

# Effective public policies for EV-dissemination

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## **Short Abstract**

In the Netherlands local governments have great influence on the dissemination of electric cars, on top of the national governments policies. Local governments use several instruments to stimulate EV's in their municipalities. To determine the effectiveness of the individual instruments, a research has been executed amongst 74 municipalities in the Netherlands. The effect of the different instruments on the number of both FEV's and REEV's have been researched. The most effective instruments were: the implementation of charging infrastructure, the municipality as launching customer and an investment subsidy for buyers.

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## **1 Introduction**

Electric transport is booming in the Netherlands: by the end of 2012 there were more than 6.000 electric passenger cars on the road. About 20% were Full Electric Vehicles (FEV) and 80% were Plug-in Hybrid Electric Vehicles (PHEV) or Range Extended Electric Vehicles (REEV). See Figure 1.

Especially for local and national governments it is important to have a significant and growing percentage of electric vehicles (EV) on the road, for the following reasons:

- EV have a positive impact on innercity air-quality;
- EV reduce the CO<sub>2</sub> impact and the oil-dependency, both locally and regionally;
- EV have a positive impact on noise reduction on local level;
- EV have a positive impact on local economies, innovations sustainable development.

Therefore the Dutch government is stimulating growth of the EV sector.

The national Dutch government has successfully implemented several tax-incentives to stimulate EV's. But there are also several instruments implemented by the local governments that have created extra local growth.

In this paper the results of the research conducted by APPM Management Consultants is presented. The objective of the research was to evaluate the effectiveness of the policies of Dutch local governments to stimulate the growth of electric vehicles. In the research the relative number of EV's on the road in a certain municipality was matched with the instruments the local government had applied.

## **2 Research method**

### **2.1 Introduction**

The effectiveness of the instruments is measured with regression-equations (see Eq 1). Within such an equation a quantitative connection is made between a dependent variable and an independent variable. In this research the percentage of electric vehicles is the dependent variable.

For the dependent variable the total number of cars and the percentage electric cars was calculated for all of the 415 municipalities in the Netherlands, using the data from the Vehicle Licensing Agency of the Department of Transport. For the independent variables different sources were used. A number of 50 municipalities were selected based on their active role in government EV-programs and 24 municipalities were added based on other information. The selection was based on the instruments used and the availability of data.

The percentage of EV's is the dependent variable. Within this research two different equations were used:

1. an equation to measure the effect of instruments on the number of FEV (see Eq 2);
2. an equation to measure the effect of instruments on the total number of EVs: FEV plus REV (see Eq 3)

By using these two equations it is possible to analyse if there is a difference in the effect between these two types of EV.

For the independent variables three categories were defined:

- A. Characteristics of the municipality;
- B. Other factors;
- C. Policy instruments.

Within these categories a total number of 13 variables were used (see Table 1).

The goal of the research is to determine the effect of the category C variables: the policy instruments. These are the instruments that local governments can use to stimulate EV. The variables within the A and B category were used as verification variables. These variables do not have a relation with the instruments, but can give an explanation for a significant higher percentage of EVs in a certain municipality.

With the regression equation the impact of the different instruments was measured based on the percentage of EVs within a certain council,

## 2.2 Dependent variables

For the dependent variable (the percentage of EV's) a distinction has been made between FEV's and all EV's (FEV + REEV). The calculations were done for both groups, using the equations (2) and (3). The effectiveness of the instruments on both variables were thus measured.

## 2.3 Independent variables

The three independent variable categories are described below.

### 2.3.1 A. Characteristics of the municipality

Some characteristics of a municipality can have an impact on the relative percentage of EV's in a municipality. To make the different municipalities better comparable, the following factors are defined in the independent variables.

