



Flex4RES status

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Flex4RES

Flexible Nordic Energy Systems



Flex4RES **status**

Flexibility for Variable Renewable Energy
Integration in the Nordic Energy System

Nordic Flagships - External Reference Group, 29th March 2016, Oslo

Nordic Energy Research Flagship project
September 2015 - March 2019

project coordinator:

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DTU Management Engineering , Denmark



Nordic Energy Research

Hypotheses

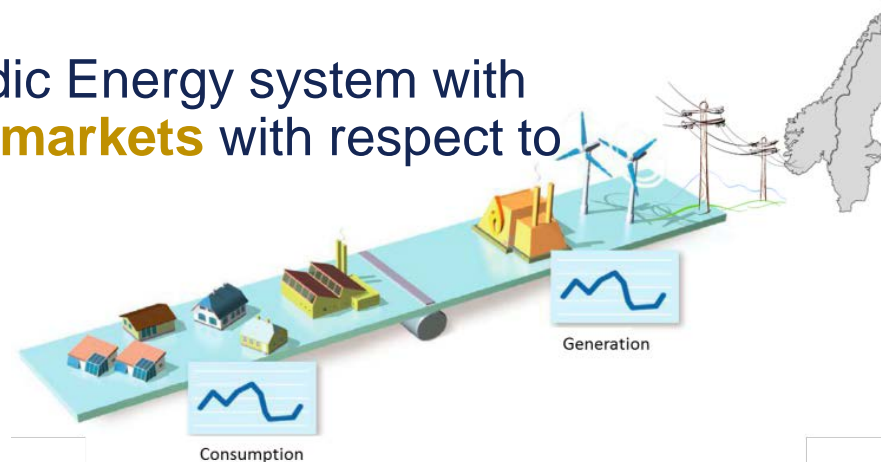


Comparative advantages of combining different energy markets, both with respect to flexibility, but also with respect to synergy and economics.

The Nordic power market is well functioning despite a few technical challenges.

With the right coupling to the underlying national and local energy markets for heat, gas, and transport fuels, enough flexibility can be generated in a cost efficient way and so embrace a larger amount of VRE.

