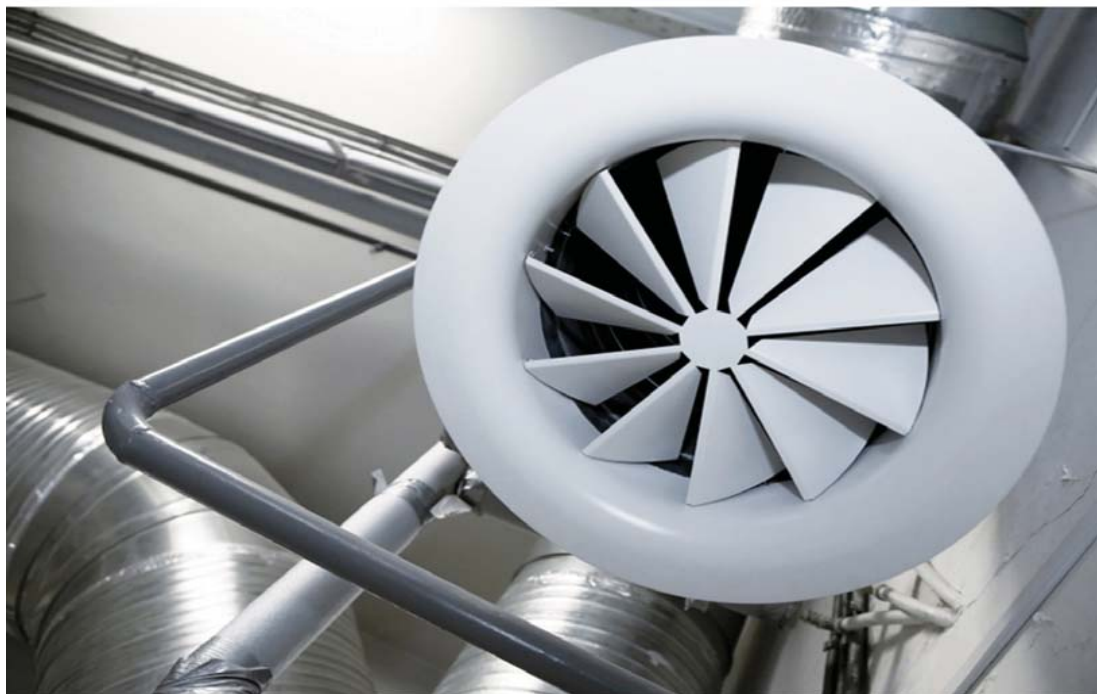


West

More efficient ventilation

ELECTRICITY



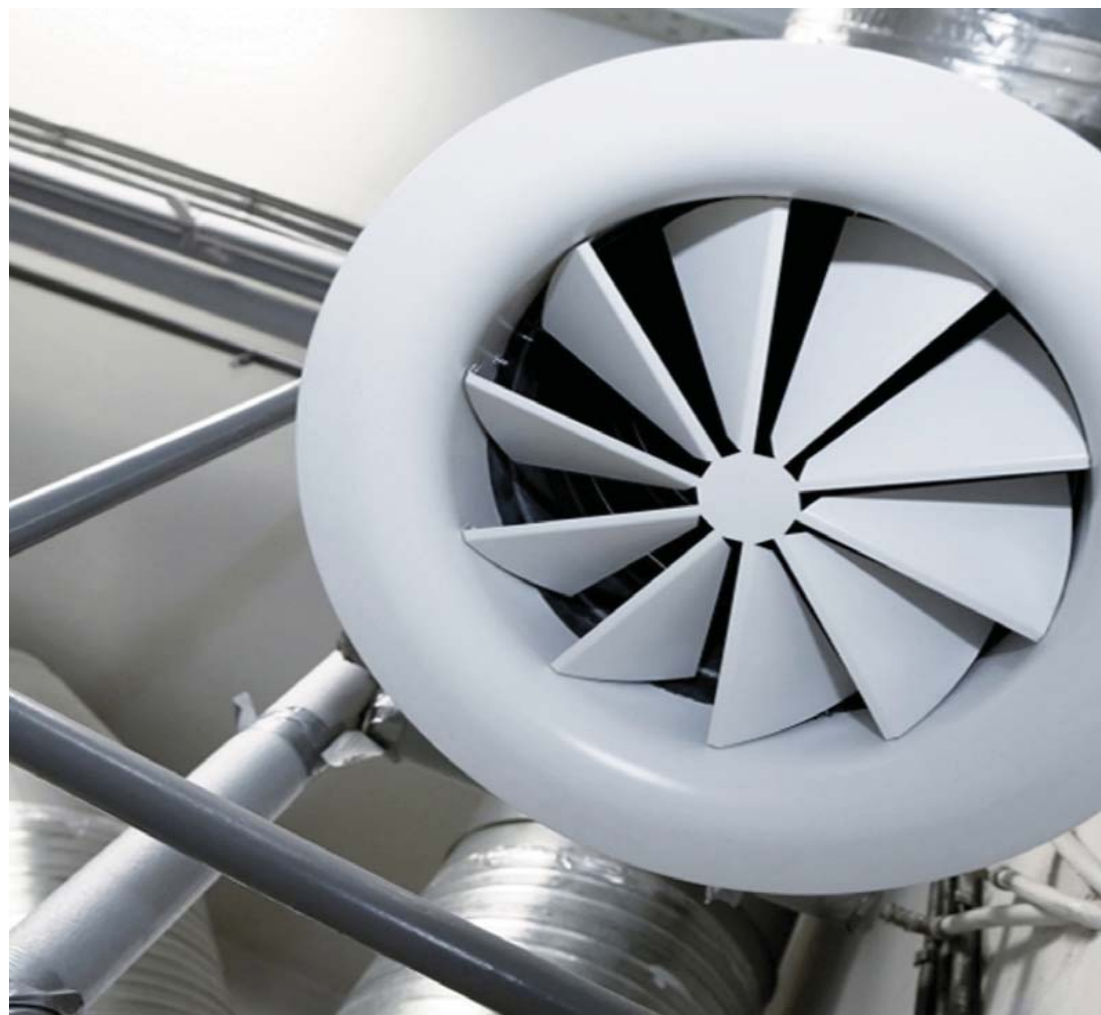
Ventilation contributes to a large part of the electricity consumption. Significant electricity savings can be achieved by cleaning ducts and by using electronics for smarter control of fans.

