THE MOBILITY HOUSE

Integration of electric vehicles and power grids (VGI)

Vision 2030 for Germany:
Reduction of CO_2 without subsidies: up to 39 mtpa

10 million emission-free cars in 2030

September 2019

Make EVs cheaper than conventional cars through creating value from provision of battery energy services

TMH VGI-Initiative

TMH Approach

- **EV + bidirectional charger** should become **cheaper** than ICE regarding initial cash investment.
- This will enable **mass adoption** of EVs on socially equitable basis.
- It can be achieved by factoring-in the **value** of **VGI**.
- For this we need VGI with **equal legal framework for** EVs and stationary storage regarding levies.
- **€4300 per car** – VGI present value over 10 years.
- **€1700 per battery + charger** – VAT reimbursement.

2030

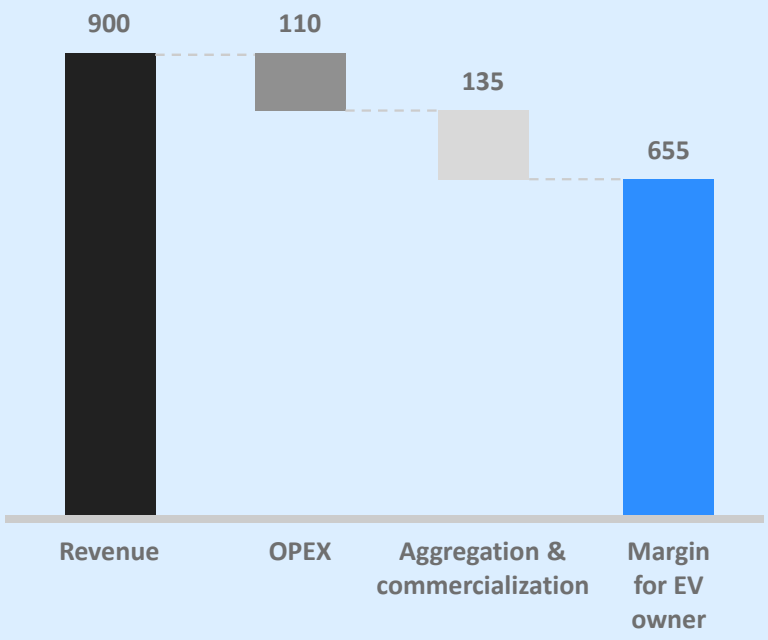
- **10 million EVs** in Germany in 2030 are ambitious but **possible***.
- Norway – **more than 50% of new sales are EVs** as soon as all-in cash costs are lower than ICEs.
- German grid volatility provides unique opportunity to do the same with **no additional burden on taxpayers**.
- Just **regulatory changes** and **VAT treatment** of the battery and the charger as business are needed, to achieve value of **€6000 per car without subsidies – higher than the current subsidy of €4000** in Germany.

* **NPM** (Report by WG1 of the 'Future of Mobility' National Platform, March 2019)
Source: The Mobility House, NPM

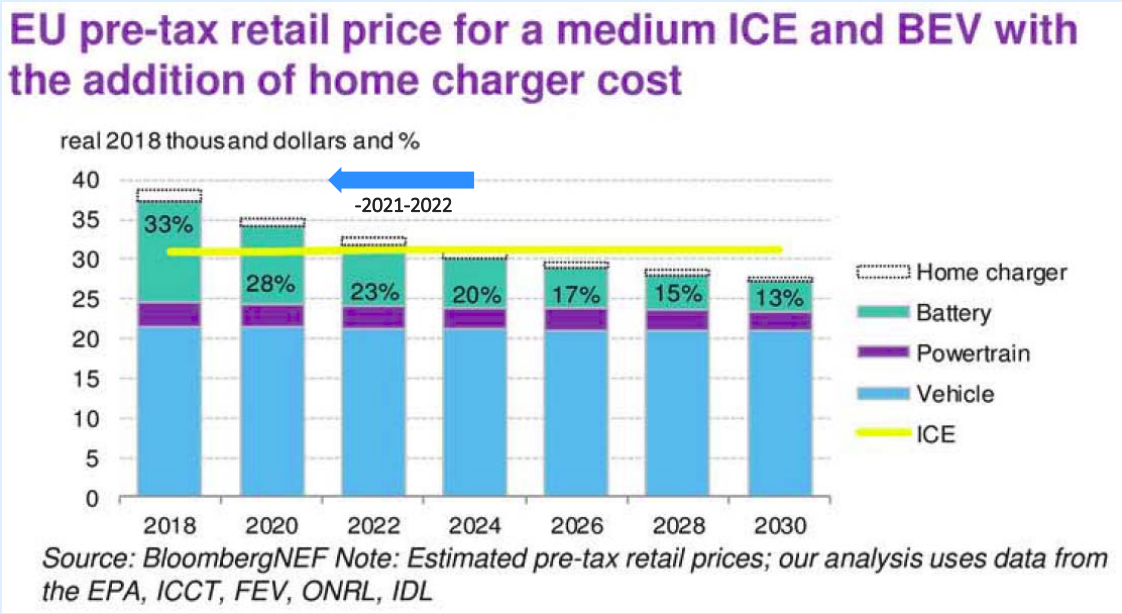
Germany can have 10 million EVs on the road in 2030 if cash costs of EVs are lower than ICE sooner rather than later

