Guidance note – Reporting of electric and more resource-efficient transport equipment in EPEA and EGSS accounts

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Contents

1. Purpose and overview

The task force on the classification of environmental activities (TF) identified in June 2018 the need to clarify the recording of *"electric and more resource-efficient transport equipment",* an item listed in the indicative compendium of environmental goods and services[1].

This note recalls available guidance from EPEA and EGSS handbooks, summarises reporting practices, and presents recommendations for a consistent and accurate recording of relevant products. The guidance note's key purpose is to support the EGSS compilers in their task of delimiting electric from conventional transport equipment and assigning it to a specific environmental purpose. Apart from that, to facilitate compilation of EPEA data on 'extra costs' of electrified vehicles, the guidance note provides estimates of price premium by type of vehicles. It ends with a section on implementation and a potential future review[2].

The guidance incorporates scientific evidence and practical considerations raised in TF discussions as well as the input from the Working Group on Monetary Environmental Statistics and Accounts (MESA WG), specifically its feedback during the written consultations in 2019 and 2020.

The recommendations in this note were endorsed by the task force on 3 April 2020 and supported by the MESA WG in its 2020 virtual meeting. They should ensure that EPEA and EGSS data meet the needs of users and remain comparable across the EU.

Key recommendations

The primary purpose of transport equipment – understood here as vehicles and essential infrastructure - is not the protection of the environment but the carriage of persons and goods. In the context of monetary-environmental accounts[3,4], ***"electric and more resource efficient transport equipment"*** **represents** ***adapted goods*** that fulfil a non-environmental purpose, albeit in a cleaner and more efficient manner than conventional standard goods.

Given the diversity of *"electric and more resource efficient transport equipment"*, referred to here as *"electric transport equipment"*, TF members raised the question which equipment to include and how to value relevant products. Leaving the decision to countries might lead to divergent recording practices not always justified by country specificities. To harmonise the approach for important products and activities and, consequently, ensure cross-country comparability of EGSS data, this guidance note therefore recommends to:

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[1] Regulation (EU) 2015/2174 (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R2174).
[2] The review might also help to address recurring scope questions on activities and products that do not fall within the existing framework of monetary environmental accounts.
[3]2016 EGSS handbook (https://ec.europa.eu/eurostat/documents/3859598/7700432/KS-GQ-16-008-EN-N.pdf/f4965221-2ef0-4926-b3de-28eb4a5faf47).
[4]2017 EPEA handbook (https://ec.europa.eu/eurostat/documents/3859598/7903714/KS-GQ-17-004-EN-N.pdf/7ea9c74b-eda4-4c23-b7bd-897358bfc990).

- ***include*** the production and export of vehicles listed in Table 2 in the recording of monetary environmental accounts (note that Table 2 explicitly includes fuel-cell vehicles running on hydrogen);
- ***include*** infrastructure that is essential for the operation of electric vehicles (such as electric charging units and stations) and the production of technical components of electric vehicles (such as fuel cells, traction batteries, inverters, electric motors);
- ***examine*** whether vehicles listed in Table 3 replace to a significant degree other motorised transport; if so, include all such vehicles in monetary environmental accounts; if not, exclude these vehicles from the reporting;
- ***exclude*** vehicles without electric-only drive mode (such as conventional cars and mild hybrids; see definition on page 9);
- ***exclude*** conventional vehicles (equipped with an internal combustion engine only) that run on compressed natural gas, liquefied petroleum gas, biodiesel, bioethanol or other combustible fuels from EGSS if these do not classify as plug-in/non-plug-in hybrid vehicles (see Table 2);
- ***record*** in EGSS accounts the production of the entire electric vehicle/equipment and the related exports (at basic prices); where ***information is unavailable, countries could consider reporting: 1) output and exports of electric powertrains and vehicle components*** (***instead of the full vehicle) or 2) the additional costs of electric vehicles relative to standard vehicles***, and explain their approach in the quality report; if production or exports of vehicles are only partially covered, Eurostat should be provided alongside EGSS data submission with information to facilitate estimating full vehicle value for the data publication and calculation of the EU aggregates; corrected country data will be flagged as Eurostat estimate with footnote 's)' and relevant explanation will be provided to users in metadata for Eurobase tables with EGSS figures;
- ***record*** in EPEA the extra cost of electric vehicles/equipment (compared to the market value of conventional vehicles and equipment);
- ***record*** production and export of electric transport equipment under CEPA 1 (see also the draft CEPA 1 description in the revised CEPA and CReMA explanatory notes).

2. Reporting requirements

Regulation (EU) 691/2011 on European environmental economic accounts defines environmental products as goods and services that prevent, reduce or eliminate pollution and any other degradation of the environment or help managing natural resources in a sustainable manner. To delimit environmental goods and services in a uniform manner, Regulation (EC) 2015/2174 establishes an indicative compendium of the most relevant environmental goods, services, and

production activities. The compendium is complemented by an operational list[5] that specifies how environmental products and activities should be classified according to CEPA (Classification of Environmental Protection Activities)[6] and CReMA (Classification of Resource Management Activities)[7] categories.

Both the indicative compendium and the operational list refer to *"electric and more resource-efficient transport equipment"* as an environmental product. The operational list suggests the following product groups are potentially relevant:

- motor vehicles, trailers and semi-trailers; other transport equipment listed under CPA[8] and NACE[9] Codes 29 and 30;
- vehicles other than railway or tramway rolling stock, and parts and accessories thereof; railway or tramway locomotives, rolling stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electromechanical) traffic as included under CN (2016) Codes 86 and 87.

The EGSS and EPEA handbooks emphasise the importance of an environmental purpose to distinguish environmental from non-environmental products. Environmental purpose might be understood as primary or secondary purpose, the latter is relevant for electric transport equipment whose primary purpose is not environmental but transporting people and goods, albeit in a cleaner and more energy efficient manner than done by conventional vehicles. The secondary environmental purpose can be identified through the technical nature of transport equipment and its presumed or actual environmental impacts. The EGSS and EPEA handbooks do not provide specific recommendations on how to evaluate environmental impacts but suggest taking into consideration auxiliary product information such as environmental labels. By this guidance, vehicles could be considered as environmental products, e.g., if they received the highest rating in the European car labelling scheme.

