



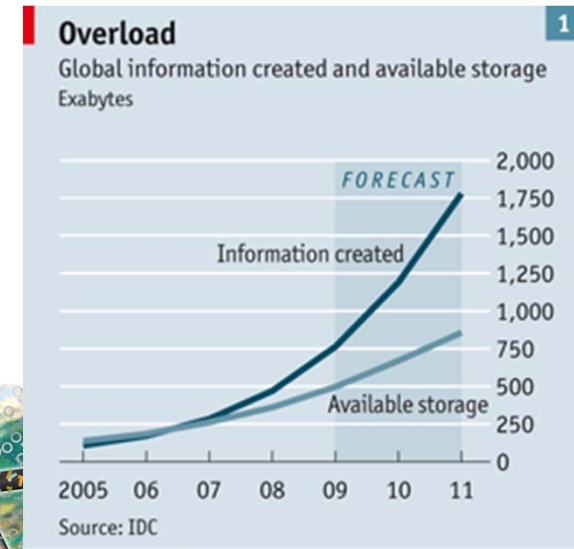
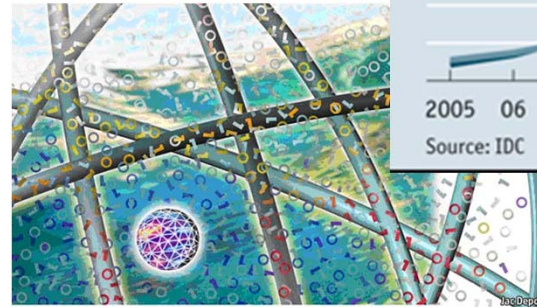
# Transmission & Distribution of Electricity – The Challenge

Peter Vaessen

CWI in bedrijf, Amsterdam, November 11<sup>th</sup> 2010

# The digital dilemma

- Data tsunami
- Networking/Sensors  
→ functionality
- New equipment and players
- Security risk ?



# Acting on aging assets

- Grey wave from the 1970-ties
- Less money available
- Different component life cycles
- Maintenance / Replacement ?

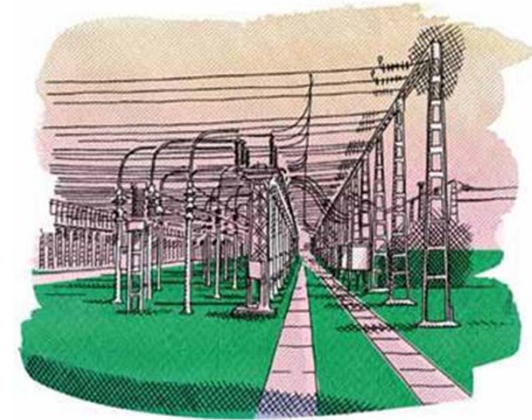


## HOW TO MANAGE AN AGEING WORKFORCE



# European Power System

- 495 million people served
- 3500 TWh/year
- 760 GW installed capacity
- 250.000 km HV network
- Approx. 6.000.000 km MV & LV network
- Largest business sector (capital)
- Largest man-made system
- Approximately 1500 € investment per EU citizen





