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## Including Health Cost in the CEEH version of the Energy System Optimisation Model Balmorel

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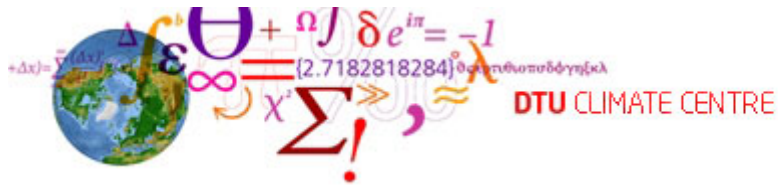
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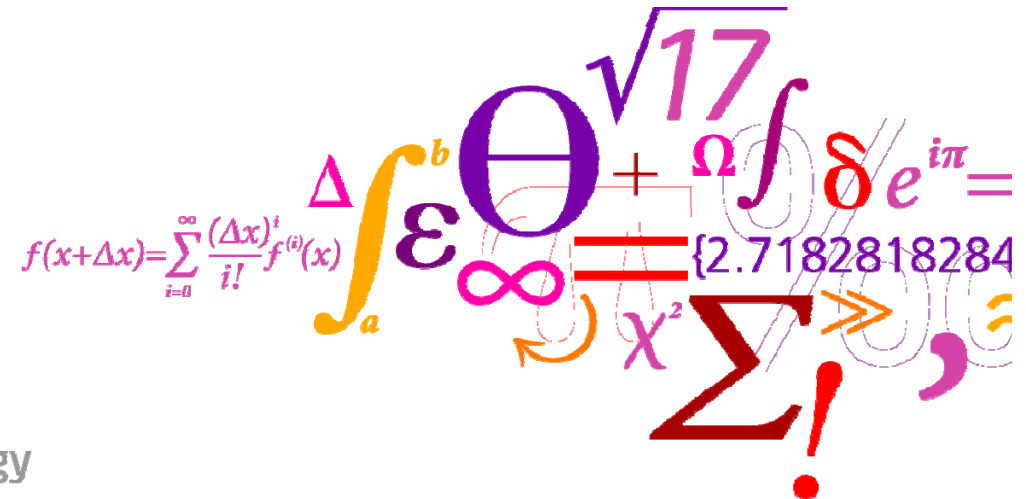
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# Including Health Cost in the CEEH version of the Energy System Optimisation Model Balmorel

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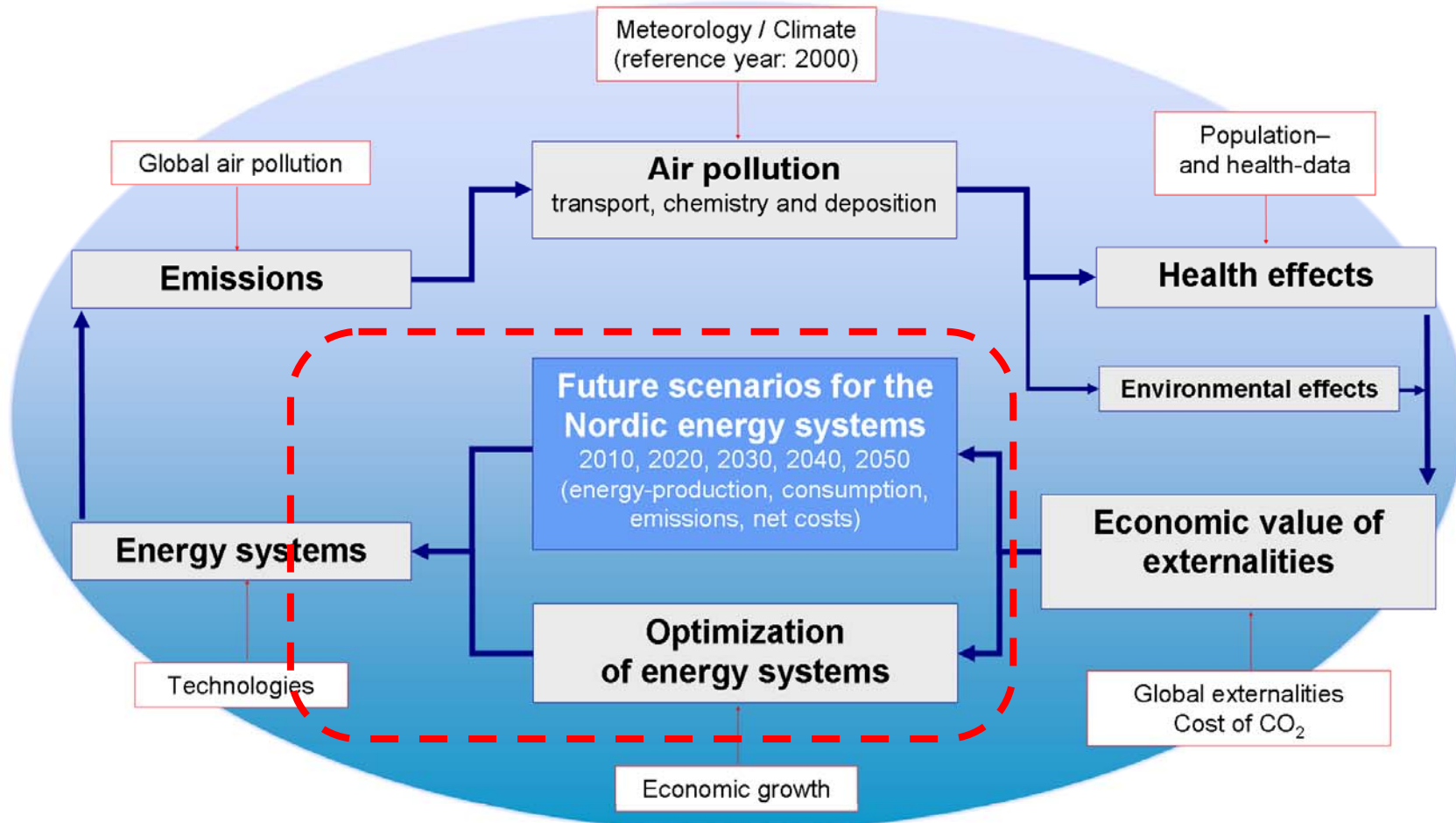
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May 31<sup>st</sup>, 2010  
Copenhagen, Denmark



