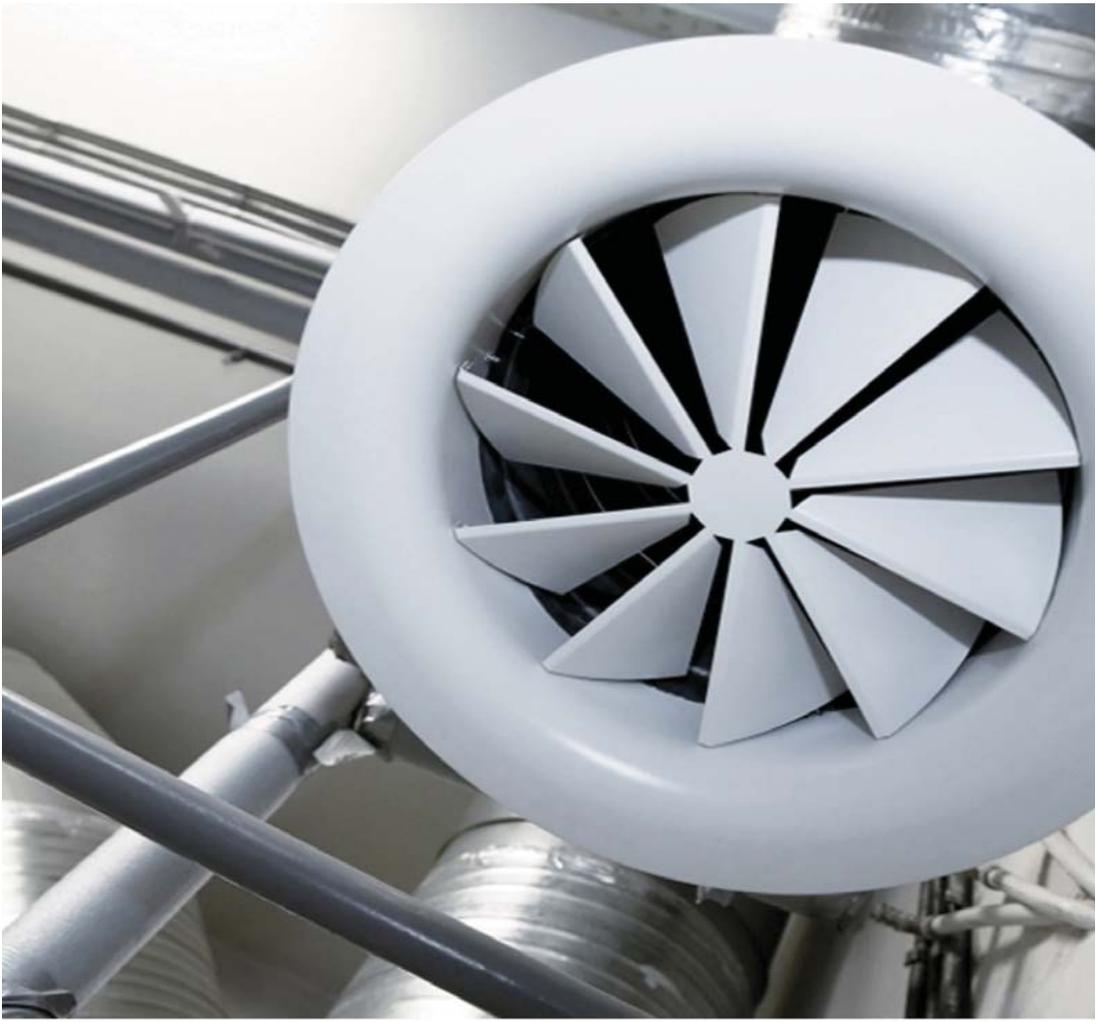
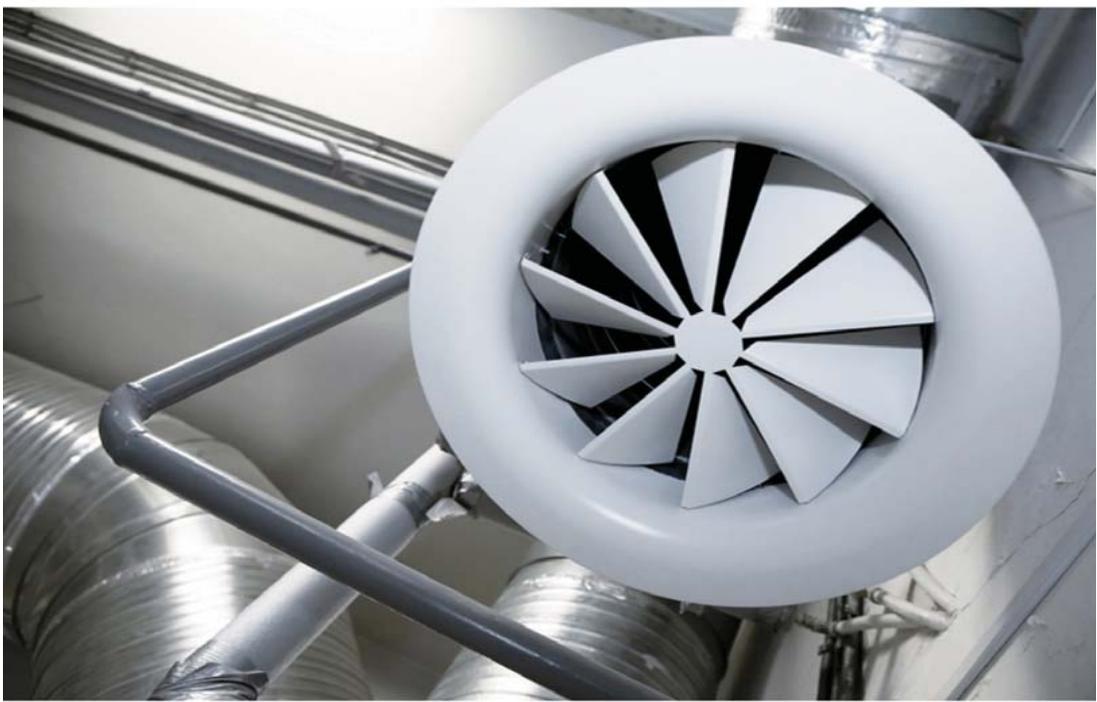


South  
**More efficient  
ventilation**

ELECTRICITY



Ventilation contributes to a large part of the electricity consumption. Significant electricity savings can be achieved by cleaning ducts and by using electronics for smarter control of fans.

