

The logo for 're INVEST' features the word 're' in white lowercase letters on a dark blue square background. To the left of this square is a vertical green bar. Below the dark blue square are two horizontal bars: a brown one on the left and a yellow-green one on the right. To the right of the square, the word 'INVEST' is written in large, dark blue, uppercase letters.

# re INVEST

## **Kick-off meeting**

Tuesday 13 June, 2017

Location: DONG Energy, Nesa Allé 1, 2820 Gentofte



Innovation Fund Denmark



## Programme

- Moderator **Poul Østergaard**, Professor Aalborg University
- 09:00 – 09.30 Arrival and coffee
- 09:30 – 09:35 **Frederik Dalgård Andersen**, Head of Group Regulatory Affairs, DONG  
Welcome to DONG Energy
- 09:35 – 10:15 **Brian Vad Mathiesen**, Professor, Aalborg University  
- Welcome and presentation round  
- Introduction to the RE-INVEST project  
- *WP0 - On Management, communication and timeline*
- 10:15 – 10:35 **Henrik Lund**, Professor, Aalborg University  
**Gorm Bruun Andresen**, Associate Professor, Aarhus University  
*WP1 - Ideas and output – Representation of the current 2015 European Energy systems*
- 10:35 – 10:55 **Poul Alberg Østergaard**, Professor, Aalborg University  
**Martin Greiner**, Professor, Aarhus University  
*WP2 – Ideas and output – A modelling platform for analysis of investment strategies*
- 10.55 – 11.20 Break – coffee/tee/snack



## Programme

- 11:20 – 11:40 **Brian Vad Mathiesen**, Professor, Aalborg University  
*WP3 – Ideas and output – Analysis of investment strategies for Danish 100 % renewable energy systems*
- 11:40 – 12:10 **Advisory Board's comments**
- 12:10 – 12:40 **Steen Schelle Jensen**, Head of Heat/Cooling solutions, Kamstrup  
Role in and expectations for RE-INVEST
- 12:40 – 13:00 **Brian Vad Mathiesen**, Professor, Aalborg University  
Wrap up
- 13:00 – 14:00 Lunch



# re INVEST



Innovation Fund Denmark



# We did it!

- From SEAL to RE-INVEST
- From November 20 2013 until October 7 2017
- Grant Agreement finished December 7 2017 – Thank you!

## SEAL – Smart Energy Alliance. Developing sustainable energy pathways for a Denmark in an international framework

Ansøgersnavn/Applicantname: Brian Vad Mathiesen

Indsendt/submitted: Monday, April 28, 2014 kl. 2:54 PM

Sent to [bvm@seal.aau.dk](mailto:bvm@seal.aau.dk)

Short Message - Decision regarding Grand Solutions application 2016 - Invitation

Dear Brian Vad Mathiesen,

Thank you for the Grand Solutions application:

*RE-Invest - Renewable Energy Investment Strategies – A two-dimensional interconnectedness approach – (6134-600224)*

Innovation Fund Denmark has evaluated the application and it is with great pleasure we can inform you that your project is invited to enter negotiations for investment agreement.

You will as soon as possible receive a formal invitation letter with further details on the decision and guide you through the process which hopefully will lead to the signing of the investment agreement.

Please keep this information confidential until the investment agreement is signed.

IFD will organise a workshop about the investment agreement on **Thursday 27th October 2016**, where two key persons from your project are invited. One of them should be an administrator. Please register as soon as possible via the following link:

<https://www.eventsite.com/e/inde-for-seal-grandsolution-projektet-tickets-2497210612>

Here you will find invitation and program:

[http://innovationsfonden.dk/sites/default/files/invitation\\_og\\_program\\_07102016\\_inv\\_05.pdf](http://innovationsfonden.dk/sites/default/files/invitation_og_program_07102016_inv_05.pdf)

