in fuels, meaning that they can be easily blended with conventional biofuels.

Annex 1. Data Sources

There are various sources of information used for this report.

1. EU Reference Scenario 2016
2. Statistical Pocketbook 2019: EU Transport in Figures
3. Global EV Outlook 2019 (IEA)
4. Renewable Energy Prospects for the European Union (IRENA, 2018)
5. REmap 2030 (IRENA, 2014)

Values in energy use and the share of renewables up to 2017 were taken from the Statistical Pocketbook 2019. For 2020 and 2030 the energy consumption levels in transport were estimated from Figure 31 of the EU Reference Scenario. For 2020, the target of 10% RE was considered. Assuming double counting, it was estimated that a physical share of 8% of renewables in 2020. For 2030, the share of renewables was set at 14%, consistent with the targets set for the EU.

The Mt of CO_2 emissions that need to be reduced in each period and their equivalents in PJ of fossil energy were calculated based on this data and the targets from the European Commission.

The global EV Outlook provided useful information about the electric car fleet. The EC Reference Scenarios also contained important information regarding the passenger car specific CO_2 emissions and the expected improvements in energy efficiency. With this information, it was possible to calculate the potential reductions in fossil energy use that could be achieved in 2030

Other sources of information were used for consultation. These are included in the references.

Annex 2. Methodology and assumptions

Two targets are set by the European Union. The first one, aiming at a 40% CO_2 reduction from 1990 levels. The second one aiming, part of the Effort Sharing Regulation, aiming at 30% reduction of CO_2 emissions from 2005 levels in the transport sector. The maximum levels of CO_2 emission allowed in both these targets were calculated from the CO_2 emission values for 1990 and 2005 presented in the Pocketbook 2018. These values were then converted to its corresponding value in PJ (6,229 PJ and 9,023 PJ respectively).

To fulfil this project, some assumptions were made:

First, it was assumed that by 2030, public transport use will grow by at least 50% compared to 2017.

Then, to calculate the emissions avoided due to electrification, it was assumed that the EU fleet would remain at 260 million cars in 2030. According to a forecast by the International Energy Agency, the market share of EVs in Europe would be around 23% in 2030. Therefore, the number of EVs in 2030 would be of 59.8 million cars. It was assumed that the EV's energy consumption is of 6 km/kWh (6km/ 3.6 MJ) and that, on average, they cover a distance of 15,000 km in a year. With this information it was possible to calculate the Total EV fleet energy consumption per year (538.2 PJ/y). In addition to that, a multiplier of 1.5 was added to account for the improvements due to energy efficiency, which led to a total of 807 PJ of fossil fuel avoided.

Finally, the aviation sector is part of the EU-ETS and as such it is bound to the 40% reduction target from 1990 levels. However, for purpose of this analysis, it was considered together with the rest of the transport sector (which does not belong to the EU-ETS).

Annex 3. References

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