

# Heat Roadmap Europe 2050

## Pre-study 2012

Decarbonising the European heating and cooling markets

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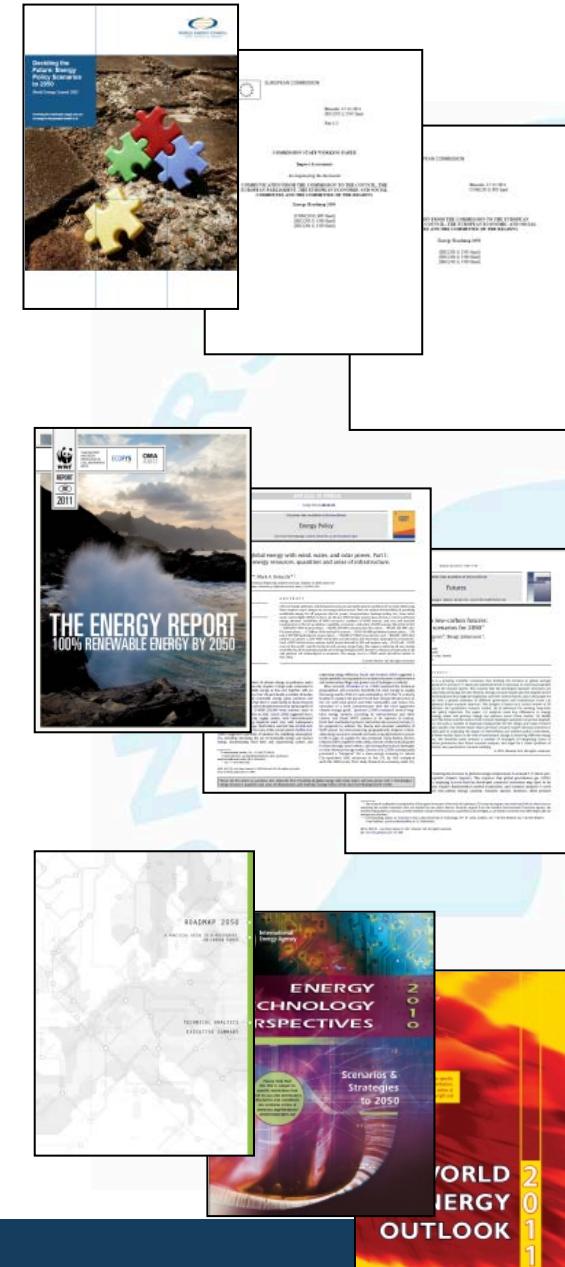
## Planenergi

Daniel Trier



# Existing Studies

- Energy Roadmap 2050 (**EU Commission**)
- Roadmap 2050 (**European Climate Foundation**)
- The energy report – 100% renewable energy by 2050 (**WWF**)
- Energy Technology Perspectives 2010 (**IEA**)
- World Energy Outlook (**IEA**)
- Deciding the Future: Energy Policy Scenarios to 2050 (**WEC**)
- 2 Academic Journal Papers (**Stanford, UC Davis, Lund University, et al.**)

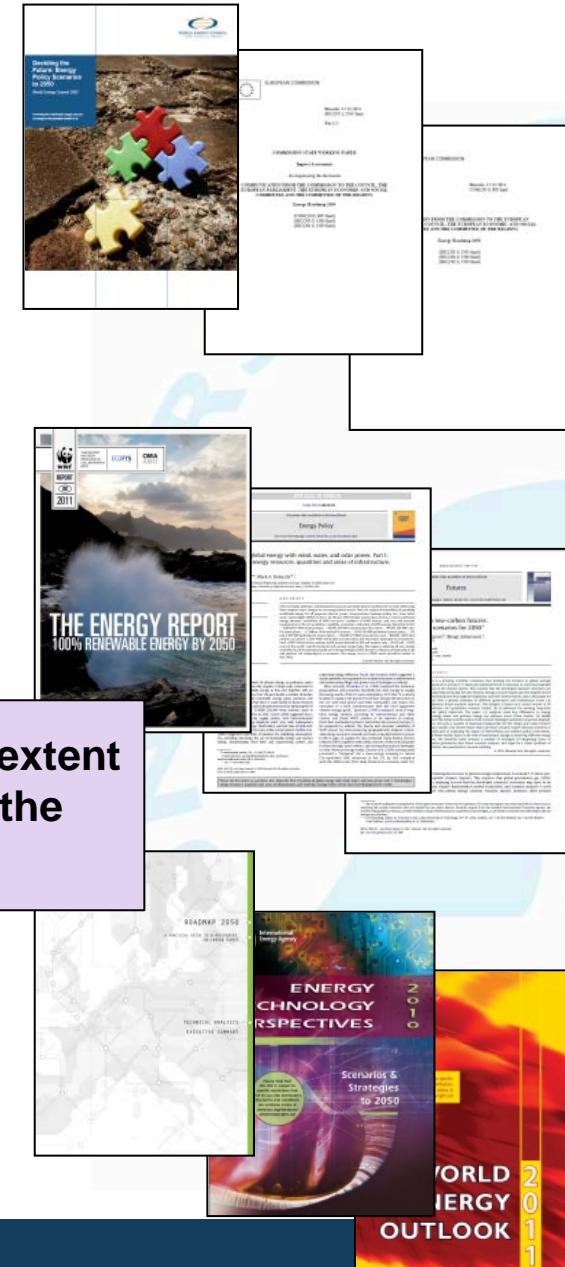


# Existing Studies

- Energy Roadmap 2050 (**EU Commission**)
- Roadmap 2050 (**European Climate Foundation**)
 

General Consensus:  
**"Combined heat & power (CHP) and district heating (DH) are important"**
- The energy roadmaps 2050 (**WWF**)
 

... but fail to quantify to which extent these options can be used in the future energy system ...
- Energy Technology Perspectives (**IEA**)
- World Energy Outlook (**IEA**)
- Deciding the Future: Energy Policy Scenarios to 2050 (**WEC**)
- 2 Academic Journal Papers (**Stanford, UC Davis, Lund University, et al.**)



# Methodology

## GIS Mapping

District Heating Demands



District Heating Resources



Indicate Costs

## Energy System Modelling

BAU (References)

