When Grids gets smart

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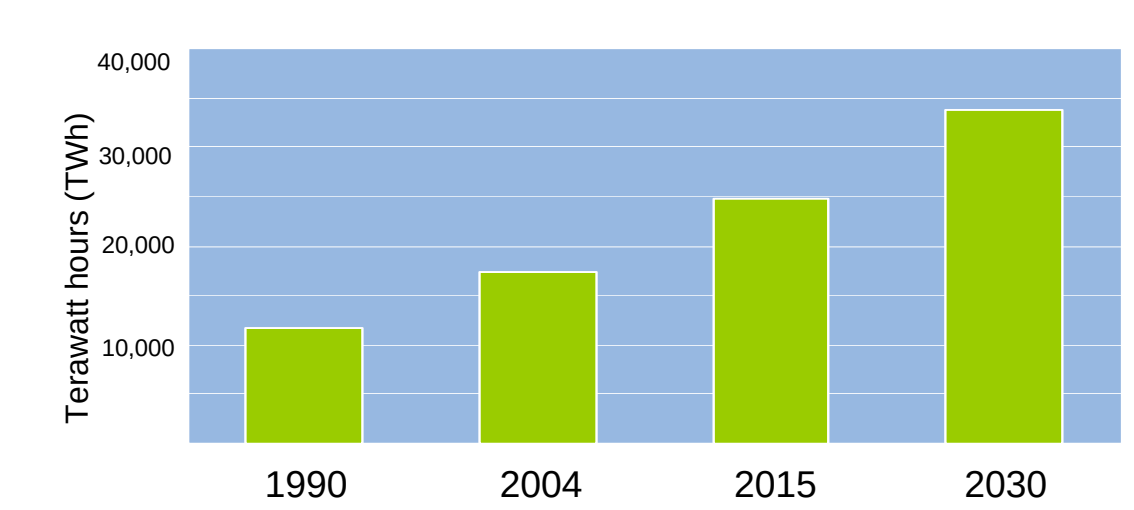
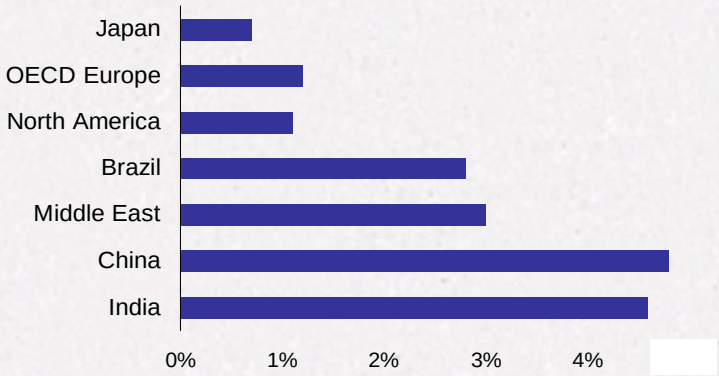
Electricity consumption set to double by 2030

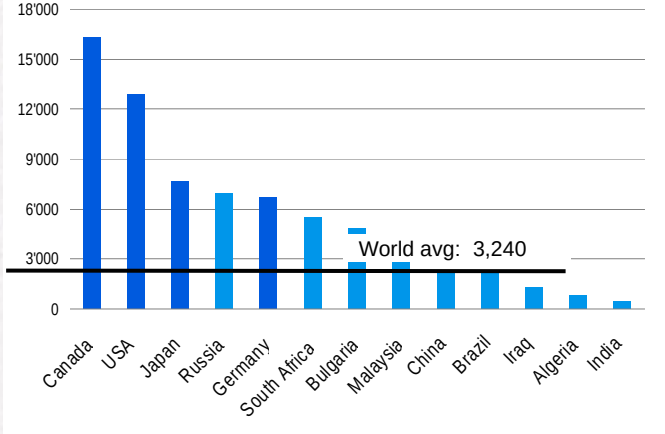


- Avg. global annual growth rate 2.5 %
- Highest growth rate in Asia :4.5 %
- China to consume more than US before 2015