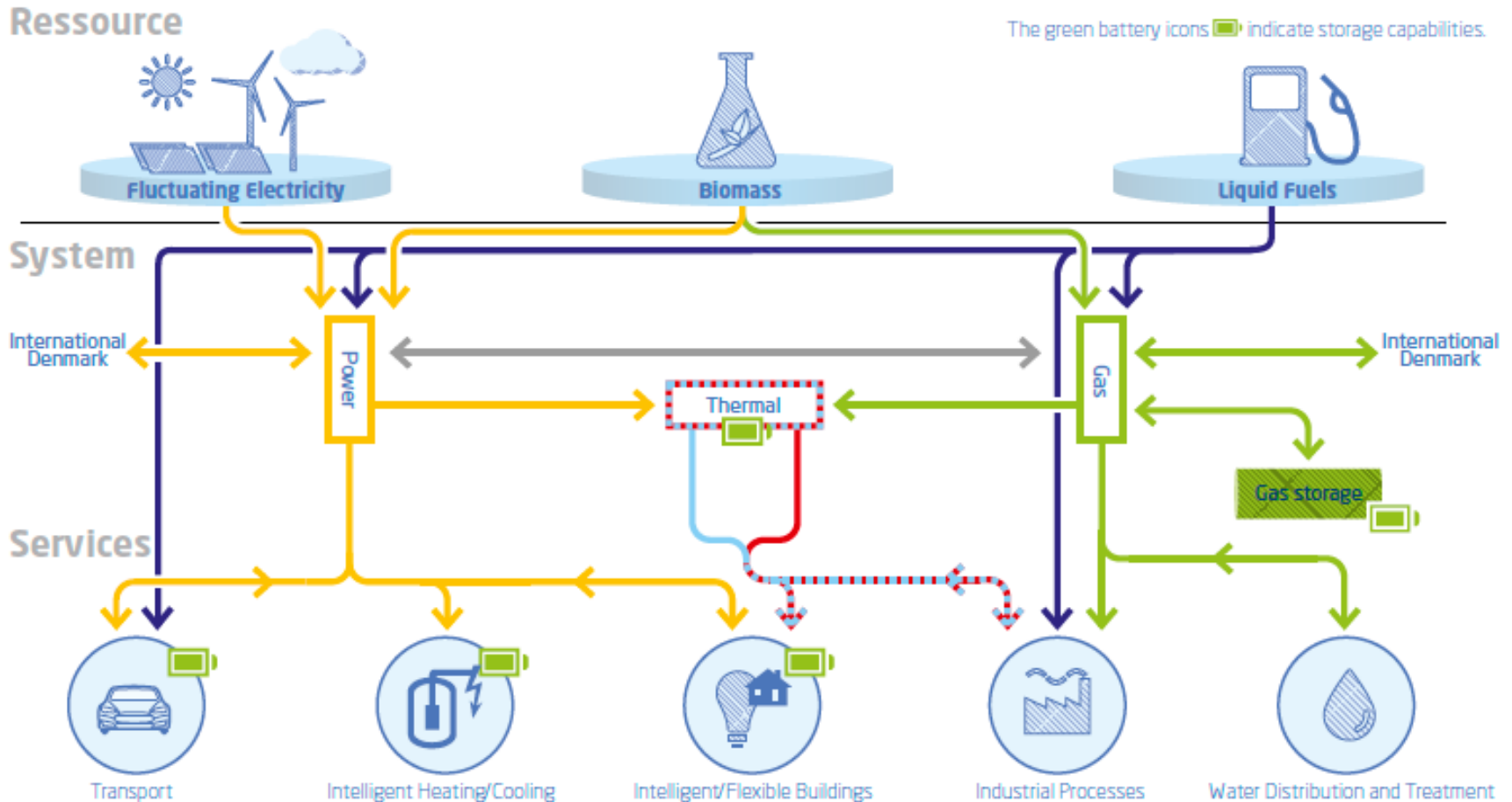
Holistic system approach to the Nordic Energy system with **flexibility obtained across energy markets** with respect to flexibility at the power markets.



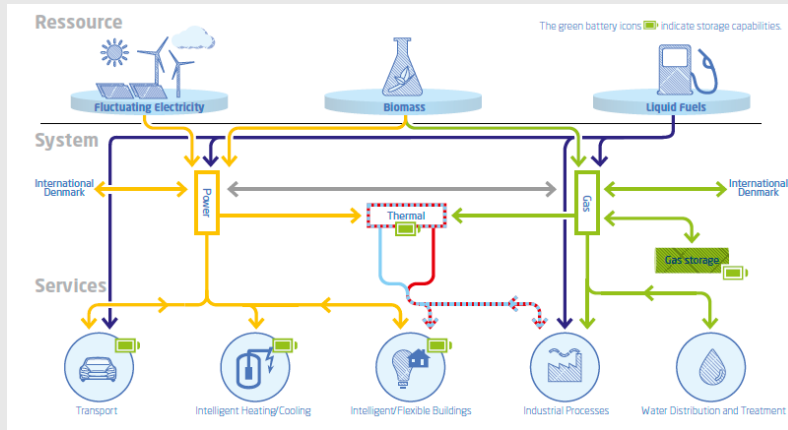
Integrated Coherent Energy Systems



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Challenges in a larger perspective