Cost: 100 MEUR

**EFFECT**



**More efficient ventilation**



**Change Card - Electricity 1**

South

# Phase out halogen lightbulbs

ELECTRICITY



Halogen light bulbs only convert about 5% of electricity to light, the rest is lost as heat. Other slightly more expensive lamps (LEDs and CFLs) have a 2-4 times higher efficiency.

Cost: 200 MEUR

**EFFECT**



## Phase out halogen lightbulbs



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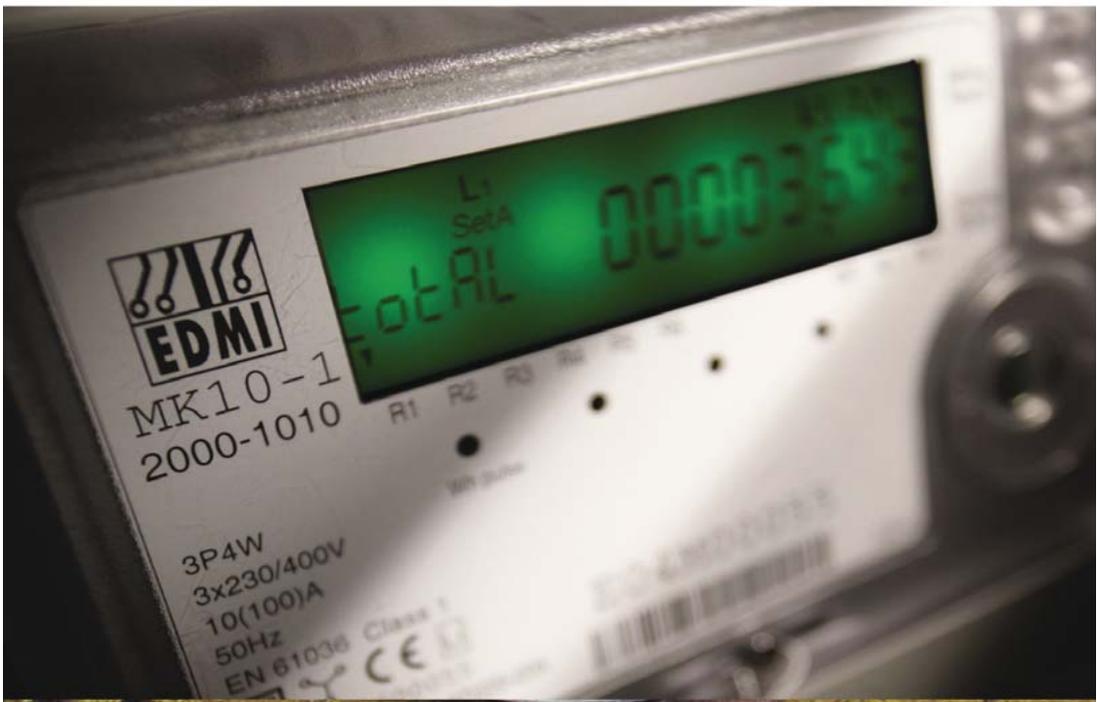
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Change Card - Electricity 2

South

ELECTRICITY

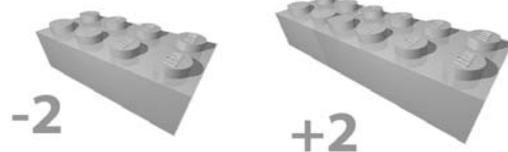
## Smart metering



Smart metering will give consumers incentives to shift consumption (technically or behaviorally) to hours where demand is generally low or uncontrollable production is high.

Cost: 400 MEUR

**EFFECT**



## Smart metering



Change Card - Electricity 3

South

## More efficient appliances

ELECTRICITY



Many appliances, such as freezers, refrigerators and washing machines, can be far more energy efficient by using better technology.

Cost: 600 MEUR

**EFFECT**



-2

## More efficient electrical appliances

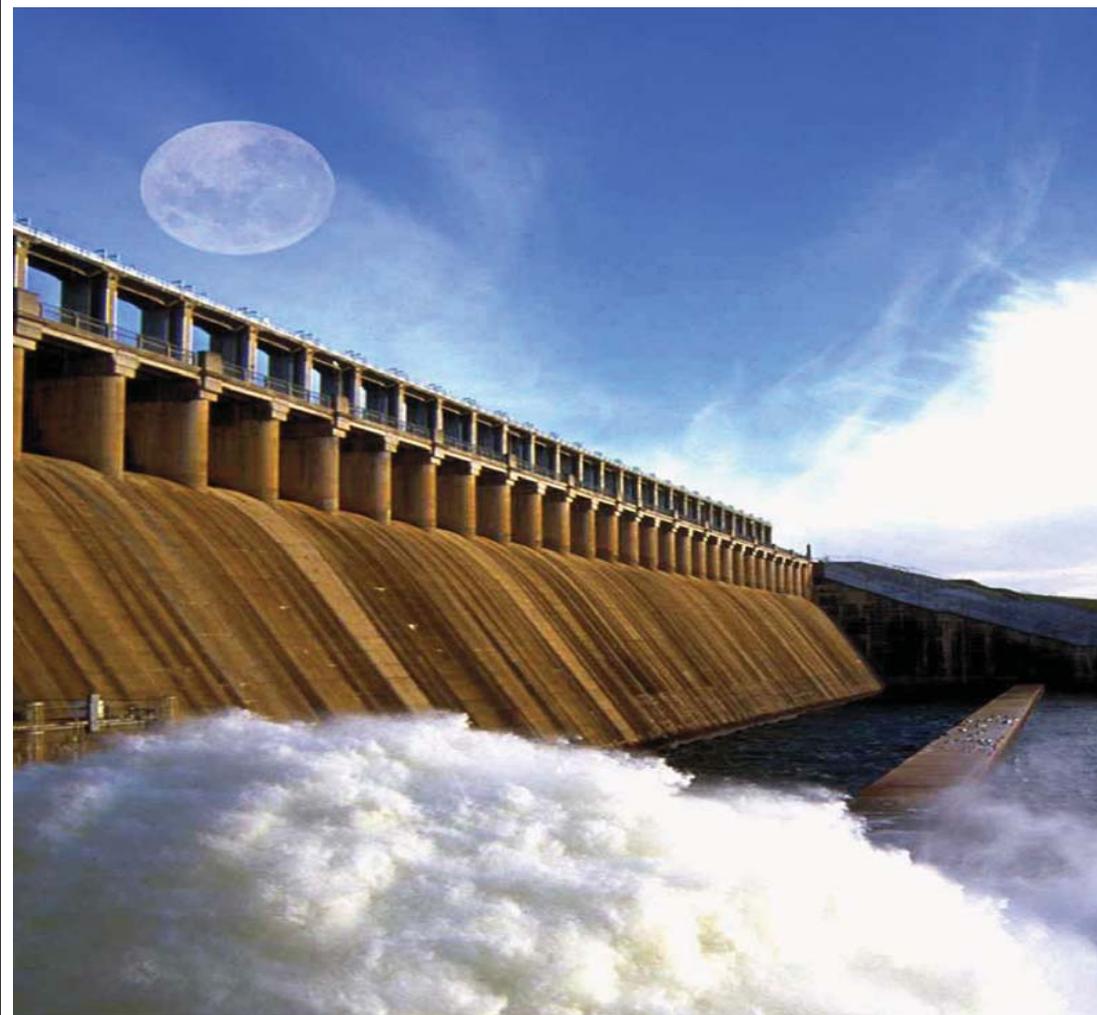
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Change Card - Electricity 4

