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Linda Olsson

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The Role of Electric Vehicles in Reducing Climate Impact: Swedish Public Debate in 2010-2018

Linda Olsson,[1] RISE Research Institutes of Sweden, Sweden

Abstract: To meet the Paris agreement, CO_2 emissions from road transport need to be severely lowered. In Sweden, as in many other countries, the number of electric vehicles (EVs) is increasing rapidly. This has led to a recurring debate on whether EVs will help reduce climate impact or not. The aim of this paper is to analyze the Swedish debate on the climate impact of EVs with respect to framing and validity of the arguments. Thirty-one opinion pieces published between 2010 and 2018 are studied. Two discourse coalitions are identified; supporters and opponents of EVs. The opponents' main argument is that EVs use imported, coal-fired electricity with high CO_2 emissions. The supporters argue that EVs use Swedish, fossil-free electricity, thereby causing no CO_2 emissions. Neither coalition's arguments are wholly valid, but nor are they wholly false. Swedish electricity production is largely fossil free, but, at times of high electricity demand, fossil-based electricity is imported. Thus, Swedish EVs often use fossil-free electricity, but sometimes they do not. This is likely to continue with a large-scale transition to electromobility. Both discourse coalitions motivate their positions with a desire to reduce climate impact. EV supporters are optimistic about technology development and frame EVs as fundamental for future carbon-neutral possibilities. While EV opponents are pessimistic, their framing of the issue implies a need for society to assume responsibility for sustainability in a wide system perspective. This should be acknowledged and used by policy-makers, to ensure that EVs' full potential for climate change mitigation be realized.

Keywords: Electric vehicles, Public debate, Climate impact of electricity use

To meet the goals of the Paris agreement and keep global warming below 2°C, CO_2 emissions from road transport need to be severely lowered. This requires a multitude of solutions, both technological and behavioral. One technological solution is the electric vehicle (EV), which does not cause local CO_2 emissions. As the electric engine is silent and does not cause local particle emissions, the EV is considered particularly important for improving urban environment and public health. With the global trend of urbanization, electrification of the road transport sector is an important part of sustainable development (Heidrich et al. 2017; Pereirinha et al. 2018; Schiller and Kenworthy 2018, Tobollik et al. 2016).

Sweden's climate policy framework states that by 2030, greenhouse gas emissions from transport shall be reduced by 70%. By 2045, the country shall be carbon neutral (Swedish Environmental Protection Agency 2018). EVs are considered a means to reach the climate goals while maintaining mobility and encouraging continued economic growth. The number of EVs increases rapidly. In 2012, Sweden had less than two thousand registered EVs. Six years later, the number exceeds sixty-six thousand. In 2018 alone, registered EVs grew by 47% (Power Circle 2019). A lot of attention is given to issues related to EVs, such as charging infrastructure and public policy to promote electrified transport (Egnér and Trosvik 2018; Habibi et al. 2018; Sovacool et al. 2018). There are subsidies for purchasing a new EV and installing private and public charging infrastructure. Policy for other sustainable transport solutions, such as pure biofuels (ethanol, biogas and biodiesel), has given way to EVs, charging infrastructure and electric roads (Ammenberg et al. 2018; Sovacool et al. 2018).

A common perception, perpetuated by EV marketing as well as policy, is that EVs are carbon neutral as they do not have exhaust pipes. However, while EVs cause no local CO_2 emissions, the electricity that they use may cause CO_2 emissions (Ma et al. 2012; Olsson and Carlson 2013; Poullikkas 2015). In a life-cycle perspective, the manufacturing of the EV and in particular its battery may also contribute to CO_2 emissions (Raugei and Winfield 2019; Romare and Dahllöf 2017). The notion that EVs can contribute to CO_2 emissions has gained public

[1] Corresponding Author: Linda Olsson, RISE Viktoria, Lindholmspiren 3a, SE-417 56 Gothenburg, Sweden. email: linda.olsson@ri.se

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COMMON GROUND

attention. There is a recurring debate on the climate impact of Swedish EVs, which engages researchers as well as industry and which may influence the Swedes’ attitudes to EVs.

