Impact of EV rollout on EU electricity system

Marko Aunedi
Imperial College London
m.aunedi@imperial.ac.uk

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Imperial College London

Green eMotion

European Commission

Key objectives

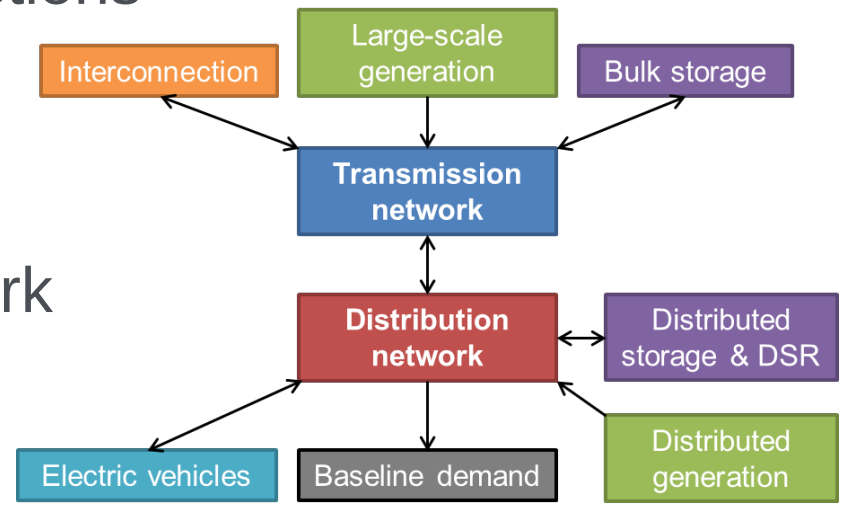
- Apply **whole-systems approach** to understand **impact of EV rollout** on:
  - Generation system operation
  - Generation system investment
  - Transmission network investment
  - Distribution network investment
  - Carbon emissions
- **Inform policy makers** and provide **evidence** about the impact of different approaches to integration of electro-mobility across the electricity sector and the potential economic value of smart charging

Whole-systems analysis: Time and Location effects

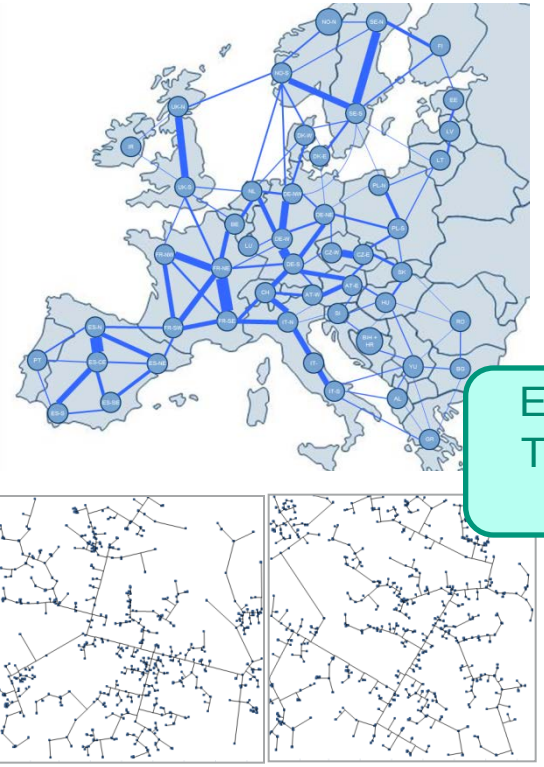
Generation, Transmission & Distribution Planning	Long-term Generation and Storage Scheduling	Day-ahead Generation, Storage & DSR Scheduling	System Balancing
Years before delivery	Months to days before delivery	One day to one hour before delivery	Actual delivery: physical generation & consumption

Whole-system modelling critical for capturing Time and Location interactions

Optimisation across the conflicting objectives to reduce the cost of investment in generation and network assets and system operation



