Heat Roadmap Europe
2050

Heat Roadmap Europe 2050

Presented by:
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Korea, July 2013

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Heat Roadmap Europe 2050

STUDY FOR THE EU27

by

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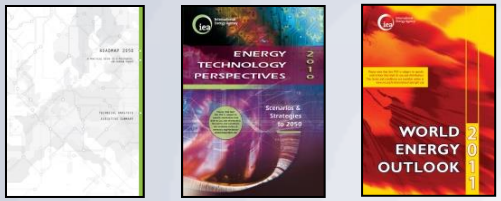
Why Heat Roadmap Europe?

- Exis
  - R heating and cooling
  - Have a too lly DHC
  - Acknowled 2030/2050, but
  - Assume high shares of electric heating, low heat
    y 2050

General Consensus:
"Combined heat & power (CHP) and district heating (DH) are important"

. . . but fail to quantify to which extent these options can be used in the future energy system . . .

The European Commission in the Energy Roadmap 2050 communication:
"An analysis of more ambitious energy efficiency measures and cost-optimal policy is required. Energy efficiency has to follow its economic potential. This includes questions on to what extent urban and spatial planning can contribute to saving energy in the medium and long term; how to find the cost-optimal policy choice between insulating buildings to use less heating and cooling and systematically using the waste heat of electricity generation in combined heat and power plants."



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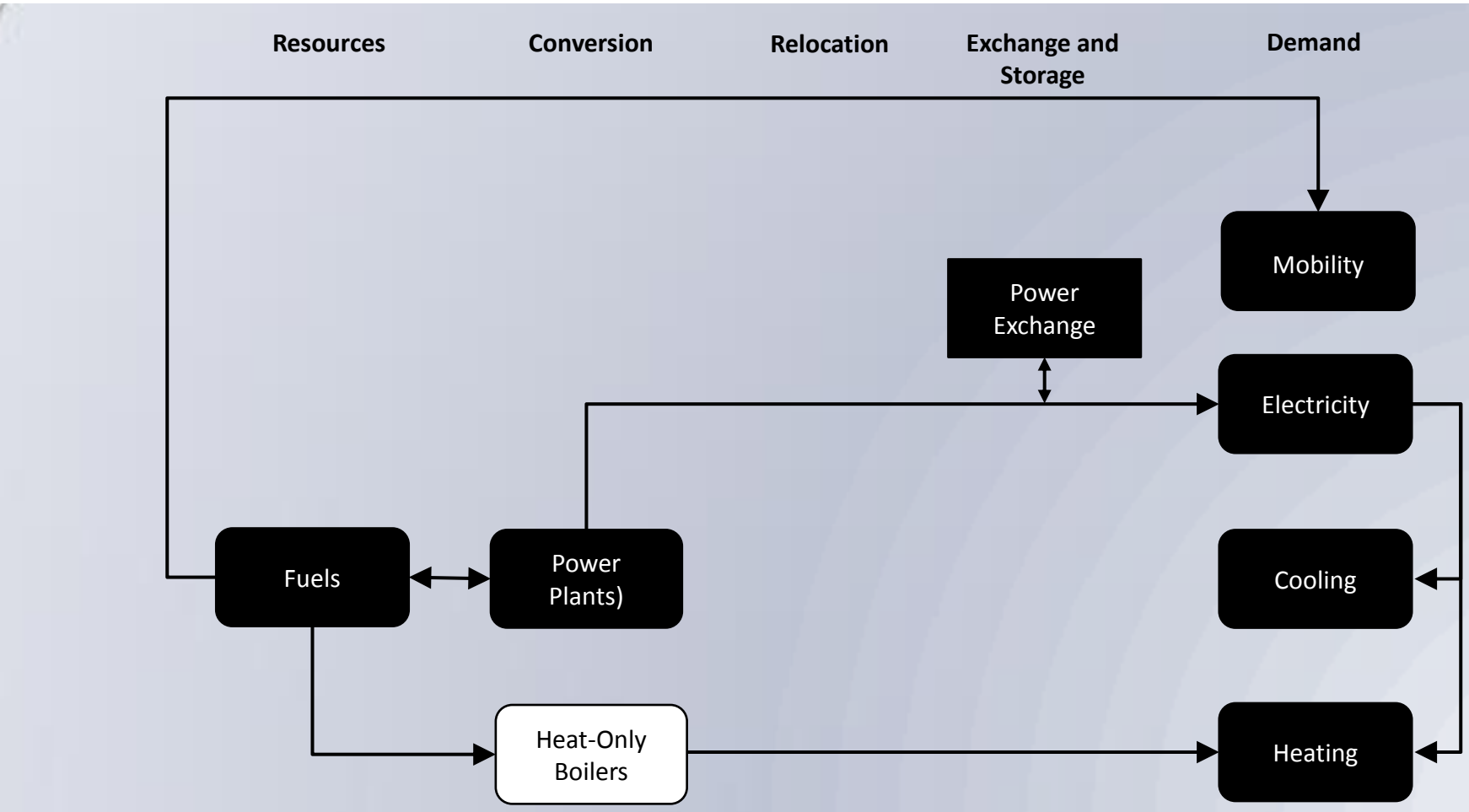
Energy System 0.0



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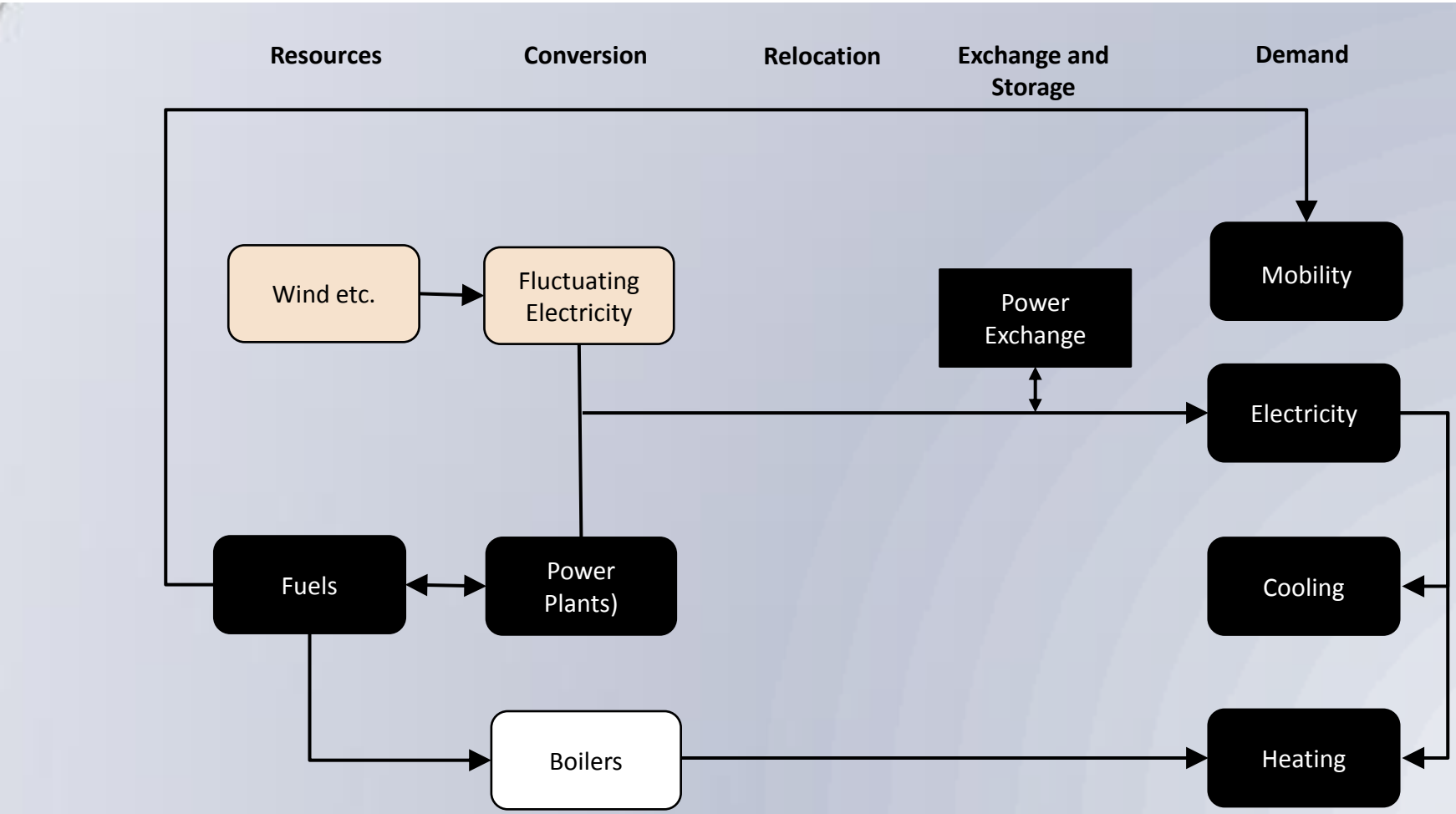
Introducing Intermittent RE



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Electricity Storage

- Turlough Hill, Ireland
- Pumped Hydro Facility

- 2,300,000 m^3 of water
- Storage Capacity of 1.8 GWh
- Site area:
  - ~1.5 km x 750 m
  - 1,125,000 m^2

- Restricted to specific sites
- Investment ~170 €/kWh

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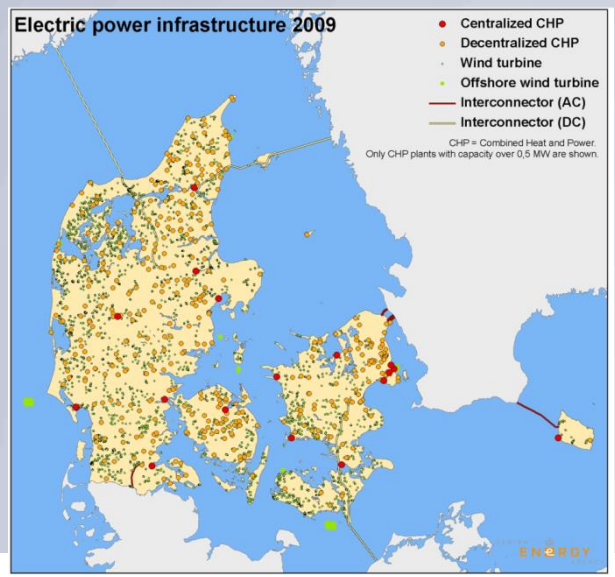
Thermal Storage

- 28,500 m^3 tank
  - ~2 GWh
    - Assuming a height of 15 m
    - Area ~1900 m^2
    - Diameter ~50 m
    - Investment ~€3/kWh
- 75,000 m^3 pit storage
  - ~5.25 GWh
    - Investment ~€0.5/kWh
- Requires a tank or pit of water



Flexibility using Electricity or Heat?