**Risø DTU**  
National Laboratory for Sustainable Energy

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# CEEH Modelling Framework



# Balmorel in Brief

## Model:

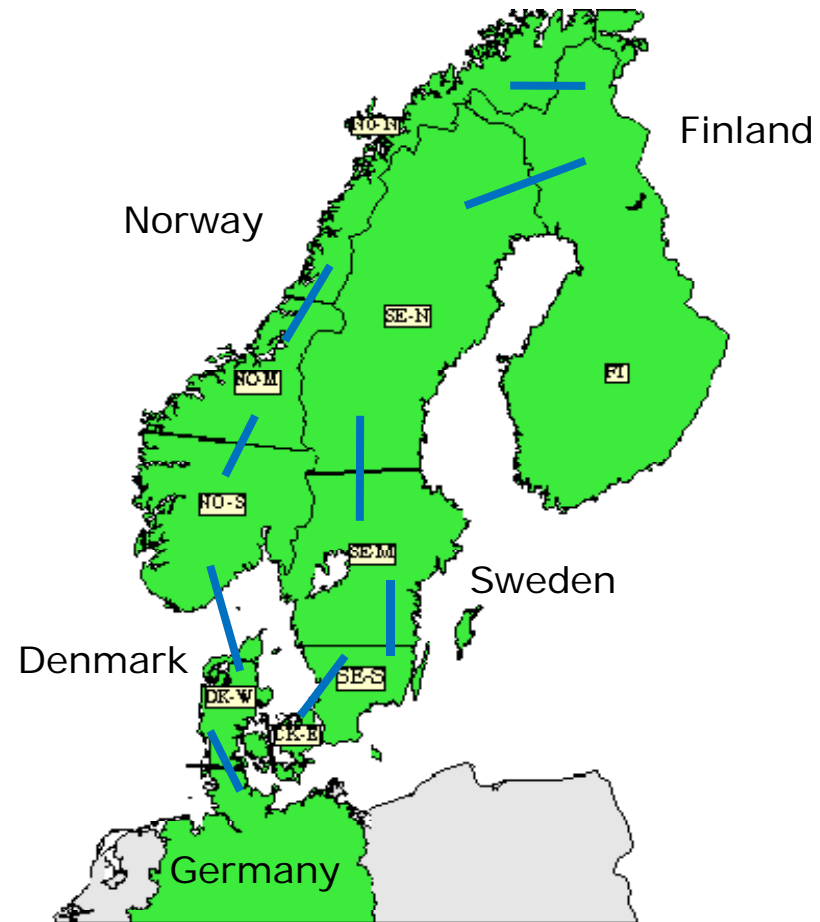
Multi region linear optimisation model,  
 Interregional power market,  
 Regional district heat markets

## Exogenous input:

Energy prices,  
 Electricity demand in regions,  
 Heat demand in heat areas

## Results:

Prices on traded energy,  
 Investments in power plants,  
 Investments in transmission lines,  
 Emissions from each region



## Balmorel: Additional Features

### Health Costs

Mechanism to take into account damage arising from emission of SO<sub>2</sub>, CO, PM<sub>2.5</sub>, and NO<sub>x</sub>.

Possible to take into account factors like population density, meteorology by varying cost depending on an area.

### Heat Savings (E. Zvingilaite)

Possibility to invest in heat saving measures and thereby reduce heat demand. Dependent upon renovation rate, building type, potential.