Modelling framework for assessing the impact of EV deployment



Future development scenarios:
- EV penetration & characteristics
- Electricity system evolution (RES)
- Market integration of European systems

EU Grid Model: Transmission + Distribution

EU Generation, Transmission and Distribution Investment and Operation Model

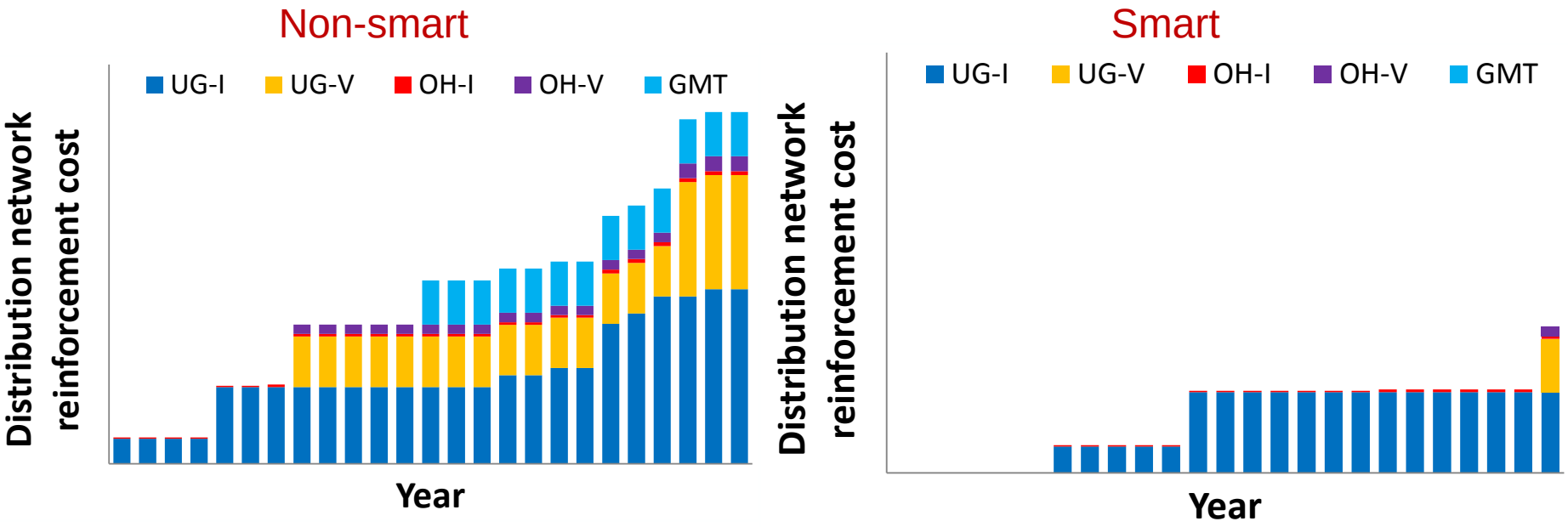
Key results

- Adequate system capacity (generation and transmission)
- RES curtailment & Carbon emissions
- Overall investment and operation cost
- Benefits of smart EV charging → Value of different charging strategies