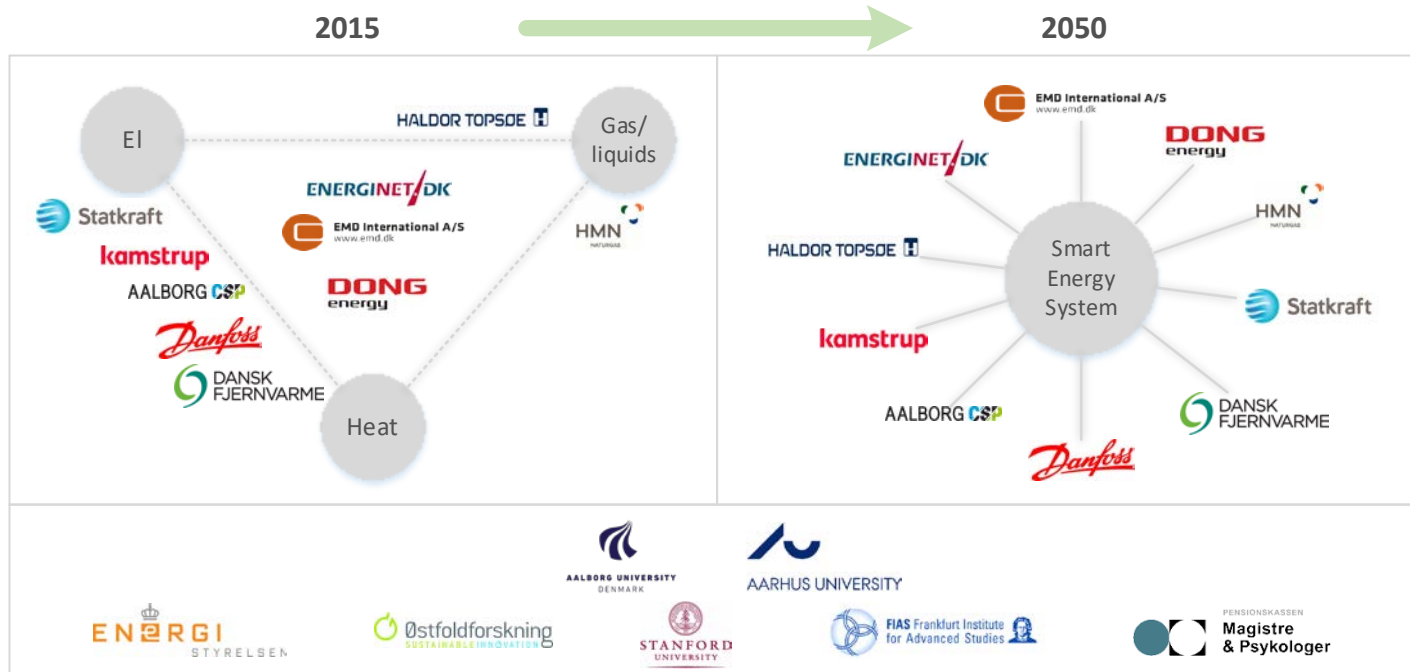
Your investment manager in this project: Sine Ebbesen

Sincerely,

**Tore Davodd**  
Executive Vice President



# We did it! In a partnership





# Advisory Board Members



Christian Kjær,  
Managing director



Peter Birch Sørensen,  
Professor



Confederation of Danish Industry

Troels Ranis,  
Director



Christian Ibsen,  
Director



UNITED FEDERATION OF DANISH WORKERS

Per Christensen,  
President



Michael H. Nielsen,  
Director



Thomas Damkjær  
Petersen, President



Jesper Høstgaard-Jensen,  
COO



Thea Larsen,  
CEO



# The Vision in RE-INVEST

**The vision of RE-Invest** is to overcome the described **silos-thinking** that characterizes traditional energy sectors, by using a **two dimensional interconnectivity approach** as well as existing and new energy infrastructures.

The aim of this is dual:

- 1) to further develop the Smart Energy System concept and *identify synergies* in low-cost storages across sectors on one side and international electricity and gas transmission on the other side
- 2) to *support expanding markets* in Denmark and Europe for Danish industries and enable the industrial partners in RE-Invest to be early adaptors of trends in integrated energy markets, thus having cutting edge R&D for key technologies in future sustainable energy systems for value creation.