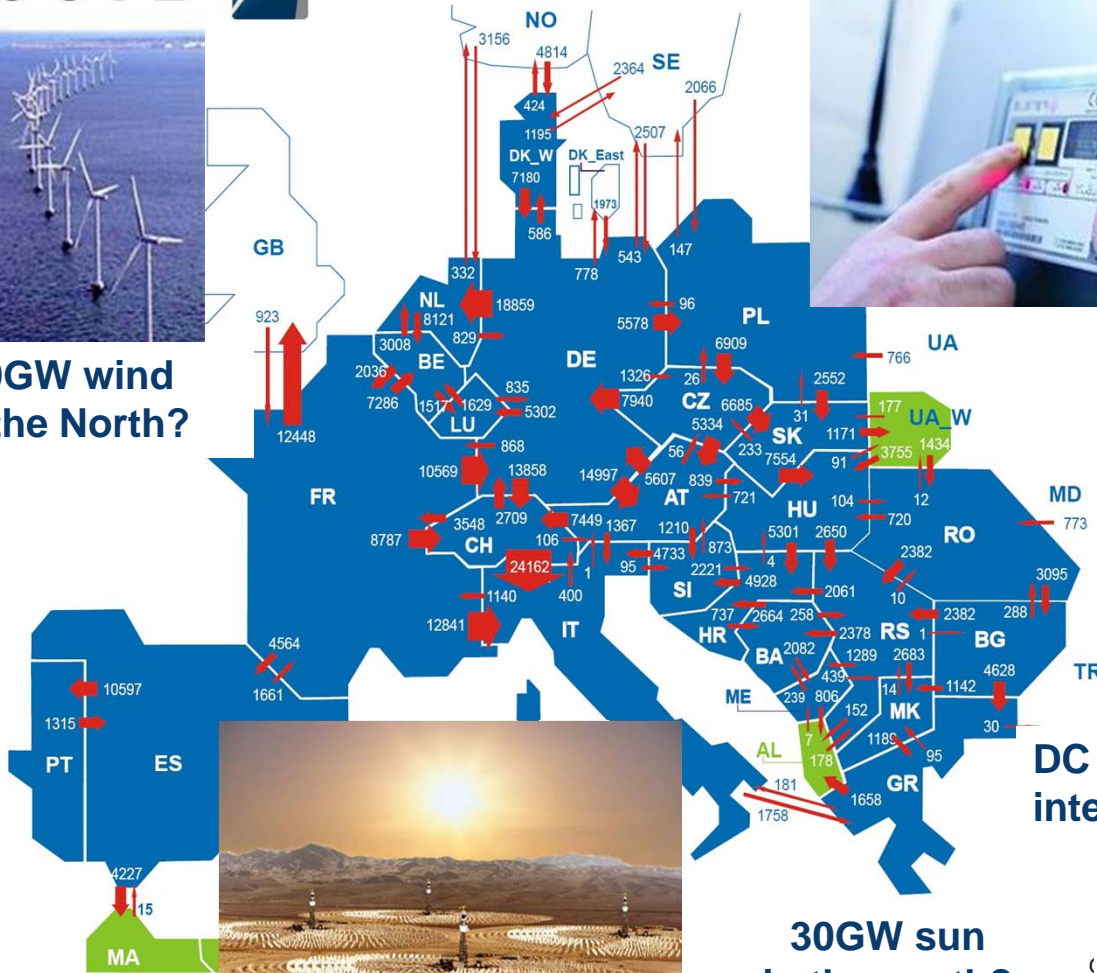
# Increased bulk transmission



Physical energy flows 2008



50GW wind in the North?



30GW sun in the south?

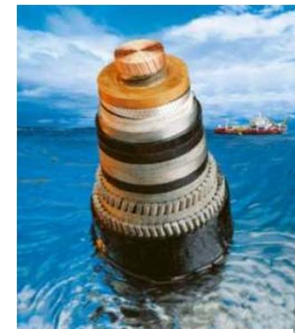


Smart Equipmt.

Control



DC links and interconnections



Source: Nexans

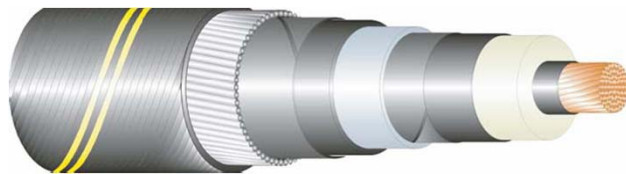
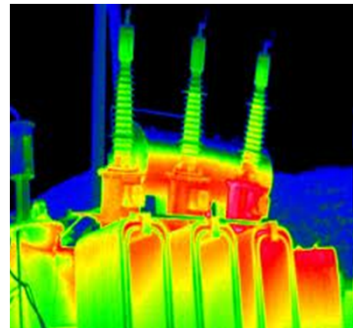
# Wind at sea impact

- Ready for large scale deployment
- AC and DC solutions
- Grid operation effects
- Sea-grid ?

