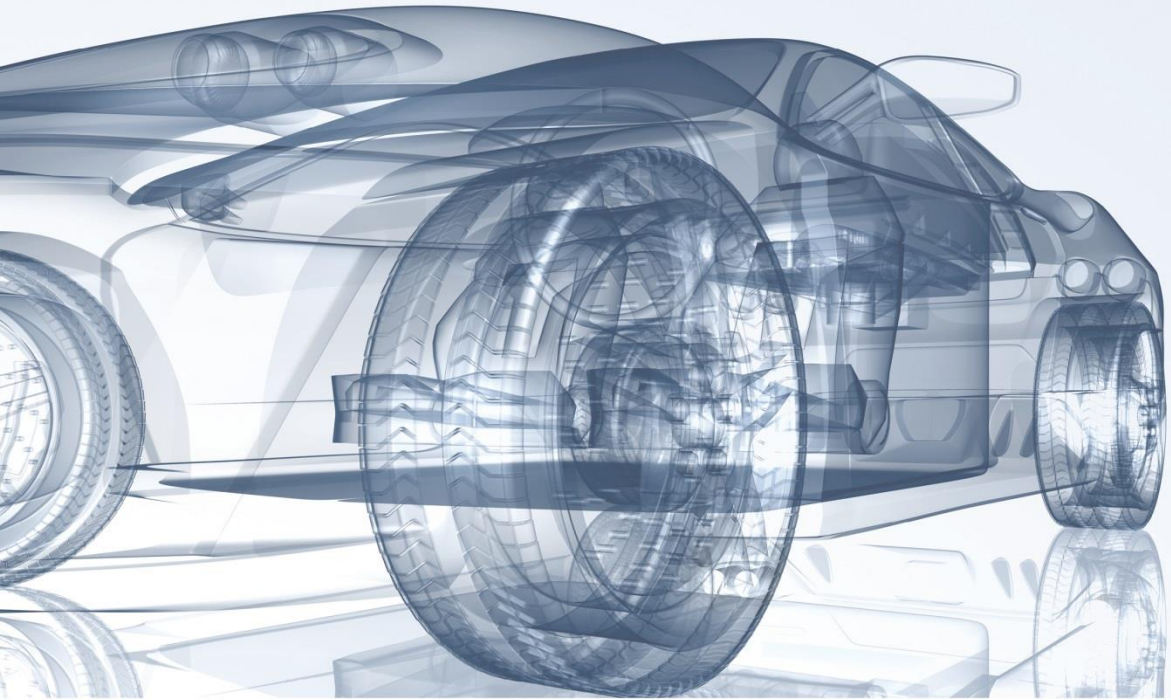
evs 30



The 30th International
Electric Vehicle
Symposium & Exhibition

October 9–11, 2017

Messe Stuttgart, Germany

www.evs30.org

Sponsored by

DAIMLER BOSCH Invented for life GROUPE RENAULT MAHLE EnBW PORSCHE swarco

Synergies and Conflicts of Integrating Electromobility and Renewable Energies into the Urban Micro Grid at Train Station Berlin Südkreuz

Norman Pieniak, Alexander Wanitschke, Florian Schaller

Financed by:

Agenda

1. Challenge – energy supply for a car-sharing station
2. Solution – multi-criterial optimization of decentralized energy systems
3. Results – cost vs. ecology vs. self-sufficiency
4. Conclusion

Financed by:

Agenda

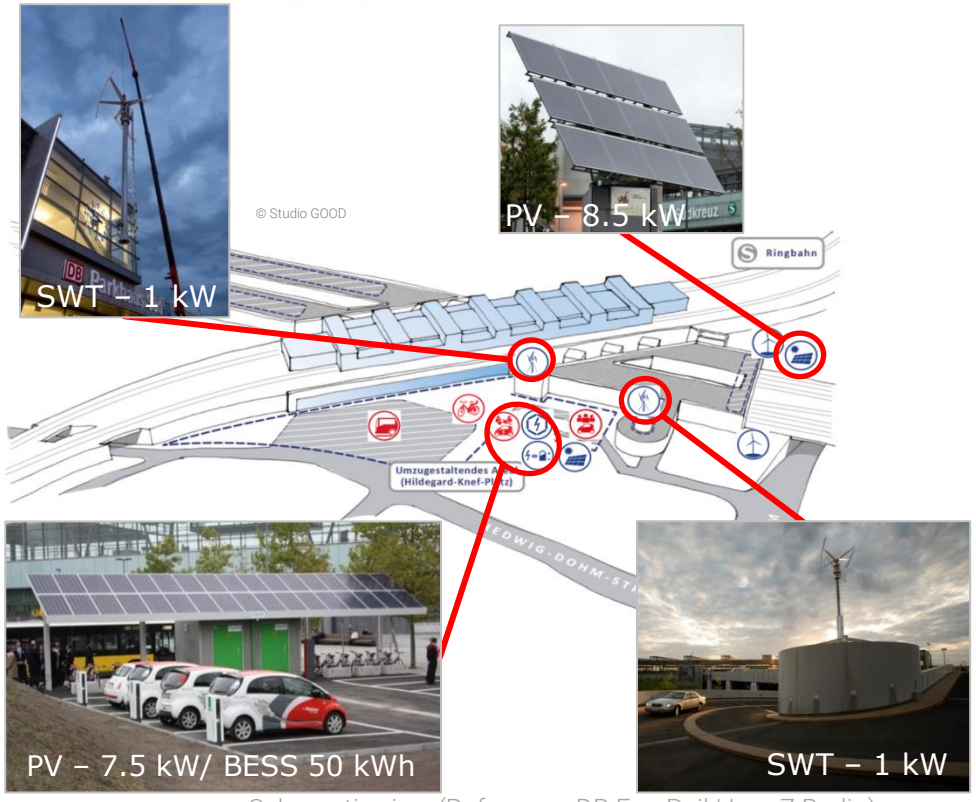
1. Challenge – energy supply for a car-sharing station
2. Solution – multi-criterial optimization of decentralized energy systems
3. Results – cost vs. ecology vs. self-sufficiency
4. Conclusion