Electricity (2 GWh)

- Requires 1,125,000 m^2
- Restricted to specific sites
- Investment ~170 €/kWh

Thermal (2 GWh)

- Requires 2000 m^2
- Requires a tank or pit of water
- Investment ~3 €/kWh

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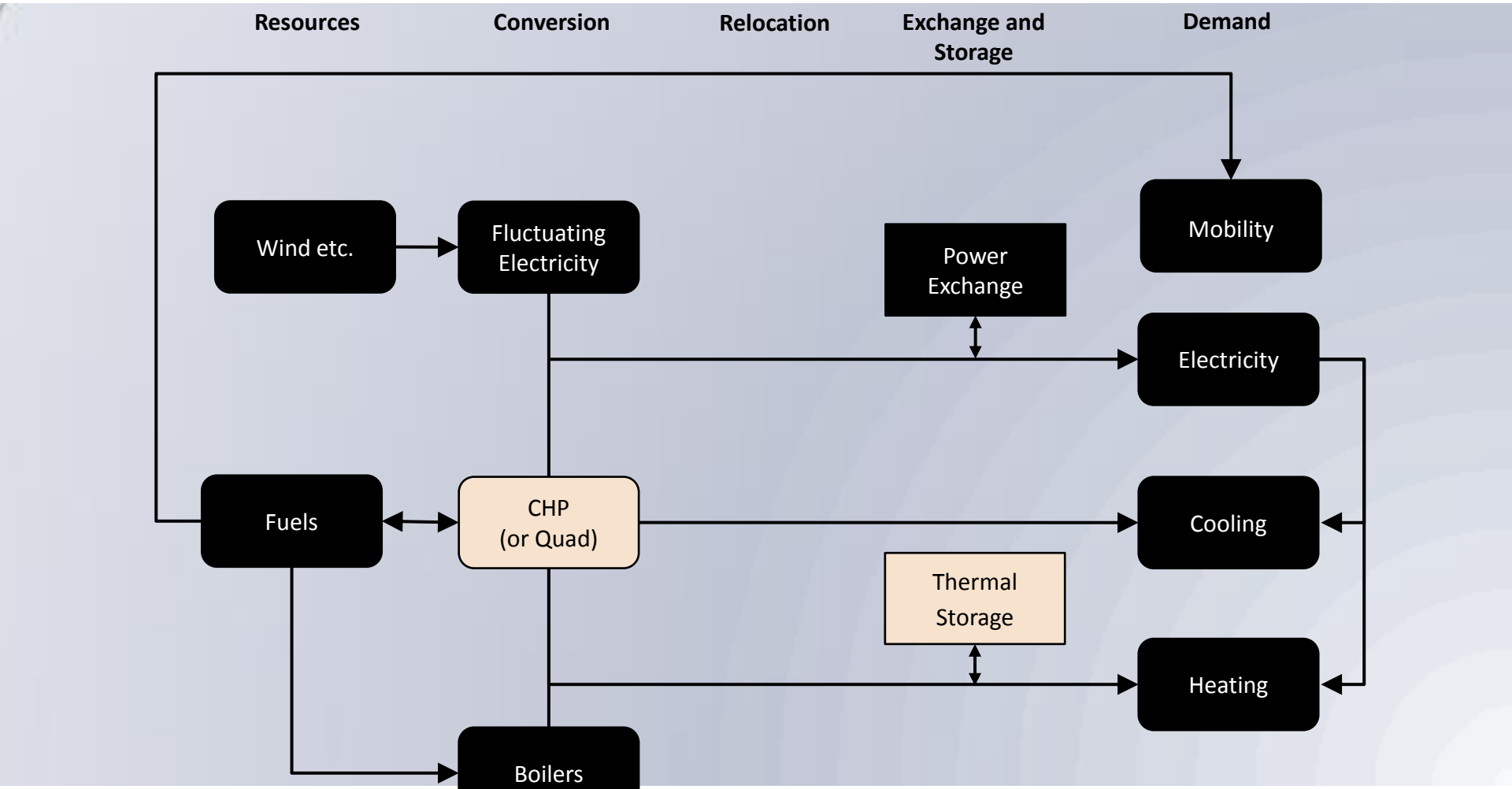
District Heating & Thermal



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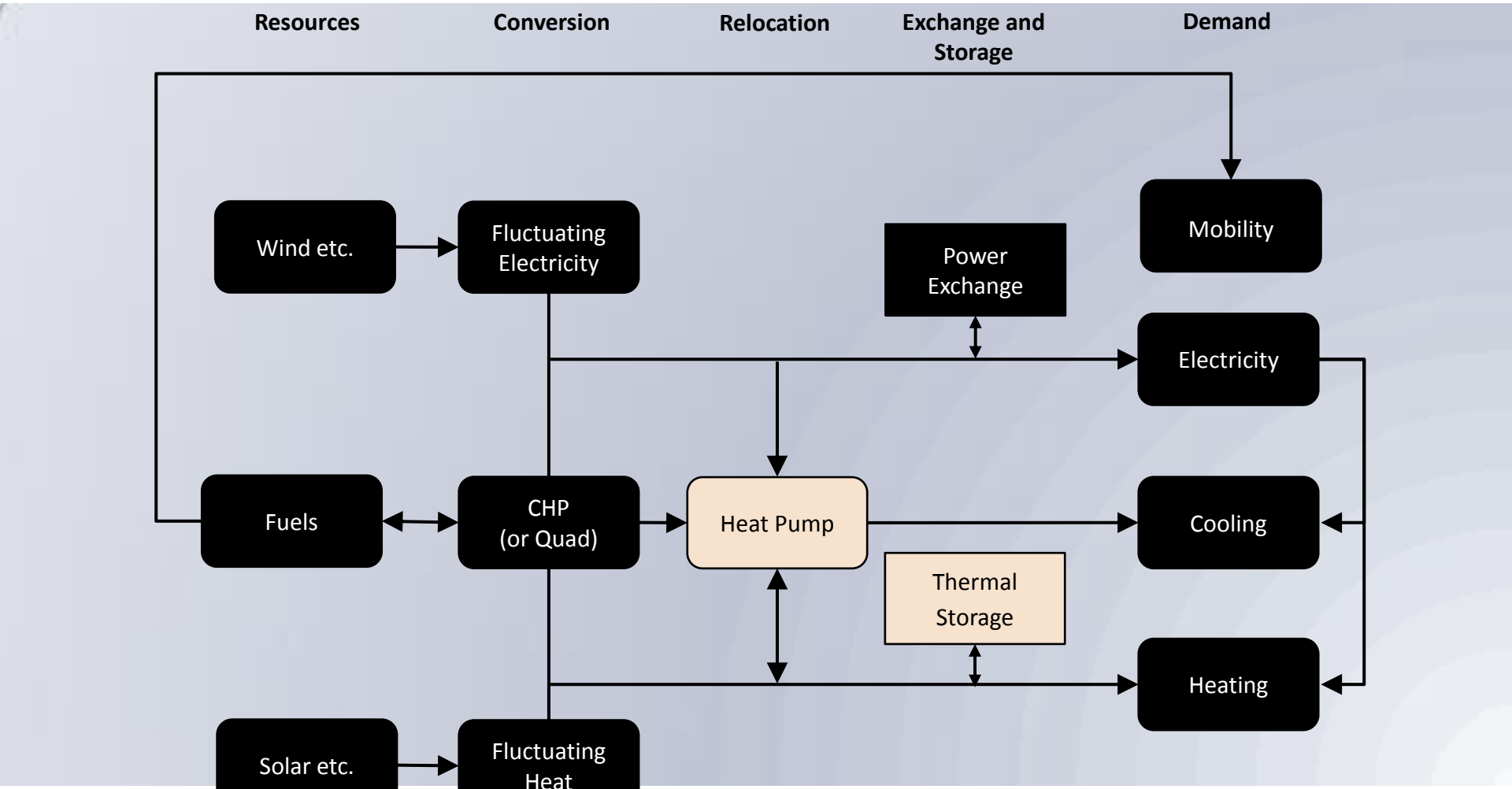
Heat Pumps & Thermal Storage



