THE PARKER PROJECT IN DENMARK–

FIRST RESULTS

5th int. Conference on electromobility: challenging issues

Armand Peugeot chair, Governance and Regulation chair, Vedecom institute

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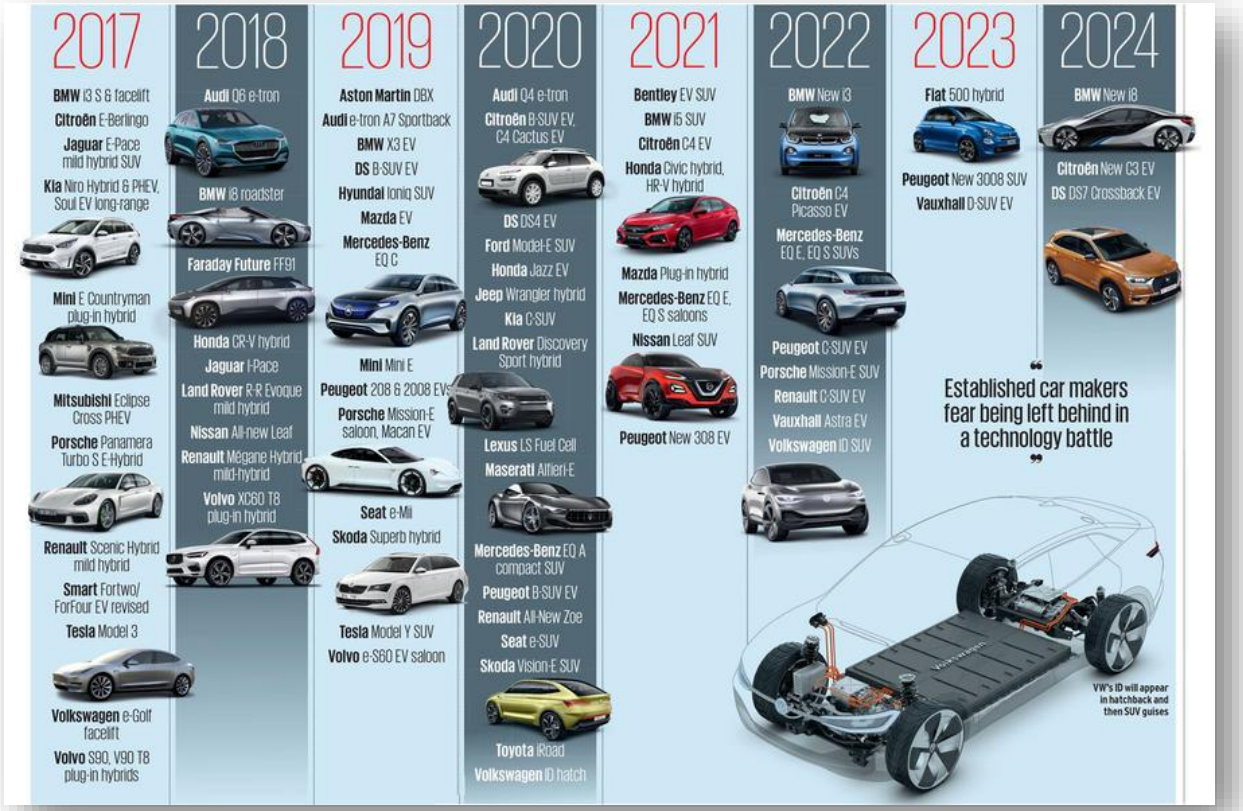
DTU Electrical Engineering