It is important to understand the debate on whether EVs can and will reduce climate impact or not, and what effects the debate might have on the development on the Swedish transport and energy systems. The aim of this paper is to provide such an understanding, by analyzing the Swedish debate in print media with regard to discourse and validity of arguments. The analysis is mainly focused on the climate impact of EVs’ electricity use, but also on which actors engage in the debate, what motivates them and how they frame their opinions.

The paper is disposed as follows: the next section describes the material used in the paper and the methodology and theoretical frameworks that are used. Then, an overview of the debate is provided, followed by a section on the climate impact of Swedish electricity use. The material is analyzed and discussed, and the paper is concluded by some implications for climate policy.

Methodology and material

Data collection

The electronic archives of three newspapers were searched for opinion pieces on the climate impact of EVs. The papers selected for the study are two of the largest and most well-known daily morning papers *Dagens Nyheter* and *Svenska Dagbladet*, and the technology-focused weekly newspaper *Ny Teknik*. These papers all have national distribution and their opinion sections are esteemed. The searches included the words (in Swedish) *electric car* and *debate* and *climate* or *emissions*. Only articles tagged with *opinion* or *reply* were selected, as this reflects that they belong to opinion sections and are not news articles. The searches were done with no specific start-date but with end-date 31st December 2018. Articles were excluded if headlines indicated their focus was neither EVs nor climate impact.

Upon reading the selected material, opinion pieces were excluded if climate impact of EVs was found not to be a relevant topic. The reading phase also included snowball methodology: additional, specific searches were made, to find any material related to the selected opinion pieces that had not been found in the initial searches. This led to the inclusion of one opinion piece from a different source. A reply to one of the selected opinion pieces was published on the web page *Second Opinion*, which is run by the Swedish energy sector’s trade organization.

It should be noted that in some cases, opinion pieces within the selection are published as replies or commentary to news articles, reports or opinion pieces with a different focus. In those cases, only the opinion pieces that focus on the climate impact of EVs are part of the selection. For example, an opinion piece advocating subsidies for EVs received a reply stating that EVs will intensify climate change. In that case the reply was included in the selection, but the initial article was not.

Framing theory and discourse analysis

According to *framing theory*, public debate can be explained as a result of how issues or problems are defined or framed (Bacchi 2008; Chong and Druckman 2007; Fuller and McCauley 2016; Nisbet and Newman 2015). An example of this shown by Peoples’ (2014) study on nuclear security, in which ‘security’ can be framed in two very different ways: either as a risk of nuclear power plant accidents, or as a possibility for national self-sufficiency regarding low-carbon electricity supply. The former framing will likely lead to a negative opinion, while the latter is more likely to lead to a positive opinion. Nevertheless, both framings of security are valid, and they may well co-exist. Framing research has been shown useful in improving the understanding of why climate change issues divide the public (Nisbet and Newman 2015). Asplund (2018) shows that climate change communication is not only a question of facts but of how the communication makes us feel, which implies that framing studies can add valuable contributions to climate change research. In this paper, framing theory is used as a basis for understanding the public debate on the climate impact of EVs.

Public debate can also be understood by *discourse analysis*, which focuses on the construction of meaning in communication (Cotton, Rattle and Van Alstine 2014; Hajer 1995; Schwedes, Kettner and Tiedtke 2013; Selbmann and Ide 2015). Discourses "represent sedimentations of meaning which are reproduced in social interactions again and again" (Selbmann and Ide 2015, p. 119). The discourse may focus on a *storyline*, which is a condensed narrative that represents the opinion of a *discourse coalition* (Cotton, Rattle and Van Alstine 2014; Hajer 1995; Selbmann and Ide 2015). A discourse coalition may contain persons or entities with different interests and motivations, who come together around a shared storyline. The shared storyline gives the discourse coalition power (Cotton, Rattle and Van Alstine 2014), which means that they may have a greater chance to influence policy. The concept of discourse coalitions is used in this paper.

A systems perspective on electricity use

The validity of debaters' arguments regarding the climate impact of EVs is examined based on a literature study of the Swedish electricity system. A *system* can be defined as a collection of components and the relations between them. The *system boundary* separates the system under study from its environment. The choice of system boundary is a crucial component in climate impact assessments. Explicitly stating which system boundaries (geographic, temporal, etc.) are used in a study is also important, to ensure that results may be correctly interpreted. In environmental assessments, greenhouse gas emissions have been shown to vary to a great extent, depending on the choice of system boundaries (Börjesson 2009; Ma et al. 2012; Olsson 2015; Wetterlund, Pettersson and Magnusson 2010).