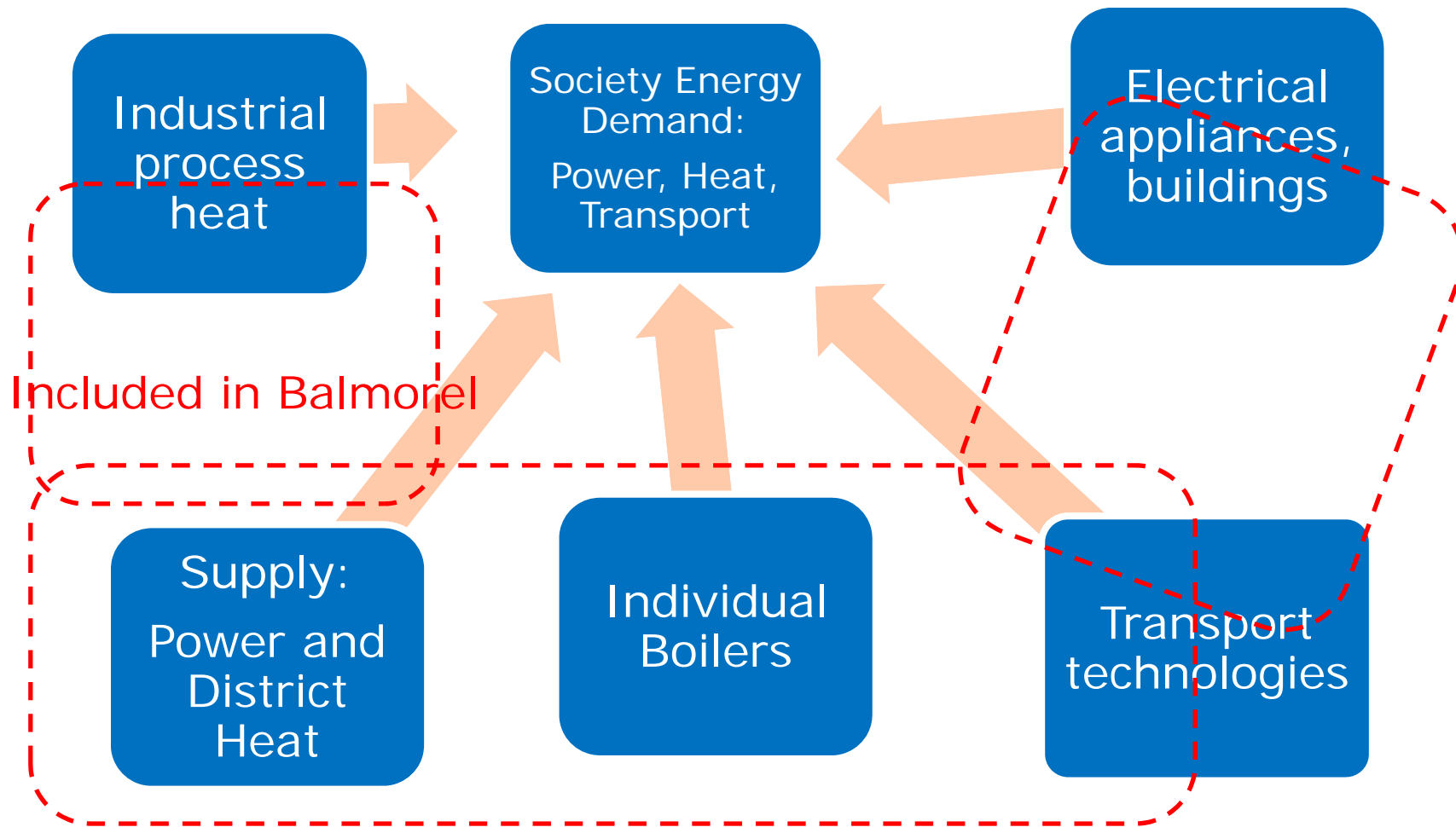
### Individual Heating (E. Zvingilaite)

Handling individual heating investment options, related emissions etc.

### Hydrogen (K. Karlsson and P. Meibom)

Utilisation of hydrogen-based technologies for transport and electricity storage.