The EGSS and EPEA handbooks further recommend identifying adapted goods through a pairwise comparison of two product alternatives, namely one that is cleaner and more efficient, and another representing the standard technology at the market. Such a comparison disregards, however, that cleaner and more efficient technologies often differ in several features from their conventional counterparts. Electric cars, for example, are more efficient than conventional ones but they also have currently a shorter drive range, require longer re-charging times, and face the inconvenience of

[5]See: https://ec.europa.eu/eurostat/web/environment/methodology.
[6]See: https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=CEPA_2000 &StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC.
[7]See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Classification_of_Resource_Management_Activities_(CReMA)&oldid=471172.
[8]Statistical classification of products by activity in the European economic community, 2008 version. RAMON – Reference and Management of Nomenclatures. Eurostat.
[9]NACE Rev. 2. RAMON – Reference and Management of Nomenclatures. Eurostat.

a patchy re-charging infrastructure. Consumers respond to differences in product attributes by modifying their purchasing behaviour or their patterns of product use. In the transport sector, changes in vehicle attributes can also shift consumer preferences for the available modes of transport. Mode shifts are widespread and frequent in the transport sector and often occur multiple times in a single day (e.g., a commuter may use the tram to reach work but her bicycle or car to join evening sports).

To capture the environmental impacts of electric vehicles, thus requires understanding which vehicles and transport modes they replace in practice. A comparison of product alternatives could then include a wider range of vehicles and transport modes available to consumers. If vehicles are clean and efficient relative to the conventional motor vehicles (with internal combustion engines) they replace, then these clean and efficient vehicles should be considered in monetary environmental accounts. Taking such a holistic approach can make EGSS and EPEA accounts more robust in view of rebound effects, through which relatively efficient and clean vehicles cause the overall environmental impacts of transport to increase.

The handbooks suggest ***the full product value is to be considered when valuing EGSS output*** and ***extra cost relative to a conventional product is to be considered when valuing expenditures in EPEA***.

Based on the feedback from the October 2018 TF meeting, Eurostat noted that data compilers may require more specific guidance on which vehicles and equipment to include within the scope of their monetary environmental accounts. Stakeholders articulated a preference for applying technical criteria when assessing transport equipment. This approach is followed below, for example, when justifying the exclusion of conventional vehicles running on biofuels or other alternative fuels.

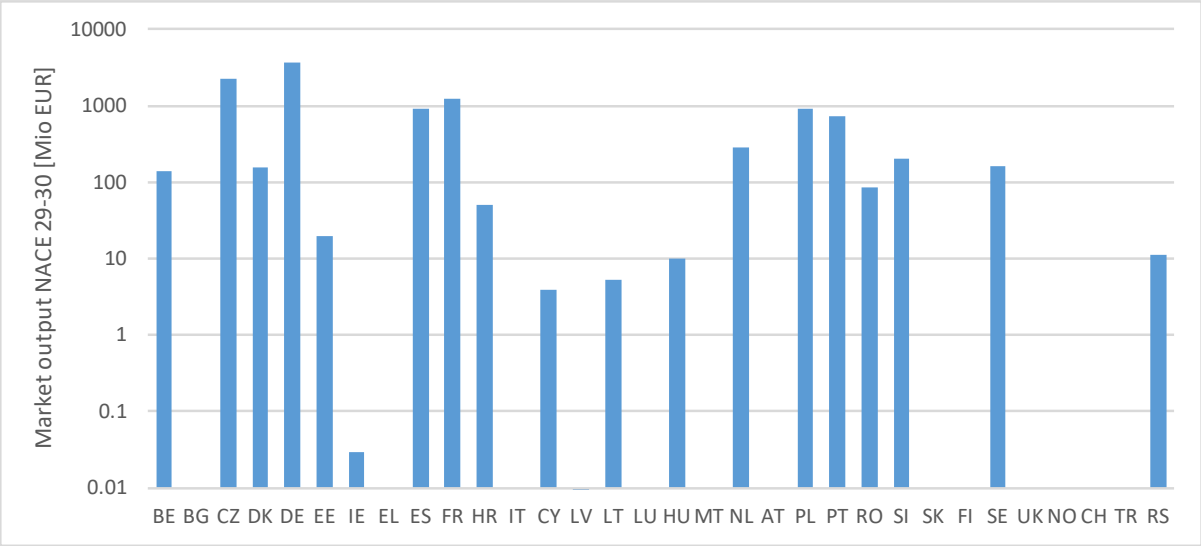
3. Data reporting - state of play

The results of the 2019 EGSS data reporting and the TF discussions suggest that countries differ in their recording of electric transport equipment, which raises issues of data comparability.

The reporting of transport equipment under NACE 29 and 30 is a voluntary item for EGSS. However, even if countries chose not to report data at this level of detail, they are obliged to include relevant products in the totals under NACE C. Figure 1 provides an overview of EGSS market output for NACE 29 and 30 for reference year 2017. Most countries with a large automotive industry report production activity. Countries also tend to identify electric transport equipment based on technical characteristics.

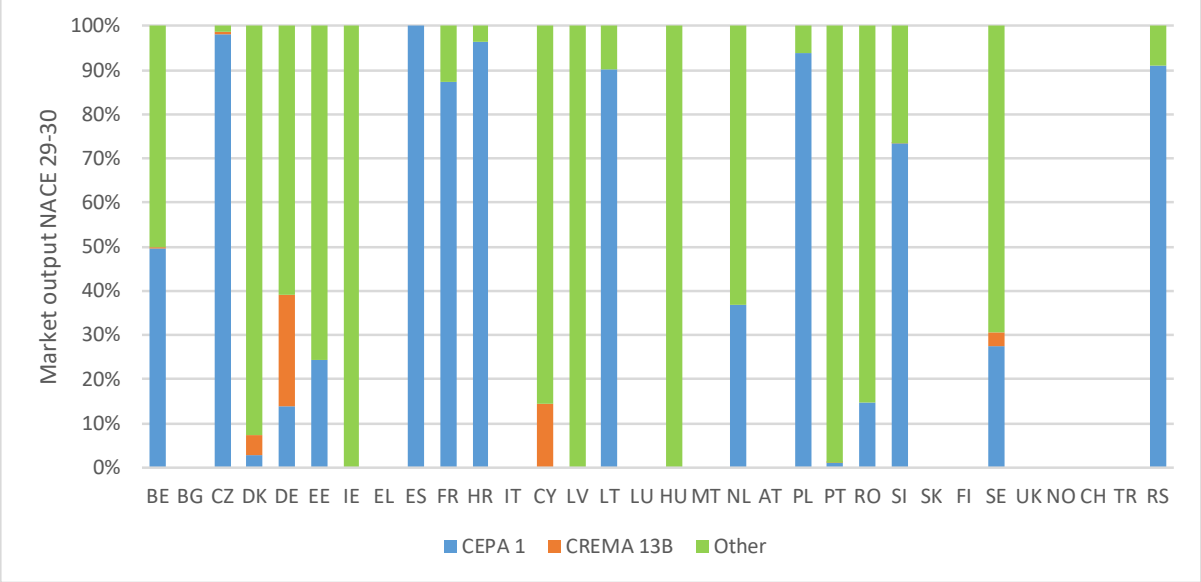
Still, there are differences in the allocation of production output to specific CEPA and CReMA categories (Figure 2). Only part of the cross-country differences might be explained by secondary activities of the automotive industry but clarification of allocation practices is still needed.