€6000 per car will allow reaching parity between EVs and ICEs as soon as the regulatory changes are made

Value of VGI (home case 2025, €/a/EV)



VGI will help to reduce the initial cash outlay in EVs



Source: The Mobility House, BNEF

VGI can contribute significantly to the emission reduction targets of the German government as well as address curtailment on local level

Prize of VGI – enable Verkehrswende with 10m EVs in 2030 and increase CO_2 reduction per EV

GHG emission reduction ($tCO_2eq/a/EV$)

2030

ICE

-2,2

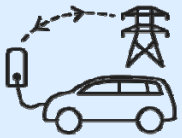
7,0-10,5 million EVs reduce 15-23 $MtCO_2eq/a$ according to NPM[1]

EV

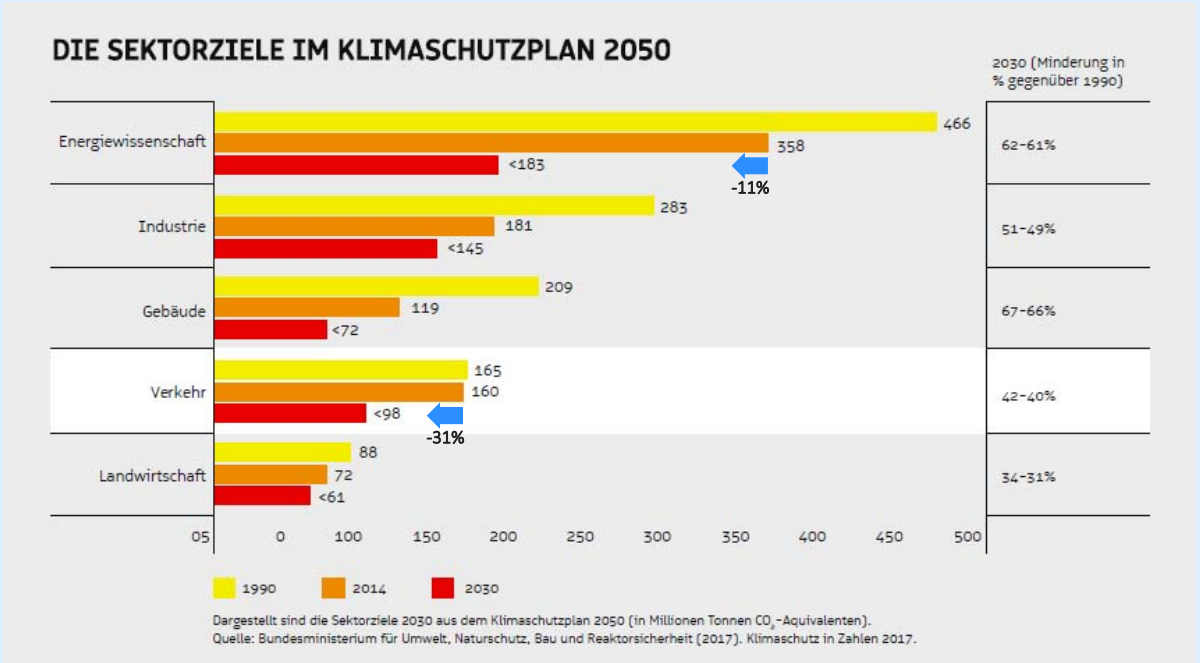
-1,7

60 VGI-cycles p.a. with 60 kWh battery, $\frac{1}{3}$ of which avoided curtailment and $\frac{2}{3}$ of which arbitrage

VGI



Contribution to emission reduction target**



* NPM (Report by WG1 of the 'Future of Mobility' National Platform, March 2019)

