

The Future Power System Challenges and Opportunities

Leadership, Workshop

Trondheim, Radisson Blue Royal Garden Hotel, 18 April 2012

Jan Ove Gjerde, SVP, R&D, Statnett

Visions Of The Future

- ⦿ The key issue in solving our environmental problems is to change our energy sources
- ⦿ Fortunately, an array of alternative energy technologies are coming on-line that will make possible abundant, cheap, and clean energy.
- ⦿ *The future energy will be based on electricity*



The role of the TSO (transmission system operator)

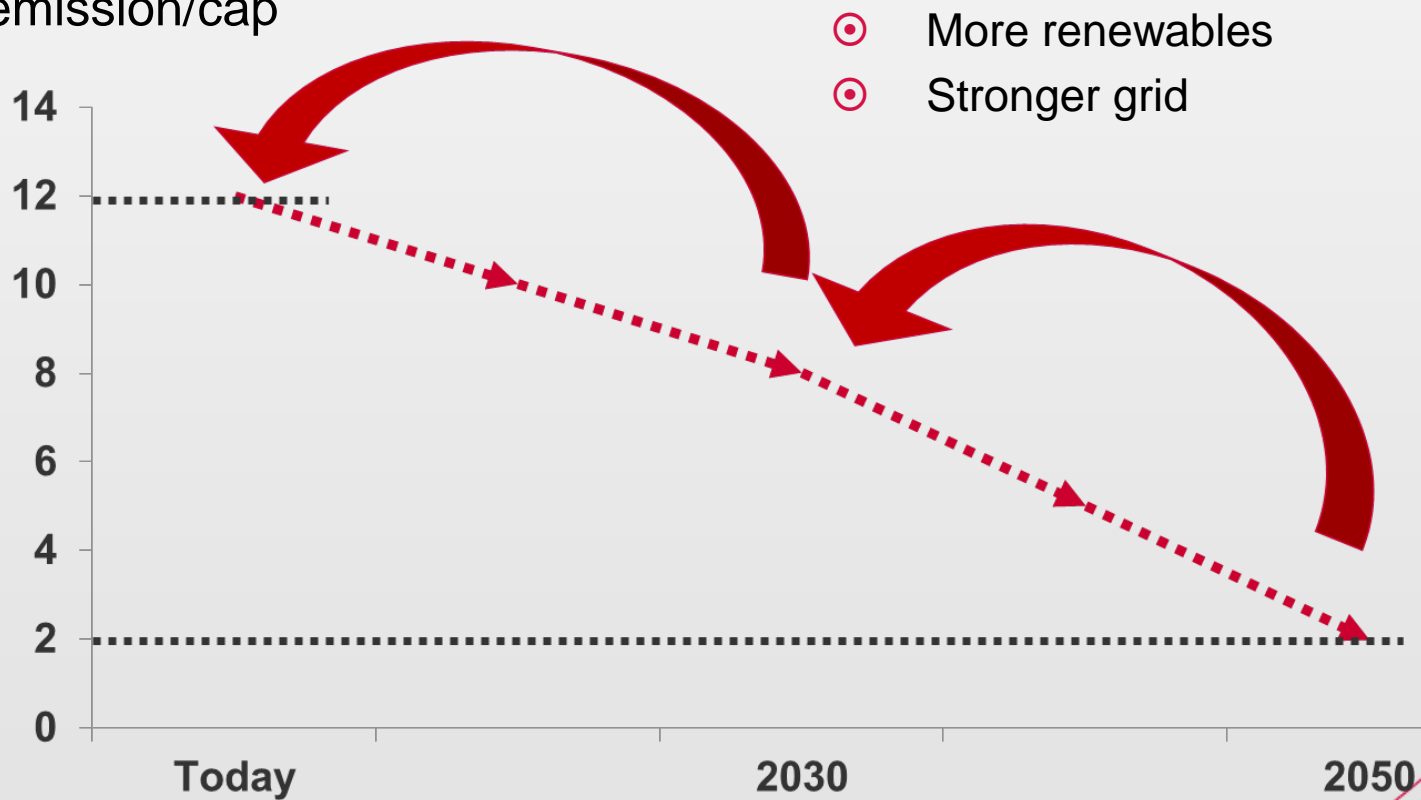
⊙ "Secure supply at any time to everybody"

⊙ Tools:

1. Operational tools – SCADA/EMS
2. Using and developing the energy markets
3. Building overhead lines

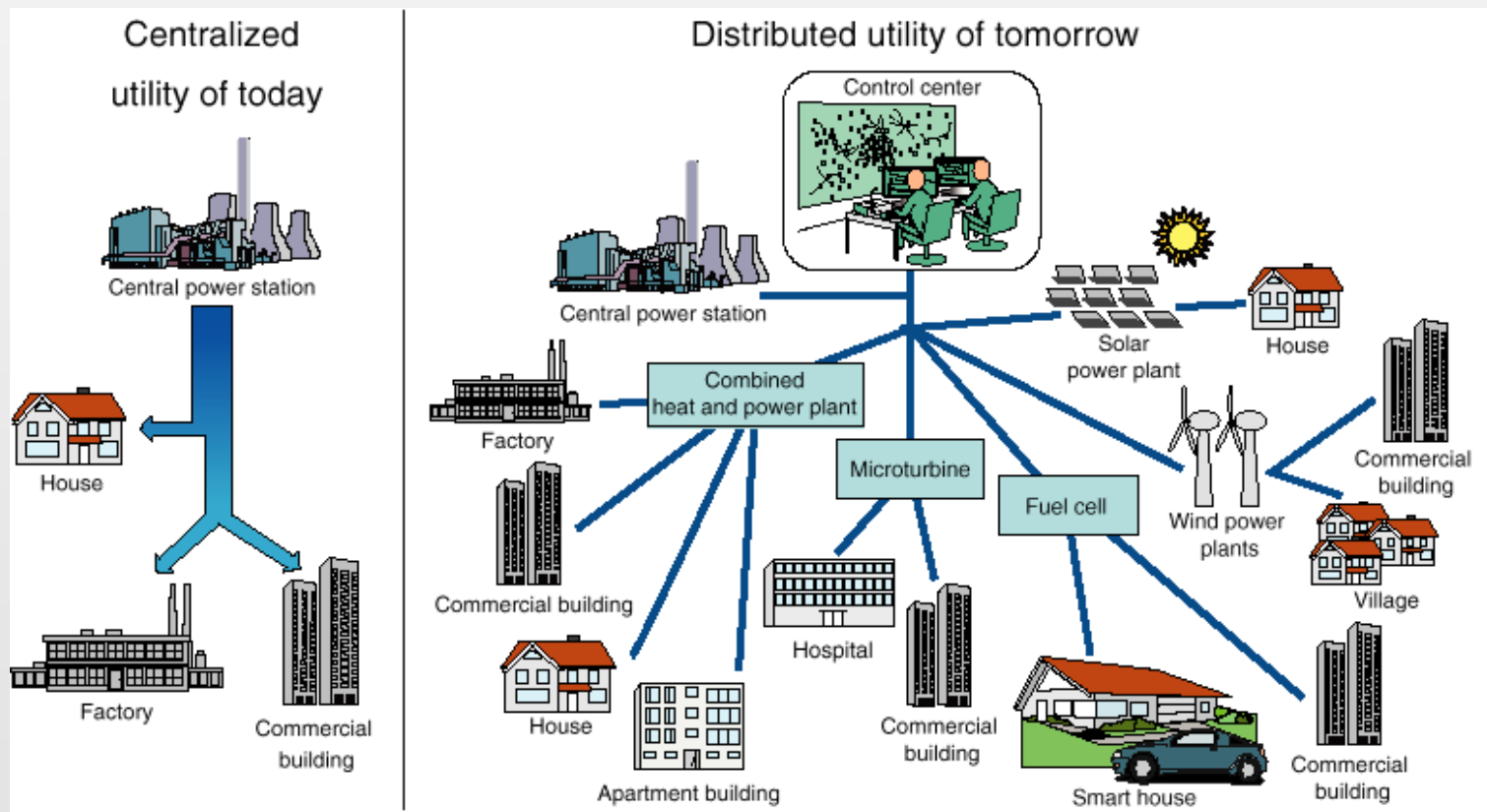
Our common challenge: Less CO₂, more electricity

