

About NTNU - EI Pow Eng.



- NTNU (2016) Recent merge created Norway's largest University
 - **39000** students, 4000 Full Time Employees in teaching/outreach.
 - **7.6** billions NOK in operating budget
 - **340** PhDs in 2015
- Electric Power Engineering
 - Students: 250 - 300 (ca. 70 pr. year), 100 in 2015/16
 - Employees: 15 Prof/Assoc, 5 adjunct, 12 Tech/Adm
 - PhD-students: 35
 - ~30 MNOK/year in external funding (50%)
 - 2 groups: Power Systems, Power Technology
- Close cooperation with SINTEF
- Projects within PSPC;
 - StrongGrid, ProOfGrids, ProSmart



SINTEF Energy Research

part of the SINTEF Group



This is SINTEF Energy Research

We shape energy solutions for the future

SINTEF Energy Research is an institute for applied research dedicated to create innovative energy solutions. We offer cutting-edge knowledge based on research that provides our clients with added-value solutions and services



Strategic focus:

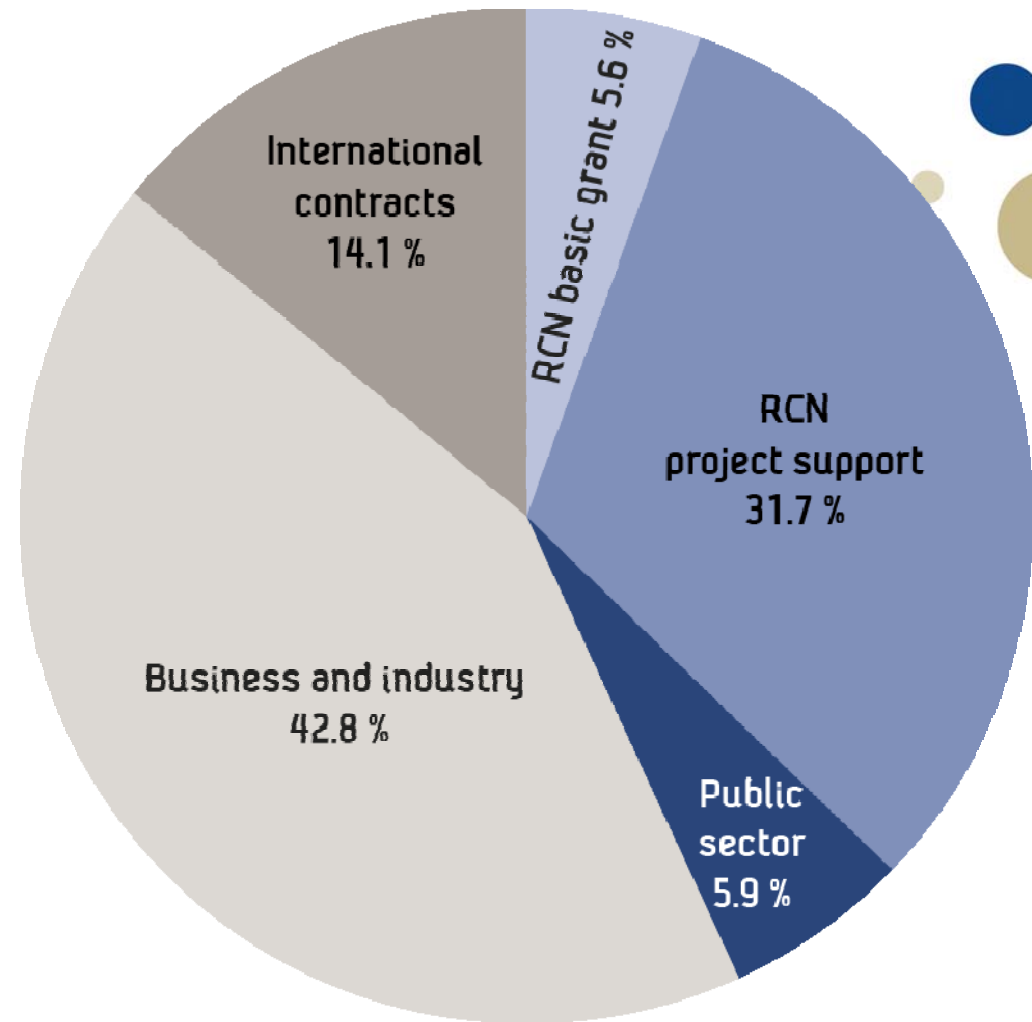
- Energy efficiency
- CO₂ capture, transport and storage
- Hydropower
- Offshore windfarms
- Bioenergy
- System integration of renewable energy
- Distribution and use of electric energy
- Power exchange between Norway and Europe
- Gas technology and LNG
- Subsea power supply and processing
- Energy policy issues