# Energy System

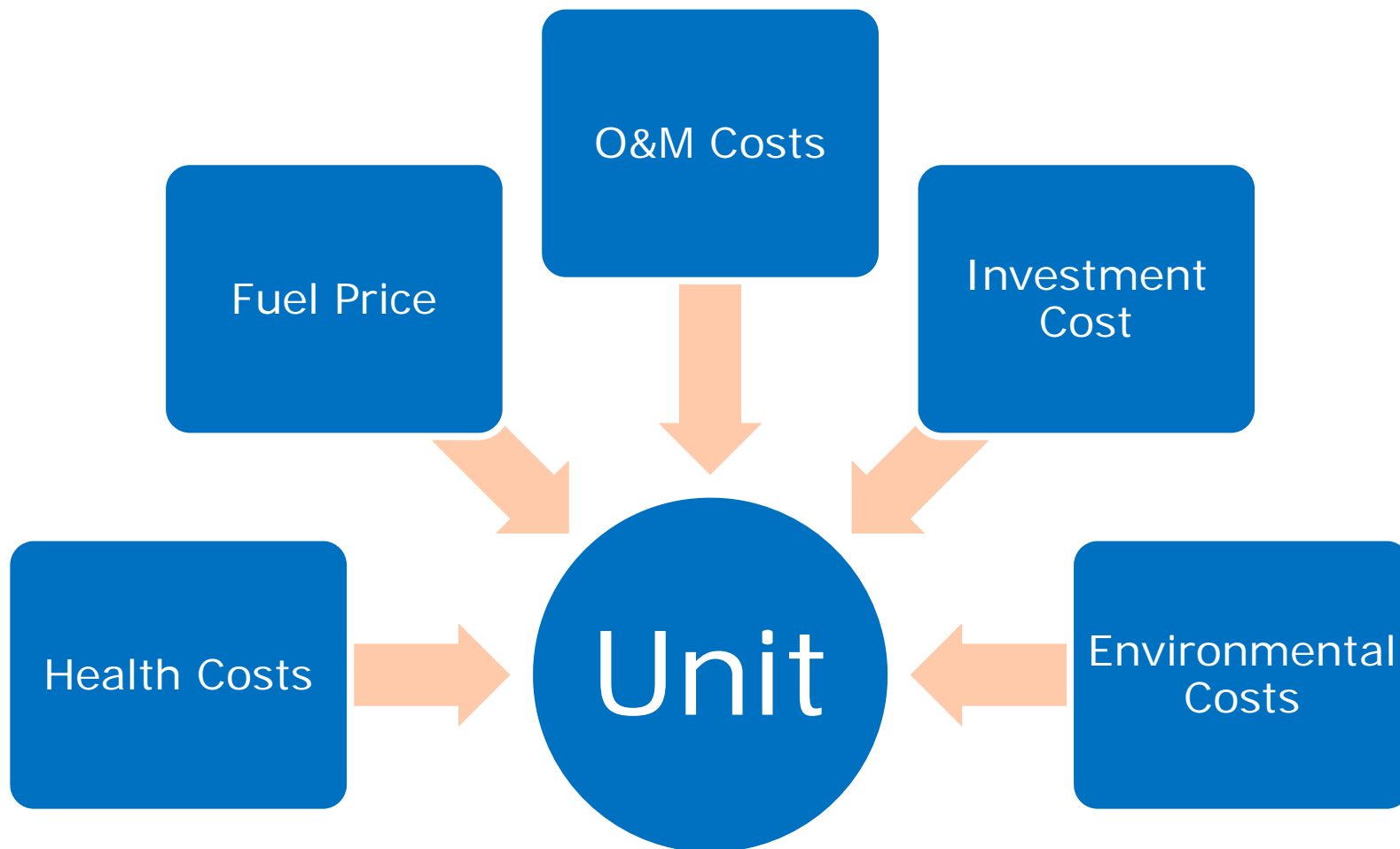


# Health Costs

Sector	Emission year	CO [C]	S [S]	N [N]	PM25
Combustion in energy and transformation	2000	0,001	22,2	23,9	19,2
Non-industrial combustion plants	2000	0,002	32,7	33,8	28,4
Combustion in manufacturing industry	2000	0,001	27,0	27,6	19,8
Production processes	2000	0,014	44,9	110,5	41,2
Road transport	2000	0,003	188,5	33,3	44,4
International ship traffic	2000	0,000	26,7	26,3	22,1