CO₂-emission/cap



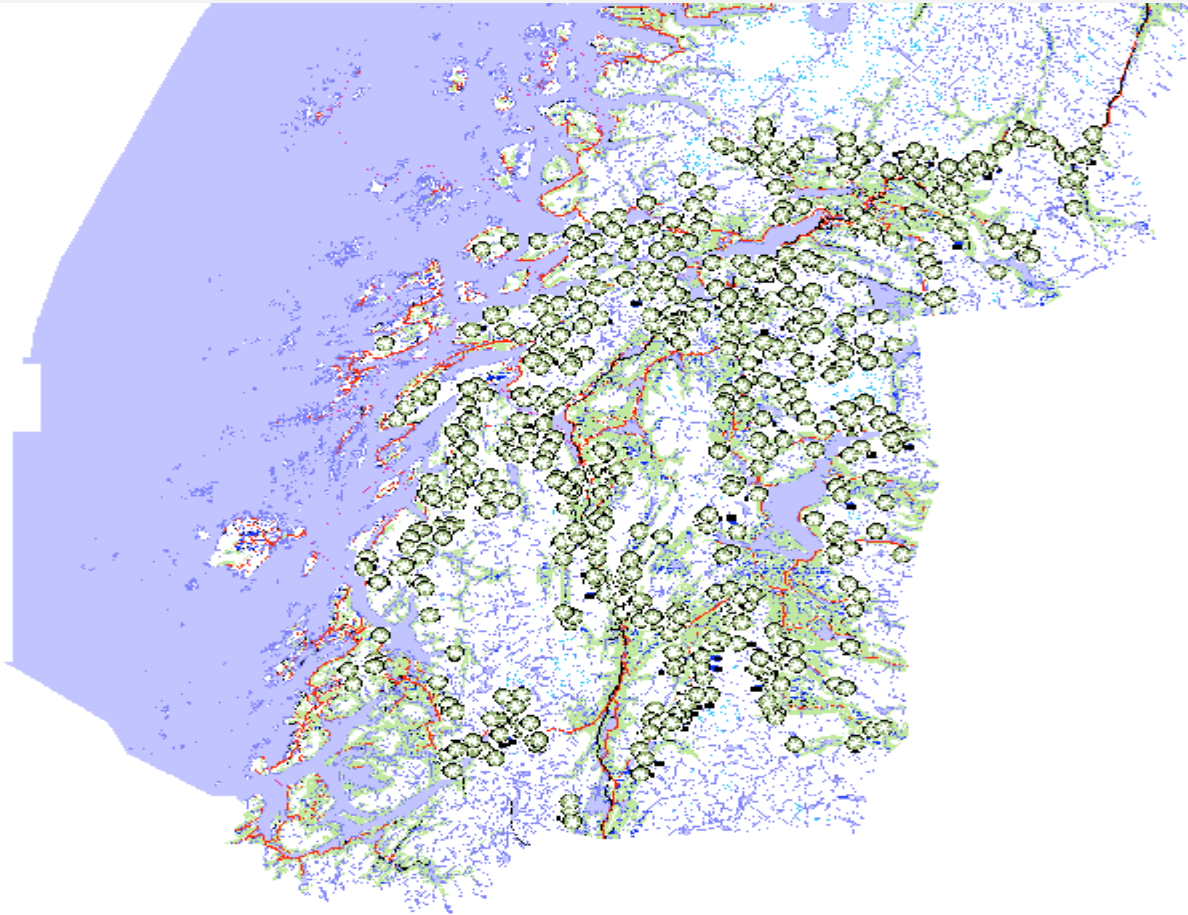
The Future Energy System

- From central production to a energy source mix

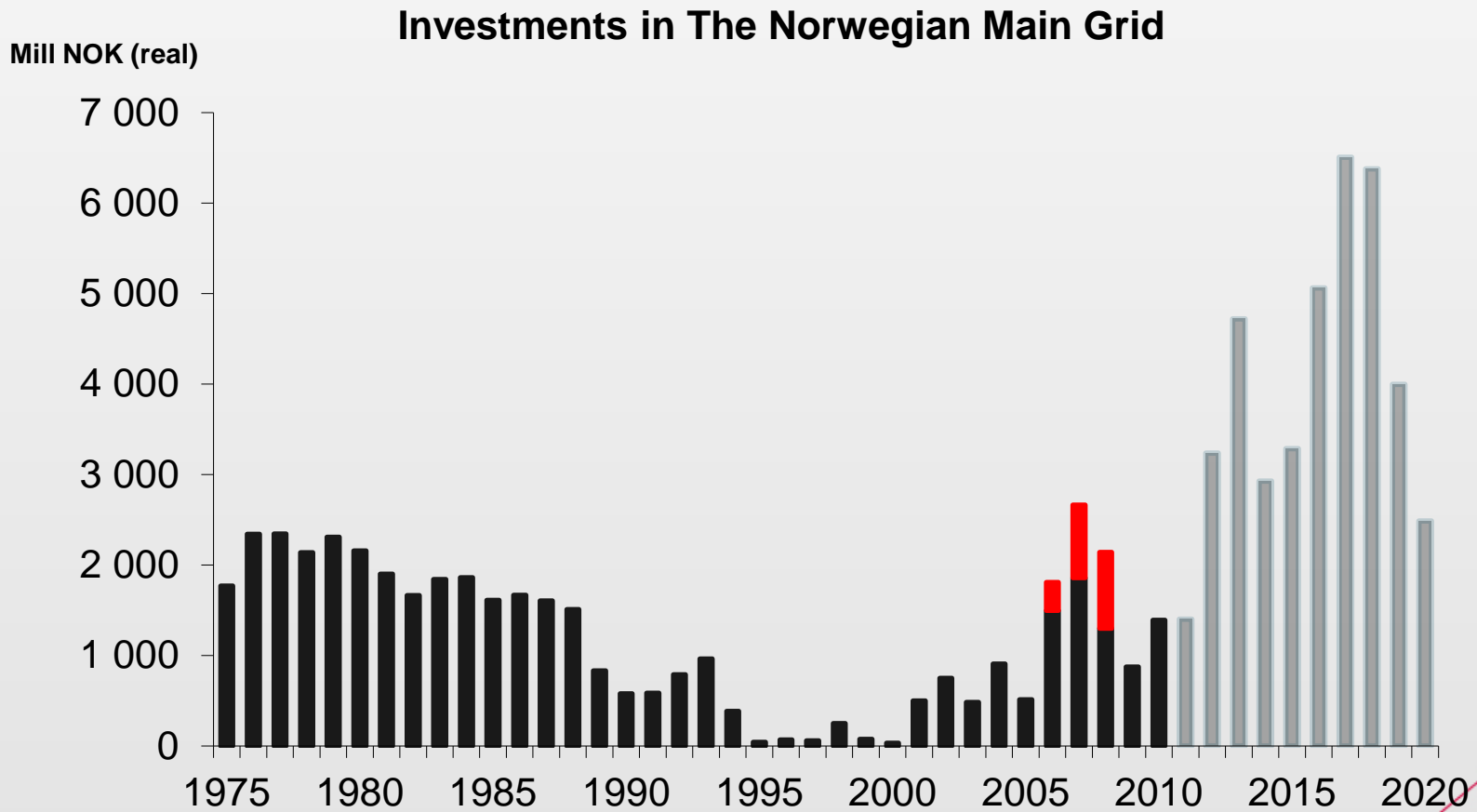


North of Norway – Helgeland coast