Department of Electrical Engineering

Source: autocar.co.uk

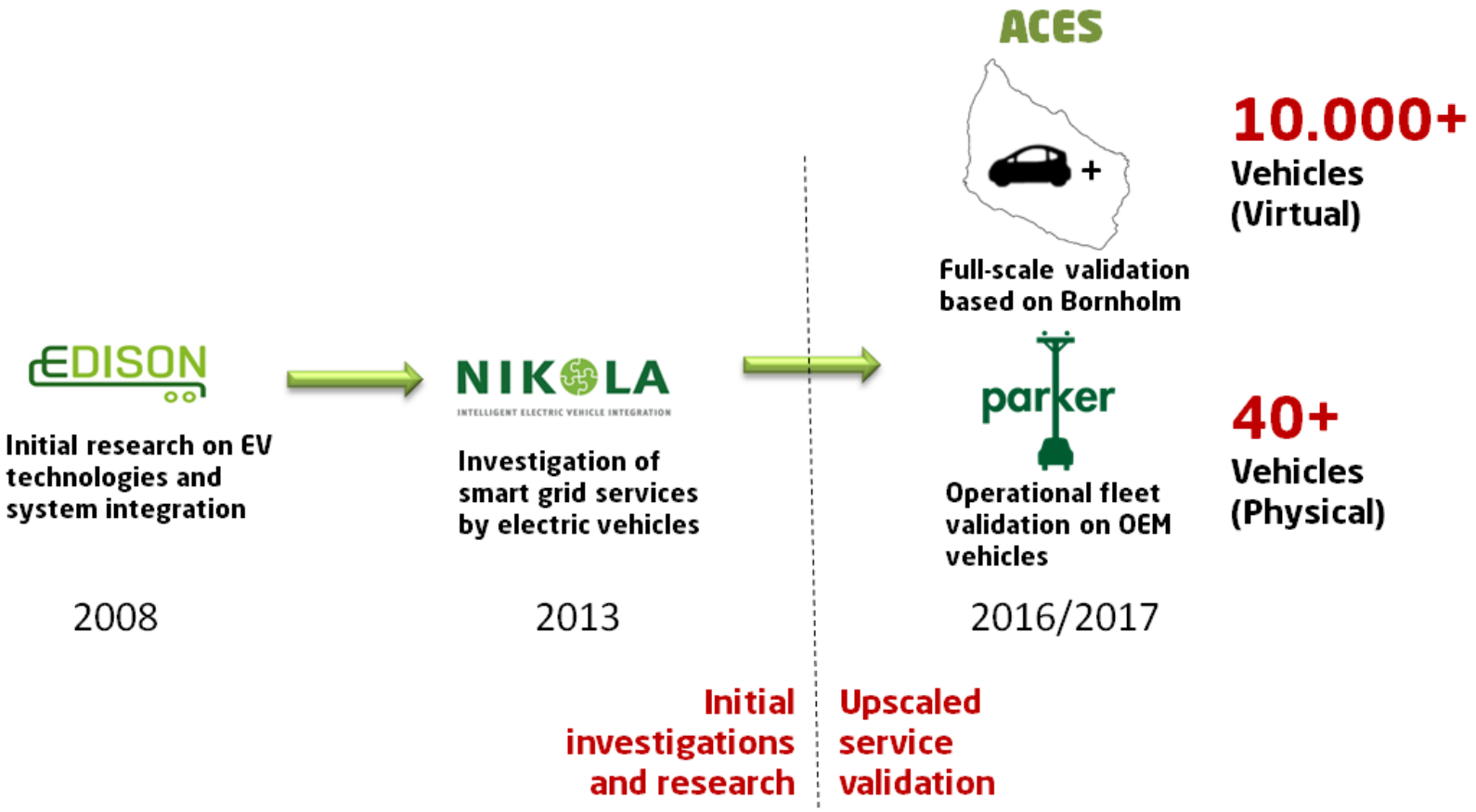


Measures of performance:

- Range, acceleration, charging time
- Grid support, emergency power, energy autonomy, mobile power

Grid Integrated Electric Vehicle (GIV):

A vehicle that, together with its supply equipment, is **purposely designed** with **capabilities and performance** allowing for advanced **grid services**


ACES
10.000+
Vehicles
(Virtual)
Full-scale validation
based on Bornholm
EDISON
NIKOLA
INTELLIGENT ELECTRIC VEHICLE INTEGRATION
parker
40+
Vehicles
(Physical)
Initial research on EV
technologies and
system integration
Investigation of
smart grid services
by electric vehicles
Operational fleet
validation on OEM
vehicles
2008
2013
2016/2017
Initial
investigations
and research
Upscaled
service
validation

parker

Thomas Parker, 1843 – 1915

Demonstrate that **contemporary** electrical vehicles can participate in **advanced** smart grid services.