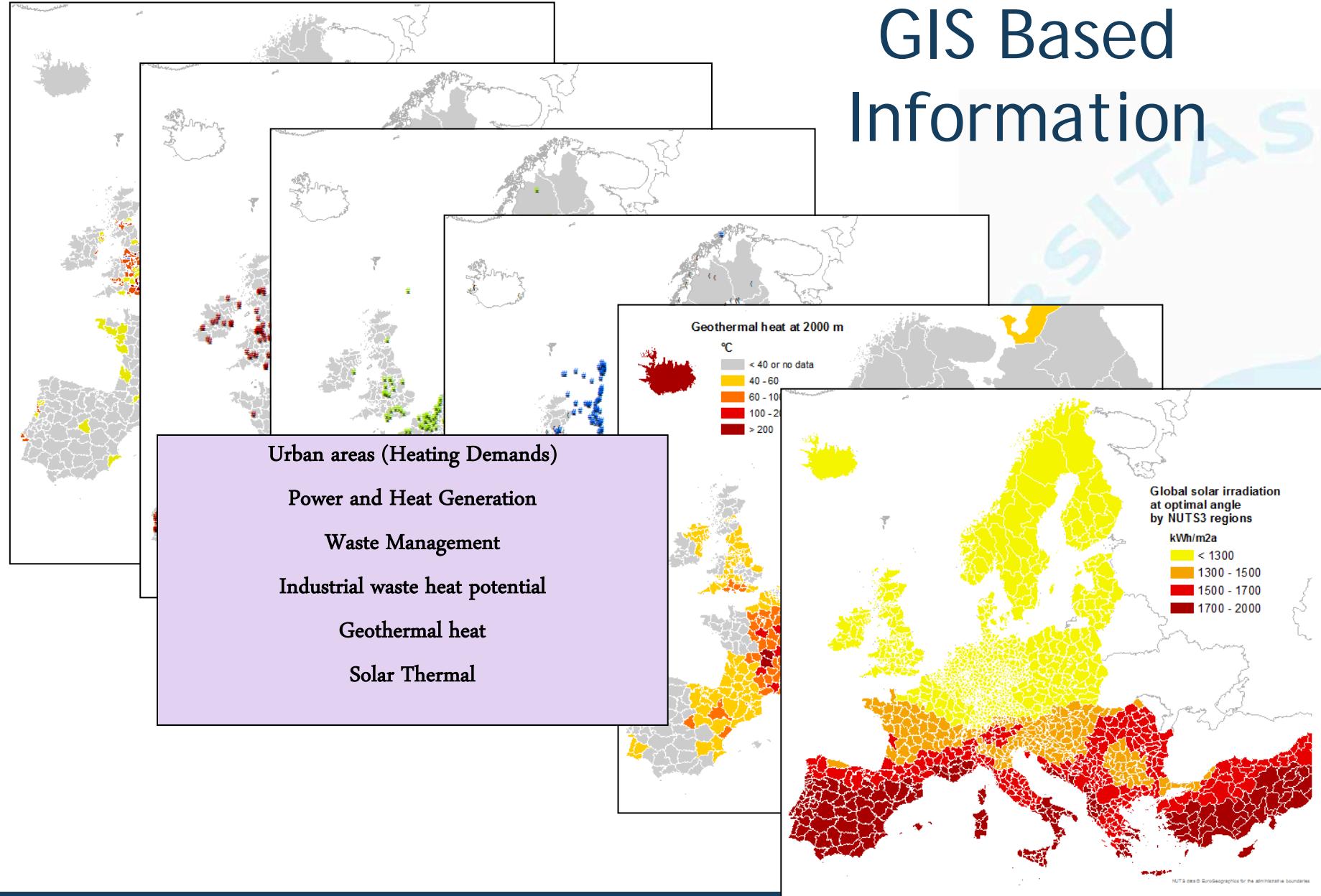


District Heating Alternatives



Results (PES,  
CO<sub>2</sub>, Costs)

# GIS Based Information



# Energy System Analysis Tool

The figure displays the EnergyPLAN software interface, which includes three main windows:

- EnergyPLAN: DK2020Reference**: Shows two line graphs: "Electricity Demand: 3 Days in January" (red line) and "Electricity Production: 3 Days in January" (yellow line). The x-axis represents time from 5 to 60 days, and the y-axis represents power in MW from 0 to 10,000.
- EnergyPLAN: Startdata**: A table showing initial data for various energy sources and loads. It includes columns for On-shore Wind Power and PV Capacity (MW), Factor (TWh/year), and Change (Hour files).
- EnergyPLAN: Startdata**: Another table for market model settings, including addition factor, multiplication factor, dependency factor, average price, and marginal import/export prices.

Below these windows is a large central diagram illustrating the energy system architecture:

```

graph TD
    HW[Hydro water] --> HS[Hydro storage]
    HS <--> HPP[Hydro power plant]
    RES[RES electricity] --> PP[PP]
    Fuel --> CHP[CHP]
    Fuel --> Boiler[Boiler]
    RES[RES heat] --> HP[Heat pump and electric boiler]
    HP --> Electro[Electro]
    Electro --> ED[Electricity demand]
    Electro --> CD[Cooling demand]
    Electro --> HD[Heat demand]
    ED --> IEFV[Import/Export fixed and variable]
    CD --> IEFV
    HD --> IEFV
    IEFV --> ESS[Electricity storage system]
    ESS <--> HP
    ESS <--> ED
    ESS <--> CD
    ESS <--> HD
    HP --> HS
    HS --> HPP
    HPP <--> HS
    HPP --> ED
    HPP --> CD
    HPP --> HD
    CHP --> ED
    CHP --> CD
    CHP --> HD
    Boiler --> ED
    Boiler --> CD
    Boiler --> HD
    HP --> ED
    HP --> CD
    HP --> HD
    
```

The diagram shows the interconnected components of the energy system, including hydro power, renewable energy sources, fuel-based generation, heat pumps, and various types of storage (hydro, electricity, heat) that feed into the electricity and heat demands.

