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Trends and Grid consequences

Henk Eleveld

Renewables Grid Initiative, Berlin October 17-18, 2011

Experience you can trust.

Challenges of large scale renewable generation

Impacts on system planning and operation

- Availability – Conventional generator dispatch
- Variability – Allocation of reserves
- Frequency Control – Short term (spinning) reserves
- Voltage / power control – Reactive reserves
- Transmission Capacity – Thermal constraints

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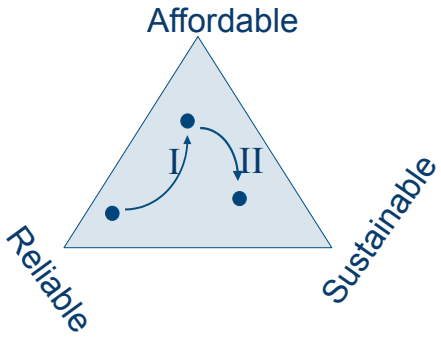
How to keep the balance with so many end-users and different customer needs?

Reliable, Affordable and Sustainable



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Wind at sea impact

- What about the sea-grid?
- AC and DC solutions
- Grid operation effects

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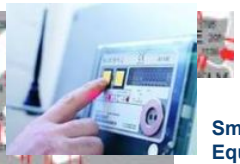
Increased bulk transmission

entsoe

50GW wind in the North?



Smart Equipmt.

Control

DC links and interconnections

Source: Nexans

30GW sun in the south?

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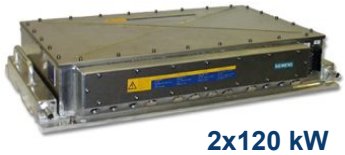
DC becomes part of the solution

- Technology is mature (HVDC-VSC 1000MW ±500kV)
- Controllability (e.g. reactive power)
- Less losses compared to AC
- Many applications use DC

250-1000 MW

5 W

1.2 kW



2x120 kW

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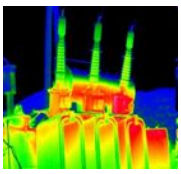
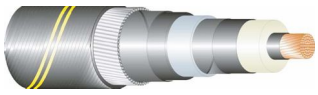
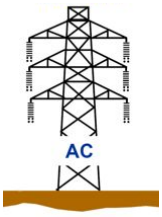
Doing more with less

- Overhead → underground
- Public voice = CAVE
- Use existing right of way

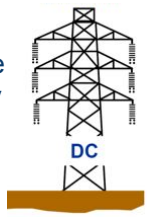
wintrack







increase capacity



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Distributed Solar Power up

- Exponential growth
- Prices drop fast
  from 5€ to 2€ / Wp
  in 2 year
- Grid parity: 2012-2015 ?
- Significant effect

YINGLI SOLAR

SolarTotal® Energy for you

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Network owner/operator needs

- Measure, monitor and diagnose (real time)
- Model, simulate, predict and communicate
- Control, steer and manage power & information
- Integral energy (including information) solution approach

- Test, certificate and validate distributed power systems and control equipment

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Testing and certification

DERlab

The Flex Power Grid (FPG) Lab offers unique services for DG and RES grid integration, power conversion equipment and power monitoring & control devices by offering a predefined grid or load in the MW range.

www.FlexPowerGridLab.com

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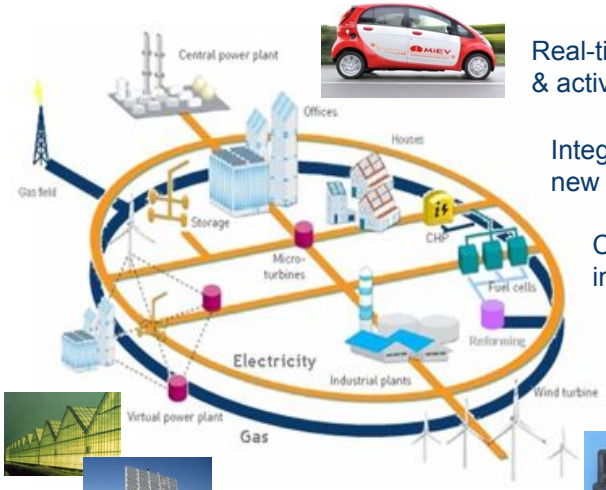
An internet-like distribution grid



Real-time information & active participation

Integration of new applications

Central & local intelligence

Central & local sources

Smart (power) electronics

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E-mobility (storage) a growing force

- Means of decoupling generation & demand
- Controllability issue
- Slow take off (or not)
- Huge effect

Opel Ampera

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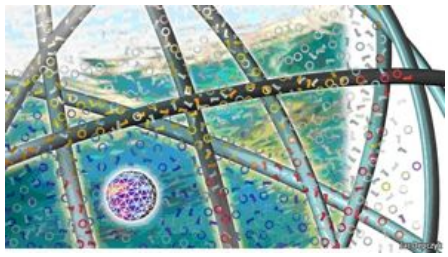
The digital dilemma

- Data explosion
- Networking, adding → functionality
- New equipment and players
- Security risk



stuxnet-worm

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Changes under the hood

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Thank you for your attention

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Experience you can trust.