Other methodological choices are equally important. In the case of electricity use, whether the assessment is *attributional* or *consequential* is vital. An attributional assessment determines the impact of electricity use that has already occurred, while a consequential assessment, determines the consequences of future changes in electricity use (Ekvall, Tillman and Molander 2005; Finnveden 2008). It is thus important to know the objective of the assessment; to assess the environmental impact of an existing system, or to determine the potential impact of a future scenario? This has impact on which methodology that should be used to calculate emissions.

There are several principles for assessing emissions from electricity production and use (Dotzauer 2010; Sjödin and Grönkvist 2004). *The average electricity principle* means using emissions from the studied system's average electricity mix in assessments. This is relevant for attributional studies, when the electricity mix has been determined. *The marginal electricity principle* should be applied in short-term consequence analyses, when the electricity use is not part of the current system but will occur in a future system. A change in electricity use demands a change in electricity generation, which will affect the marginal production unit. As electricity production units are taken into operation in merit order, based on operating costs, the marginal production unit will either be the producing unit with the highest operational costs, or the unit to next be taken into operation. *The principle of long-term development of the power system* should be applied in long-term consequential assessments. While the previous marginal principle deals with the *operating margin,* this principle deals with the *build margin*. Depending on the future development of the electricity sector, different production units will constitute the margin.

The principle of emission trading impact states that with the cap on greenhouse gas emissions in the European Union's emission trading scheme (EU ETS), increased electricity use cannot lead to increased emissions. However, the EU ETS has previously not functioned as planned, with far too many emissions permits available (Elkerbout 2018). Emissions have been known to increase within the system (Agora Energiewende and Sandbag 2018). Finally, *the principle of contracted delivery* means that if the customer buys a certain kind of electricity, e.g., hydropower, then the emissions from that kind or mix should be used in assessments. Then, however, all users without contracted delivery should calculate their emissions using the residual mix. Otherwise, the whole production mix will not be accounted for.

Overview of the debate

The search process described in the methodology section led to the selection of thirty-one opinion pieces, published between 2010 and 2018. Figure 1 shows an overview of their distribution with regard to year and source. The selection includes ten continuous chains, in which an initial opinion piece receives at least one reply, and two stand-alone opinion pieces.

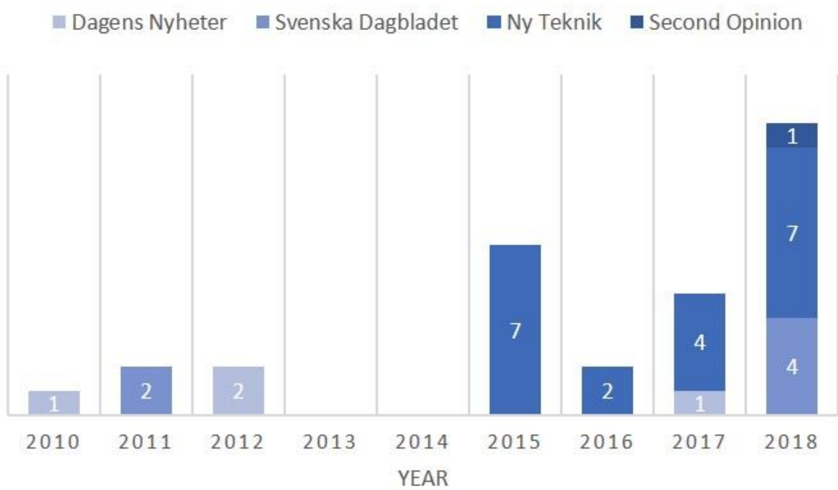

Figure 1: Distribution of opinion pieces with respect to source and year of publishing
Source: Olsson 2019

Nine of the studied opinion pieces are written by researchers, fourteen by companies, think tanks or trade organizations, and eight by independent individuals. Table 1 shows the distribution of authors' affiliations and general opinions. Approximately one third of the opinion pieces has multiple authors, in a few cases with different affiliations. Only two of the studied opinion pieces are co-authored by women.