Electricity consumption growth/yr 2006-30 in %

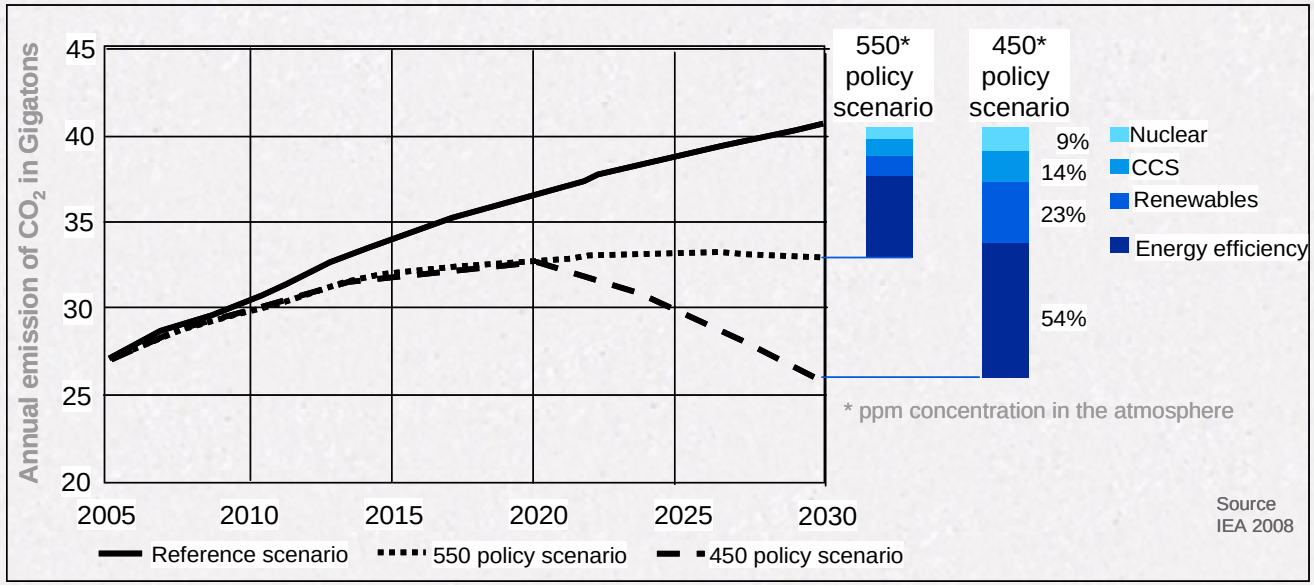


Electricity consumption in kWh per capita



Source: IEA,

Climate change concerns need to be addressed



Energy efficiency and renewable power can provide almost 80 percent of the targeted reduction

Fundamental changes in power supply are coming

More renewable power generation

Energy efficiency

Distributed and intermittent generation

Customer pricing expected to foster demand responses

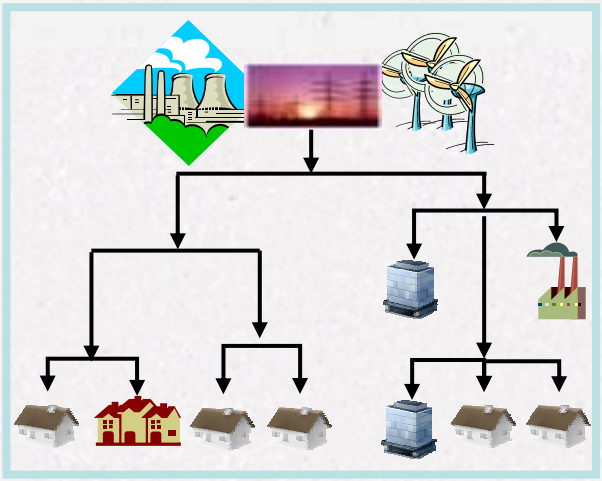
Impact on grid stability and efficiency

Grids of the future will be different from those of the past

- **Open for all types and sizes of generation technologies**
- **Integrating demand side in system operation**

