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Is elecrification a driver for sustainable mobility?

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Definition of Sustainable Mobility

Sustainable mobility is generally defined around four global goals:

(1) equitable access;

(2) security and safety;

(3) efficiency/effectiveness; and

(4) pollution and climate-responsiveness.

Under this vision, sustainable mobility would include a better provision of infrastructure and services to support the movement of goods and people. This outcome would be achieved only because the four goals are pursued simultaneously and trade-offs among them are managed (World Bank, 2017).

Main externalities generated by traffic

Impacts generated by transport and affecting the community.

They can be **positive** (e.g., increase in land values after the opening of a new transport line) **or negative** (e.g., increase in noise pressure).

Negative externalities that can be monetized are evaluated as **external costs**. They include: **noise, local and global air emissions, congestion, accidents, land and water pollution** (van Essen et al., 2020).

Role of electrification

Electrification is widely considered an **attractive solution for reducing the oil dependency and environmental impact** of road transportation. Many countries have been establishing increasingly stringent and ambitious targets in support of transport electrification.

Electric cars, trucks, and buses produce no tailpipe emissions, and thus help reduce local air pollution. Moreover, buses typically run on diesel fuel or compressed natural gas, which emit nitrogen oxides and sulfur dioxide that reduce air quality. These are significantly reduced by electrification.

Discussion

The most thorough method to analyse the complete process is the **Life-Cycle-Assessment** (LCA). It covers the **entire life cycle of a product**, process or activity, encompassing the extracting and processing of raw materials; manufacturing, transportation and distribution; use, re-use, maintenance; recycling and final disposal.

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With the **Well-To-Wheel approach** (WTW), the impact of a fuel can be determined through the description of specific pathways. These pathways are complete sets of assumptions about the resource used, including the primary energy source, the energy required for its extraction, transformations, transportation, fuel production and characteristics of the vehicle using the fuel. This is generally divided in two main phases:

- **Well-to-Tank** (WTT) describes the pathway necessary for the process of distributing fuels suitable for transport powertrains. Five main phases characterize this approach: production and conditioning of the energy, its transformation at source, transportation to market, transformation near the market and conditioning, and distribution of the finished fuels to the individual refueling points;
- **Tank-to-Wheel** (TTW) quantifies the unitary energy expended and the polluting substances emitted by a vehicle during its driving cycle. This is generally considered independently.

Concrete contributions

While other alternative to fossil fuels (biogas, agrofuels, or synthetic fuels) are not as suitable for light vehicles, **electric power is a preferred and even essential solution for achieving our climate objectives** in transport. The IPCC report states in its summary for policy makers that "*electric vehicles powered by low-carbon electricity offer the greatest potential for decarbonization of land transport in life cycle analysis*". However, even reaching a factor of 3 on emissions is not enough and would need to be improved by moving to **more fuel-efficient vehicles**.

In addition to climate change, another important issue is **air pollution**, which affects health. The consequences for public health are mainly due to emissions of fine particles (PM), followed by nitrogen oxides (NO_x) and ozone (O_3). Depending on the pollutant, the transport sector has a more or less significant impact: more than 60% for NO_x and 17.5% for $PM_{2.5}$, although these proportions increase in the most densely populated areas, particularly roadside.

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Unlike combustion vehicles, electric vehicle emissions are zero when in use, and are instead concentrated on the production of the vehicle and the energy used to produce the electricity.

Moreover**, the problems of congestion, accidents and noise pollution are also still present**.

The share of **non-exhaust particles** is becoming increasingly significant, at 59% of PM_{10} and 45% of $PM_{2.5}$ emissions. These emissions are due to the **abrasion** of brakes, tires, and the road surface, as well as the resuspension of fine particles already on the road. Electric vehicles reduce brake emissions through regenerative braking, but emissions are higher for particles from tires and pavement because of their greater

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In terms of both greenhouse gas emissions and atmospheric pollutants, **the electric car appears to be a better choice** than the internal combustion engine. But the amounts are still insufficient and should not overshadow the fact that **emission levels are still high,** particularly when compared with other forms of mobility that are more economical and more environmentally friendly. This is also the case for other impacts or externalities of transport, where the electric car does not solve the problems identified.

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As with air pollution, **noise pollution** is reduced by electric vehicles without disappearing entirely. In fact, the noise of combustion engine vehicles comes not only from the engine, but also from tire **friction** and aerodynamic noise, which is even more important at higher speeds, and these types of noises will not be significantly altered by electric cars.