South

ELECTRICITY

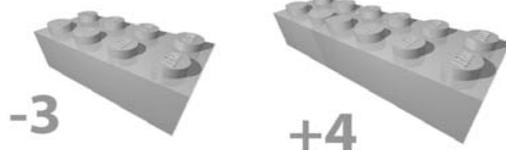
## Electrical storage



Excess electricity can be converted temporarily to another form by pumping water uphill, compressing air or generating hydrogen. Converting the electricity comes with losses.

Cost: 1000 MEUR

**EFFECT**



## Electrical storage

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Change Card - Electricity 5

South

ELECTRICITY

## Less use of electronics



A significantly decreased use of TVs, computers and various other electronics would lead to large electricity savings.

Cost: 0 MEUR

**EFFECT**



-1



## Less use of electronics

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Change Card - Electricity 7

South

## Eliminate standby consumption

ELECTRICITY



POWER



Standby consumption makes up about 10% of a household's electricity demand. It could almost be eliminated by using efficient technology or by switching appliances off completely.

Cost: 0 MEUR

**EFFECT**



-1

## Eliminate standby consumption

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Change Card - Electricity 6

South

## Better insulation 1

HEATING



To a large extent, heating and cooling costs can be reduced by investments in better insulation. A large improvement can be achieved with small changes that basically pay for themselves.

Cost: 1500 MEUR

**EFFECT**



## Better insulation 1



Change Card - Heating 1

South

## Better insulation 2

HEATING



Further investment into insulation are more expensive relative to fuel savings.

Cost: 6000 MEUR

**EFFECT**



## Better insulation 2



Change Card - Heating 2

South  
**Replace electric heating**

HEATING



Electric heating has been installed in many countries. Electricity is converted directly into heat. Heating with electricity uses 2-3 times more primary energy than burning fuel in a stove within a building.

Cost: 300 MEUR

**EFFECT**



**Replace electric heating**



**Change Card - Heating 3**

South

## Solar architecture

HEATING



Heating, cooling and lighting demands can be improved by considering local sun and weather conditions in design and construction. This affects only new buildings.

Cost: 600 MEUR

**EFFECT**



## Solar architecture

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Change Card - Heating 4

South

## Active solar heating

HEATING



Energy from sunlight can to some extent replace fuels to heat water and buildings if solar collectors are used.

Cost: 1000 MEUR

**EFFECT**



## Active solar heating



Change Card - Heating 5

South  
**Lower indoor  
temperature**

HEATING



A less comfortable indoor temperature reduces the energy need for heating.

Cost: 0 MEUR

**EFFECT**



**Lower indoor temperature**



**Change Card - Heating 6**

South  
**Higher indoor  
temperature**

HEATING



Less comfortable indoor temperature during summertime. This reduces the electricity consumption for air-conditioning but reduces the energy service level.

Cost: 0 MEUR

**EFFECT**



-2

**Higher indoor temperature**

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**Change Card - Heating 7**

South

## District heating

HEATING



District heating is applicable in urban areas. The waste heat from combined heat and power plants is distributed as hot water and is used to satisfy heat-demand in buildings.

Cost: 1200 MEUR

**EFFECT**



## District heating



Change Card - Heating 8

South

# Heat pumps

HEATING



Heat pumps use electricity to extract heat from the ground or air and use it to heat or cool buildings. Using one unit of electricity moves about three units of heat.

Cost: 1200 MEUR

**EFFECT**



## Heat pumps



Change Card - Heating 9

South  
**Import energy  
intensive goods**

**INDUSTRY**



Reduce the energy intensity of your economy by importing energy intensive goods (like steel, aluminum and concrete) instead of producing them in your region

**Import energy intensive goods**

Cost: 6000 MEUR

**EFFECT**



-2



-2



-3



-2



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**Change Card - Industry 1**

North  
**Carbon Capture & Storage in Industry**

INDUSTRY



Coal is burned to provide heat for some major industrial processes. The CO<sub>2</sub> resulting from this could be removed by CCS.

This change requires the implementation of "R&D in CCS"!

