



**The impact of V2G on local netcongestion from an agent-based energy model**



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# Who am I

- Naud Loomans
- TU/e – PhD. – Energy models of socio-technical transition pathways
- **NEON Research – Integral** models to connect social, technological and economic factors
- **Zenmo Simulations – Bringing** scientific knowledge to practice in ‘virtual labs’



# DeelDeZon model

Goal: To explore the potential of the DeelDeZon system to reduce local grid congestion

DeelDeZon system:

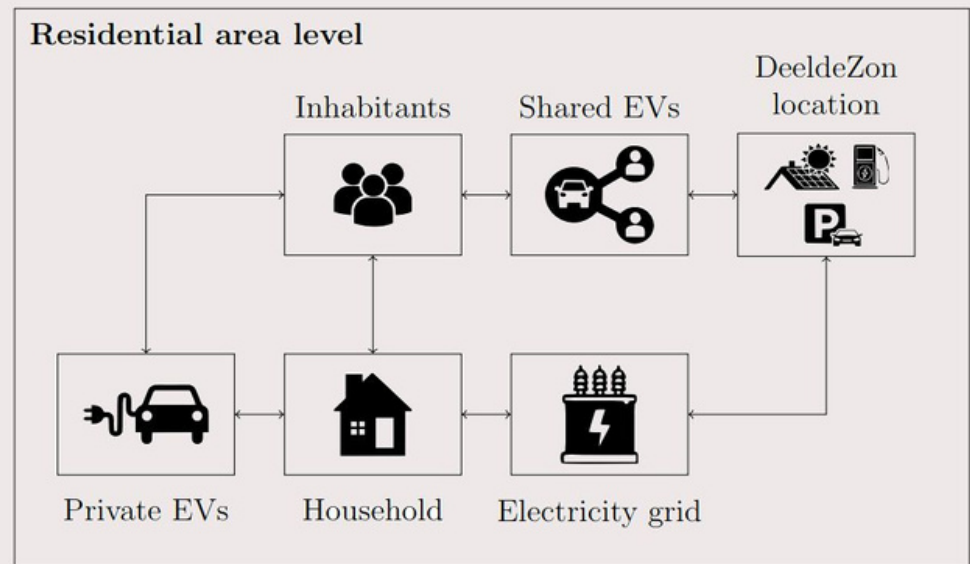
- Shared electric cars
- Large rooftop PV
- Bidirectional and smart charging

# Model set-up

- **Digital twin of e-neighborhood**
  - Everything connected to a single low-voltage transformer
  - Households
  - Chargepoints
  - PV
- **Agent-based behaviour**
  - Energy consumption at households
  - Modelled travel behaviour
  - Shared vehicle trip patterns

# ABM architecture of the residential areas

- Based on
  - GIS maps
  - BAG
  - Open source location data
  - Open source grid data
  - QViN travel behaviour
  - Buurauto trip patterns
- User-defined characteristics:
  - Number of private/shared EVs
  - Type of charging strategy
  - Solar panels
    - Heat pumps/electric cooking



# Z DEELDEZON MODEL

## GENERAL OPTIONS

Neighbourhood

Maastricht Sphinx tuin

Start month

January

## NEIGHBOURHOOD OPTIONS

### Charging strategy for private EVs

- Uncontrolled charging
- Smart charging
- Vehicle-to-grid

### EV type distribution

- Nb of private EVs  0 113 127
- Nb of shared EV  0 0 16

## DEELDEZON PARKING OPTIONS

- Uncontrolled charging on/off
- Collective solar roof on/off
- nb of CPs  0 3 16
- Percentage smart charging CP  0 50 75
- Percentage vehicle-to-grid CP  0 25 50
- Amount of PV panels  100 1,269 1,500