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Other car-related issues remain unchanged with the switch to electric cars. These include the **space taken up by cars**, which is often summarized as congestion, but which also concerns parking space (on roads, in buildings and car parks) and, more broadly, transport infrastructure, leading to soil artificialization and impacts on biodiversity. The problems of **accidentology** also remain unchanged with the switch to electric vehicles. The car is also an inactive mode, and **physical inactivity and sedentariness** are a major public health issue, although too often forgotten since they concern no less than 95% of the population.

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The problem of **unequal access to mobility**, for social or geographical reasons, can be reinforced or reduced by switching to electric vehicles, depending on the circumstances. With a higher purchase price, at least for the time being, the distribution of the car to the most financially fragile populations is complicated, but the costs of use are then much lower, for an overall cost of ownership that remains high in comparison with the use of public transport, car sharing or even more active mobility, even if the lack of motorization can sometimes require the use of car sharing.

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Finally, regarding the consumption of **resources**, and in particular certain metals (lithium, cobalt, nickel, copper, etc.), the electric vehicle may lead to **new tensions** compared to the internal combustion engine car, in terms of supply difficulties and price volatility, the limitation of certain resources or pollution linked to their exploitation.

Our contributions to the theme

Transportation Research Part A 132 (2020) 256–272

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

The adoption of grid transit networks in non-metropolitan contexts

Silvio Nocera[*], Alberto Fabio, Federico Cavallaro

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Transportation Research Part D 64 (2018) 70–89

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Should BEVs be subsidized or taxed? A European perspective based on the economic value of CO_2 emissions

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Transportation Research Part D 47 (2016) 222–236

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Economic valuation of Well-To-Wheel CO_2 emissions from freight transport along the main transalpine corridors

CrossMark

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Transportation Research Part D 106 (2022) 103266

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Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Are transport policies and economic appraisal aligned in evaluating road externalities?

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Research in Transportation Business & Management 40 (2021) 100570

Contents lists available at ScienceDirect

Research in Transportation Business & Management

journal homepage: www.elsevier.com/locate/rtbm

The combination of e-bike-sharing and demand-responsive transport systems in rural areas: A case study of Velenje

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Transportation

https://doi.org/10.1007/s11116-022-10291-y

Check for updates

Effects of high-speed rail on regional accessibility

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Our contributions to the theme

INTERNATIONAL JOURNAL OF SUSTAINABLE TRANSPORTATION
2021, VOL. 15, NO. 6, 456–473
https://doi.org/10.1080/15568318.2020.1762951
Taylor & Francis
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Climate change impacts and tourism mobility: A destination-based approach for coastal areas

Federico Cavallaro, Olga Irranca Galati, and Silvio Nocera

IUAV University of Venice, Venezia, Italy

INTERNATIONAL JOURNAL OF SUSTAINABLE TRANSPORTATION
2023, VOL. 17, NO. 6, 639–648
https://doi.org/10.1080/15568318.2022.2079446
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Modeling cyclist behavior using entropy and GPS data

Cristian Poliziani[a], Federico Rupi[a], Joerg Schweizer[a], Maria Nadia Postorino[a], and Silvio Nocera[b]

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Nocera *et al. European Transport Research Review* (2018) 10:53
https://doi.org/10.1186/s12544-018-0323-7
European Transport Research Review

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Options for reducing external costs from freight transport along the Brenner corridor

Silvio Nocera[1*], Federico Cavallaro[1,2] and Olga Irranca Galati[1]

Research in Transportation Economics 65 (2017) 44–55
Contents lists available at ScienceDirect
Research in Transportation Economics
journal homepage: www.elsevier.com/locate/retrec
ELSEVIER

A two-step method to evaluate the Well-To-Wheel carbon efficiency of Urban Consolidation Centres

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Transport Policy 67 (2018) 85–92
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Transport Policy
journal homepage: www.elsevier.com/locate/tranpol
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The potential of road pricing schemes to reduce carbon emissions

Check for updates

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Research in Transportation Economics 86 (2021) 101027
Contents lists available at ScienceDirect
Research in Transportation Economics
journal homepage: http://www.elsevier.com/locate/retrec
ELSEVIER

Pathways to active mobility planning

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Conclusions

Necessity of a WTW approach: the extraction of mineral resources has an undeniable environmental impact, and their refining, like the production of batteries, also consumes energy. In the production phase of the vehicle, electric cars emit more greenhouse gases (in addition to other environmental impacts) than combustion cars, because of the addition of the battery. This needs to be added to our calculations