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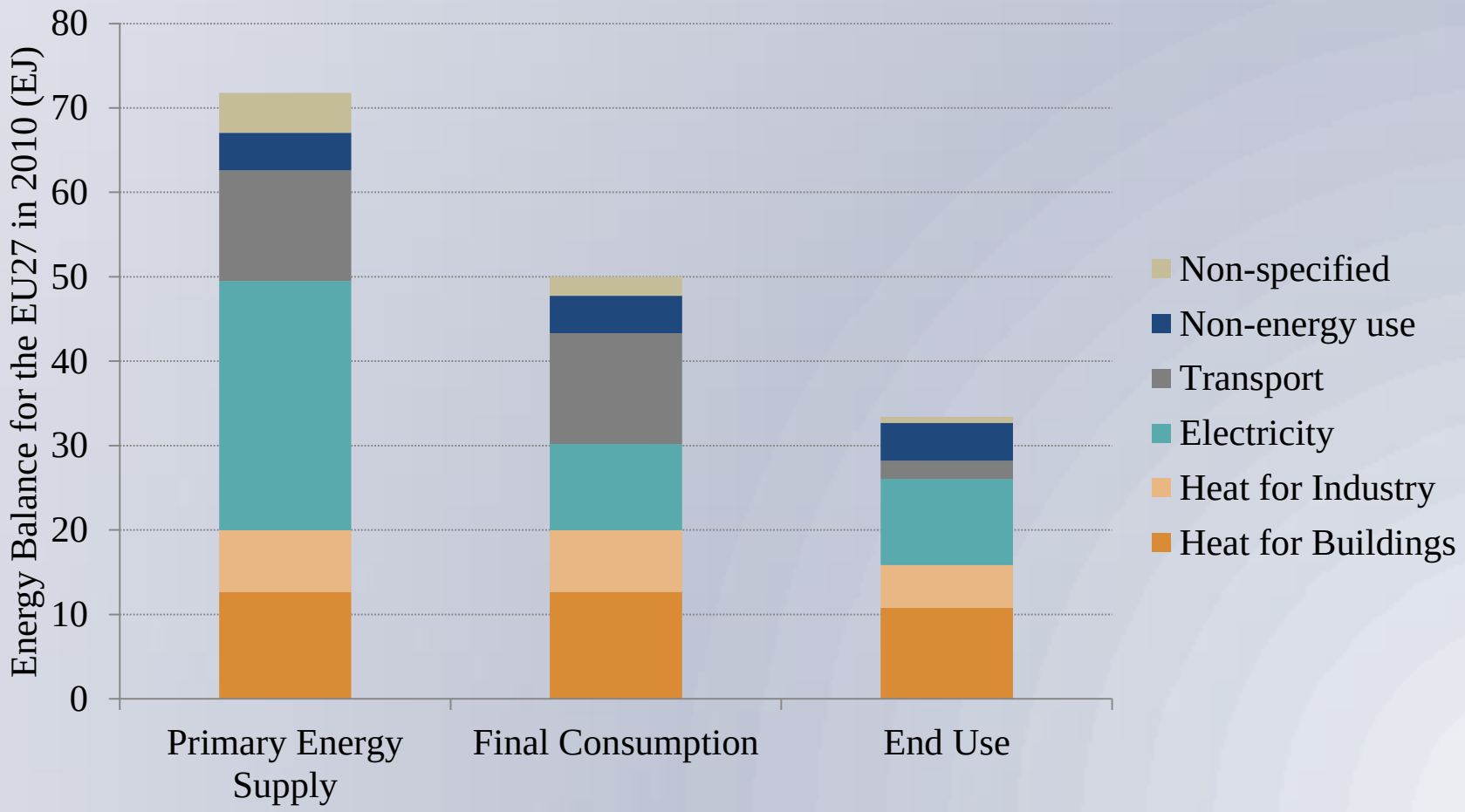
The EU is wasting energy (heat)...



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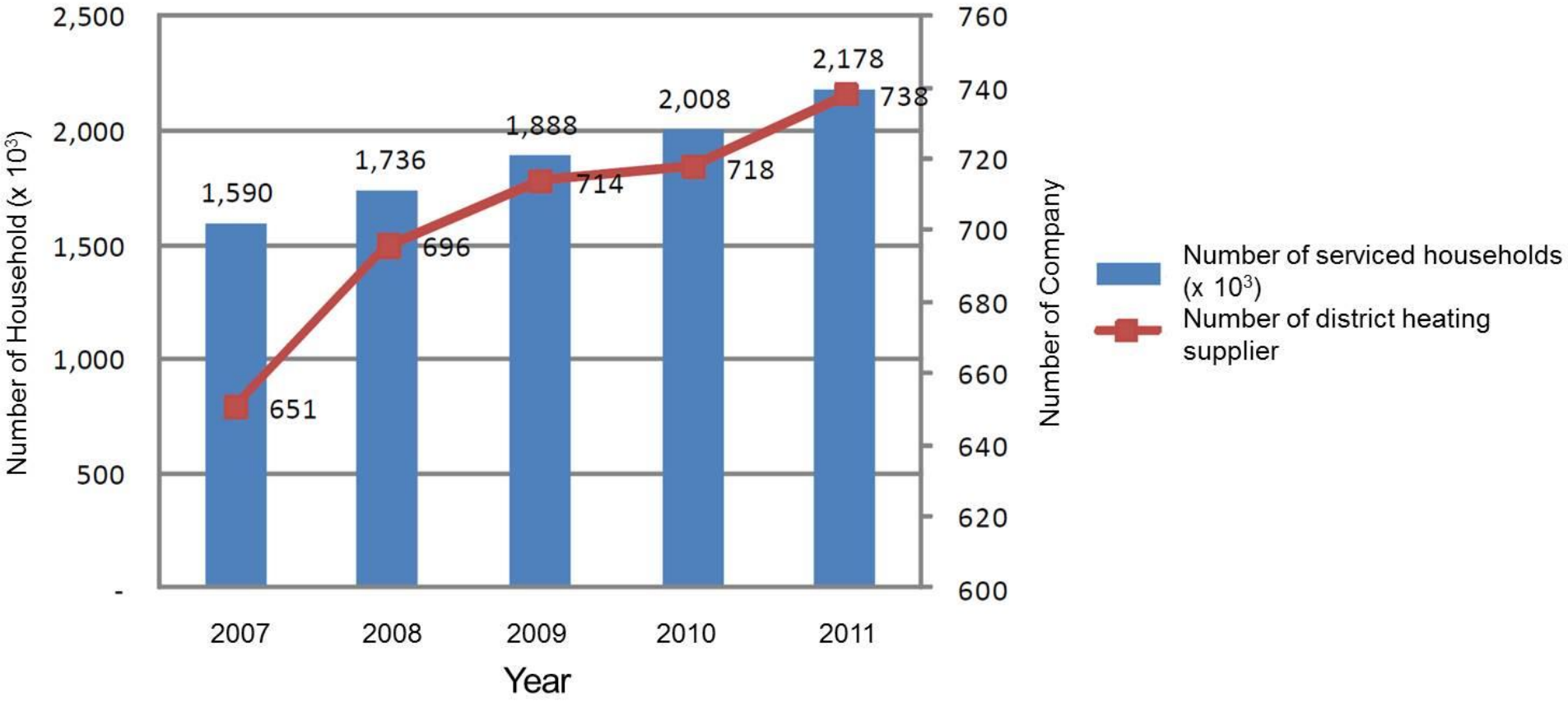
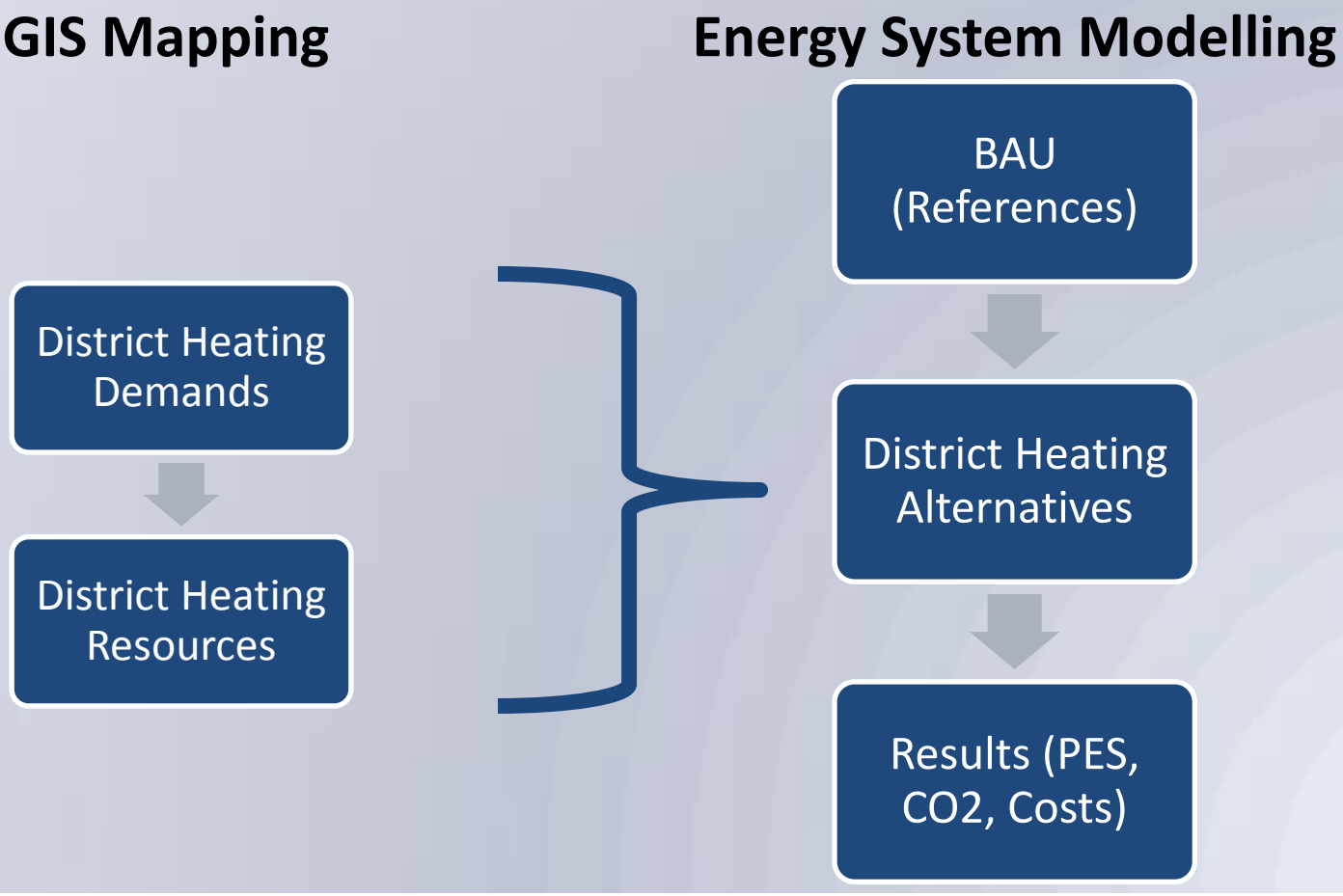
DH in South Korea ~14% of Houses



What is this Study?

