



## **Modelling consumers in smart grids**

**Mart van der Kam**



# Realizing the smart grid: aligning consumer behaviour with technological opportunities

- Utrecht University
- University of Groningen
- Alliander
- Delta Netwerkbedrijf
- Stedin



# Presentation outline

- Project introduction and motives
- Previous work: electric vehicles and the grid
- PV and EV
- Future



# Smart grid pilot projects

- LomboXnet -> Vehicle to grid
- Also Amsterdam, Texel, Groningen, ...
- Focus on technical aspects and economic incentives
- Bias: users in pilot projects are pioneers



# Role of consumers in smart grids

- Smart grid technology can have a high impact on daily life
- Changing relationship consumer and utilities (e.g. prosumer)
- Learn what “smart grid” can be



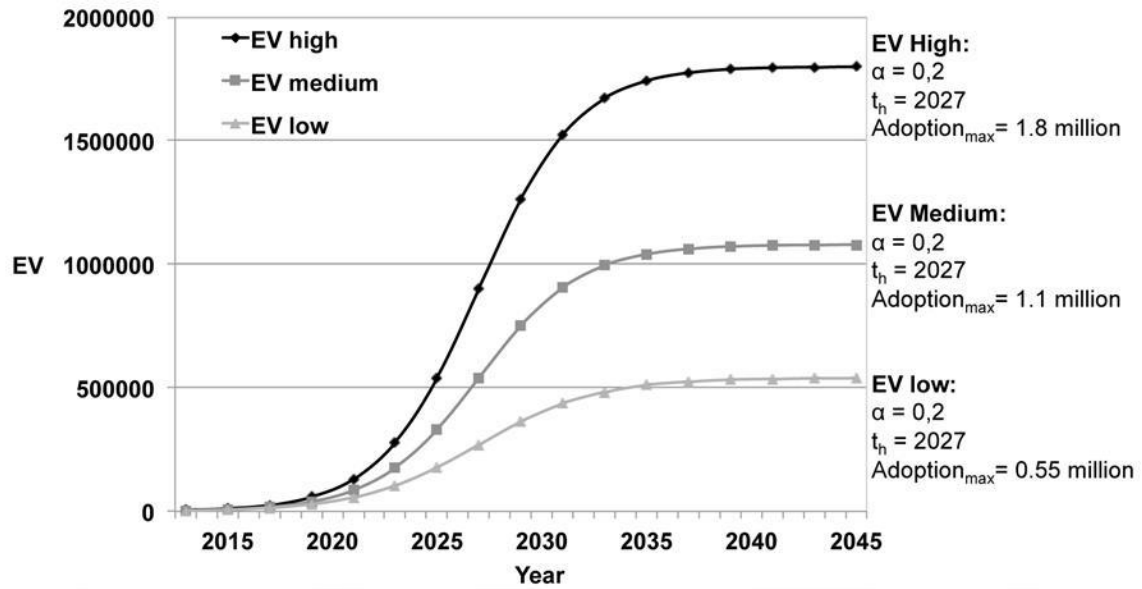
# Role of consumers in smart grids

- Adoption and behaviour
- Impact on existing electricity grid
- Goal: bottom-up scenarios from user-perspective