Cost: 100 MEUR

EFFECT



-2



More efficient ventilation



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Change Card - Electricity 1

West

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

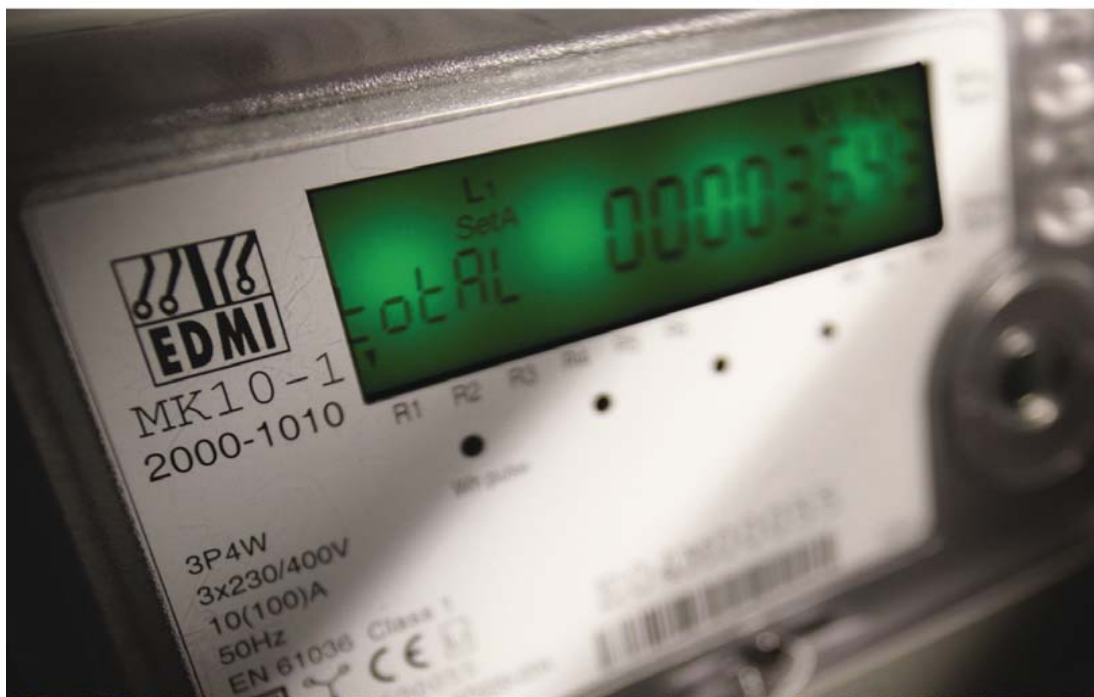


Change Card - Electricity 2

West

ELECTRICITY

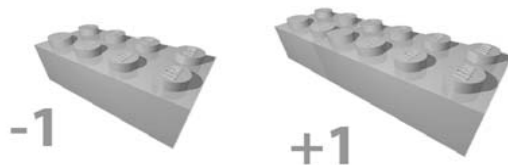
Smart metering



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



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Change Card - Electricity 3

West

More efficient appliances

ELECTRICITY



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

Cost: 300 MEUR

EFFECT



-1



More efficient electrical appliances



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Change Card - Electricity 4

West

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



-3



+4



Electrical storage



Change Card - Electricity 5

West

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



Less use of electronics



Change Card - Electricity 7

West

Eliminate standby consumption

ELECTRICITY



POWER



Eliminate standby consumption



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Change Card - Electricity 6

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

West

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: 2000 MEUR

EFFECT



Better insulation 1



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Change Card - Heating 1

West

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

West