Figure 1: Market output under NACE 29 and 30, by country, 2017 (logarithmic scale)



Source: 2019 EGSS country reporting; confidential data are excluded

Figure 2: Market output under NACE 29 and 30, by CEPA-CReMA category and country, 2017



Source: 2019 EGSS country reporting; confidential data are excluded

4. Recommendations

4.1 Scope

The recommendations in this section shall ensure electric transport equipment is recorded in EPEA and EGSS accounts: (i) ***consistently*** across countries and in line with Regulations (EC) 691/2011 and (EC) 2015/2174, (ii) ***accurately*** regarding technical characteristics and environmental impacts, (iii) in a ***robust*** manner regarding future technological developments, market trends, and mode shifts, and (iv) in a ***practical*** manner that does not imply excessive burden for data collection.

The recommendations concern ***transport equipment*** - commonly understood as machinery and trailer intended for moving persons and objects (including livestock)[10]. Eurostat notes that state-of-the art electric powertrains are no longer modular but highly integrated into the rolling chassis of vehicles, affecting the design of wheels and the breaking system (that accommodate wheel-hub motors and regenerative breaking) and the chassis itself (that accommodates battery packs). For this reason, the target cleaner product to record in EGSS accounts is a vehicle as a whole, and not only its selected components.

As road vehicles are responsible for the largest part of transport-related greenhouse gas emissions and local air pollution, the recommendations focus on this type of transport equipment but include also other vehicles such as non-road machinery and ships (Table 1). An outlook of other transport equipment and related activities which now go beyond the boundaries of the environmental goods and services sector, but still are potentially relevant in the context of further development of the monetary-environmental accounts is provided in section 4.7.

This note does not address *"exhaust pipes and their parts"*, particle filters, and catalytic converters. Such vehicles components should be: (i) considered environmental products according to the indicative compendium in Regulation (EU) 2015/2174 and (ii) reported under CEPA 1 according to the operational list of environmental products and activities.

Table 1: Scope-related recommendations

Type of transport equipment	Included	Excluded
Vehicles	Electric and hybrid motor vehicles for passenger and freight transport on the road, non-road machinery, other vehicles such as ships	Rolling railroad products, airplanes, other aerospace equipment as well as parts thereof
Vehicle components	Technical components of electric vehicles (such as batteries, fuel cells, electric motors)	Electric equipment not installed in electric vehicles
Infrastructure	Infrastructure that is necessary and specific to the operation of electric vehicles (such as recharging units and stations)	Other transport infrastructure

[10] Following ESA (2010), transport equipment comprises any equipment for moving people and objects. Examples include products other than parts included in Classification of Products by Activity 2008 (CPA 2008) division 29: motor vehicles, trailers and semi-trailers, and division 30: other transport equipment.

4.2 Relevant electric transport equipment

To identify electric transport equipment, Eurostat considered the technical characteristics of vehicles and infrastructure in conjunction with their absolute and relative environmental impacts. Road vehicles were considered as environmental products if they are ***electric and clean relative to:***

- ***their direct conventional counterparts (i.e., vehicles offering comparable utility);***
- ***any motorised vehicles or transport equipment they may replace in practice***.

Following these criteria, Eurostat identified in Tables 2 and 3 relevant ***transport equipment for EPEA and EGSS accounts***. The recommendations in both tables follow the concept of adapted goods and are justified in detail below.

4.2.1 General considerations – definition of fully electric vehicles

The explicit reference of the indicative compendium to *"electric transport equipment"* implies ***fully electric vehicles are per se considered as environmental products in Regulation (EU) 2014/2174.***[11] Eurostat recommends ***defining fully electric vehicles as any vehicles equipped with one or multiple electric motor(s), drawing their energy solely from an electric battery, a fuel cell, or another energy storage or supply device such as solar panels***. This definition includes fuel-cell vehicles but it excludes equipment propelled or equipped with combustion engine(s) (such as plug-in and non-plug in hybrid vehicles) that are addressed separately below.

4.2.2 Electric cars

Fully electric passenger cars

Eurostat recommends to record first and foremost the production and export of ***fully electric cars (Table 2, item 1)*** as these do not show tail-pipe emissions and can thus decrease local air pollution, specifically in densely populated urban areas. The reduction of local air pollution - which exceeds in many cities the regulatory limits for the concentration of particulate matter and nitrogen dioxide[12] -

[11]Electric vehicles are clean during use as they do not emit pollutants at the tail-pipe. However, their production is relatively energy-intensive and may exert pressure on rare metal resources. The overall climate benefits of electric vehicles are sensitive to the carbon intensity of the electricity mix. A recent study suggests electric cars in Europe emit less greenhouse gases along their life cycle than diesel cars even when powered by carbon-intensive electricity (https://www.transportenvironment. org/press/electric-cars-emit-less-co2-over-their-lifetime-diesels-even-when-powered-dirtiest-electricity). An increasing share of renewables in the electricity mix as envisaged by the Europe 2030 energy strategy and second-life stationary battery applications, e.g., in the residential sector will continue to increase the climate benefits of electric cars.

[12]See report by the European Environmental Agency (https://www.eea.europa.eu/highlights/air-pollution-still-too-high).

could thus be considered the main environmental benefit of electric cars and electric vehicles in general, leading to the recommendation to report them under CEPA 1 (see section 4.6).

Hybrid passenger cars

Eurostat also recommends to record plug-in hybrid and non-plug-in hybrid cars (Table 2, items 2-3). These vehicles possess a traction battery and an electric motor as two technical features that differ distinctly from conventional cars and serve the main purpose of enhancing powertrain efficiency, thus decreasing fuel consumption and CO_2 emissions. Plug-in and non-plug-in hybrid cars can also decrease pollutant emissions, specifically when operated in electric drive mode. Under real-world operation, their emissions performance can vary depending on the design of after-treatment systems and the recharging frequency of plug-in hybrids (see also review clause in section 4.7).