- Potential for many small micro hydro generators



The investment hurdle



Towards 2030

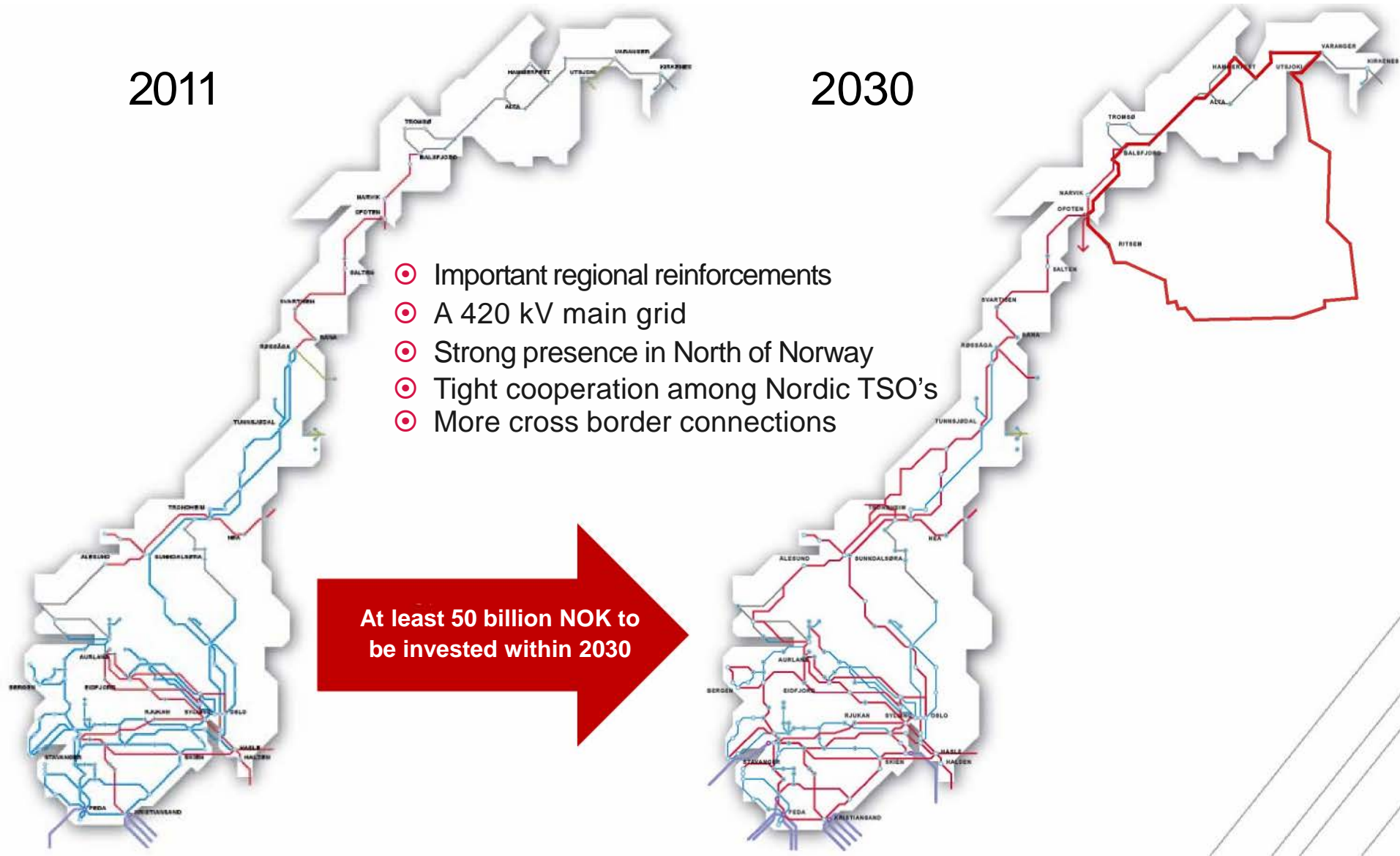
Build a robust and environmental friendly Main Grid