1. Average income:
  - The average income can have an impact: the higher the income the more likely it is that people are able to afford a relatively expensive EV.
2. Number of inhabitants:
  - With a low number of inhabitants (and thus a low number of cars), the use of 1 electric vehicle (i.e. by the municipality) has a relatively strong impact on the relative percentage of EV's.
3. Density of houses:
  - With a relatively high number of houses per km<sup>2</sup>, there may be a parking problem and the use of an instrument with parking benefits for EV's can have a relatively strong impact.
4. Wadden Island:
  - Some municipalities are an island, whereby the limited range of an EV may be less of a problem and thus people may be more inclined to buy EV's.

These variables are taken into account in the research.

### 2.3.2 B. Other factors

Three other factors need to be considered: the percentage of hybrid cars and the presence of car lease companies in a municipality.

5. Percentage of hybrid cars:
  - In the research by Axsen and Kurani [1] it has been proven that the presence of hybrid cars can increase the chances of people buying an EV in certain municipality. Furthermore the presence also give a green image and thus an implicit impulse.
6. Presence of a car-lease company:
  - Since cars are registered at the location of the lease-company, a municipality with a lease-company has a relatively high percentage of EV's. This variable can correct this effect in the research.
7. Pilot projects:
  - Several municipalities have been part of EV-pilot projects performed by the national government and thus have a relative high percentage of EV's. This effect is also accounted for in the research.

These factors are part of the equation in the research.

### 2.3.3 C. Policy instruments

There are many policy instruments used by municipalities to stimulate EV in their environment. The following six were selected to be included in this research since these are the most widely used and have the most direct effect.

8. Charging infrastructure:
  - The number of public charging points in a certain municipality can have a positive effect on the number of EV's.
9. Launching customer:
  - The role of launching customer by the municipality can have a positive effect on the relative number of EV's in a municipality.
10. Investment subsidy:
  - The fact if a subsidy is available from the municipality. The amount of subsidy was not quantified.
11. Charging infrastructure subsidy:
  - A municipality can also give subsidy for the implementation of private charging infrastructure.
12. Parking benefits:
  - In some municipalities there are no fees applied to EV's for parking in a paid parking spot.
13. Information and marketing:
  - Some municipalities give information on their website or organise EV-events, hereby influencing the willingness of people to buy an EV.

These variables are included in the equation.

## 3 Conclusion

This research has quantitatively measured the effectiveness of different policy instruments on the relative number of EV's in a certain municipalities. By measuring the EV-density in a municipality and taking into account several influential factors, the effect of these instruments were quantified. The outcome of the regression equation is given in Table 1.

The conclusion of the research (see Table 2) is that the following three instruments prove to be effective to raise the number of EV in a certain city or municipality:

- the implementation of public charging instruments;
- the role of the local government as launching customer;
- an investment subsidy by the local government.

Furthermore there are two factors that also have a positive effect on the number of EV's: the implementation of certain pilot projects in a municipality and the percentage of hybrid cars already on the road in that municipality. The presence of a car-lease company also has a positive effect, but this is a bit of a distortion since these cars are only registered in this municipality (but may drive elsewhere).