If plug-in hybrid and non-plug-in hybrid cars are to be considered environmental products, how can they be differentiated from conventional cars? ***Eurostat recommends identifying plug-in hybrid and non-plug-in hybrid vehicles based on the ability to drive solely by means of the electric motor***. In the absence of such detailed information, passenger cars can be considered as environmental products if they are classified as clean vehicles[13], emitting not more than 50 gCO_2/km. ***This criterion is consistent with policy documents promoting clean vehicles but it excludes de facto non-plug-in hybrids.***

Eurostat recommends to exclude so-called mild-hybrid cars, that is, cars equipped with a small electric motor for dynamic start and stop of the combustion engine during driving that enables prolonged coasting. Such cars facilitate only to a very limited extent regenerative breaking. Their efficiency and emission benefits are small, and their technical characteristics similar with those of conventional car.

4.2.3 Other electrified road vehicles and machinery

Eurostat recommends to record fully electric, plug-in hybrid, and non-plug-in hybrid light-commercial vehicles, heavy-duty vehicles (such as buses and trucks), tractors, forestry equipment, and non-road machinery (Table 2, items 4-7) as environmental products. These vehicles could be differentiated from their conventional counterparts by the same technical criteria as recommended for passenger cars. At present, fully electric and hybridised heavy-duty vehicles, tractors, and non-road mobile machinery (including bulldozers and excavators) are still in an experimental stage or represent niche applications. However, by accounting for them, EPEA and EGSS accounts could

[13]According to Directive (EU) 2019/1161 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L1161&from=EN).

accommodate future developments.[14] ***Eurostat also recommends to include electric ships (Table 2, item 8)*** as a niche application to mitigate CO_2 emissions and local air pollution from water transport.

4.2.4 Infrastructure and electric vehicle components

Following the TF meeting on 15 October 2018 and the MESA WG on 16 May 2019, ***Eurostat also recommends to record:***

- ***essential infrastructure - such as electric charging units and stations - that are specific to the operation of electric vehicles;***
- ***the production and export of technical powertrain components of electric vehicles such as electric batteries, fuel cells, inverters and electric motors).***

Table 2 provides an overview of relevant infrastructure and components (see items 9-13). Whereas charging units are considered specific and essential for the operation of electric vehicles, rental and sharing stations are not and should therefore not be considered environmental activities. It is undisputed that such stations increase the availability of electric vehicles to users but not in a fundamentally different way than bike or car sharing increases the availability of bicycles and conventional passenger cars to users. The exclusion of sharing and renting stations is consistent with the guidance in the EGSS and EPEA handbooks and with the exclusion of wholesale and retail operations of environmental products that likewise is not considered an environmental activity.

The inclusion of technical components raises the issue of potential double-counting of production activity, for example, when electric motors produced by company A, are integrated by company B into a powertrain, that is then installed into a vehicle by company C. Overall, Eurostat regards it consistent with the EGSS handbook to report environmental products used as intermediate input for the production of other environmental products. The reported production output may double count activity but gross value added and employment still represent environmental production activities in a consistent manner.

4.2.5 Other electric passenger vehicles

E-bikes, electric kick scooters, and other lightweight electric vehicles designed for passenger transport do not emit NO_X, particulate matter, and other pollutants at the tail-pipe and can therefore help mitigating air pollution when replacing conventional motorised vehicles. Lightweight electric vehicles are by far more efficient - in terms of energy use per person-kilometre driven - than both electric and conventional passenger cars. To illustrate the case, electric cars are typically

[14]See, e.g., the increasing popularity of the StreetScooter light-commercial vehicle in Germany.

powered by 80-300 kW motors that consume under real-world driving conditions 15-25 kWh/100 km. The equivalent fuel consumption of conventional gasoline and diesel cars may range around 40-100 kWh/100 km (assuming an energy density of 10 kWh/l diesel and 8.9 kWh/l gasoline). This amount of 40-100 kWh/100 km is equivalent to the energy consumption of some 60-140 e-bikes (250 W motor; 0.7 kWh/100 km electricity consumption) Even when accounting for an average occupancy rate of 1.45 persons per car and considering that e-bikes could also replace electric cars, the on-road energy consumption of e-bikes and electric kick scooters is still factor 1:15-90 lower than that of cars; the energy consumption of electric motorcycles/step-through scooters can be a factor 1:5-30 lower than that of cars.[15]

Yet, lightweight electric vehicles could also increase traffic by replacing walking or use of public transport and they could substitute bicycles that are the cleanest and most resource-efficient mode of transport. Depending on climate, orography, and infrastructure conditions, mode-shift to lightweight electric vehicles may vary between countries, regions, and cities.

Countries should therefore examine whether the electric light-weight mono-, two-, three-, and four-wheel vehicles listed in Table 3: 1) are recognised as environmental-friendly vehicles in established regulations or policy initiatives and/or 2) replace to a significant extent individual conventional motorised transport equipment. If either of the two criteria applies, all such vehicles should be included as electric transport equipment in EGSS accounts; if not, all such vehicles can be excluded from EGSS accounts. Data compilers could obtain information about relevant environmental and transport policies from official administrative documents. Information on mode-shift patterns could be obtained from dedicated surveys. Moreover, data compilers could consult research articles, technical and scientific reports, and consult with stakeholders such as producers, the public administration, and consumer organisations. Data compilers should apply expert judgement and explain their choices in the quality report, which is then verified by Eurostat for plausibility and consistency. Eurostat notes that the value of output, GVA, employment, and exports related to electric light-weight vehicles is relatively small for EU Member States. For this reason, the choice left to the compiler will permit fully taking into account a country specificity without unduly affecting the cross-country comparability of the EGSS data.

In the absence of the evidence or data essential to inform the statistical analysis, Eurostat recommends to exclude the products from the scope of the environmental accounts.

Eurostat also notes that the approach described above does not entirely fit the definitions and valuation principles of EPEA. This point is addressed in more detail in section 4.5.

[15]For the energy consumption of electric scooters, see, for example: https://www.autobild.de/artikel/elektroroller-test-13693043.html.

4.2.6 Boundary cases

Eurostat recommends to <u>exclude</u> (next to mild-hybrid vehicles) conventional vehicles that are exclusively propelled by a spark-ignition or compression-ignition engine, even if they run on alternative fuels such as CNG, LPG, biofuel, or synthetic fuel.