2011

2030

- ⊙ Important regional reinforcements
- ⊙ A 420 kV main grid
- ⊙ Strong presence in North of Norway
- ⊙ Tight cooperation among Nordic TSO's
- ⊙ More cross border connections

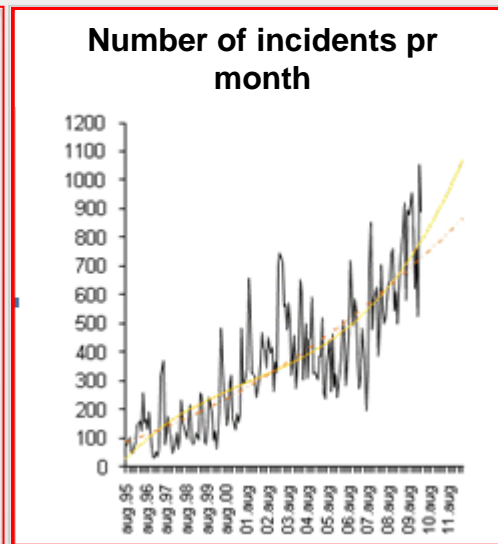
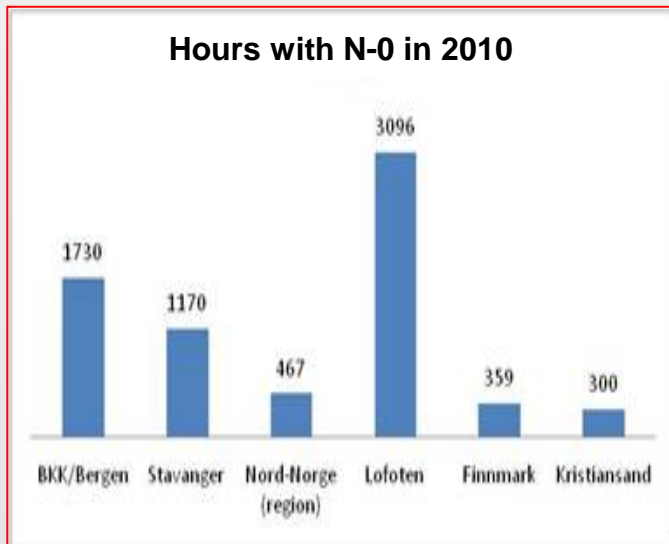
At least 50 billion NOK to be invested within 2030



In addition Smart Grid Operation

Ensure a safe and efficient operation

- Background
 - We have experienced some years with strained energy situations, more N-0 operation, reduced frequency quality and voltage regulation problems
 - But less faults for end customers



Energy situation in Norway
winter 2010/2011

Well Functioning Market

Balancing via European
Electricity Market and
Transmission Grid

Load or
Consumption
Centers in highly
populated areas

Urban Areas



Renewable
Energy

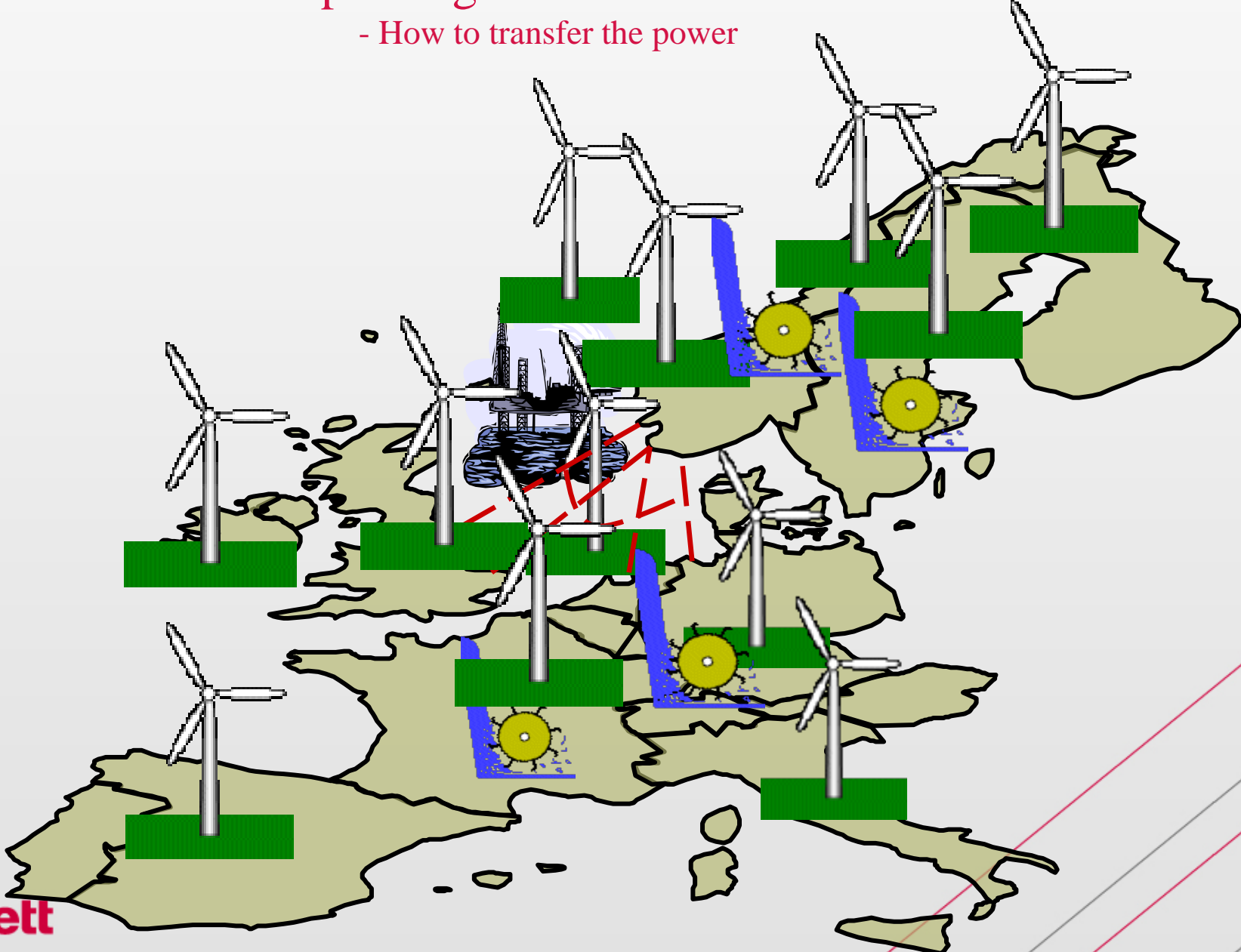
Resources
mainly in Rural
Areas



Balancing between distribution areas is needed
Different grid requirements in load and renewable generation areas