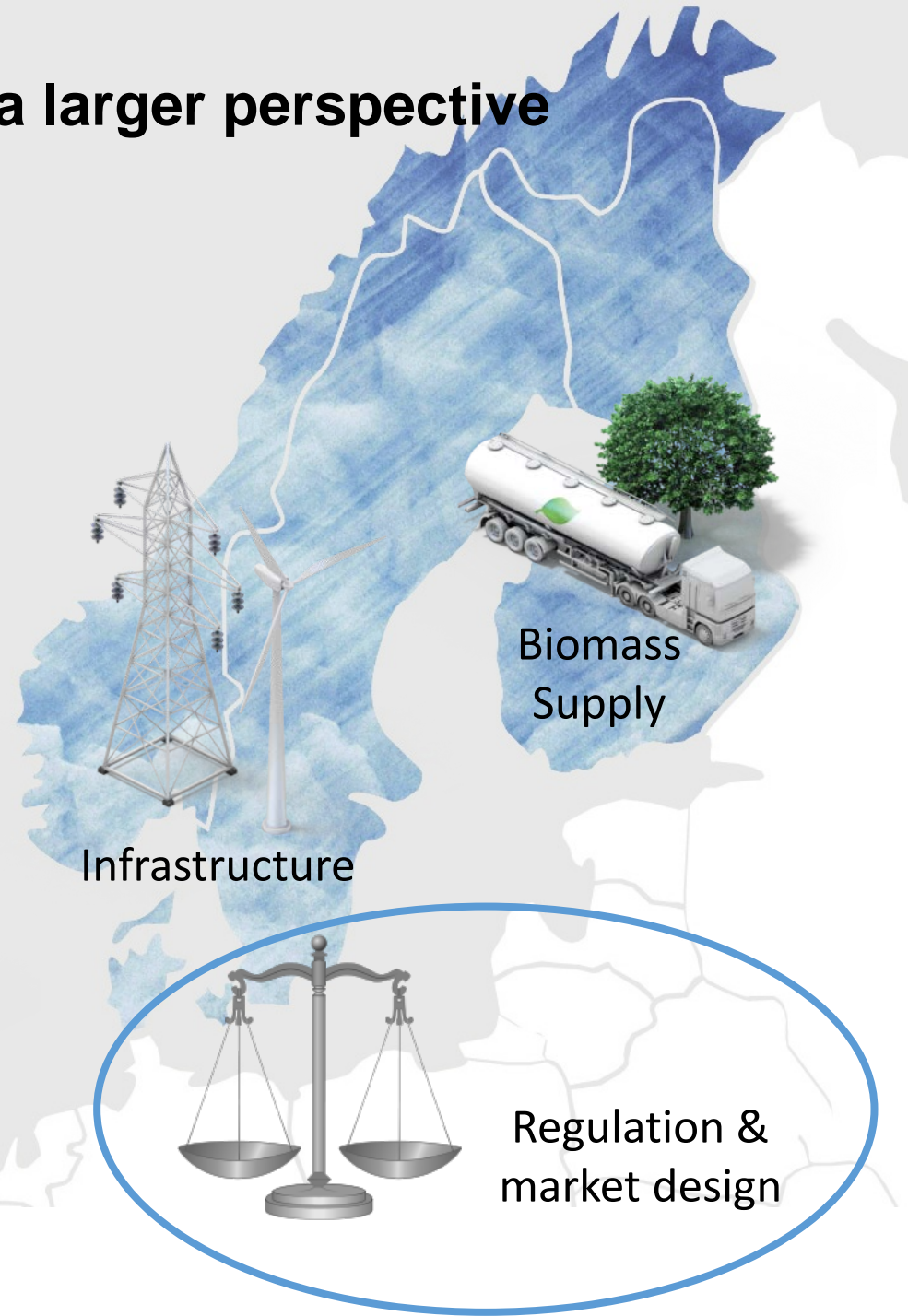
Energy system integration



Energy Efficiency



CCS



Infrastructure

Biomass Supply

Regulation & market design

Objectives



Flex4RES

The primary objective of Flex4RES is to

Identify and assess regulatory and technical pathways towards coherent Nordic energy systems

The secondary objectives are to:

- a) **Estimate the potentials and costs of flexibility** in the Nordic power market created by the coupling of and increased interaction between different energy markets (electricity, heat, gas and transportation).
Estimate the need for flexibility in the future Nordic power market.
- a) **Identify regulatory and technological barriers.**
- b) **Develop coherent regulatory frameworks and market designs** that facilitate energy market couplings that are optimal for the Nordic conditions in an EU context.
- a) **Adapt a high-resolution Nordic energy market model** covering heat, power and transport for quantification of the impacts of different market couplings, regulatory frameworks and market designs.
Estimate the cost and benefits of a coherent energy system framework.

