




# Challenges in pathways towards a 100% renewable energy system

Thursday 20 June 2019, 14.00-15.30, Charlemagne, Jenkins, Rue de la Loi 170, 1000 Brussels, Belgium

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# Welcome and Programme

## Keynotes

- Modelling Understanding the technologies and policies for deep decarbonisation in Europe and integrated modelling of the pathways – Paul Ekins, University College London
- Modelling 100% Renewable Energy, Highlighting some sector coupling effects – Christian Breyer, LUT University


## Pitches

- RE-INVEST project: Exploiting sector synergies and countries interconnections to decarbonise the energy systems – Marta Victoria, Aarhus University
- The role of energy mapping in modelling – Bernd Möller, Europa-Universität Flensburg
- Presentation of the online tools and decarbonisation pathways for INNPATHS – Paul Ekins, University College London

## Discussions

- Hans Van Steen, DG-ENER, European Commission,
- Panel discussion: Brian Vad Mathiesen, Paul Ekins, Christian Breyer and Hans Van Steen
- Q&A session moderated by Jakob Zinck Thellufsen







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Challenges in pathways towards a 100% renewable energy system

# Modelling Smart Energy Systems and the supply chain effects of Energy efficiency in RE-INVEST and sEEnergies

Brian Vad Mathiesen  
Aalborg University, Denmark



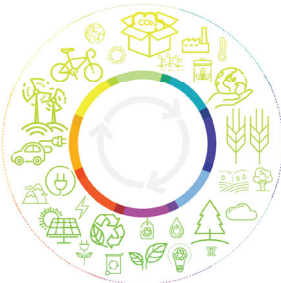
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# New scenarios: Target of net zero emissions in Europe?

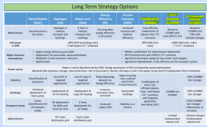
IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION  
COMMUNICATION COM(2018) 773

A Clean Planet for all  
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Positives

- A large variety of scenarios
- Two net zero emission scenario
- More details within buildings and industry



Scenario problems

- Very high ambition in all scenarios with regards to energy efficiency in buildings
- No district heating implemented
- Politically driven scenarios for gas
- Large critical excess electricity
- Claim to make "optimal systems"

Tool problems

- 5 year time steps
- partial equilibrium modelling system that simulates an energy market
- Investment optimization (with limits e.g. wind and nuclear)
- No clear distinction between private/business economy and socio-economy.

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**Constrained equilibrium 5 year plank by plank from today does not:**

- Current investments has an effect on the future possible investments
- Radical technological change NOT possible (has to be independent of current market and system design)
- Identify synergies across sectors
- Ensure a cost-effective energy system design in 2050



**Renewable energy system modelling needs:**

- Ability to look into the hour for the electricity system
- Ability to understand the temporal differences between heat/electricity demands and heat/electricity supply (capacities)
- Ability to analyse the use of waste heat and heat storages (and other storages)
- Explore and identify synergies across sectors (e.g. CHP, heat pumps, electrolyses)




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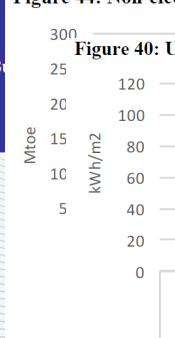
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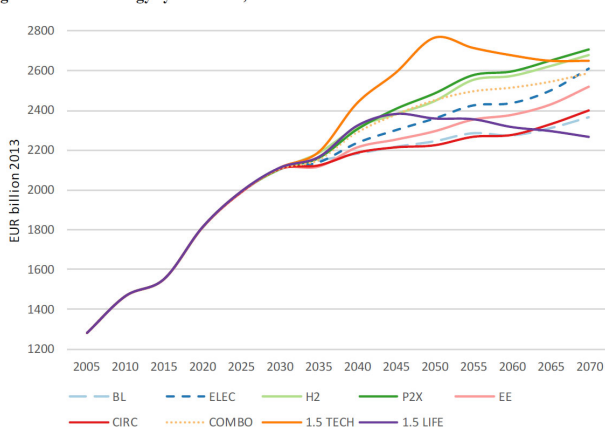


# Buildings in the Energy Union in 2050

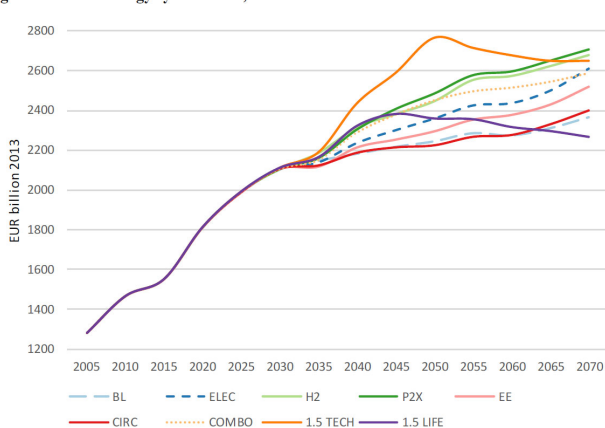
**Figure 44: Non-elec**



**Figure 40: Us**



**Figure 97: Total energy system costs, 2005-2070**



Source: PRIMES.