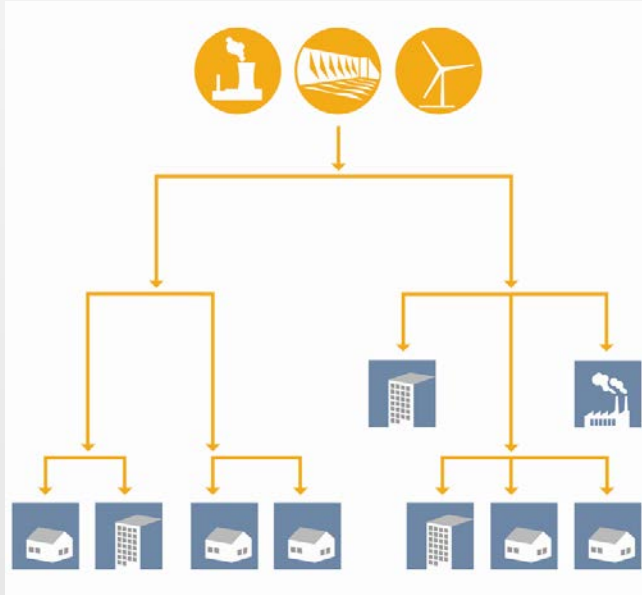
It is about exploiting the renewable resources....

- How to transfer the power



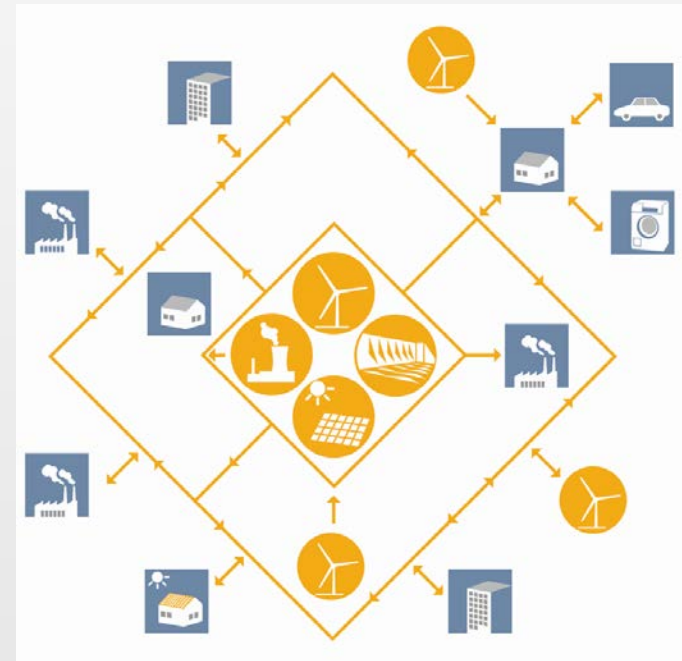
Smart Grid is not enough – Need Smart Operation

Traditional grid & Operation



- ⦿ Centralized power generation
- ⦿ One-directional power flow
- ⦿ Operation based on historical experience

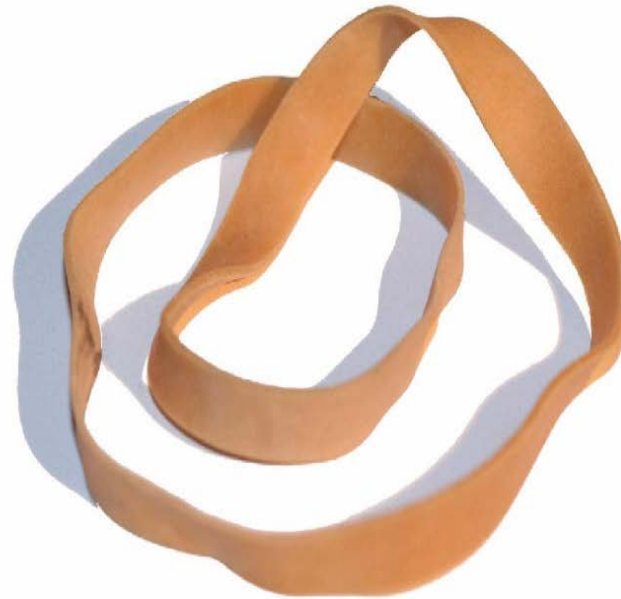
Smart Grid & Operation



- ⦿ Centralized and distributed power generation (renewable)
- ⦿ Multi-directional power flow
- ⦿ Operation based on real time data

Flexibility is crucial ...