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: 600 MEUR

EFFECT



-4



+2



Replace electric heating



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Change Card - Heating 3

West

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: 400 MEUR

EFFECT



Solar architecture



Change Card - Heating 4

West

Active solar heating

HEATING



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

Cost: 1200 MEUR

EFFECT



Active solar heating



Change Card - Heating 5

West

**Lower indoor
temperature**

HEATING



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

Cost: 0 MEUR

EFFECT



Lower indoor temperature



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Change Card - Heating 6

West

**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



Higher indoor temperature



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Change Card - Heating 7

West

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

West

Heat pumps

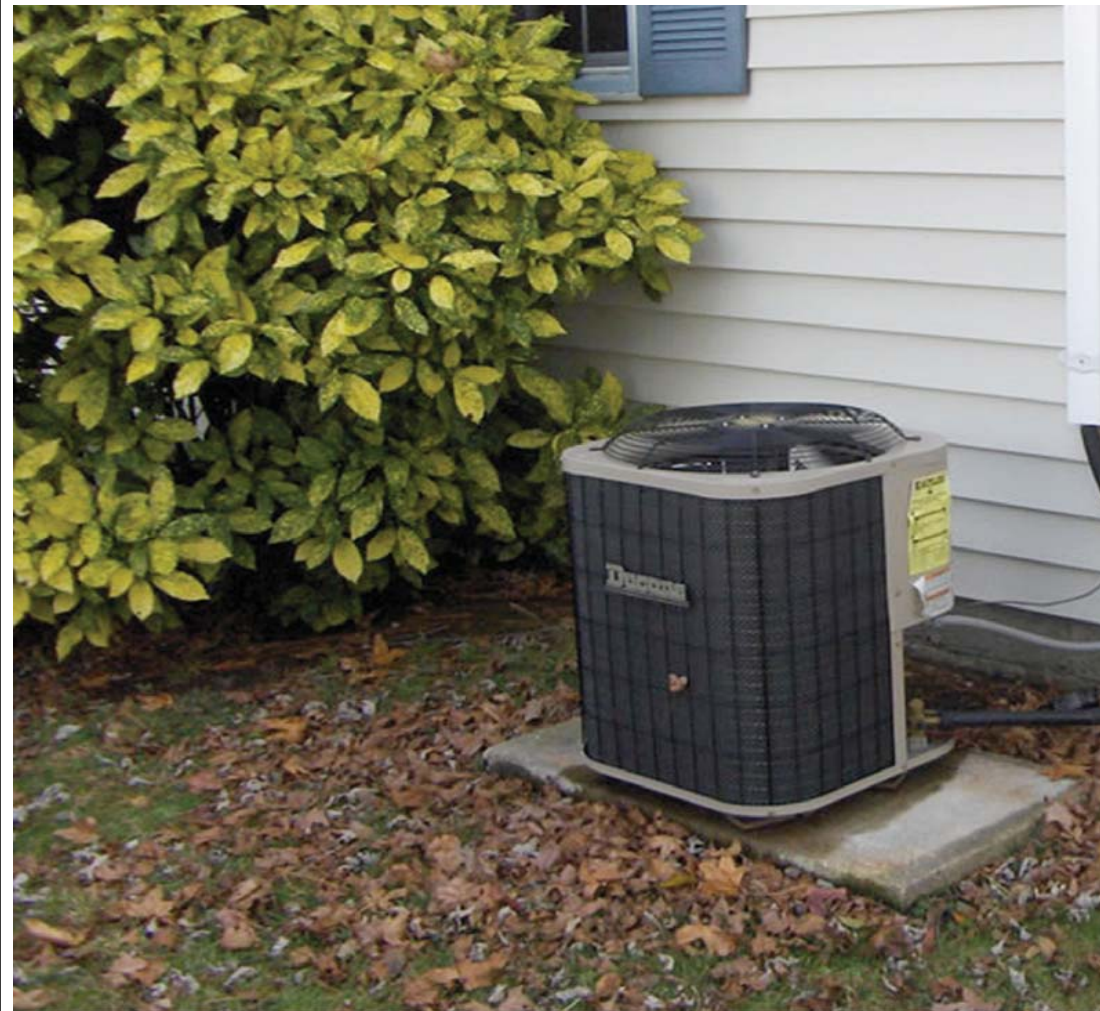
HEATING



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: 900 MEUR

EFFECT



Heat pumps



Change Card - Heating 9

West

**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

Cost: 6000 MEUR

EFFECT



Import energy intensive goods



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Change Card - Industry 1

West

Carbon Capture & Storage in Industry

INDUSTRY



Coal is burned to provide heat for some major industrial processes. The CO₂ 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