Table 1: Distribution of authors' affiliation and opinion for the thirty-one opinion pieces (in cases of co-authors with different affiliations, the first author is represented here)

	For EVs	*Against EVs*	*Neither*
Independent individual	-	7	1
Energy company	2	-	-
Car manufacturer	2	-	-
Trade organization	4	-	-
Think tank	6	-	-
Researcher	4	3	2

Source: Olsson 2019

Arguments against EVs

Roughly 30% of the opinion pieces are negative towards EVs, and the authors mean that EVs will increase CO_2 emissions. Debaters argue that the lack of an exhaust pipe does not imply zero CO_2 emissions. Additionally, several debaters raise the issue of emissions in the manufacturing phase and argue that applying a life cycle perspective is necessary when establishing the emissions from an EV. The main, recurring argument for this position is however that new Swedish EVs are charged with electricity from coal-fired plants, which cause very high CO_2 emissions.

In Svenska Dagbladet, April 28th, 2011, a debater writes that *"An increased electricity use must currently be supplied by increased production in coal-fired power plants. Thus, actual greenhouse gas emissions from electric cars are approximately three times greater than from corresponding diesel cars. In the short-term perspective, going for electric cars is a direct environmental hazard."* On October 5th, 2018, also in Svenska Dagbladet, debaters write that *"an increase in Swedish electricity consumption generates a corresponding increase in fossil electricity production somewhere in Europe. A transition from direct fossil consumption, such as gasoline or diesel, to electricity consumption, is therefore like stepping out of the ashes and into the fire."*

Other arguments against EVs include the environmental impact of mining to obtain lithium-ion battery material, and that the batteries are expensive and inefficient. Some debaters point out that the electricity grid needs costly development to meet the requirements of EV charging, and others warn that EV subsidies draw funding and attention from other means of sustainable transport, such as public transport. Finally, the debaters generally state that there is no such thing as an environmentally friendly car. *"No cars are environmentally friendly, as they all entail consumption of finite resources which will have devastating consequences for future generations"*, writes a debater in Ny Teknik on February 22nd, 2018. However, they fail to describe any alternatives.

Arguments for EVs

Approximately 60% of the opinion pieces are positive towards EVs. The main argument is that in Sweden, new EVs use renewable electricity and thus they do not cause any (or very low) CO_2 emissions in their use phase. Some debaters argue that contracted delivery of renewable electricity entails zero emissions for electricity consumers who have made that choice. On 31st October 2018, a debater writes in Ny Teknik that *"Electric cars run on renewables in Sweden – not on coal. We have almost no coal left in the electricity mix, public chargers are almost always supplied by renewable electricity, and those who charge their electric car at home are to a very high extent – hardly surprising – those who buy green electricity or are even electricity producers themselves."* Other debaters argue zero emissions due to the EU ETS, which puts a cap on CO_2 emissions from electricity production. A debater writes in Ny Teknik, October 8th, 2018, that "*The power industry's CO_2 emissions fall under the cap of the emission trading system, which means that an increasing electricity use cannot lead to increased emissions."*

Several debaters argue the importance of using EVs extensively, to reduce environmental impact per driven distance, and advocate that EVs be used as taxis or in carpools. Battery recycling is often advocated, to justify environmental impact in the manufacturing phase. Some debaters mean that battery materials can be recycled indefinitely. To prolong the life cycle, giving the batteries a second life after they are no longer useful in a vehicle is advocated. Some debaters also propose that the batteries be used to stabilize the electricity grid, either while in the vehicles or in second-life applications.

A common argument is that EVs are particularly beneficial in cities, as they cause less air pollution and noise than conventional vehicles. Some debaters argue that EVs may simply benefit innovation of smart mobility solutions. Finally, debaters generally admit that EVs have sustainability problems, but they generally also fail to describe how to solve them. A debater writes in Ny Teknik, 12th July 2018, that *"The electric car will not solve everything, and electric transports are not perfect. But it is important not to let legitimate objections delay or obstruct the transition from the fossil car in which Sweden is about to take the lead."*

The climate impact of Swedish electricity use

The current Swedish electricity system

The Swedish electricity production is based on hydro- and nuclear power, with smaller shares of biomass- or waste-fueled combined heat and power (CHP) and wind power, and a small but steadily growing share of solar power. In 2016, the mix consisted of 40% hydropower, 40% nuclear power, 10% wind power, 9% CHP and 1% solar power and condensing power (Swedish Energy Agency 2017). There are small shares of fossil fuels in the system, mainly used in reserve power plants to cover peak loads on cold winter days. Thus, the Swedish electricity production mix has quite low CO_2 emissions.