The production of biofuels is considered as a resource management activity in EGSS, i.e., means to preserve non-renewable fossil resources. However, the vehicles and engines combusting such fuels should, by themselves, not be considered as environmental products for four reasons:

- First, the combustion of alternative fuels causes tail-pipe emissions. The benefits of biofuels and other alternative fuels for local air quality are ambiguous[16] when compared to conventionally-fueled vehicles and they are negative when compared to electric vehicles (that show zero tail-pipe emissions). The climate benefits of biofuels are case-specific and can become negative when accounting for indirect land-use change and when taking renewable electricity as reference product.
- Second, the combustion of biofuels and alternative fuels in internal combustion engines is more or less as efficient, from an energetic point of view, as the combustion of conventional fuels. Vehicles running on biofuels and other alternative fuels lack distinct technical features that generate efficiency benefits.
- Third, and related, the technical characteristics of vehicles running on alternative fuels, including biofuels, are largely similar to those of conventional vehicles. Modern diesel vehicles do not require modifications of engine or after-treatment systems to run on biodiesel. Bio-ethanol can be combusted in conventional spark-ignition engines after rubber sealants are replaced to resist the corrosive effects of ethanol.
- Fourth, the exclusion of vehicles running on biofuels is consistent with the treatment of down-stream manufacturing processes that are, likewise, not considered as environmental activities unless they either serve a direct environmental purpose or produce specifically designed products whose use serve an environmental purpose. In analogy, neither fuel combustion itself serves the environment *directly* nor does the transport of passengers and goods produce an environmental service.

[16]See, for example: Martini et al. (2009): Effect of fuel ethanol content on exhaust emissions of a flexible fuel vehicle. Report EUR 24011 EN. Ispra, Italy; Edwards, R. et al. (2014): Well-to-wheels report version 4.a, JEC well-to-wheels analysis. JRC Technical Report EUR 26236 EN. Ispra, Italy; Ashnani, M. H. M., et al. (2015): Environmental impact of alternative fuels and vehicle technologies: A life cycle assessment perspective. Procedia Environmental Sciences 30, pp. 205-210; Kollamthodi, S. et al. (2016): The role of natural gas and biomethane in the transport sector. Final Report ED 61479. Ricardo Energy & Environment.

Likewise, vehicles running on CNG and LPG are technically similar to conventional gasoline vehicles; the main differences are limited to a pressure tank, pressure regulator, and secondary fuel injectors that accommodate methane as fuel but are not linked, in our opinion, to an obvious environmental purpose. The exclusion of vehicles running on alternative fuels is broadly consistent with the definition of environmental cars in the recommendation for the amendment of Directive 2009/33/EU that considers clean vehicles as those emitting *at the tailpipe* not more than 50 gCO_2/km[11].

4.3 Data sources

Business surveys could be used as the primary data source to identify relevant production activity. If unavailable, PRODCOM and trade statistics could be consulted (see Tables 2 and 3), but product codes typically include environmental and non-environmental products. Available data therefore need to be combined with additional information from governmental subsidy schemes or business reports of producers or producer associations to identify relevant product shares. The latter data sources could also be used to directly obtain information on the number and value of produced vehicles, vehicle components, and charging stations.

4.4 Valuation principles

Eurostat recalls that ***EGSS covers the entire value of vehicles, electric components, and essential infrastructure (at basic prices)***. The 2016 EGSS handbook states that "EGSS measures the output of adapted products at their total value (at basic prices)". This recommendation is consistent with SEEA-CF[17].

Where necessary information is unavailable, countries should consider reporting the costs related to electric powertrain and vehicle components[18] instead of the full vehicle value or the additional costs of electric transport equipment. If either of the two latter approaches is chosen: 1) the reporting method has to be explained in detail in the quality report and 2) instruction and information should be provided, e.g., on costs shares and cost differentials so that Eurostat is in the position to re-calculate EGSS estimates to the full vehicle value. If corrections are made, data will be flagged prior to publication as Eurostat estimate with footnote 's)'.

As electric transport equipment does not serve a primary environmental purpose, ***data compilers should not report in EPEA the expenditure on vehicles and components at full value. Instead the extra costs of electric transport equipment should be reported.*** This recommendation is consistent with the 2017 EPEA handbook, stating that: "only the 'environmental protection share' should be

[17]See: https://seea.un.org/sites/seea.un.org/files/seea_cf_final_en.pdf.

[18] This approach implies a more stringent definition of adapted goods, namely that electric powertrains rather than entire vehicle are considered the cleaner and adapted products.

accounted for, which can be measured by the extra cost of the cleaner product compared to an equivalent normal product." For practical guidance and estimates of price premium, see Table 4 under section 4.5.

For a few technologies such as electric recharging infrastructure or lightweight electric vehicles, it is not always straightforward to identify a direct conventional counterpart. Especially for lightweight electric vehicles, mode shift complicates the selection of a suitable conventional vehicles to estimate extra costs. ***For practicality, it is therefore recommended to report the full value of essential infrastructure and lightweight electric vehicles as an environmental expenditure in EPEA.***

Table 2: Electric transport equipment for reporting in EPEA and EGSS accounts; PRODCOM codes are indicative and may include non-environmental products

#	Equipment	Description	PRODCOM code	CN code	Major environmental impacts	Distinct technical features	Rationale for reporting as environmental product
1	Fully electric cars	M1 vehicles[19] designed primarily for passenger transport, having no more than eight seats next to the driver's seat, and being powered exclusively by an electric motor supplied by a rechargeable battery, fuel cell, or any other electric energy storage system	29.10.24.50	87 03 80-90	Energy intensive production; energy efficient and no tail-pipe emissions during use; can mitigate local air pollution; climate benefits, that are, however, sensitive to mode shift and the carbon intensity of electricity; renewable electricity and second-life battery use decrease climate impacts	Electric motor, inverter, traction battery or fuel cell	Electric transport equipment; no tail-pipe emissions; more energy efficient than conventional cars
2	Plug-in hybrid cars	M1 vehicles[15] designed primarily for passenger transport, having no more than eight seats next to the driver's seat, and being equipped by at least two different motors, of which one is an electric motor, and two different propulsion energy storage systems, of which one can be recharged from an external electricity source	29.10.24.30	87 03 60-70	Energy intensive production; energy efficient during use; benefits for local air quality depend on charging frequency and emissions after-treatment; climate benefits sensitive to user behaviour and carbon intensity of electricity; renewable electricity and second-life battery use decrease climate impacts	Electric motor, inverter, relatively small traction battery	More efficient and potentially less-polluting than conventional cars

[19]According to Regulation (EU) 2018/858 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles. Official Journal of the European Union L151, p. 1-218.

