

Unlocking grid flexibility:



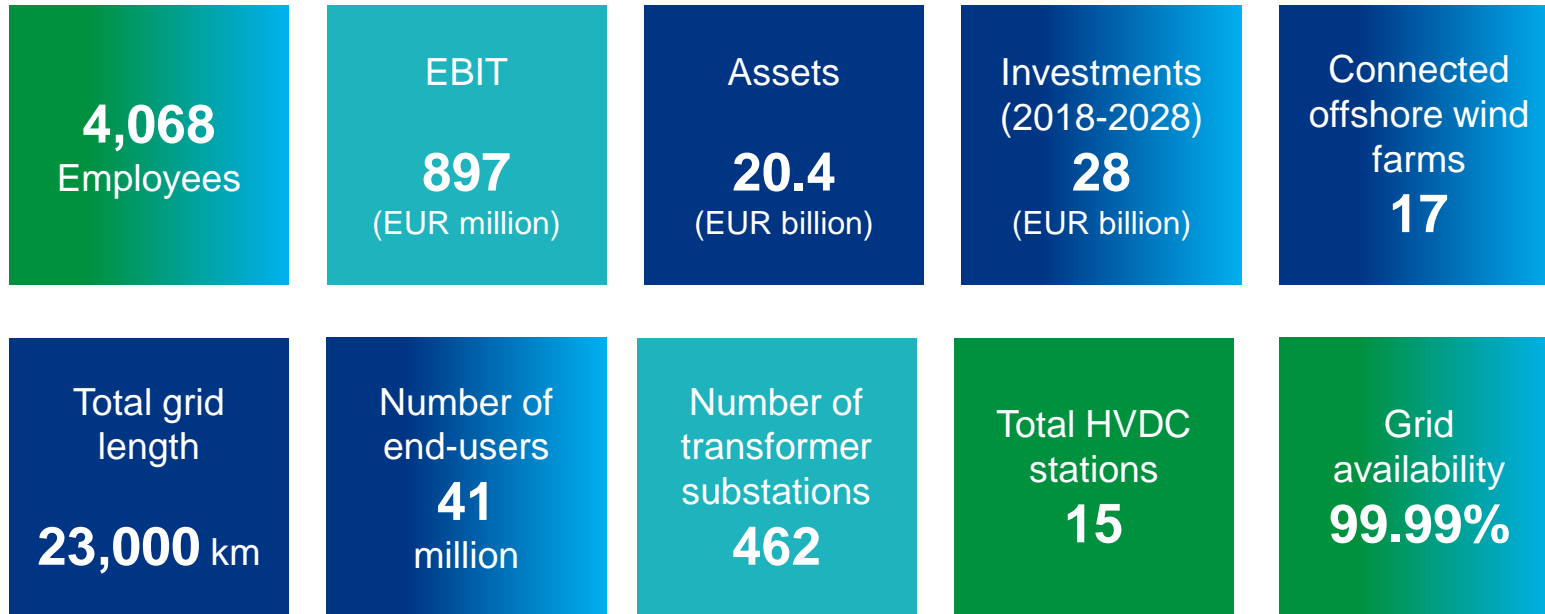
November-7-2018

Jan Vorrink

TenneT at a glance 2017



Europe's first cross-border grid operator





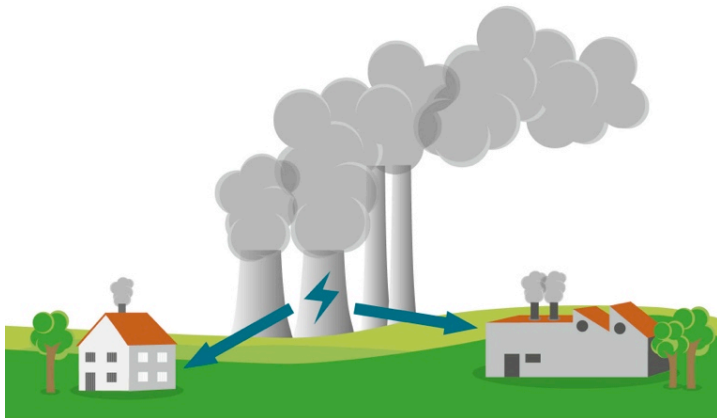
Renewables challenge the Grid

Renewables fundamentally change how power grids work

The old Electrical
Power System



The new Electrical
Power System



Big fossil or nuclear power plants close to the industrial centers feed electricity into the transmission grid. The connected distribution grid supplies consumers.