- Two Reports:
  - Pre-study 1 (2012): is DHC beneficial in a business-as-usual scenario
  - Pre-study 2 (2013): is DHC beneficial in a low-heat demand scenario

Methodology



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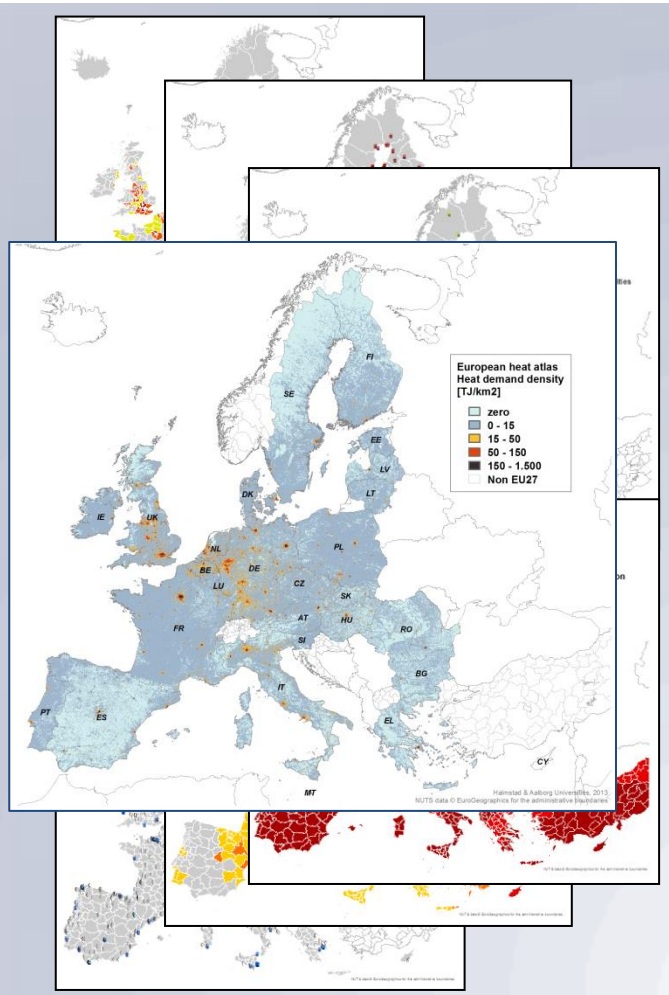
GIS Mapping: Many Heat Sources

- Urban areas (Heating Demands)
- Power and Heat Generation
- Waste Management
- Industrial waste heat potential
- Geothermal heat
- Solar Thermal
- the study indicates that the **market shares for district heating** for buildings **can be increased to 30% in 2030 and 50% in 2050.**



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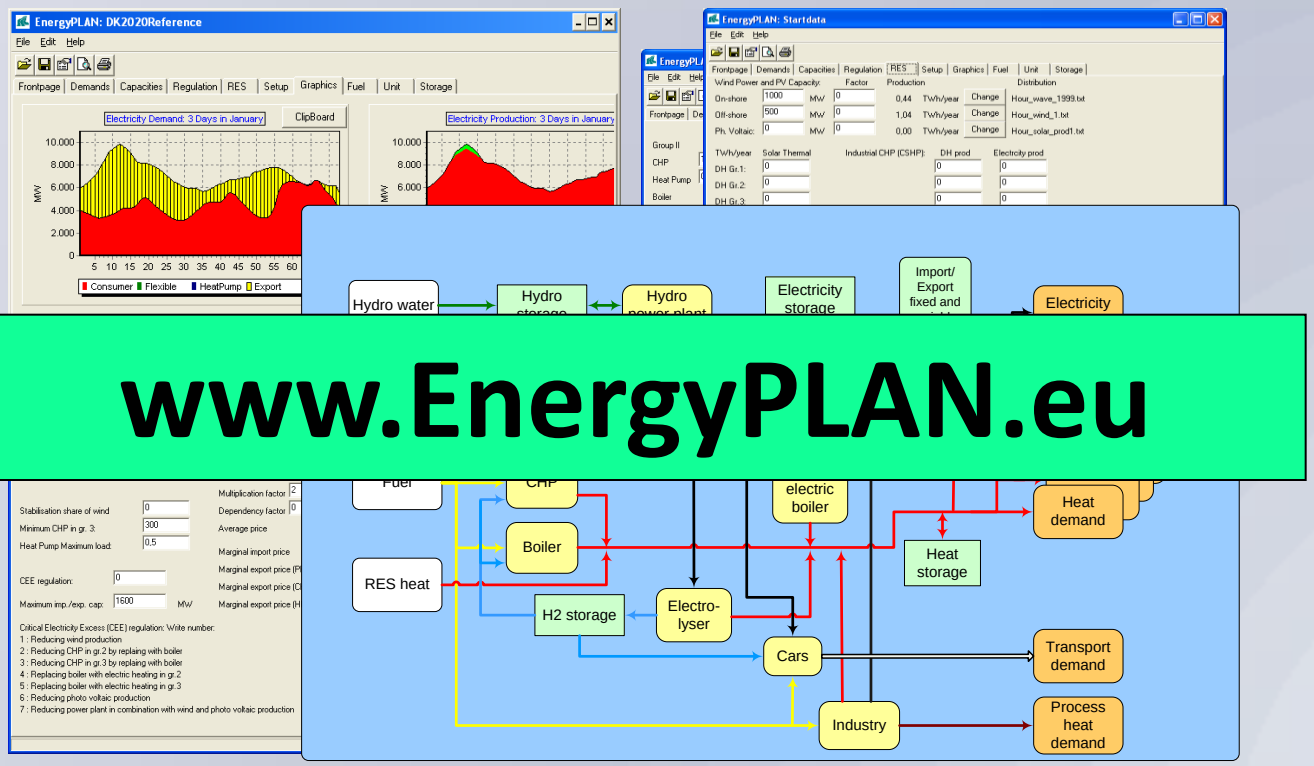
Energy Systems Analyses Model



www.EnergyPLAN.eu

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Pre-Study 1 (2012)

Is DHC beneficial for the EU energy system in a business-as-usual scenario?

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What is a Business-as-Usual Scenario?

- Energy Roadmap 2050
  - Completed for the European Commission in 2011, by the National Technical University in Athens

- Presents 6 energy scenarios for the EU27:
  - Reference: Business-as-usual
  - CPI: Updated business-as-usual
  - EE: Energy Efficiency
  - CCS: Carbon Capture and Storage
  - Nuclear
  - High Renewable Energy

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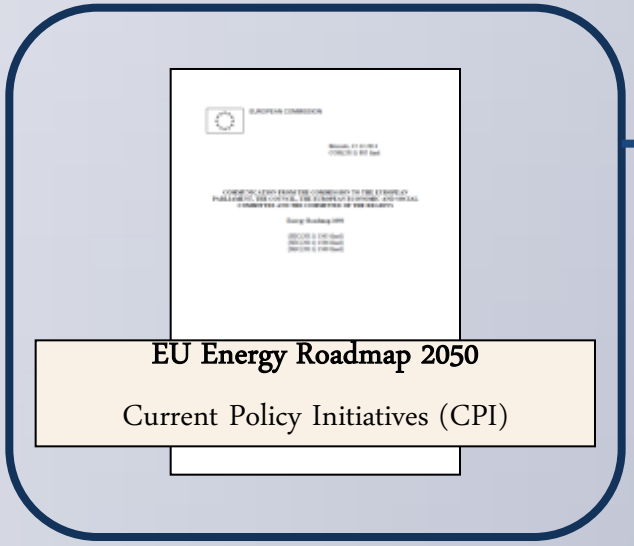
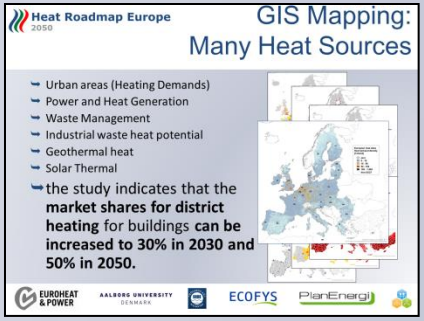
Designing the DHC Alternatives



EU Energy Roadmap 2050

Current Policy Initiatives (CPI)



EU CPI
PRIMES Data
2030 & 2050 Model

District Heating Alternatives

2010 = 12% DH
2030 = 30% DH
2050= 50% DH

Results
(PES, CO2, Costs)