**Renewable Energy Systems** (Henrik Lund) logo is visible in the bottom left corner.

**www.EnergyPLAN.eu**

## Step 1: (Energy Efficiency)

- Increasing DH Penetrations
- Increasing CHP
- Using Oil/Natural gas in CC-CHP



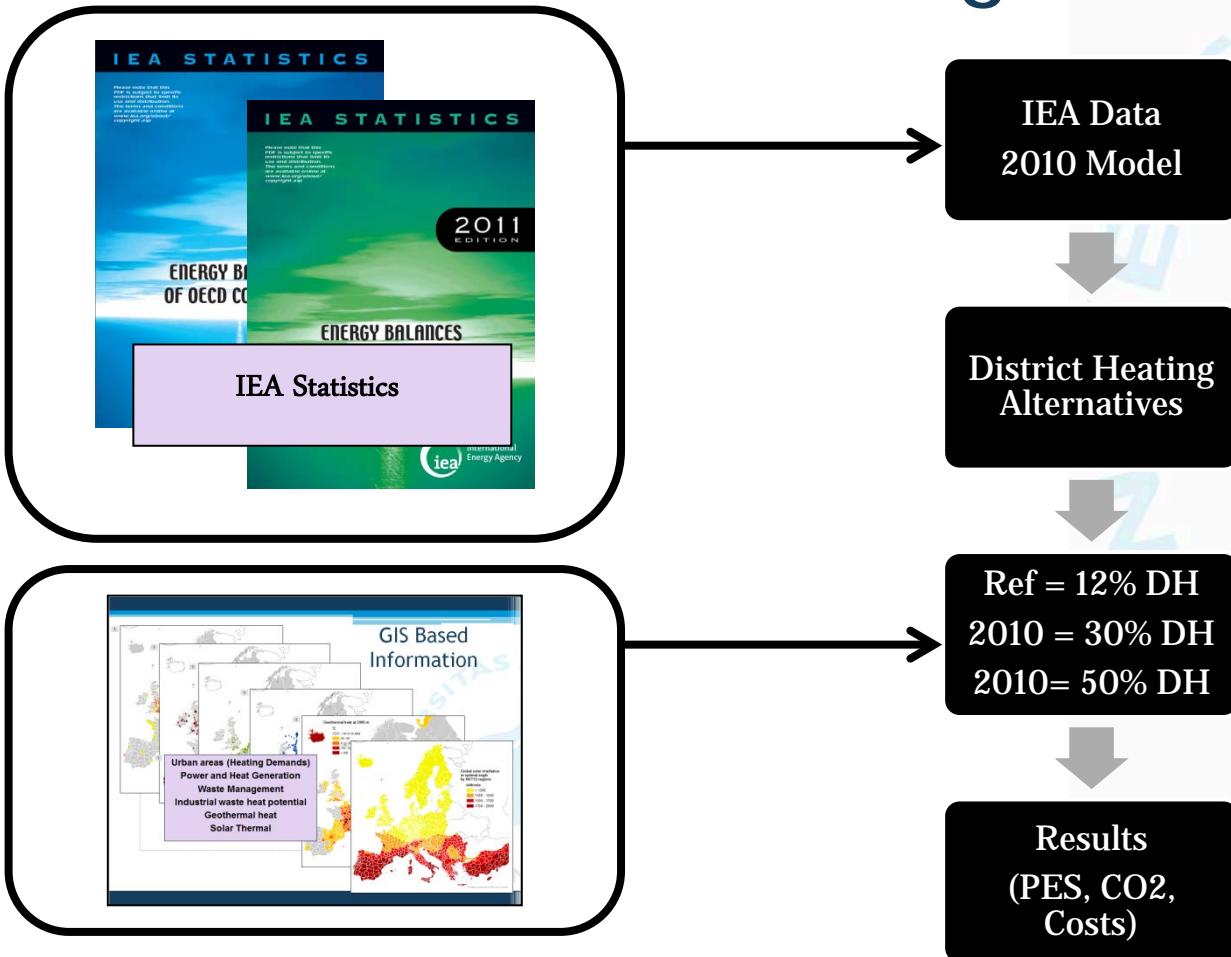
# Showing DH Benefits in 2 Steps

## Step 2: (Utilise waste and RE sources)

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

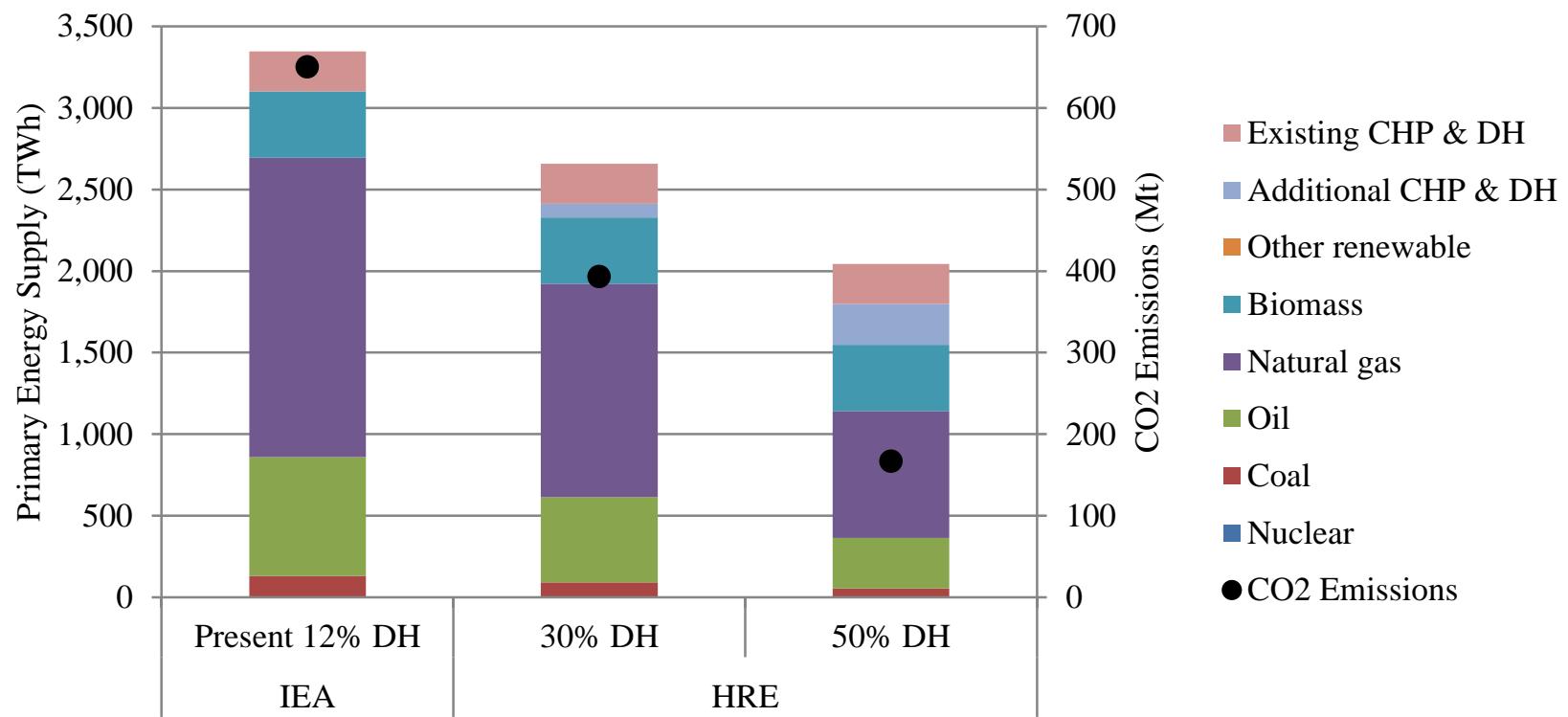