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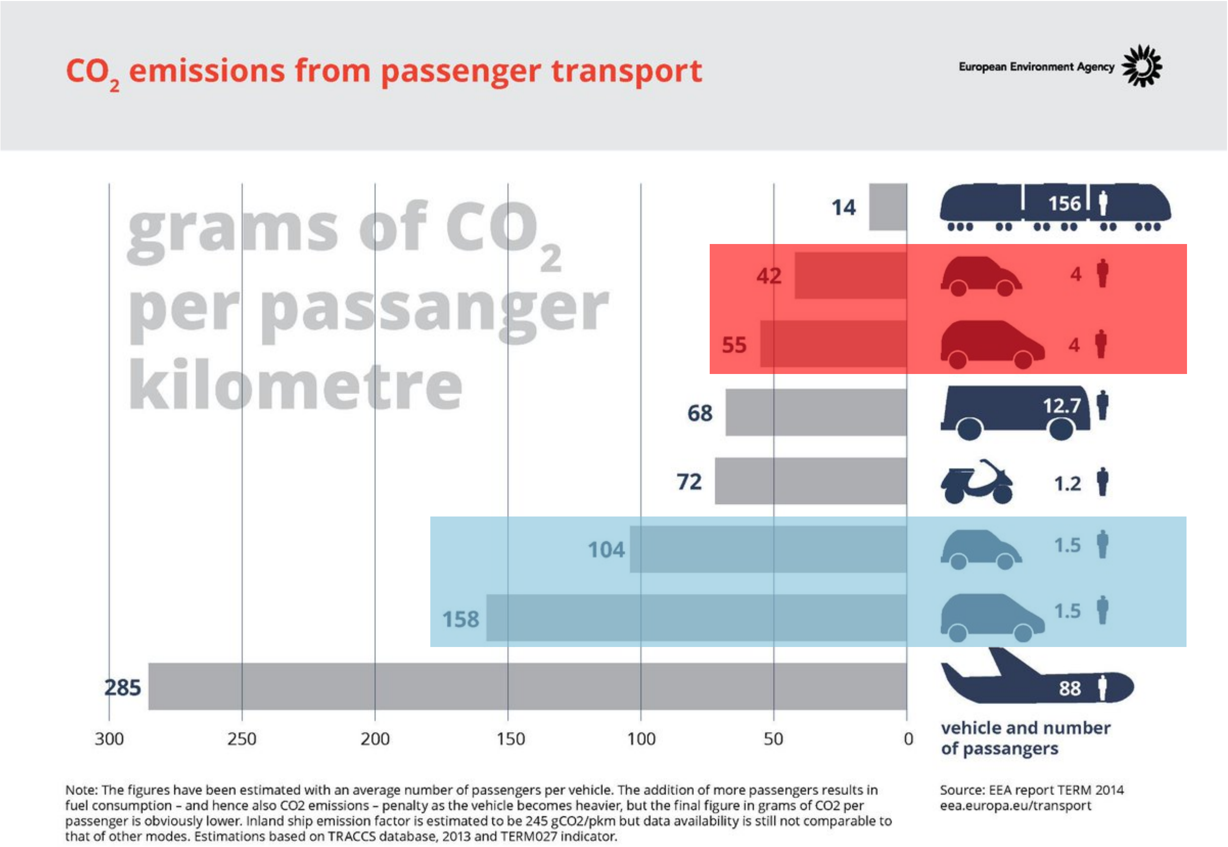
New mobility paradigm: Responding to these different issues together will therefore require going beyond a simple switch to electric cars – assuming it is possible to do so without major constraints, especially as the world’s car fleet is expected to grow in the coming decades.

The first step could regard car specifically (less ownership, more sharing…

…and more pooling): a car generally has five seats, can go up to 180 km/h, and weighs around 1.3 tonnes, whereas the most frequent uses are for one person, on roads limited to 80 or 90 km/h maximum (more rarely up to 130 km/h), for distances of a few kilometers to a few dozen kilometers.



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More generally, we also need to review the place and uses of the car in mobility, by acting on the **five levers of decarbonization of mobility**, cited by the national low-carbon strategy, namely **moderation of transport demand**, by getting closer to people on a daily basis and reducing the longest journeys; **modal shift**, by favouring walking, cycling, trains, buses and coaches as much as possible (and in this order), well ahead of cars and planes, whose use must be reduced; by **improving vehicle occupancy**, in particular through carpooling; **energy efficiency**, which also concerns the reduction of speed on the roads, in addition to the levers of more environmentally friendly and electric vehicles already mentioned; and finally the **decarbonization of energy**, in particular through electrification for the lightest vehicles, and also hydrogen, biogas, agrofuels, or synthetic fuels as a complement or for the other modes that are more difficult to electrify.

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If technology, and in particular this last lever, are major and indispensable, they must be placed in their rightful place in the transition, as the last levers of decarbonization, after the previous levers which better enable the impacts of mobility to be tackled at the root and thus respond positively to more sustainability issues. As far as the car is concerned, **the electric car must be encouraged**, because it is the best alternative to get rid of oil, but it cannot be seen as a miracle cure… because it is not.

Thank you!

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