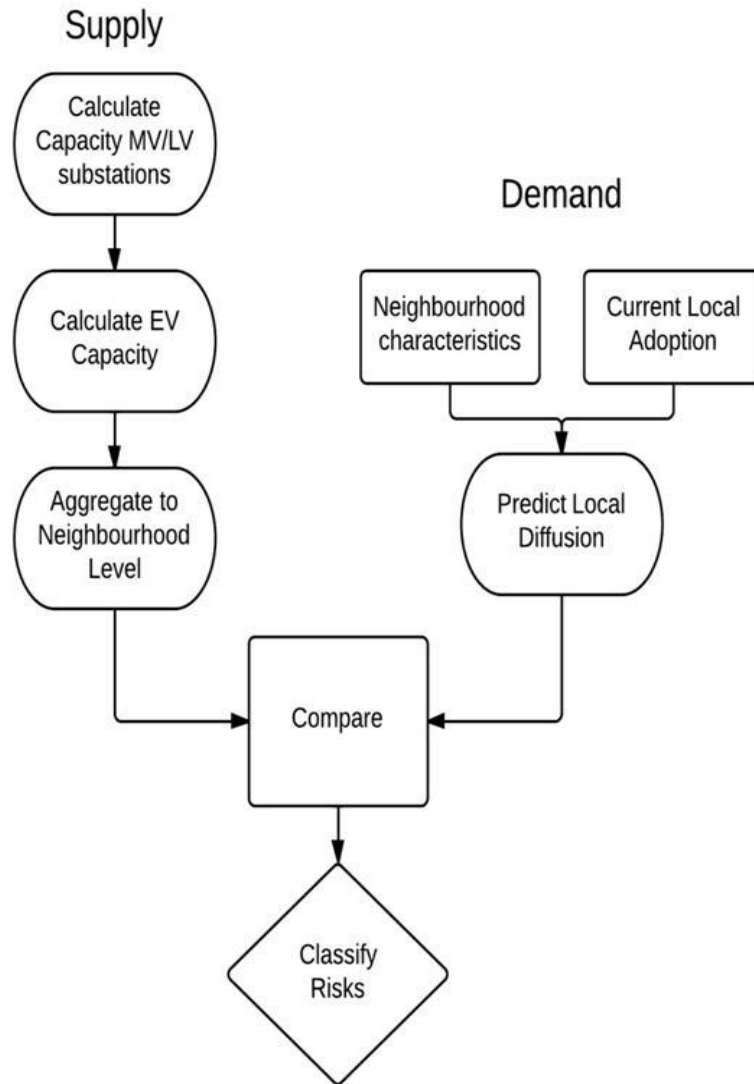


# Previous work: Electric vehicles and the grid

- EV (RDW)
  - Location, date, lease, charging stations
- Socio-demographic (CBS)
- Data about the grid (Alliander service area)
- Methodology: estimate diffusion using simulation









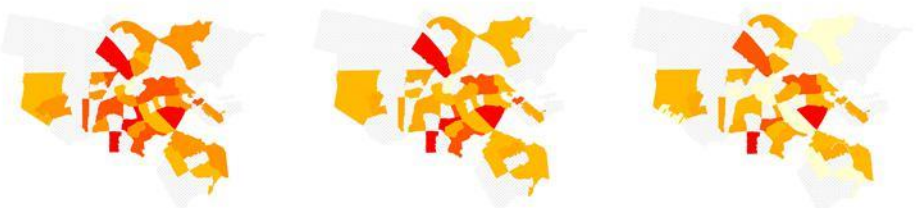
Total Service Area



North-Holland



Amsterdam



Eising, J., T. van Onna, and F. Alkemade.  
*Applied Energy*, 123: 448-455, 2014





# Outcomes

- In some areas grid problems as early as 2015
- Insight in (geographical) adoption patterns needed



# Main research question

- Which individual factors predict, explain, and influence consumer adoption and use of smart energy technologies that will result in a reduction of uncertainty in smart energy systems?
- Adoption
- Behaviour
- Incentives
- Impact on existing grid



