



Painting the EV incentive landscape

A review and visualization of how EV incentives are affecting EV uptake

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INTRODUCTION – Who are we?

**Department of Design, Production and Management
Systems Engineering and Multidisciplinary Design (SEMD) Group | Electric Mobility Team**

| | | | |
|--|----------------------------|-------------------------|---|
| | Associate Professor | Dr. Ir. Maarten Bonnema | Chair of SEMD and Project Supervisor |
| | PostDoc Researcher | Dr. Ir. Steven Haveman | Lead Researcher - Systems Engineering and Systems Modeling Research |
| | Junior Researcher | Marlise Westerhof, MSc | User Centered Design Research of Electric Mobility Systems |
| | Junior Researcher | J. Roberto Reyes García | Data Driven Architectures and Knowledge Sources for Electric Mobility Systems |



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INTRODUCTION – Who are we?

University of Twente SEMD Group

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| | Associate Professor | Dr. Ir. Maarten Bonnema |
| | PostDoc Researcher | Dr. Ir. Steven Haveman |
| | Junior Researcher | Marlise Westerhof, MSc |
| | Junior Researcher | J. Roberto Reyes García |

Fier Automotive

| | | |
|--|-------------------------------------|--|
| | Project Manager / Consultant | Rob Kroon BSc |
| New mobility business development | | |
| Fier believes in moving from | | <ul style="list-style-type: none">• Conventional to smart• Combustion to electric• Ownership to MaaS |



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INTRODUCTION – proEME

promoting Electric Mobility in Europe

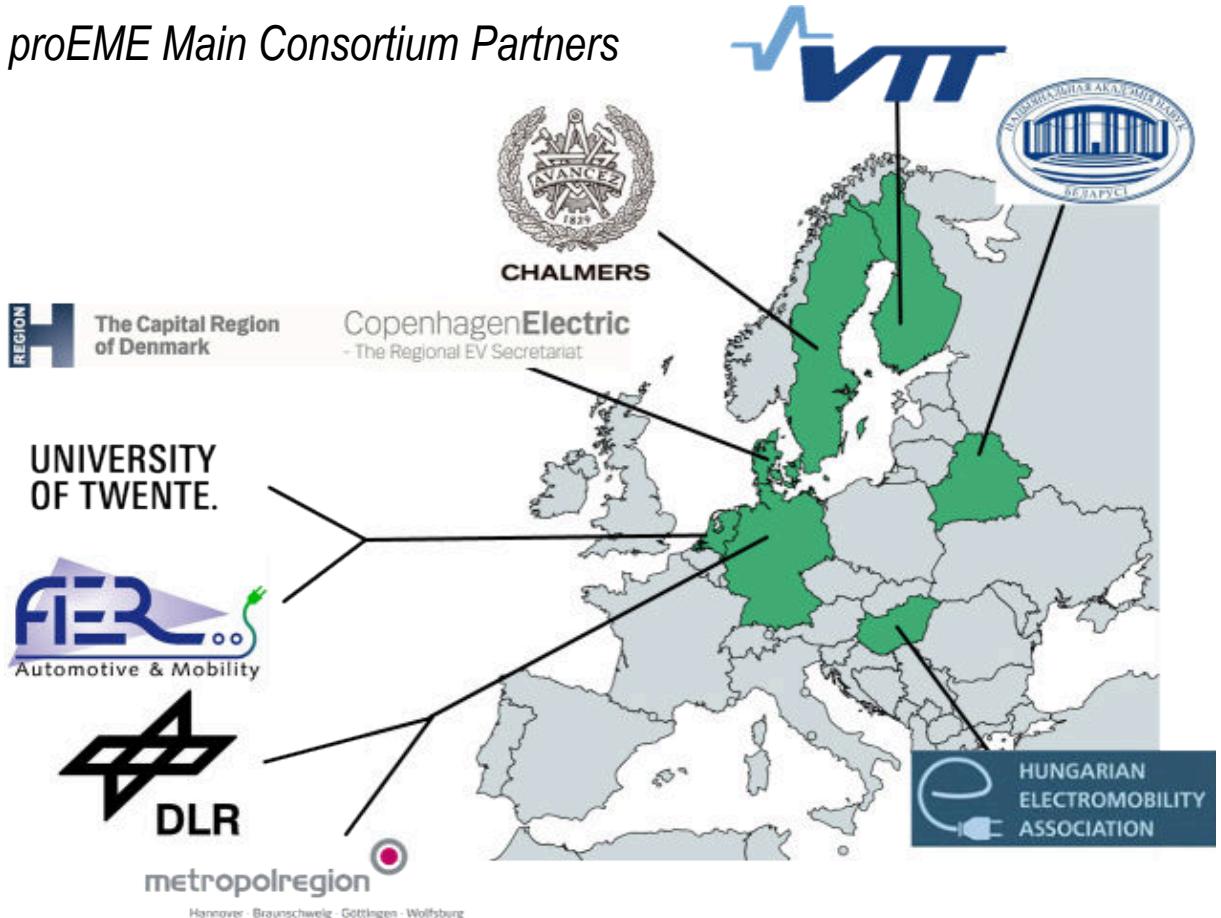
Main goal

- Increase uptake of e-mobility in Europe by building capacities, networks and tools to reach stakeholders and consumers
- Electric mobility still not self-selling!

