

# Moving Towards The Smart Grid: The Norwegian Case

The Norwegian Smartgrid Center  
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# 1. What is the Norwegian Smart Grid Centre (NSGC)

- Characteristics Norwegian Power system

# 2. Moving towards the smart grids

- What does the NSGC do?

# 3. A few comments on R&D policy for smartgrids



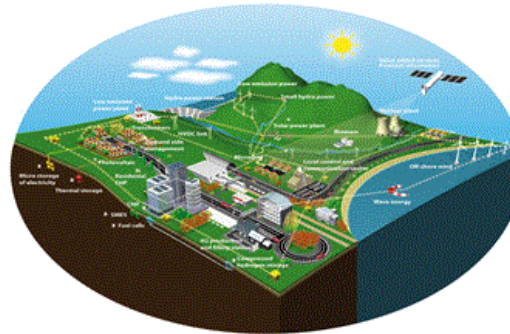
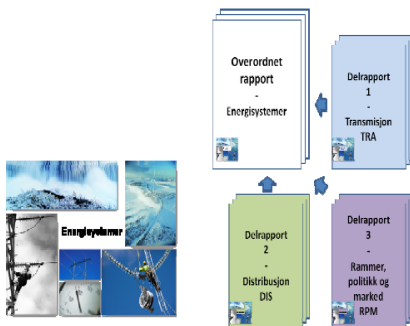
## Recommendations

### R&D-D priorities

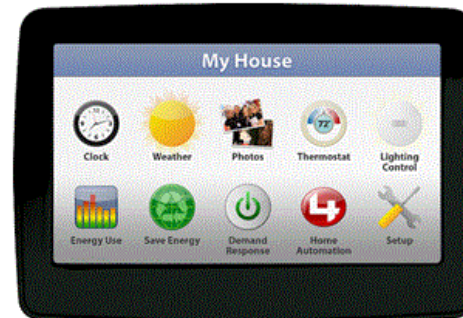


Innsatsgruppe Energisystemer  
Overordnet rapport

14. desember 2010



## The Norwegian Smartgrid Center



- Cross-sectoral membership org.
- Industry-led stakeholder forum
- Address cross-sectoral R&D-D challenges
- Mobilisation and dissemination function
- "Permanent working group" within high level priorities of Energi21



A national team: 48 members

## Utilities and grid operators

- Statnett SF (TSO)
- Lyse Elnett AS
- Hafslund Nett AS
- NTE Nett AS
- Skagerak Energi AS
- BKK Nett AS
- Fredrikstad Nett AS
- Trønder Energi AS
- Istad Nett AS
- EB Nett AS
- Helgelands Kraft AS
- Eidsiva Nett AS
- Energi Norge AS
- Agder Energi AS
- Bodø Energi AS
- Sogn og Fjordane Energi

## "Power and automation"

- Eltek
- ABB
- Siemens
- Smart Grid Norway AS

## Communication

- Telenor (tele operator)
- Nexans Norway AS (cables)
- BKK Fiber (power communication)

## AMS and AMI:

- Aidon Norge AS
- Kamstrup AS
- Landis+Gyr
- Valider

## ICT safety and reliability

- DNV GL
- Greenbirds

## IT solutions and services

- Powel AS
- Enfo Energy AS
- Bitreactive AS
- eSmart System
- Logica Norge AS
- Rejlers AS
- EPOS Consulting
- Tieto Norway AS
- Devoteam daVinci AS
- Embriq AS
- Greenbirds Solutions
- Trimble (Tekla)