Financed by:

Challenge – supplying electromobility with renewable energy

- **Aim:**
  Integration of renewable energy sources and stationary battery systems to supply charging stations for battery electric vehicles (22/43/50 kW)

- **Requirements:**
  reducing GHG emissions, optimizing cost-effectiveness, locally self-sufficient?

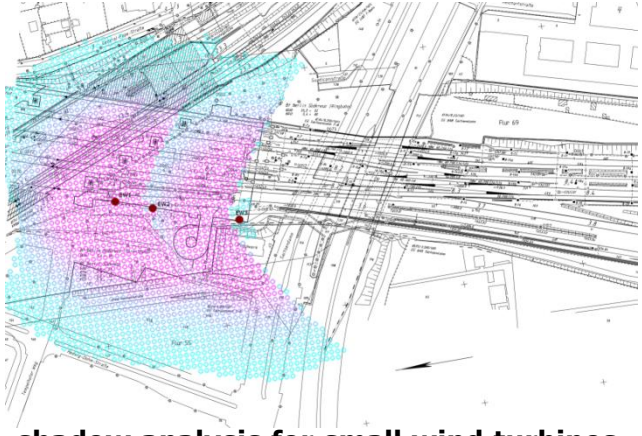


Schematic view (Reference: DB Eco Rail | InnoZ Berlin)

Challenge – What to consider in urban environment?

Common challenges at a train station:

- bats & birds
- visual interference
- expensive installation



shadow analysis for small wind turbines

analysing trajectories of bats and birds

Agenda

1. Challenge – energy supply for a car-sharing station
2. Solution – multi-criterial optimization of decentralized energy systems
3. Results – cost vs. ecology vs. self-sufficiency
4. Conclusion

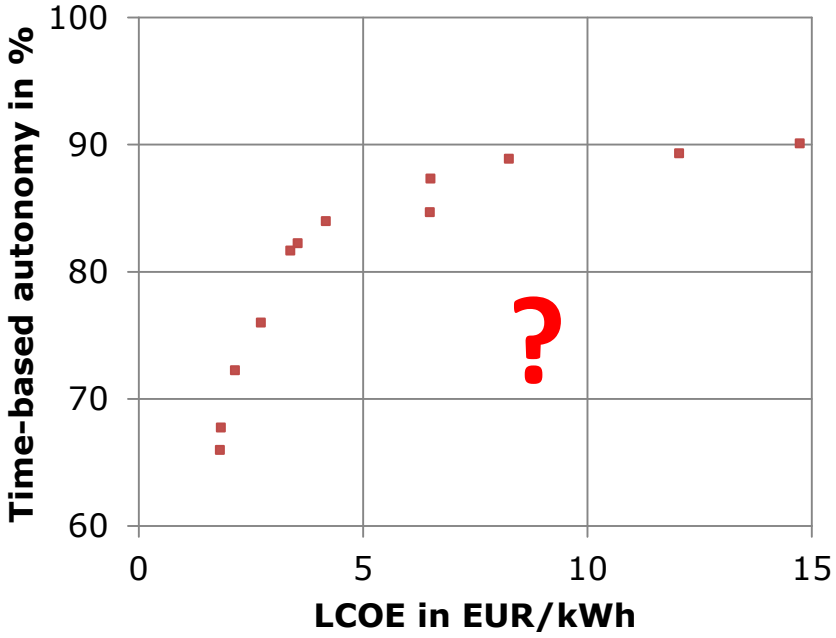
Solution - Can we optimize all our objectives at once?

We want to …

- maximize cost-effectiveness
- maximize local self-sufficiency
- minimize GHG emissions

Defining **key performance indicators:**

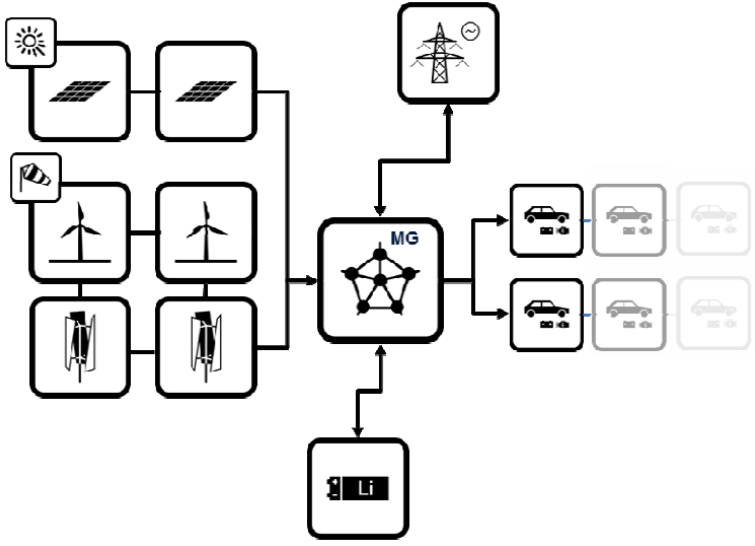
- Levelized cost of electricity (LCOE)*
- Time-based autarky (TA)
- Life-cycle greenhouse gas emissions (LCE)