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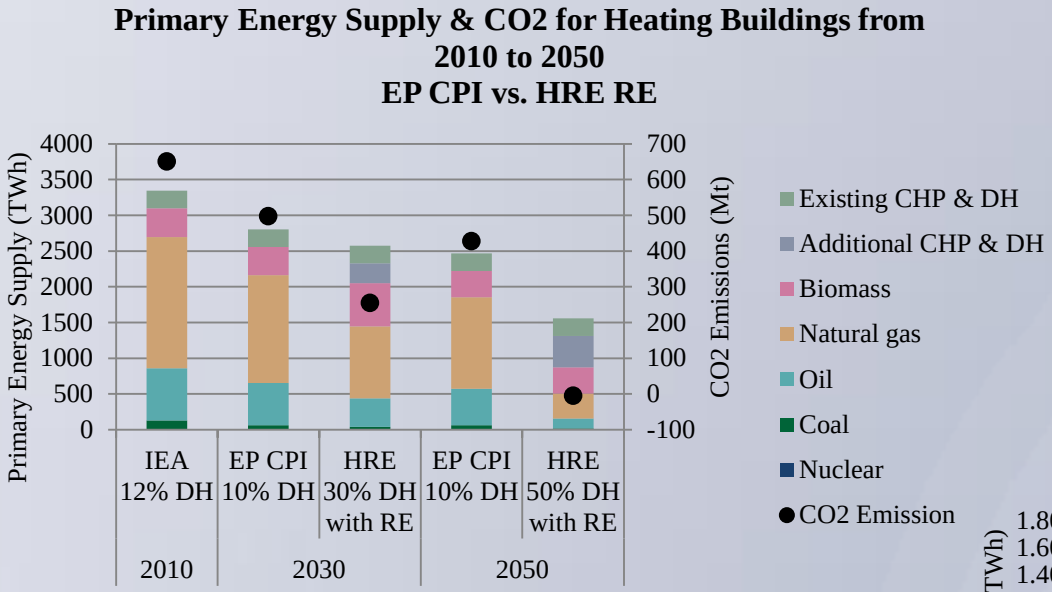
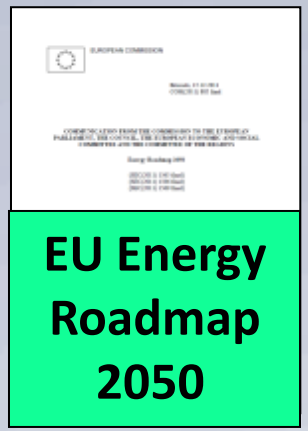
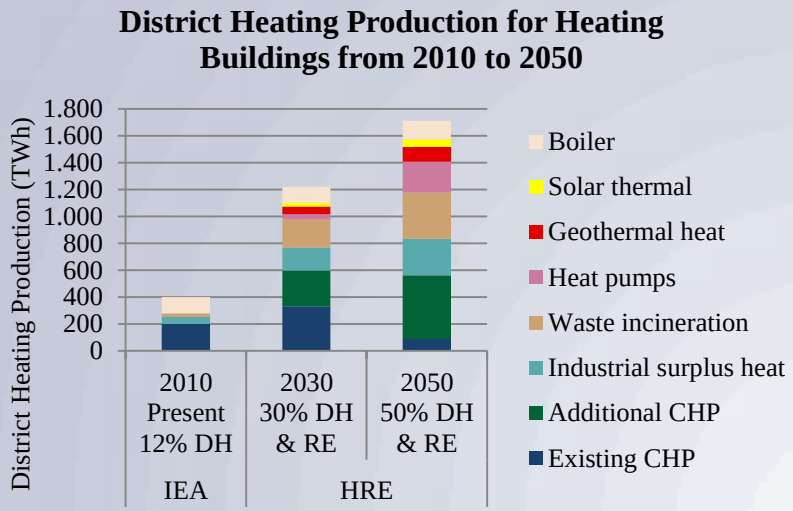
Heat Roadmap Europe 2050

Year 2030 & 2050: Steps 1 & 2







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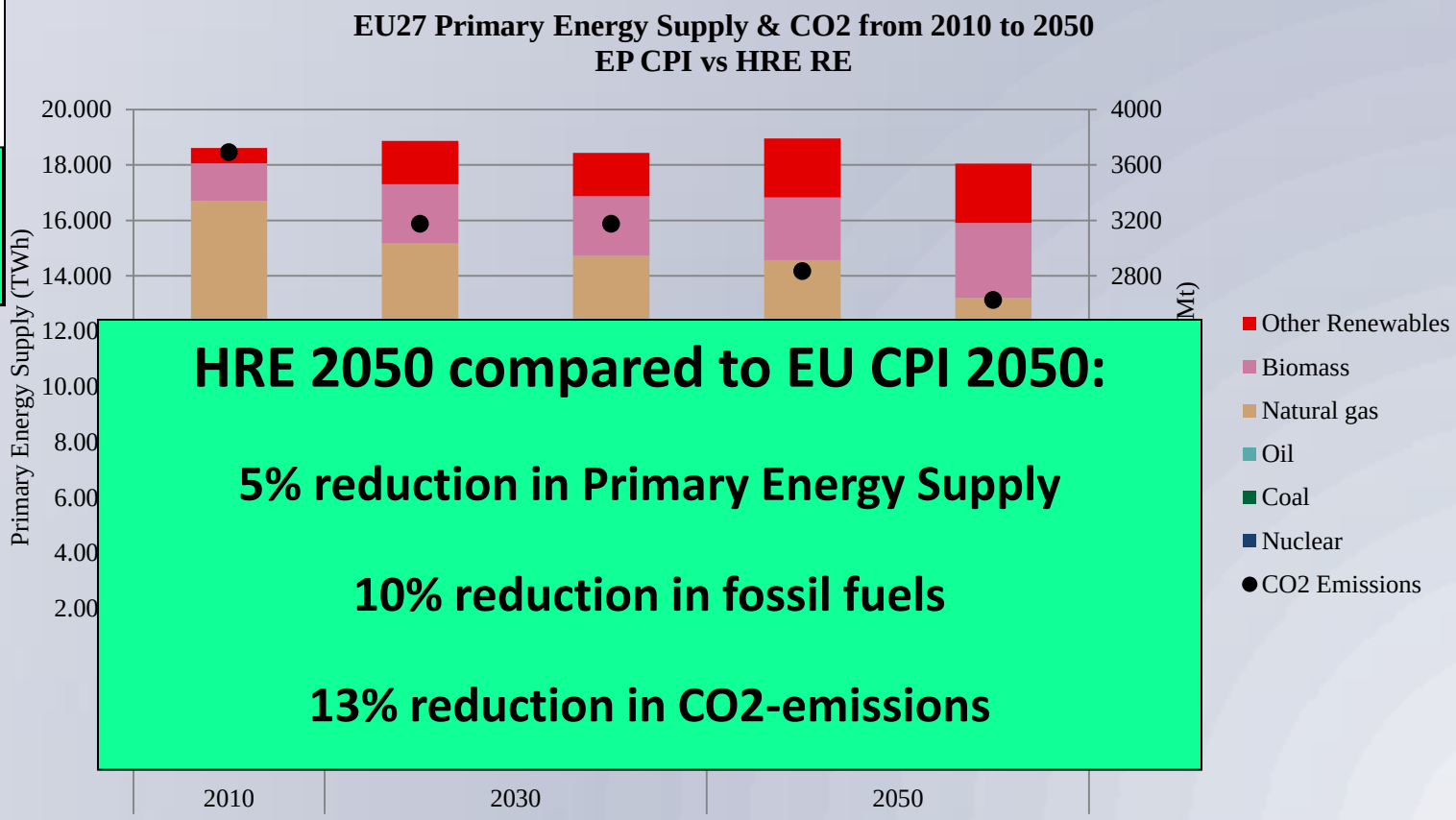
Heat Roadmap Europe 2050

Year 2030 & 2050: Total Energy Supply

EU Energy Roadmap 2050



HRE 2050 compared to EU CPI 2050:

5% reduction in Primary Energy Supply

10% reduction in fossil fuels

13% reduction in CO2-emissions

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District Heating Benefits in 2 steps

Step 1: (Energy Efficiency)

- Increasing DH to 30% then 50%
- Increasing CHP
- Using Oil/Natural gas in CC-CHP

Step 2: (Utilise waste and RE sources)

- Industrial waste heat
- Waste incineration
- Geothermal heat
- Large-scale Solar Thermal







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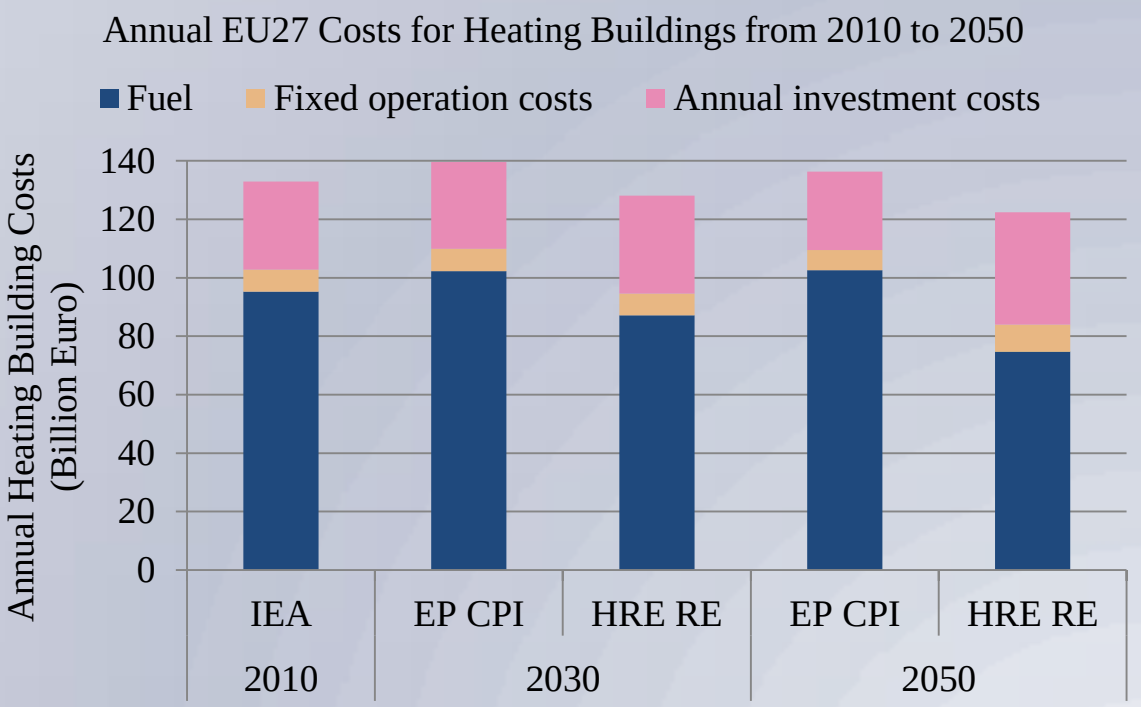
Cost and Jobs

- Saved fuel costs of annual approx. 30 Billion EUR in 2050
- In total cost are reduced by 14 Billion EUR in 2050
- Additional investments of a total of 500 billion EUR
- Additional jobs from to 2013 to 2050: 8-9 million man-year in total

  Approx. 220,000 jobs.