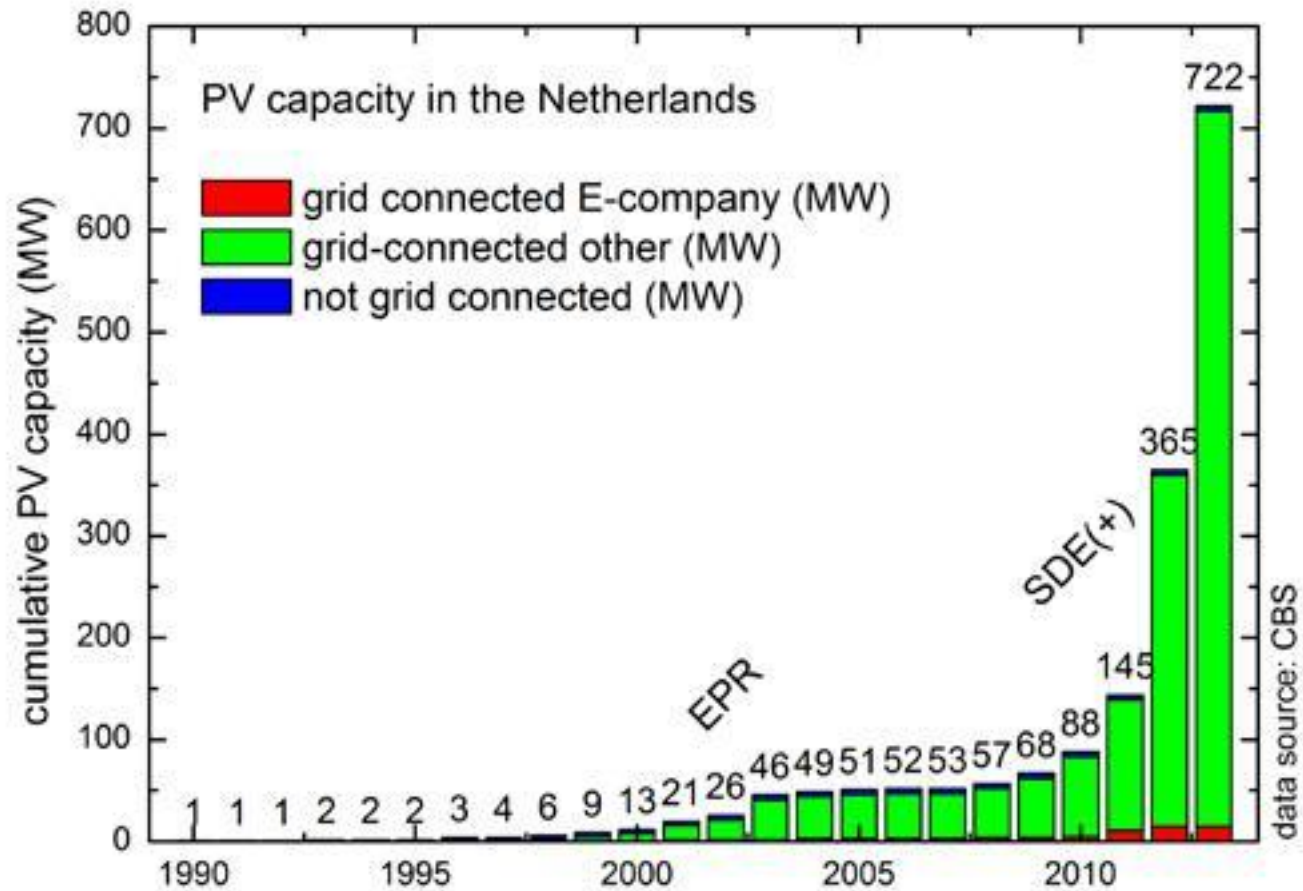
# Smart grid technologies

- We focus first on photovoltaic (PV) solar panels and electric vehicles (EV)
  - Supply vs demand
  - Relatively high market uptake
  - Off-peak charging
  - Vehicle-to-grid
- Who are the early adopters?