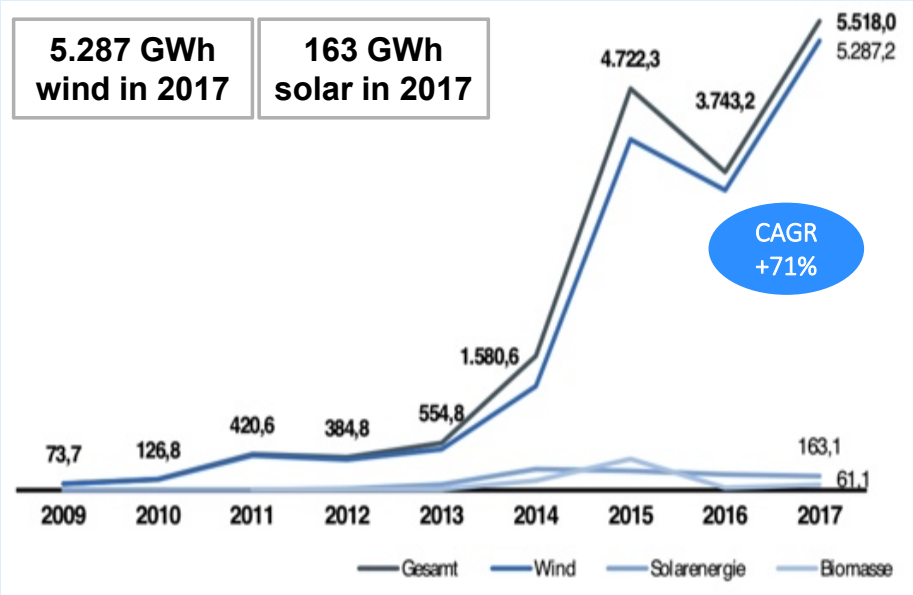
- ** Assuming 50-50 allocation to Transportation and Energy sectors

Source: The Mobility House, NPM

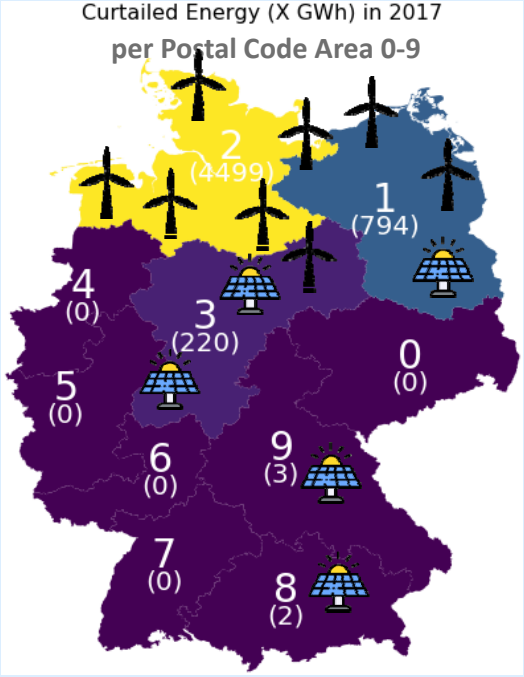
Curtailment occurs currently primarily in northern Germany and grew annually by 71% on average since 2009, with 5.5 TWh curtailed in 2017

Curtailment growth will continue as renewables increase from 38% in 2018 to 65% in 2030

Growth until now



Current distribution



Source: The Mobility House, Umweltbundesamt

10 Million EVs with VGI in Germany would be a key element for achieving German 2030 CO_2 reduction targets

Call for action – what is needed?

- Equal footing of EV swarm batteries on vehicle-grid-integration technology with other sources governed by the German Renewable Energy Act (EEG)
  - Apply grid and renewables' levies only to energy consumed for driving, **not** the temporarily stored energy.
- Commitment to using decentralized storage to avoid curtailment of renewable energy and to supply system services to relieve pressure on the grid
  - Create unlimited access to ancillary services and short-term energy markets for EV swarms by reducing the commitment periods and power thresholds.
  - Use the features of battery storage such as precision, fast reaction & ramping times and their distributed nature with corresponding grid service products – as already successfully in place in some US regions.
- Cooperation of stakeholders (BNetzA, DSOs and TSOs, car manufacturers, car leasing companies, lenders, KfW and aggregators like TMH) to work together to develop new models for funding VGI
  - TMH has systems and processes in place and the model's technical feasibility has been verified with leading car manufacturers and successfully tested in pilot projects in Germany and Europe.