proEME provides

- Tools and analysis
- Stakeholder outreach

proEME Main Consortium Partners

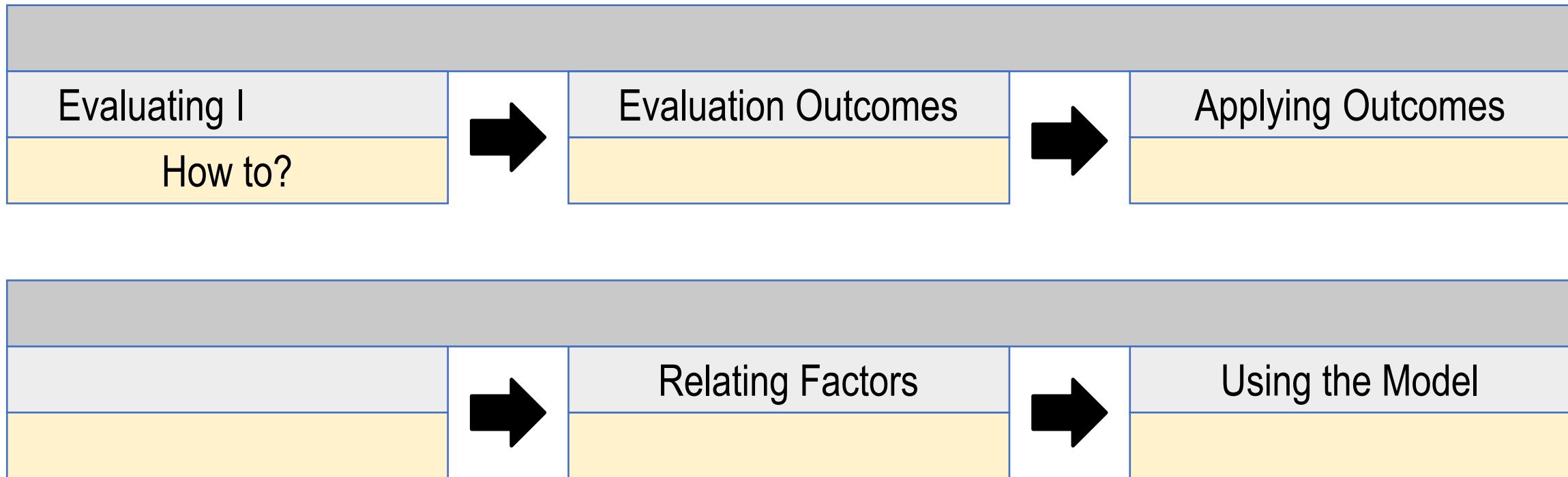




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INTRODUCTION – Scope of This Work





INCENTIVES EVALUATION – How to?

Characteristics of Evaluation Methods

Measure Effectiveness (or Efficiency)

- the number of EVs sold with a specific policy incentive n_1 and the number of EVs sold without that specific policy incentive n_1 (after *Langbroek et al, 2016*)
- Our review excluded efficiency evaluation methods

Timing

- Up-front – often stated preference surveys (“what-if”)
- Afterwards – often collection of data points



INCENTIVES EVALUATION – How to?

Identified Evaluation Methods

| Cross-Sectional Regression Model | Discrete Choice Model | Scenario Based Predictive Model | Qualitative Assessment |
|----------------------------------|--|---------------------------------|------------------------|
| | <p>Petrol € 30.000</p> <p>Electric 230km range € 40.000</p> <p>Electric 450km range € 55.000</p> | | |

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INCENTIVES EVALUATION – How to?

Identified Evaluation Methods – Pro's & Con's

| Cross-Sectional Regression Model | Discrete Choice Model | Scenario Based Predictive Model | Qualitative Assessment |
|---|---|--|---|
| <ul style="list-style-type: none">Easy comparison between effect of different variablesbutRequires translation towards possible future situations | <ul style="list-style-type: none">Good basis to create a decision modelbutRelies on (subjective) user inputs for fictive situations | <ul style="list-style-type: none">Allows widespread exploration of possible future scenario'sbutRelies on quantified inputs of other methods | <ul style="list-style-type: none">Can be used for quick & to the point assessmentsbutProne to biases, outcomes should be considered with great care |



INCENTIVES EVALUATION – Outcomes

- **Outcomes that were reinforced through our research:**
 - Consistent evidence that consumers focus on purchase price over use costs
 - Context Sensitive Incentives
 - Recurring financial incentives can be a deciding factor
 - Road tolling exemptions in localities with extensive tolling schemes
 - Convenience incentives are also very context sensitive
- **Sometimes – sources analyze the effect of the basic monetary value of financial incentives on uptake, without taking into account TCO**
 - These support incorrect perceptions!