Work Packages



Flex4RES

WP1: Flexibility need and potentials

Task 1.1 Review and Method development

Task 1.2 Flexibility potential cost curves, Technology catalogue

Task 1.3 Flexibility need, uncertainty and impact on reserve need

WP2: Framework conditions

Task 2.1 Review of existing framework conditions

Task 2.2 The Nordic energy system designs

Task 2.3 Market integration, frameworks, and market designs

Task 2.4 Coherent market scenario set-ups

Task 2.5 Pathways to a flexible Nordic energy system

WP3: Energy system analysis of integrating energy systems

Task 3.1 Model update / adaption

Task 3.2 Market coupling analyses

Task 3.3 Analytical results: comparison and interpretation

WP 4: Policy recommendations

Task 4.1 Economic impact of VRE and flexibility

Task 4.2 Creating a sustainable and stable Nordic energy System

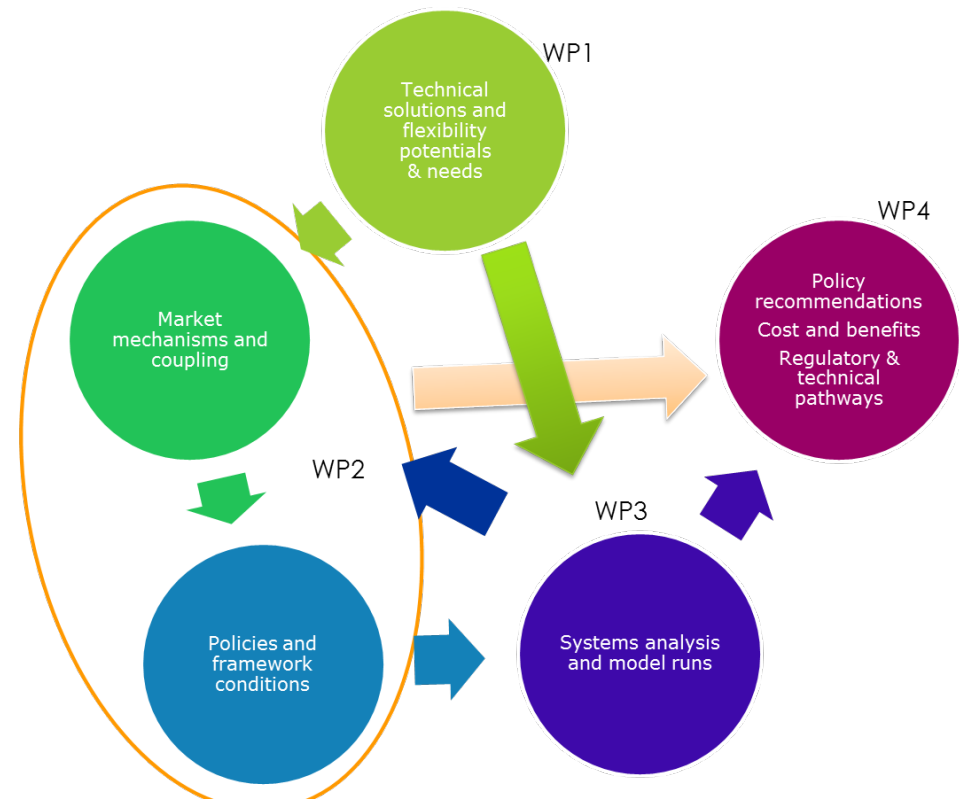
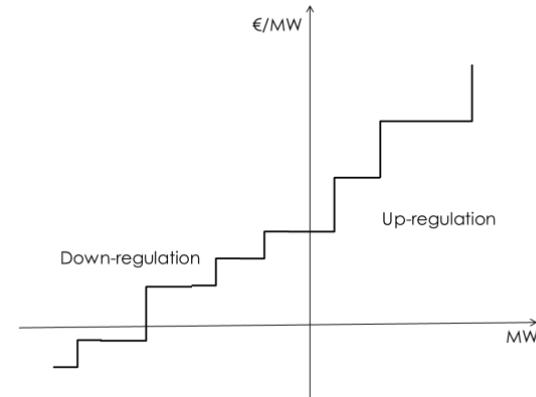
WP 5: Dissemination and capacity building