Partners: Nissan, Mitsubishi Corporation, Mitsubishi Motors Corporation, PSA ID, NUVVE, Frederiksberg Forsyning A/S, Insero A/S, Enel and DTU.

Duration: August 2016 to July 2018.

Budget: Two million euros, funding by ForskEl

A close cooperation with vehicle and EVSE OEMs

Worlds first V2G hub

Photo: Nissan DK

Frederiksberg Forsyning

- Utility company – domestic gas, tap water, district heating and sewage
- Approximately 100.000 Residents
- Part of greater Copenhagen

Partner:

NUVVE

NISSAN Innovation that excites

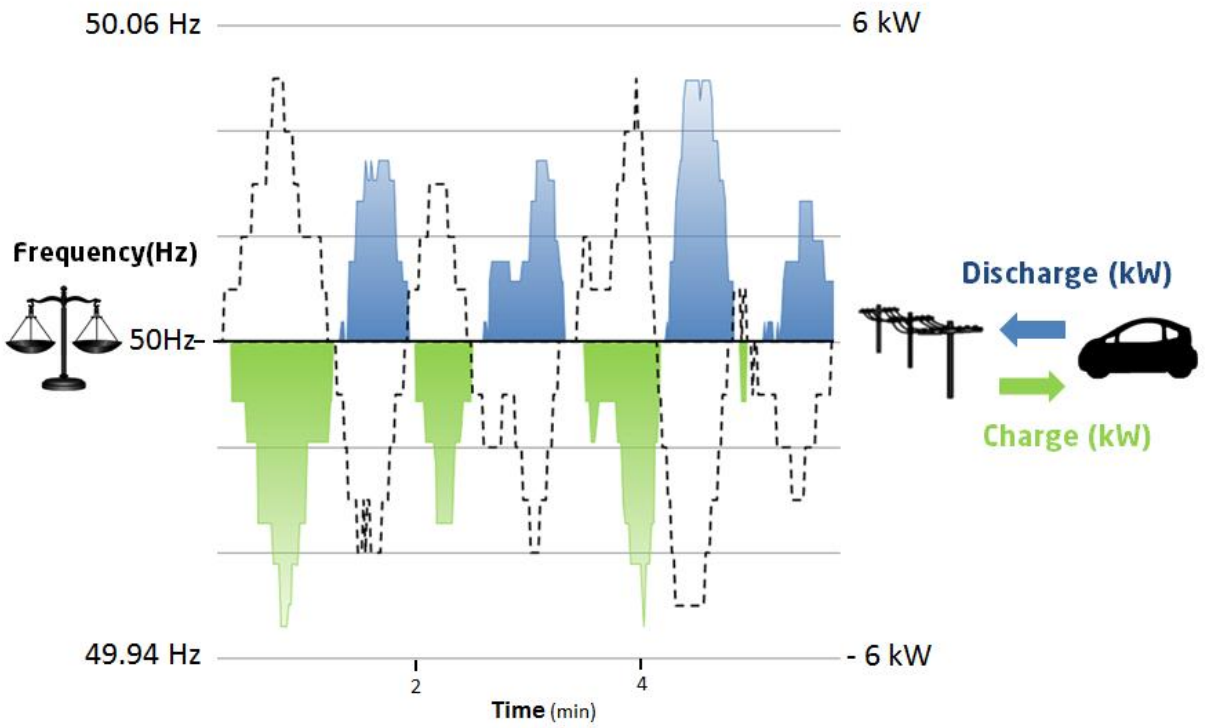
enel

Services – Frequency regulation

Photo: Nissan DK

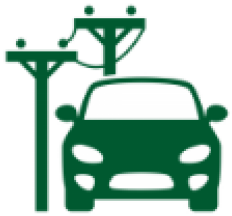
- 10x Nissan eNV200 electric Vans
- 10x ENEL V2G units (bidirectional 10 kW)
- Used mainly for maintenance and service tasks.
- Usage hours = Work day 7 AM – 4 PM

Services – Frequency regulation



Potential earning with 10kW V2G units (FCR-N, ~14 h/day)

<u>120 Euro/Month pr Vehicle</u>



Grid Applications

Grid Readiness Certificate

Scalability and replicability

Grid Applications

Explore and **demonstrate** new EV services using state-of-the-art vehicles and chargers.