* including costs for charging infrastructure

Solution – modelling, simulation and optimization

- Partially-validated model of the Smart Grid
- Using year-based simulation with hourly energy balance
- Optimization via a **multi-objective evolutionary algorithm**

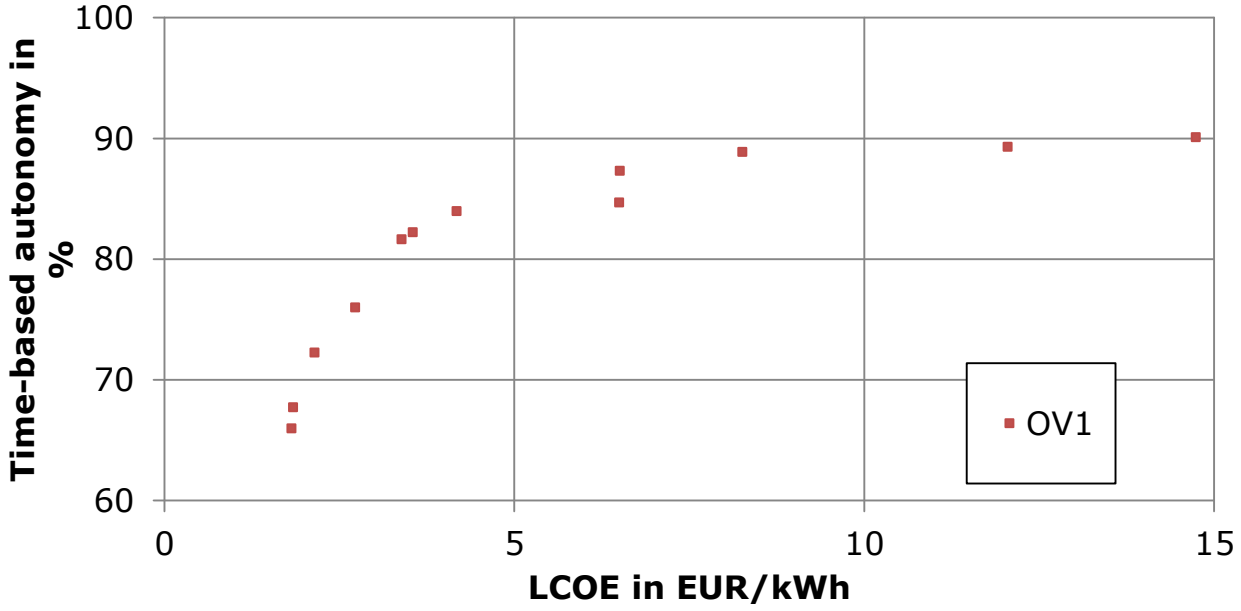


Agenda

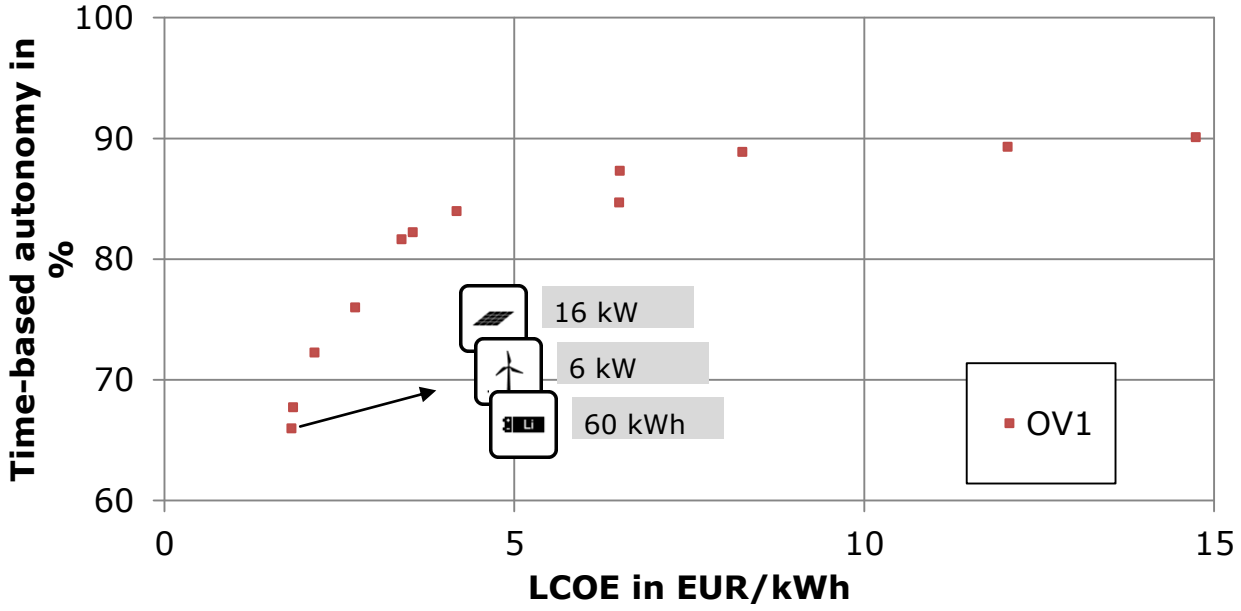
1. Challenge – energy supply for a car-sharing station
2. Solution – multi-criterial optimization of decentralized energy systems
3. Results – cost vs. ecology vs. self-sufficiency
4. Conclusion