# 2010 Modelling



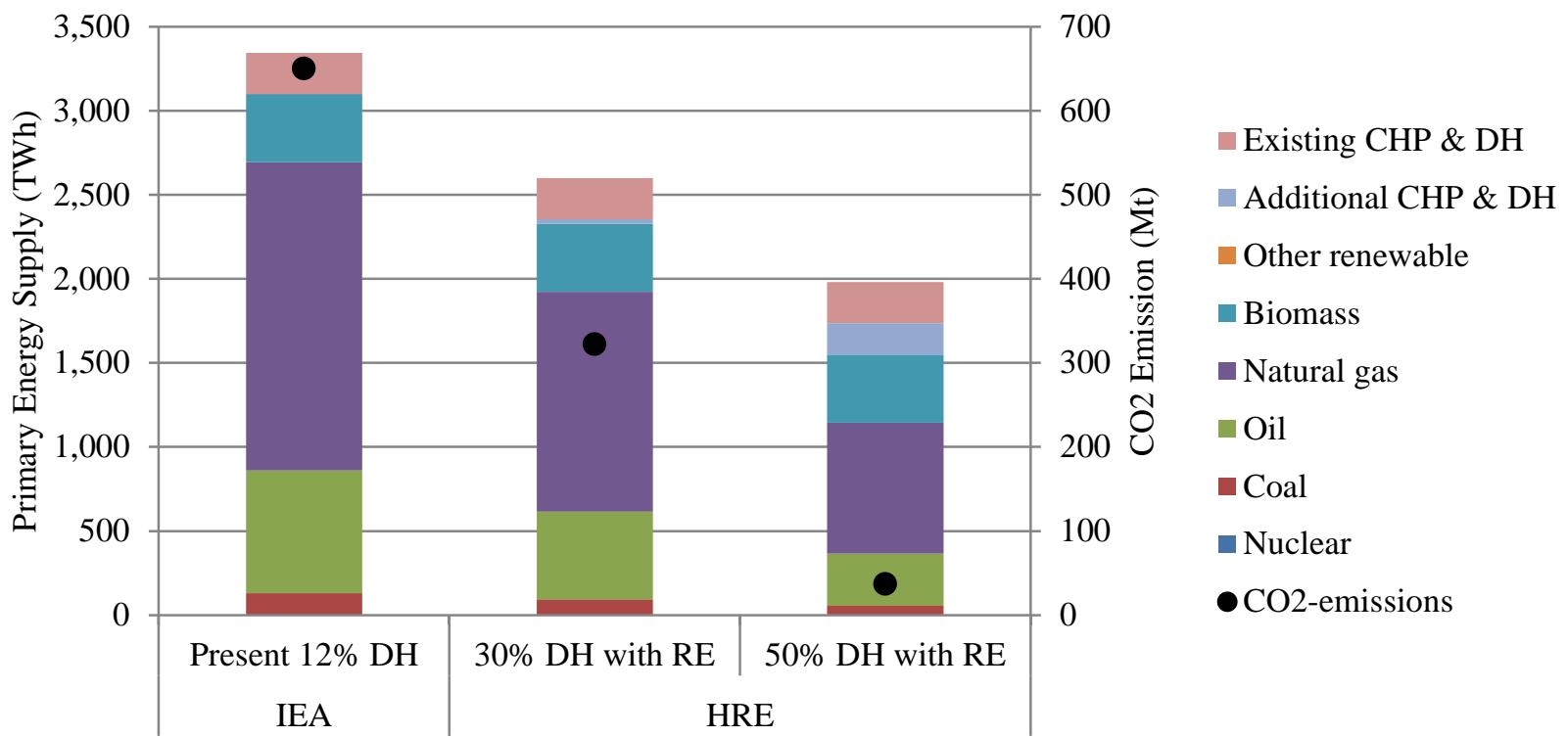
# 2010 Step 1: Energy Efficiency

**EU 27 Primary Energy Supply and CO2 for Heating Buildings in 2010 at Different DH Penetrations**



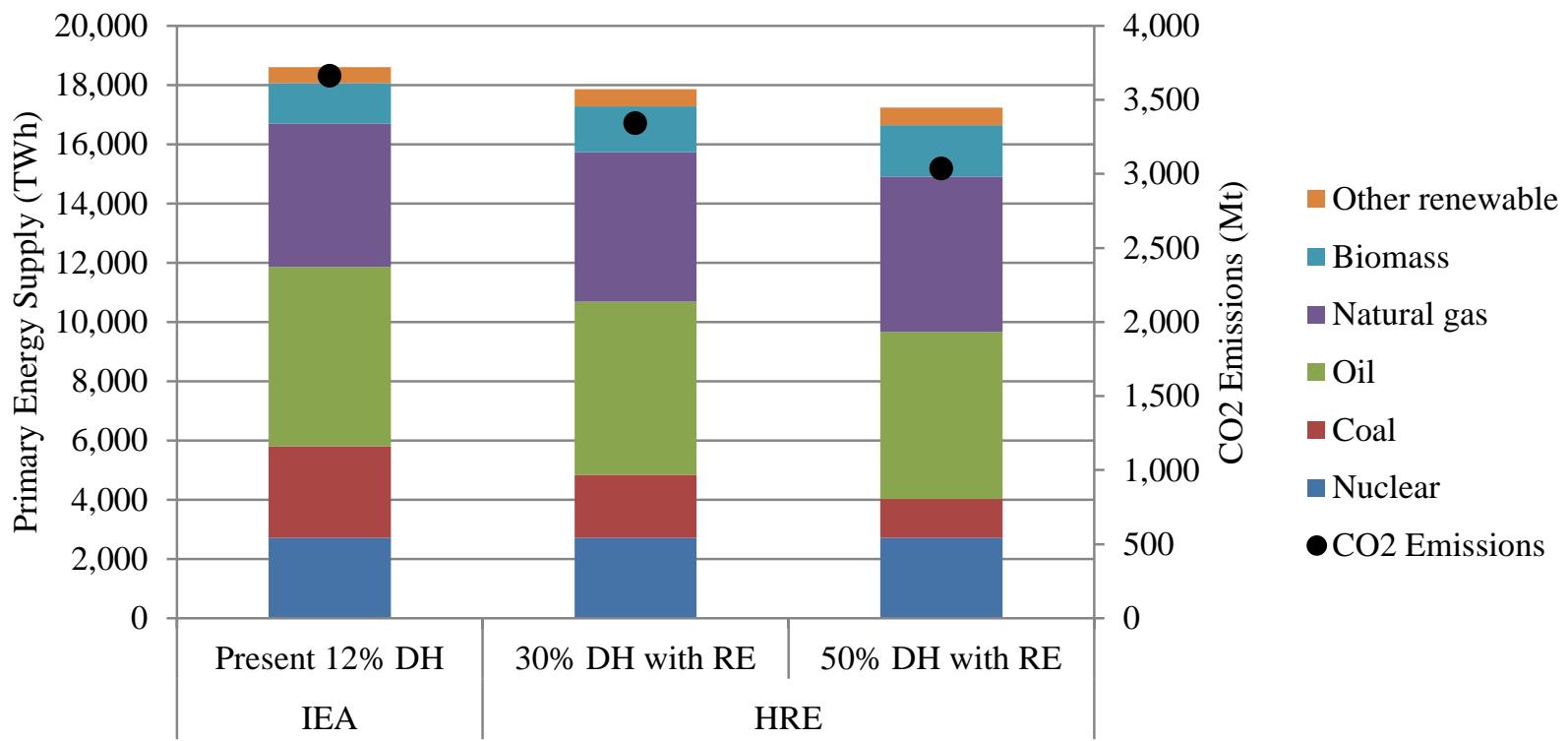
# 2010 Step 2: Utilising Resources

**EU 27 Primary Energy Supply & CO<sub>2</sub> for Heating Buildings in 2010 at Different DH Penetrations while also Utilising RE Resources**