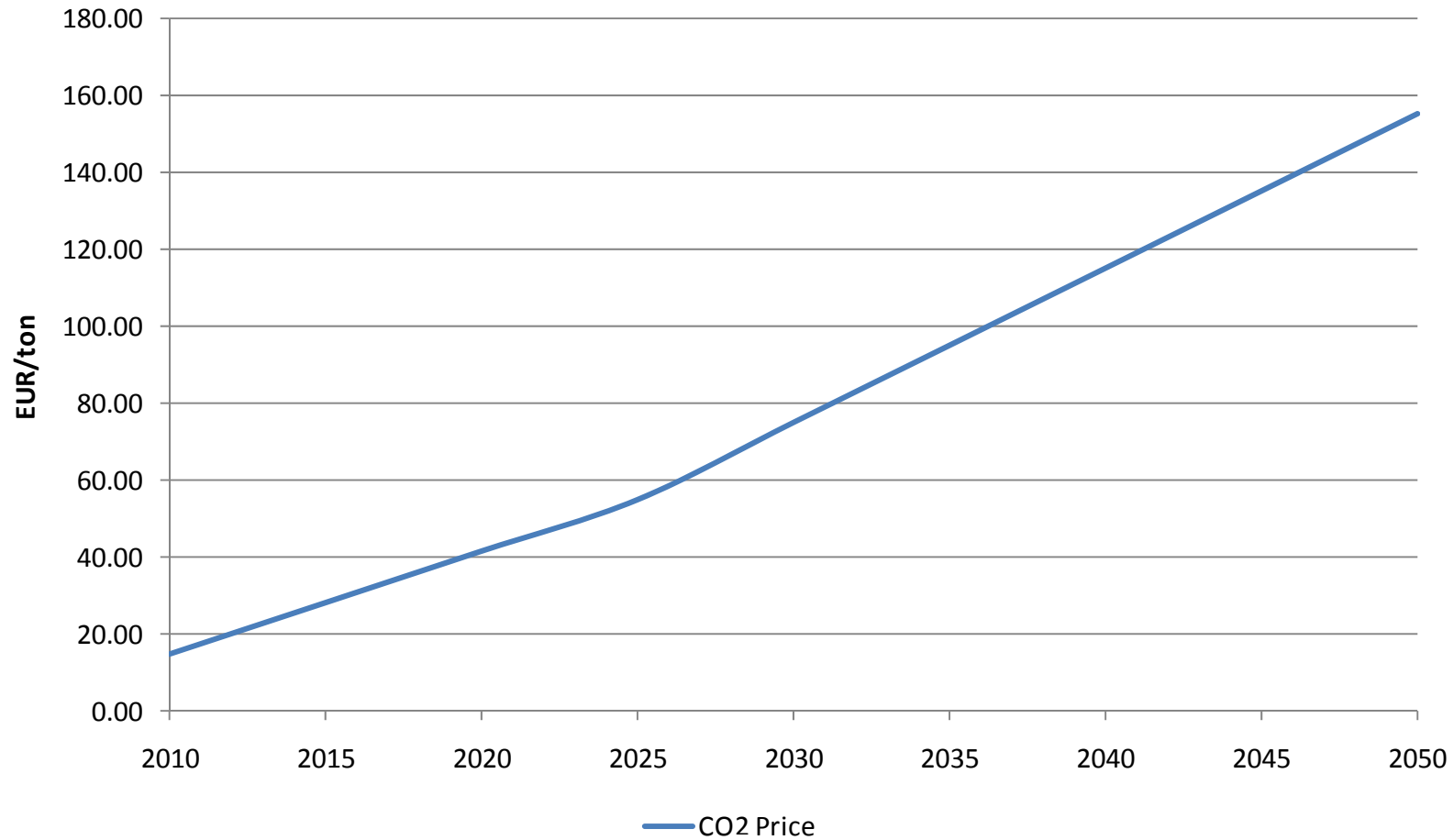
Cost in EUR/kg

# Energy System Modelling: Cost of Running a Unit in an Energy System

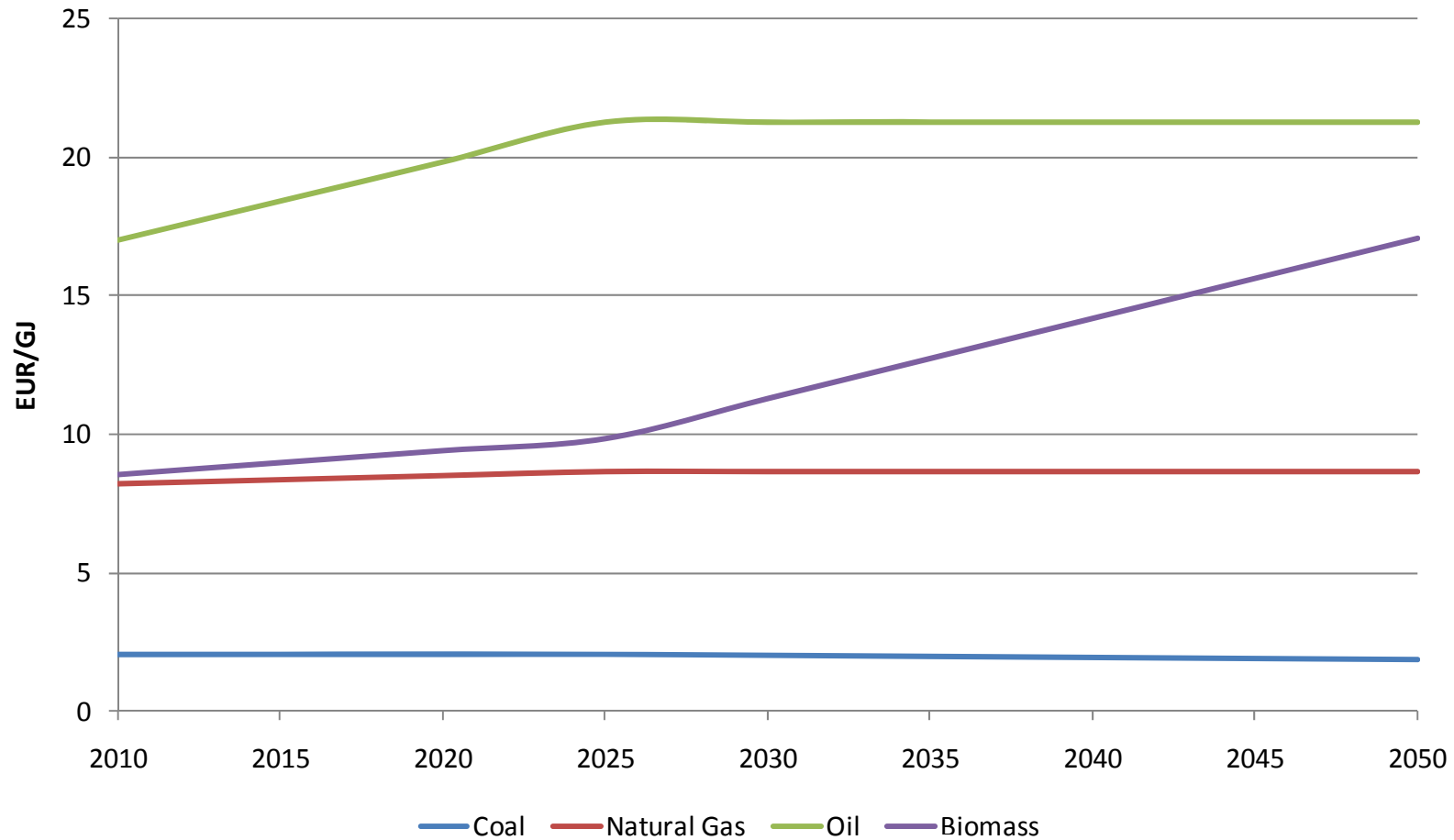