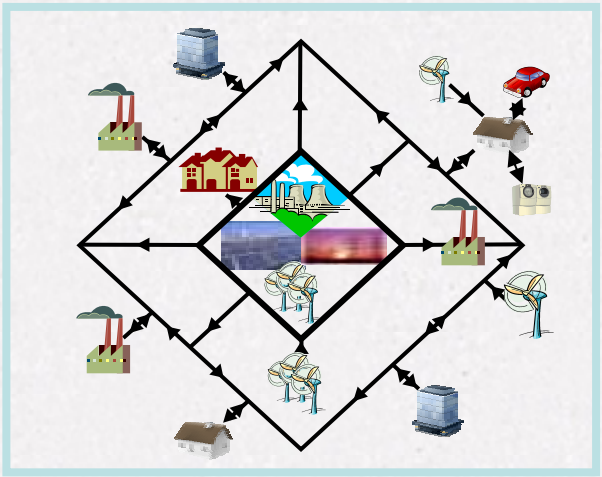
Evolution of grid design
From traditional to future grids

traditional grids



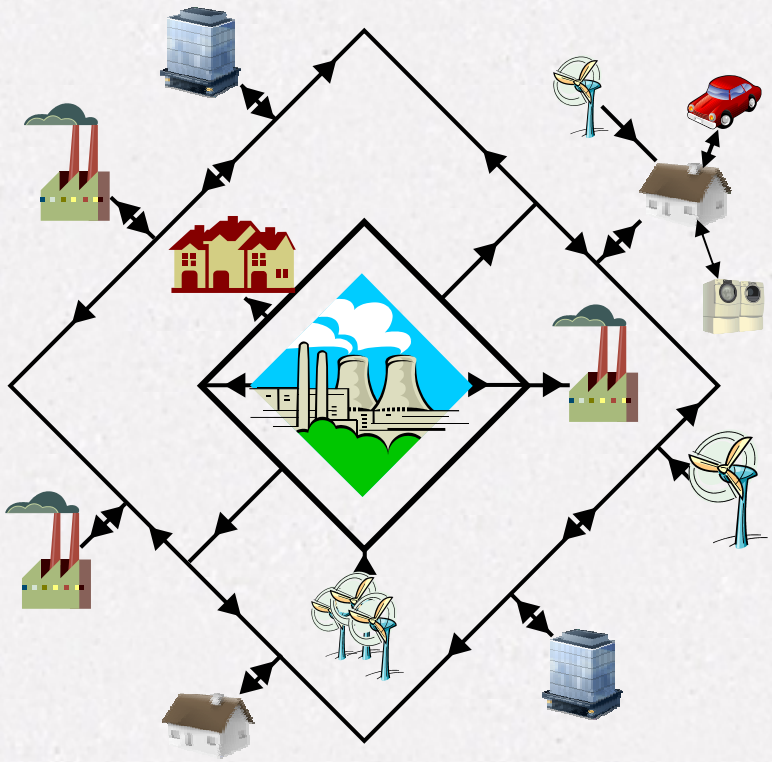
- Centralized power generation
- One-directional power flow
- Generation follows load
- Operation based on historical experience
- Limited grid accessibility for new producers

future grids



- Centralized and distributed power generation
- Intermittent renewable power generation
- Consumers become also producers
- Multi-directional power flow
- Load adapted to production
- Operation based more on real-time data

Impact of Smart Grids - example of challenges



Generators:

- Optimize ‘spinning reserves’ with increased amount of renewables

Transmission utilities:

- Maintain grid stability with increased amount of renewables
- Reduce transmission losses