Renewable energy, produced locally, sometimes far away from industrial centers and storage facilities provide electricity at all grid levels depending on the weather.



Distributed Flexibility

With an increasing amount of volatile renewable energy in the system, an **optimal dispatch of flexibility options is needed** to guarantee security of supply and affordability.

Demand-side management (DSM)



Storage



Flexible supply



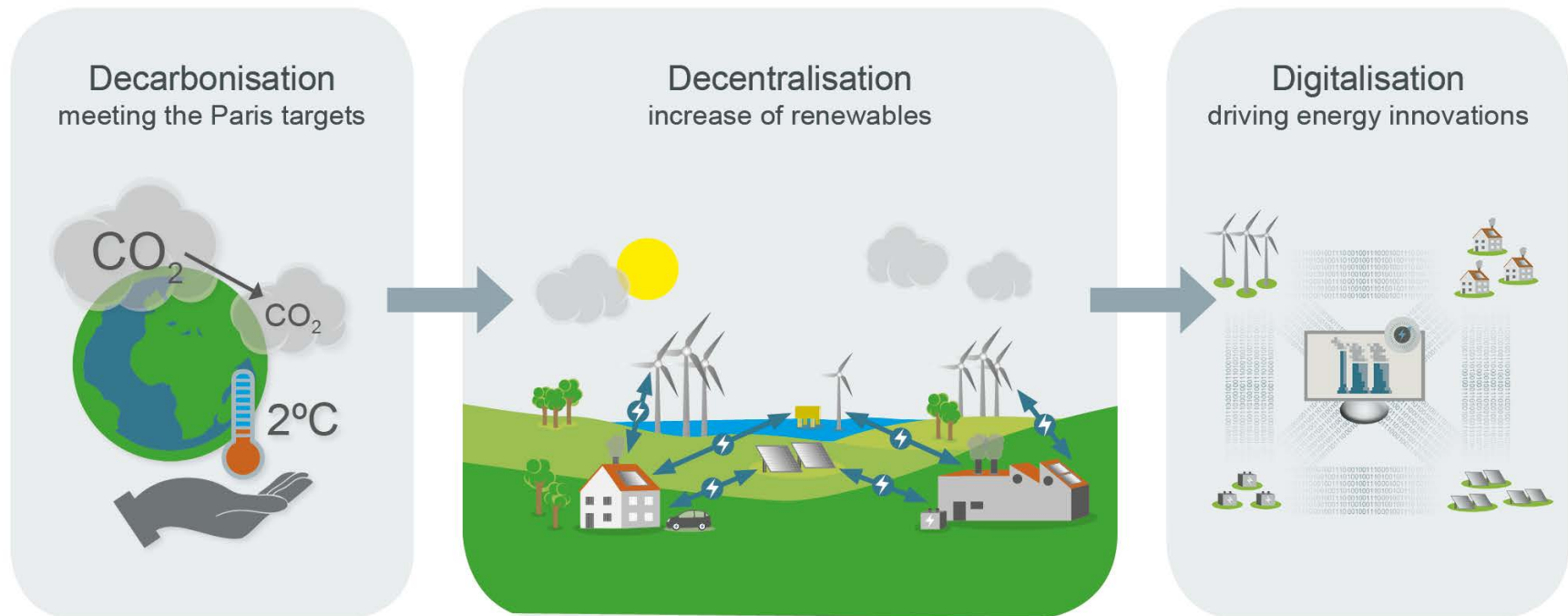
Energy efficiency/savings





Innovation drives the Energy System of the Future

Decarbonisation and the resulting decentralization of power supply raise demand for digital innovations.



An economic layer the web never had



Transactions without blockchain



Distributed system of records shared across a public or business network

Shared Ledger

All parties agree to verified transaction on the same network

Consensus

Transactions with blockchain



Crypto-graphy

Secure, authenticated & verifiable transactions

Smart Contract

Business terms embedded in ledger & automatically executed with transactions

Note: **Bitcoin** operates on the basis of Blockchain technology, but a **Blockchain** can be used for many more applications than just Bitcoin.