Financed by:

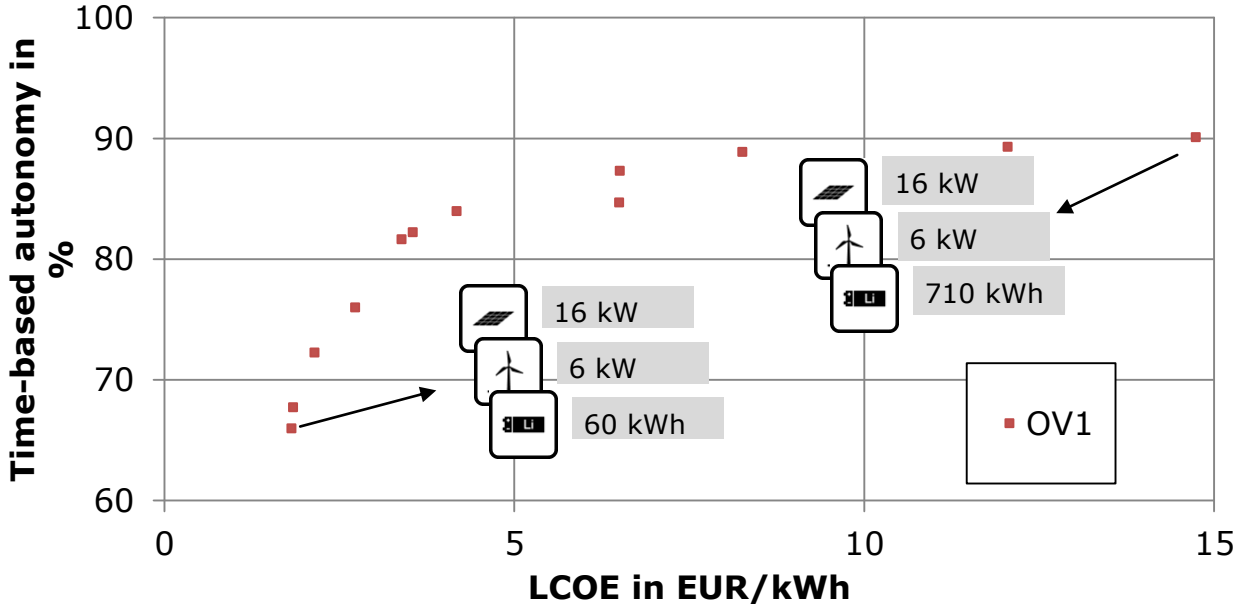
- Battery effects: for **operating with high self-sufficiency, large battery capacity is required** which increases the costs of locally generated energy



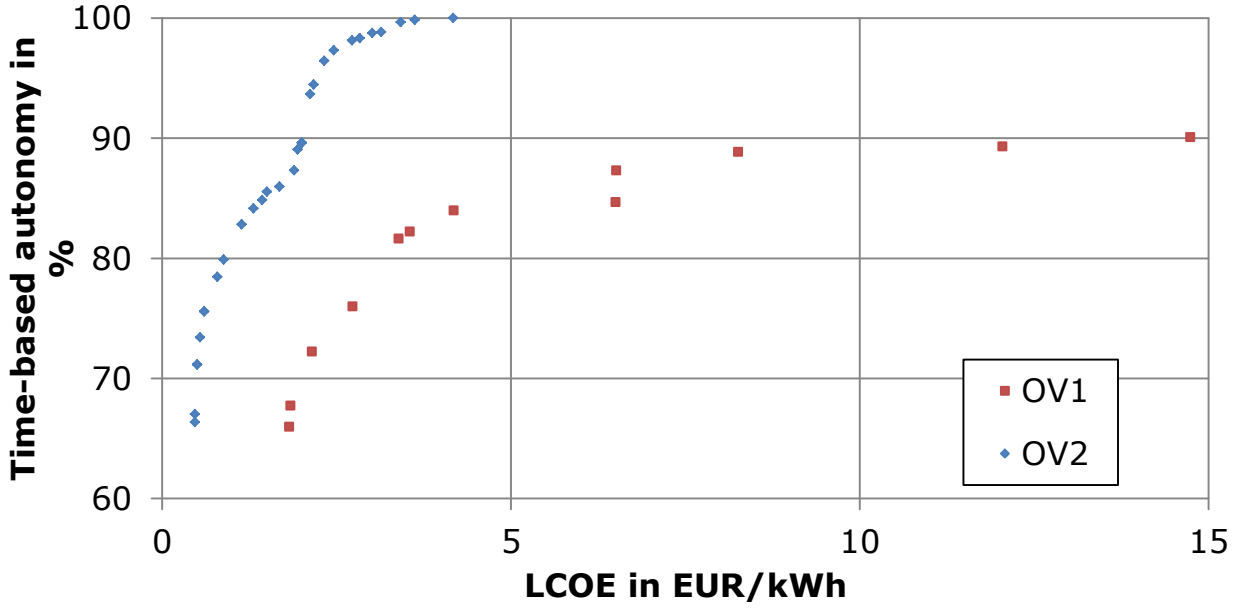
- Battery effects: for **operating with high self-sufficiency, large battery capacity is required** which increases the costs of locally generated energy