Table 2 (cont.): Electric transport equipment for reporting in EPEA and EGSS accounts; PRODCOM codes are indicative and may include non-environmental products

#	Equipment	Description	PRODCOM code	CN code	Major environmental impacts	Distinct technical features	Rationale for reporting as environmenta product
3	Non-plug-in hybrid cars	M1 vehicles[15] designed primarily for passenger transport, having no more than eight seats next to the driver's seat, and being equipped with at least two different motors, of which one is an electric motor capable of electric-only mode of propulsion, and two different propulsion energy storage systems, which cannot be recharged from an external electricity source	29.10.24.10	87 03 40-50	Relatively energy intensive production; energy efficient during use; pollutant emissions ambiguous and dependent on emissions after-treatment; climate benefits relatively small and sensitive to efficiency trade-offs	Electric motor, inverter, relatively small traction battery	More efficient and potentially less-polluting than conventional cars
4	Fully electric, plug-in hybrid, and non-plug-in hybrid busses	M2 and M3 vehicles[15] designed primarily for passenger transport, having more than eight seats next to the driver's seat, and being equipped with similar powertrain technologies as passenger cars listed above	29.10.30	87 02 20; 87 02 30; 87 02 40	Analogous to fully electric, plug-in hybrid, and non-plug-in hybrid cars	Analogous to fully electric, plug-in hybrid, and non-plug-in hybrid cars	Analogous to passenger cars
5	Fully electric, plug-in hybrid, and non-plug-in hybrid light-commercial vehicles, heavy-duty trucks, and other vehicles	N vehicles[15] designed primarily for goods and freight transport and being equipped with comparable powertrain technologies as passenger cars listed above	29.10.41.10-40; 29.10.42; 29.19.43; 29.10.51; 29.10.59.30-90	87 01 20; 87 03 40; 87 03 50 00; 87 03 60-80; 87 04 10 90; 87 04 21-23 87 04 31-90 87 05 10-90 87 09 11 90			

Table 2 (cont.): Electric transport equipment for reporting in EPEA and EGSS accounts; PRODCOM codes are indicative may include non-environmental products

#	Equipment	Description	PRODCOM code	CN code	Major environmental impacts	Distinct technical features	Rationale for reporting as environmental product
6	Other electric, plug-in hybrid, and non-plug-in hybrid non-road mobile machinery	Non-road mobile machinery such as caterpillars, excavators[20] with or without wheels and not intended for road transport being equipped with distinct technical features that increase efficiency and decrease tail-pipe emissions	29.10.52	84 29 11-59; 84 30 10-69 87 03 10 18	Analogous to electric, plug-in hybrid and non-plug-in hybrid cars	Analogous to electric, plug-in hybrid and non-plug-in hybrid cars	Analogous to passenger cars
7	Electric, plug-in hybrid, and non-plug-in hybrid tractors and other agricultural and forestry machinery	T and C vehicles[21] designed as agricultural or forestry vehicles with at least two axles for pulling, pushing, carrying, or actuating equipment being equipped with similar powertrain technologies as the M1 vehicles listed above	28.30.10-23; 28.30.39-59	84 32 10-80 84 33 11 10; 84 33 40-59 87 01 00; 87 01 30 00; 87 01 91-95;	Analogous to electric, plug-in hybrid and non-lug-in hybrid cars	Analogous to electric, plug-in hybrid and non-plug-in hybrid cars	Analogous to passenger cars
8	Electric ships	Motorboats and larger ships propelled by one or multiple electric motors drawing their energy from an electric battery or fuel cell	30.11; 30.12	89 01; 89 02 00; 89 03; 89 04; 89 05; 89 06	No exhaust emissions; can mitigate local air pollution; climate benefits sensitive to carbon intensity of electricity	Electric motor, battery, fuel cell	Electric transport equipment; clean adapted technology

[20]According to Regulation (EU) 2016/1628 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery. Official Journal of the European Union L252, pp. 53-117.

[21]According to Regulation (EU) No 167/2013 on the approval and market surveillance of agricultural and forestry vehicles. Official Journal of the European Union L60, pp. 1-51.

Table 2 (cont.): Electric transport equipment for reporting in EPEA and EGSS accounts; PRODCOM codes are indicative may include non-environmental products

#	Equipment	Description	PRODCOM code	CN code	Major environmental impacts	Distinct technical features	Rationale for reporting as environmental product
Essential infrastructure							
9	Recharging infrastructure	Charging stations and other essential infrastructure for recharging electric transport equipment	27.12.40 27.90.44	85 04	Improving urban air quality and potentially decreasing CO_2 emissions from transport	Specific design (e.g., plug) to charge electric vehicles	Essential for electric transport equipment
Technical components of electric vehicles							
10	Fuel cells*	see PRODCOM/CN code	27.90.42.00	85 01 31-34	(see fully electric cars)	Electric equipment	Essential for electric vehicles
11	Batteries*	see PRODCOM/CN code	27.20.11-24	85 06; 85 07	(see fully electric cars)	Electric equipment	Essential for electric vehicles
12	Electric motors*	see PRODCOM/CN code	27.11.10; 27.11.21.00; 27.11.25.30	85 01 10; 85 01 20 00; 85 01 31 00; 85 01 32 00; 85 01 33 00; 85 01 34 00; 85 01 40; 85 01 51 00; 85 01 52; 85 01 53 50	(see fully electric cars)	Electric equipment	Essential for electric vehicles
13	Other electric equipment*,**	see PRODCOM/CN code	27.90.41; 27.90.45; 29.31.10; 29.31.30; 29.32.30	85 35-36; 85 44	(see fully electric cars)	Electric equipment	Essential for electric vehicles

* Only components of electric, plug-in and non-plug-in hybrid vehicles are relevant; components used for other purposes, e.g., in manufacturing or for stationary applications in households are to be excluded from the reporting of electric transport equipment. **The listed PRODCOM and CN codes are indicative; other electric equipment may be included if it is specific to and installed in electric, plug-in and non-plug-in hybrid vehicles.