**Highlights**

- Gas for heating dominates
- Stagnating district heating
- High ambition on EE in buildings due to tool)
- Higher costs than today


	TWh	Total heat demand	Heat demand heat pumps	Total electricity demand
Baseline	2207,1	863,1	1537,3	
COMBO	1789,1	883,7	1271,4	
1,5 TECH	1620,7	806,2	1127,7	
1,5 LIFE	1488,2	712,3	1101,7	

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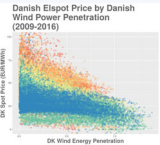
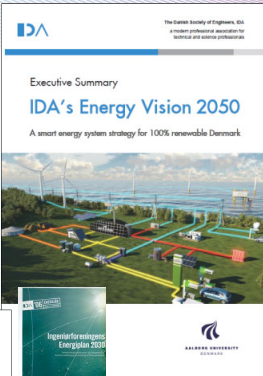
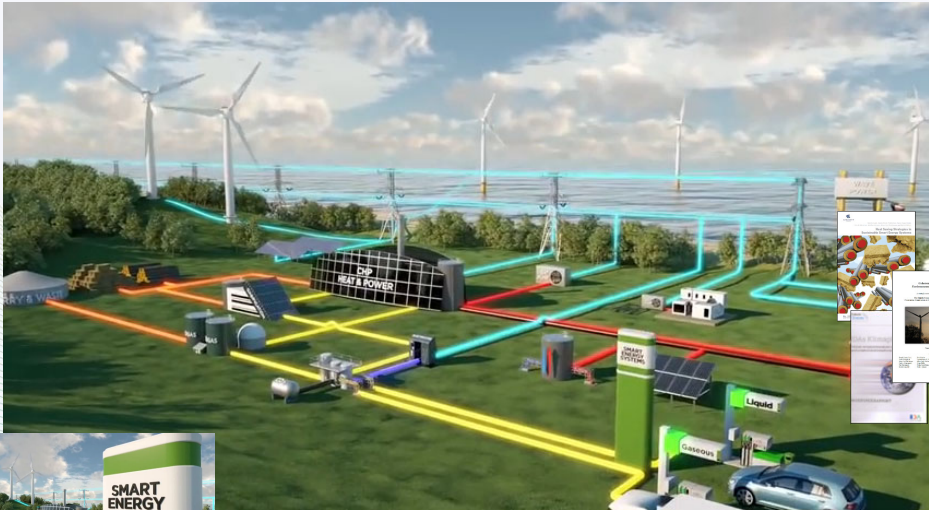
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# Smart Energy Systems

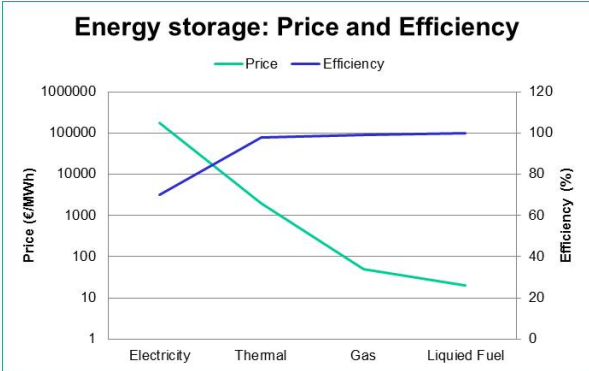


**Download rapport:**  
[www.EnergyPLAN.eu/IDA](http://www.EnergyPLAN.eu/IDA)





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## Energy storage: Price and Efficiency



Storage Type	Price (€/kWh)	Efficiency (%)
Pump Hydro Storage	175	~80
Thermal Storage	1-4	~100
Oil Tank	0.02	~100
Natural Gas Underground Storage	0.05	~100



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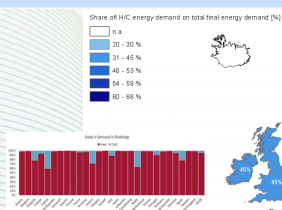


### Energy System Challenges and opportunities

- 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

### Questions and strategic decisions

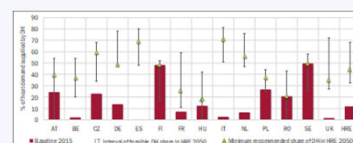
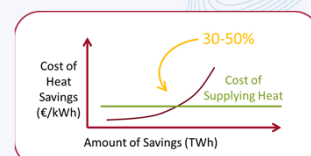
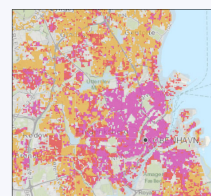
- What are the role of the grids in the future
- How can energy storage be used across sectors to transform all demands to renewable energy cost-effectively?
- How important are energy savings in the future and what is the balance between electricity or heat savings compared to renewable energy?