Cost: 1000 MEUR

**EFFECT**



-2



+2

**NB! CCS coal must be bought from the Bank.**

**CCS in industry**



**ENERGYCROSSROADS**

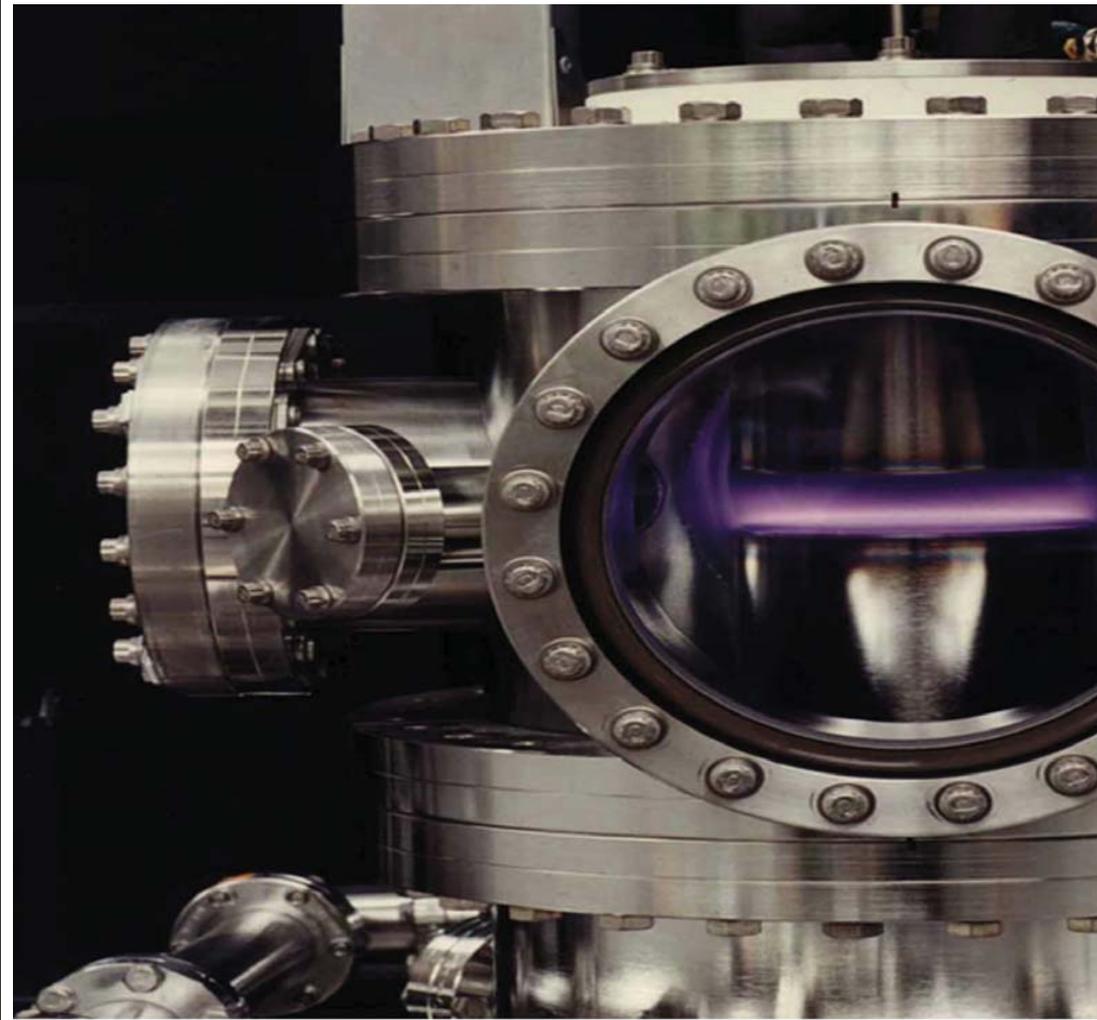
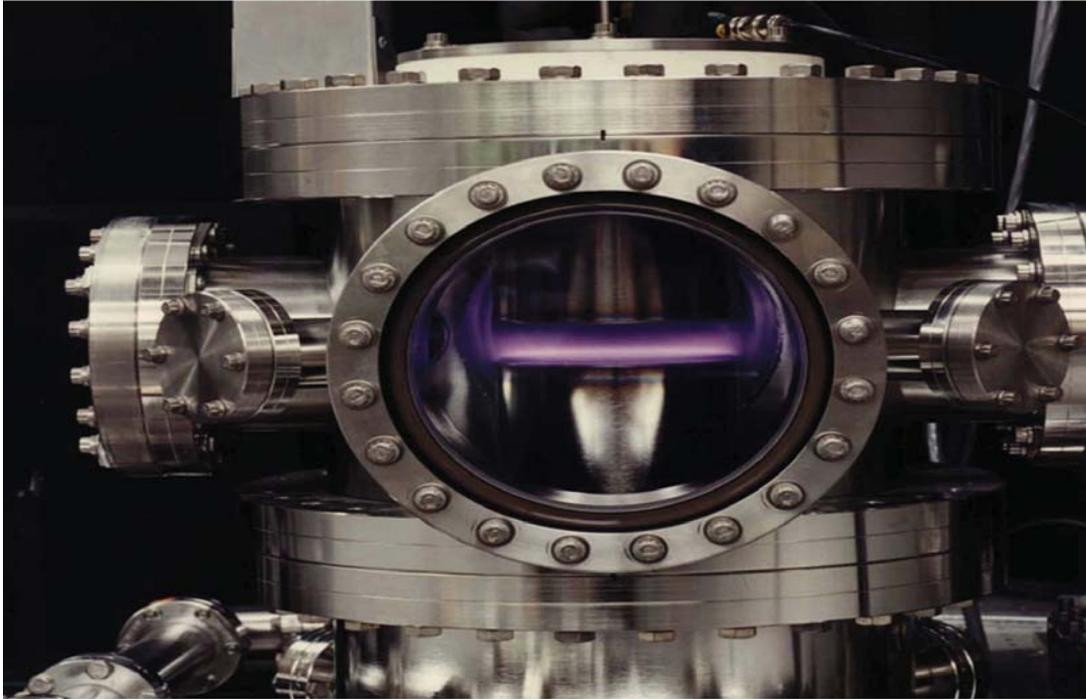
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**Change Card - Industry 2**

South

INDUSTRY

## Process optimization



Large energy efficiency improvements in industry are possible, but require some investment. Improvements include waste-heat re-use and process optimization.