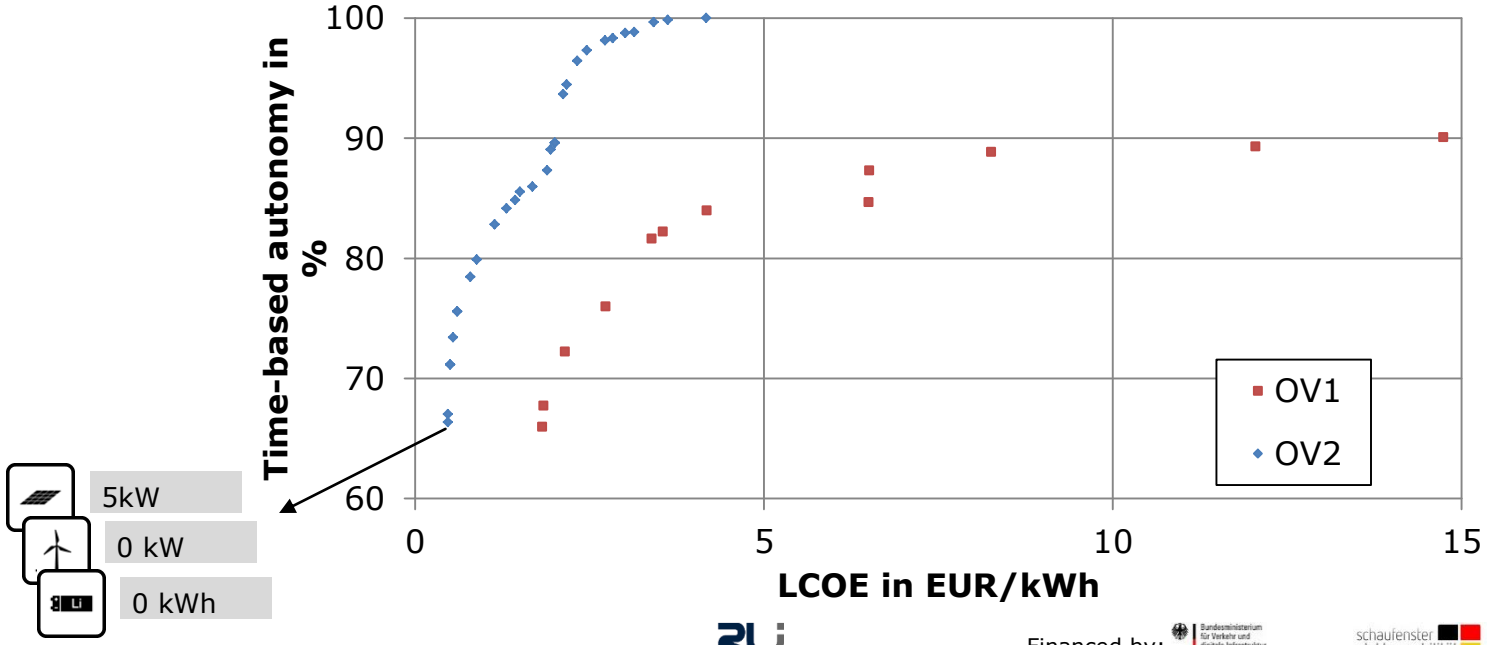
- Battery effects: for **operating with high self-sufficiency, large battery capacity is required** which increases the costs of locally generated energy



- Curtailing effects: By **curtailing the energy output**, battery capacity can be substituted by larger energy generating capacities