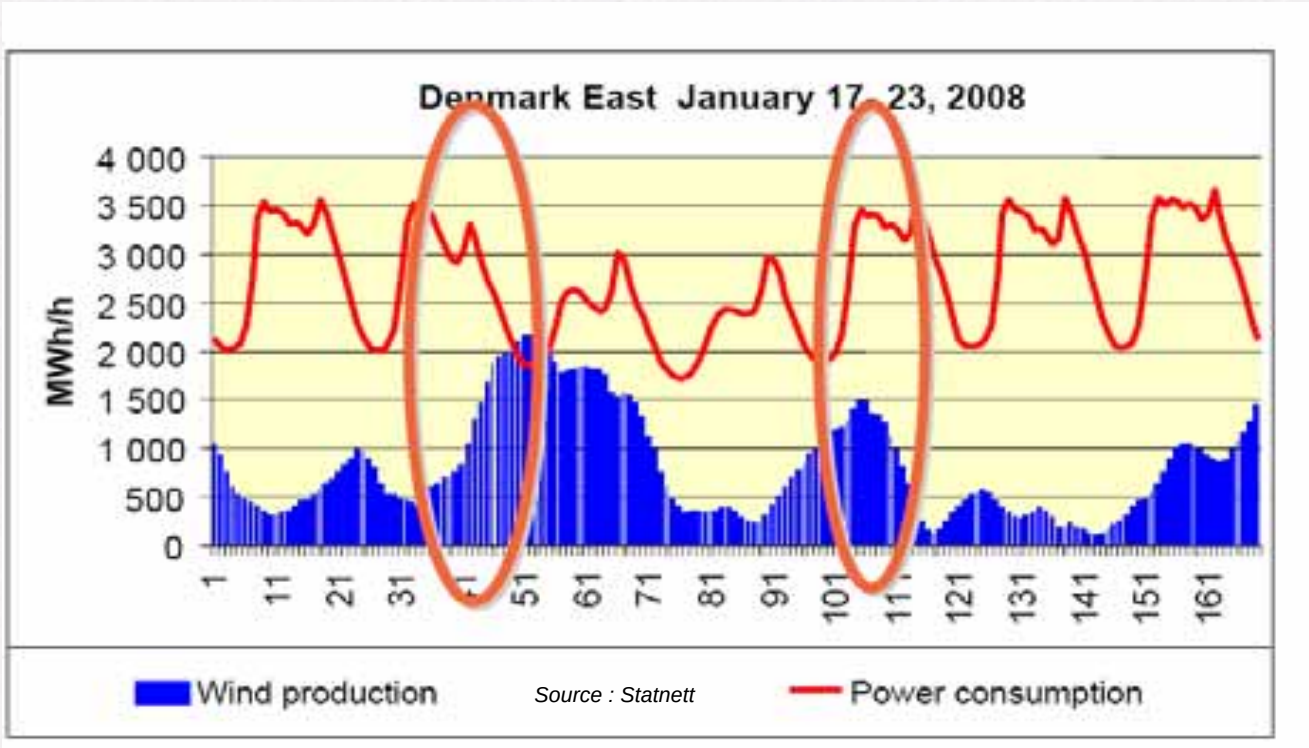
Distribution utilities:

- Maintain protection system integrity with increased amount of renewables
- Demand Response and real time price information
- Reduce distribution losses