## Advanced neighbourhood options

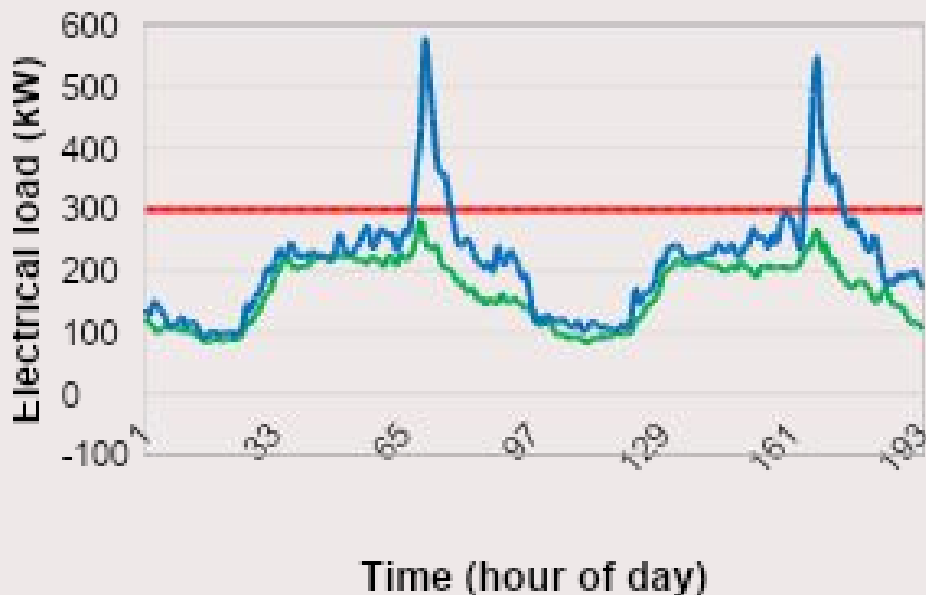
- Percentage electric stoves  0 50 100
- percentage PV panels  0 20 100
- Percentage private CP  0 90 100
- Nb of users per shared EV  2 10 20
- Percentage heat pumps  0 30 100