## R&D and Education

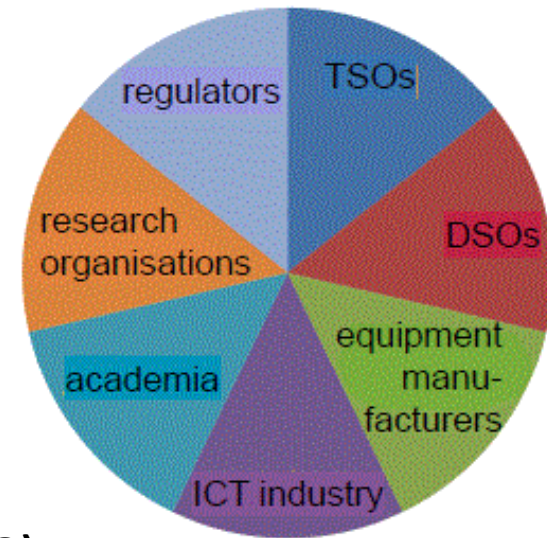
- NTNU, Faculty of ITE
- SINTEF Energy and SINTEF ICT
- University of Stavanger
- University College of Narvik
- University College Østfold
- EnergiNorge (industry association)

## Commercialization (regional clusters)

- ARENA Smartgrid services (mid-norway)
- NCE Smart energy market (south-east Norway)

# Steering Committee

- **Chair:** Eilert Henriksen, CEO grid, **Fredrikstad Energi (DSO)**
- Knut Samdal, R&D Director, **SINTEF Energi**
- Bjarne Helvik, Vice Dean, **NTNU**, Faculty of ITC, Mathematics and Electrical Engineering
- Stig Løvlund, Manager Regional Control Centre, **Statnett (TSO)**
- Trygve Kvernland, CEO grid, **NTE (DSO)**
- Bjarne Dybvik, Vice president Market, **Sogn- og Fjordane Energi (utility)**
- Sigurd Kvistad, Manager Smartgrid, **Hafslund Nett (DSO)**
- Kjetil Storset, Vice President Smart Grid, **Powel (IT)**
- Svein Kåre Grønås, CEO, BKK Fiber (**Communications**)
- Hilde Bekkevold, Projectleader, **NCE Smart energy market (regional cluster)**
- Trond Lein, COO Smartgrids, Norway, **Siemens**
- Stian Reite, R&D Manager, **ABB**
- Åshild Helland, Director Grid, **Lyse Elnet (DSO)**



## Observers:

Representatives of NVE;  
RCN; Innovation Norway;  
Enova

# Norwegian Power System

- Average annual electricity use for households: **16 000 kWh**
- Large share of electricity in the domestic sector used for space and water heating
  - **offers much flexibility** for demand response and demand side management schemes.
  - Flexibility estimates: **3000 MW** in industry and **1700 MW** in households & offices
- Well-developed electricity markets in the Nordics: Significant volumes for day-ahead, intra-day and balancing services.
- Fast growing use of battery based **electric vehicles** due good incentives (tax exempt., free parking, free use of toll roads and bus lanes etc.)
  - 50 000 EVs
  - 2 electrical busses in operation in Stavanger
  - Scenario of large scale deployment of electrical busses in Oslo
- App. 500 000 companies and 2.8 millioner households connected to the power grid
- Reliability of the power system: **99,9 %**

# Norwegian (Power) System

- App. 2.8 million Smart Meters (AMS) to be rolled out by 1.1 2019.
- Centralized dataHUB for smart meter values in operation 1.2 2017.
- Well-developed broadband communication to homes and increased use of fiber-to-home communication network
  - 1,3 million households with high-speed/broadbands
  - 842 000 with access to fiber-to home networks
- Overall reliability of the telecom network: **96%**
- AMS + Gateways + Broadband = > **Platform for smart home** automation and the development of smart home services, including EE and DR
- Relatively smart operation at TSO level due to the handling of a large amount of hydropower
- Distribution? Not smart.
  - *125 924 Secondary substations*
  - *132 144 distribution transformers*
- Significant part of the LV distribution system is of **type 230 Volt IT system** (230 V line voltage) different from the 400 Volt line voltage systems in most of Europe.
- Weak grids with approx. 40% of the supply terminals weaker than the standardized EMC reference impedance give more **severe voltage quality problems** when connecting EVs, PVs etc. than many other countries.