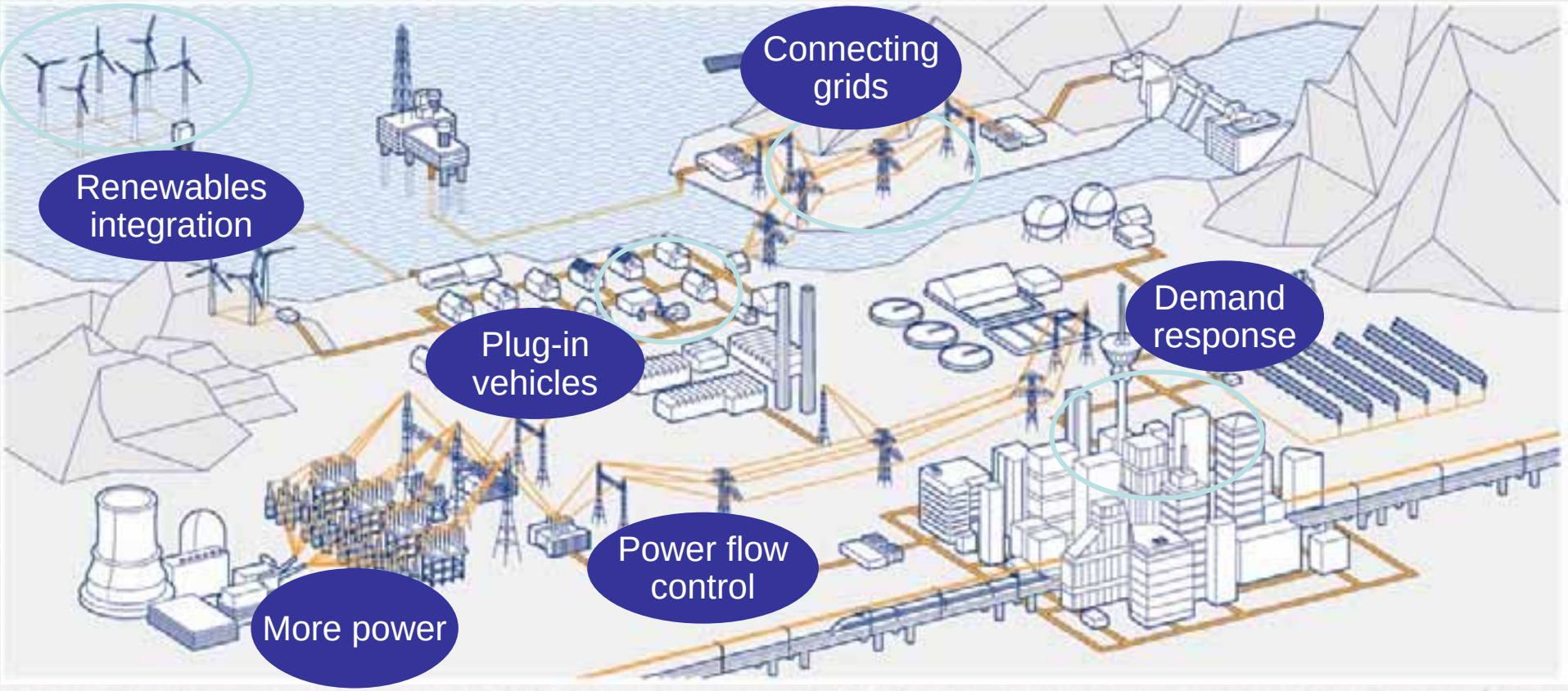
Consumers:

- Optimize electricity consumption – home automation (incl. local generation PV, vehicle,….)