Cost: 1500 MEUR

**EFFECT**



-2



-1

## Process optimization



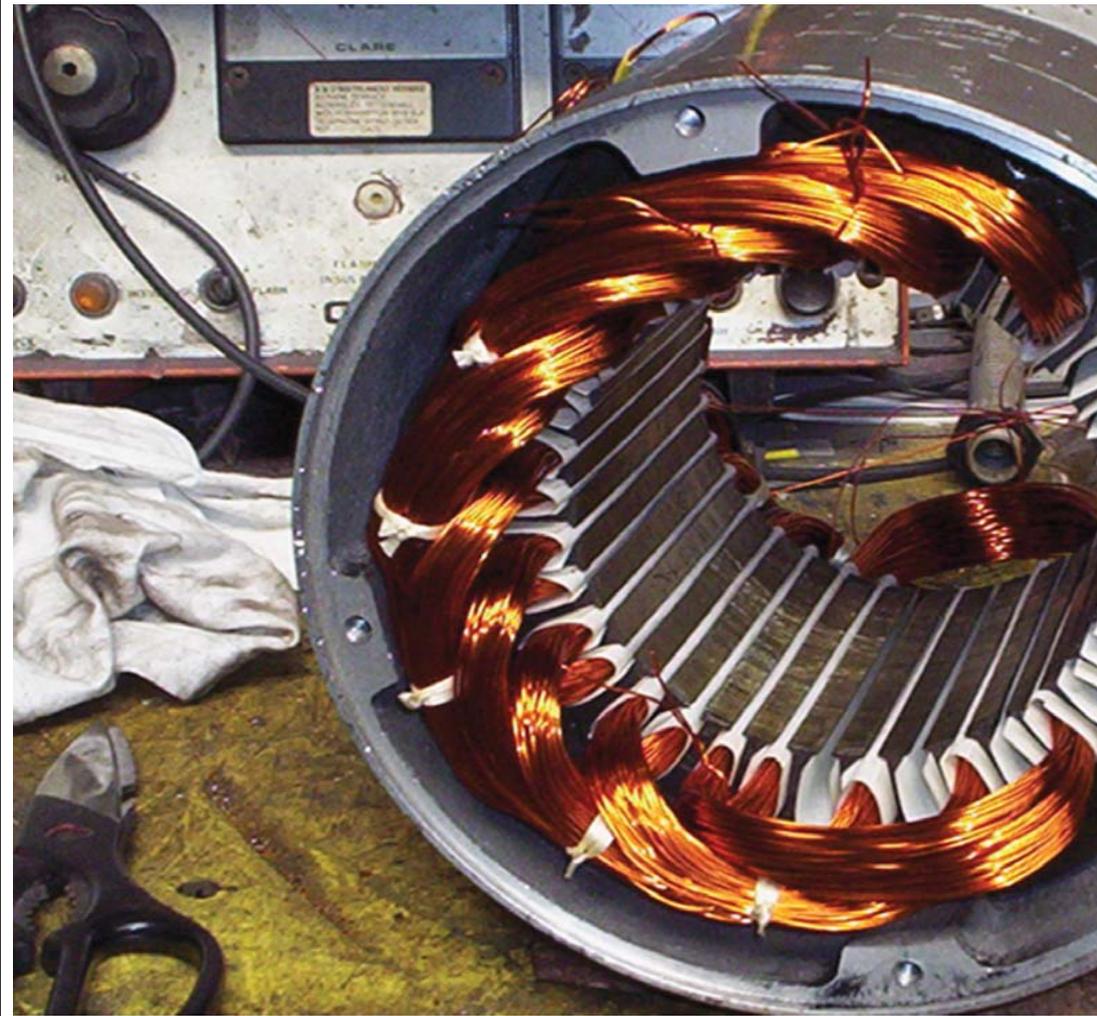
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Change Card - Industry 3

South  
**More efficient electric  
motors**

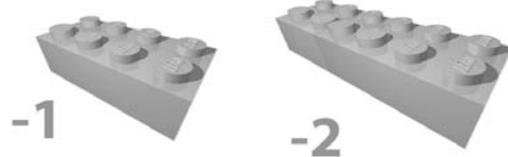
INDUSTRY



About 2/3 of electricity consumption in industry goes to electric motors. There is a large potential for efficiency improvements with better motor design and control.

Cost: 1200 MEUR

**EFFECT**



**More efficient electric motors**



**Change Card - Industry 4**

South

# Concentrated Solar Power in Industry

INDUSTRY



Heat and steam generation for processes in e.g. chemical industry could be done using concentrated solar power instead of burning fuels.

Cost: 1200 MEUR

**EFFECT**



**NB! Only works in Southern Europe**

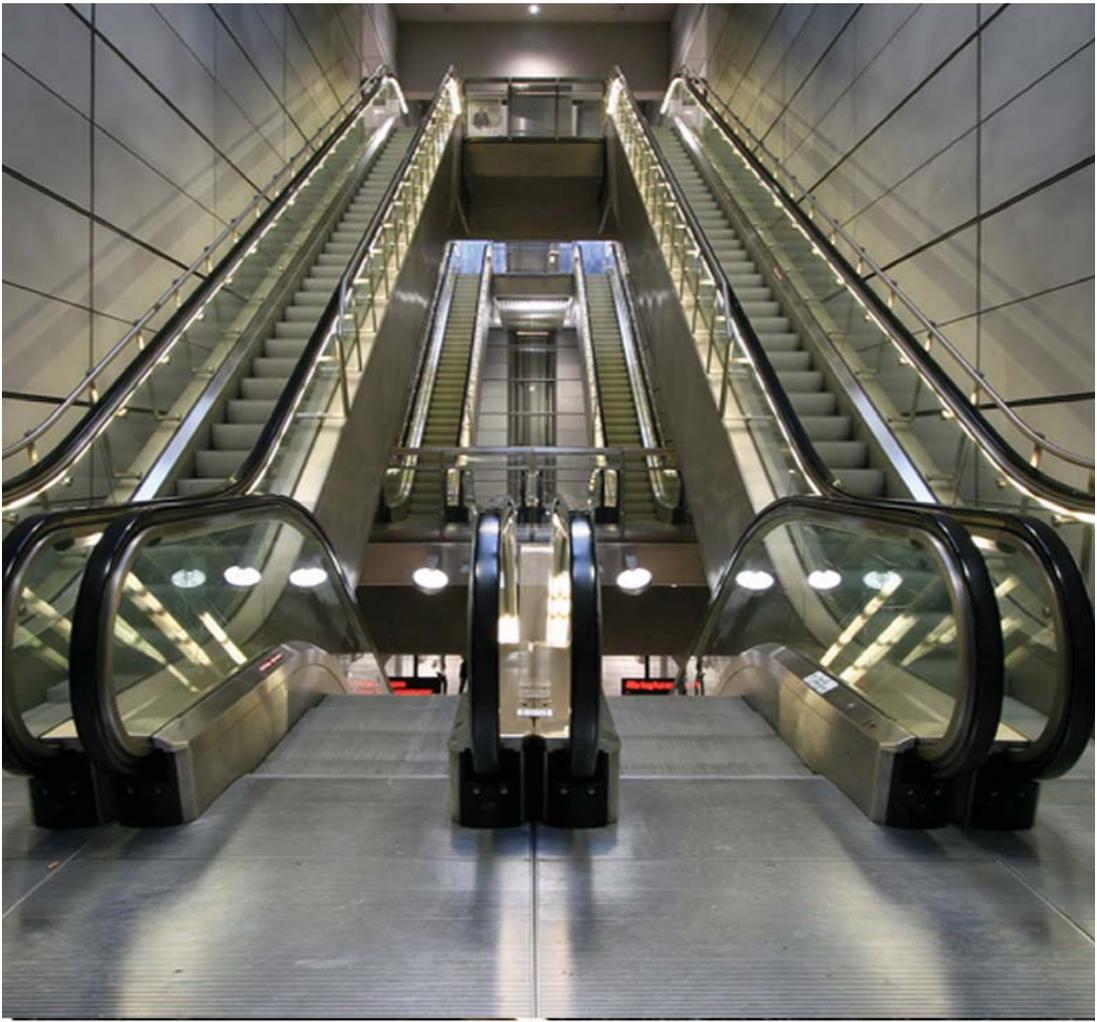
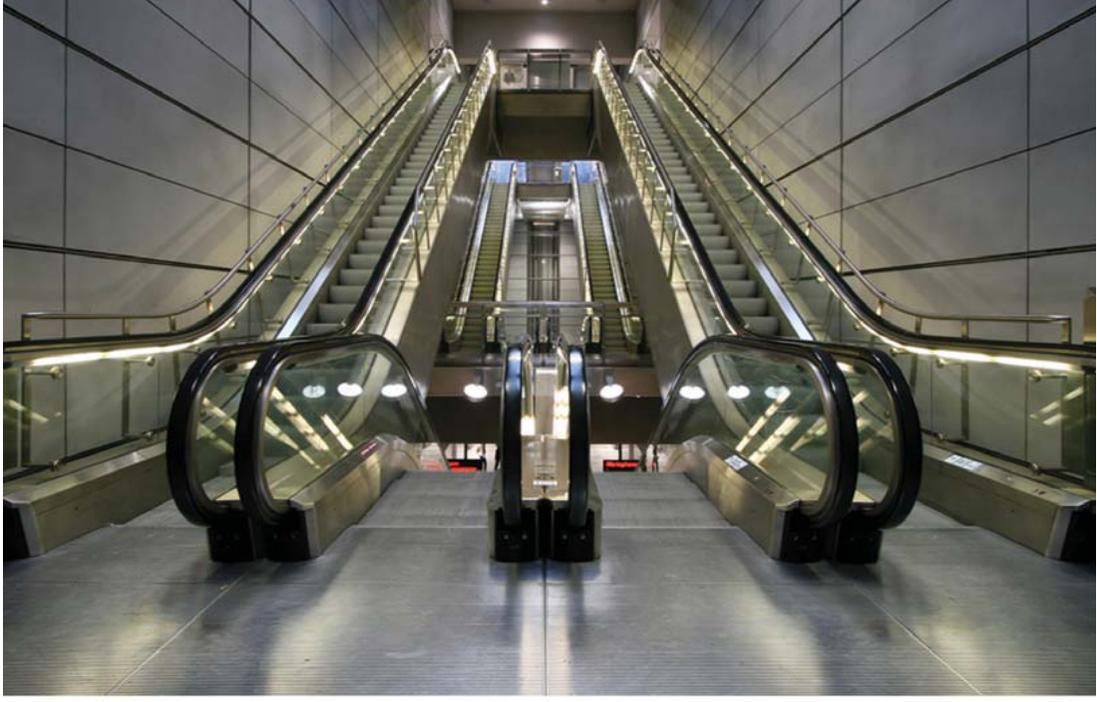
## CSP in industry