There is a lot of potential

Blockchain is here to stay: foundational technology

Learn fast, fail often (business use cases)

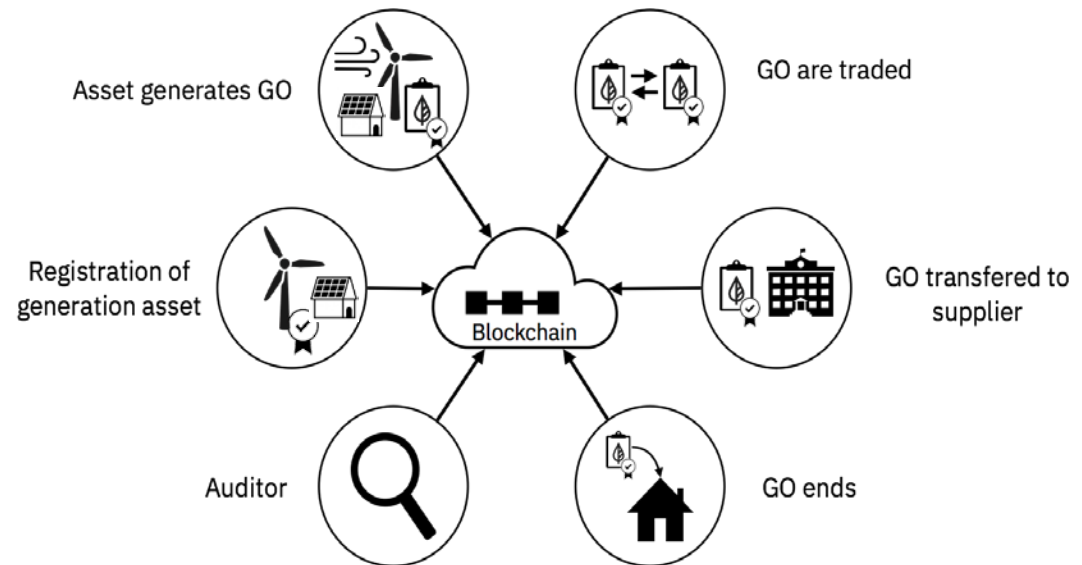
Why blockchain?

The leading blockchain platform is not invented yet

Only store relevant data on-chain

Certify decentral sustainable energy production

→ Blockchain captures the end-to-end process in one ledger.
All parties work on the same data.



certiq



There is a lot of potential

Blockchain is here to stay: foundational technology

Learn fast, fail often (business use cases)

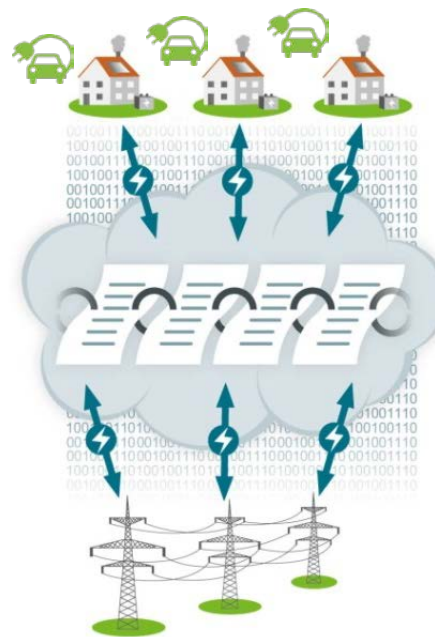
Why blockchain?

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Unlocking decentral flexibility

→ Gaining practical experience with blockchain technology and interfacing with existing TenneT systems and processes.



 **Aquarii**

redispatch with home batteries

 **RepubliQ**

aFRR with electric vehicles

Aggregator Vandebbron

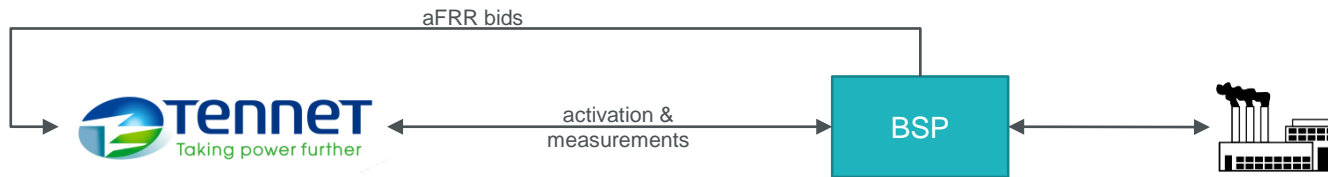
Stop and postpone charging process: regulating up

Pilot description

- Voluntary aFRR bids (1 MW)
- Realtime data communication:
 - TenneT setpoint & verification
 - Aggregated power signals
 - *Data on asset level*