Table 3: Electric transport equipment to be included in or excluded from EPEA and EGSS accounts depending on whether they replace non-motorised or motorised vehicles; PRODCOM codes are indicative may include non-environmental products

#	Equipment	Description	PRODCOM code[22] (numbers in parentheses to be verified)	CN code[23]	Major environmental impacts	Distinct technical features	Rationale for reporting as environmental product
1	Electric unicycles	Vehicles touching the ground with only one wheel and driven by an electric motor	(30.91.13.00)		Relatively energy intensive production; highly energy efficient and no tail-pipe emissions during use; mitigate local air pollution and exposure to NO_x, particles, hydrocarbons; large climate benefits, that are, however, sensitive to mode shift and the carbon intensity of electricity; renewable electricity and second-life battery use can decrease climate impacts considerably	Electric motor, inverter, and small traction battery	Electric transport equipment; no tail-pipe emissions
2	Electric scooters	Stand-up rollers/scooters with a large deck in the centre driven by an electric motor	30.91.13.00	87 11 20 10			
3	Pedal assisted e-bikes, e-tricycles, and e-quadricycles	Powered cycles categorised as L1e-A vehicles[24] with an electric motor of a maximum rated power of 250 W, whose operations does not require a driver's licence	30.91.13.00	87 11 60 10			
4	Small electric scooters and mopeds	Two-wheelers categorised as L1e-B vehicles[14] without pedal assistance, having a maximum speed of 45 km/h, and being propelled solely by electric motor(s) of a maximum rated power of >0.25–4 kW	30.91.13.00	87 11 60 00; 87 11 60 90			
5	Large electric scooters and motorcycles	Two-wheelers categorised as L3e and L4e vehicles[14] with a maximum speed of >45 km/h, being propelled solely by electric motor(s) of a maximum continuous rated power of >4 kW	30.91.13.00	87 11 60 00; 87 11 60 90			
6	Electric three- and four-wheelers	Three- and four-wheelers designed for passenger transport or utility purposes, categorised as L2e, L5e, L6e, L7e vehicles[14], being solely propelled by electric motor(s)	29.10.24.50	87 11 60 00; 87 11 60 90			

[22]Regulation (EU) 2017/2119 establishing the 'Prodcom list' of industrial products provided for by Council Regulation (EEC) NO 3924/91. Official Journal of the European Union L325, pp. 1-214.

[23]Regulation (EU) 2018/1062 amending Annex I to Council Regulation (EEC) No 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff. Official Journal of the European Union L273, pp. 1-960.

[24]According to Regulation (EU) No 168/2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles. Official Journal L53, pp. 1-117.

4.5 Additional guidance

Reporting of electric transport equipment in EPEA

The reporting of production output, gross value added, and employment related to electric transport equipment and other adapted goods is rather straightforward in EGSS. However, it might become more complicated for EPEA, given that the accounts cover a broader range of transactions and the extra costs valuation principle set out for a number of its transactions such as cleaner technologies and cleaner (adapted) products.

Acquisition of transport equipment by government and corporations, or by households for their productive activities, is recognised as gross fixed capital formation (ESA 2010 code P.51), while acquisition of transport equipment by households for other purposes will be recorded in macroeconomic statistics as final consumption expenditure (ESA 2010 code P.3) on consumer durables. The whole of the gross capital formation (including electric vehicles) by specialist and secondary producers of environmental protection services is recorded at purchasers' prices. Thus, for this category of EPEA producers, there is no need to identify and record electric transport vehicles in data sources (given that they would be included in respective aggregates of the macroeconomic statistics). For other producers and for households, only extra costs of the electric transport equipment should be recorded, under gross fixed capital formation in adapted products[25] or final consumption expenditure in adapted products, respectively.

It should be noted that ESA 2010 categories of gross fixed capital formation and final consumption expenditure on consumer durables are in fact net measures given that they are defined as 'acquisitions less disposals'.

Export and import of electric transport equipment

Consistent with the exclusion of retail and wholesale from environmental accounts, only export of domestically produced new electric transport equipment should be reported in EGSS. Export of second-hand cars is to be excluded.

EPEA considers the export and import of environmental protection services only. The international trade of electric transport equipment and other adapted goods should therefore be excluded from EPEA reporting.

Domestic transactions in second-hand equipment

It is assumed that domestic transactions in second-hand equipment are outside the scope of EGSS.

[25] Or under 'cleaner technology' in the absence of a separate entry for transactions in adapted capital goods.

However, for EPEA, second-hand electric transport equipment is relevant, for example, when acquired as fixed assets by specialized and non-specialized producers or when purchased for final consumption by households (see above). Consistent with ESA (2010)[26] and SNA (2008)[27], compilers should report in EPEA the acquisition of second-hand electric transport equipment as a fixed asset or as an item for final consumption by households. For the producer or household transferring the ownership, negative gross fixed capital formation or negative consumption expenditure should be recorded. In practice it may be difficult to collect data at the necessary level of detail. Compilers may therefore decide to disregard second-hand equipment and only report capital formation and final consumption related to new equipment. The resulting error may be small compared to the overall uncertainty in the reporting of electric transport equipment[28].

Estimating total value of vehicles for EGSS

Countries tracing in their data sources only costs related to electric powertrain components of vehicles should estimate the full value of electric vehicles by multiplying their data with a correction factor. In the absence of specific information, a default factor of 2.5 could be applied, which assumes that the costs of electric powertrains account for around 40% of the basic price of electric vehicles.[29] If the estimation is not undertaken at a country level, the recording convention should be explained in the EGSS quality report so that Eurostat can undertake the adjustments necessary to ensure cross-country data comparability.

Estimating extra costs of vehicles for EPEA

The extra costs of electric vehicles could be approximated based on their price difference relative to conventional vehicles. As it is difficult to determine precisely which conventional vehicle types are replaced in practice by electric vehicles and to what extent mode shift from passenger cars to other vehicles occurs, it is recommended to consider the price difference between electric vehicles and conventional ones with similar characteristics. ***In the absence of detailed information, such as country-specific price differences, the following approaches can be applied:***

- Tier I: Assuming that electric vehicles are 30% more expensive than conventional vehicles with similar characteristics.
- Tier II: Assuming specific price differences for each vehicle type as given in (Table 4).

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[26] European System of Accounts 2010 (https://ec.europa.eu/eurostat/documents/3859598/5925693/KS-02-13-269-EN.PDF/44cd9d01-bc64-40e5-bd40-d17df0c69334).

[27] System of National Accounts 2008 (https://unstats.un.org/unsd/nationalaccount/docs/sna2008.pdf).