Task 5.1 Website, LinkedIn, and Newsletter

Task 5.2 Advisory board meetings

Task 5.3 Workshops/Seminars

Flexibility potentials



Gantt chart



Flex4RES

3,5 years - September 2015 - March 2019

| WORK PACKAGES AND TASKS | Lead | Start month (beg. of) | End month (end of) | |
|--|----------------|--------------------------|-----------------------|------------|
| | | | | 0 12 24 36 |
| WP1 Flexibility need and potentials | KTH | | | |
| Task 1.1: Review and Method development | KTH | 1 | 10 | |
| Task 1.2: Flexibility potential cost curves & Technology catalogue | RTU | 1 | 18 | |
| Task 1.3: Flexibility need, uncertainty and impact on reserve need | DTU Wind | 3 | 12 | |
| Task 1.4: From technical to realisable potentials | DTU MAN | 10 | 22 | |
| WP2 Framework conditions | DTU MAN | | | |
| Task 2.1: Review of existing framework conditions | RTU | 1 | 12 | |
| Task 2.2: Barriers for an intensified coupling | KTH | 7 | 20 | |
| Task 2.3: Market integration, frameworks, and market designs | DTU MAN | 12 | 33 | |
| Task 2.4: Coherent Market Scenario Set-Ups | NMBU | 19 | 30 | |
| Task 2.5: Pathways to a Flexible Nordic Energy System | Aalto | 28 | 38 | |
| WP3 Energy System Analysis of integrating energy systems | NMBU | | | |
| Task 3.1: Model update / adaption | NMBU | 1 | 32 | |
| Task 3.2: Market Coupling Analyses | DTU MAN | 10 | 38 | |
| Task 3.3: Analytical Results: Comparison and Interpretation | KTH | 6 | 40 | |
| WP4 Policy recommendations | Aalto | | | |
| Task 4.1: Potentials of and Barrier for VRE and Flexibility | | 14 | 20 | |
| Task 4.2: Economic Impact of VRE and Flexibility | | 34 | 42 | |
| Task 4.3: Creating a Sustainable and Stable Nordic Energy System | | 36 | 42 | |
| WP5 Dissemination and capacity building | DTU | | | |
| Task 5.1: Website, LinkedIn, and Newsletter | | 1 | 42 | |
| Task 5.2: Advisory board meetings | | 6 | 40 | |
| Task 5.3: Workshops/Seminars | | 9 | 42 | |

Status 29/3 -2015



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WP1: Case: District heating

- **Initial district heating data:** Obtained from S, SF, Dk, Ee, Lt, Li
- **Initial Technology report = available reports:** Obtained from S, Ee, Dk
- **Initial Flexibility potentials = estimated levels in available reports:** Obtained from S, Should be delivered, end of March-16

This work will be finished within a month.