Hide advanced options



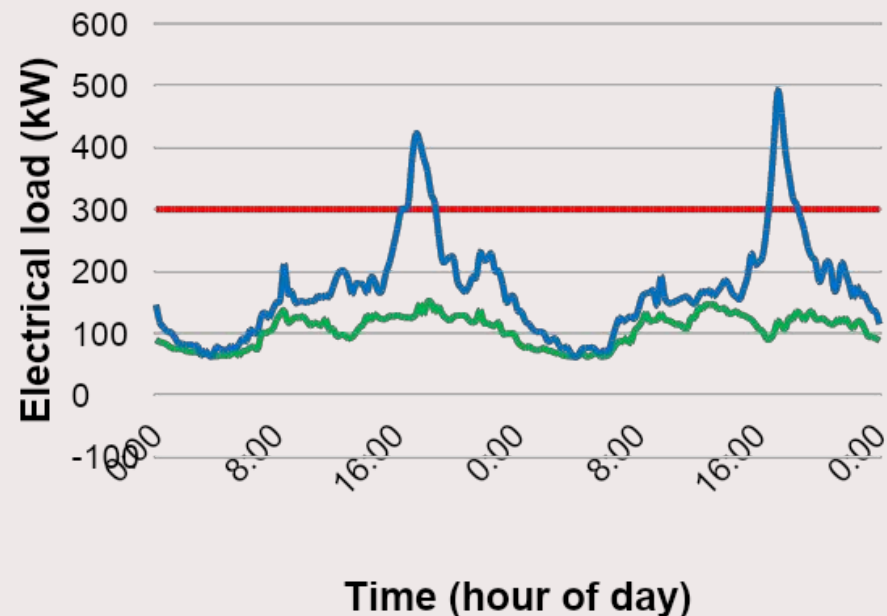
# Results and discussion

## Winter



— Threshold

## Summer

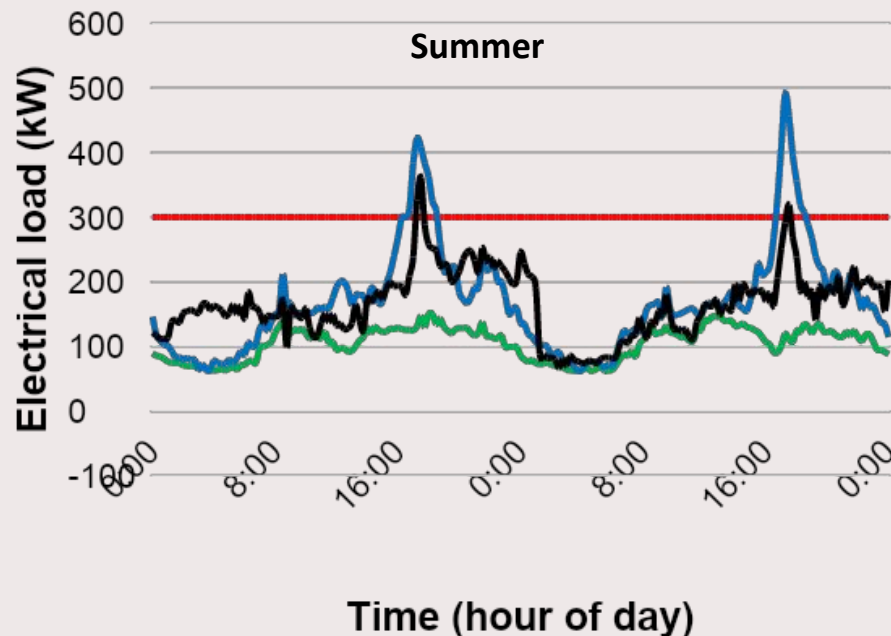
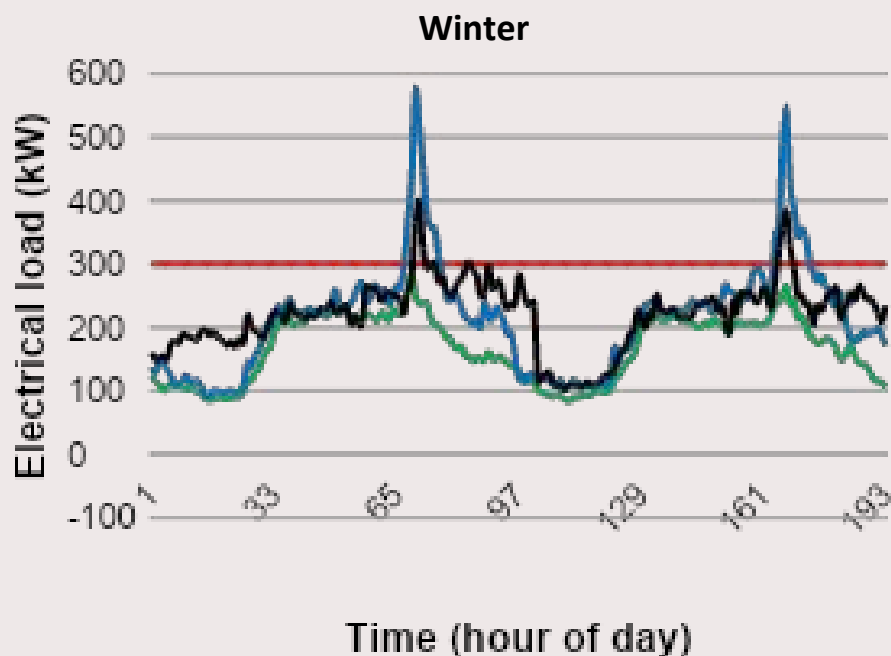


— Current situation

— Worst case

Charging strategy (private)	Charging strategy (shared)	Private EVs	Shared EVs	Heat pump/ electric stoves	Household PV	Collective PV systems
UCS	-	High	-	High-		-