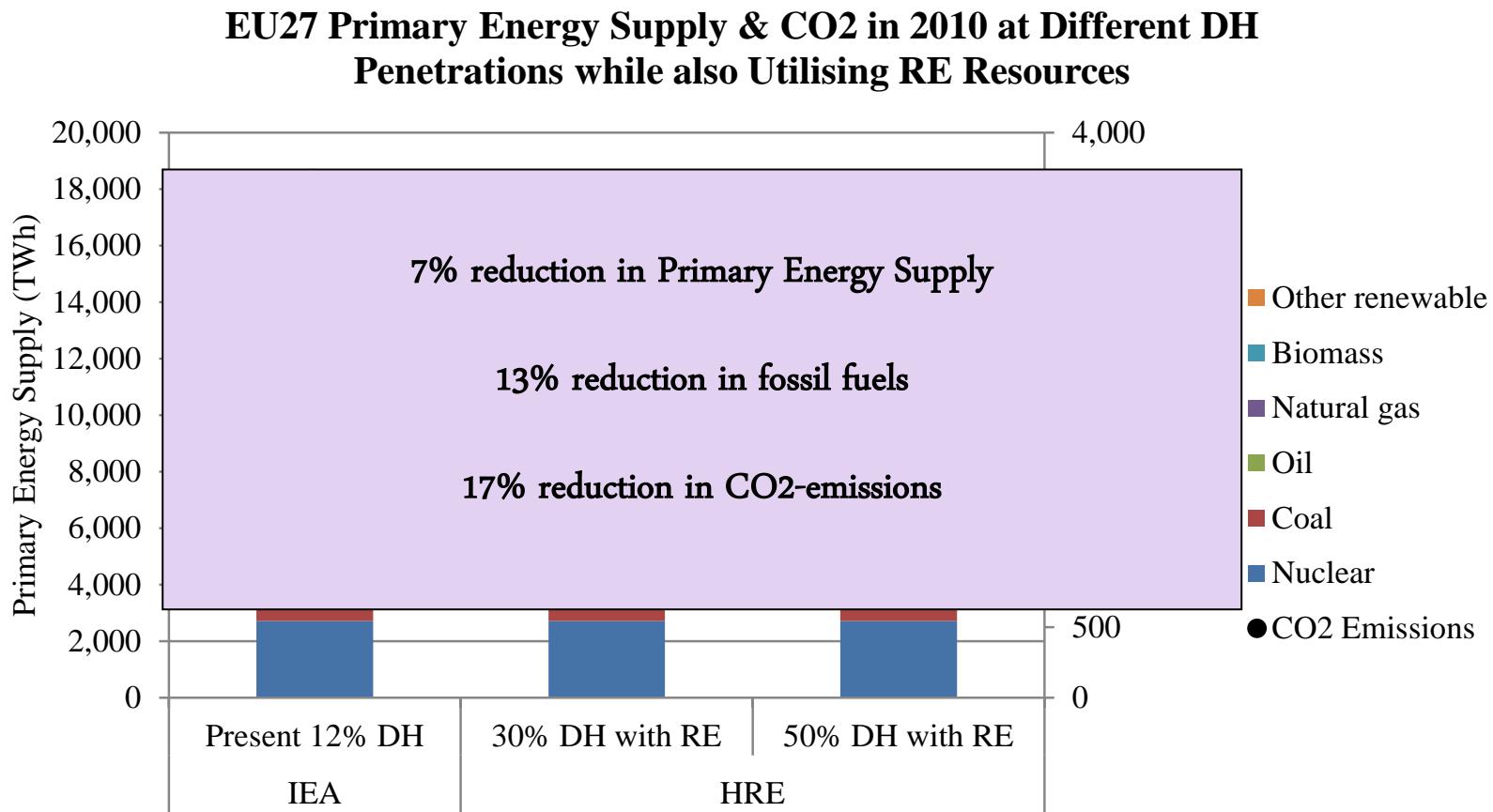


# Total European Energy Supply

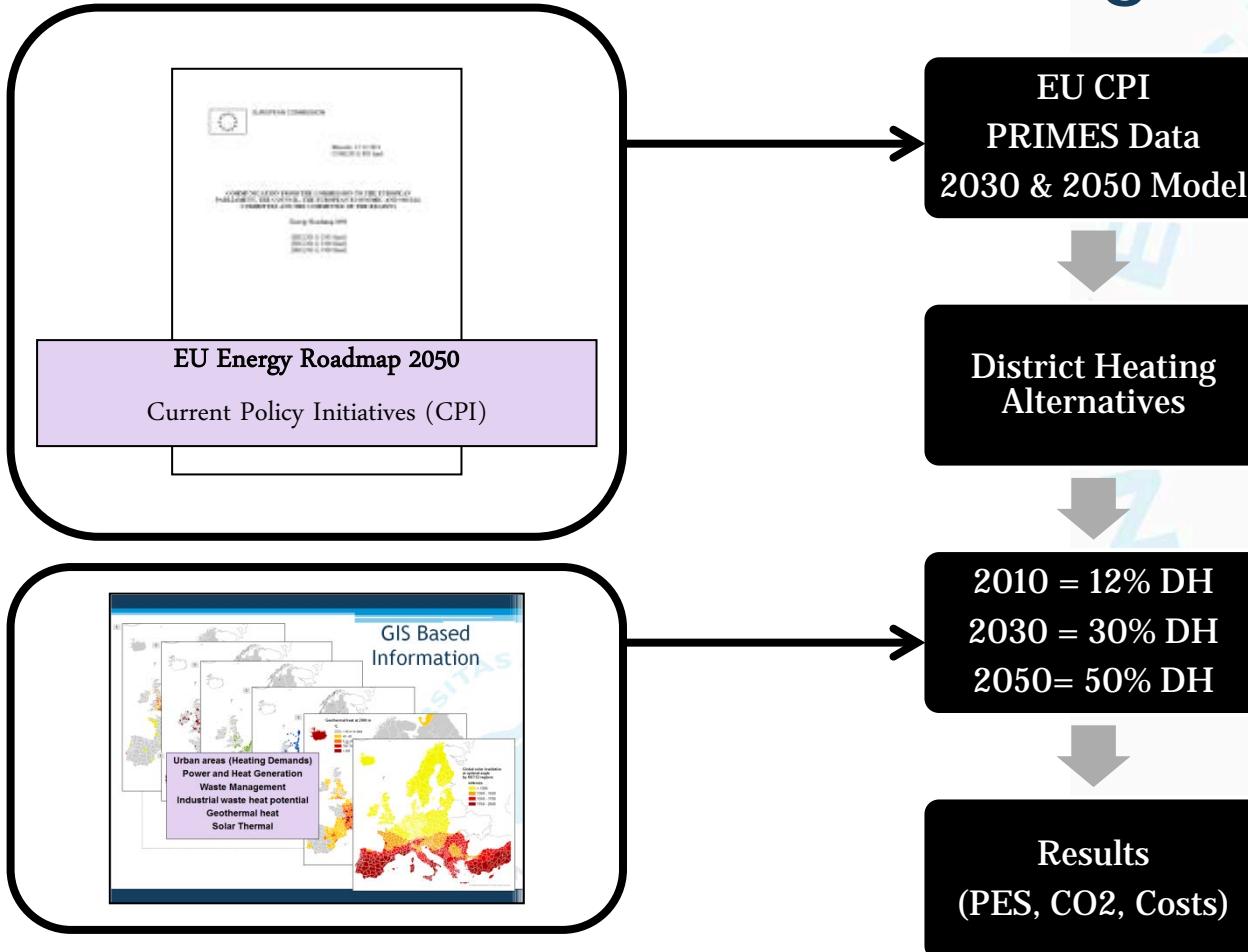
**EU27 Primary Energy Supply & CO<sub>2</sub> in 2010 at Different DH Penetrations while also Utilising RE Resources**