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



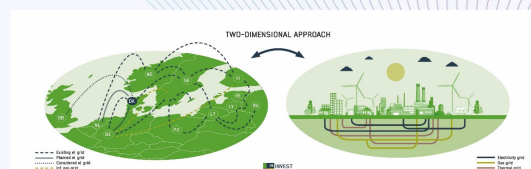
www.heatroadmap.eu  
@HeatRoadmapEU



France: total energy system costs (M€ year)		Residential sector space heating savings (additional to a 30% reduction already in the baseline)					
	0%	10%	20%	30%	40%	50%	60%
100	175032	175032	175032	175032	175032	175032	175032
200	175032	175032	175032	175032	175032	175032	175032
300	175032	175032	175032	175032	175032	175032	175032
400	175032	175032	175032	175032	175032	175032	175032
500	175032	175032	175032	175032	175032	175032	175032
600	175032	175032	175032	175032	175032	175032	175032
700	175032	175032	175032	175032	175032	175032	175032
800	175032	175032	175032	175032	175032	175032	175032
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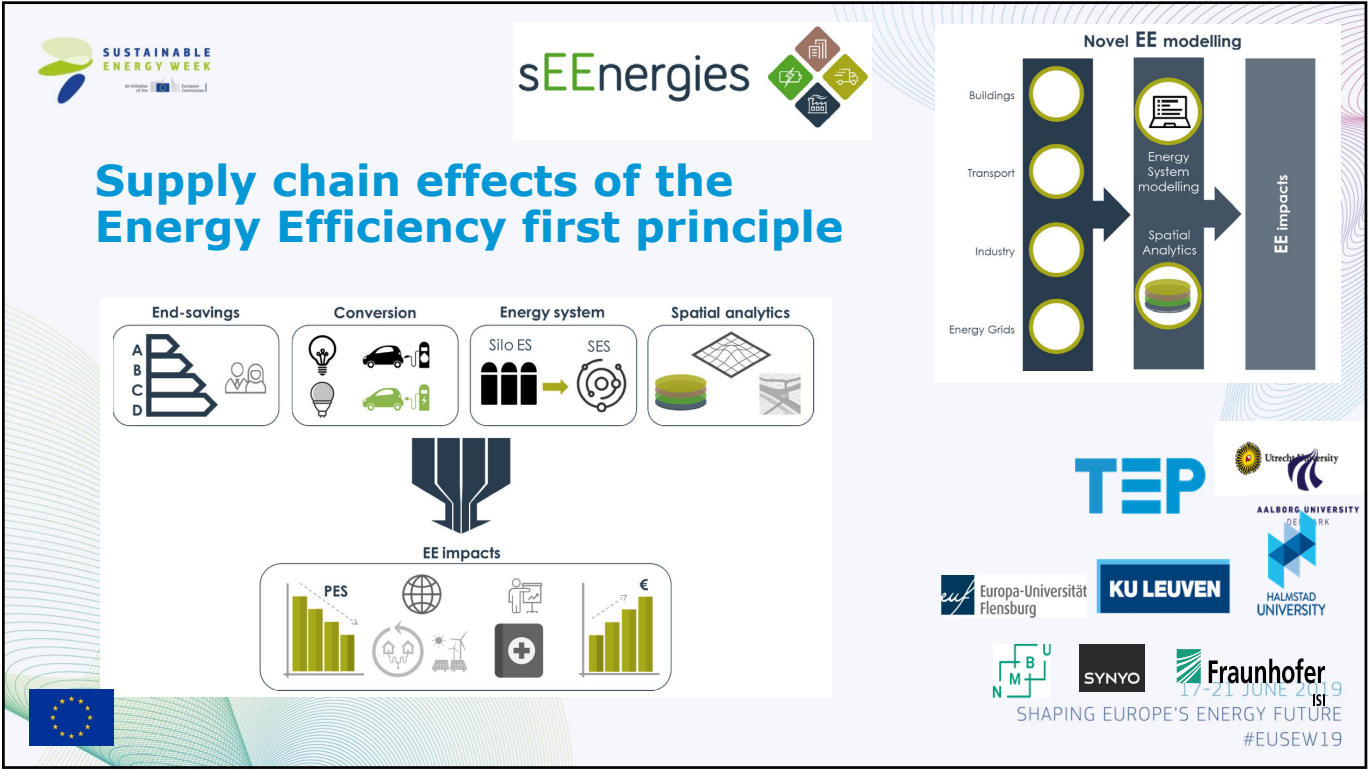
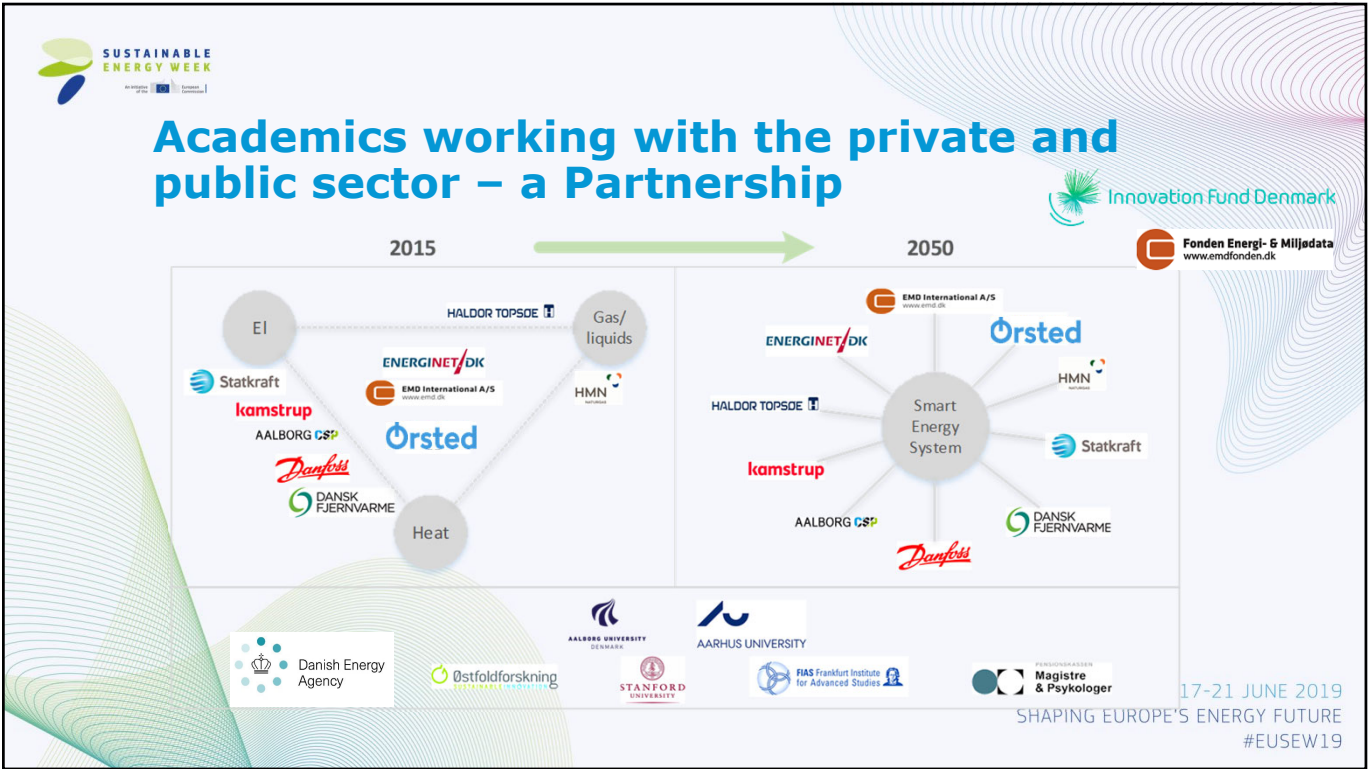
## reINVEST



- Robust and cost-effective investment strategies that will facilitate an efficient transformation towards a sustainable energy system
- The overall aim of RE-Invest is to better understand the next feasible investments necessary to move towards a low-carbon sustainable energy future as well as to support and retain international market potentials by positioning Danish energy stakeholders
  - that results from RE-Invest help non-university partners shape their individual goals for technologies or investments and strategic decision-making
  - that research competence of the university partners is strengthened to stay at a global forefront within modelling and design of future renewable energy systems
  - that results attract the attention of decision-makers and ultimately may help in the shaping of the future energy sector

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**reINVEST**

WWW.REINVESTPROJECT.EU



Energy System Analyse Model

WWW.ENERGYPLAN.EU



**4DH**

4th Generation District Heating Technologies and Systems

WWW.4DH.DK



**HEAT ROADMAP EUROPE 2050**

WWW.HEATROADMAP.EU



**sEnergies**

HOMEPAGE COMING

<https://WWW.ENERGYPLAN.EU/SMARTENERGYSYSTEMS/>



**SMART ENERGY SYSTEMS**



Smart Energy Europe: The technical and economic impact of one potential 100% renewable energy scenario for the European Union

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