[28] Eurostat notes that this point might require further investigation, notably given the different valuation principles of electric transport equipment in GFCF of specialised and secondary producers and other producers and households.

[29]Sources: https://www.theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf; https://www. investors.com/news/electric-car-teardown-tesla-model3-chevy-bolt-bmw-i3/.

- Tier III: Reporting equipment at a full value with relevant caveats in EPEA quality reports.

Table 4: Price premium of electrified vehicles over comparable conventional vehicles, by type; data represent default estimates as of 2020 based on miscellaneous sources and should be updated as part of the regular review of this guidance note

Vehicle type	Price premium per vehicle	Comment
Fully electric cars	12 000 EUR or 250 EUR/kWh battery capacity	Estimate of average price premium compared to conventional cars; large case-specific variability depending on market positioning of vehicles
Plug-in hybrid cars	6 000 EUR	
Non-plug-in hybrid cars	0 EUR	The price of non-plug in hybrid cars is comparable to that of efficient conventional cars with state-of-the-art after-treatment systems.
Fully electric, plug-in hybrid, and non-plug-in hybrid busses	200 000 EUR or 1 000 EUR/kWh battery capacity	Rough estimate for large electric city buses compared to conventional buses; price levels volatile and subject to battery capacity and demand for electric busses; for non-plug-in hybrid busses a price premium of zero should be assumed.
Electric, plug-in hybrid, and non-plug-in hybrid light-commercial vehicles, heavy-duty trucks	1 000 EUR/kWh battery capacity	Rough estimate based on a comparison with conventional trucks; electrified trucks are just about to enter the market; price levels are likely volatile and subject to battery capacity and demand for electric trucks.
Electric, plug-in hybrid, and non-plug-in hybrid tractors and other agricultural and forestry machinery	1 000 EUR/kWh battery capacity	Rough estimate compared to similar conventional equipment; most electric equipment is still test phase.
Other electric, plug-in hybrid, and non-plug-in hybrid non-road mobile machinery	500 EUR/kWh battery capacity	Estimate based on electric forklifts; most electric equipment is still test phase.
Stand-up scooters, e-bikes	400 EUR	Estimate of mean price premium; case-specific variability depending on market positioning and specifications of vehicles.
Small electric scooters and mopeds	1 500 EUR	
Electric three- and four-wheelers	1 500 EUR	
Large electric scooters and motorcycles	4 000 EUR or 250 EUR/kWh battery capacity	

The data in Table 4 do not account for country-specific subsidies. If subsidies are granted, both the purchaser's price and the price premium of electric vehicles decrease accordingly even though the overall environmental expenditure remains unchanged. This happens since subsidies shift the burden of environmental expenditure from the purchasers of vehicles to the

government. Thus, although subsidies do not need to be taken into account for the calculation of the price premium they should be considered for computation of NEEP in the EPEA reporting (under transfers).

The recommendations provide only a rough estimate for the price premium of electrified vehicles but still are considered an acceptable approach in the absence of the detailed information in data sources. Values can span a wide value range and are likely to decrease over time depending on the rate of technological learning and the strategic pricing policy of manufacturers.

4.6 Classification of electric transport equipment

Consistent with the TF position, Eurostat recommends ***reporting electric transport equipment unanimously under CEPA 1 as a measure of protecting ambient air and climate.*** Specifically relevant is category CEPA 1.1.1 – *"Prevention of pollution through in-process modifications for the protection of ambient air"*. This recommendation ensures coherence with the current reporting practice and captures the substantial benefits of e-mobility for local air quality. It also helps recording plug-in and non-plug in hybrid vehicles in a practical manner even if it may not capture the nuances of all benefits of these vehicles that tend to be more efficient but not necessarily cleaner than conventional cars.[30]

4.7 Implementation, review and future work

National Statistical Institutes are asked to implement the recommendations of this guidance note without undue delay as part of their regular methodological review procedure. Once implemented, reporting principles should be applied, as far as feasible, to all years covered in the data reporting to Eurostat, most importantly the mandatory reference period from 2014-onwards. Eurostat will assess the implementation of the guidance in the course of the EGSS data validation and inform users about important comparability issues through country caveats in the metadata or specific information in country quality reports (once publishable).

To accommodate technological developments, new priorities of policy makers, and ongoing regulatory developments such as amendments to Regulation 691/2011 and possibly also the work on a sustainability finance taxonomy[31], as well as the data availability for compilers, the guidance note should be reviewed in the future. Such a review may specifically clarify whether

[30]See Franco et al. (2016): Evaluation of exhaust emissions from three Diesel-hybrid cars and simulation of after-treatment systems for ultralow real-world NO_x emissions. Environmental Science & Technology 50, pp. 13151-13159.

[31]https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en.

non-plug-in hybrid vehicles should still be considered environmental products given the level of regulatory CO_2 emissions targets for light- and heavy-duty vehicles.

Upcoming reviews should also consider the valuation principles recommended in section 4.3 and examine products not yet addressed in this guidance note. The reviews could also revisit the recording of infrastructure supporting the transition towards clean and sustainable transport although not specific to electric vehicles and therefore outside of the scope of the 'electric transport equipment' addressed here, among them dedicated driveways, road infrastructure (such as bike lanes) and rental stations (e.g., for e-bikes and e-scooters).

Country-specific developments should be monitored by data compilers and information on major new products and technologies shared with Eurostat. For further discussion and a potential inclusion in monetary environment accounts, the following electric transport equipment could be considered:

- production and transactions related to new electric tramways, metro, and other railway equipment (including trains, track fixtures and fittings) that replace standard and more polluting transport modes;
- provision of public transport services that are fully electrified and without tail-pipe emissions and replace standard and more polluting public transport;
- production of electric air planes.

Abbreviations and acronyms

CEPA	-	Classification of Environmental Protection Activity
CN	-	Combined Nomenclature
CNG	-	Compressed Natural Gas
CO_2	-	carbon dioxide
CPA	-	Statistical classification of Products by Activity
CReMA	-	Classification of Resource Management Activity
EGSS	-	Environmental Goods and Services Sector
EPEA	-	Environmental Protection Expenditure Accounts
km	-	kilometre
LPG	-	Liquefied Petroleum Gas
MESA WG	-	Monetary Environmental Statistics and Accounts Working Group
NO_X	-	Nitrogen oxides
SEEA-CF	-	System of Environmental-Economic Accounting 2012 – Central Framework
TF	-	task force
W	-	watt