# Investments in transmission and distribution

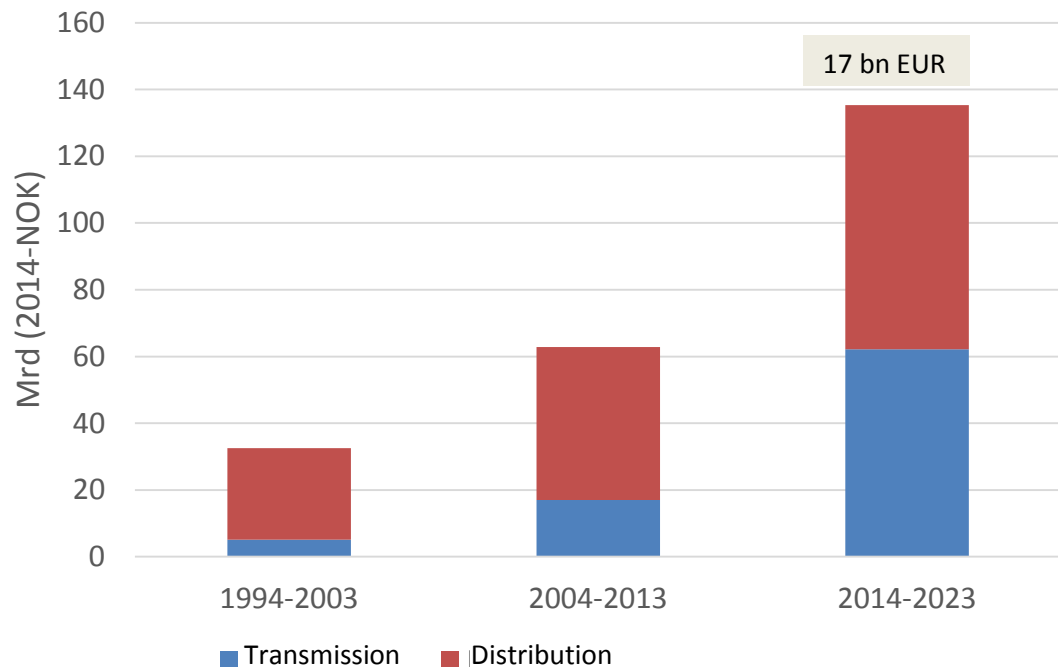
Climate and Renewables targets

Old infrastructure

Urbanization and growth of population

Increasing peak load; power-efficiency & energy efficiency

Power quality issues. Increased use of sensitive electronic appliances

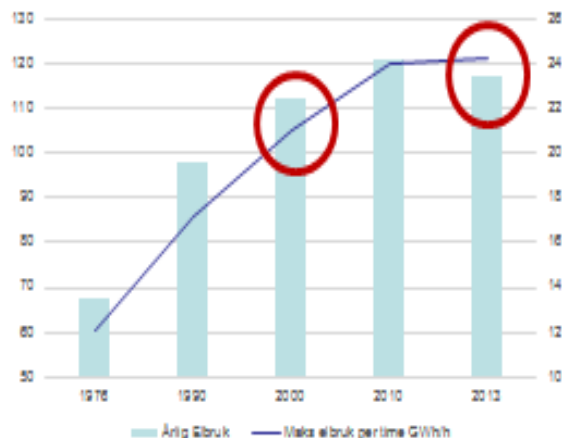


Source: SSB, NVE % Statnett  
From Eivind Reiten's «Et bedre organisert strømnnett», 5. mai 2014

Increasing peak load; power-efficiency & energy efficiency

Power quality issues and increased use of sensitive electronic appliances

## Utvikling i elbruk og effekt

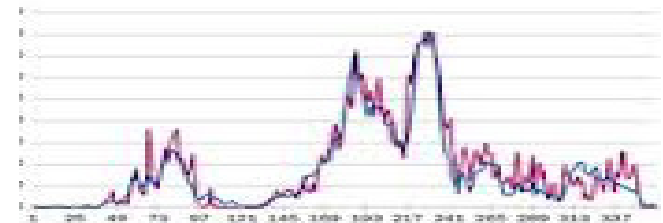


Kilde: Energiforbruksrapporten 2013, NVE rapport 11, 2014  
Tall fra 2013 er foreløpige