Grid Applications

The act of altering the **timing**, **size** or **direction** of the **power and energy** exchanged between the **battery** and the **grid**.

- **Frequency containment**
- **Voltage support**
- **Emission reduction**
- **Stacked services**

Lab

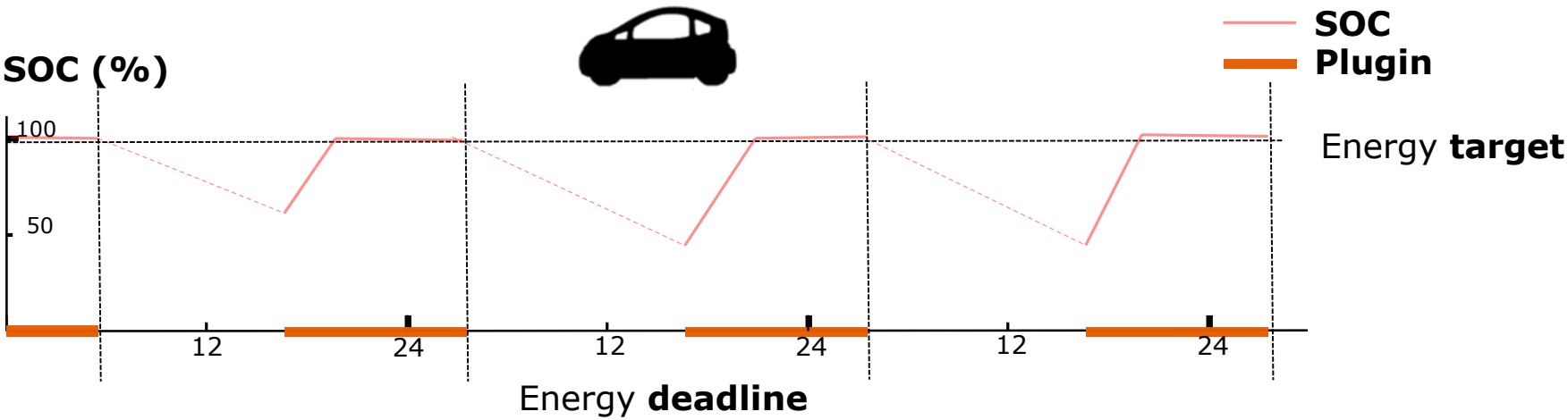
- ✓ Cross-brand technical feasibility
- ✓ Battery usage

Field Pilot

- ✓ User patterns
- ✓ Technical/economic barriers

Grid Applications

Usage patterns "Time is money"