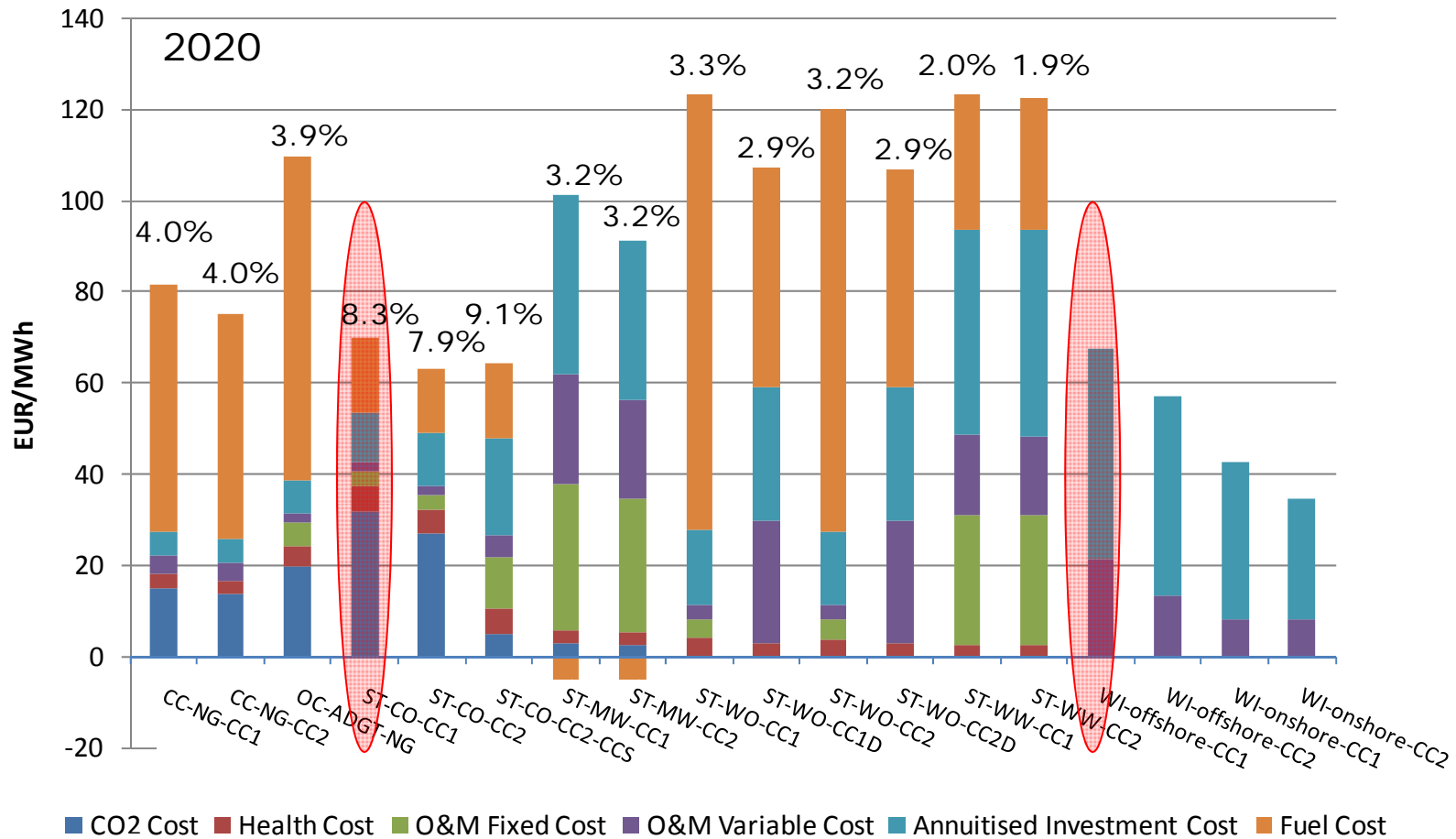
# Assumptions I: CO2 Price Development



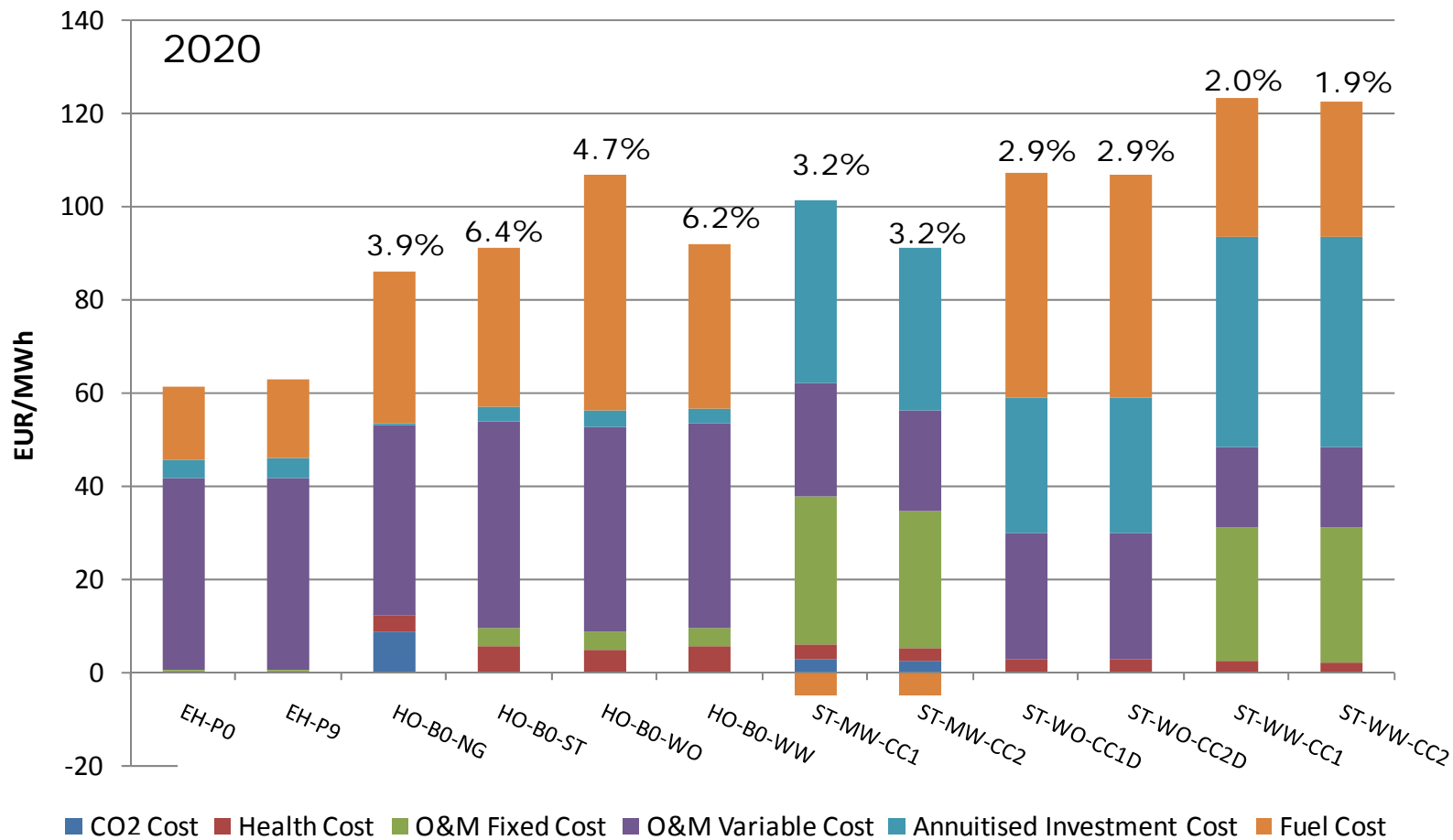
# Assumptions II: Fuel Price Development