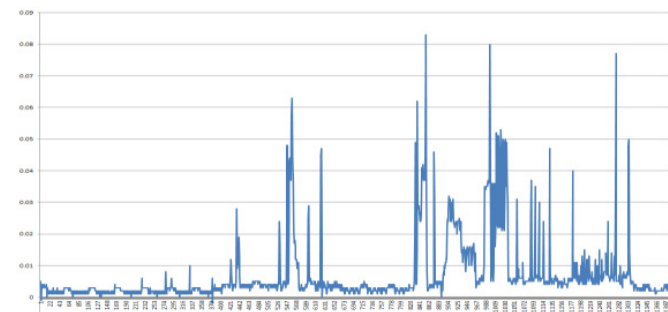
Changes 2000-2013:

Electricity use (kWh):  
4% increase

Peak load (W):  
15% increase



Today's load profiles



Future load situation  
(fluxtuations and increased peak load)

*\*Illustrations: NVE and Agder Energi*

# Moving Towards The Smart Grid


What does the NSGC do?

# What we do (1): Common priorities

## Opinions to the Government's White Paper on Energy (2016)

## Common R&D-D challenges for DSO's

## Scientific Committee: Research strategy



26 November 2014

**Innspill til Stortingsmeldingen om en helhetlig energipolitikk  
– hvor energiforsyning, klimautfordringen og næringsutvikling  
ses i sammenheng.**

The Norwegian Smartgrid Centre (Smartgridsenteret) benytter anledningen til å uttrykke støtte til ambisjonene og virkemidlene for Energi og Klima uttrykt i regjeringens politiske plattform formulert på Sundvollen i 2013.


Smartgridsenteret er særlig opptatt av overordnede politiske målsettinger som omhandler elektrisitetens rolle i energiforsyning, og spesielt det smarte strømmettet som virkemiddel for forsyningsikkerhet, næringsutvikling og for realisering av et mer klimavennlig energisystem.

Å gjøre distribusjonsnett, men også transmisjonsnett, smartere gjennom teknologi for bedre overvåking, styring og kontroll, vil styrke forsyningsikkerheten og kvaliteten i kraftleveransene. Smartnett teknologi er nødvendig for å muliggjøre økt fornybar produksjon, økt elektrifisering i transport, og håndtering av effektopper som følge av nye apparater i hjemmene, landstrøm til skip, lading av elbiler, plussus med mere. Et smartere strømmett vil bidra til at nettet ikke blir en barriere for ambisiøse målsettinger for energieffektivisering og fornybar energi. Et smartere nett gjør at nettselskapene med større sikkerhet kan beregne tilstrekkelig kapasitet ved oppgradering og nybygging. Da unngås overinvesteringer som er kostbare for samfunnet og forbrukerne, og man belaster ikke naturen med unødige master og kabler.

Tre overordnede prioriteringer er foreslått innledningsvis, etterfulgt av en liste med 9 konkrete tiltak i siste del av dokumentet.

Innspillet er utarbeidet av styret og ledelsen i Smartgridsenteret som er en tverr-industrielt sammensatt medlemsorganisasjon ([www.smartgrids.no](http://www.smartgrids.no)):