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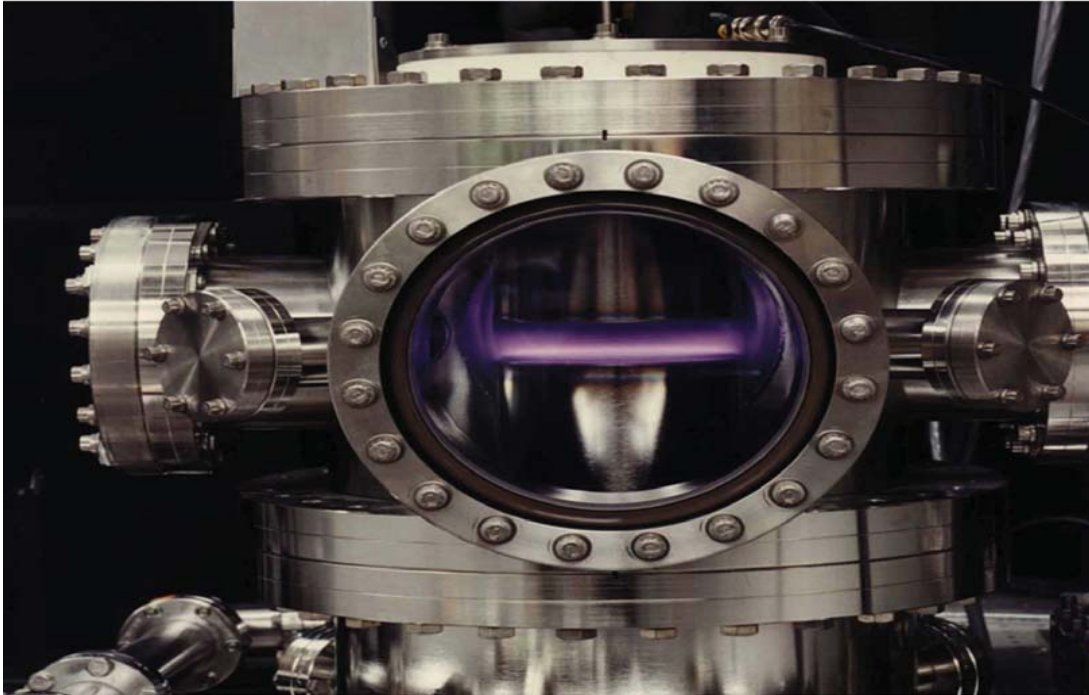
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Change Card - Industry 2