## 4 Figures, Tables and Equations

### 4.1 Figures

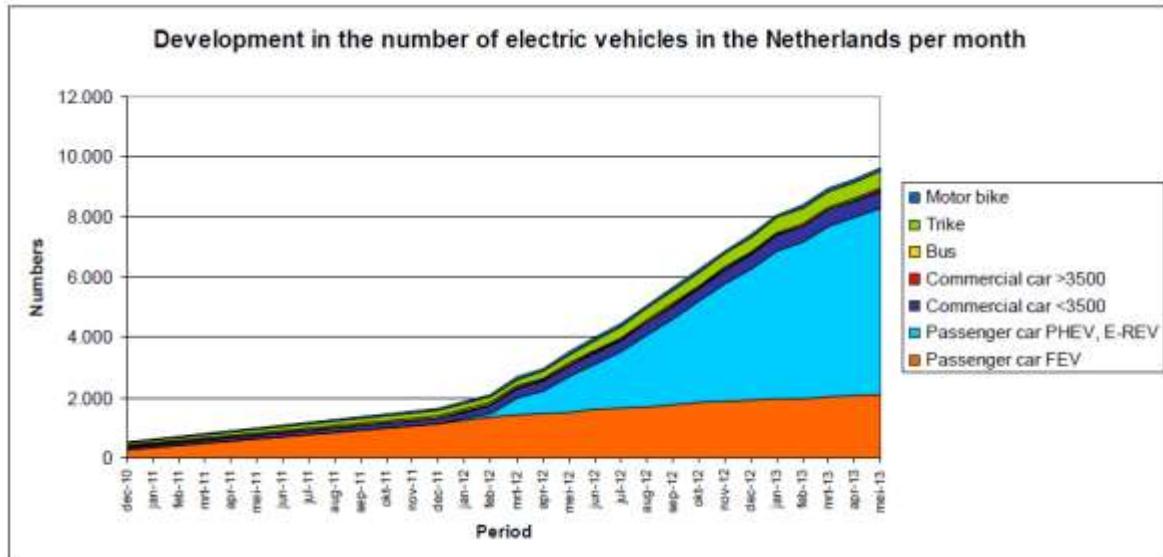


Figure 1: Number of EV's in the Netherlands

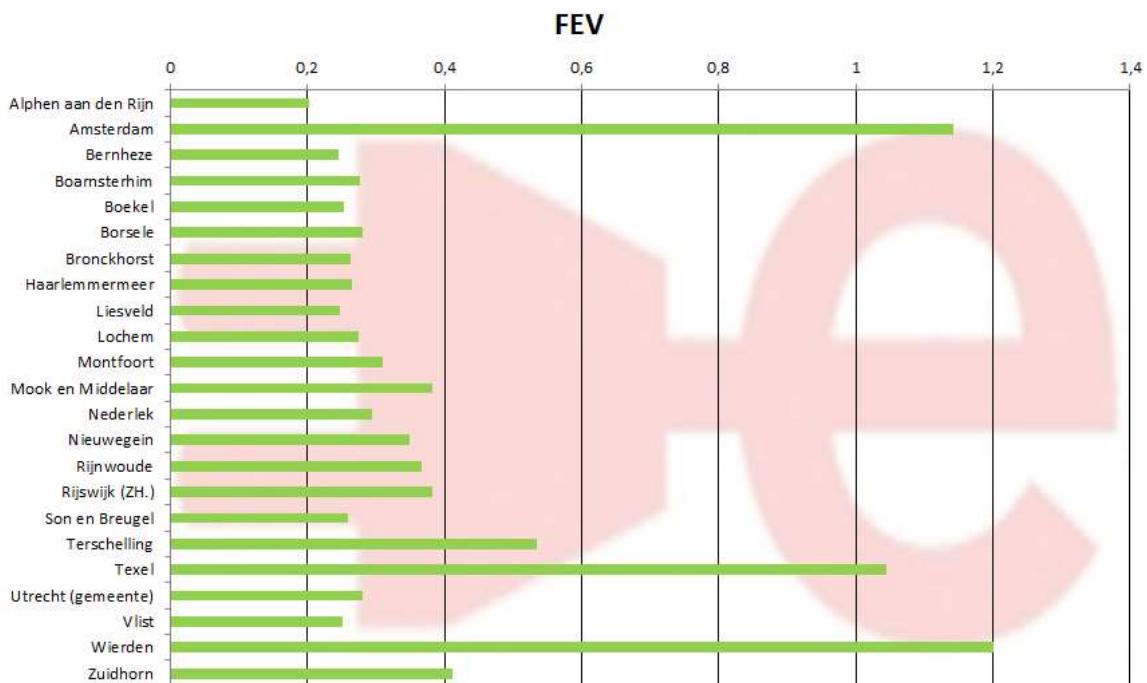


Figure 2: Percentage of FEV per council in the Netherlands (councils > 0,2%)