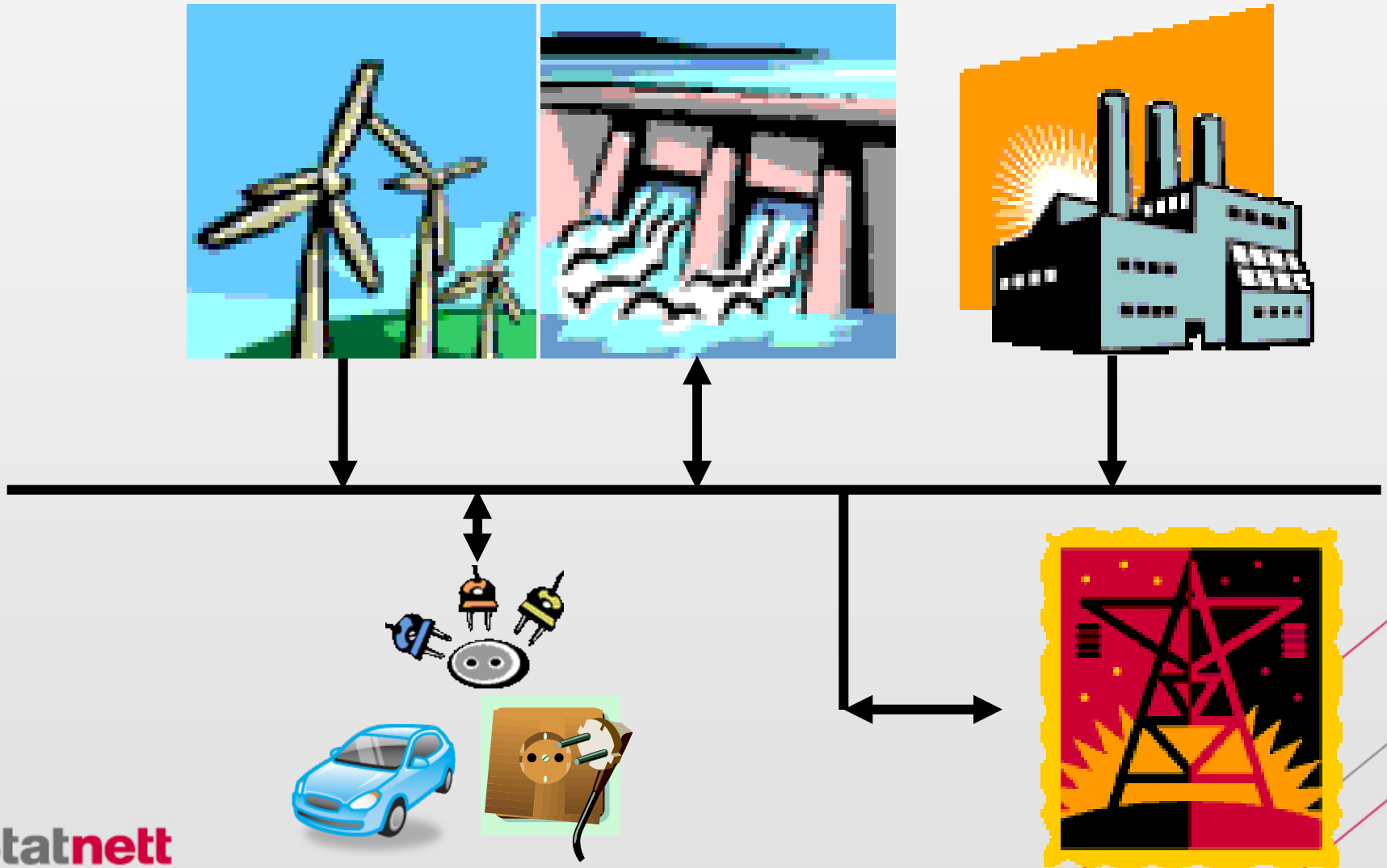
- To have access to flexibility is a need in the future power system



- Design and long term planning
- Operational Planning
- On-line operation

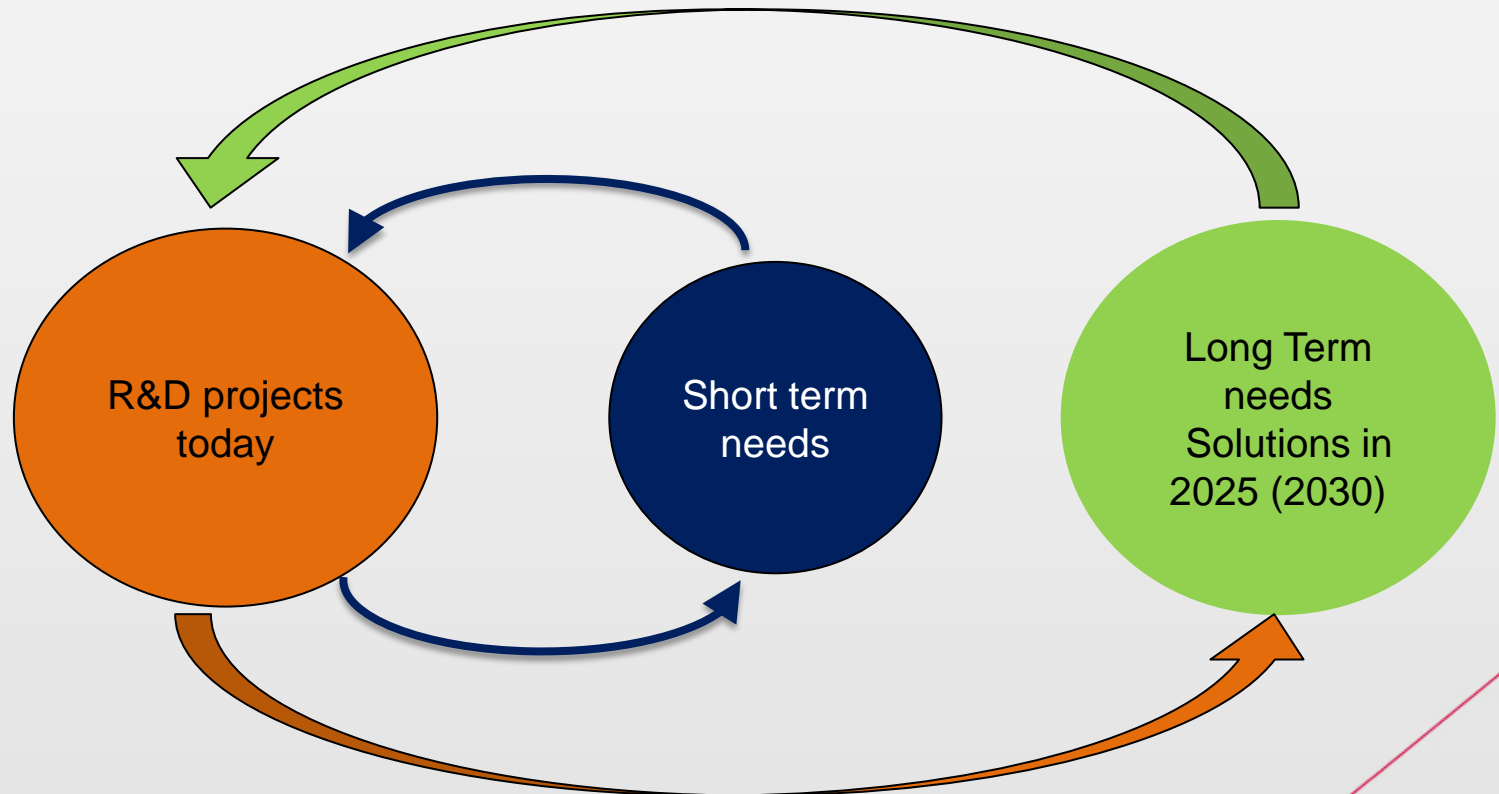
WAMS, WACS, WAPS are enabling systems for Smart grid and key building block are PMUs, FDR and RTU