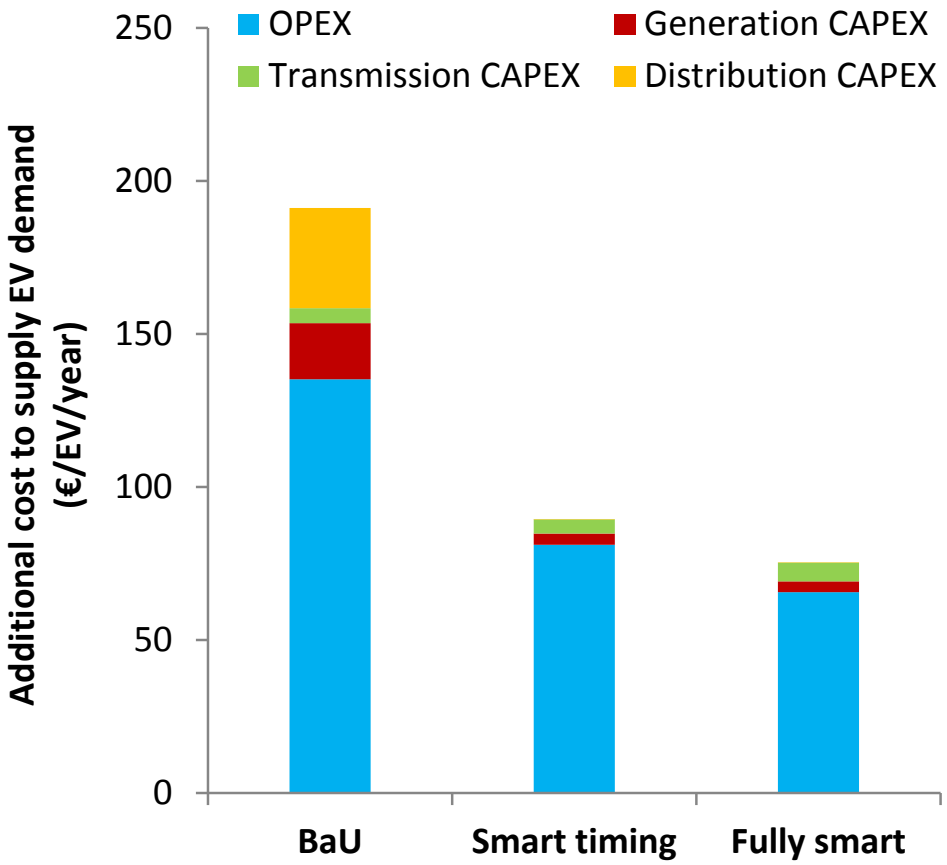
EU-wide impact of mass rollout of EVs

Impact of EVs on local distribution networks

- **ITRES tool**
  - Developed in Green eMotion (to be published on project website)
  - Designed to quantify the impact of EV uptake on reinforcements in LV distribution networks
- Example: cumulative reinforcement cost with different EV charging strategies