INCENTIVES EVALUATION – Avoiding Pitfalls!

- Example 1 – What is the value of a specific incentive in an incentive package?
 - Case: We should apply free parking for EVs like in Norway in the Netherlands!
 - Evidence: Consider EV buyers motivation in Norway
 - Advice: Understand EV buyers motivation in the Netherlands

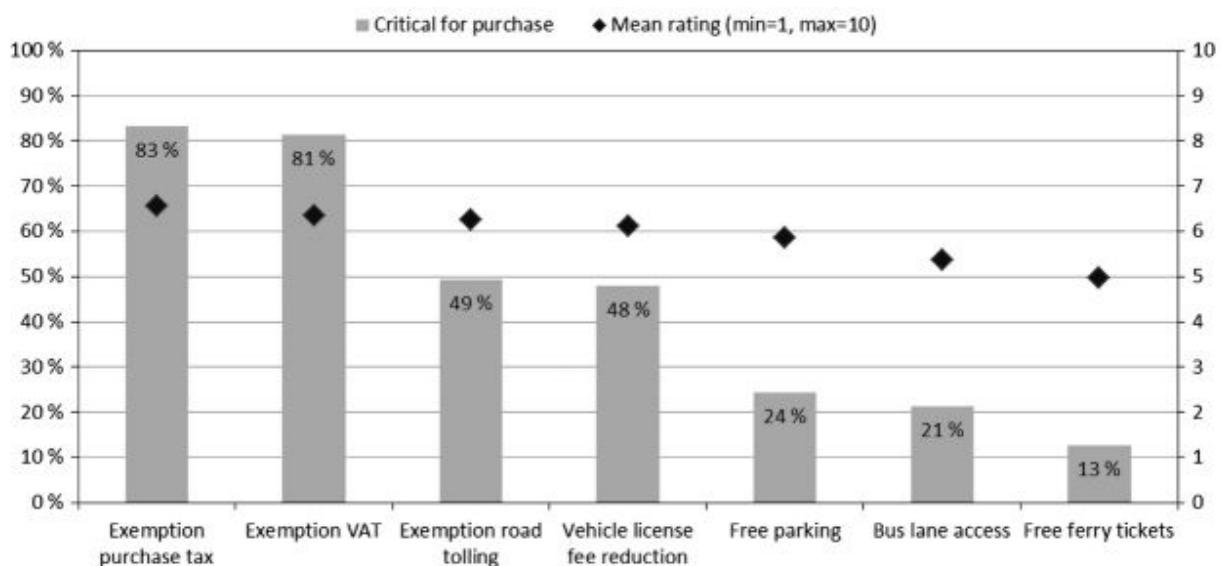
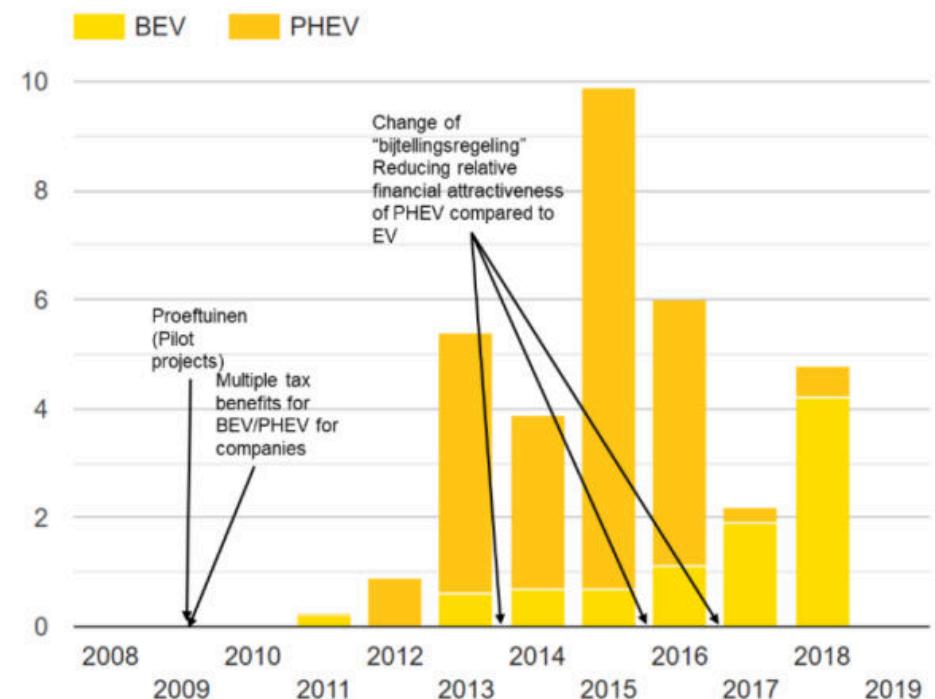


Fig. 2. Role of incentives for BEV purchase ($N = 3384$).