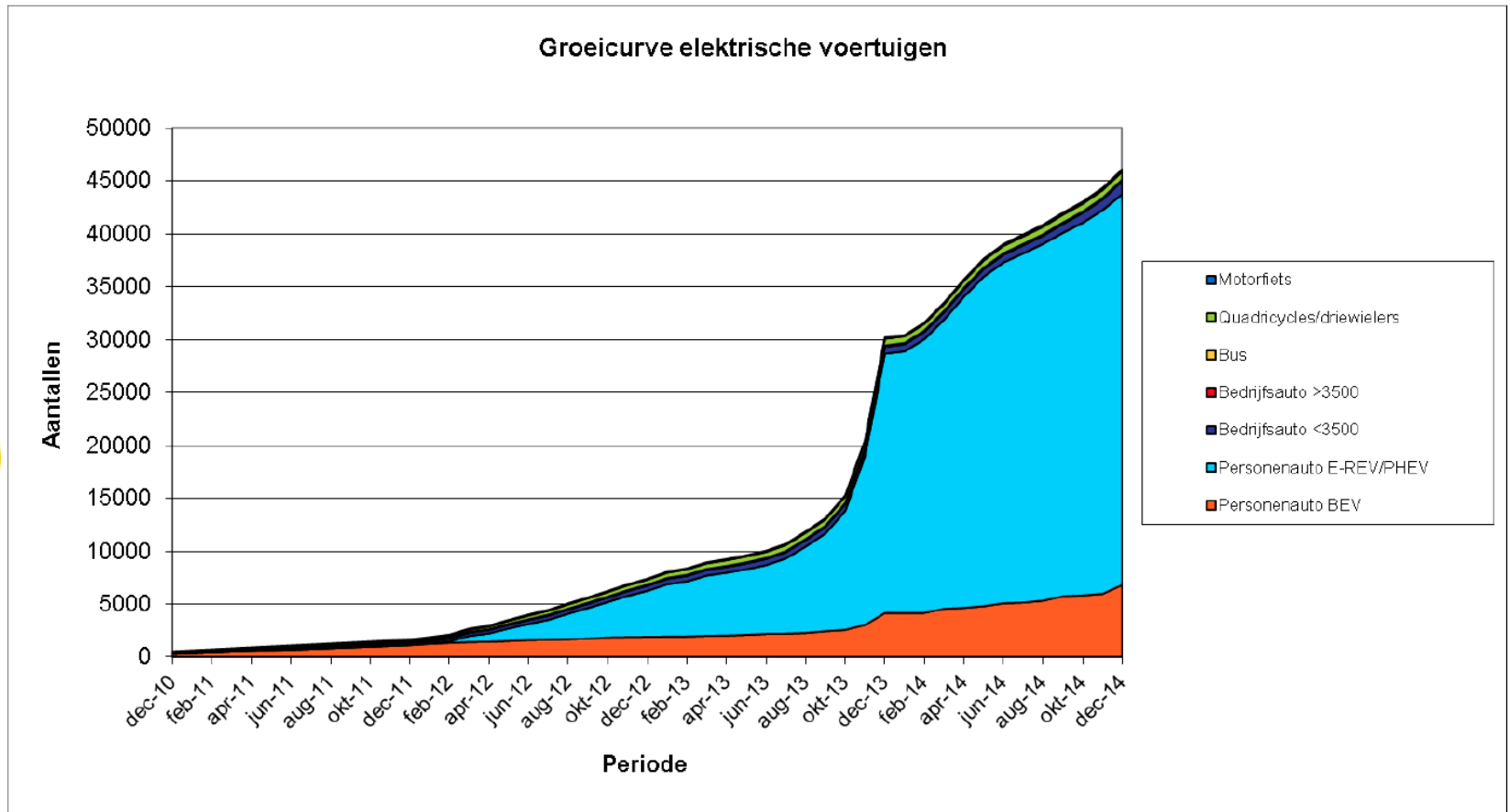


## Diffusion - data

- PV (PIR)
  - Location, date, Wp
- EV (RDW)
  - Location, date, lease, charging stations
- Socio-demographic (CBS)
- Data about the grid (Alliander, DNWB, Stedin service area)