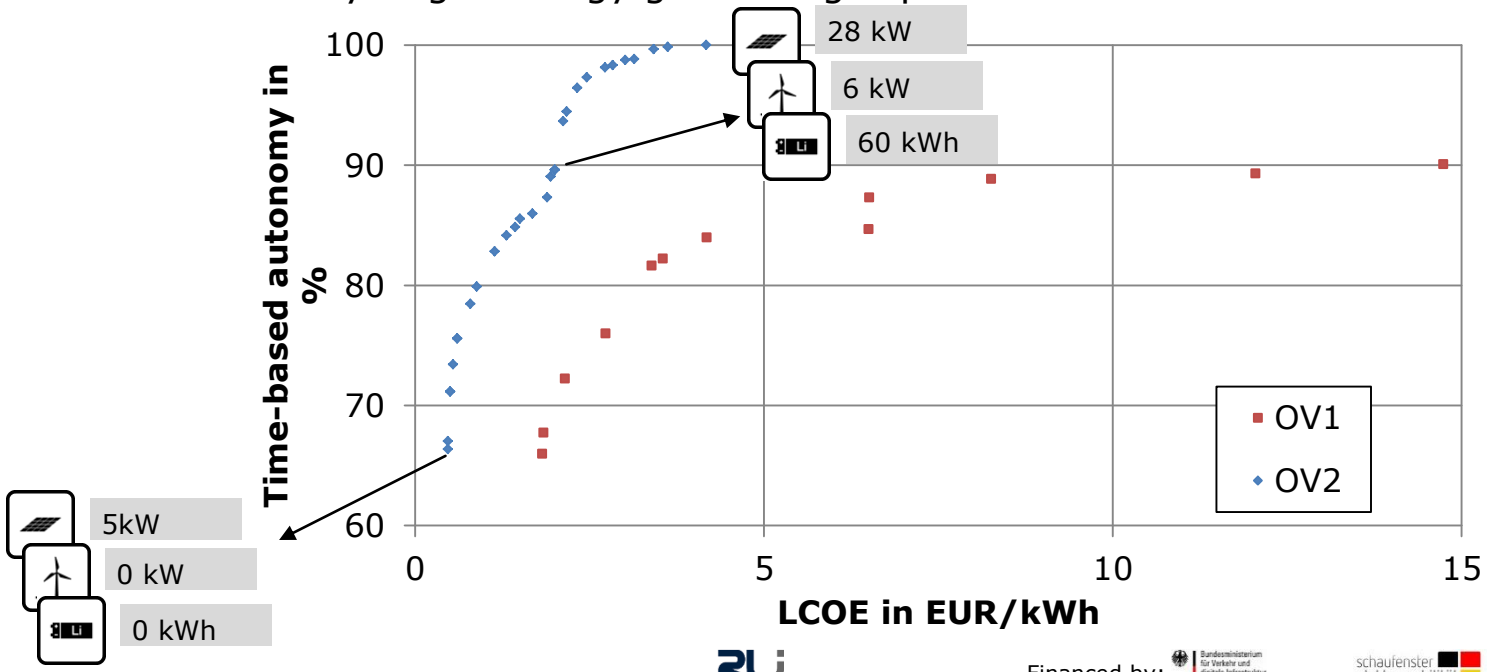


- Curtailing effects: By **curtailing the energy output**, battery capacity can be substituted by larger energy generating capacities