WP2:

- Survey of District heating frameworks in Nordics + Baltic
Comparative study of the surveys will be finished within the next 2 weeks
Report for DH finished within a month
- 3 abstracts + 1 paper have been submitted to conferences

WP3:

- PhD course - Balmorel model
- Model versions at NMBU, DTU and RamLØSE is currently being harmonized (completed by mid April)
Prepared implementation of version control (training session for all WP-participants to be organized April 1st)
- Next steps (Q2-16)
 - Add new and better data for Baltic region (April/May)
 - Add new and better heat market data
 - Conduct test model runs for discussion with other WPs

WP5 - dissemination

- several abstracts and 1 conference papers have been submitted from WP2
- Newsletter no 2 is planned to mid April.
- LinkedIn page
- Web site - ??????



Thumbs up for Balmorel
*12 PhD students giving the Balmorel
model in Flex4RES top score!*

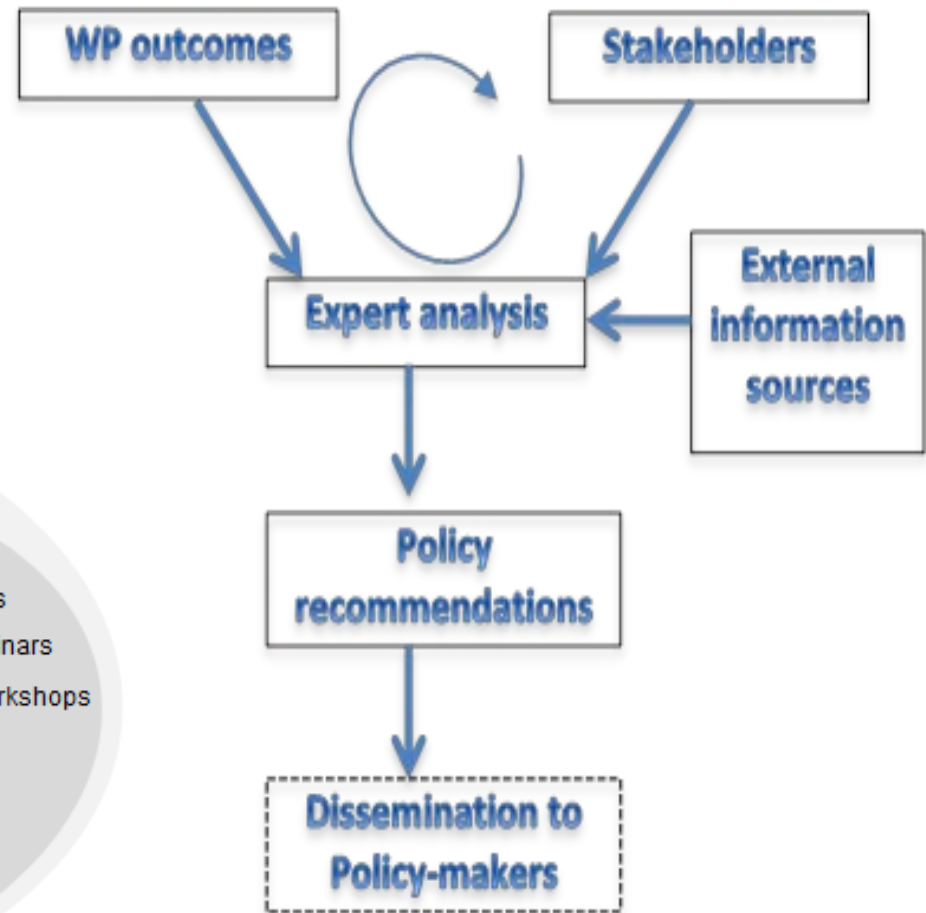
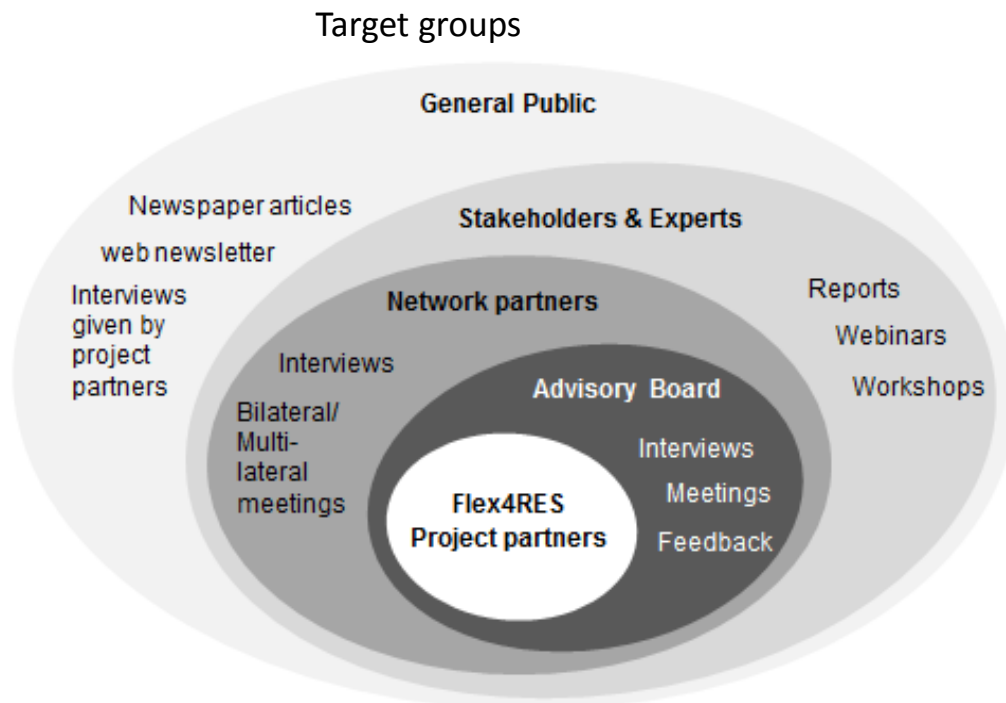