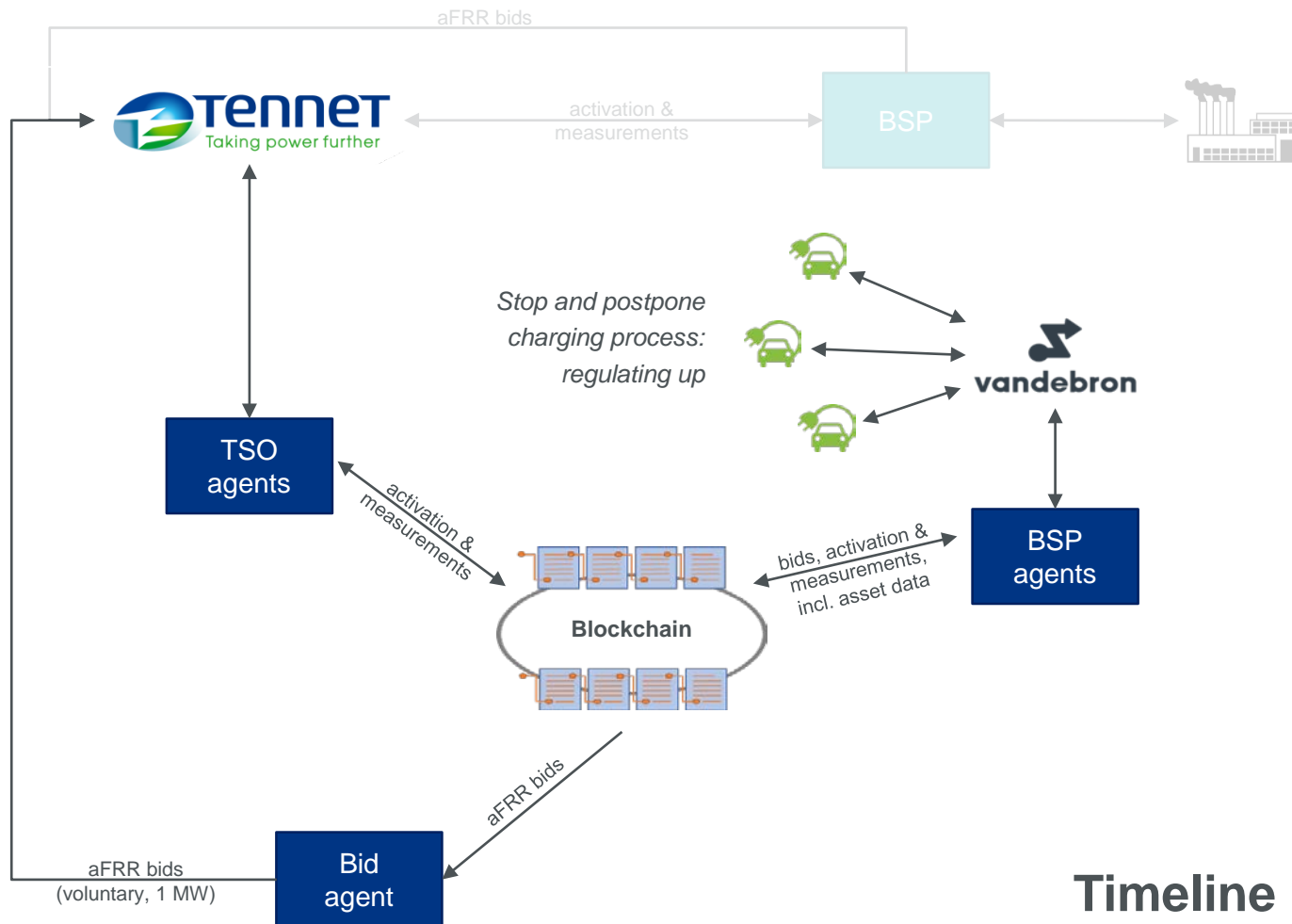


automatic Frequency Restoration





RepubliQ implementation