European electricity production technology varies vastly between countries, from the nearly fossil-free production mix of Sweden to the primarily coal-based production of Poland and with countries such as Germany, where both renewable and fossil fuels play big parts, in between. In total, fossil fuels were the basis for 44% of the European electricity production in 2017 (Agora Energiewende and Sandbag 2018). A common trend is that renewable energy sources (wind in particular) are increasing, in 2017 even overtaking coal (Kaivo-oja, Vehmas and Luukkanen 2016; Agora Energiewende and Sandbag 2018). However, electricity generation from lignite and natural gas also grew in 2017 (Agora Energiewende and Sandbag 2018).

Sweden is part of the deregulated European electricity market, and Swedish electricity is traded on NordPool Spot where electricity is traded across borders. The Swedish electricity grid is connected to Norway, Finland, Denmark, Germany, Poland and Lithuania, and electricity is traded across all these borders and in both directions. On annual basis, Sweden is a net exporter of electricity (Swedish Energy Agency 2017). On a cold winter day there can however be a net import (Svenska Kraftnät 2018). As the Swedish grid through its connections with neighboring countries is connected to most of Europe, it may be argued that emission assessments should assume a European system boundary and use European electricity production data. The European electricity production margin is generally considered to primarily consist of electricity from fossil generation (see, e.g., Dotzauer 2010; Olkkonen and Syri 2016).

A Finnish study of the Nordic electricity system (encompassing Sweden, Finland, Norway and Denmark) shows that hydro- and nuclear power production are not affected by changes in electricity use. Changes on the margin are met by export or import, which means that European marginal electricity production constitutes the Nordic margin (Olkkonen and Syri 2016). This implies that at times when Sweden has an electricity import, the European margin should be used in climate impact assessments, but that at other times, Swedish production constitutes the margin.

With regard to diurnal variations in electricity production and use, a German study found that the time of EV charging does not significantly affect average emissions (Jochem, Babrowski and Fichtner 2015). The time of charging may however affect marginal emissions, as different technologies might constitute the margin at different times. Matching demand to supply may thus have significant effect. Controlling when EV charging occurs (e.g. off-peak) could reduce CO_2 emissions (Jochem, Babrowski and Fichtner 2015; Van Mierlo, Messagie and Rangaraju 2017).

To summarize, Swedish electricity use is most often met by Swedish electricity production, which is largely fossil free. Due to the common European electricity market, there is however reason to assume a European system boundary, especially at times of high electricity demand as Sweden then imports electricity. When assessing the impact of future increases in electricity use, it is advisable to keep in mind that the marginal technology may change depending on time of day as well as time of year. Future changes to electricity production technologies should also be taken into account.

Future development of the Swedish electricity system

Total Swedish electricity use is fairly stable, despite a growing population (Swedish Energy Agency 2017), which shows that energy-efficiency measures have had the desired effect. However, with increased electricity demand in new sectors such as transport, it is likely that total electricity use will increase (IVA 2016a). Nuclear power plants are being phased out and hydropower production is already at maximum capacity under current legislation. While renewable electricity production is increasing, much is needed for it to fill the demand.

Scenarios for future Swedish electricity production have been created in order to identify system requirements (IVA 2016b). For a major increase in wind and solar power, installed capacity must be very high in order to ensure enough available power at peak load occasions. This is however likely to lead to big power surpluses at other times, which puts a strain on the electricity grid. Transmission capacity would need to increase, and energy storage would be required for an efficient use of the system. A major increase in biomass-fired power production would mainly depend on the availability and cost of feedstock. Biomass will likely be an important feedstock for several lines of business, so competition may be high. Investment in new nuclear power, with modern technology, would require that political decisions to commission new plants be made rather soon. That could be unlikely, considering previous decisions to phase out existing nuclear power plants. Increase of hydropower production is not possible given current legislation, which protects rivers and their ecosystems. Evidently, all the pathways to a continued renewable electricity system pose challenges.