Grid service provider

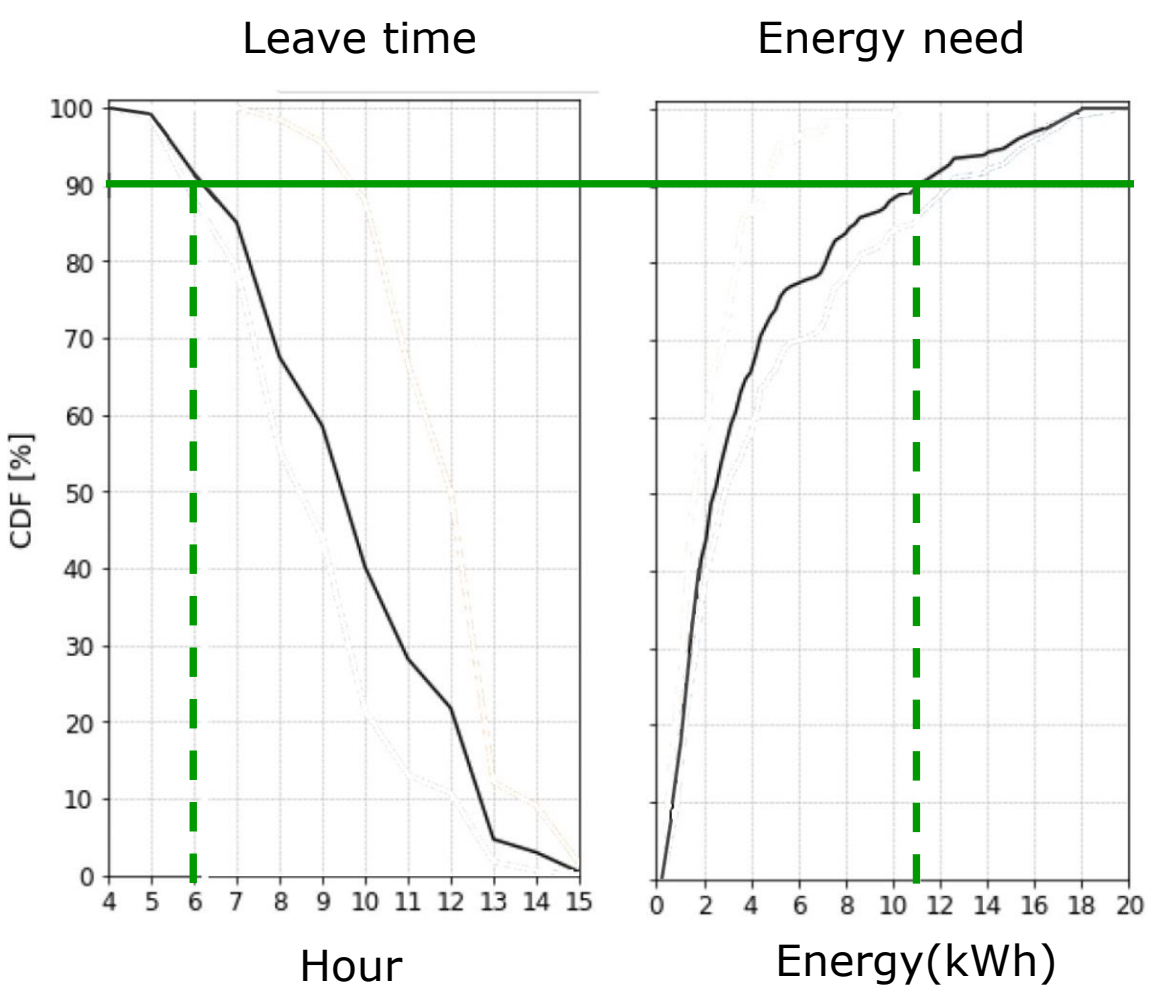
*"What is the availability and constraints of using the **battery** for services"*

User

*"My **car** must be sufficiently charged when needed"*

- Energy target
- Energy deadline

Grid Applications



Profile 1

Risk: 0%

Energy deadline: 4:00

Energy target: 20 kWh

Profile 2

Risk: **10%**

Energy deadline: **6:00**

Energy target: **11 kWh**

2-3 hours of extra service provision per day!

Source: Lea Sass Berthou, 2017

Grid Readiness Certificate

A **Common definition** of technical capabilities needed to support services

Grid Readiness Certificate

1. Grid Keys

Controllability
+
Performance
+
Observability

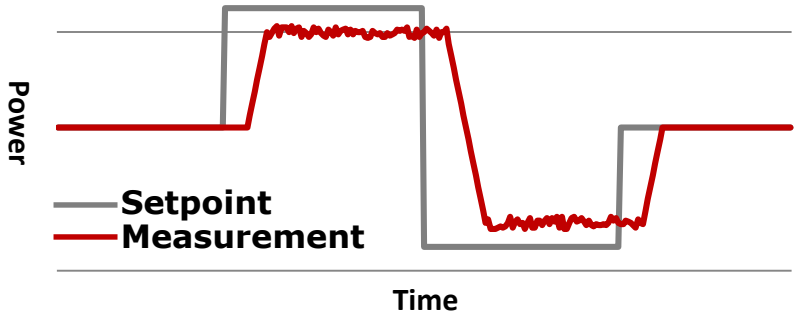
Active power

Reactive power

Grid formation

- Emission reduction
- Frequency containment
- …
- Voltage support
- …
- Vehicle-to-Building
- Vehicle-to-Tools
- …