Source: van Sark 2014



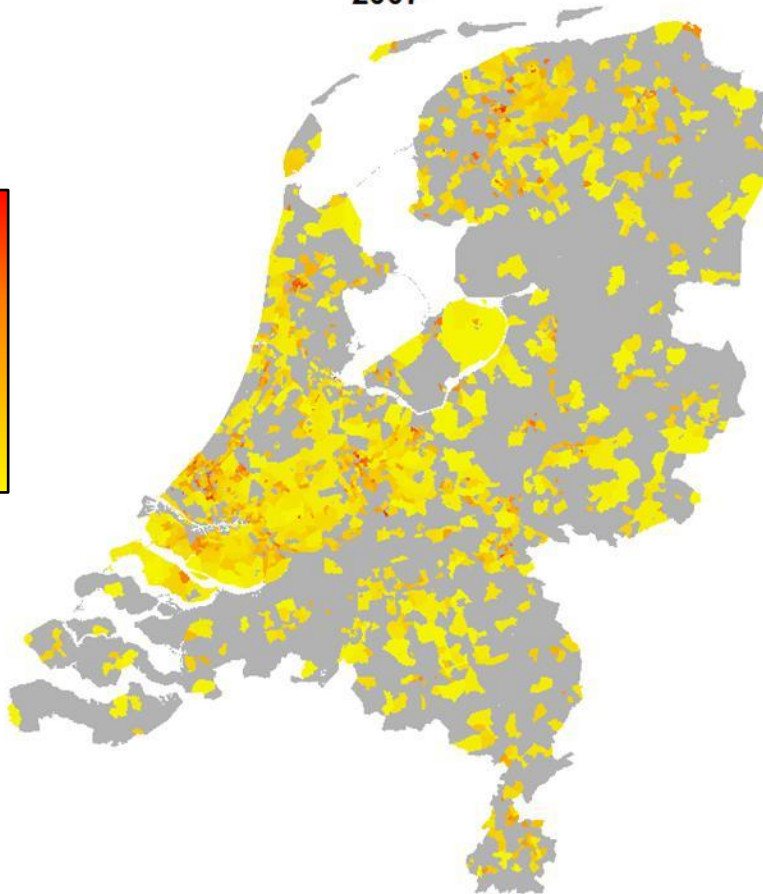
Source: RVO based on RDW data



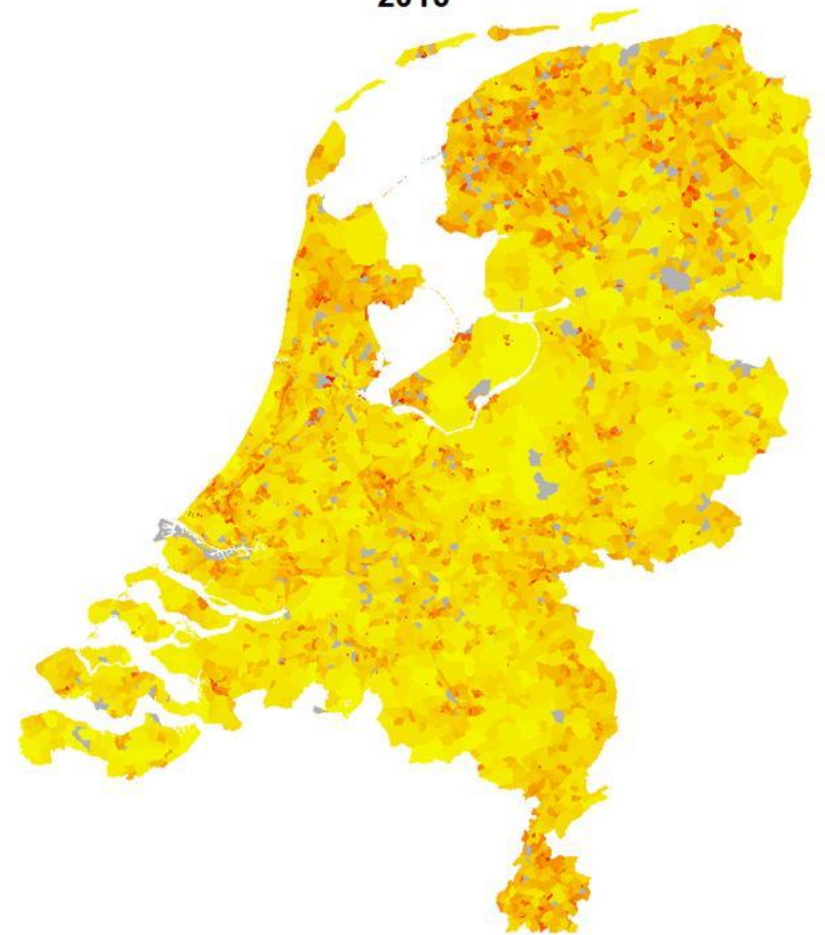


# PV normalized

2007