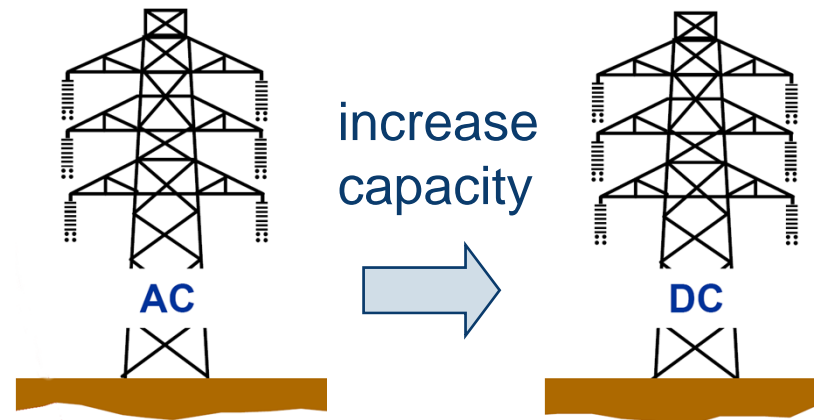


# Doing more with less

- Dynamic rating needs sensors & rules
- Overhead → underground
- Public voice = CAVE
- Use existing right of way

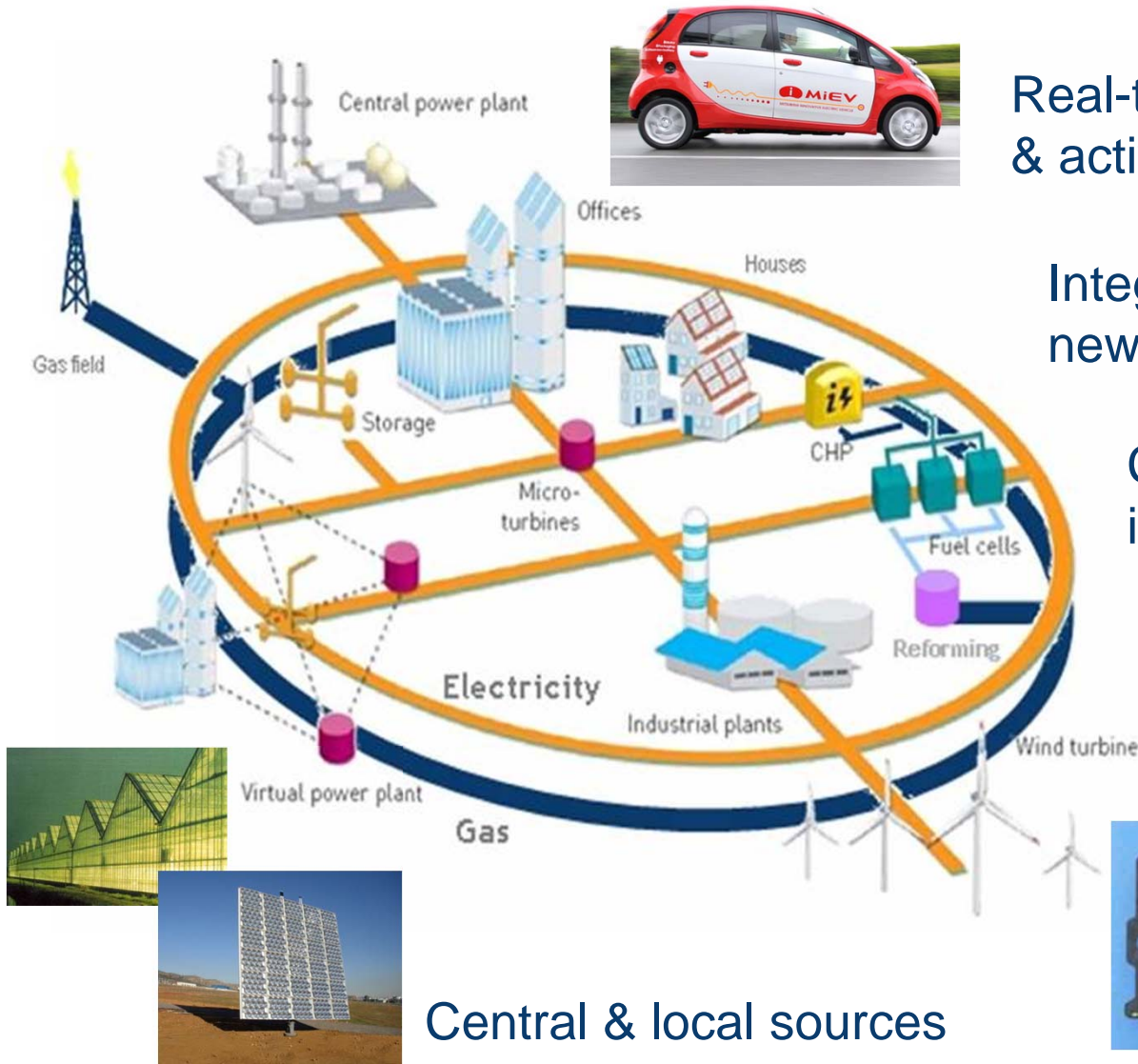


wintrack





# An internet-like distribution grid



Real-time information  
& active participation

Integration of  
new applications

Central & local  
intelligence

Central & local sources

Smart (power)  
electronics



# Solar Power up

- Exponential growth
- Prices drop fast from 5 to 2.5€/Wp in 2 year