Source: K. Y. Bjerkan, T. E. Nørbech, and M. E. Nordtømme, "Incentives for promoting Battery Electric Vehicle (BEV) adoption in Norway," *Transp. Res. Part D Transp. Environ.*, vol. 43, pp. 169–180, 2016

INCENTIVES EVALUATION – Avoiding Pitfalls!

- Example 2 – What effects do EV Incentives have?
 - NL PHEV example – huge boom just before reshaping EV incentives
 - But why did people buy?
 - Were they going to buy regardless? (no effect)
 - Where they able to drive a nice & big car cheaply? (direct)? Was this the goal?
 - Where they purely triggered by the change in incentive structure? (indirect)



Source: H. Weken, R. Kroon, E. Bestebreurtje, M. W. Westerhof, and S. Haveman, "Effectiveness of financial incentives for stimulating BEV uptake," in EVS 32, 2019

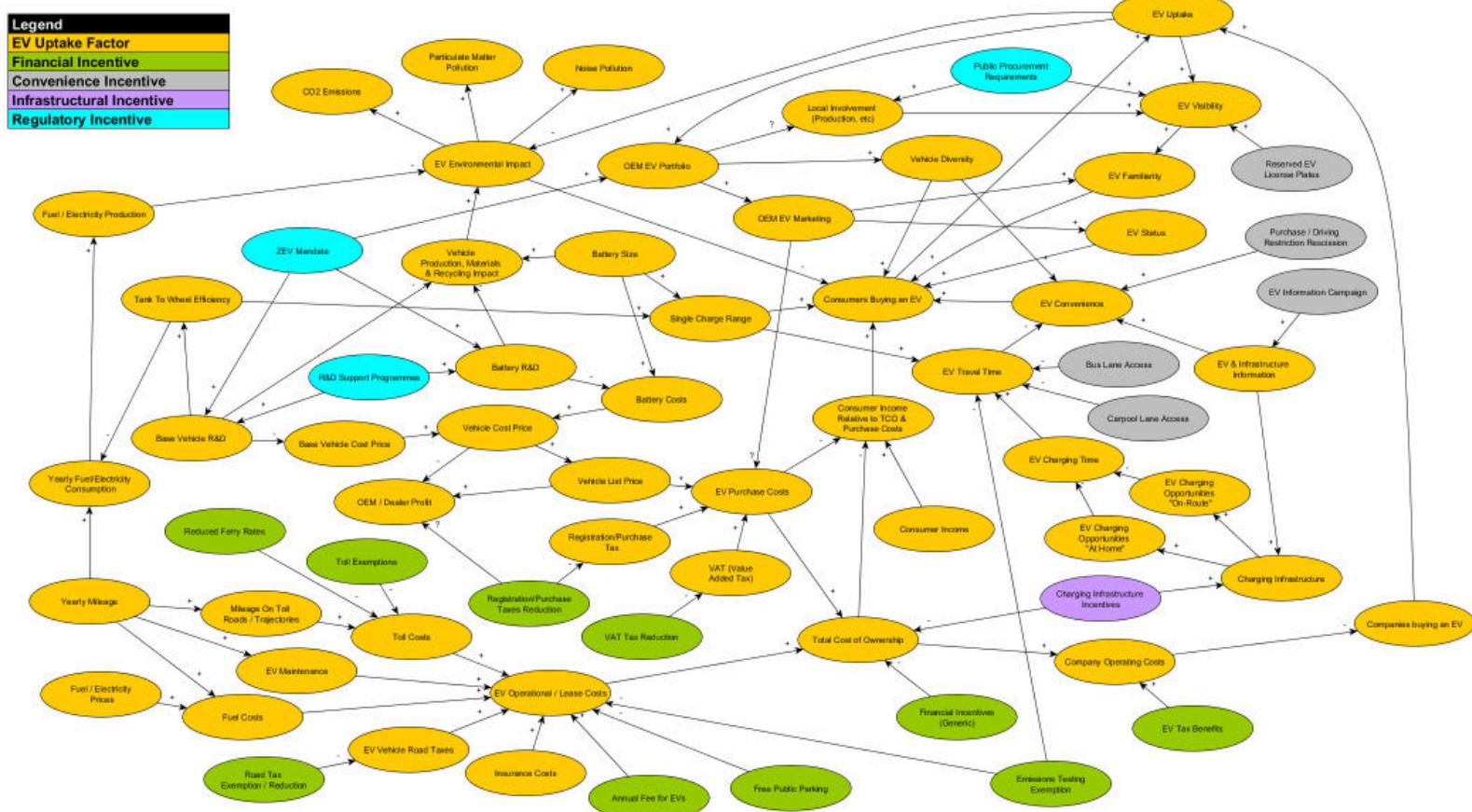


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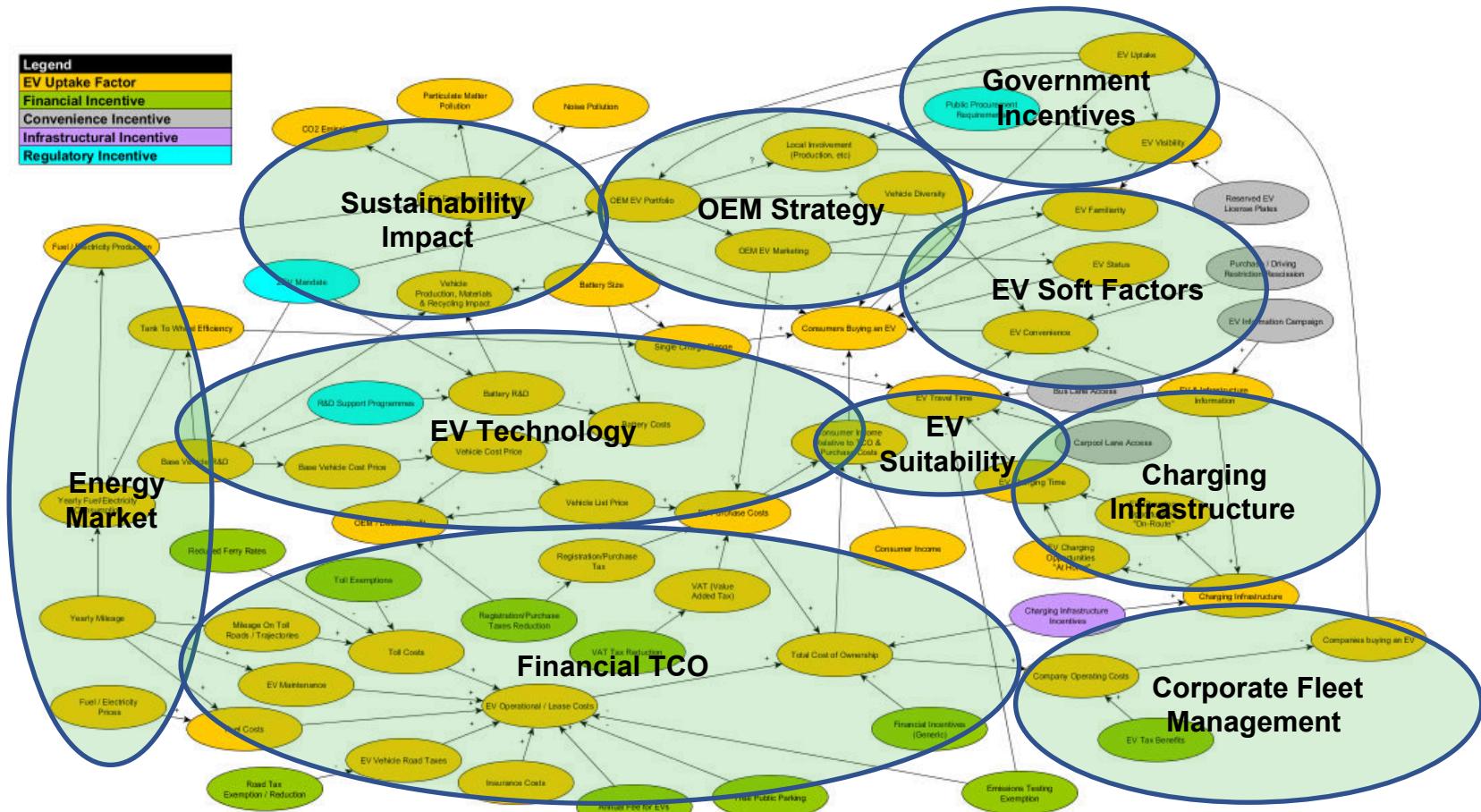
RELATIONAL MODEL – Overview

- Also known as causal loop diagram
- This model is developed to map factors influencing EV uptake
 - A closer look is up next
- Incentives – where do they influence?
 - We (think we) know this!
 - Visualization is explicit and easier to reason about