# Results and discussion

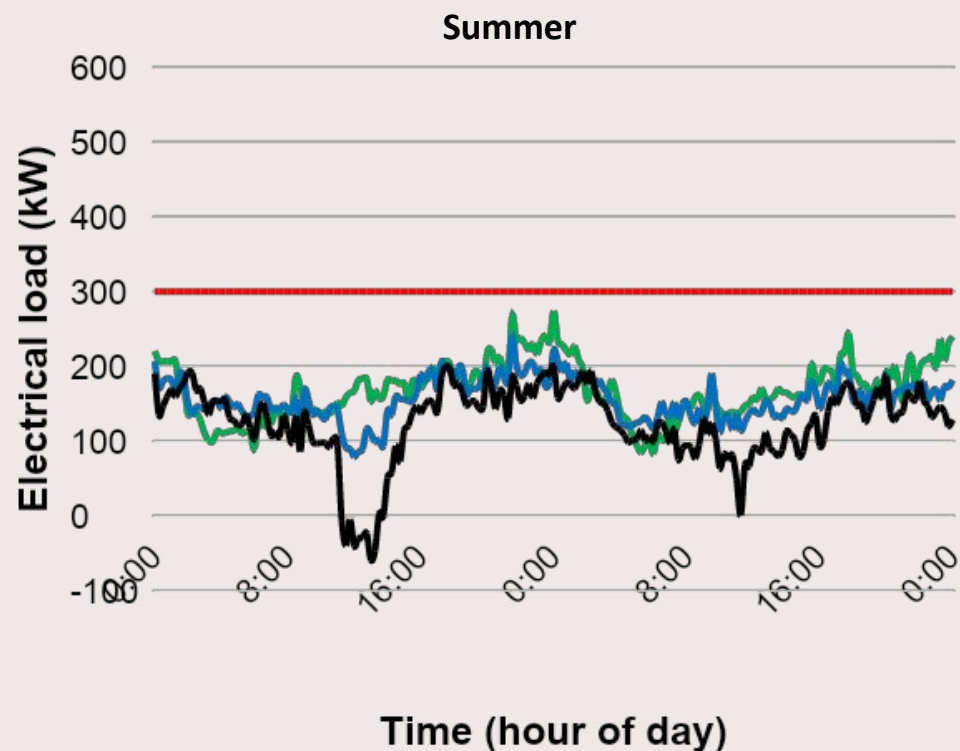
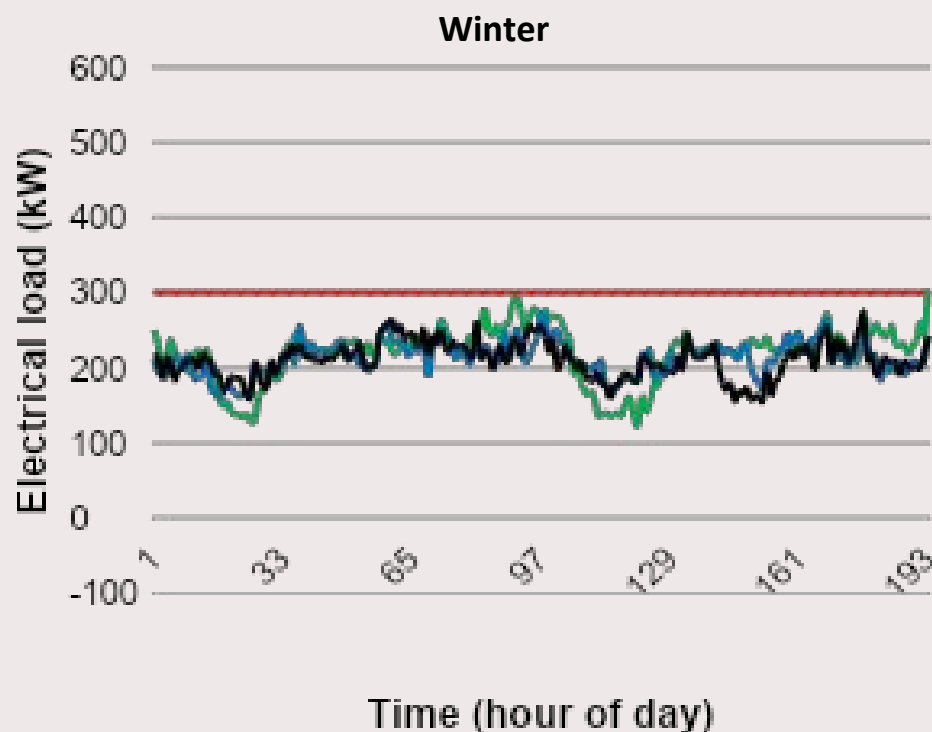


— Threshold     
 — Current situation     
 — Worst case     
 — Worst case with shared EVs and V2G compensation

Charging strategy (private)	Charging strategy (shared)	Private EVs	Shared EVs	Heat pump/ electric stoves	Household PV	Collective PV systems
UCS	V2G	High	High	High-		-



# Results and discussion



- Threshold
- SCS and PV household systems
- SCS, PV household systems and DDZ compensation

Charging strategy (private)	Charging strategy (shared)	Private EVs	Shared EVs	Heat pump/ electric stoved systems	Household PV	Collective PV systems
SCS	V2G	High	High	HighHigh		High

# Conclusions

- An ABM model is successfully created to evaluate five residential areas in the Netherlands and investigate the impact on the electricity of shared EVs, different type of charging strategies, and collective solar roofs.
- V2G proves successful in reducing grid congestion from other charging Evs and to reduce curtailment from PV.
- The effect of 'other' electric vehicles is large. V2G can offset only limited numbers of 'conventional' charging cars.
- So smart charging of the entire fleet maintains a top priority
- V2G is especially useful in storing excess PV energy, as regular smart charging is often hampered by full batteries in summer

# THANK YOU