- Grid parity: 2015 ?



# E-mobility (storage) a growing force

- Means of decoupling generation & demand
- Controllability issue
- Slow take off ...or not ?



Opel Ampera





# PowerMatching City - Full Concept Smart Grid Solution

(partners: KEMA, ECN, HUMIQ, RWE/Essent)

Intermittent Renewable Energy Sources



Smart Appliances for Demand Response



Smart Hybrid Heat Pumps



mCHP for Flexible Power

Smart Charged Electric Vehicles



KEMA



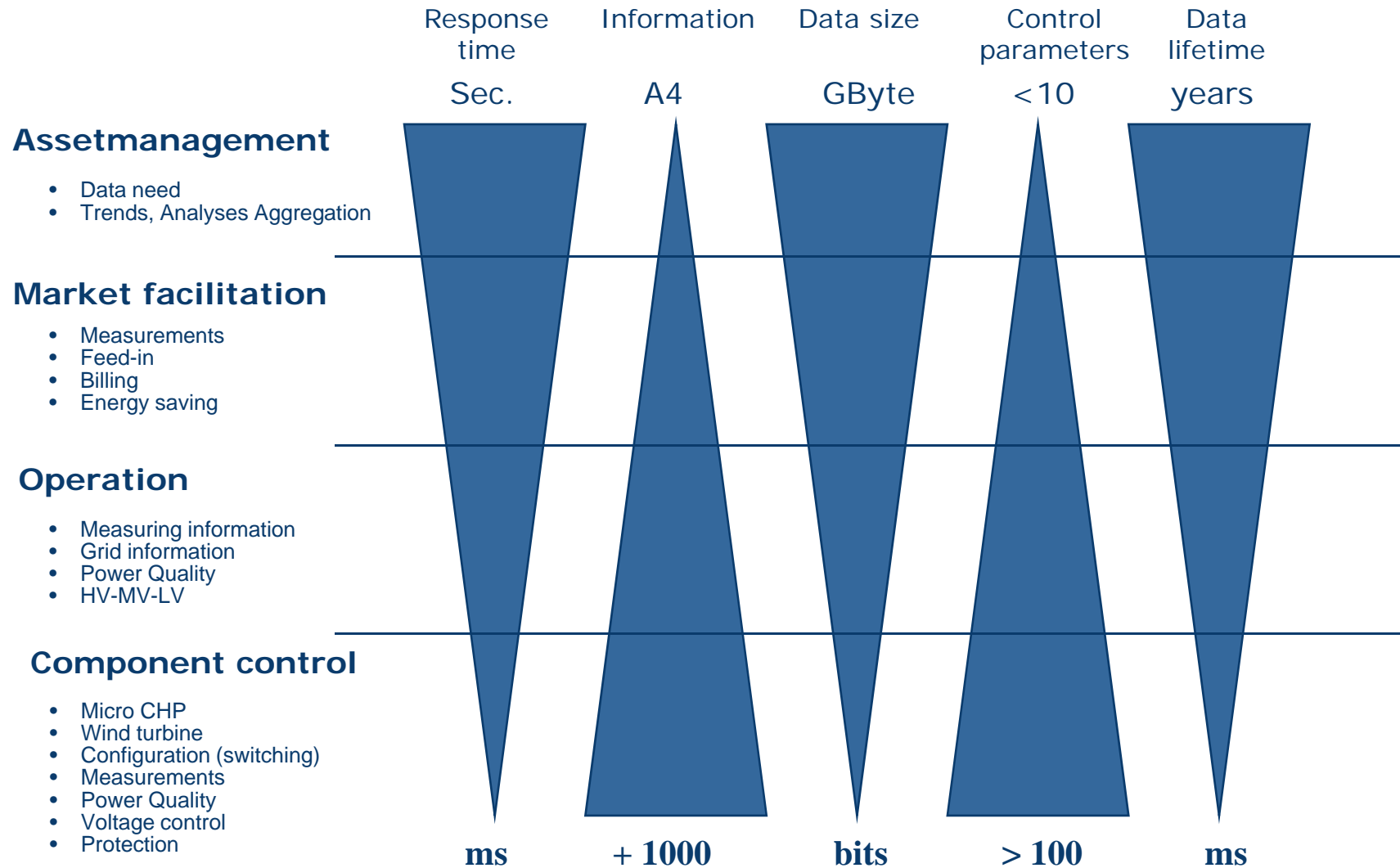
# The pyramid Challenge (Netherlands)