# Total European Energy Supply

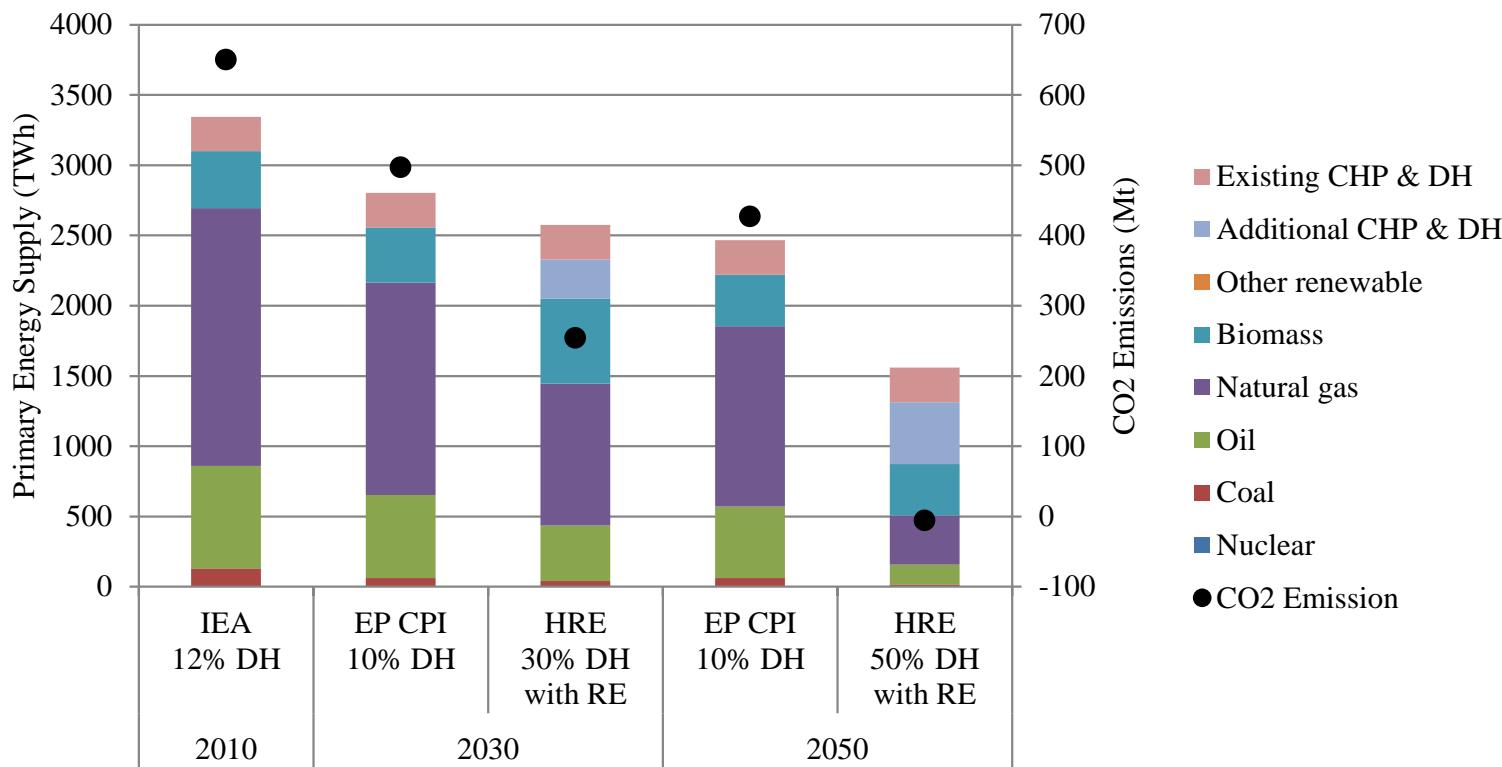


# 2030/2050 Modelling

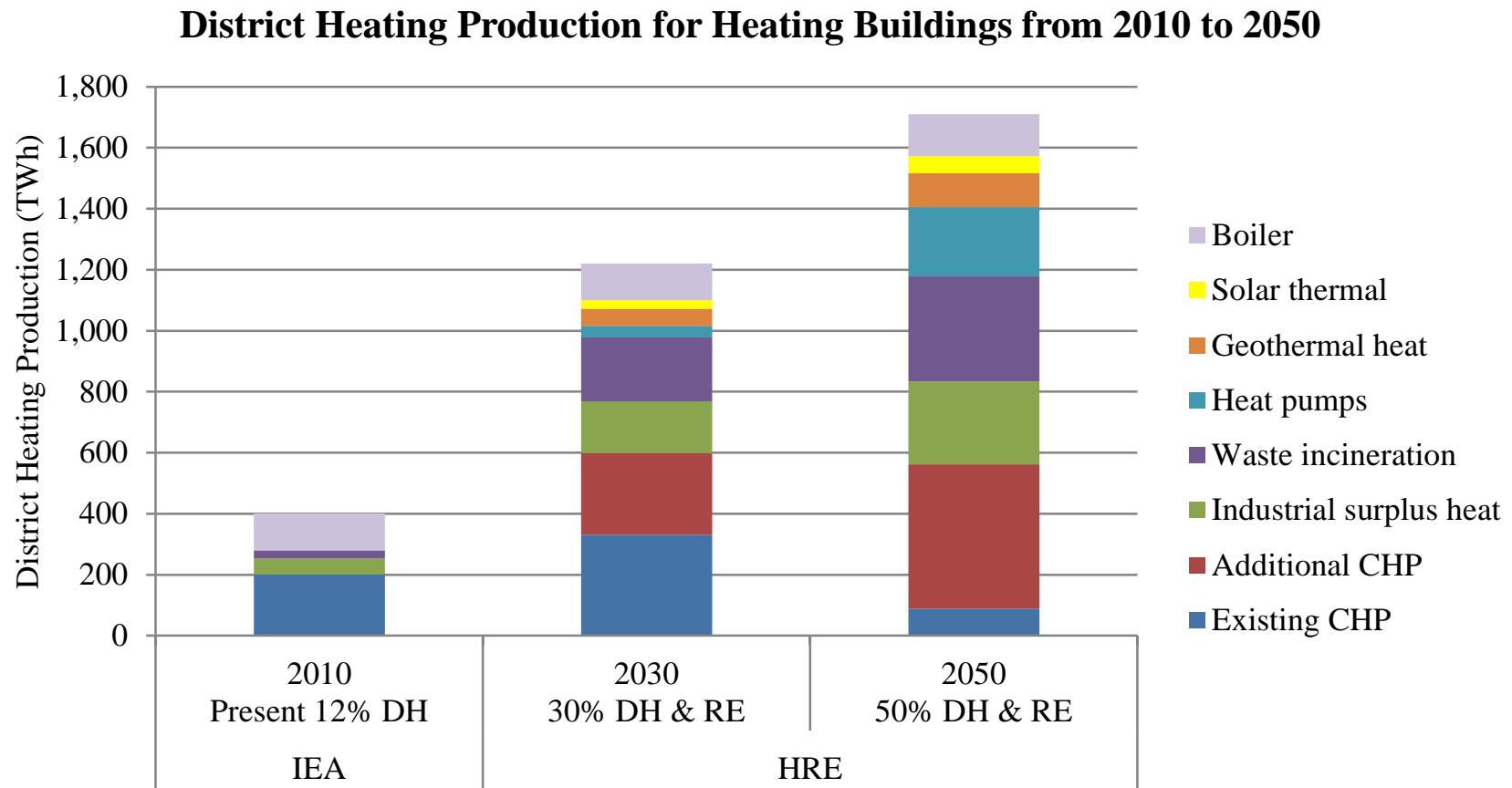