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HRE1 Conclusion: 50% DH and CHP

- Decrease primary energy supply and especi… O2 emissions — **LESS FUEL**
- Decrease annual costs of energy in Europe … 14 Billion in 2050 — **LESS MONEY**
- Create … obs over the period 2013-2050 — **MORE EU JOBS**
- Furthe… — **MORE RE**

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Pre-Study 2 (2013)

Is DHC beneficial for the EU energy system in a low-heat demand scenario?

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Future: EU Energy Roadmap 2050

- Completed for the European Commission in 2011, by the National Technical University in Athens

HRE2: Is district heating a good idea if we implement a lot of energy efficiency in the buildings?

- Pr
  - Reference: Business-as-usual
  - CPI: Updated business-as-usual
  - Energy Efficiency (EU-EE)
  - Carbon Capture & Storage
  - Nuclear
  - High Renewable Energy

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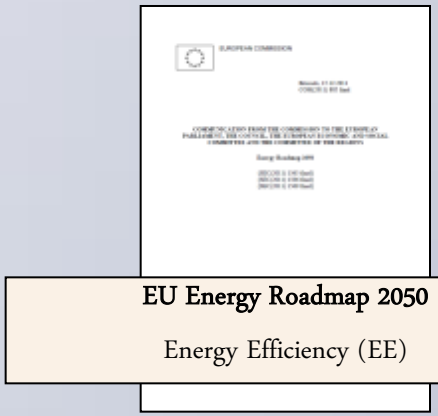
Energy Modelling

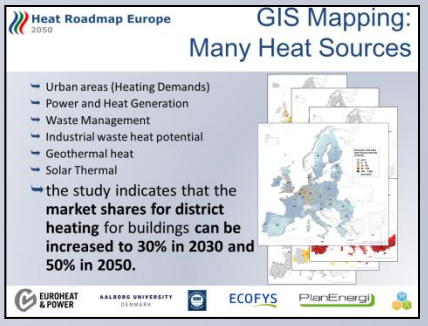


EU Energy Roadmap 2050

Energy Efficiency (EE)

EU-EE
PRIMES Data
2030 & 2050 Model

District Heating
Alternatives



2010 = 12% DH
2030 = 30% DH
2050= 50% DH

Results
(PES, CO2, Costs)

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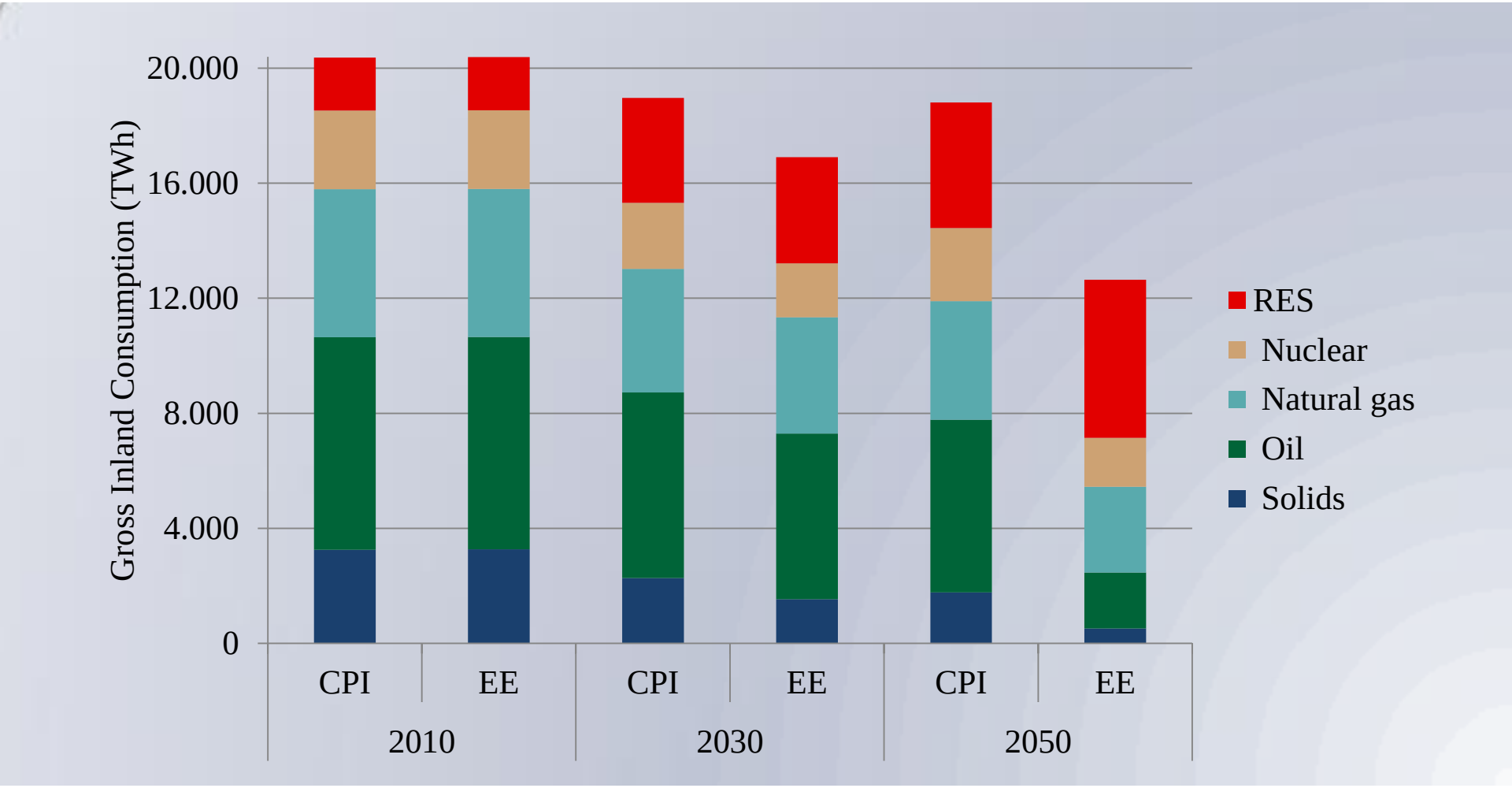
Key Measures in the EU-EE Scenario

- High renovation rates for existing buildings due to better/more financing and planned obligations for public buildings (more than 2% refurbishment per year)
- Passive houses standards after 2020
- Obligation of utilities to achieve energy savings in their customers' energy use over 1.5% per year (up to 2020)
- Strong minimum requirements for energy generation, transmission and distribution including obligation that existing energy generation installations are upgraded to the

CPI vs. EE


Gross Inland Consumption (TWh)
20.000
16.000
12.000
8.000
4.000
0
CPI
EE
CPI
EE
CPI
EE
2010
2030
2050
RES
Nuclear
Natural gas
Oil
Solids

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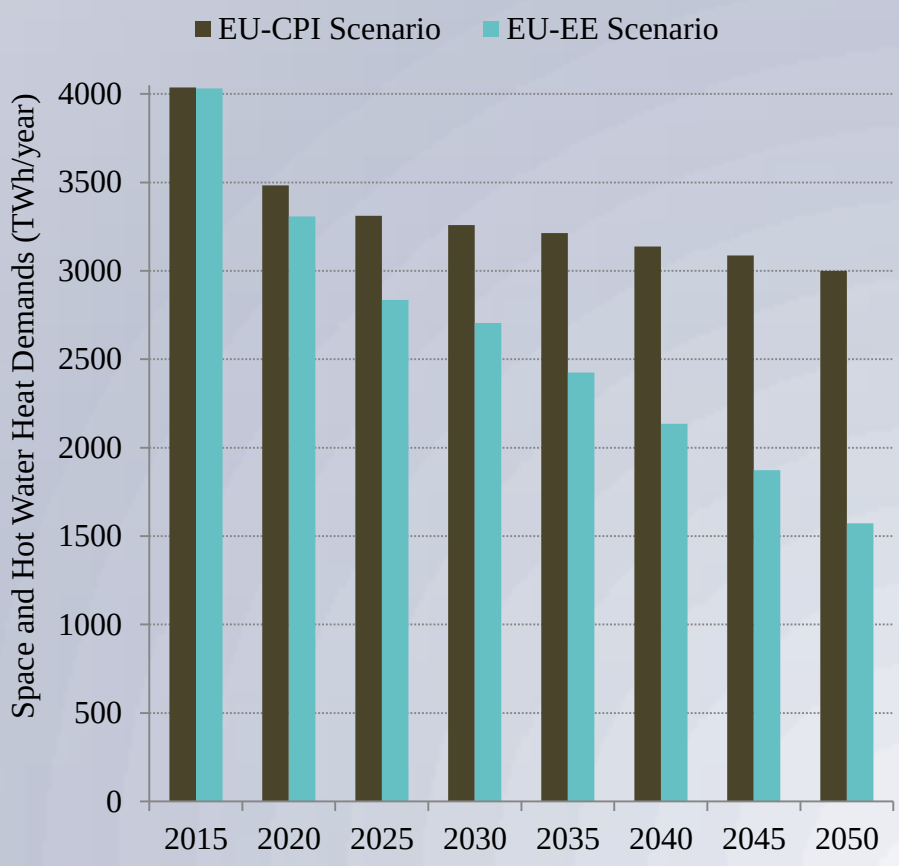
EU-EE Scenario Heat Demand Concerns

- Hot water demand decreases by 50% between 2010 and 2050
- Specific Heat Demands reduce by 70% between 2010 and 2050