**Change Card - Industry 5**

South  
**More public  
transportation**

TRANSPORT



In urban areas in particular public transportation is a far more energy efficient means of transport.

Cost: 3000 MEUR

**EFFECT**

+2



-4



**More public transportation**

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**Change Card - Transport 1**

South

TRANSPORT

**More efficient vehicles**



Efficiency improvements in engine design and aerodynamics are still possible for cars and trucks. These vehicles will be smaller, cost a little more and have limited design options.

Cost: 1500 MEUR

**EFFECT**



**-3**

**More efficient vehicles**



**Change Card - Transport 2**

South

TRANSPORT

## Fuel cell vehicles



Fuel Cell vehicles use hydrogen, which is produced by electrolysis of water at night time. Conversion of electricity into hydrogen and the use of hydrogen in vehicles comes with large energy losses.

Cost: 3000 MEUR

**EFFECT**



## Fuel cell vehicles



Change Card - Transport 3

South

TRANSPORT

## Electrical vehicles 1



Electric vehicles can be charged with electricity from the grid, but they have a shorter driving range than fuel-based vehicles. EVs require the establishment of a charging infrastructure. (Includes Plug-in hybrid electric vehicles.)

Cost: 3000 MEUR

**EFFECT**



## Electrical vehicles 1



Change Card - Transport 4

South

## Electrical vehicles 2

TRANSPORT



The battery makes up about half the cost of an electric car. The size needed depends on the maximum driving distance in a day. It is thus more expensive to shift to electric for vehicles that sometimes need to drive longer distances.