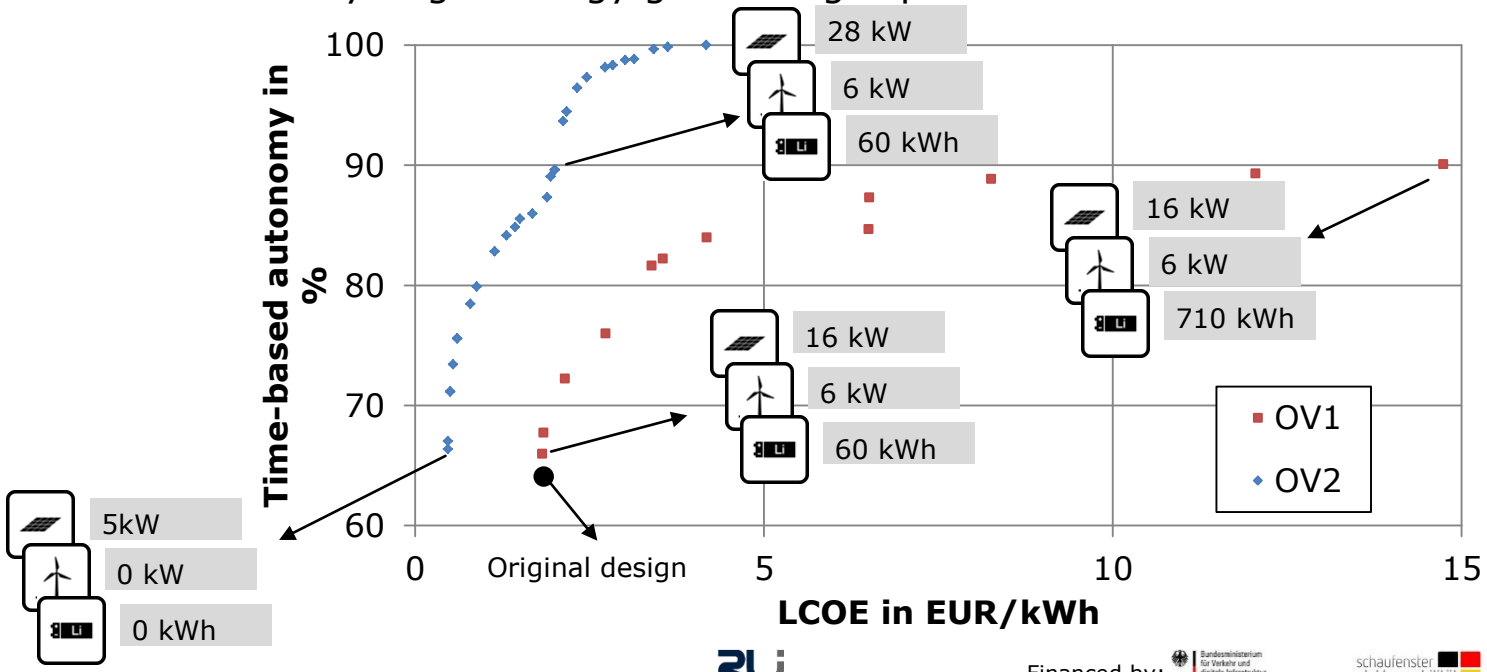


Results - Economic cost of self-sufficiency

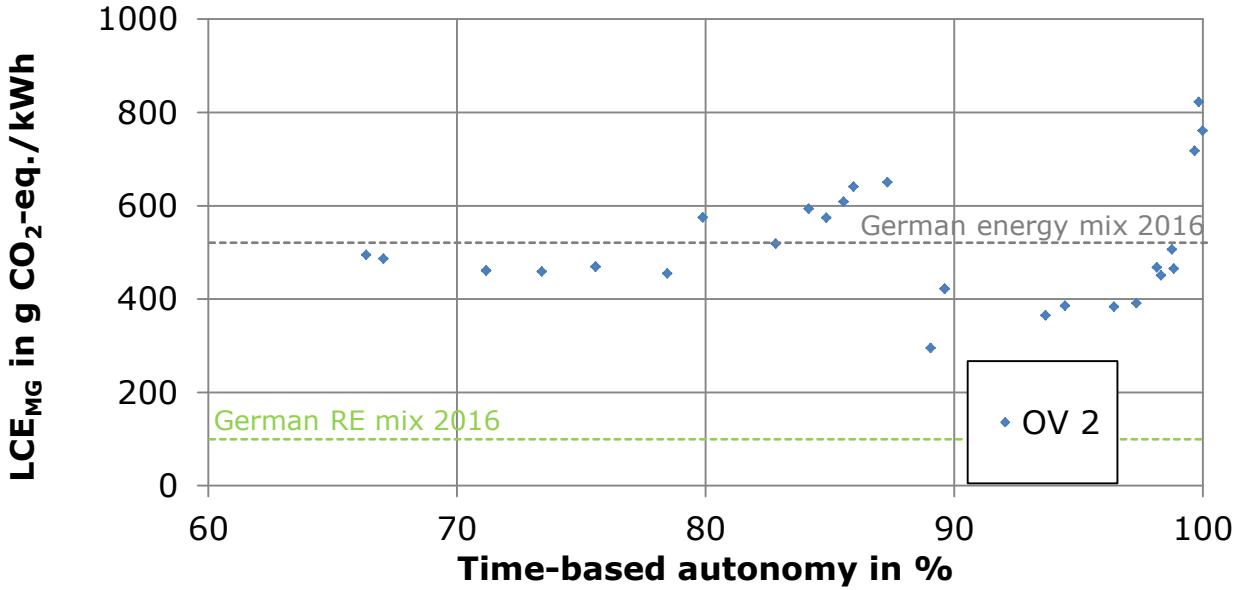
- Curtailing effects: By **curtailing the energy output**, battery capacity can be substituted by larger energy generating capacities



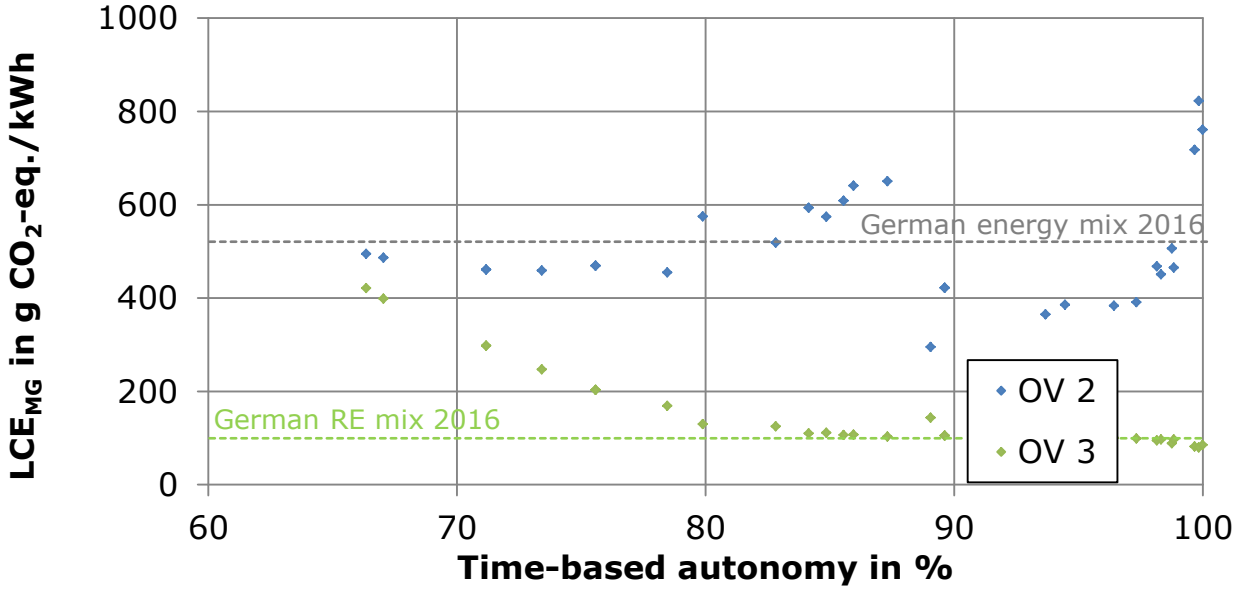
- Curtailing effects: By **curtailing the energy output**, battery capacity can be substituted by larger energy generating capacities



- Effects on greenhouse gas emissions: Insisting on high self-sufficiency **causes high life-cycle emissions**



- <u>Effects on greenhouse gas emissions:</u> Allowing feed-in of surplus energy leads to lower life-cycle emissions – feed-in needs to be attuned to the national grid