West

Process optimization

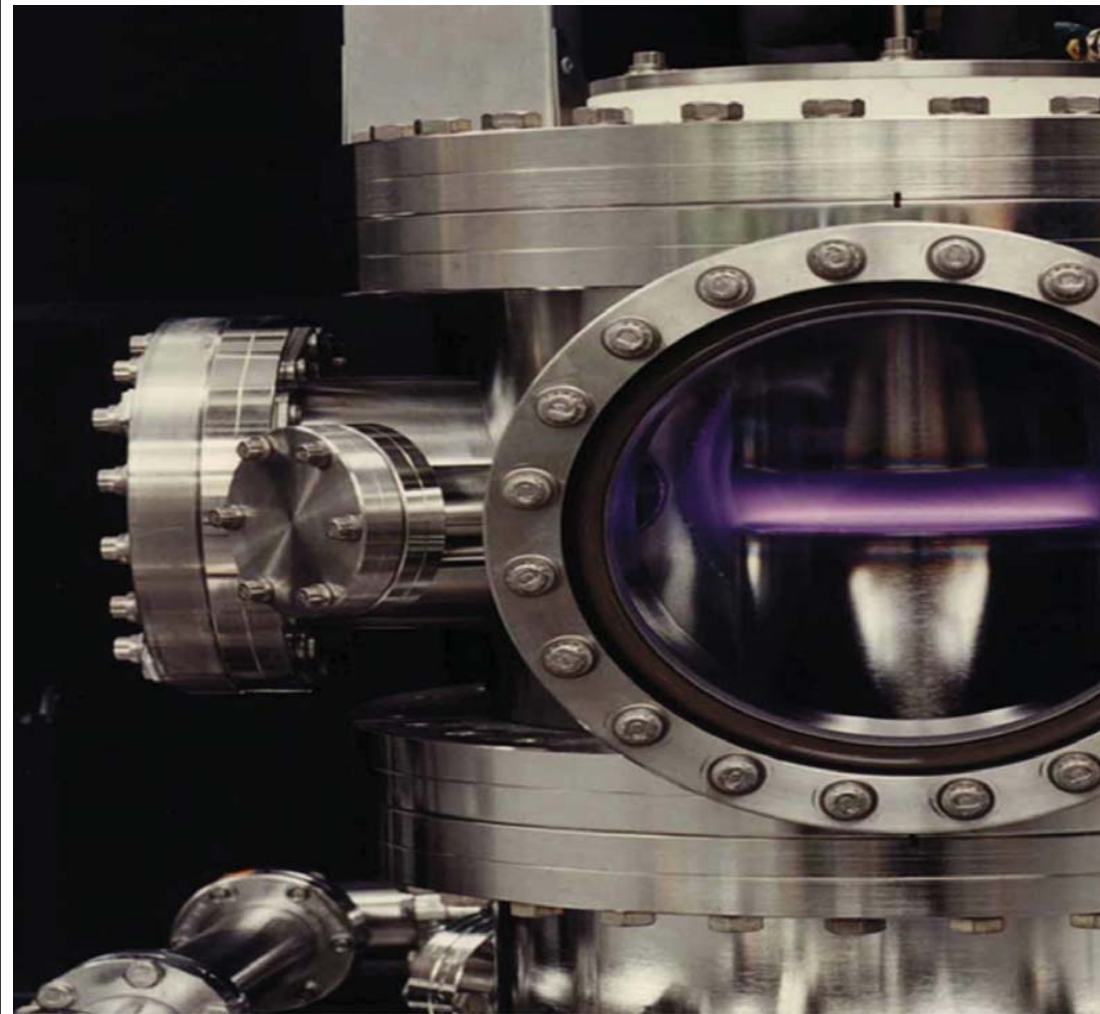
INDUSTRY



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



Process optimization



Change Card - Industry 3

West

More efficient electric motors

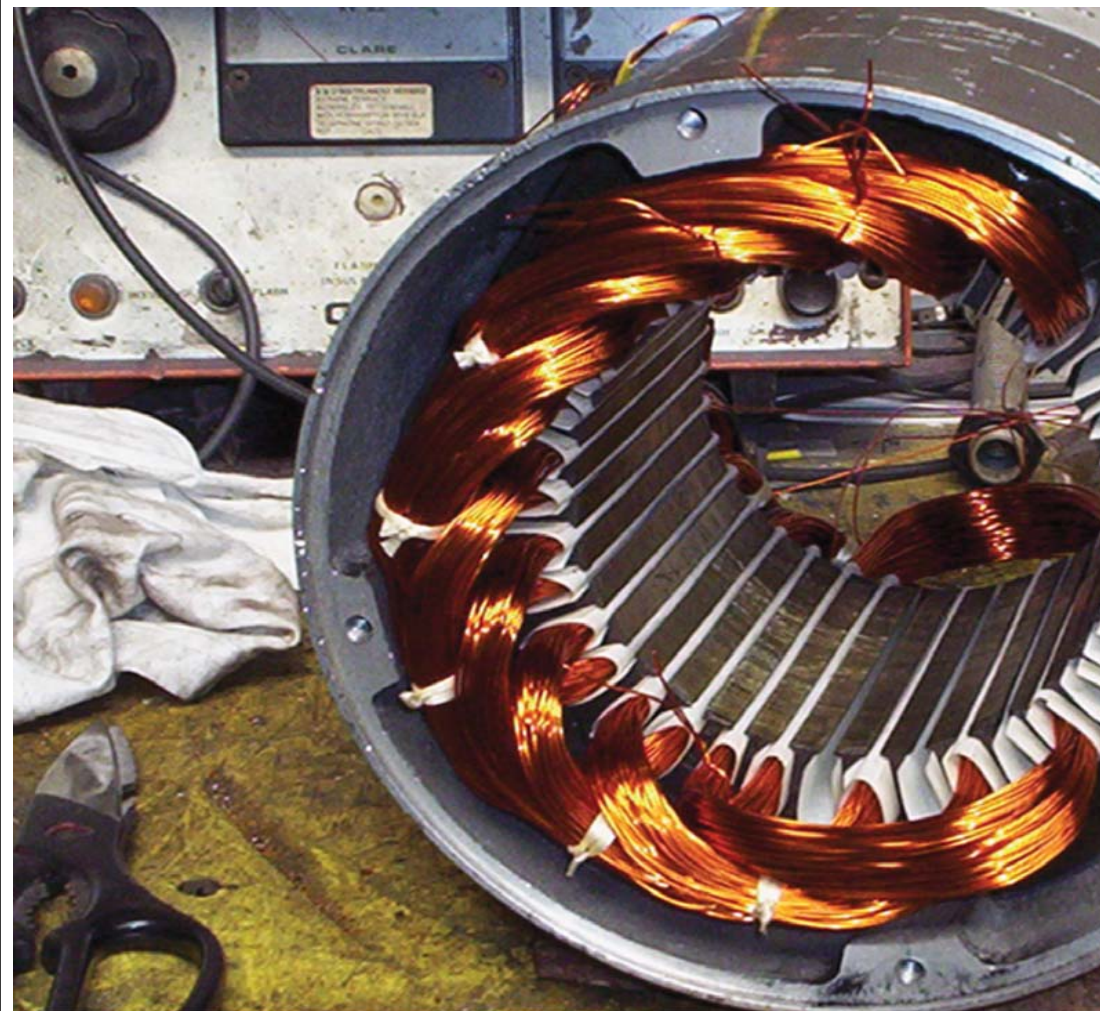
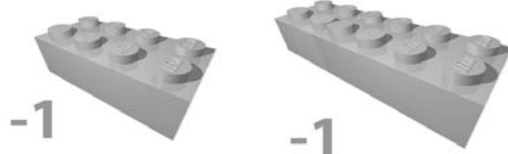
INDUSTRY



