



## Strong link between charging infrastructure and adoption of electric vehicles

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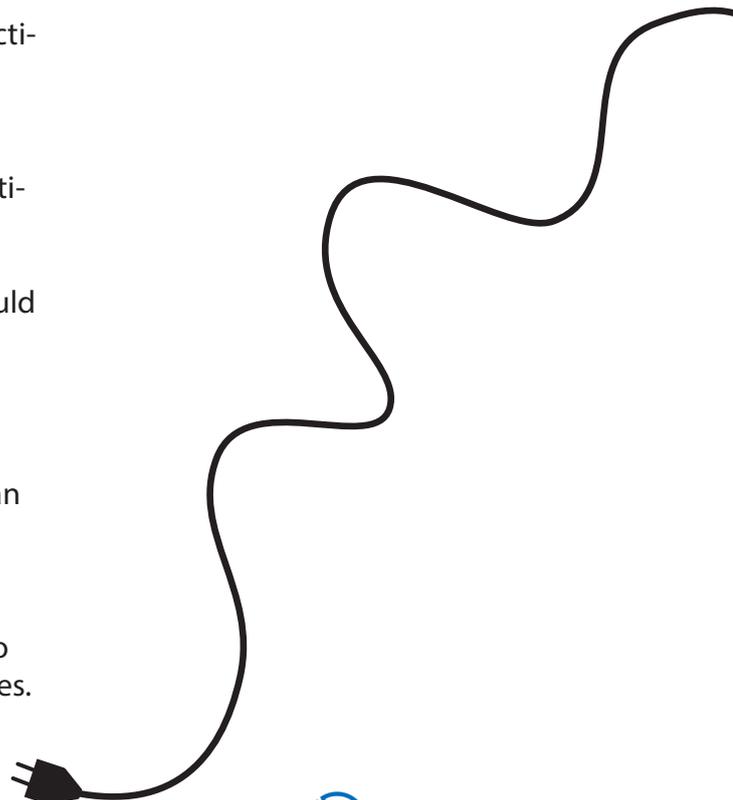
The number of electric vehicles is increasing in Sweden, but the adoption rate varies substantially across municipalities. In joint studies, financed by the Nordic Energy Research project Shift, researchers at IVL Swedish Environmental Research Institute and University of Gothenburg have used panel data to estimate the effect of local policy instruments on the share of newly registered electric vehicles in Swedish municipalities during the period 2010 – 2016.

The studies are the first to examine a causal relationship between the impact of local policy instruments on the EV adoption in Sweden.

### Key findings

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- Expansion of charging infrastructure is an effective instrument to increase the share of electric vehicles.
- Public procurement of electric vehicles is an effective policy instrument.
- Differentiating local policy instruments to the characteristics of municipalities increase the effectiveness of the instruments.
- Public charging points in rural municipalities should be placed mainly along roads with much traffic to counteract range anxiety.
- In urban municipalities, public charging points should be placed close to homes as the main urban barrier is limited charging possibilities at home.
- Municipalities using electric vehicles create a positive externality in terms of experience spill-over to citizens, the effect being larger in rural municipalities.





### Background:

## Understanding EV adoption by examining its determinants

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**The reduction of greenhouse gas emissions from the transport sector is essential for achieving the targets of climate change policy. To reduce these emissions, Sweden has set a target to achieve a fossil independent vehicle fleet by 2030. Depending on the source of electricity, a transition towards electric vehicles (EVs) has the potential to reduce greenhouse gas emissions and therefore Sweden has implemented several policy instruments to increase the adoption of electric vehicles.**

#### **Significant variations across municipalities**

The aim of this study is to contribute to the understanding of electric vehicle adoption by empirically examining its determinants. The study specifically addresses the significant variation in the adoption rate of electric vehicles across municipalities, despite the fact

that national financial incentives are the same across municipalities. The study focuses on battery electric vehicles (BEVs) and examine the impact of local policy instruments designed to promote the adoption at a municipal level.