<ul style="list-style-type: none"><li>• <b>Styreleder Smartgridsenteret:</b><ul style="list-style-type: none"><li>• Eilert Henriksen, Direktør Nett, Fredrikstad Energi</li><li>• Knut Samdal, Forskningsjef i SINTEF Energi</li><li>• Trygve Kvernland, Direktør Nett, NTE</li><li>• Bjarne Dybvik, Markedsdirektør, Sogn- og Fjordane Energi</li><li>• Sigurd Kvistad, Leder Smartgrid, Høslund Nett, og Prosjektleder AMS-prosjektet Høslund</li><li>• Hilde Bekkevold, Prosjektleder, NCE Smart energy market</li><li>• Stig Løvland, Leder Smartgridprogrammet og Regional Driftsenteren i Alta, Statnett</li><li>• Kjetil Storset, Vice President Smart Infrastructure, Power</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Jan Kristensen, Vice President, Telenor</li><li>• Nils Klippenberg, COO Power Division, Siemens</li><li>• Stian Reite, Smart Communities Manager, ABB</li><li>• Knut Gustavsen, COO, eSmart Systems</li><li>• Eilert Bjerkan, CEO, Enfo Consulting</li><li>• Bjarne Helvik, Prorektor, IME Fakultetet NTNU</li><li>• Grete Coldevin, Direktør, Smartgridsenteret</li><li>• Kjell Sand, Faglig ansvarlig, Smartgridsenteret</li></ul>
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**Smartgridstrategi for forskning,  
utvikling og demonstrasjon  
(FoU-D)**

for nettselskapene i  
The Norwegian Smartgrid Centre

Trondheim, mai 2014

*Norwegian Smart Grid  
Research Strategy*

Prepared by

The Scientific Committee of the Norwegian Smart Grid Centre

Version: April 2014

# What we do (2):

## Coordination and mobilization

National Coordination:  
"Demo Norway for Smart  
Grids"

**Committee** for national  
demo-activities: *living labs*  
& *off-grid lab*

**4 meetings** a year

**Aim:**

knowledge sharing;  
need for new activities;  
replication and scale.

**Funding!**

Trendspotting & sharing:  
ETP Smart Grids (EU)  
GSGF and ISGAN



Mobilizing for Selected Calls:  
FME (national)  
H2020 (EU)

**FME** = Centres for  
Environment-friendly  
Energy Research (open call)

**EU Horizon 2020:**  
Funding for test/demo

**Role of NSGC:**  
Industry relevance in R&D &  
good dissemination  
mechanisms

# Demo Smart Grid for Norway

## Pilot North: Statnett

**Transmission:** Congestion management, SVC, WAMS, PMU, load management, TSO/DSO cooperation

**Univ. College Narvik**

## Demo Steinkjer: NTE

**Distribution:** AMS (4500), residential and businesses, communication solutions, tariffs, customer behaviour, information security

- Smart grid T&D simulations
- EV charging and energy storage
- Smarthouse
- DER

**Smart grid Lab at NTNU/SINTEF**

**Utility:** Fiber to home, AMS+ generic gateways (160 000), smart home services & welfare services

**Distribution:** AMS (8000), holiday houses, smart substations, DMS, PV, EV, tariffs, local market

## Demo Lyse

## Smart Energy Hvaler: FEAS

**NCE smart, Halden**

## Skarpnes plusshouses: AE

**Distribution:** 40 Plusshouses, PV, CSP, energy well, power variations, grid interaction, planning tools, aggregators

# New test/demo activities

## Statnett (TSO)

Replication and scale in load management through TSO-DSO cooperation:

- From 45 units in pilot (2014) to 200 units in large demo (2015)

## BKK (DSO)

Strategies for grid automatization:

- 20 secondary substations with different degrees of automatization and different geographical location
- Communication systems

## SFE (Utility)

Smart Valley/Smart Rural grid for the whole electrical value chains:

- Customer services; grid operations; production with large amount of small scale hydro power plants

Anført av en entusiastisk Fremskrittsparti-ordfører satser Hvaler kommune på flere klimatiltak. Norges største private solpark er nå under etablering.

### ENERGI

Øyvind Finstad  
Hvaler

Husier og elektriker Svein Simensen sjekker solcelleanlegget som nettopp er montert, mens ordfører Øyvind Norman (Sp) følger med på gårdsplassen.

- Dette anlegget produserer 3000 kilowattimer i året, sier Simensen når han kommer ned fra tallet.

Han er blant de mange på Hvaler som nå installerer solcelleanlegg.