2013



More



Less

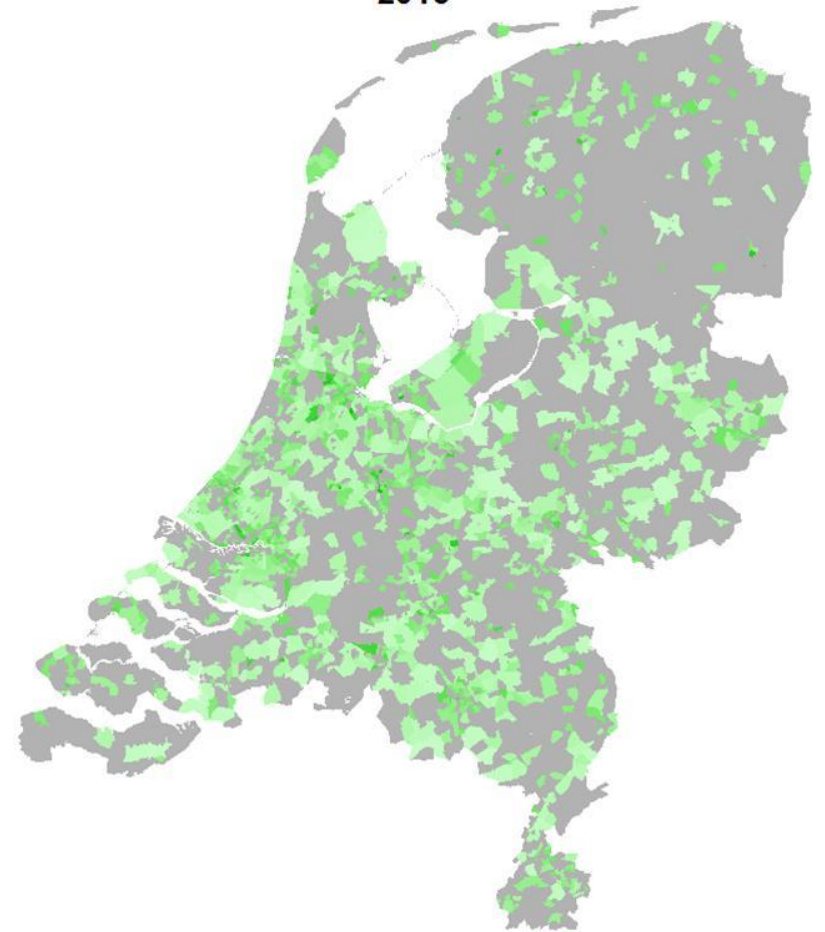


# EV normalized

2010



2013



More

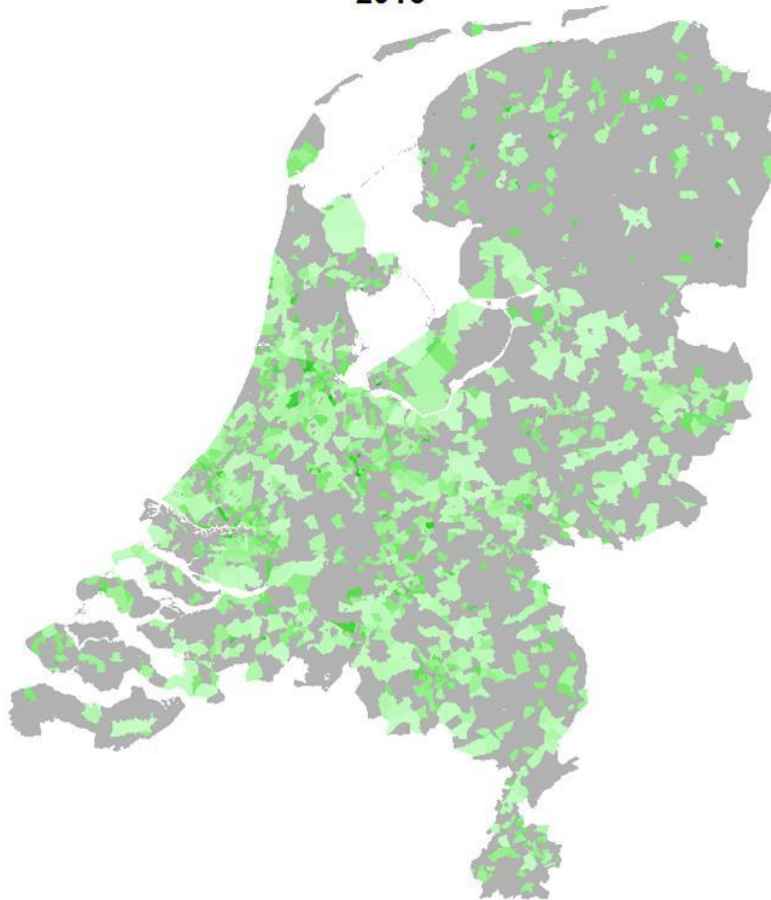
Less