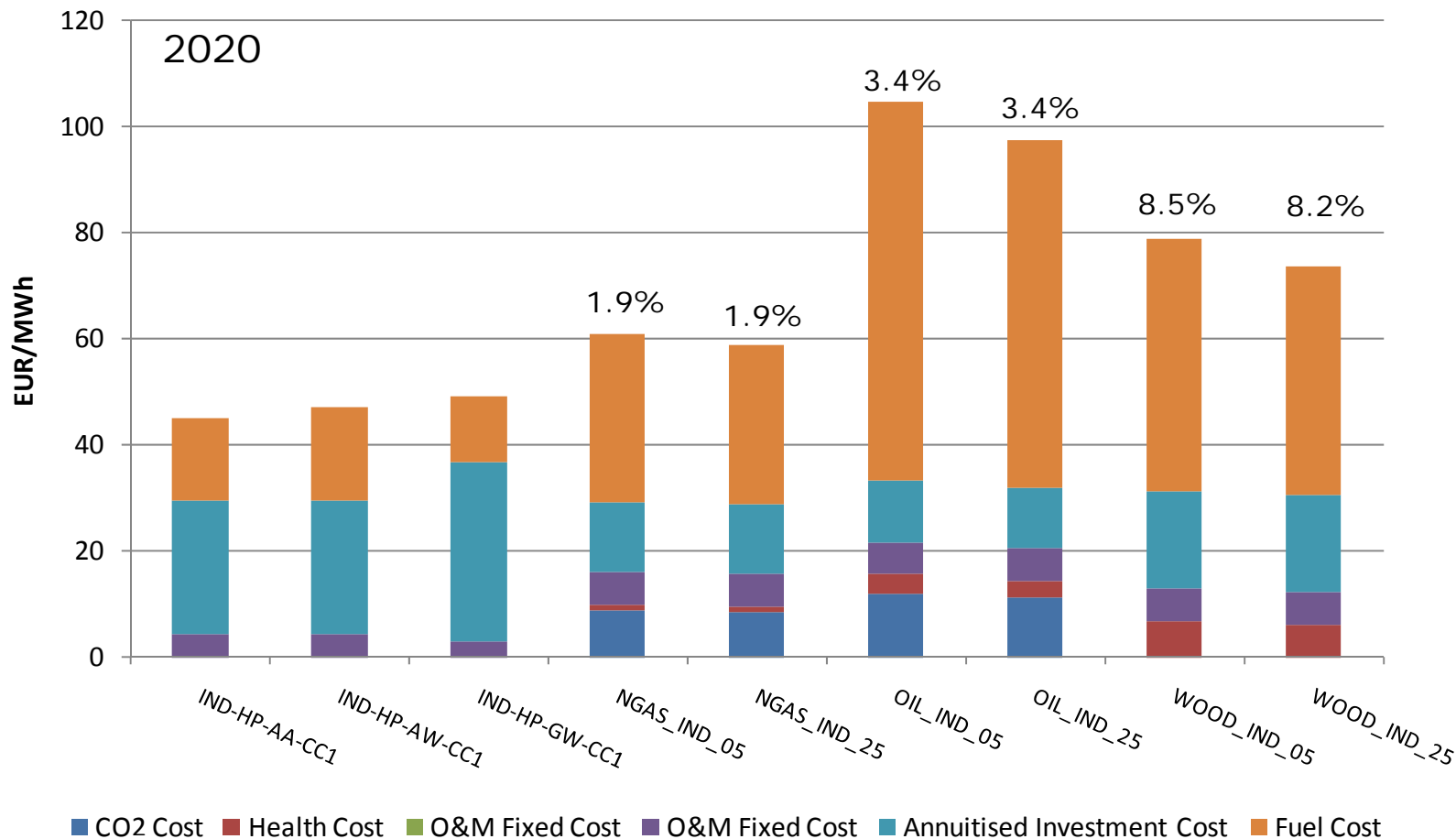
# Technology Competitiveness I: Electricity