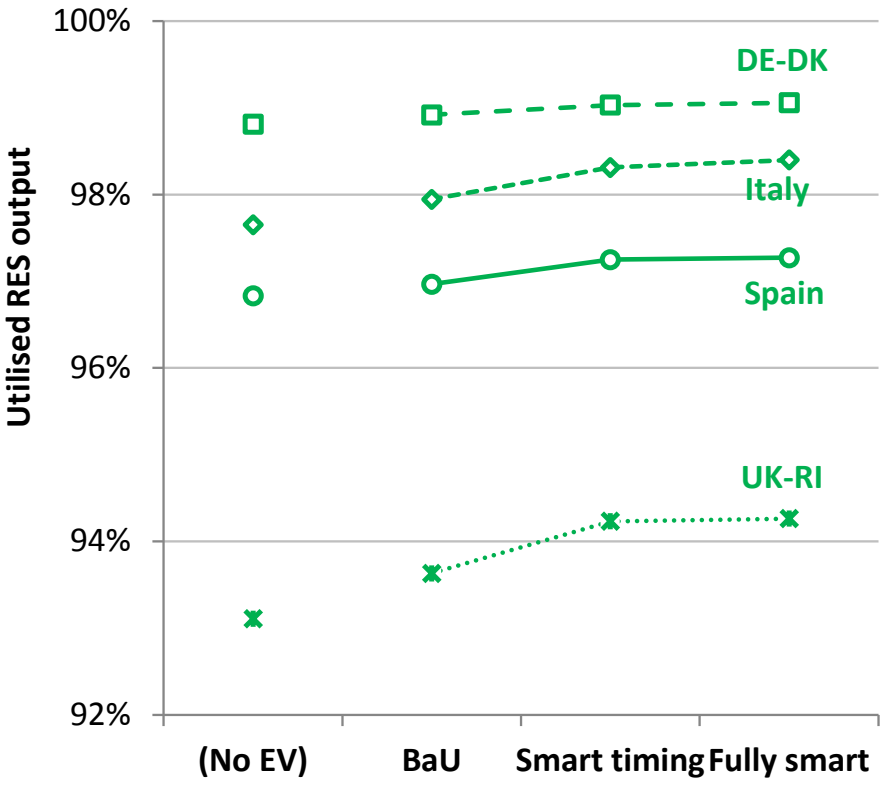


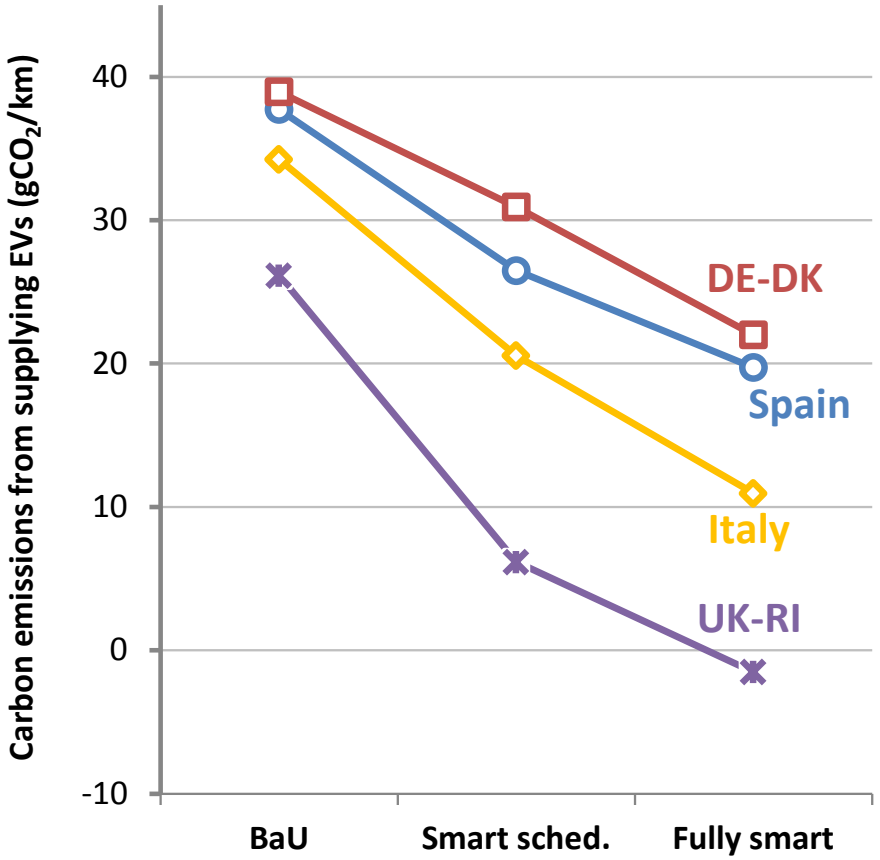
Cost of supplying EV demand (per EV): UK & Ireland example (Medium EV penetration)



- Similar trends for cost levels and cost breakdown are observed for other European systems and EV penetrations between 5% and 30%

Utilisation of RES and carbon emissions with smart EV management (Medium EV penetration)





Comparison with emissions from conventional passenger vehicles (EU):

- Current emission factor (2013): **127** g/km
- Target fleet average for 2021: **95** g/km

Key findings

- Cost of supplying EVs with no smart charging is around €200/EV/year
- With smart EV management this cost reduces to between €5 and €100/EV/year (depending on the system and EV penetration)
- Smart EV control also reduces the carbon impact of supplying EV demand
- Challenge: creating commercial arrangements that deliver adequate revenues to flexible EV owners

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Deliverable 9.2

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Imperial College London

Marko Aunedi, Predrag Djapic, David Newbery, Dimitrios Papadaskalopoulos, Goran Strbac

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