Balancing the Power System



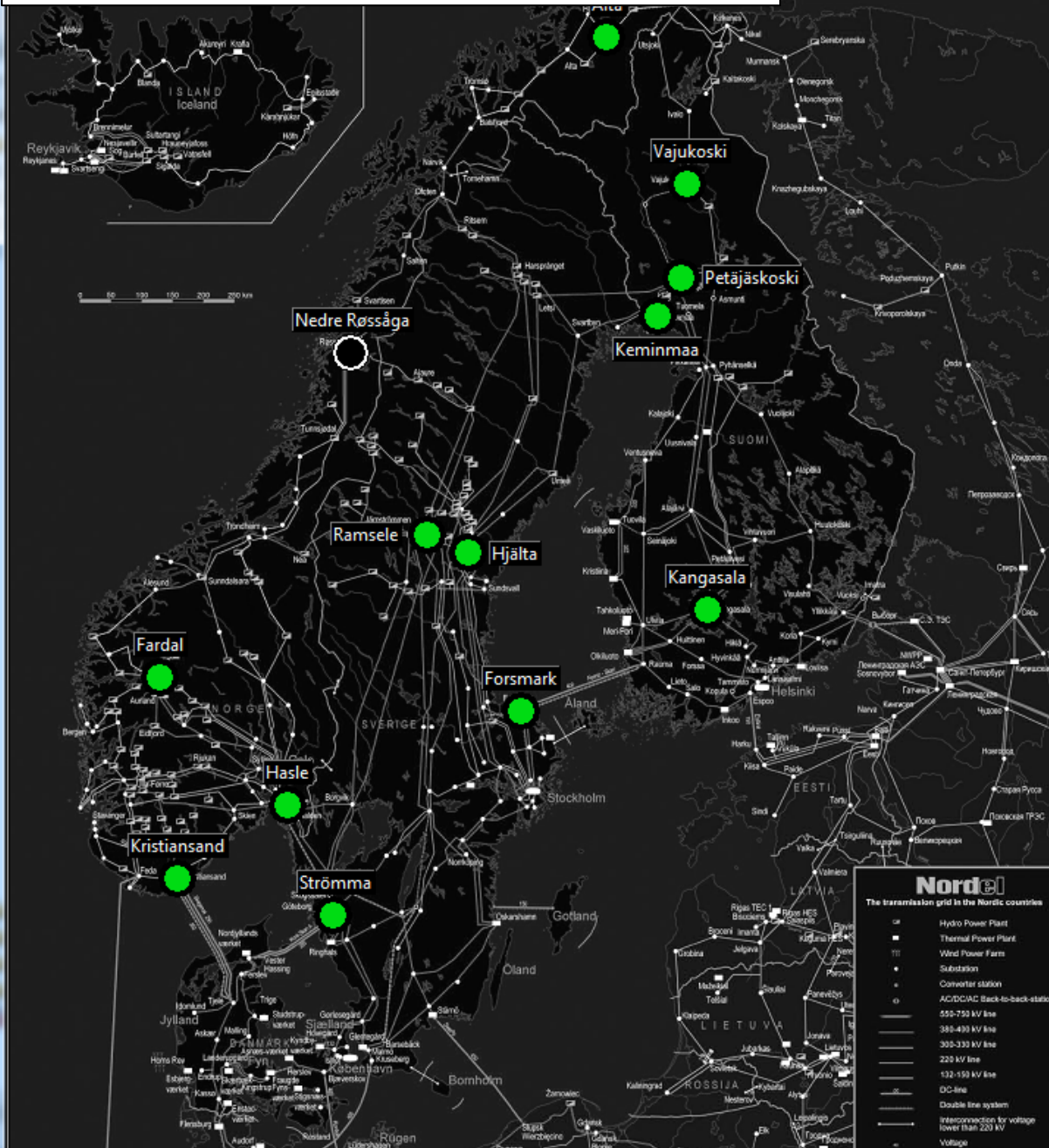
The solutions tomorrow are created NOW

What R&D projects has to be started now?