Studies show that an increase in European renewable electricity production (wind power in particular) is coupled with a minor increase in thermal electricity generation using fossil fuels, as this is required for load balancing (Marques, Fuinhas and Pereira 2018; Verdolini, Vona and Popp 2018). During years with low rainfall and thus low hydropower production, European fossil electricity production increases, and fossil fuels are subsidized to ensure the existence of backup production (Agora Energiewende and Sandbag 2018). Fossil fuels are thus likely to be part of European electricity production for the foreseeable future, despite the growth in renewable electricity production. A model of a Swedish 2045 renewable electricity system shows that even then, there may be a need for import of fossil power from Germany and Poland in winter (IVA 2016a).

EVs – saving the climate or not?

Categorizing debaters

The debate on the climate impact of EVs is centered around electricity production; for the main part electricity for charging but to some extent also for car and battery manufacturing. The debate is highly polarized. One side claim that EVs use European coal-fired power, which entails high CO_2 emissions. The other side claim that EVs either use Swedish, fossil-free electricity or that it is irrelevant to consider CO_2 emissions from electricity use due to EU ETS. Two discourse coalitions can be distinguished; the EV supporters and the EV opponents.

Representatives of energy companies, car manufacturers, trade organizations and think tanks, together with some researchers form a discourse coalition which is undividedly positive towards EVs. They reckon that EVs in a Swedish context will be charged with renewable electricity and foresee an unproblematic future in which challenges such as load balancing and cobalt supplies will be solved by new technology and new business models. Their common storyline is technology optimism. The EV supporters frame EVs as a possibility for a better future: EVs are simply a chance too good to pass by. The technology and user behavior that are needed for EVs to reach their full sustainability potential are not yet mature and in place, but in this framing, that should not be allowed to impede development.

Independent individuals and some researchers form a discourse coalition around the storyline of alarmism. They consider EVs an immature replacement for fossil-fuel cars and argue that a large-scale transition to electromobility will cause increased CO_2 emissions due to the increased need for coal-fired power production. EV opponents share a dissatisfaction with existing climate politics and their related costs, and frame EVs as an issue of not trading one sustainability problem for another. They wish to tread carefully on the path to reduced climate impact, by ensuring that EVs do not turn out to be as polluting as fossil-fuel vehicles. This frame includes a wide system perspective, in which the climate impact of the electricity system must be reduced to near-zero before EVs can do their part for the climate.

The three opinion pieces that are not written by either of the identified discourse coalitions form a very interesting part of the analysis. The authors do not argue that EVs are good or bad for the climate but point out that sustainable product development does not happen automatically and suggest requirements to ensure greater sustainability in the production and use of EVs. These opinion pieces are met by critique from the EV supporters, who in their replies use the same rhetoric as they do when replying to EV opponents. This demonstrates the vagueness of the EV supporters with respect to *how* technology will develop. Their framing of the issue is that the right technology *will* develop, and that will be beneficial for the climate.

Validity of the arguments

All principles for assessing emissions are visible somewhere in the debate. EV opponents generally use the marginal electricity principle, although the extent to which they explain this varies. Their position is that EVs use marginal electricity, and as they assume a European system boundary, the margin consists of coal-fired power plants. EV supporters either use the average electricity principle, the principle of emission trading impact or the principle of contracted delivery, or a combination of these principles. Regardless of principle, their position is that new EVs will use fossil-free electricity.

One of the problems in the debate is *which* perspectives are applied. Another problem is *how* those perspectives are applied. As the debate is mainly about a future with more EVs, it is reasonable to use the marginal electricity principle. But then it is important to know what technology can be expected to constitute the future margin. The literature study shows that currently, at most times, Swedish electricity production constitutes the Swedish margin. Even in a life-cycle perspective, Swedish electricity production causes low CO_2 emissions. At times of high electricity demand, it is however likely that imported electricity of fossil origin constitutes the margin. This situation is likely to remain even with a future increase in renewable electricity production. Hence, debaters who argue that EVs always use coal-based electricity apply a reasonable emissions-assessment principle, but they are wrong to assume that the margin always is, or will be, made up by coal-fired power plants.