2. Test

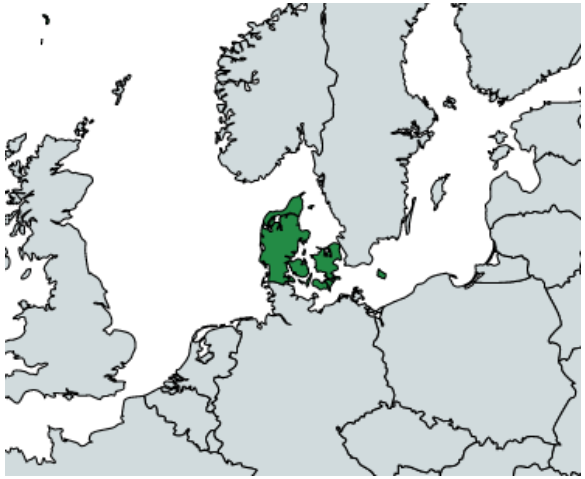


3. Evaluation

Scalability and replicability

Understand scalability in terms of system and market impacts and **replicability** across users and regions.

Scalability and replicability



Scalability

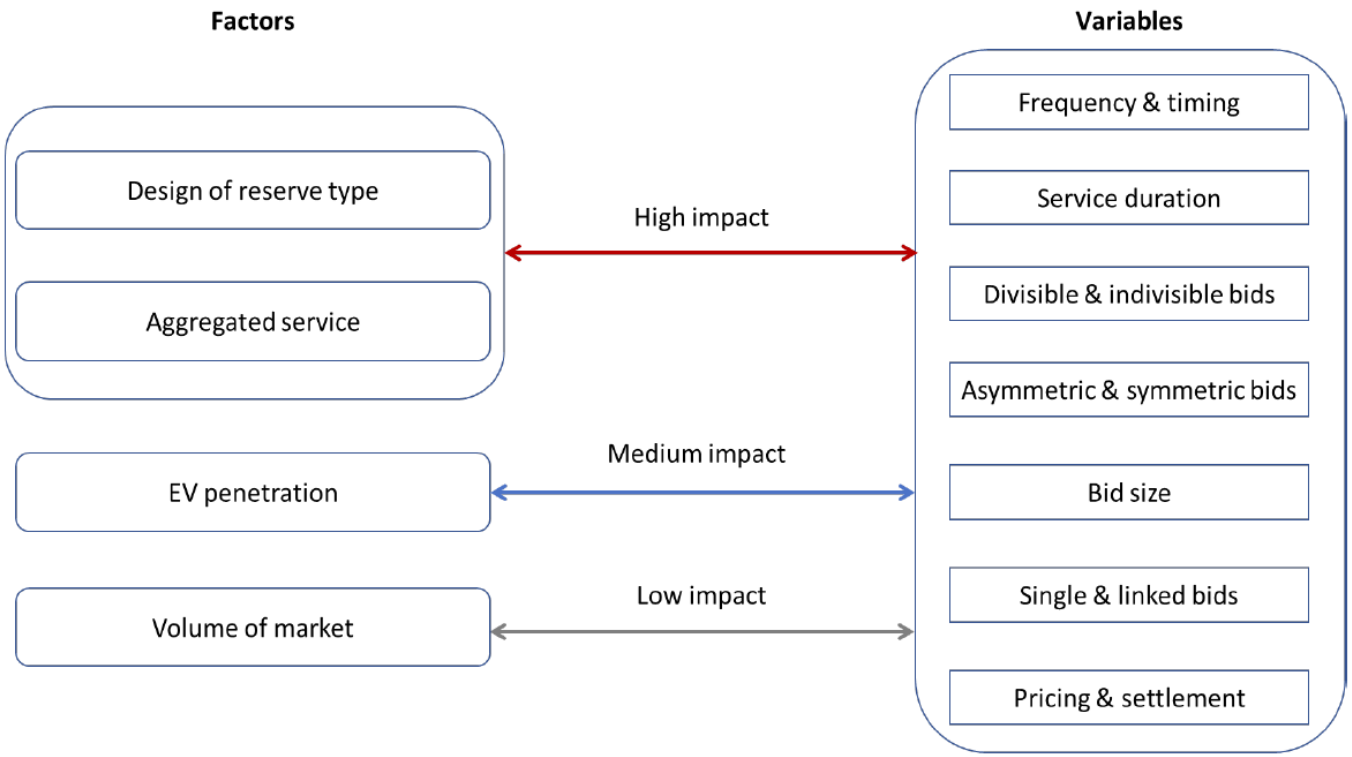
- Market volume analysis
- Power system impact
- Market barriers