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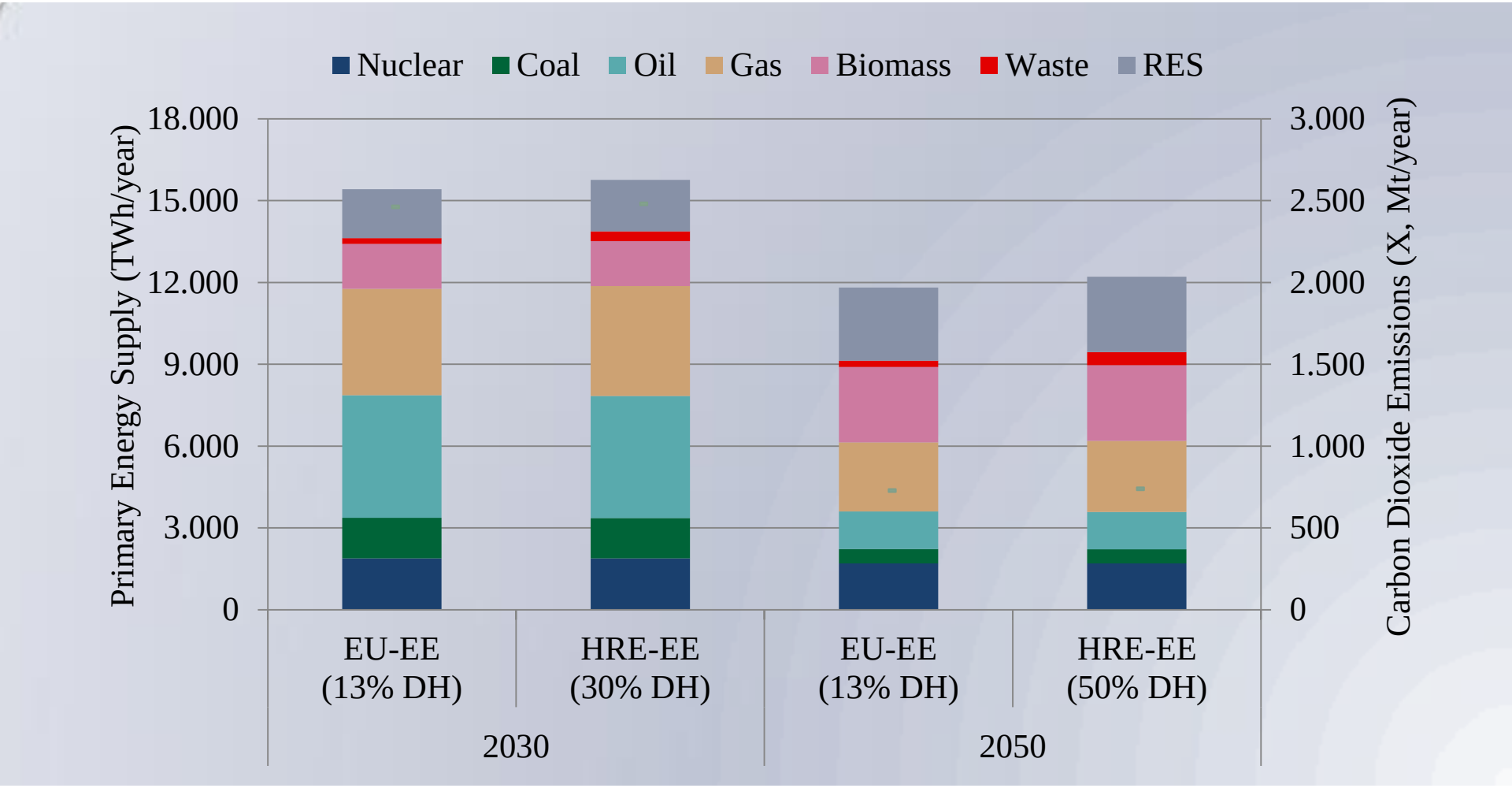
Results

Heat Roadmap Europe 2050

EU-EE vs. HRE-EE: Primary Energy Supply & CO2



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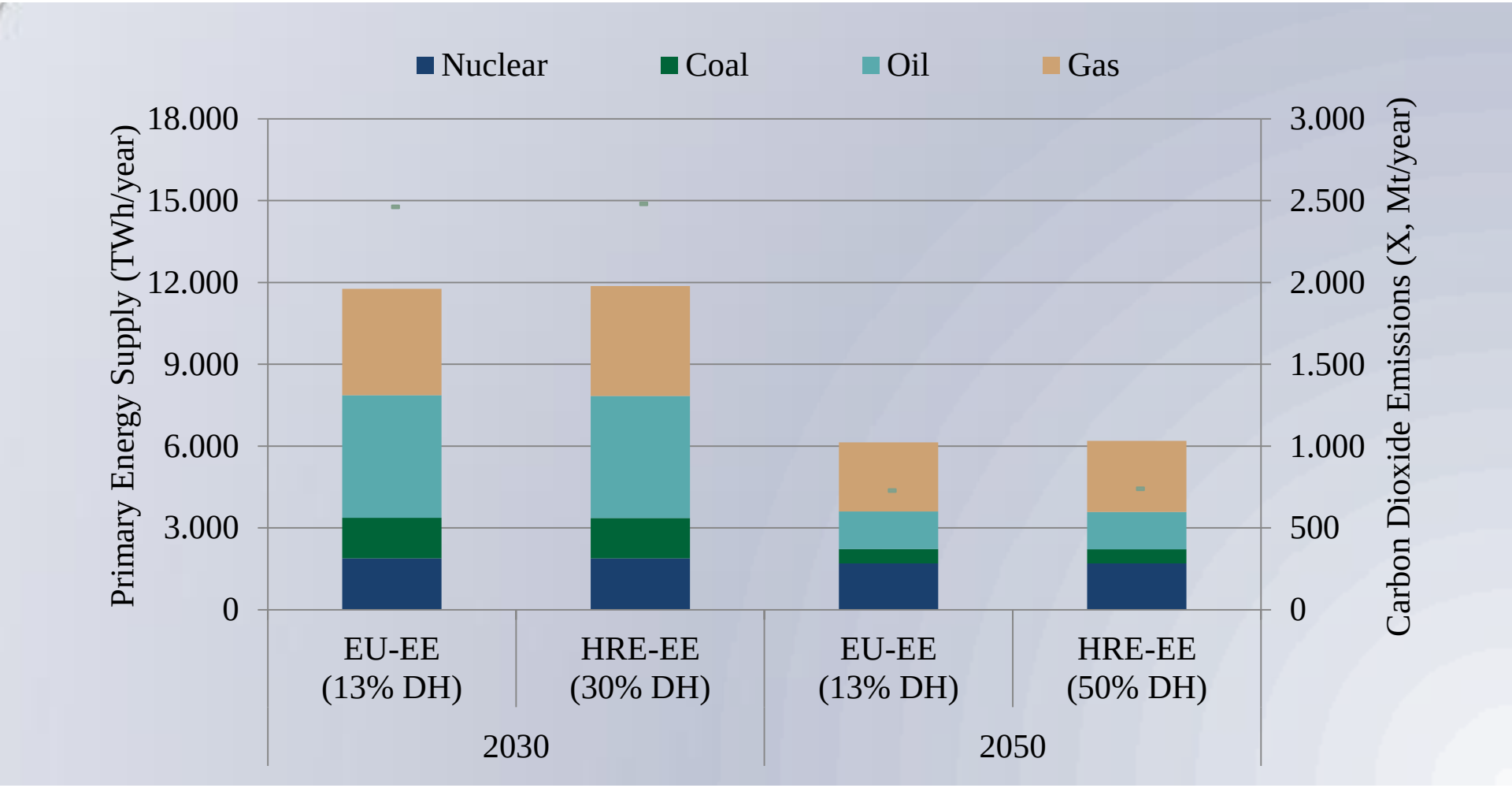
EU-EE vs. HRE-EE: Primary Energy Supply & CO2



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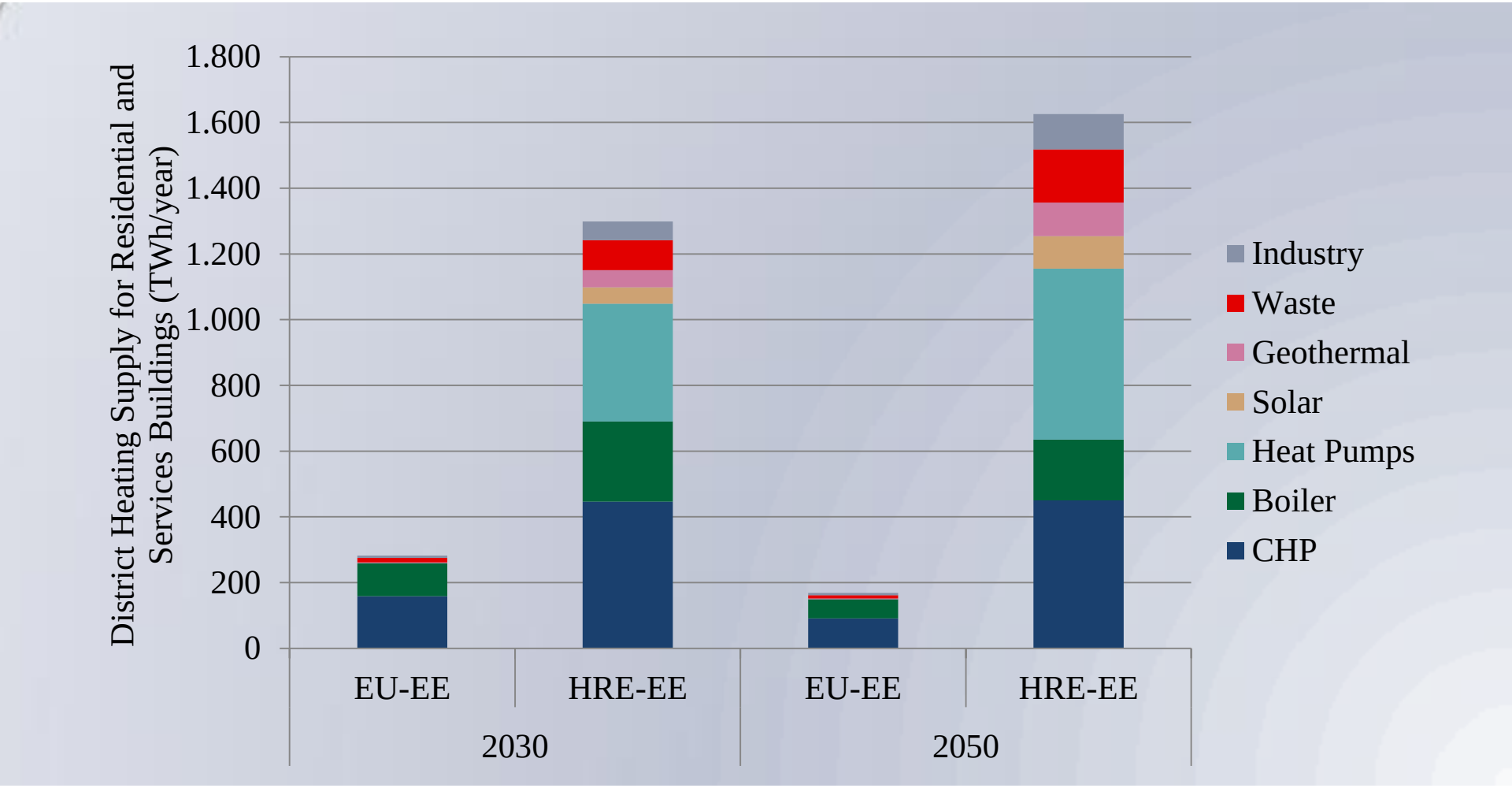
EU-EE vs. HRE-EE DH Supply