Satser på 100 anlegg



- Er du den grønneste Fremskrittsparti-ordføreren i landet?  
- Det er vel intet close race her

Øyvind Norman (Sp), ordfører i Hvaler kommune

## Solcelle-rush på Hvaler



## Hvaler kommune & Fredrikstad Energi Market & FEN Nett (DSO)

- Island grid operation for PV installations (60-100 units)
- Local market (R&D)

## Lyse Elnett:

Smart grid for the historical city of Stavanger:

- 25 smart secondary substations, smartmeters with gateway, DMS and SCADA systems



# What we do (3):

## Trendspotting & Dissemination

### National Smart Grid Conference

2013, 10.-11 sept., Trondheim



- 200 Participants
- 30 Presentations
- 10 PhD students w/ poster and pres.

2014, 10.-11 sept., Oslo



- 283 participants
- 32 Presentations
- 22 exhibitions of solutions

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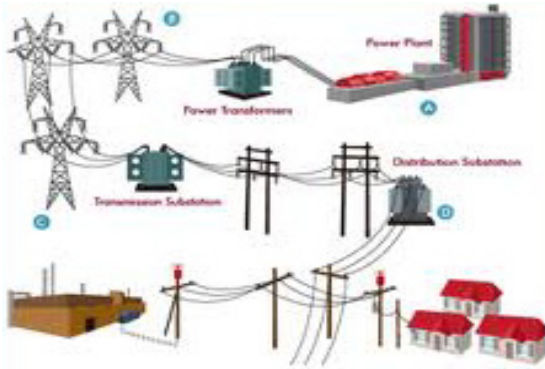
# 2. Moving towards the smart grids

- What does the NSGC do?

# 3. A few comments on R&D policy for smart grids

# Different types and pace of innovation

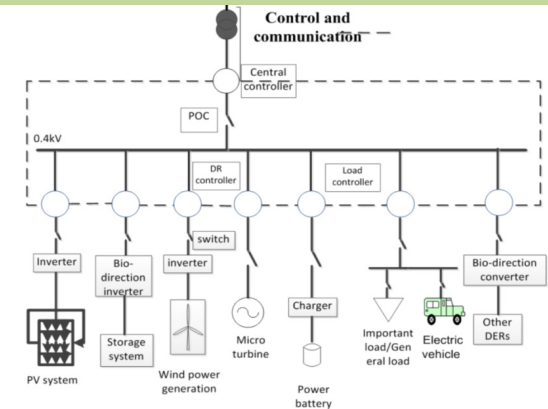
## Continuous evolution of established systems



## ICT Revolution; "Internet of energy"



## Radical Microgrid-DER movement



### R&D policies/incentives:

- To encourage TSO and DSO to test and to deploy new technologies
- Speeding up innovation through replication and scale
- Industry wide dissemination
- Ensuring interoperability and standardization
- For development of "Smart Regulation"

### R&D policies/incentives:

- Speeding up adoption/migration of ICT solution from other sectors
- Allowing new players into the field
- Innovation in business models and work practices
- ICT security and reliability
- Relevance and quality in cost-benefit methods

### R&D policies/incentives:

- Development of low cost, stand alone systems
- Contributing to "electricity access to billions"
- Consumers'/prosumers' ability to participating in innovation
- Reliability and security

R&D Policies: Different innovation cycles and types going on: This calls for a broad toolbox