Cost: 5000 MEUR

**EFFECT**



## Electrical vehicles 2

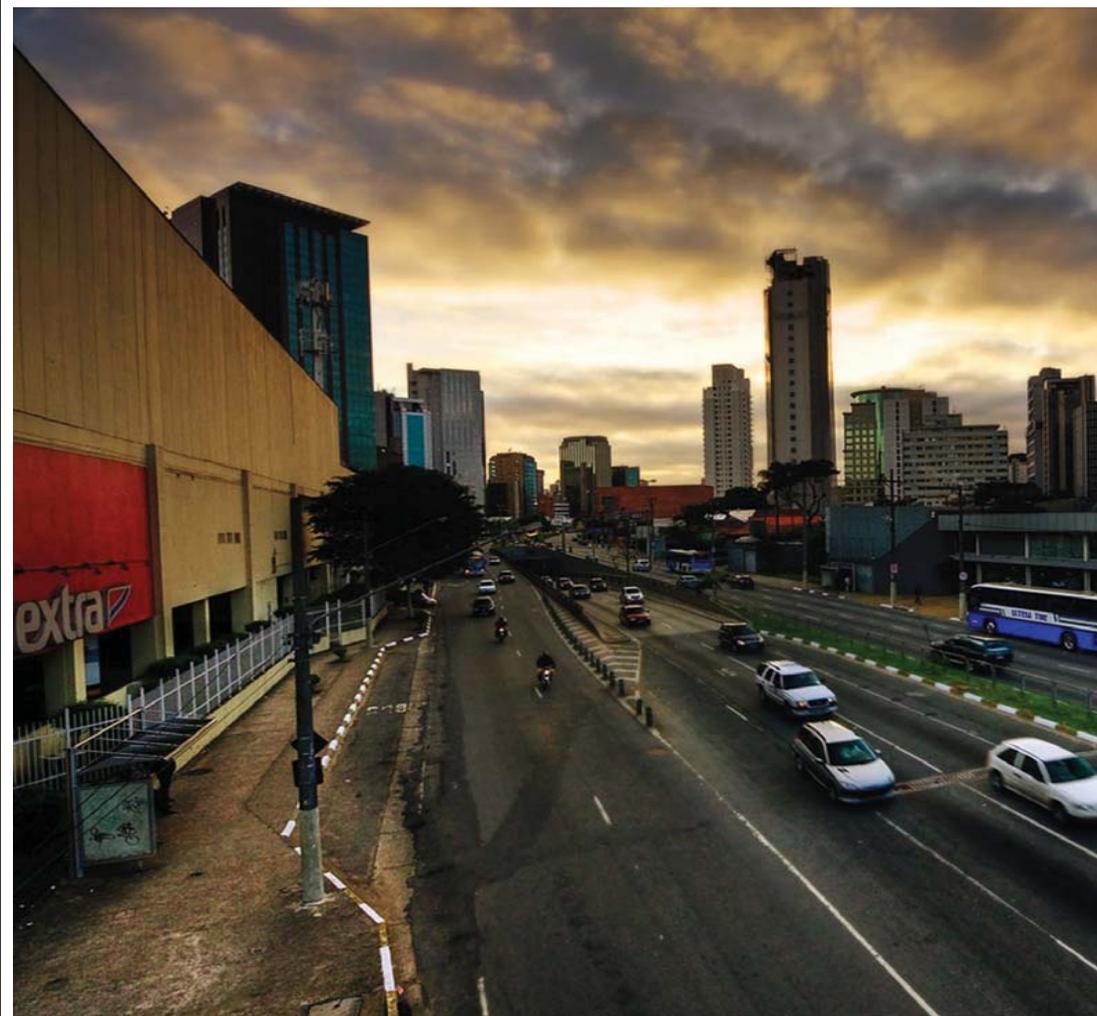
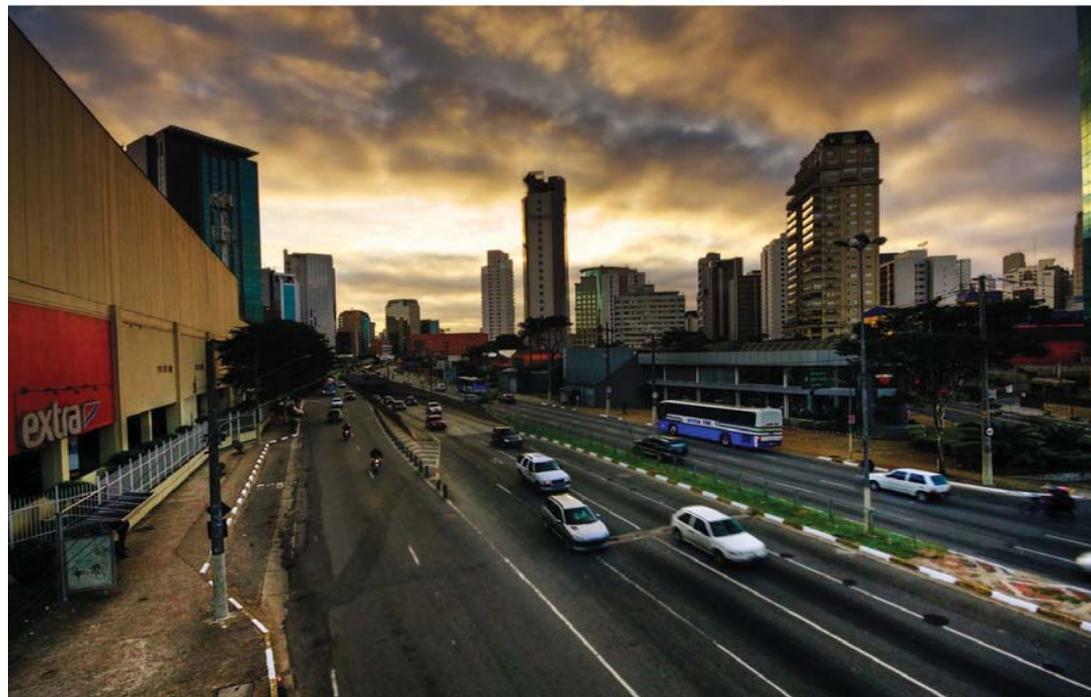


Change Card - Transport 5

South

**Work where you live**

**TRANSPORT**



Commuting is the necessary transport between workplace and home. Living closer to your work or working more from home reduces the need for transport and thus energy consumption.

Cost: 100 MEUR

**EFFECT**



**Work where you live**

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**Change Card - Transport 6**

South

TRANSPORT

## Car free Sundays



As was done during the oil crisis in 1973, car free Sundays is an option to reduce oil consumption.

Cost: 0 MEUR

**EFFECT**



## Car free Sundays



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Change Card - Transport 7

South

## 2<sup>nd</sup> generation biofuels

TRANSPORT



Biofuels produced on agricultural waste (e.g. straw) can substitute gasoline or diesel. Only a little more infrastructure is needed as current filling stations can work with biofuels with little modification.

Cost: 400 MEUR

**EFFECT**



-3



+4

**NB! Biomass bricks must be bought from the Bank**

## 2<sup>nd</sup> generation biofuels



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**Change Card - Transport 8**

South

# Natural gas fuelled vehicles

TRANSPORT



Cars, trucks and buses can run on natural gas with small modifications. Some infrastructure investments are needed to build modified engines and filling stations.

Cost: 2000 MEUR

**EFFECT**



+4



-4

**NB! Natural gas bricks must be bought from the Bank**

## Natural gas fueled vehicles



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**Change Card - Transport 9**

South

TRANSPORT

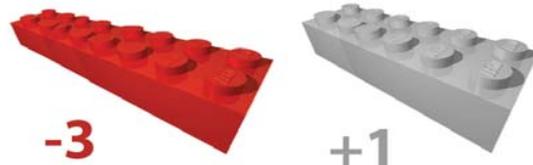
Invest in rail



Trains can be an alternative to trucks for long distance goods transportation. This requires an improved and extended rail infrastructure.

Cost: 5000 MEUR

**EFFECT**



Invest in rail



Change Card - Transport 10

South

# Super-Grid

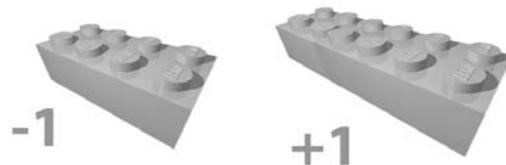
OTHER



A supergrid will allow for increased exchange of electricity within and between regions. This helps the integration of uncontrollable production.