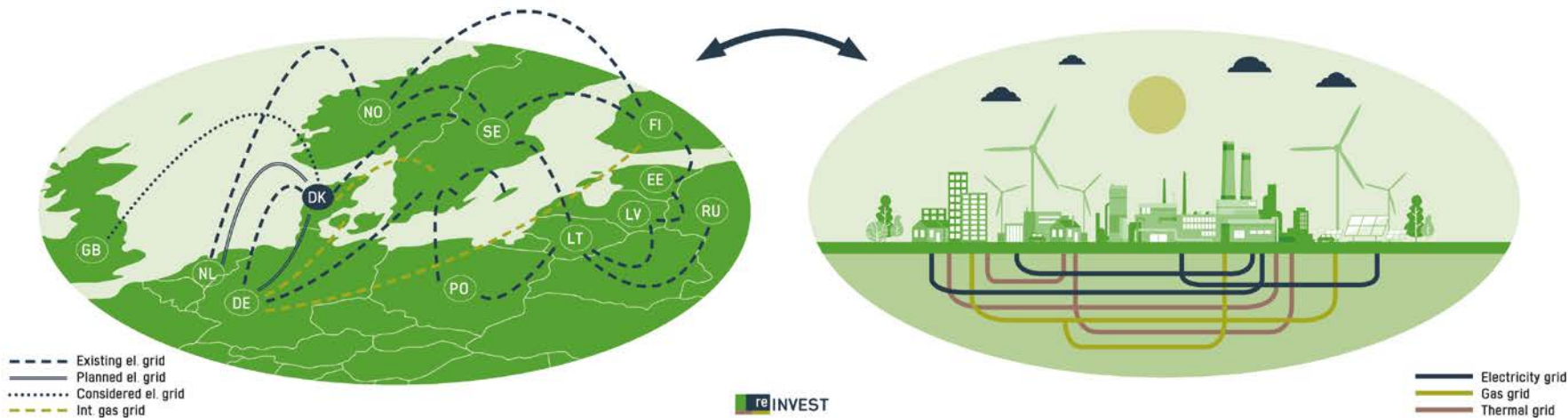


Strategic interest	Partner
1) Support robust, cost-effective decisions by societal stakeholders and avoid wrong investments	Danish Energy Agency, Energinet.dk
2) Identify the future role of key technologies and enable Danish industry to garner market shares globally estimated to increase to 2,000 billion dollars annually in 2030 by the IEA after the Paris COP21 agreement	Danfoss, Kamstrup, EMD, Aalborg CSP, Haldor Topsoe
3) Further develop technology R&D, enabling them to have cutting edge knowledge to stay in front of international competitors	Danfoss, Kamstrup, EMD, Aalborg CSP, Haldor Topsoe
4) Enable future profit for energy sector investors with knowledge on feasible and uncertain investments, respectively, in an international context	MP Pension, HMN Natural Gas, Energinet.dk, Statkraft, DONG Energy, The Danish District Heating Association
5) Further develop Danish research competences on the integrated Smart Energy System approach in an international context	Aalborg University and Aarhus University as well as Østfold Research, Stanford and FIAS



# Why the two-dimensional approach?

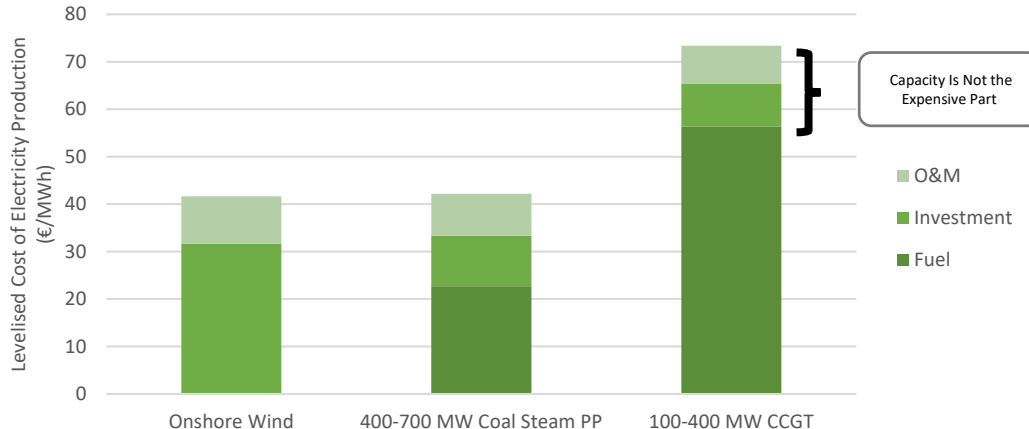
TWO-DIMENSIONAL APPROACH





Energy System Challenges and opportunities	Questions and strategic decisions
<ul style="list-style-type: none"> <li>- Lower and lower Renewable Energy investment costs (Electricity especially)</li> <li>- Batteries are falling in price</li> <li>- Electricity prices are falling (sign of system design failure) and cannot merit investments in new capacity</li> <li>- Power plants for back-up is closing down (lower operation hours)</li> </ul>	<ul style="list-style-type: none"> <li>- How should we use and balance (energy storage) more electricity from renewable energy?</li> <li>- How should we re-design the energy system and how much renewable energy is needed?</li> </ul>