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: 1000 MEUR

EFFECT



More efficient electric motors



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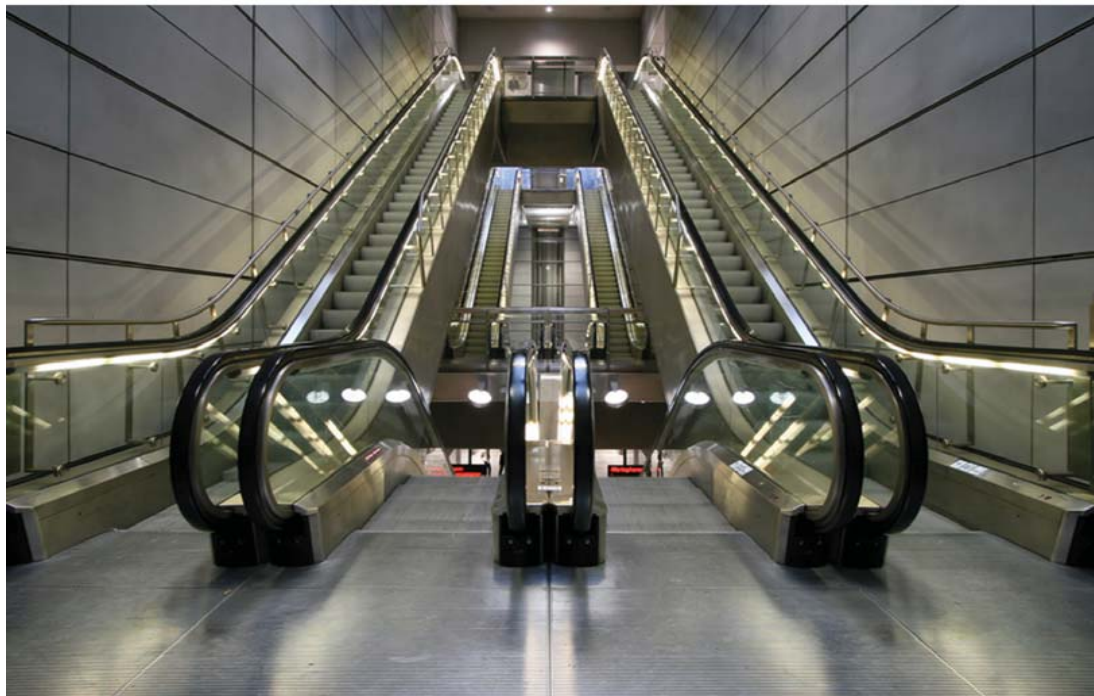
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Change Card - Industry 4