Impact of Smart Grids – example of challenges

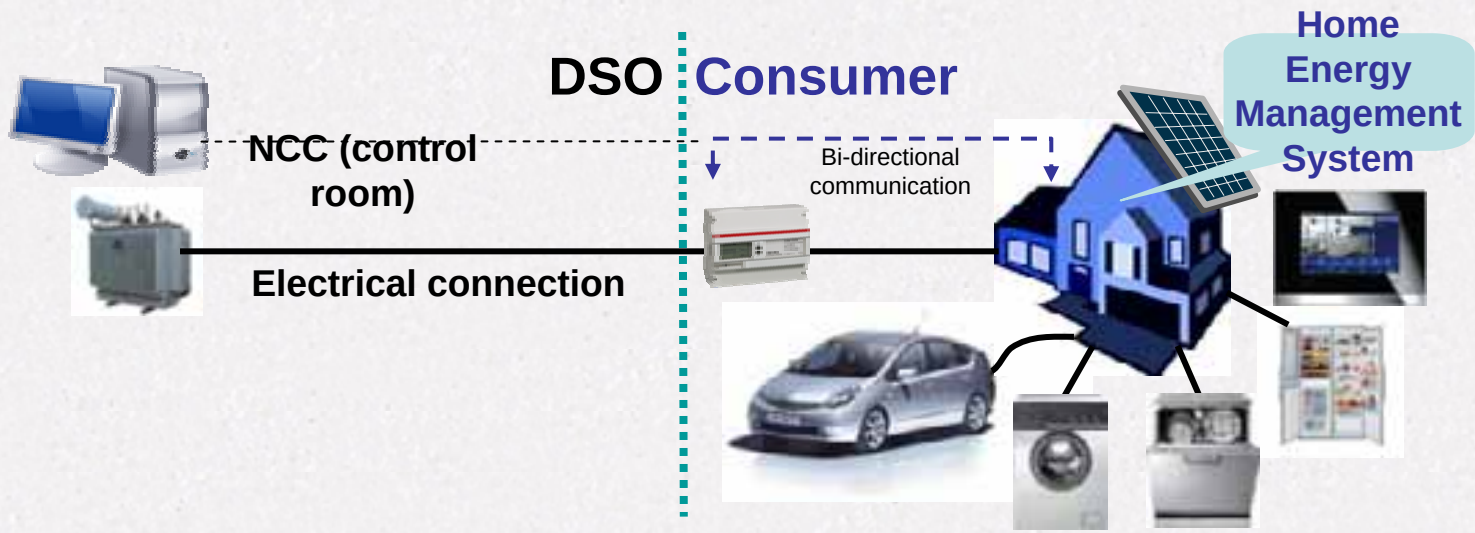


Balancing the need for more power with lower climate impact



Key enabler:
ICT - Information & Control Technologies

Demand response

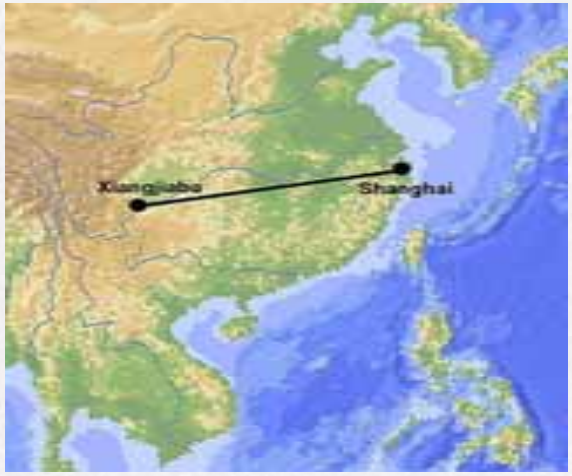


- Consumer interaction and services
- Improved load management
- Enhanced reliability

Example SmartGrid projects from ABB

Off shore wind park HVDC Grid Connection, Germany

-Lowers CO2 emissions by ~1.5 mill. t/yr by replacing fossil-fuel generation



2000 km HVDC line to connect hydro power, China

-93% efficiency

-Savings vs AC line enough to supply power to more than 1 million consumers in China

PV Solar plant in Spain

- Produces 2.2 GWh/yr, displaces 2,200t greenhouse gas emissions p.a.

Future scenario:
Solar power from Sahara

Connecting large scale solar-based generation eg, deserts, with distant load centers via an efficient transmission system like HVDC

Do smart grids matter?

Without a Smart Grid	With a Smart Grid
▪ <13% variable renewables penetration	▪ >30% variable renewables penetration
▪ 5% demand response	▪ 15% demand response
▪ <1% consumer generation used on the grid	▪ 10% consumer generation used on the grid
▪ 47% generation asset utilization	▪ 90% generation asset utilization
▪ 50% transmission asset utilization	▪ 80% transmission asset utilization
▪ 30% distribution asset utilization	▪ 80% distribution asset utilization

Source: DoE and NETL