Unlocking grid flexibility:
# TenneT at a glance 2017

Europe's first cross-border grid operator

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees</td>
<td>4,068</td>
</tr>
<tr>
<td>EBIT</td>
<td>897 (EUR million)</td>
</tr>
<tr>
<td>Assets</td>
<td>20.4 (EUR billion)</td>
</tr>
<tr>
<td>Investments (2018-2028)</td>
<td>28 (EUR billion)</td>
</tr>
<tr>
<td>Connected offshore wind farms</td>
<td>17</td>
</tr>
<tr>
<td>Total grid length</td>
<td>23,000 km</td>
</tr>
<tr>
<td>Number of end-users</td>
<td>41 million</td>
</tr>
<tr>
<td>Number of transformer substations</td>
<td>462</td>
</tr>
<tr>
<td>Total HVDC stations</td>
<td>15</td>
</tr>
<tr>
<td>Grid availability</td>
<td>99.99%</td>
</tr>
</tbody>
</table>

Unlocking grid flexibility:
An economic layer the web never had

Transactions without blockchain

- Distributed system of records shared across a public or business network
- All parties agree to verified transaction on the same network

Transactions with blockchain

- Shared Ledger
- Crypto-graphy: Secure, authenticated & verifiable transactions
- Consensus
- 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.

Asset generates GO

Registration of generation asset

Auditor

GO are traded

GO transferred to supplier

GO ends

September-5-2018  Unlocking grid flexibility:
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**

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 Vandebron

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
Unlocking grid flexibility:

automatic Frequency Restoration

- aFRR bids
- activation & measurements
- BSP
- Power plant
Unlocking grid flexibility:

RepubliQ implementation

Timeline

- 2017: first BC implementation
- 2018: evaluation phase
- 2019: to be determined
Unlocking grid flexibility: Evaluating activated bids
Unlocking grid flexibility:

Evaluating activated bids
Outlook

Continuation of pilots!

- Evaluation / operation with Vandebron: 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