West

More public transportation

TRANSPORT



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

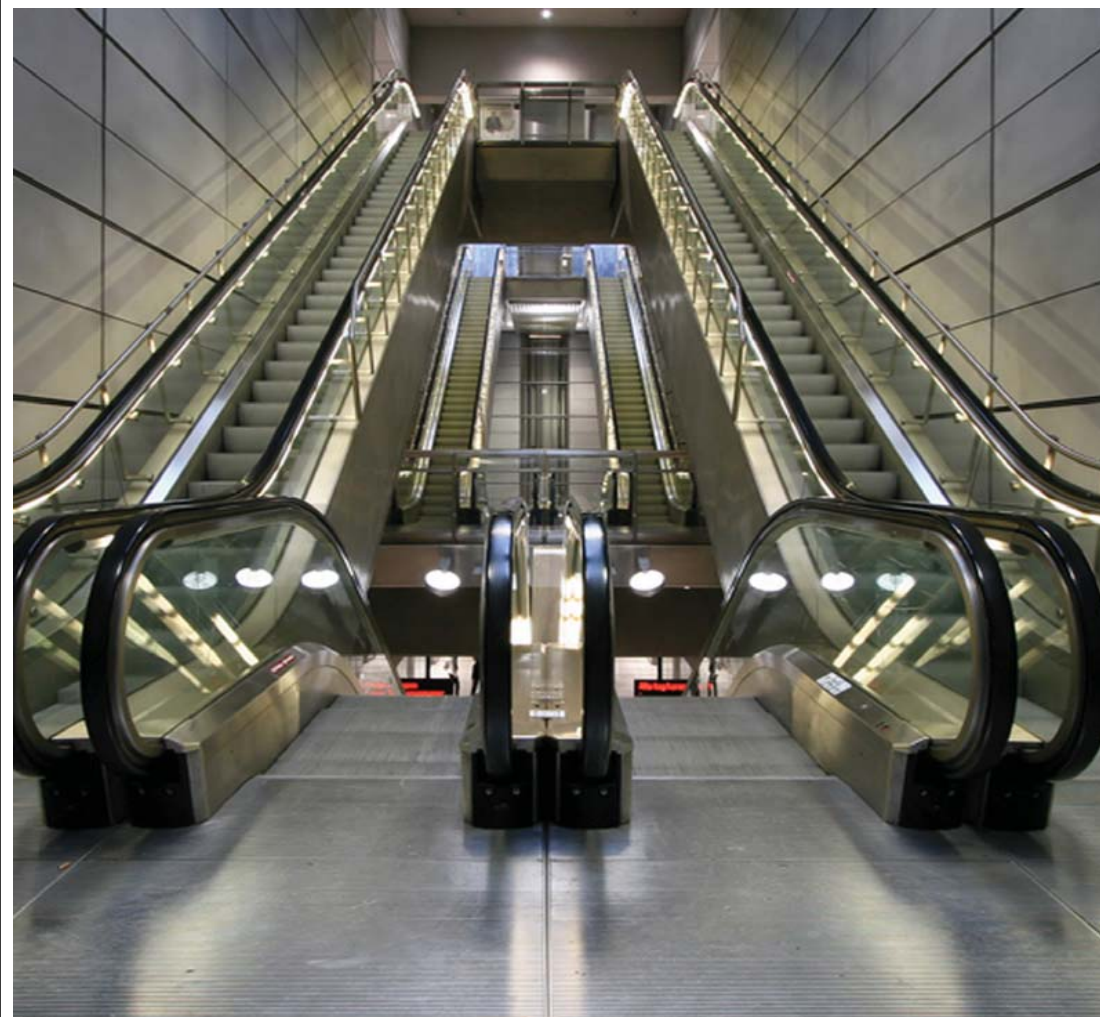
Cost: 2000 MEUR

EFFECT

+1



-2



More public transportation



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Change Card - Transport 1

West

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: 500 MEUR

EFFECT



More efficient vehicles



Change Card - Transport 2

West

Fuel cell vehicles

TRANSPORT



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

West

Electrical vehicles 1

TRANSPORT



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

West

Electrical vehicles 2

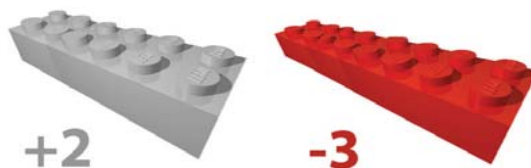
TRANSPORT



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: 3000 MEUR

EFFECT



Electrical vehicles 2



Change Card - Transport 5

West

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

West

Car free Sundays

TRANSPORT



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

West

2nd 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



2nd generation biofuels



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Change Card - Transport 8