Wind power is cheap



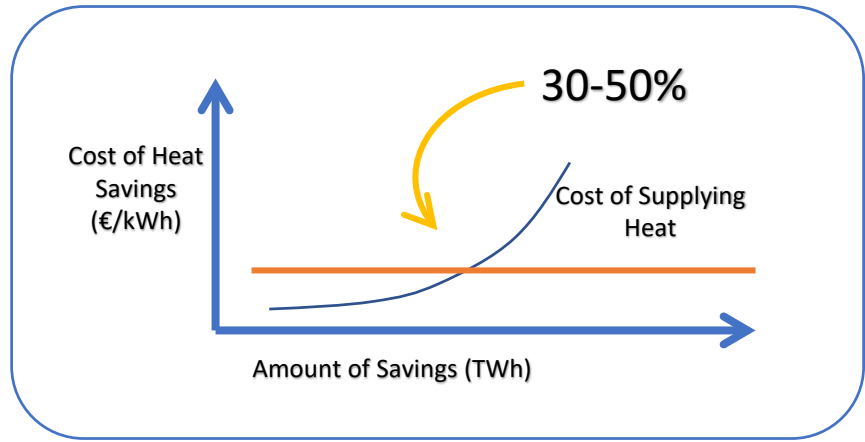
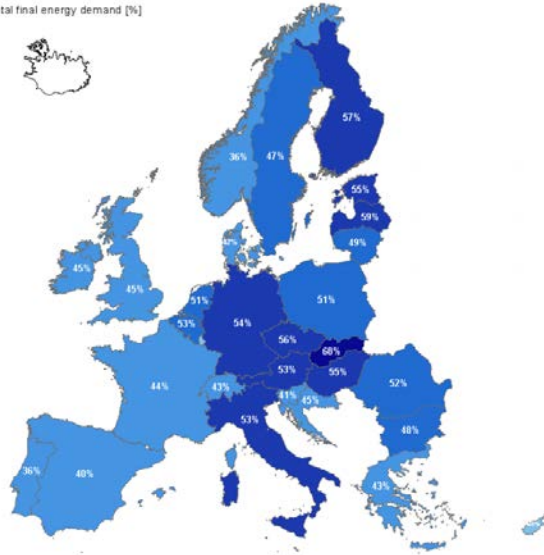
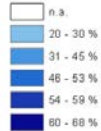


Energy System Challenges and opportunities	Questions and strategic decisions
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- Electricity demands the smallest of the demands
- Both transport & heating/cooling demands larger
- Electricity grids are much more expensive than thermal grids/gas grids (pr. capacity)
- Energy storages have different costs in different sectors and different scales

- What are the role of the grids in the future
- How can energy storage be used across sectors to transform all demands to renewable energy cost-effectively?
- How important are energy savings in the future and what is the balance between electricity or heat savings compared to renewable energy?

Share of H/C energy demand on total final energy demand [%]



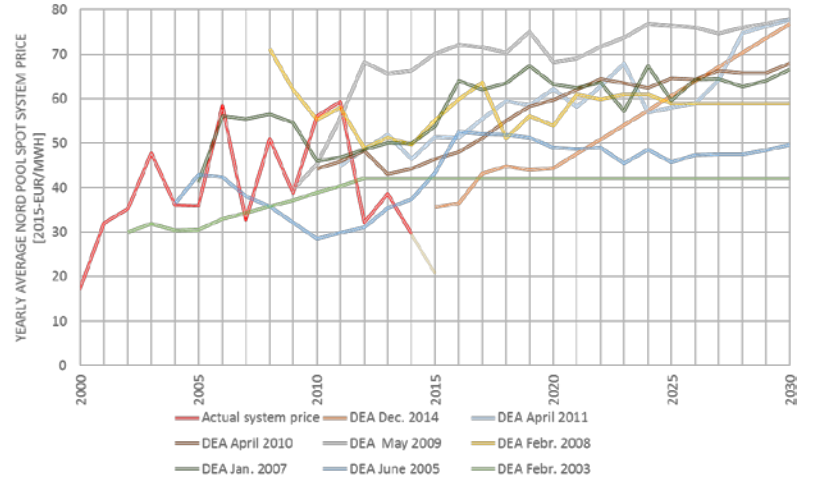
Source: Mapping and analyses of the current and future heating-cooling fuel deployment, DG Energy, 2016