Cost: 500 MEUR

**EFFECT**  
(Per region)



**NB! Effect is proportional to number of regions who played the card**



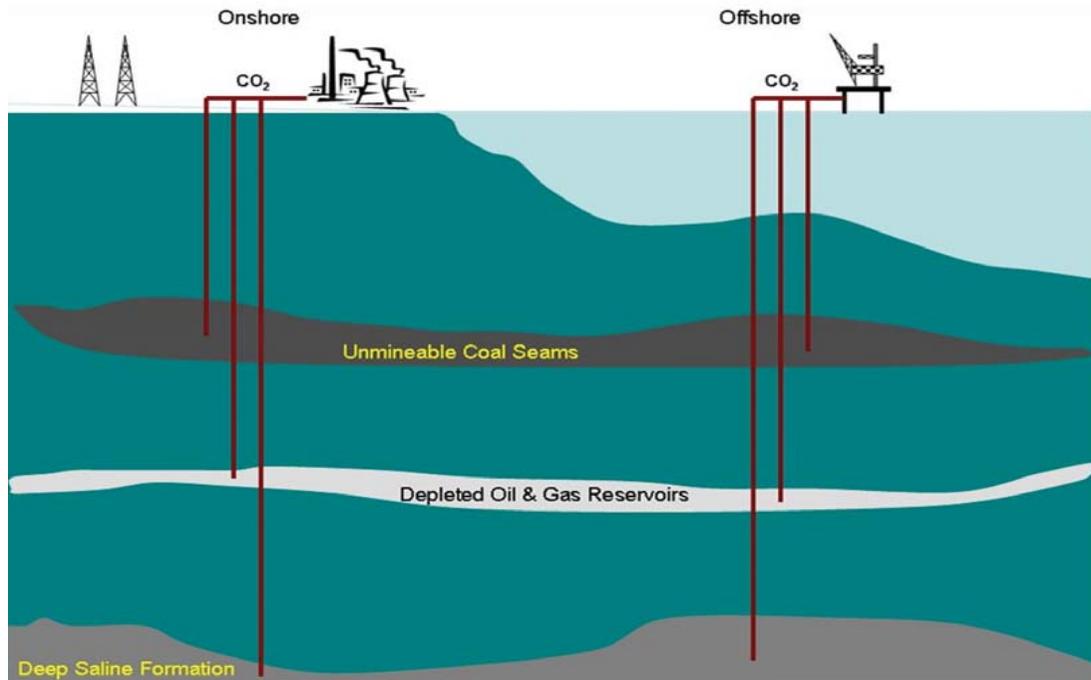
# Super-Grid

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**Change Card - Other 1**

# South R&D in Carbon Capture & Storage

OTHER

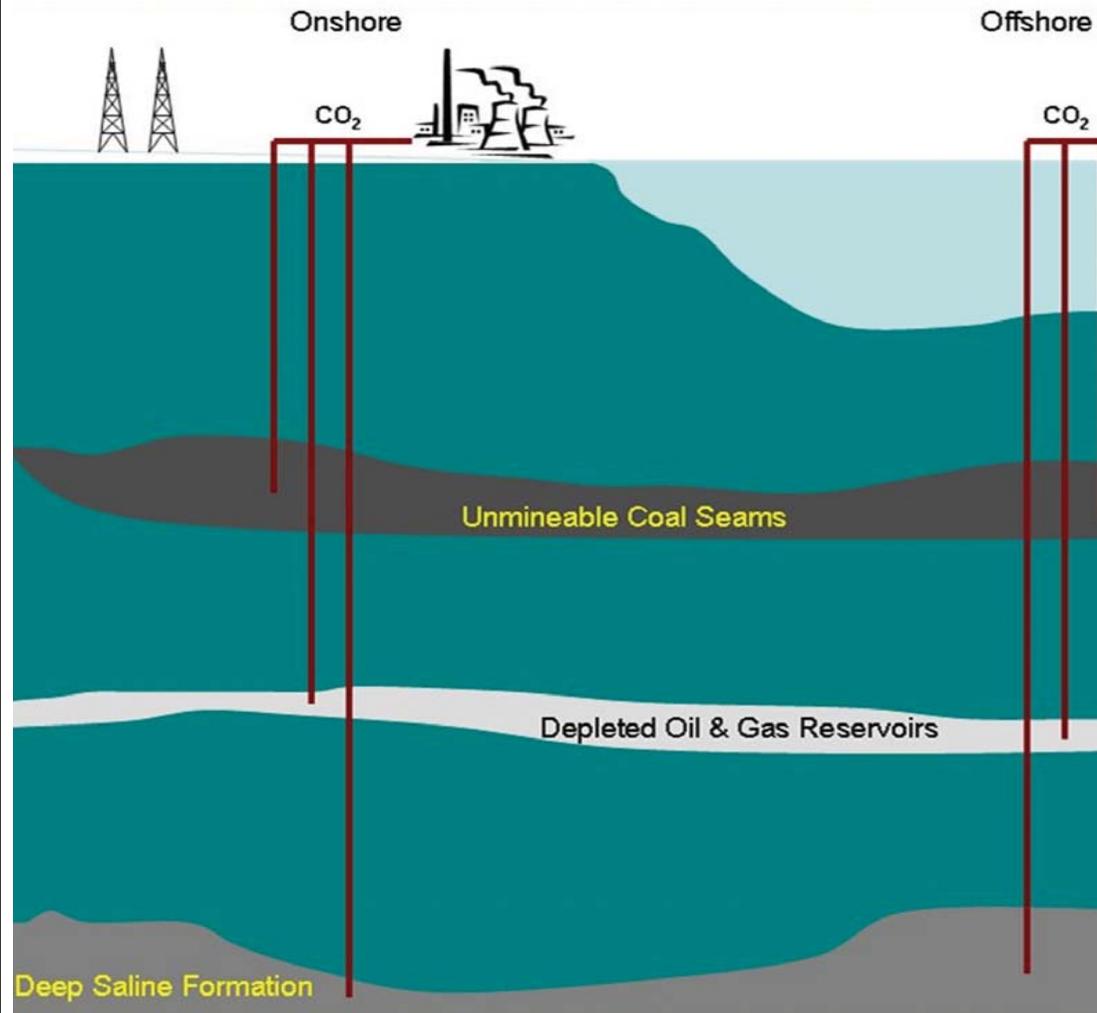


CCS is a technology in which CO<sub>2</sub> can be captured out of the exhaust of power plants and industrial processes. The CO<sub>2</sub> can subsequently be stored in underground rock formations or aquifers.

Cost: 4000 MEUR (Cost can be shared with other regions)

## EFFECT

Enables "Coal Power with CCS"  
Enables "CCS in industry"



# R&D in Carbon Capture & Storage



Change Card - Other 2

South

**Define your own  
change!**

OTHER

?

**Ask your energy expert to evaluate cost and effect!**

Change description:

Cost: MEUR

**EFFECT**

?

**Define your own change**



**Change Card - Other 3**

South

**Define your own  
change!**

OTHER

?

**Ask your energy expert to evaluate cost and effect!**

**Change description:**

Cost: MEUR

**EFFECT**

?

**Define your own change**



**Change Card - Other 4**