# Member States Priorities – 1st questionnaire

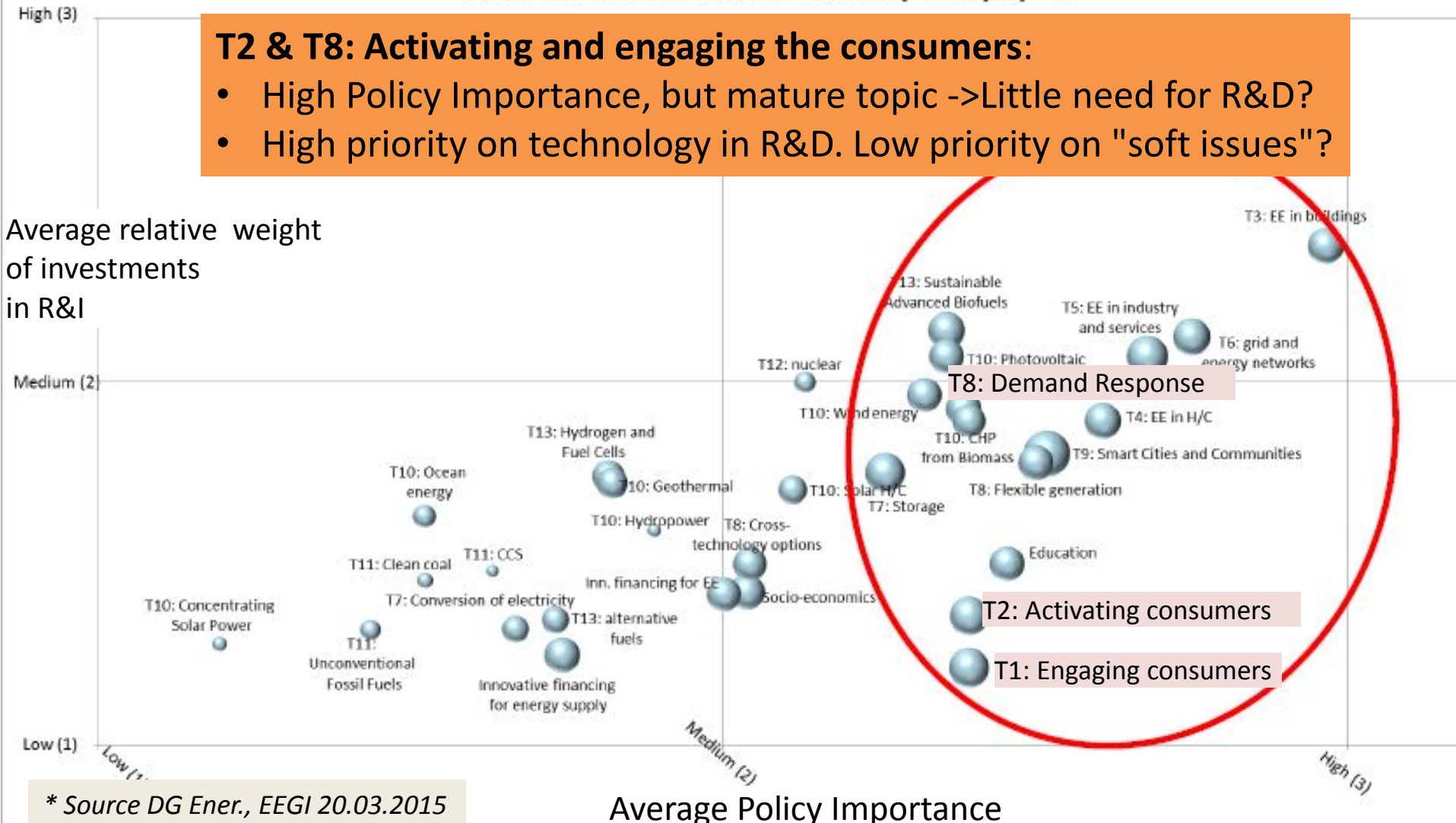


## Overview of themes identified as a priority by MS

### T2 & T8: Activating and engaging the consumers:

- High Policy Importance, but mature topic -> Little need for R&D?
- High priority on technology in R&D. Low priority on "soft issues"?

Average relative weight of investments in R&I



\* Source DG Ener., EEGI 20.03.2015

Average Policy Importance

- Consumers have a weak voice in setting the priorities of R&D policies.
- A need for "smart regulation" in the smart grid development:
  - **"Public – Private - Regulator Partnerships"** in setting the priorities and deciding on the instruments
- A framework of "Systems thinking" in R&D-I policies (ref IEA ETP 2014)
  - Evaluation of R&D proposals: Easier to recognize potential for innovation in single components than in system performance
- Exchange/mobility of scientists and students:
  - An idea: Exchange and sharing between test/demonstration sites