# 2030/2050 Step 1 & 2

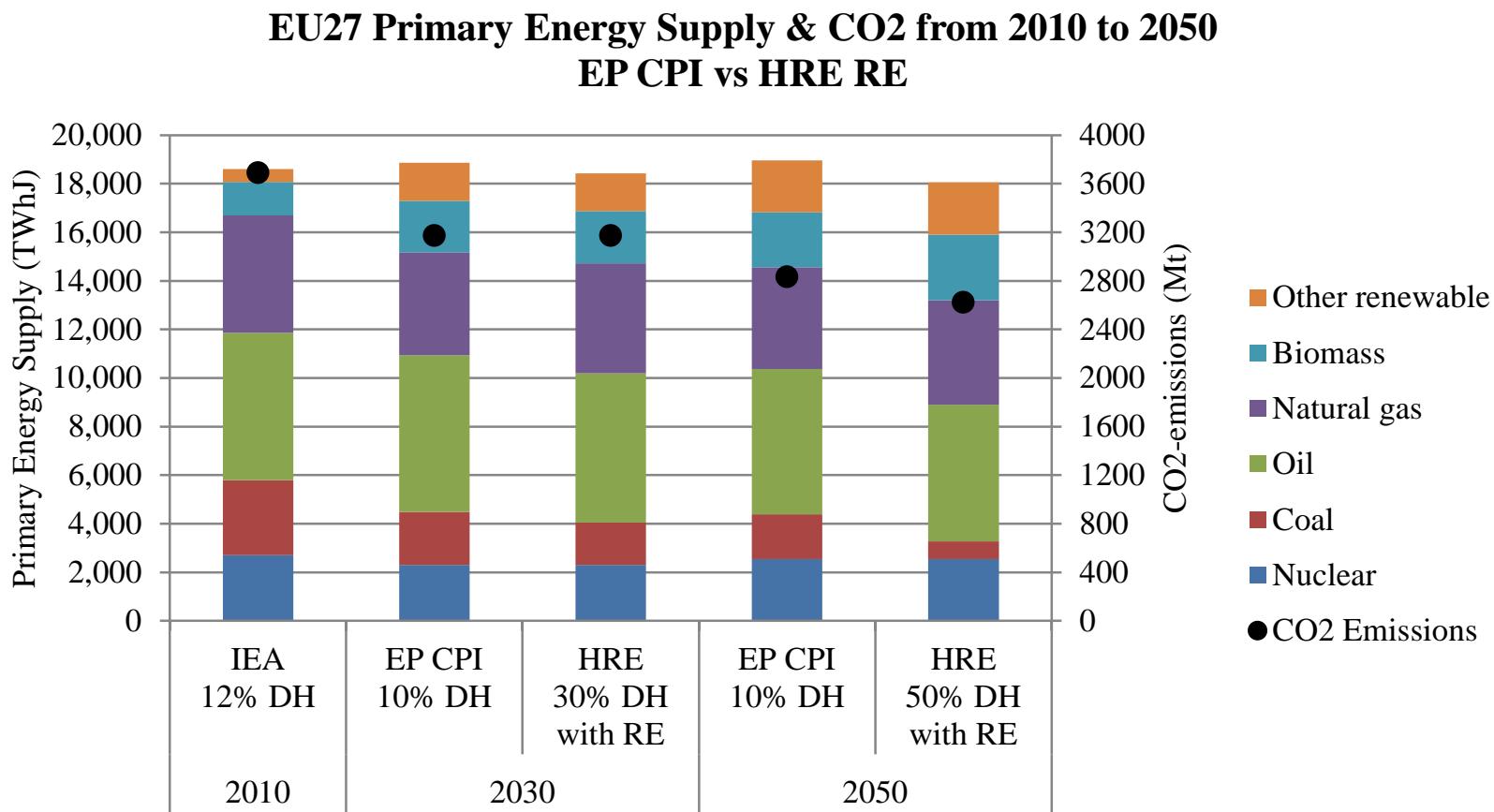
**Primary Energy Supply & CO2 for Heating Buildings from 2010 to 2050  
EP CPI vs. HRE RE**