Figure 3: Percentage of total EV (FEV + REV) per council in the Netherlands (councils > 0,3%)

## 4.2 Tables

Variabels	FEV	FEV & E-REV
1. Income	2.76e-07 (2.68e-06)	9.51e-07 (4.76e-06)
2. Inhabitants	-9.80e-07*** (3.59e-07)	-1.29e-06* (6.96e-07)
3. Density of houses	1.60e-05 (1.06e-05)	2.22e-05 (1.82e-05)
4. Wadden Island	0.175 (0.122)	0.370 (0.250)
5. Hybrid	0.00555 (0.0218)	0.0409* (0.0209)
6. Leasecompany	0.254* (0.152)	0.328** (0.145)
7. Pilot project	0.445** (0.200)	0.775* (0.432)
8. Charging infrastructure	0.00331*** (0.000517)	0.00326*** (0.000749)
9. Launching customer	0.0792** (0.0395)	0.116** (0.0557)
10. Subsidy on charging infrastructure	-0.0347 (0.107)	-0.122 (0.209)
11. Investment subsidy	0.0850* (0.0477)	0.111* (0.0588)
12. Parking benefits	-0.134 (0.108)	-0.205 (0.199)
13. Information and marketing	0.0134 (0.0262)	0.0251 (0.0343)
Constant	0.0402 (0.0417)	0.0791 (0.0717)
Observaties	415	415
R <sup>2</sup>	0.434	0.407
Robuste standaard errors tussen haakjes		
*** p<0.01, ** p<0.05, * p<0.1		

Table 1: Outcome of the regression-equation

Positive effect	Negative effect	No effect
Hybrid	Inhabitants	Income
Leasecompany		Density of houses
Pilot project		Wadden Island
Charging Infrastructure		Charging infrastructure subsidy
Launching customer		Parking benefits
Investment subsidy		Information and Marketing

Table 2: Conclusion on the effect of the instruments

### 4.3 Equations

#### (1) Regression Equation

$$\frac{EV_i}{Total_i} * 100\% = \alpha + \beta_1 Income_i + \beta_2 Inhabitants_i + \beta_3 Houses_i + \beta_4 Wadden Island_i + \beta_5 \frac{Hybrid_i}{Total_i} * 100\% + \beta_6 Leasecompany_i + \beta_7 Pilotproject_i + \beta_8 ChargingInfrastructure_i + \beta_9 Launching Customer_i + \beta_{10} ChargingInfrastructureSubsidy_i + \beta_{11} InvestementSubsidy_i + \beta_{12} ParkingBenefits_i + \beta_{13} InformationMarketing_i + \varepsilon_i)$$

This equation has been used for all 415 councils, resulting in the average coefficient ( $\beta$ ).

The coefficient  $\alpha$  is the constant in the equation, independent from any variable.

#### (2) Equation FEV

$$FEV = \frac{Full\ Electric\ Vehicles}{total\ number\ of\ cars} * 100\%$$

#### (3) Equation Total EV

$$FEV \& REV = \frac{Full\ Electric\ Vehicles + Range\ Extended\ Vehicles}{total\ number\ of\ cars} * 100\%$$

## Acknowledgments

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## References

[1]: 'Reflexive Layers of Influence (RLI): a model of social influence, vehicle purchase behaviour and pro-societal values', Axsen, J. and Kurani, K.S. (2010)

## Authors

Mark van Kerkhof is managing consultant with APPM Management Consultants in the Netherlands. Mark has extensive experience in the successful roll-out of EV-implementation strategies for both public bodies and private companies in the Netherlands and Belgium. Mark has an Msc in Public Administration at the Nijmegen School of Management (Radboud University Nijmegen) and studied International Traffic Management at the Breda University of Applied Sciences.

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