Replicability

- Markets and services
- User segments
- Standards and charging options

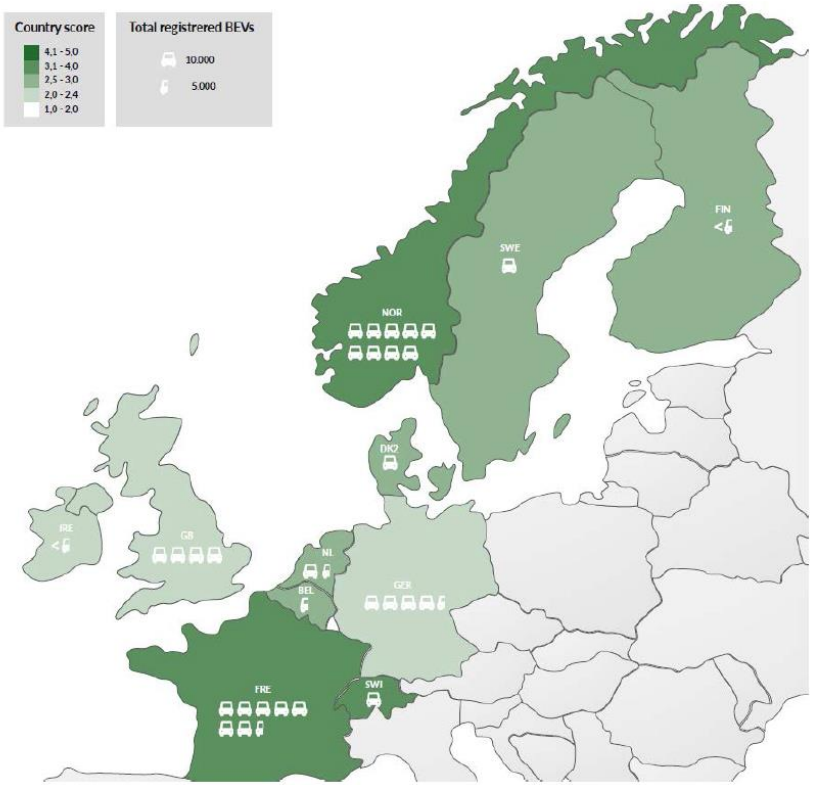
Scalability and replicability

Grid Variables and factors for FCR



Scalability and replicability

Best FCR market for V2G



Whitepaper

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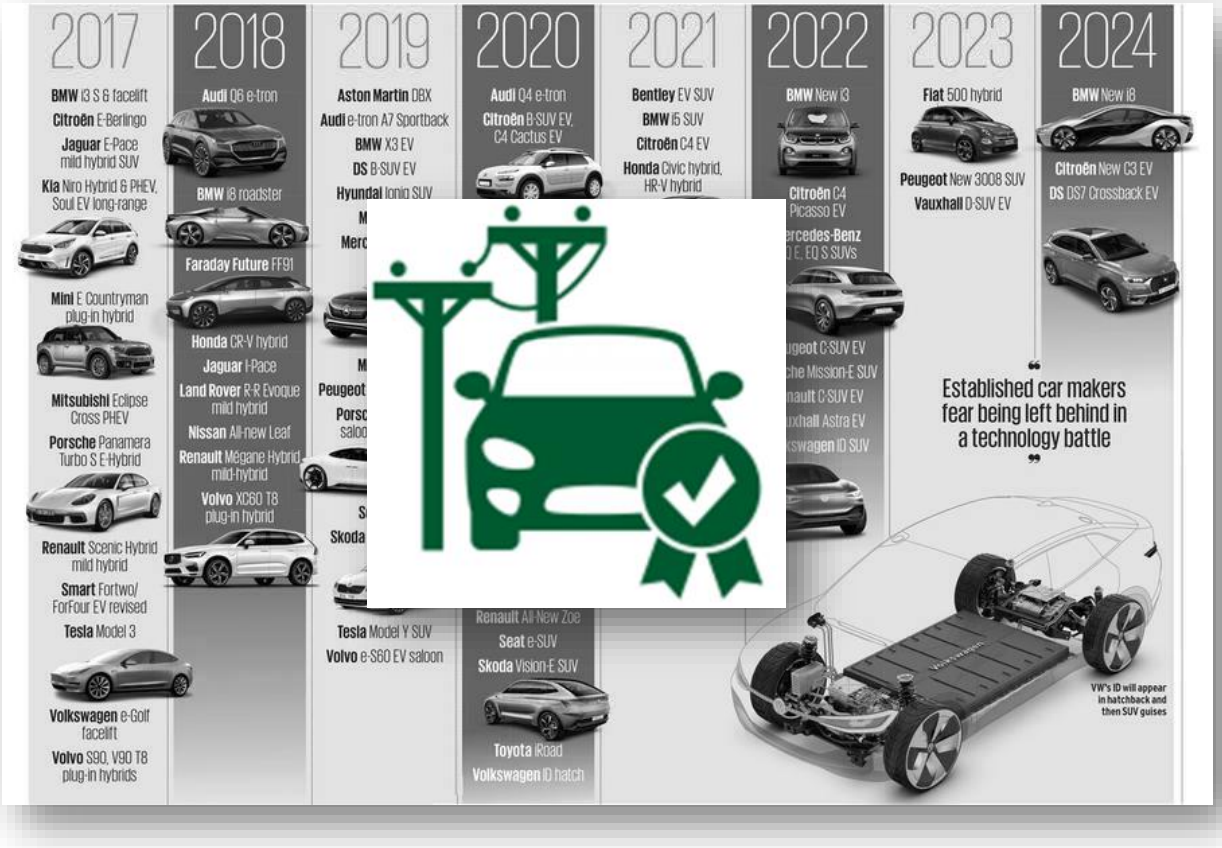
Scalability and replicability

Current DK challenges in providing FCR with V2G

Challenge	Action
Energy tariffs and taxation	Differentiate between energy used for driving and energy used for services.
Requirement for settlement meters	Consider a whitelist for EVSE meters approved for settlement
Frequency energy bias	Allow dynamic operation points or relaxation periods for storage based providers
Two-way energy loss	Technical improvements
Battery degradation	Technical improvements
Market model for aggregators	New market models that define the aggregator role and grant equal access to markets.

The grid integrated electric vehicle



Vehicle specifications

Powertrain

DRIVE TYPE:	Front-wheel	ENGINE LOCATION	front
HORSEPOWER	147hp@3,283RPM	TORQUE	230 lb.-ft.@RPM
BATTERY	40 kWh	TRANSMISSION	1 speed automatic

Dimensions

BODY WIDTH:	1,791MM(70.5”)	FRONT HEADROOM	1,046mm(41.2”)
LENGTH:	4,481MM(176.4”)	FRONT LEGROOM	1,069mm(42.1”)

Grid options

BI-DIRECTIONAL (V2G)	Yes	VEHICLE-TO-X	Yes
GRID PROTOCOLS	CHAdeMO	EMERGENCY POWER	Yes

Questions?

More info:

www.parker-project.com