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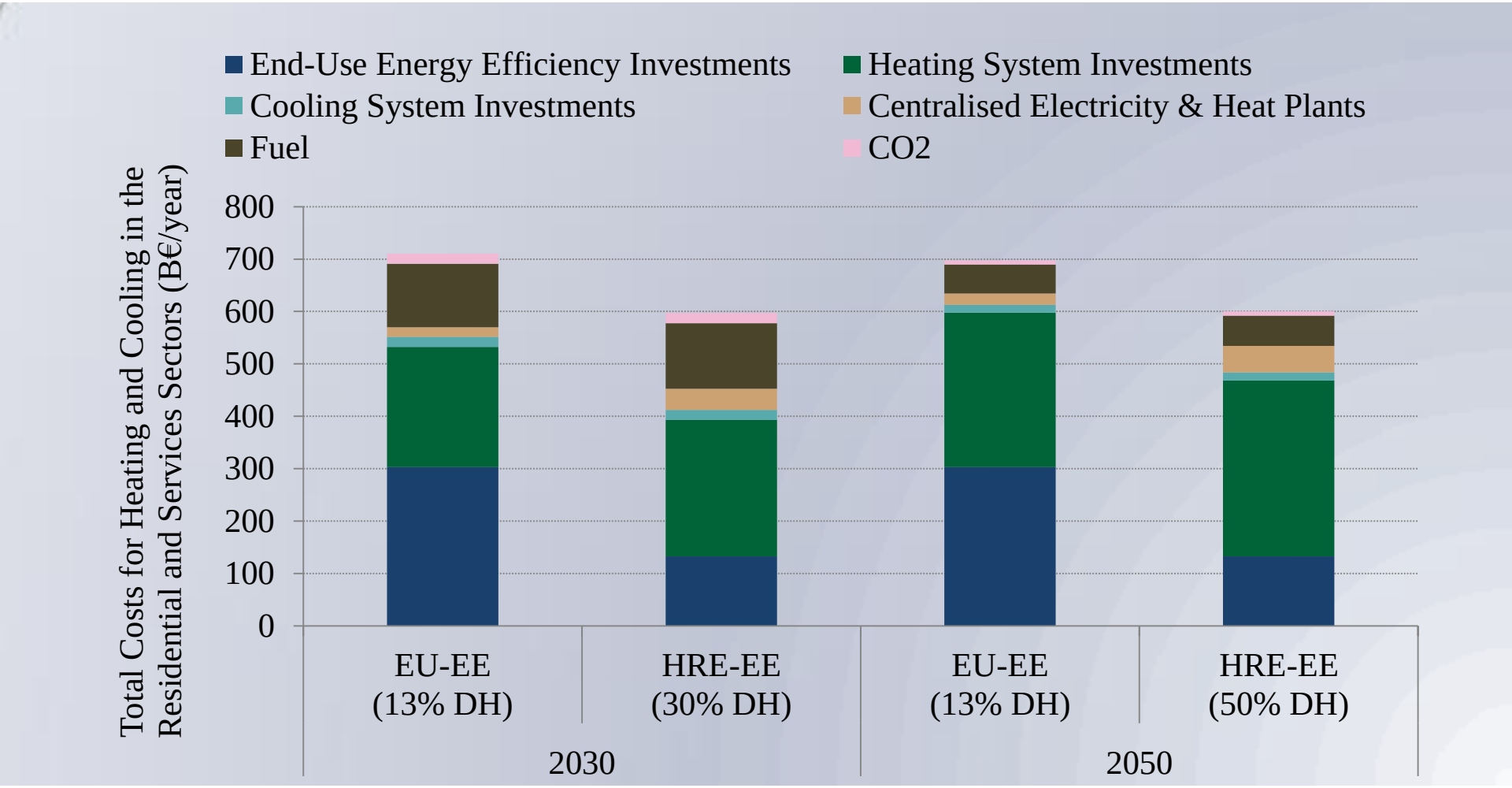
EU-EE vs. HRE-EE: Heat & Cooling Costs -15%



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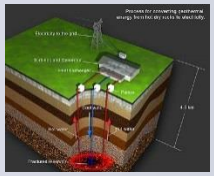
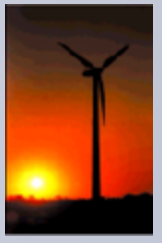
Renewables and Energy Efficiency

Additional Renewables

- 100 TWh Geothermal
- 100 TWh large-scale solar
- 65 TWh wind (due to a smarter energy system)

Context: 2050 total heat is 2600 TWh





Energy Efficiency

- Demand side is extremely important, but eventually it will become expensive

- Supply side also has many options:
  - PP converted to CHP
  - 100 TWh surplus industrial heat
  - 200 TWh heat from waste incineration

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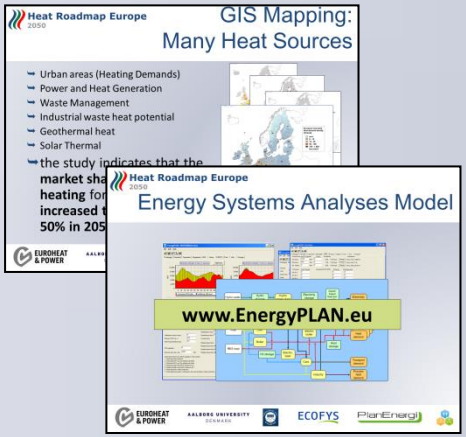
HRE1 Conclusions



- If we continue under a business-as-usual scenario, then district heating can:
  - Reduce the PES
  - Reduce the CO2 emissions
  - Reduce the costs of the energy system
  - Use more renewable energy

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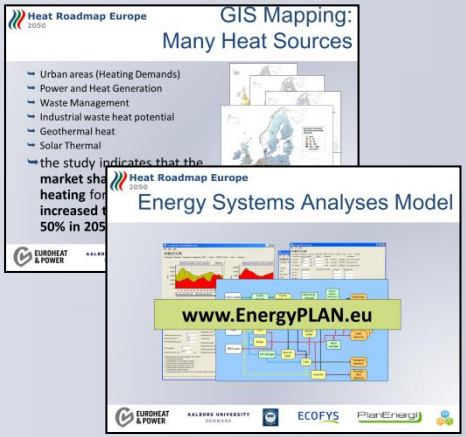
HRE2 Conclusions



- If we implement a lot of energy efficiency measures, then district heating will:
  - Meet the same goals:
    - Utilise the same amount of fossil fuels
    - Enable the same CO2 emission reductions
  - BUT, Cost approximately 10% less

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Key Benefits of District Heating

- Improves the efficiency of the system (CHP, O&M, etc.)
- Creates short-term and long-term flexibility
- Enables more renewable energy resources and surplus heat to be utilised
- Reduces the thermal capacity necessary
- Increases the comfort-levels for the end-user

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Study 3?
(20??)

Is DHC beneficial for the EU energy system in a ??? scenario?

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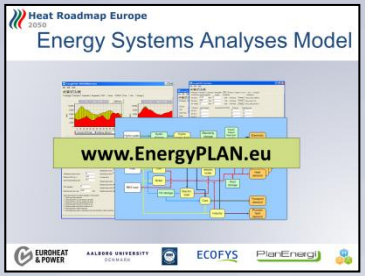
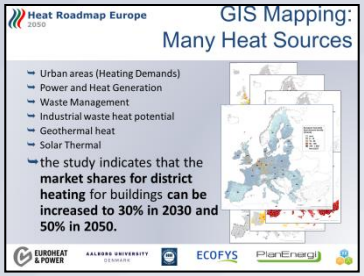
Research To Be Continued…

- Develop national plans that connect the local (mapping) and EU (modelling) results.
- Optimise the EU energy system by reducing baseload electricity and developing more smart energy system technologies
- 4th Generation District Heating: http://www.4dh.dk/
- Create an electric heating scenario for the EU27





Role of Heat Roadmap Europe

- Mapping:
  - Potential for DHC in the EU
  - Potential for heat recycling in the EU
  - Estimate the renewable heat resource in the EU
- Modelling:
  - Hourly energy system modelling of electricity, heat, and gas
  - Capture the benefits of district heating
  - Enhance the Energy Roadmap scenarios

Thank you

- Need a copy of the report?
- www.heatroadmap.eu
- www.4dh.dk/hre