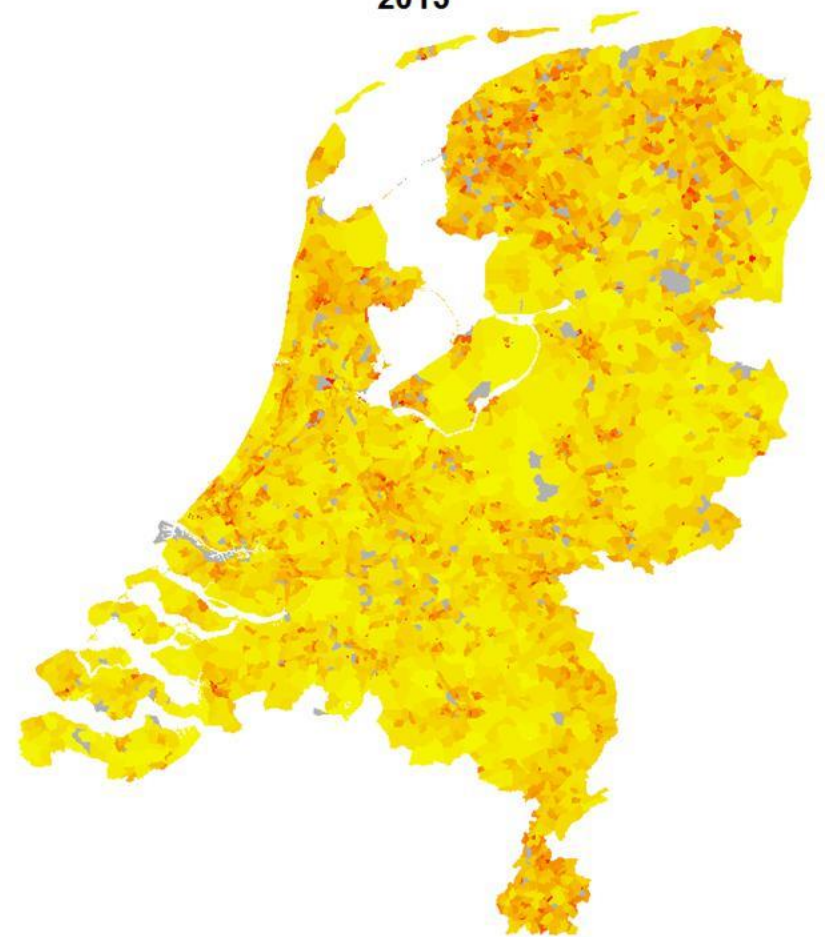


# EV and PV

2013



2013





# Future

- Incorporate behaviour
- Motives, incentives and policies
- Storage and off-grid