The local policy instruments in Sweden include parking benefits and public charging infrastructure. In addition to these existing policy instruments, the study also investigates whether public procurement of BEVs at the municipality level has the potential to increase the BEV adoption.

#### **EVs vs BEVs**

Compared to other EV types, BEVs have the potential to lower greenhouse gas emissions during driving to a higher extent since they don't require any fossil fuel. The emissions instead depend on the power source and since



over 90 percent of the electricity production in Sweden is generated from renewable or nuclear sources, the greenhouse gas emissions from BEVs are low. On a local level, BEVs also bring benefits such as air quality improvements and reduced noise.

However, barriers such as high costs, limited battery capacity, and dependence on charging infrastructure are limiting the widespread diffusion of the EV technology. Studies further suggest that imperfect information and limited knowledge about EVs contribute to slow diffusion rates.

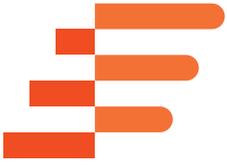
### **National instruments have been weak**

Related literature has in several countries found both nationally implemented financial incentives and locally implemented policy instruments to have a positive impact on

EV adoption. However, the effectiveness of the Swedish national financial instruments promoting EVs have so far been weak and the local policy instruments in Sweden have not previously been empirically examined with quantitative methods. The long-term effects of the bonus malus system introduced in Sweden in 2018 remain to be evaluated.

### **First study to look at the causality of local instruments**

By taking advantage of the municipal variation in BEV adoption rates and local policy instruments in Sweden, this study is the first to causally investigate the impact of local policy instruments on the BEV adoption in Sweden by testing for so called reverse causality between charging infrastructure on the BEV share in the regressions.



### Key findings:

## Public charging points increase the adoption of EVs

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The results indicate that an increased number of public charging points causally increase the adoption rate of electric vehicles, especially in urban municipalities. Differences in the expansion of public charging infrastructure across municipalities could explain why the adoption rate of electric vehicles was faster in some municipalities. Expansion of charging infrastructure is therefore indicated to be an effective instrument to increase the share of electric vehicles.

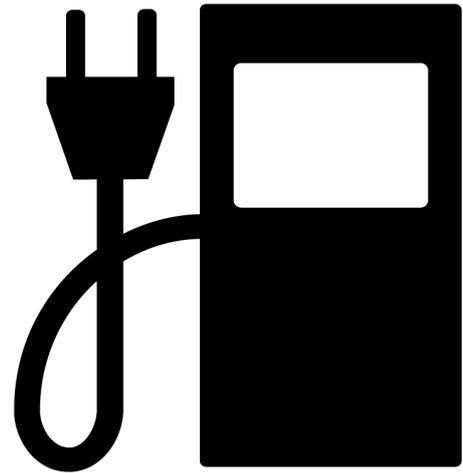
#### Differentiated charging infrastructure

The effect of public charging infrastructure was also found to be larger in urban municipalities than in suburban and rural municipalities. Adjusting policy instruments to the specific characteristics of municipalities and making them visible to the public can increase the effectiveness of the instruments.

Public charging points in rural municipalities are recommended to be placed mainly along roads with high traffic work to counteract range anxiety. In urban municipalities, public charging points should also be placed close to the home as the main urban barrier is limited charging possibilities at home.

#### Positive externality and spill-over

The results also show that public procurement in municipalities also increases the adoption rate of electric vehicles. The hypothesis is that municipalities that use electric vehicles in the municipality work create a positive externality in terms of experience spill-overs to other citizens. Again, there is a difference in the size of effect between rural and urban municipalities with the effect being larger in rural municipalities.



The higher effect could be explained by that municipally owned electric vehicles are relatively more visible and receive more attention in smaller municipalities where smaller social networks contribute to more experience spill-over.

This result suggests that public procurement of electric vehicles is an effective policy instrument and that local policy instruments should be differentiated to the characteristics of municipalities to increase their effectiveness.

### References

Egnér, F and Trosvik, L (2018). Electric Vehicle Adoption in Sweden and the Impact of Local Policy Instruments. *Energy Policy* 121:584-596.

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