The EV supporters, who argue that Swedish EVs are always charged with fossil-free electricity, generally base their opinions on the wrong principles. The principle of average electricity is applicable for existing EVs but not for the future ones that the debate concerns. The principle of contracted delivery is not applicable either, unless all users without contracted delivery calculate their emissions using the residual mix. Otherwise, the whole production mix will not be accounted for. The principle of emission trading impact would be applicable if the EU ETS cap on emissions were effective. However, emissions have increased under the cap (Agora Energiewende and Sandbag 2018). The EU ETS has recently been updated, which may turn it into the powerful tool to reduce climate impact that it is meant to be.

To summarize, the EV opponents use a correct principle but with incorrect information, thus ending up with an incorrect result. The EV supporters use incorrect principles, which entails that they too end up with incorrect results. The EV supporters can be viewed as being slightly more correct as currently, Swedish EVs primarily do use fossil-free electricity. Considering a future with a large-scale transition to EVs and some uncertainty as to how the Swedish and European electricity systems will develop, the EV opponents' perspective may however be important to apply in order to visualize impacts and consequences.

Implications for climate policy

Both discourse coalitions motivate their positions with a desire to reduce climate impact. While the EV opponents are alarmistic, their framing implies that society should assume responsibility for ensuring sustainable development in a wide system perspective. The EV supporters paint a picture of a future of limitless, carbon-neutral possibilities to reduce climate impact. Their framing does not involve assuming responsibility for technological development. Rather, the EV supporters assume that the "right" technology will simply come to be developed and used. The EV supporters are the more powerful coalition, with nationally well-known voices who represent Swedish industry. Although the coalition's members may have different reasons for advocating EVs, they come together around the storyline of technology optimism: EVs will reduce climate impact while presenting opportunities for Swedish industry. The greater power and the optimistic and undemanding framing of the EV supporters could give them greater influence over the general attitude towards EVs.

It is unknown to what extent a large-scale transition to EVs will contribute to reduced climate impact. Given fossil-free electricity generation, the emission-reducing potential of EVs could be great. Improved manufacturing, reuse and recycling of EVs and batteries could also mean great potential for increased sustainability. But as this paper has shown, a large-scale transition to EVs could imply some climate impact even in a country with nearly fossil-free electricity production. Not acknowledging that, could lead to not achieving the full potential for climate impact reduction.

The more focus that is put on EVs as important mitigators of climate change, the more focus needs to be put on ensuring that EVs will reduce CO_2 emissions. Going with the EV supporters' framing, it would be easy to believe that emission reductions will occur regardless. This could lead to less than optimal climate policy. To illustrate this with a recent example, the Swedish government has declared their intention to prohibit sales of new gasoline- and diesel-fueled cars by 2030 (Ewenfeldt 2019). That would mean phasing out cars that use fossil fuels. It also means phasing out cars that could use biofuels, thus losing one of the currently available options for carbon-neutral transport. The only currently realistic alternatives to conventional cars are EVs. As the reason for the intended policy is to reduce climate impact from transport, it is a safe assumption that it rests at least partly on an expectation that EVs will ensure fossil-free transport.

Conclusions

This paper has shown that there are two discourse coalitions in the Swedish debate on the climate impact of EVs; EV supporters and EV opponents. The EV supporters argue, based on flawed assumptions, that EVs are carbon-neutral and they frame EVs as a possibility for a better future. The EV opponents argue, also based on flawed assumptions, that EVs will cause higher CO_2 emissions than conventional cars and they frame EVs as just another a sustainability problem. Both are correct, to a certain extent. Swedish electricity production is largely fossil-free, but at times of high electricity demand, fossil electricity is imported. Charging EVs at such times would mean using fossil electricity. While renewable electricity production is increasing, it is likely that fossil electricity import will remain necessary. Thus, a future large-scale transition to electromobility will entail some reliance on fossil fuels. Policy attention should be directed at creating a sustainable energy system for EVs to be part of. Thus, policy could ensure that EVs' full potential for climate change mitigation can be realized and that EVs do not become another sustainability problem that needs solving. Listening to both sides of the debate would thus be relevant for policymakers.

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ABOUT THE AUTHORS

Linda Olsson: Senior Researcher, RISE Viktoria, RISE Research Institutes of Sweden, Gothenburg, Sweden.