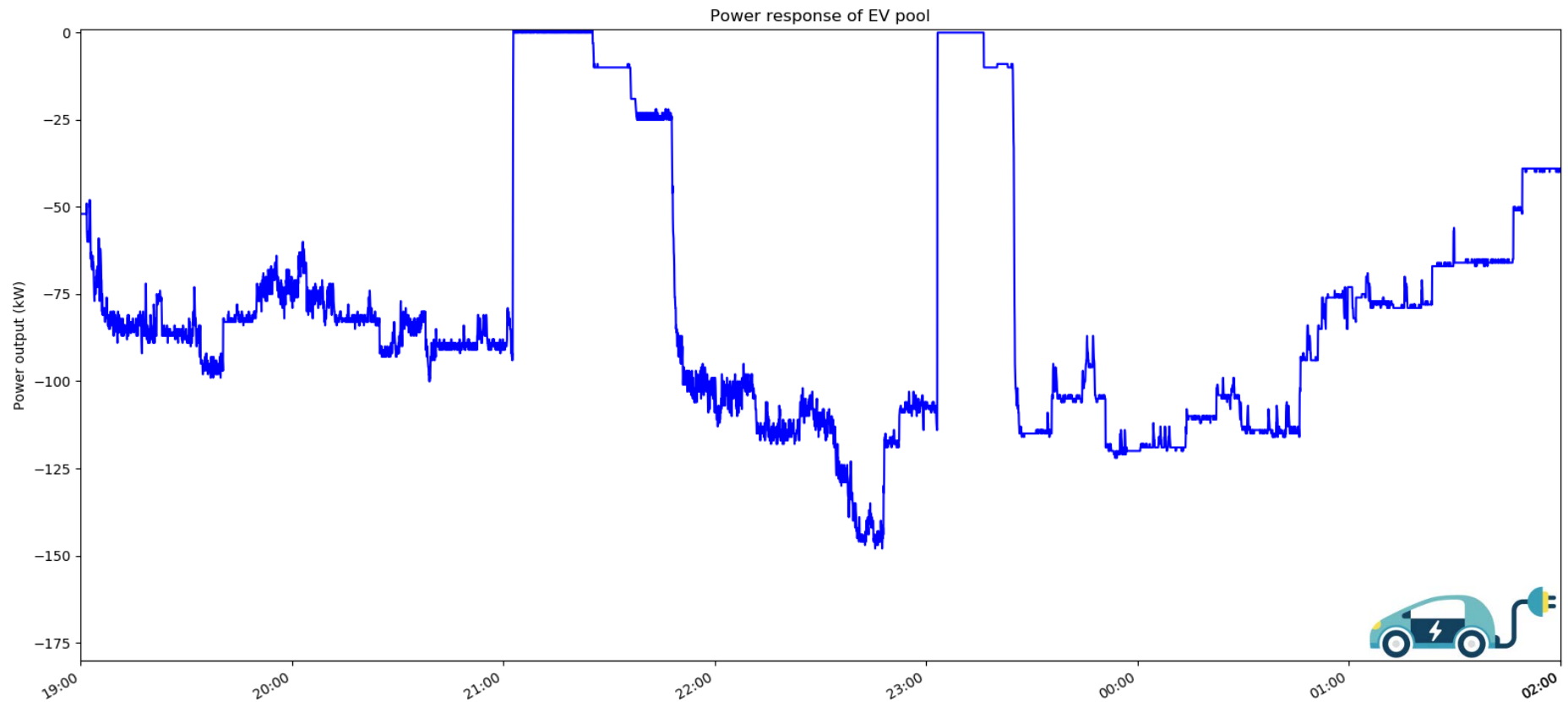


Timeline

- ✓ 2017: first BC implementation
- 2018: evaluation phase
- 2019: to be determined