Source: The Mobility House

TMH has proven track record in VGI

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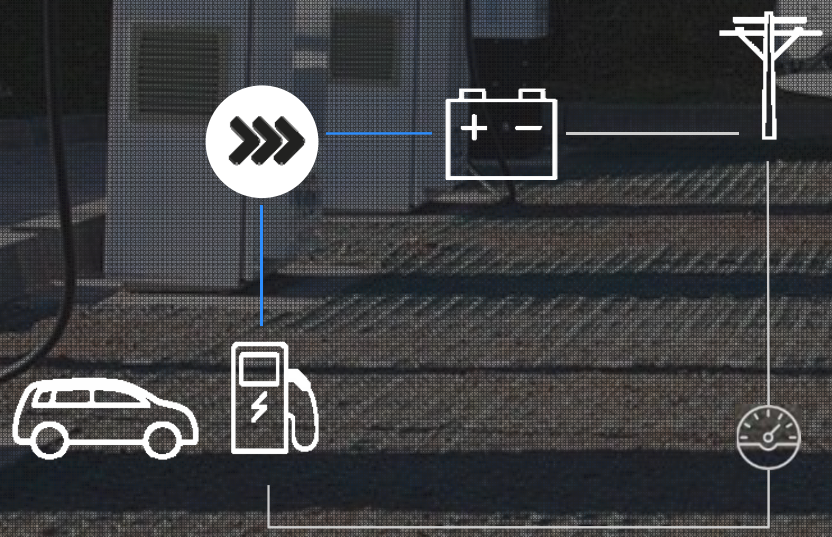
First EV stabilizing German electricity grid