# District Heating Supply

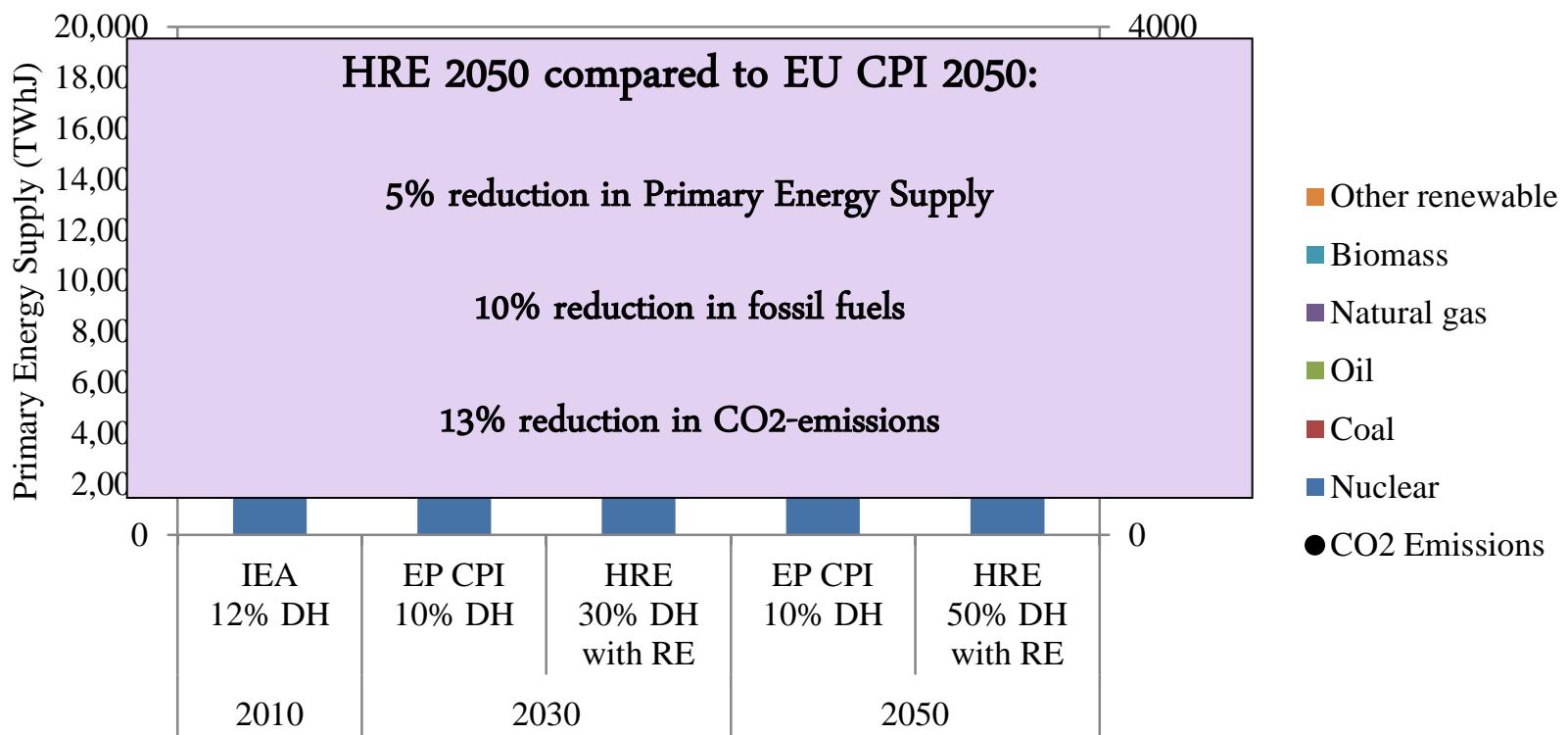


# Total European Energy Supply



# Total European Energy Supply

**EU27 Primary Energy Supply & CO<sub>2</sub> from 2010 to 2050**  
**EP CPI vs HRE RE**

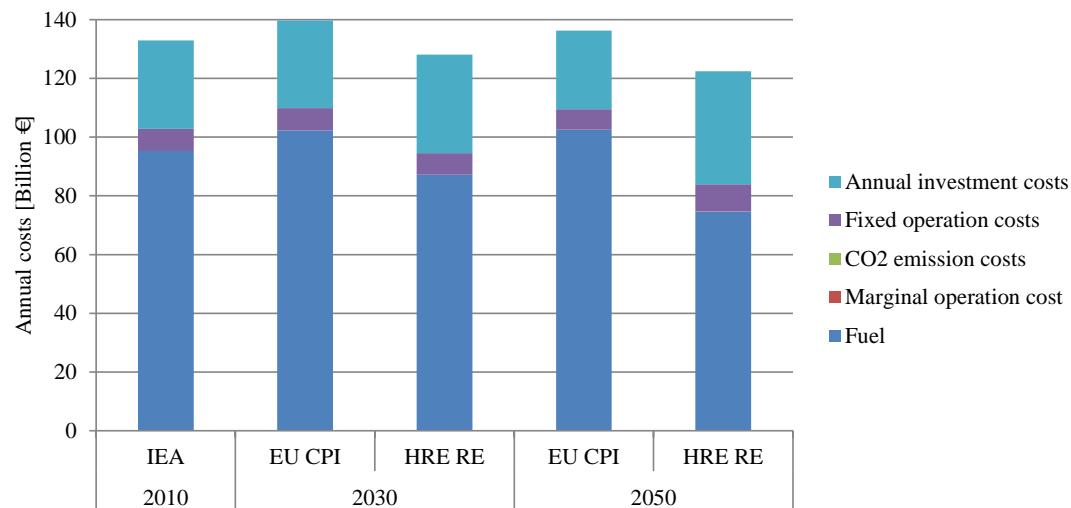


# Cost and Jobs

## 2050

- Annual saved fuel costs of ~€30 Billion
- Total costs reduced by ~€14 Billion

Annual EU27 costs for heating buildings in 2010 to 2050



## 2013-2050

- Total Additional Investment of ~€500 Billion
- Additional jobs:
  - 8-9 million man-years in total
  - Approximately 220,000 jobs/year

# Conclusion: 50% DH and CHP



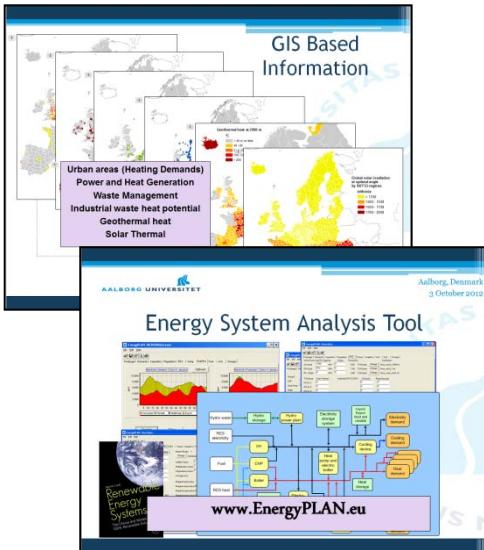
- Decrease primary energy supply and especially fossil fuels and CO<sub>2</sub> emissions
- Decrease annual costs of energy in Europe by approximately €14 Billion in 2050
- Create additional 220,000 jobs over the period 2013-2050
- Further integration of RES

# Conclusion: 50% DH and CHP



- Decrease primary energy supply and especially fossil fuel and CO<sub>2</sub> emissions  
**LESS FUEL**
- Decrease annual costs of energy in Europe  
**LESS MONEY**  
Billion in 2050
- Create additional 1000 000 jobs over the period 2015-2050  
**MORE EU JOBS**
- Further  
**MORE RE**

# Conclusion: Methodology



- Use a low-heat demand scenario i.e. energy efficiency scenario
- More detailed understanding of the energy balance data
- Advocate more heat data in future IEA/PRIMES energy balances
- Further optimise the DH-scenarios (replace electric heating, expand CHP and HP, include district cooling, further the integration of wind and PV etc.)

# Questions?

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<http://www.euroheat.org/Heat-Roadmap-Europe-165.aspx>