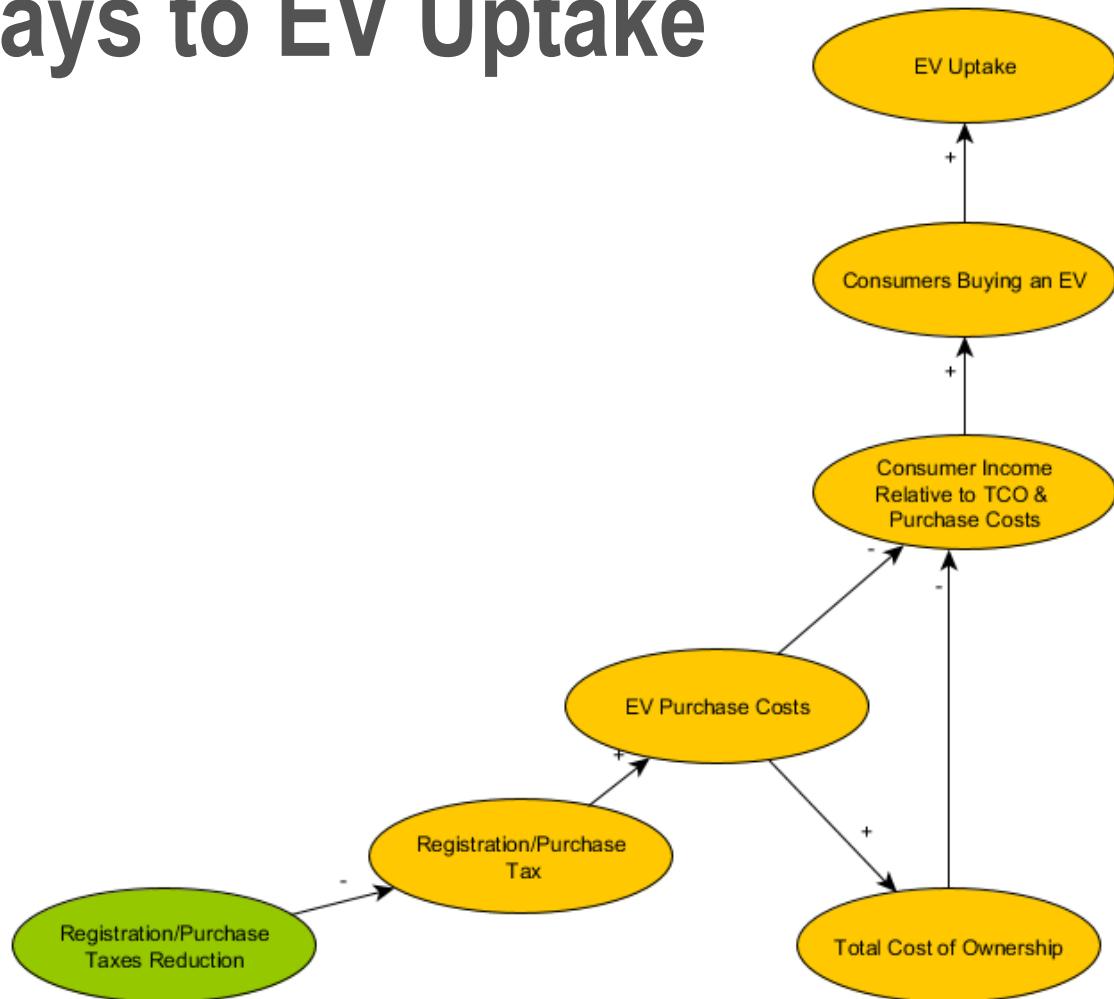
RELATIONAL MODEL – Overview

- Factors can be grouped in different focus areas
 - Our UT research group
 - EV Soft Factors
 - Government Incentives
 - ProEME consortium
 - Financial TCO
 - OEM Strategy (availability)