**Energy System Challenges and opportunities**      **Questions and strategic decisions**

- Bio-refinery technology is developing rapidly but bioenergy is a limited resource and can have adverse effects outside the energy sector
- Transport sector technologies are emerging fast
- New technologies may develop
- The international energy context is uncertain

- What technologies are key for the transport sector?
- What is the role of bioenergy in future energy systems?
- How can key Danish strength help on an international level and what investments are robust in an uncertain future?

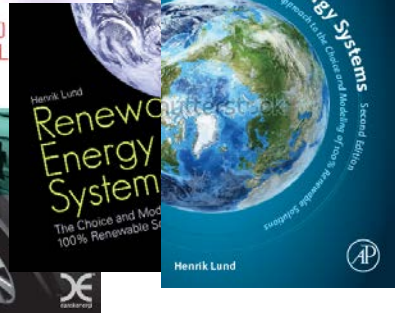
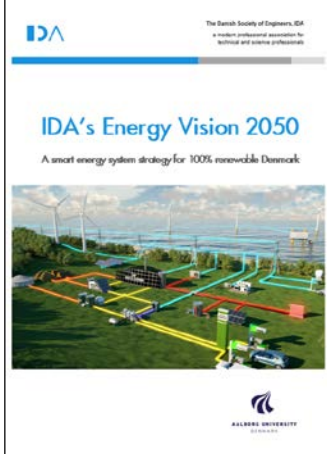
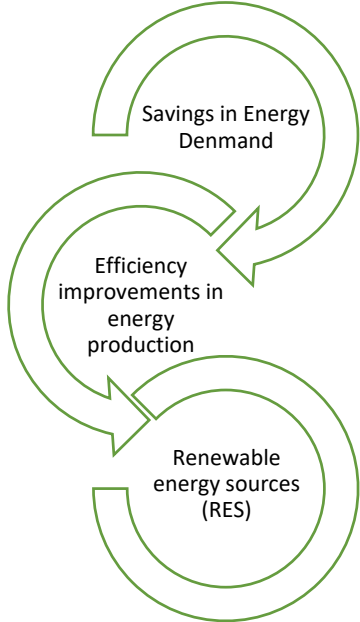




Energy System Challenges and opportunities	Questions and strategic decisions
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# STATE-OF-THE-ART-KNOWLEDGE ON 100% RENEWABLE ENERGY IN 2050





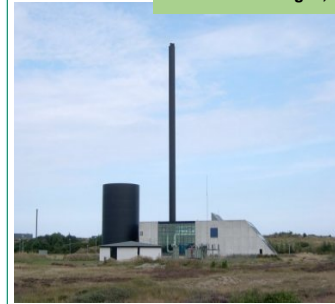
**Pump Hydro Storage**  
175 €/kWh

(Source: Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits. Electric Power Research Institute, 2010)

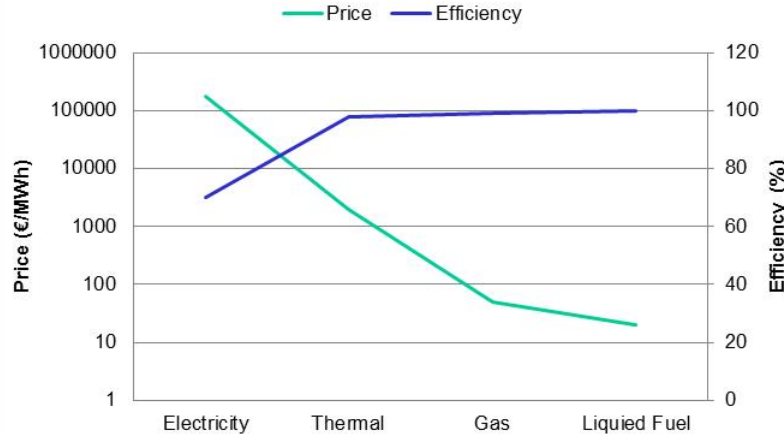


**Thermal Storage**  
1-4 €/kWh

(Source: Danish Technology Catalogue, 2012)