Out of the BOX-inside Out
New Solutions, Methodology, Competence

Wide Area Monitoring Systems



aarstrand.com ENFO Statnett Quit

Configuration Statnett PMU Monitor

Scheme Original

ready

49,99 Hz 08:20:21 11.06.2011

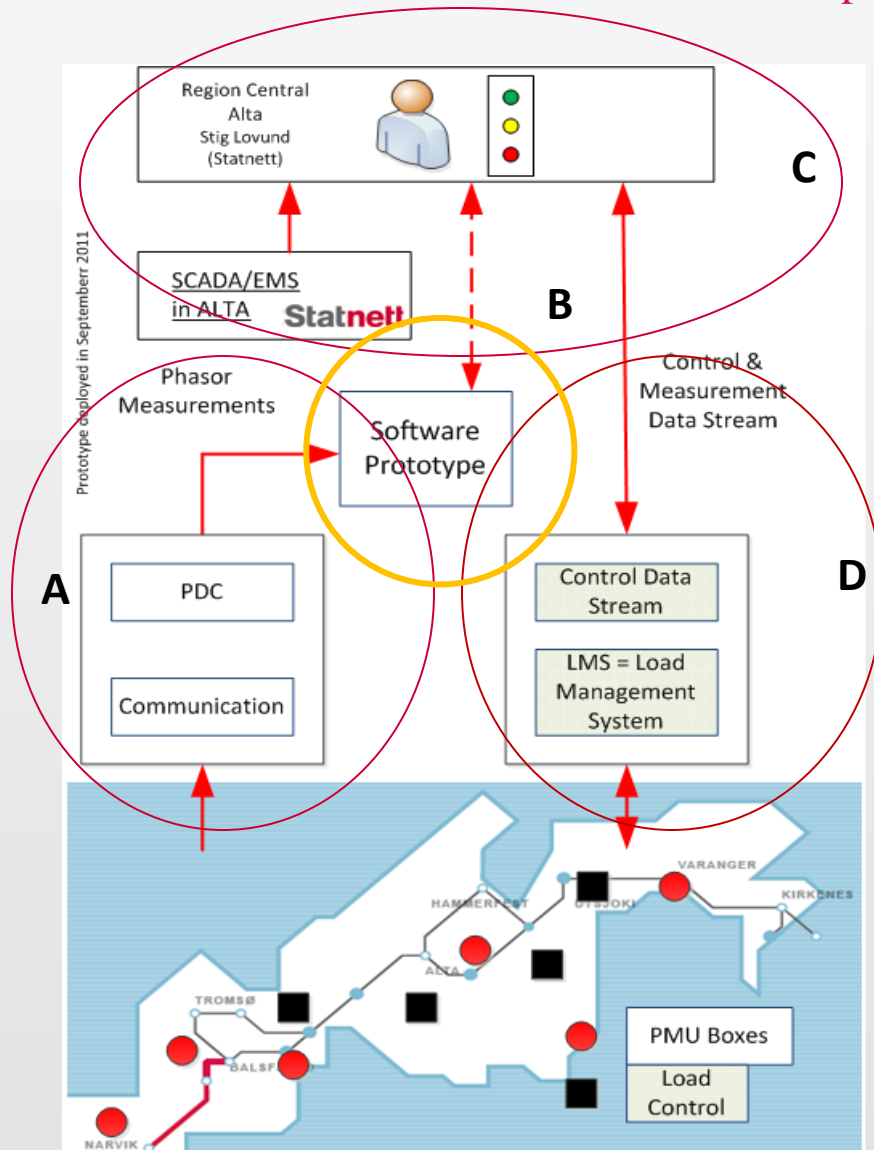
Phase relative to Hasle

Kristiansand	-11
Fardal	27,1
Alta	65,6
Vajukoski	36,6
Keminmaa	34,4
Hjälta	16,7
Ramsele	18,1

Map [F1]
 Details [F2]
 Live Signal [F3]
 Oscillation Detector [F4]
 Frequency Quality [F5]
 Signal Settings [F6]

Smart Operation

- Step 1

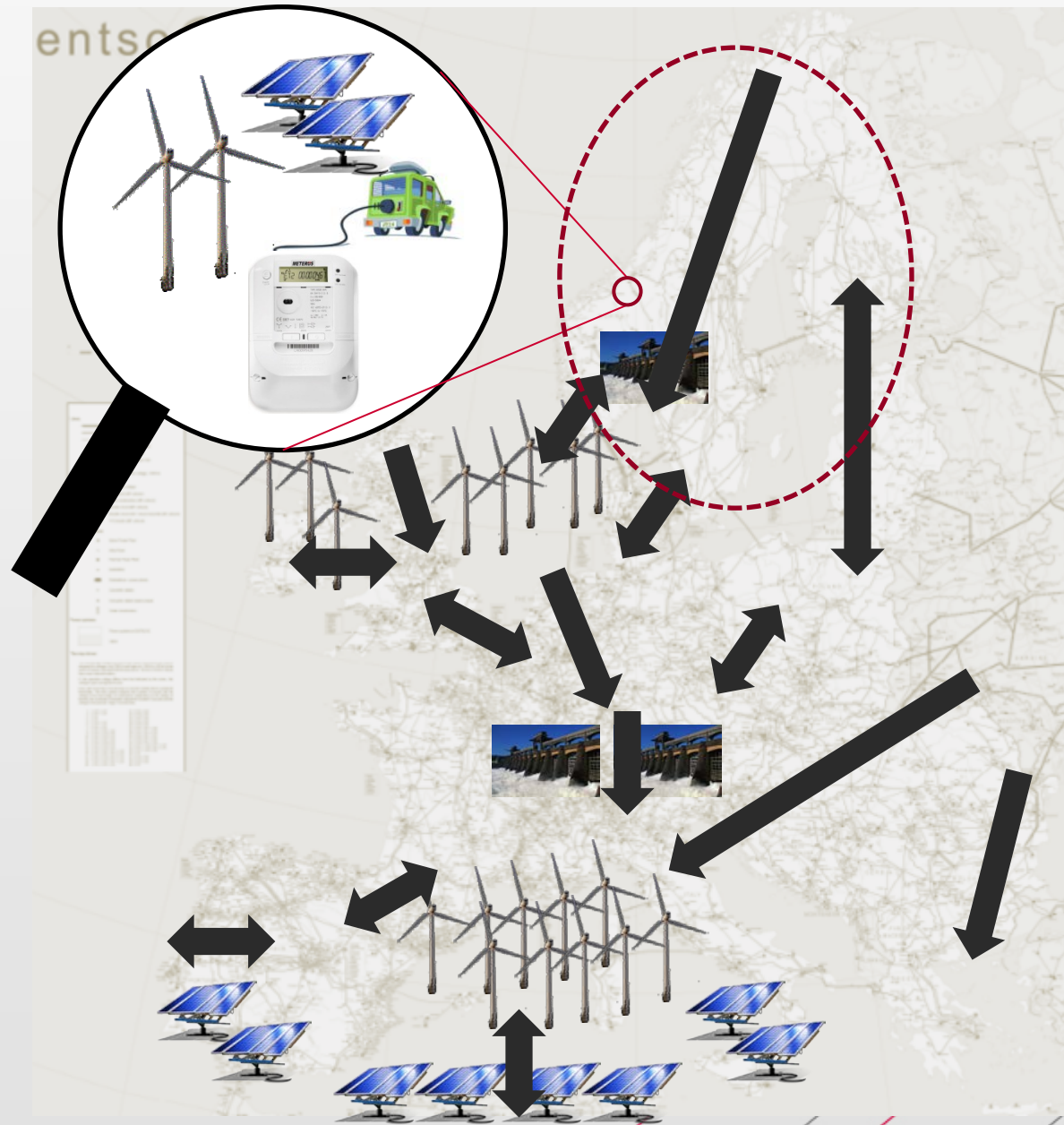


- **A: Power system monitoring**
 - Use PMU devices, Smart Meters
- **B: Software Platform**
 - Determine distance to Voltage Collapse
 - Transient stability margins
 - Thermal conditions
 - Security margin
- **C: Decisions**
 - Manual, decision support, Close Loop
- **C: Control actions**
 - Use of available loads - Pilot
 - Verify electrical loads dynamic characteristics – Pilot
 - Prognosis - Pilot

TSO cooperation is not enough

- ❖ Many of the challenges can also be solved locally by grid users
- ❖ In order to find the most cost-effective solutions, a wide cooperation between TSOs, DSOs, regulators and grid users is needed

Smart SuperGrids do not help if we have **StupidProduction** and **StupidDemand!**



Thank You for Your Attention !