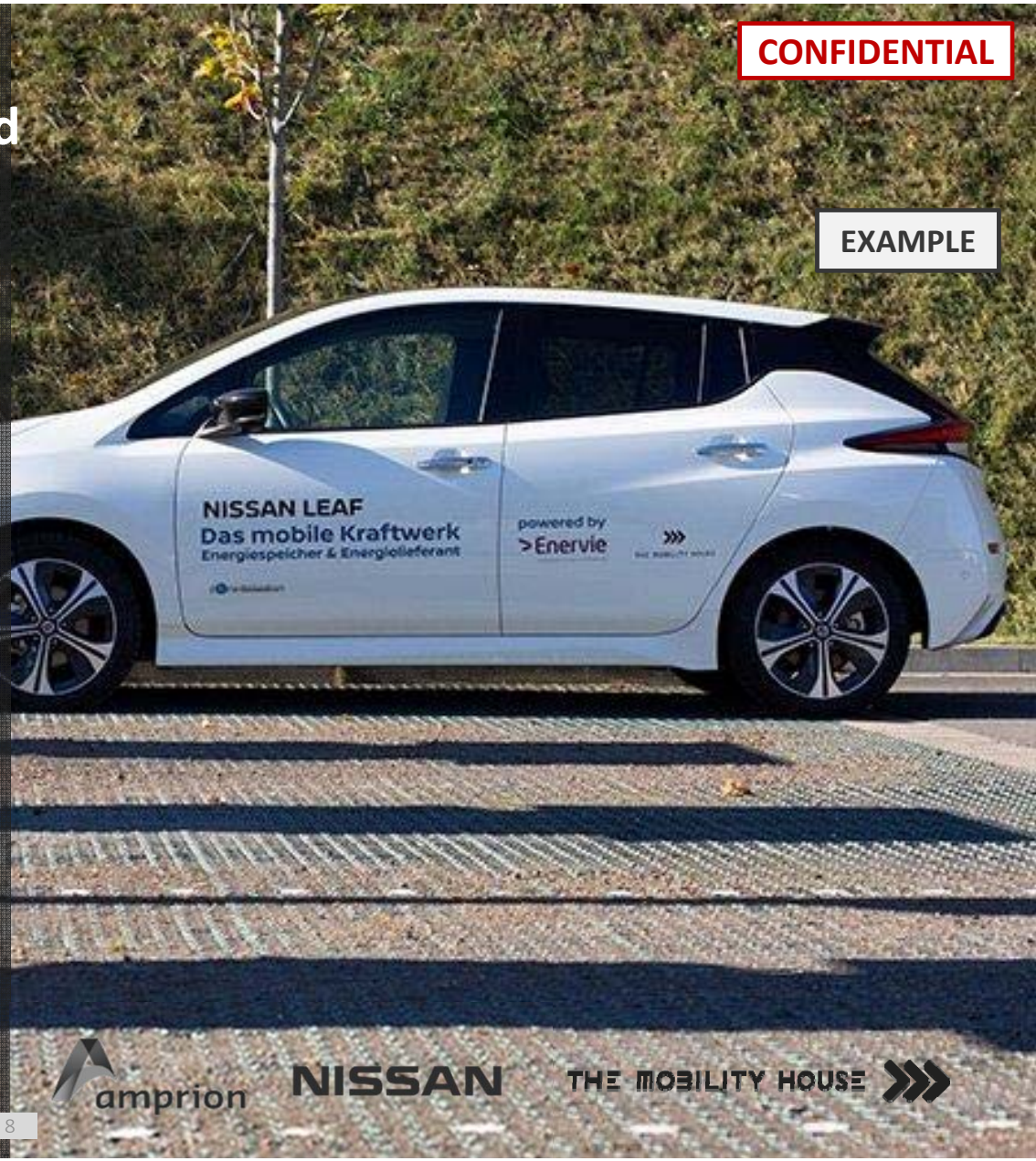
EXAMPLE

FCR with EVs

> Generation of revenues through supply of FCR (Frequency Containment Reserve)

> Prequalification for FCR following TSO directives identical to a large-scale power plant





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Source: The Mobility House

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Audi opens battery storage on Berlin EUREF Campus

EXAMPLE

Multi-use Stationary Storage with Volkswagen Group

Source: The Mobility House

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EXAMPLE

Impressions inside of battery storage

Stationary Storage with Daimler

Spare part batteries

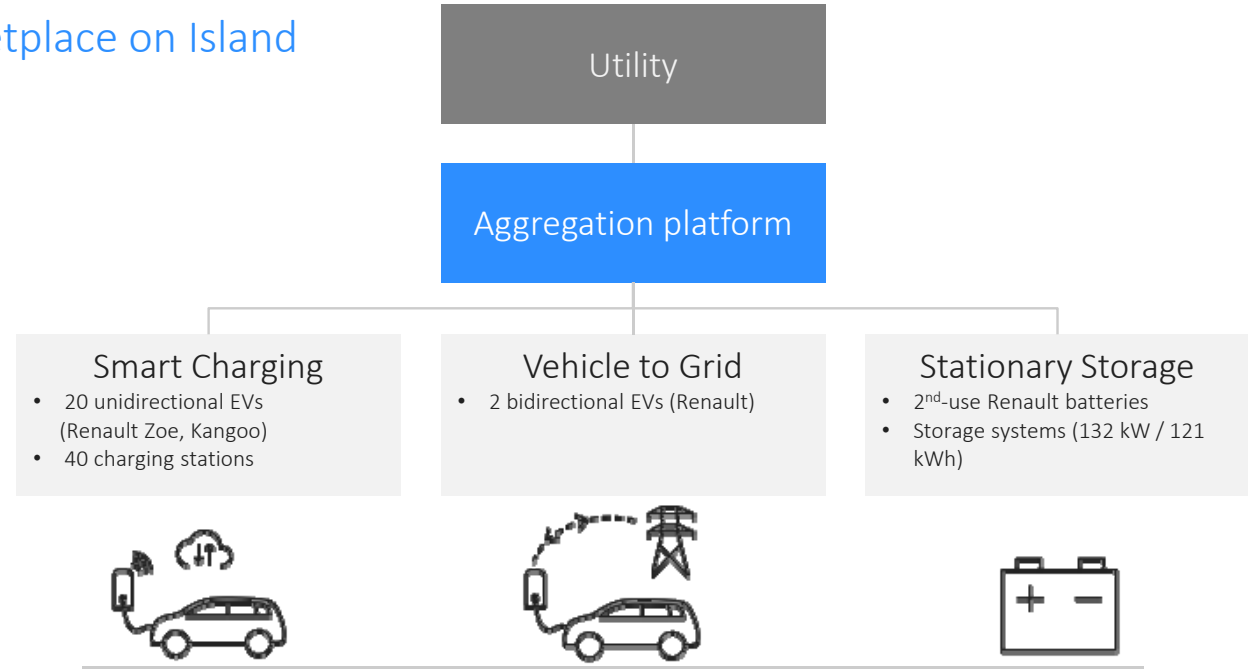
Second life batteries

Inverter and DC cabinets

Source: The Mobility House

Porto Santo is the first island powered by Renault EVs managed by TMH

Marketplace on Island



CO_2 Leverage first fossil free island

Decrease cost of electricity

Stabilize power grid with different assets

Increase renewable energy sources

http://www.mobilityhouse.com/en/the-mobility-house-groupe-renault-realizing-first-smart-electric-ecosystem-porto-santo-island/

Source: The Mobility House

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EV-battery based multi-use storage system generates revenues through various services

EXAMPLE

ESS Amsterdam

Source: The Mobility House

Optimized PV Integration

Peak Shaving & Backup Power

Grid Services

Vehicle-to-Grid

EV Car Sharing

*3 MW / 2.8 MWh storage system made of **148 Nissan Leaf batteries***

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