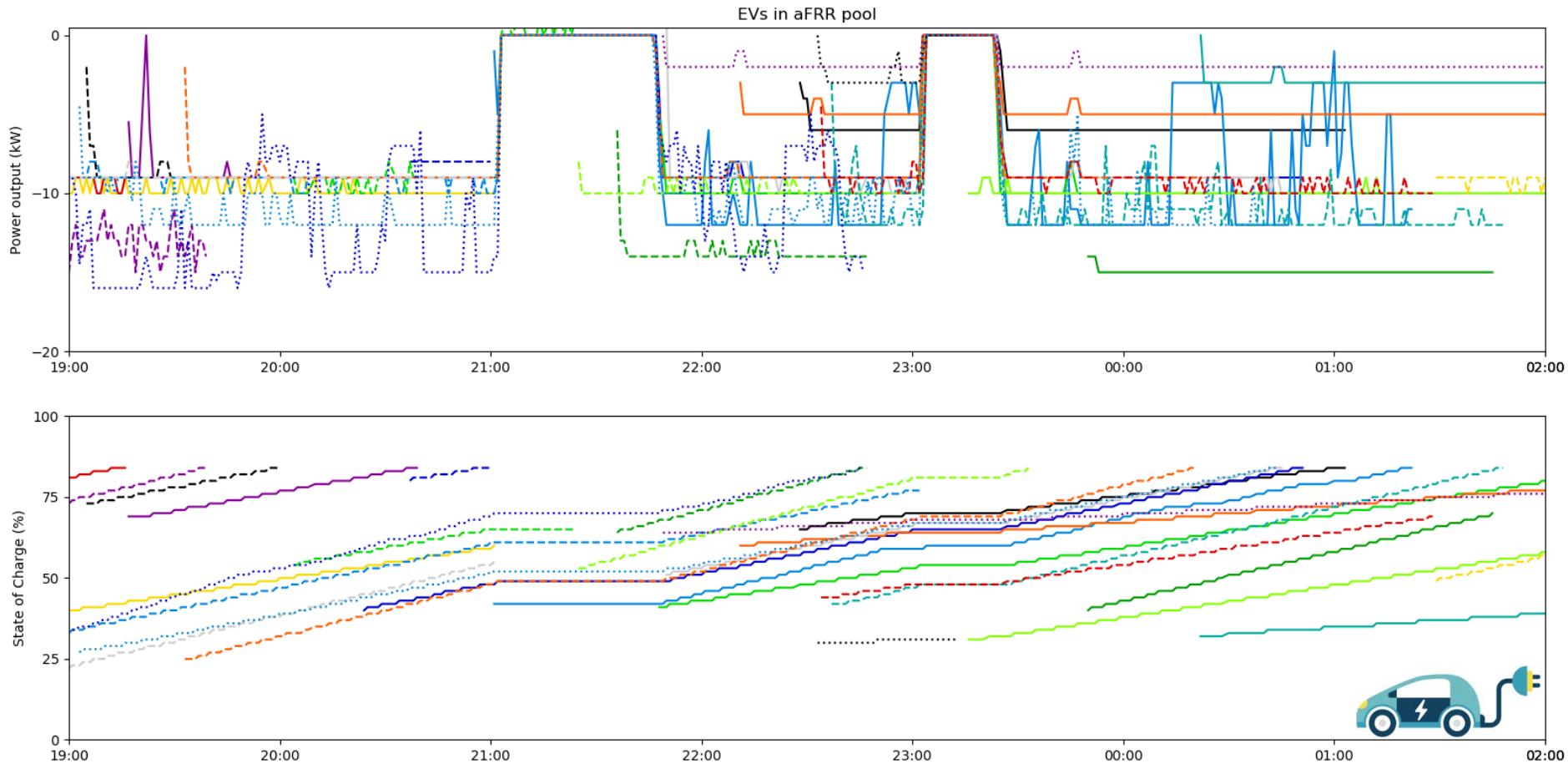


Evaluating activated bids





Evaluating activated bids

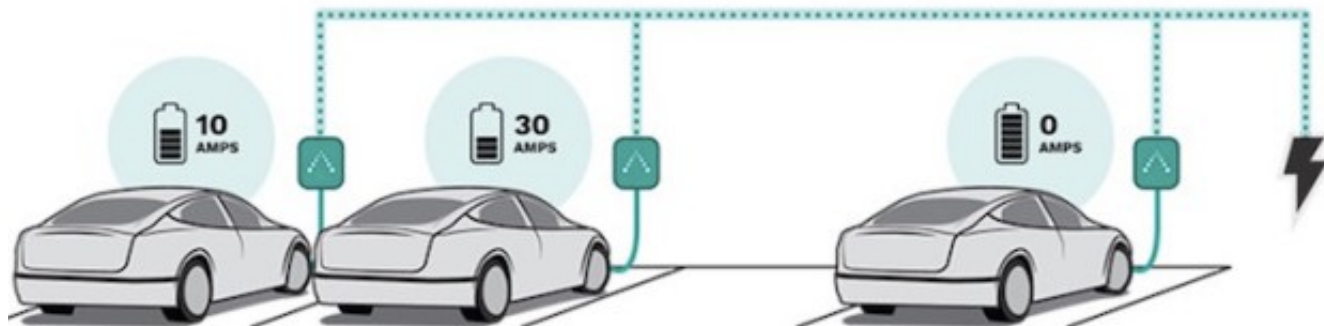




Outlook

Continuation of pilots!

- Evaluation / operation with Vandebbron: more cars, more bids
- Startup of aFRR pilots in Q3 2018
- Further development of blockchain pilot following European tender procedure



Thank you for your attention!

Questions?

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Taking power further