**Energy storage: Price and Efficiency**



**Oil Tank**  
0.02 €/kWh

(Source: Dahl KH, Oil tanking Copenhagen A/S, 2013: Oil Storage Tank. 2013)



**Natural Gas Underground Storage**  
0.05 €/kWh

(Source: Current State Of and Issues Concerning Underground Natural Gas Storage. Federal Energy Regulatory Commission, 2004)







# Smart Energy Systems





# Project structure





# Work packages in RE-INVEST

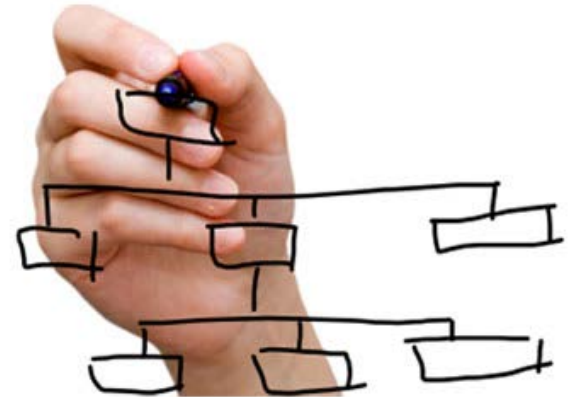


- WP0: Management & Communication
  - Brian Vad Mathiesen (AAU) and Poul Alberg Østergard (AAU)
- WP1: Tool development and calibration for advanced energy system analyses
  - Henrik Lund (AAU) and Gorm Andreasen (AU)
- WP2: Establishment of modelling-platforms for analyses of Denmark – a wind power, PV, biomass, nuclear or fossil based Europe
  - Poul Alberg Østergaard (AAU) and Martin Greiner (AU)
- WP3: Analyses of Smart Energy System Denmark 2050 in a volatile European context and robust synergistic investment strategies for technologies, infrastructures and storage systems
  - NN Post doc and Jakob Zinck Thellufsen



# Organisation and management

- Organisation:
  - WP0: the Management and Communications Work-Package (described in Exhibit 1)
  - Three scientific work packages WP1-WP3 (described in Exhibit 1)
- Project Management:
  - A Steering Committee with 14 members (overall responsibility)
  - A Head and a Deputy Head of the project (WP0)
  - Management Board which includes WP-leaders
- An Advisory Board





# WPO

		2017			2018			2019			2020		
		2	3	4	1	2	3	4	1	2	3	4	1
<b>WPO</b>	<b>Management &amp; Communication</b>												
0.1	Project management, coordination, and project resources												
0.2	Project webpage, online dissemination and promotional material												
0.3	Annual conferences and organisation of thematic workshops												
0.4	Dissemination in conferences												
	<b>Milestone/Deliverable</b>												
M-0.1	Plan for the dissemination and communication activities in the project in collaboration with all partners	M											
D-0.1	<i>Establish project homepage, newsletter facility, project logo and twitter account</i>	D											
D-0.2	<i>Promotional material to promote the project activities</i>	D											
D-0.3	<i>Detailed up-dated project plan (initiation of annual work program plan)</i>	D											
M-0.2	List of external stakeholders and experts (national and international) for thematic workshops and dissemination	M											
D-0.4	<i>Plan for thematic workshops</i>	D											
M-0.3	Review of how existing international projects, databases and energy models can contribute to RE-Invest	M											
D-0.5	<i>Data management plan</i>		D										



# Current focuses

- Staff and recruitment
  - AAU 3 postdocs (2 years) + 1 PhD
  - AU 2 postdocs + 1 Phd
  - Partner contributions (e.g. postdoc at FIAS)
- Bilateral meetings with all partners
- Planning and dissemination activities
  - Upgrade homepages and newsletter
- Preparation of conference (12-13 September 2017)
- Alignment of staff with key partners
  - Kamstrup, Danfoss, EMD, Energinet.dk, DONG Energy, HMN Naturgas, Statkraft





# re INVEST



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