Agenda

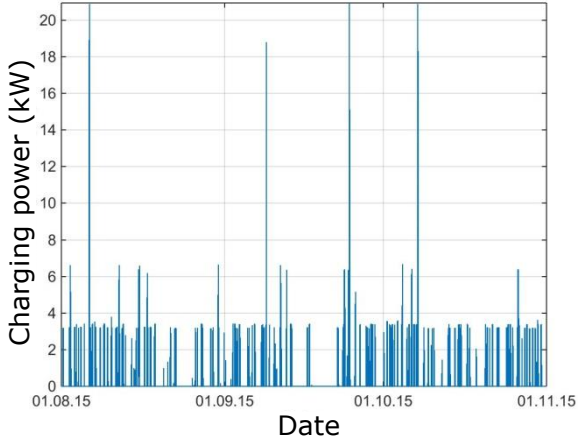
1. Challenge – energy supply for a car-sharing station
2. Solution – multi-criterial optimization of decentralized energy systems
3. Results – cost vs. ecology vs. self-sufficiency
4. Conclusion

Conclusion

- **Local self-sufficiency** is neither economically feasible nor environmentally viable at the train station Berlin Südkreuz
- **Curtailing of RE generation** lowers battery capacity requirements
- **Feed-in of RE** is required for low life-cycle emissions

- **When providing energy for battery electric vehicles** peak shaving should be used to lower the electricity costs and to reduce the load at the grid connection

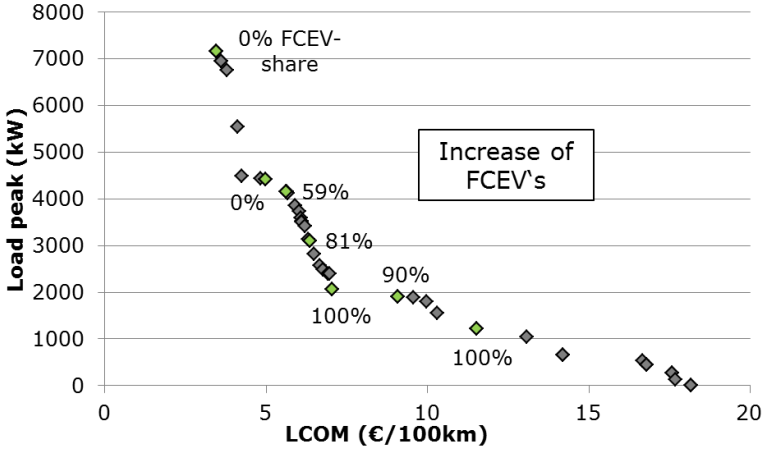
How to provide charging power up to 350 kW and more?
Porsche already installed the first HPC-stations.

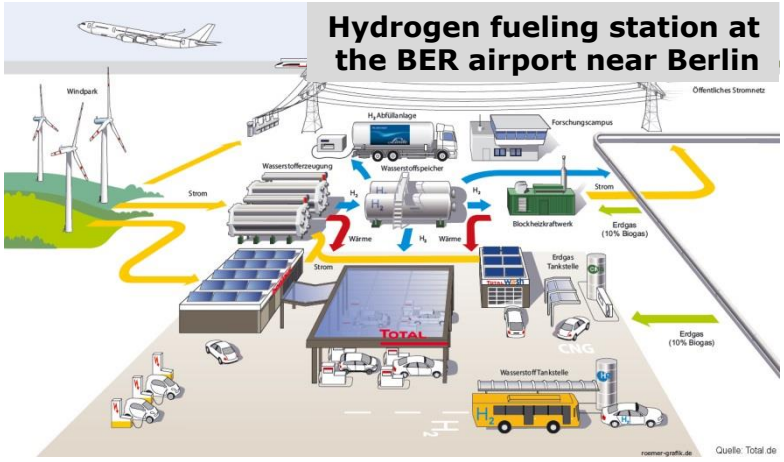


Measured data: Charging stations are characterized by discontinous load curves, with temporarily high load peaks (here 22 kW)

Conclusion

- **Current projects at the RLI** focus on infrastructure for fuel-cell as well as for battery electric vehicles

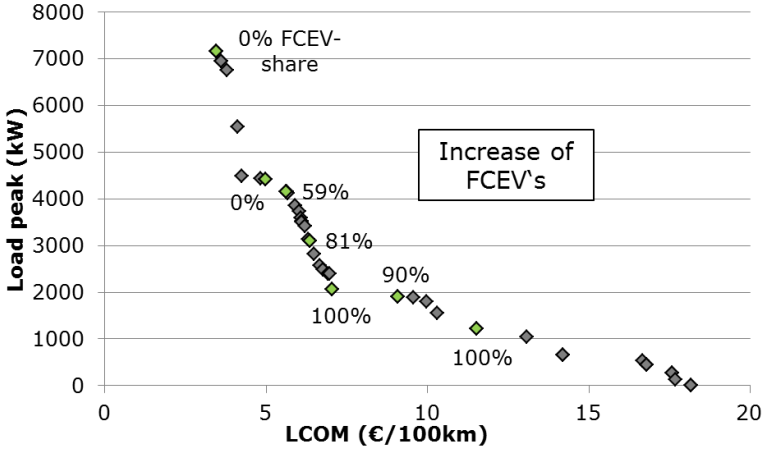




- **Both technologies are required** to deal with the challenge of transport electrification

Conclusion

- **Current projects at the RLI** focus on infrastructure for fuel-cell as well as for battery electric vehicles



- **Both technologies are required** to deal with the challenge of transport electrification

Thank you for your attention

WE CAN HELP YOU

- Modelling, simulation and optimization
- Research co-operation
- Collaborative project applications
- Industry partnerships

CALL US

M. Sc.
Norman Pieniak
Managing Researcher

Tel.: +49(0)30 1208 434-38
Email: norman.pieniak@rl-institut.de
Web: www.reiner-lemoine-institut.de