Kick-off at DTU in November

Stakeholder involvement & Dissemination



Science-policy approach involving key Nordic stakeholders





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Flex4RES newsletter #1, January 2016

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Flex4RES

Flexible Nordic Energy Systems

The flagship project Flex4RES has set sail

Dear Klaus Skytte,

Welcome to this first newsletter from the Flex4RES project.

The Flex4RES project investigates how an intensified interaction between coupled energy markets, supported by coherent regulatory frameworks, can facilitate the integration of variable renewable energy (VRE). This may in turn ensure stable, sustainable and cost-efficient Nordic energy systems.

There is a comparative advantage of combining different energy markets, both with respect to flexibility, but also with respect to synergy and economics.

Research partners



Flex4RES

| Organisation / Institution | Country |
|---|---------|
| DTU, Management Engineering, Systems Analysis | Denmark |
| NMBU, Institutt for Naturforvaltning | Norway |
| KTH, Electric Power Systems | Sweden |
| Aalto U, Applied Physics/New energy techn. | Finland |
| Riga Technical U, Energy Systems & Env | Latvia |
| DTU, Wind Energy | Denmark |
| RAM-løse edb, Hans Ravn / Balmorel.com | Denmark |
| NIFU | Norway |
| Stockholm School of Economics | Sweden |
| Tallinn University of Technology | Estonia |



Advisory board- confirmed partners



Flex4RES

| Organisation | Country |
|--|---------|
| NEPP/Energiforsk | SE |
| Statkraft | N |
| Statnett | N |
| Danish Energy Association | DK |
| DONG Energy | DK |
| Energinet.dk | DK |
| Energistyrelsen | DK |
| Dansk Fjernvarme, District Heating Ass | DK |
| Enova | N |
| AGORA Energiewende | D |
| Energimyndigheten, Swedish Energy Agency | SE |
| Cleen Ltd | FIN |
| Elering, TSO | EE |
| GASUM | FIN |

Thank you for your interest



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Questions ?



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www.Flex4RES.org