West

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: 1500 MEUR

EFFECT



+3



-3

NB! Natural gas bricks must be bought from the Bank



Natural gas fueled vehicles



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Change Card - Transport 9

West

Invest in rail

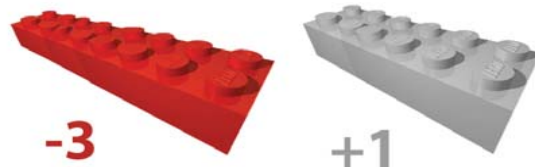
TRANSPORT



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

West

Super-Grid

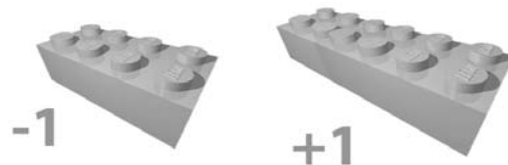
OTHER



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



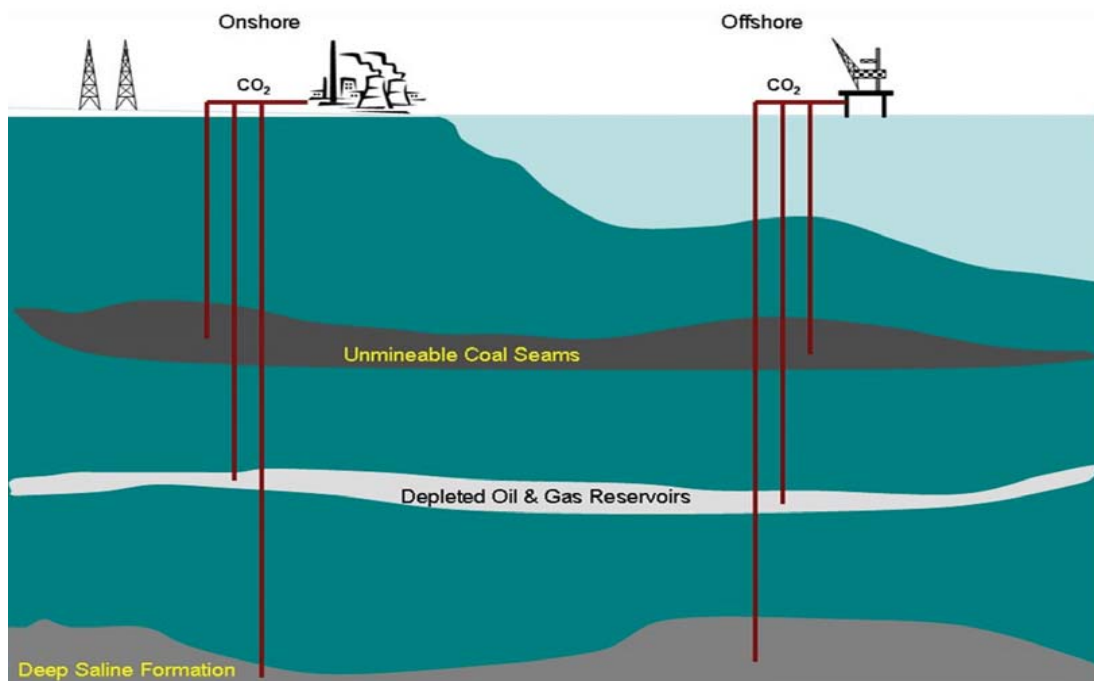
Super-Grid



Change Card - Other 1

West R&D in Carbon Capture & Storage

OTHER

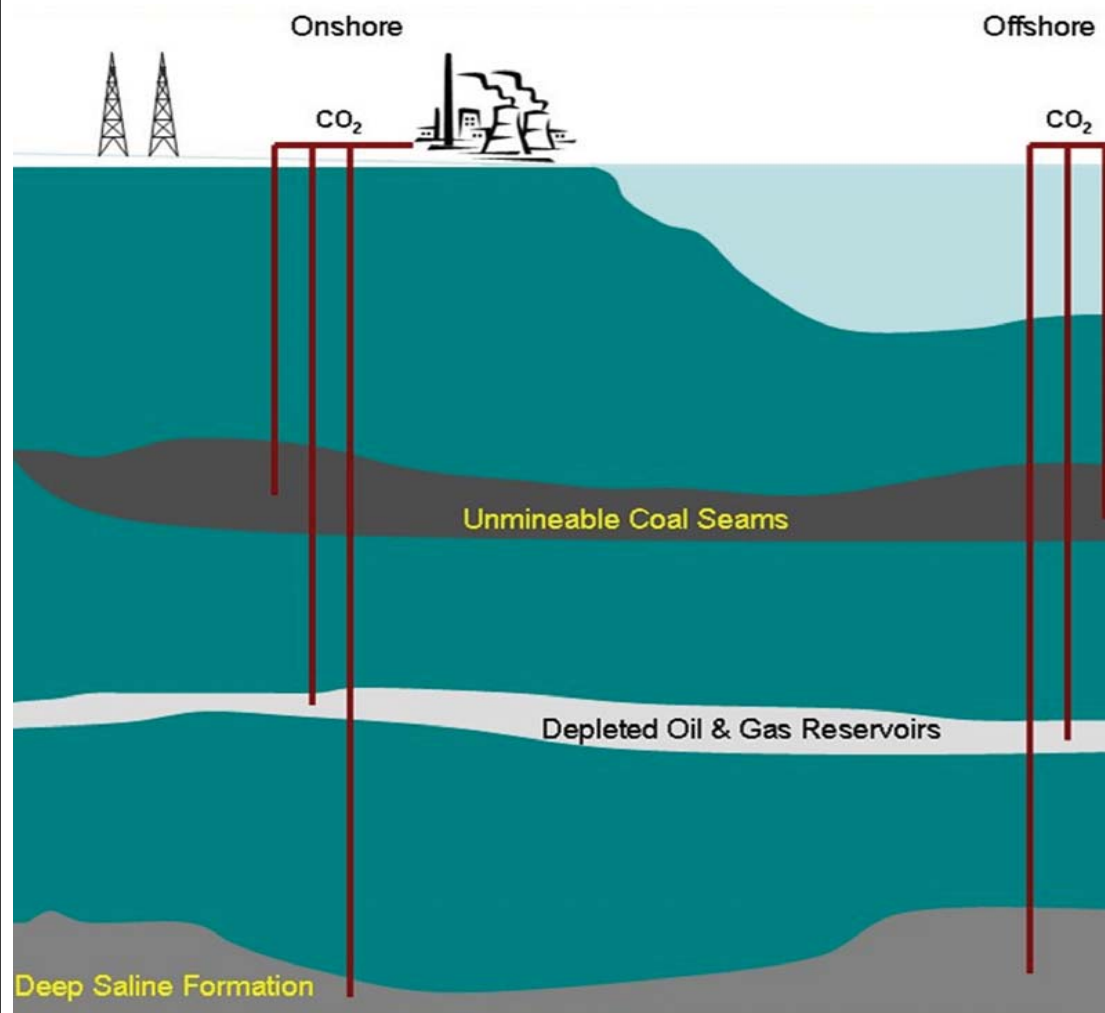


CCS is a technology in which CO₂ can be captured out of the exhaust of power plants and industrial processes. The CO₂ can subsequently be stored in underground rock formations or aquifers.

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

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Change Card - Other 2

West

**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

West

**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