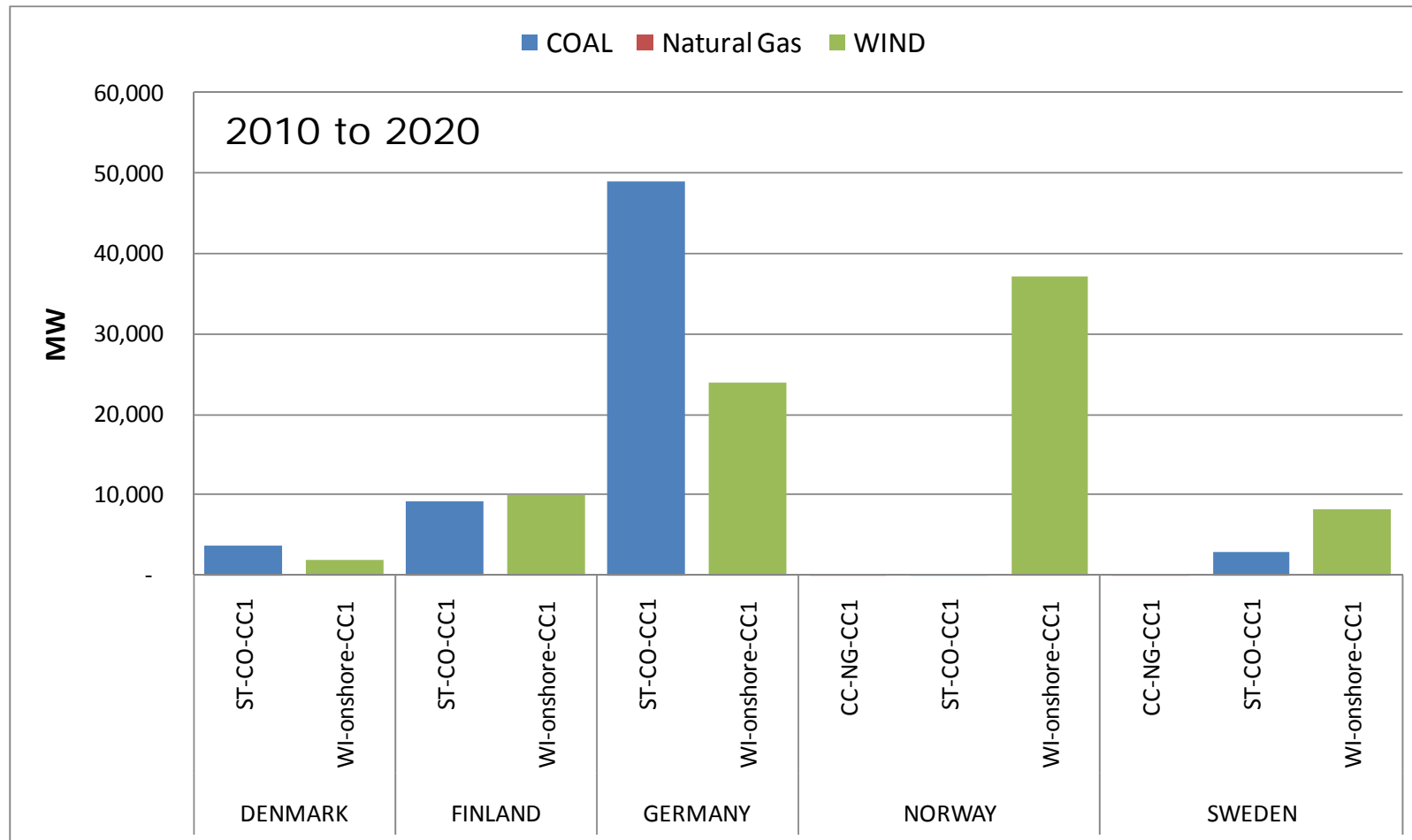
# Technology Competitiveness II: District Heating

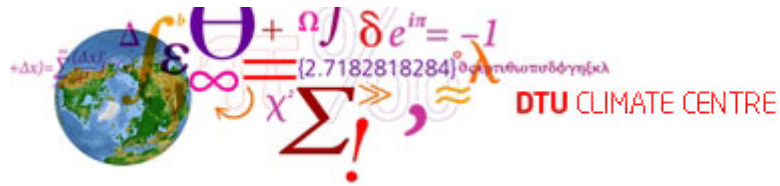


# Technology Competitiveness III: Individual Heating



## Example of Results: New Power Capacity





# Way Forward

## **Inclusion of transportation**

Possibility of investing in car fleet

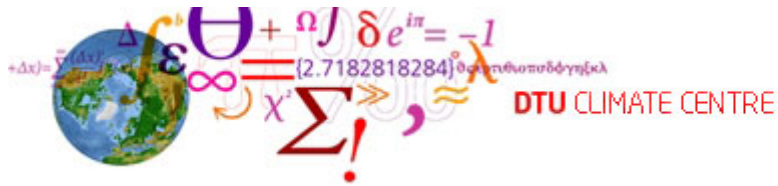
Competition between different technologies, e.g. electric, gasoline.

## **Inclusion of industrial processes**

Possibility of fuel substitution

## **Electricity Savings**

Possibility of investing in more efficient appliances



# THANK YOU FOR YOUR ATTENTION!

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<http://www.dtu.dk/centre/klimacenter/english>