4  
30  
320  
120.000  
7.000.000  
100.000.000

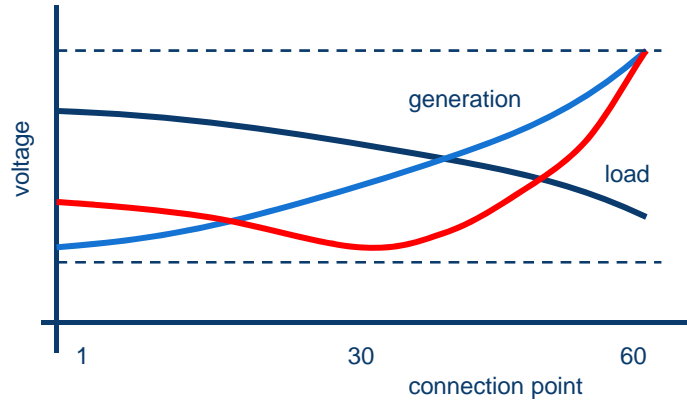


# Process information challenge

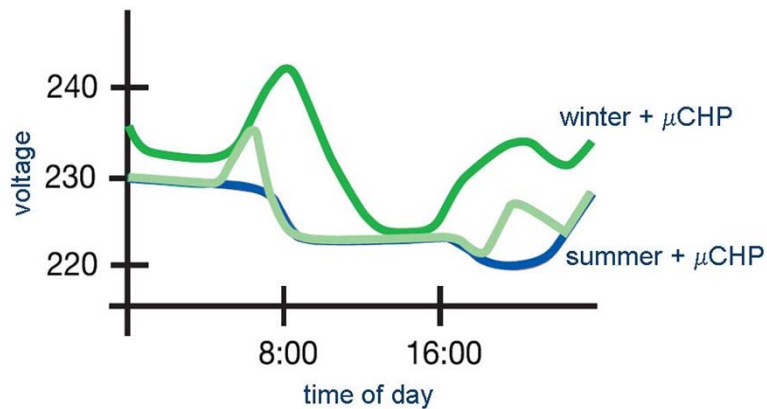
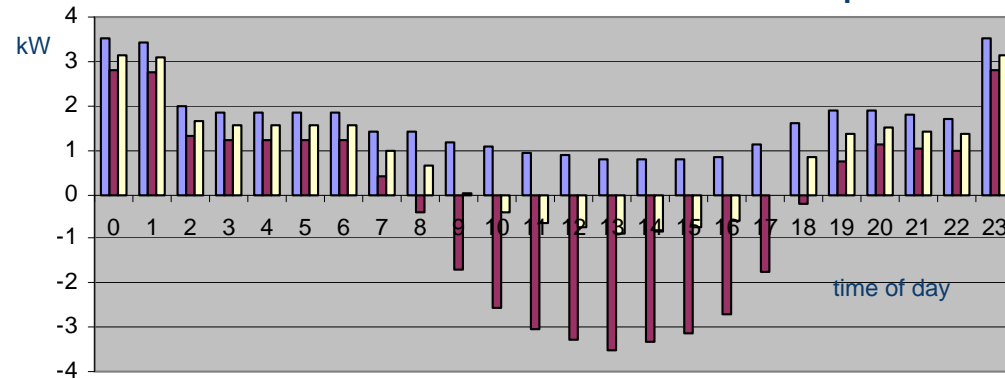