RELATIONAL MODEL – Pathways to EV Uptake

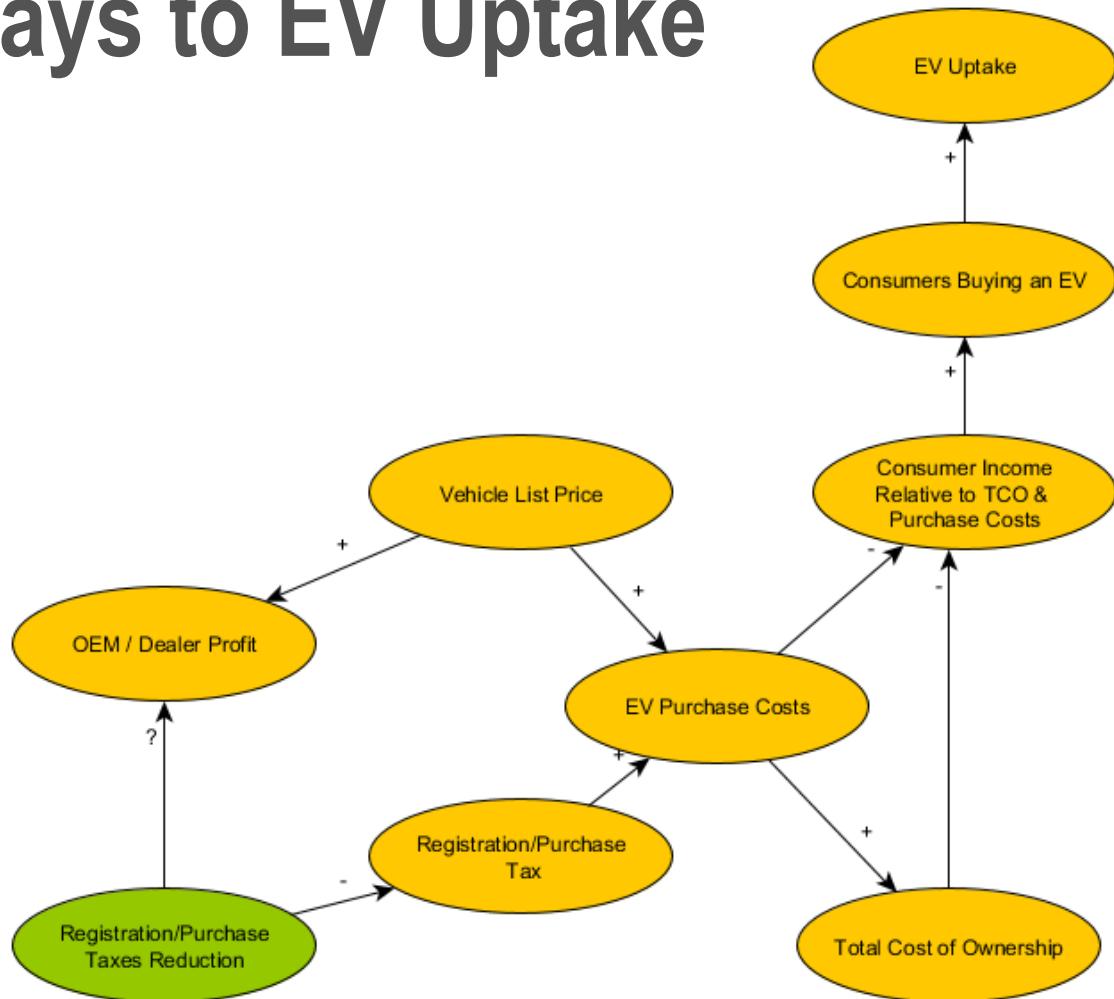
- Pathway of impact of a Registration/Purchase Tax Incentive





RELATIONAL MODEL – Pathways to EV Uptake

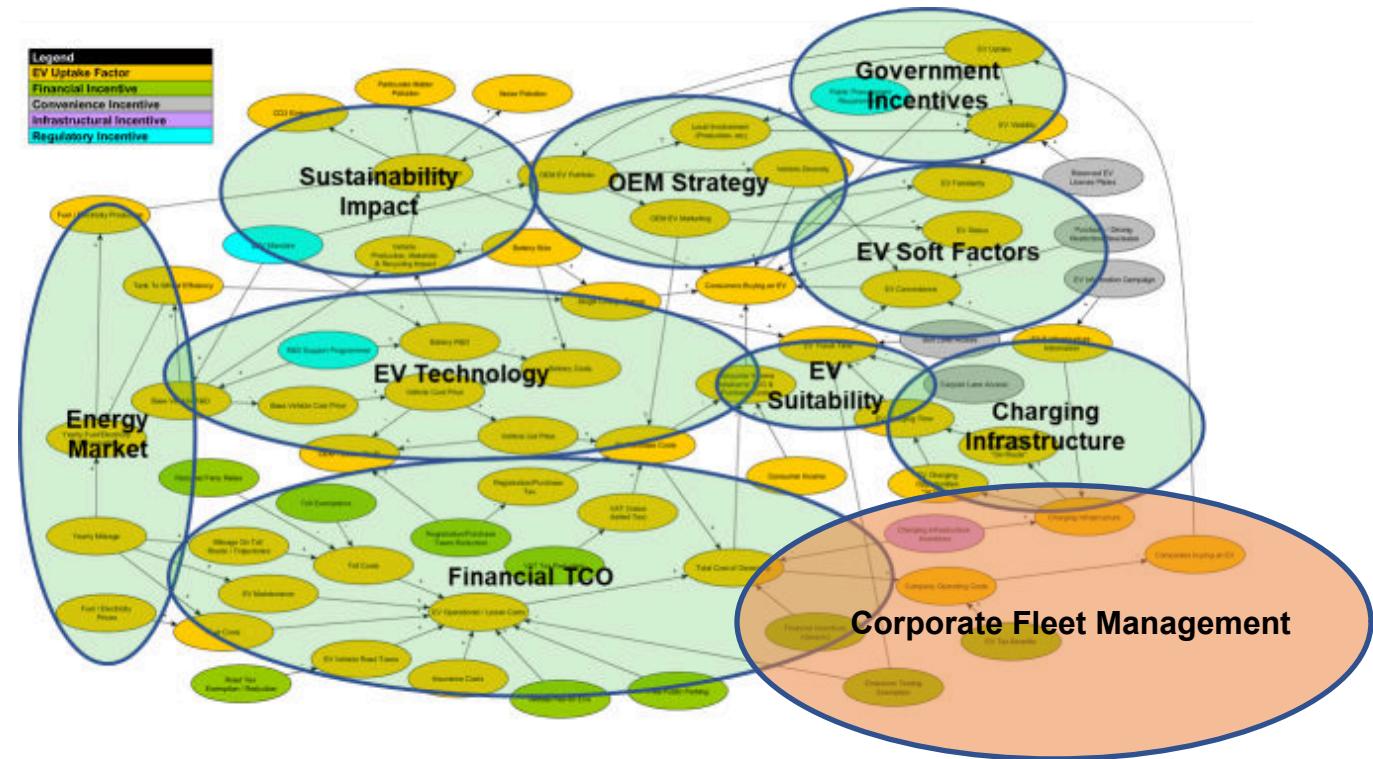
- Pathway of impact of a Registration/Purchase Tax Incentive
- Are there hidden effects?
 - How does the OEM / dealer market respond to incentives?
- Use a systems thinking approach!





