TenneT – The digital transformation

Towards Improvements on RES Integration
7th Solar Integration Workshop

Berlin, 24.10.2017
Donald Kreiken
TenneT – a Leading European TSO

GRID
> 22,000 km

END-USERS
> 41 m

EMPLOYEES
> 3,000

INVESTMENT
next 10 years
25 billion €
What we Do

Key tasks

Transmission services
planning, constructing and maintaining a robust high and extra high voltage grid

System services
maintaining the balance between electricity supply and demand at all times

Market facilitation
facilitating a smoothly functioning, efficient, liquid, and stable electricity market
A Grid for Renewables

Renewables fundamentally change how power grids work

The old 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.

The new Electrical Power System

Renewable energy, produced locally, sometimes far away from industrial centers and storage facilities provide electricity at all grid levels depending on the weather.
Renewables drive Innovation, which comes through Digitalization.

- **Control**: smart grid technologies
- **Efficiency**: cheaper and higher computing performance
- **Transparency**: smart meters and sensors
- **Forecast**: using new data sources and models for real time forecasts
- **Analysis**: processing grid-, market-, and environment data
Improved data sources, data processing, extrapolations, and models make it possible to know the state of the system at every time and to accurately predict future states.

Real time data and accurate predictions are a precondition for increased flexibility.
Sensors for Energy Forecasting

Sensors (IoT) provide unconventional data sources to improve forecasting the energy system and environmental conditions.

- cars and mobile sensors provide local, real-time weather information
- smart meters provide live information on demand and production
- production, storage, and energy consuming assets provide information about their potential and actual energy infeed
Virtual Power Plants

Central power plants and their system services are more and more replaced by smaller, decentralized power producers. Virtual power plants aggregate their power, partially superseding central power plants.

- many small and renewable production and storage facilities provide distributed flexibility for the energy system
- by crowdsourcing the flexibility potential of production and storage units, a virtual power plant is created
- virtual power plants provide system services like reactive power, control power and enhances a system of flexible consumption and ability to blackstart
- smart technologies coordinate the distributed flexibility
Increased Flexibility via Blockchain

Blockchain technology offers opportunities for efficient market integration of distributed flexibility providers:

• Use of Blockchain technology facilitates market access for flexibility services to prosumers, creating a customer-empowered energy system.

• The technology therefore potentially increases energy supply and thus can help stabilize grid costs.

• Blockchain potentially provides a transparent, easy to access, and safe platform for trading system services.
Revolutionizing the energy system

The old energy system

- Central power plants
- Power Suppliers

The new energy system with Blockchain

- By reducing transaction time and costs, Blockchain technology has the potential to empower prosumers
- Blockchain facilitates safe transactions directly between suppliers and consumers
- Intermediaries, like power suppliers, will play a smaller role in facilitating a functioning energy market
- Combining smart contracts with the Blockchain allows for automated balancing of supply and demand
In two pilot projects with Sonnen and Vandebron, TenneT is using a private Blockchain to balance the grid.

- **Sonnen** pools household batteries to provide redispatch services
- **Vandebron** provides automated secondary control reserve from a pool of charging stations for electric vehicles

- The flexibility is managed by TenneT via an **IBM** Blockchain solution and used to balance the grid

- Once the concept has been proven, the use of the Blockchain solution will be made available to further flexibility providers
Thank you for your attention
Disclaimer

Liability and copyright of TenneT

This PowerPoint presentation is offered to you by TenneT TSO B.V. ('TenneT'). The content of the presentation – including all texts, images and audio fragments – is protected by copyright laws. No part of the content of the PowerPoint presentation may be copied, unless TenneT has expressly offered possibilities to do so, and no changes whatsoever may be made to the content. TenneT endeavours to ensure the provision of correct and up-to-date information, but makes no representations regarding correctness, accuracy or completeness.

TenneT declines any and all liability for any (alleged) damage arising from this PowerPoint presentation and for any consequences of activities undertaken on the strength of data or information contained therein.
TenneT is a leading European electricity transmission system operator (TSO) with its main activities in the Netherlands and Germany. With over 22,000 kilometres of high-voltage connections we ensure a secure supply of electricity to 41 million end-users. We employ approximately 3,000 people, have a turnover of EUR 3.2 billion and an asset value totalling EUR 19 billion. TenneT is one of Europe’s major investors in national and cross-border grid connections on land and at sea, bringing together the Northwest European energy markets and enabling the energy transition. We take every effort to meet the needs of society by being responsible, engaged and connected. **Taking power further**