# Even more challenges

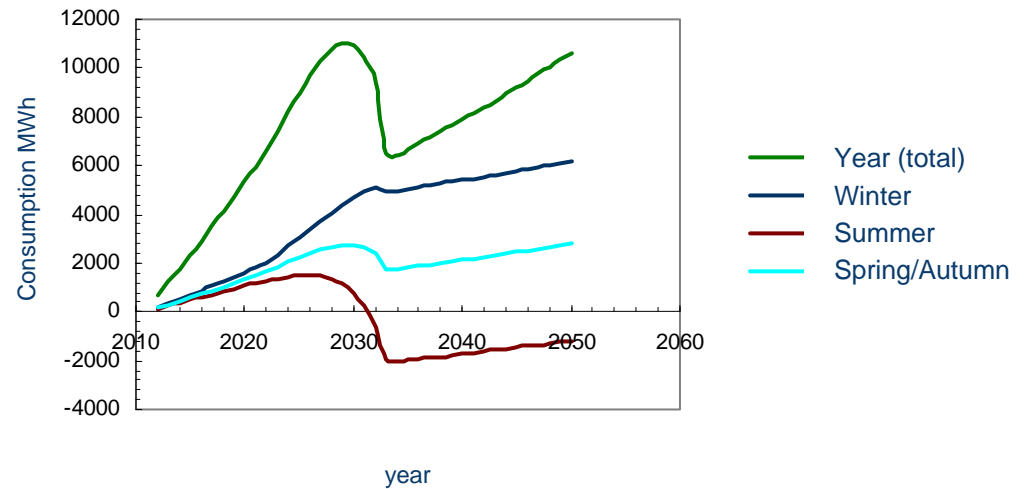
## Feeder voltage profile



## Customer profile



## Voltage at connection point

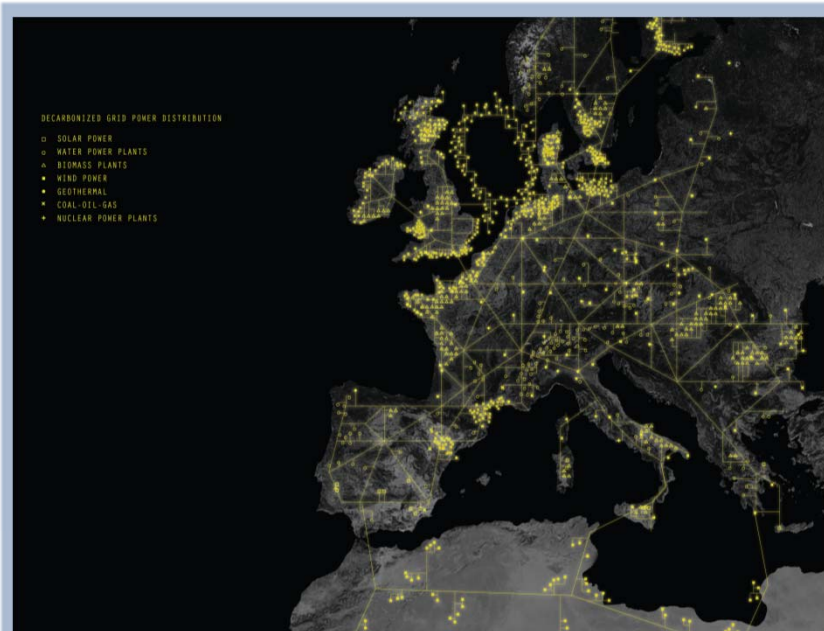


## Scenario / Prediction





Thank you for your attention



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Experience  
you can trust.