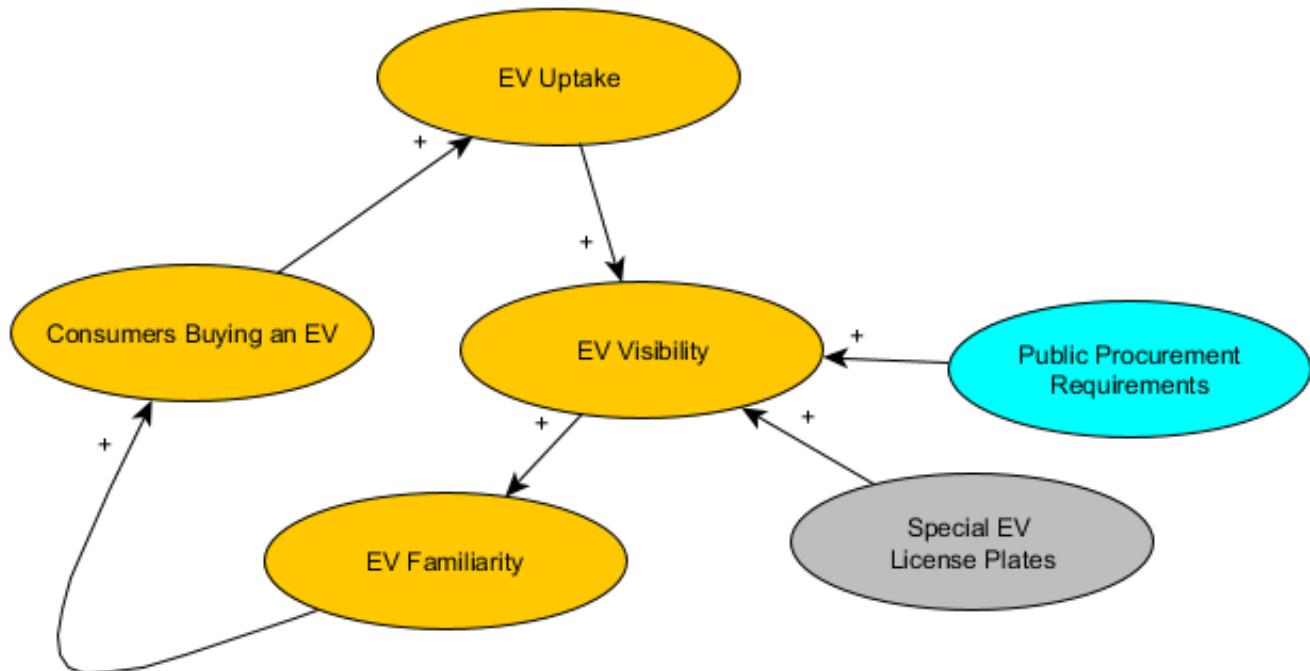
RELATIONAL MODEL – Using the model (1)

- Emphasize certain aspects through inclusion and detailing relations
- The model is a story!
 - e.g. importance of corporate fleet management
 - In 2018 - 85% of new EV went to businesses in NL!



RELATIONAL MODEL – Using the model (2)

- Reason about relations
 - Show relations
 - Discover relations
- Another example
 - Reinforcing loop of EV visibility with very simple policy controls
 - Can act as simple catalyst





TAKE-AWAYS & NEXT STEPS

- **Various strategies to evaluate incentives**
 - Quantified methods are needed!
 - Incentives are evaluated to have positive impact
 - Exact effects are hard to pinpoint – difficult in complex societal systems
- **Relational Models (with systems thinking) can help to**
 - Visualize Pathways and identify hidden relations
 - Focus attention and create a story
- **Next steps**
 - More detailed (executable & agent-based) modeling efforts
 - Analyze different stages of uptake (e.g. effects on 2nd hand market)



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Thank you for your attention!

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