Key figures 2014

- Share capital NOK 7.5 mill
- Equity NOK 406 mill
- Income NOK 399 mill

- No of employees 253

per 31 December 2014



| | |
|-------------------------|--------|
| RCN basic grant | 5.6 % |
| RCN project support | 31.7 % |
| Public sector | 5.9 % |
| Business and industry | 42.8 % |
| International contracts | 14.1 % |

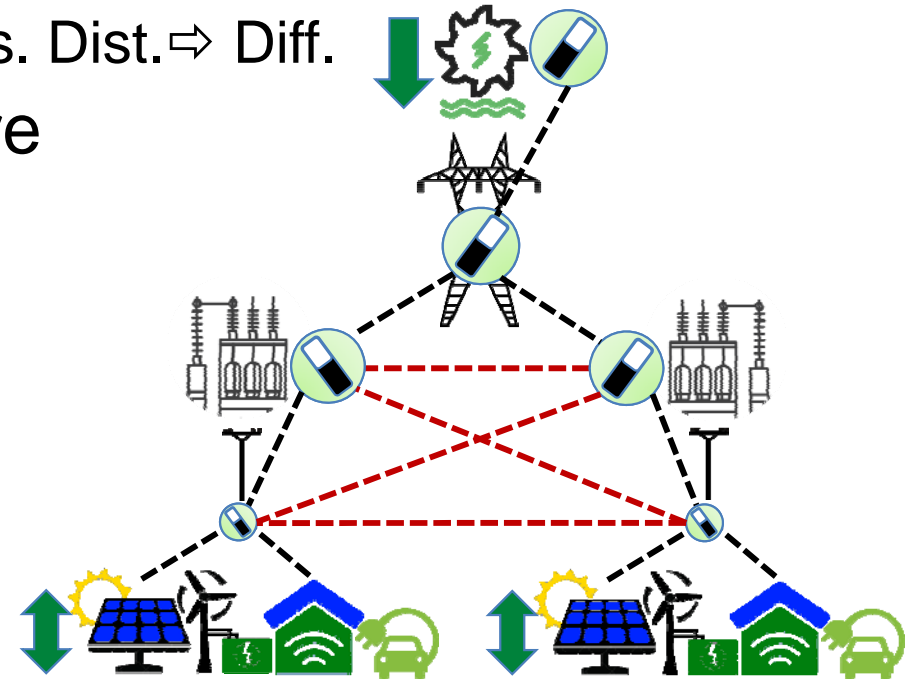
About ProSmart- Power system protection in a smartgrid perspective



- KPN-project; The Norwegian Research Council
- Partners; Statnett, ABB, Eidsiva, Hafslund, Lyse, Skagerak, Statkraft
- NTNU-Electric Power Engineering, Telematics, Michigan Tech. (MTU).
- Associate; The Norwegian Smartgrid Centre
- Budget; 18.4 MNOK, 2015-2019.
- 4 ½ PhD, 3 at NTNU
- One postdoc associated

Project motivation

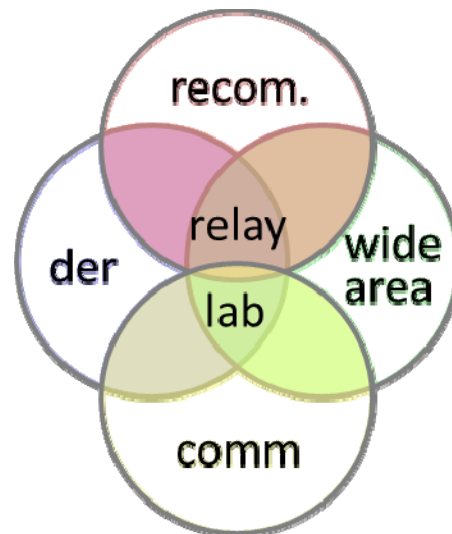
- Higher penetration of Distributed Energy Resources
 - Classical upstream/downstream concepts break down. Fault current direction unknown.
 - Changed fault current levels.
 - Islanding
 - Adaptive relaying
 - Distribution: Over-current \Rightarrow Distance protection
 - Transmission: Starting-zone settings. Dist. \Rightarrow Diff.
- Roll-out of smartgrid infrastructure
 - Communication channels available
 - IT-revolution in the electro business
 - System protection (wide-area)
 - Power swing blocking
 - Voltage stability tracking
 - Load shedding etc.



Project content



- PhD 1: *Protection of power systems with DER*
- PhD 2: *Wide-area protection and control*
- PhD 3: *Communication for protection purposes*
- PhD 4: *System integration and performance*
- *Protection requirements for integration of DER*
- *Power system protection demonstration laboratory*



- Recommendations
- Distributed energy resources
- Wide-area protection
- Relay laboratory
- Communication

ProSmart kick-off May 21, 2015

