

**TNO is the main organisation for applied science
in the Netherlands with 4600 employees.**

TNO mission statement

To apply scientific knowledge with the aim of strengthening the innovative power of industry and government



**TNO Quality of
Life**



**TNO Defence,
Security and
Safety**



**TNO Science
and Industry**

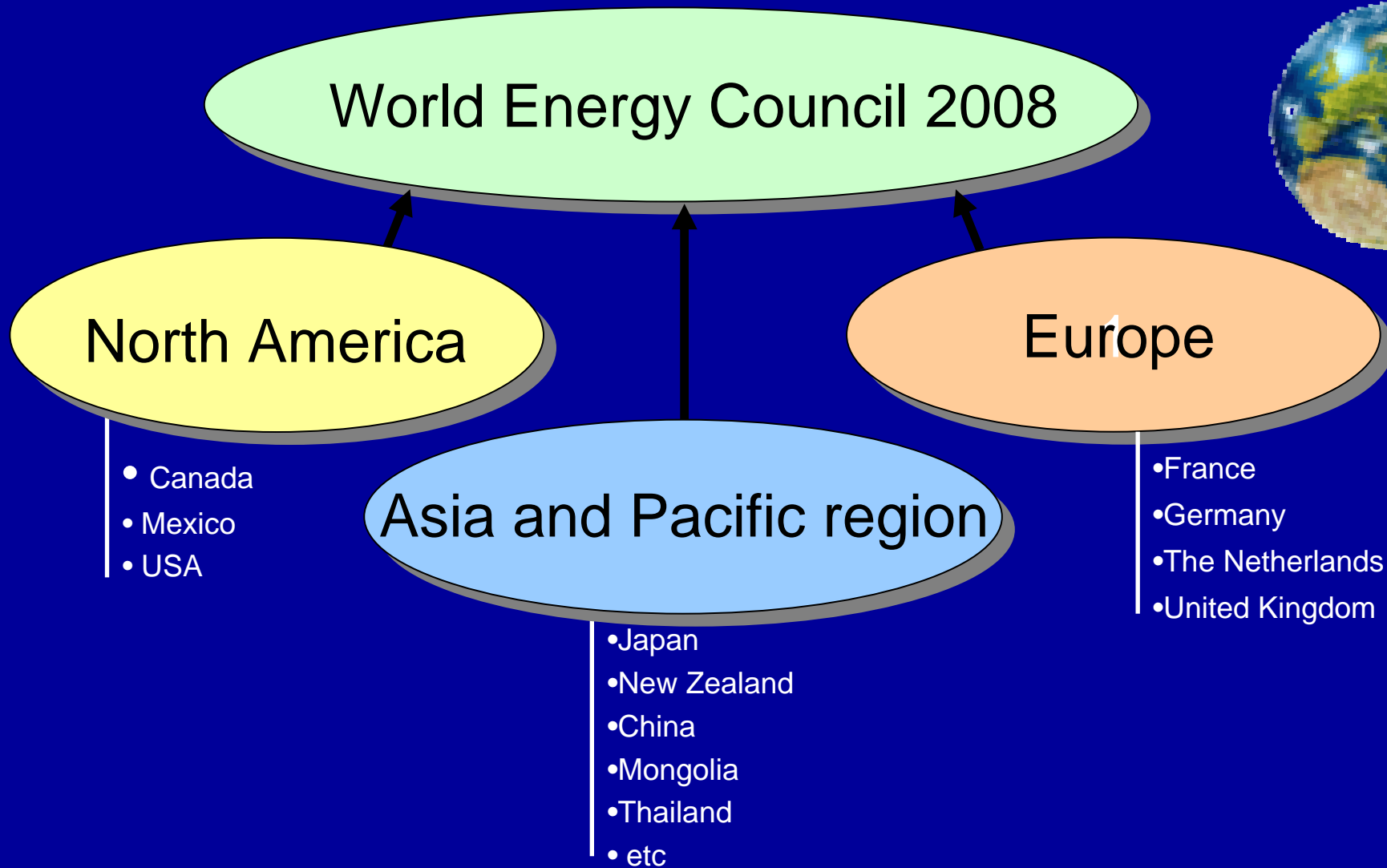


**TNO Built
Environment
and
Geosciences**



**TNO Informa-
tion and
Communication
Technology**

Energy Efficiency policies around the World



European building directive

EPBD = Energy Performance of Buildings

Directive: saving energy in buildings

The EPBD demands Member States to:

- 1. Apply methodology of calculation of energy performance of buildings**
- 2. Introduce minimum energy performance requirements for new and major renovated buildings**
- 3. Consider alternative systems for energy supply and heating and cooling generation in large buildings**
- 4. Make available energy certificate when buildings are build, rented or sold**
- 5. Regularly inspect existing systems**

New energy concepts for the housing sector in Lithuania

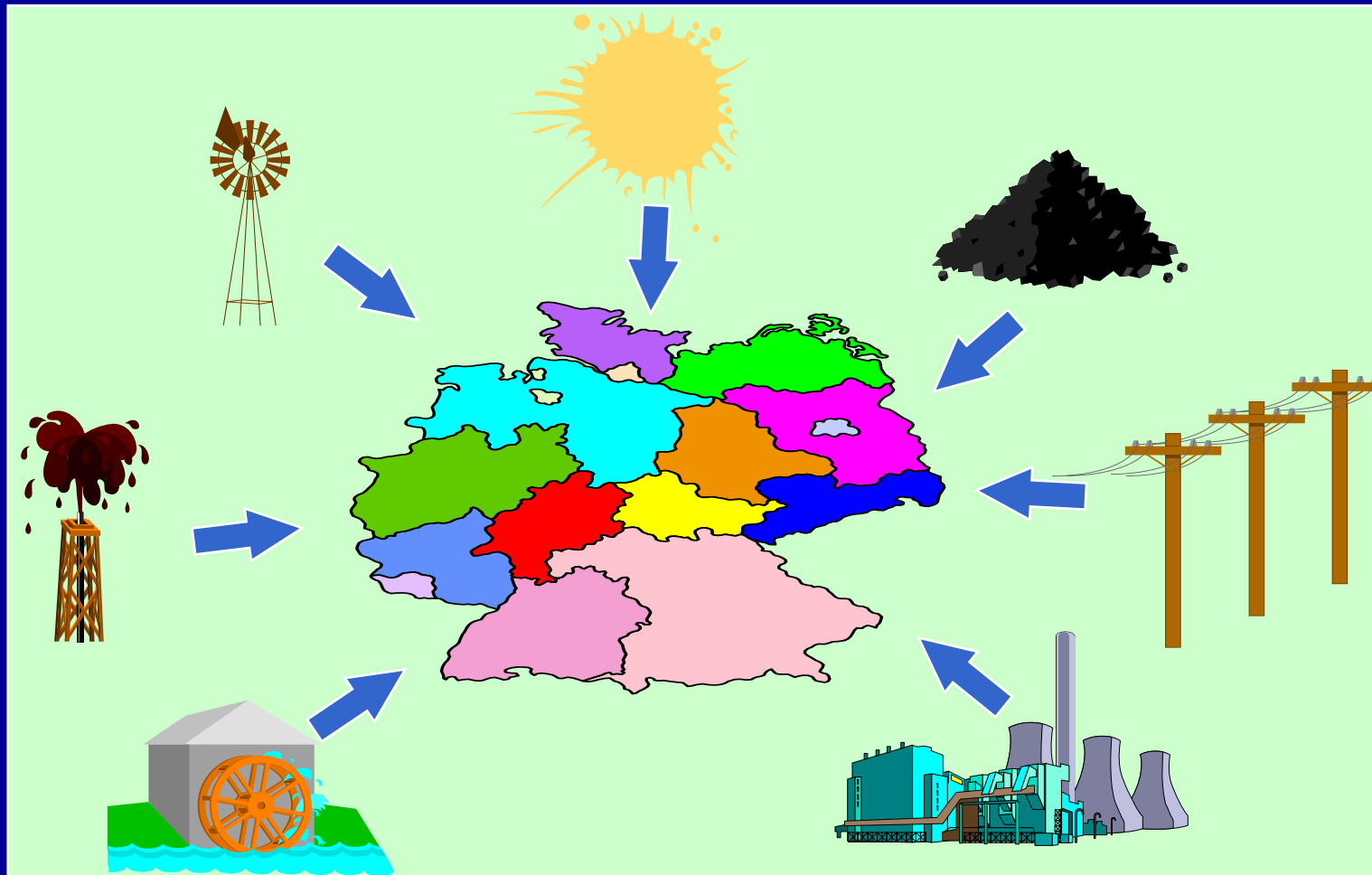
- *Energy transition programme*
- *Regional energy planning*
- *Most attractive options for Lithuania*
- *Conclusions and recommendation*

Energy transition programme

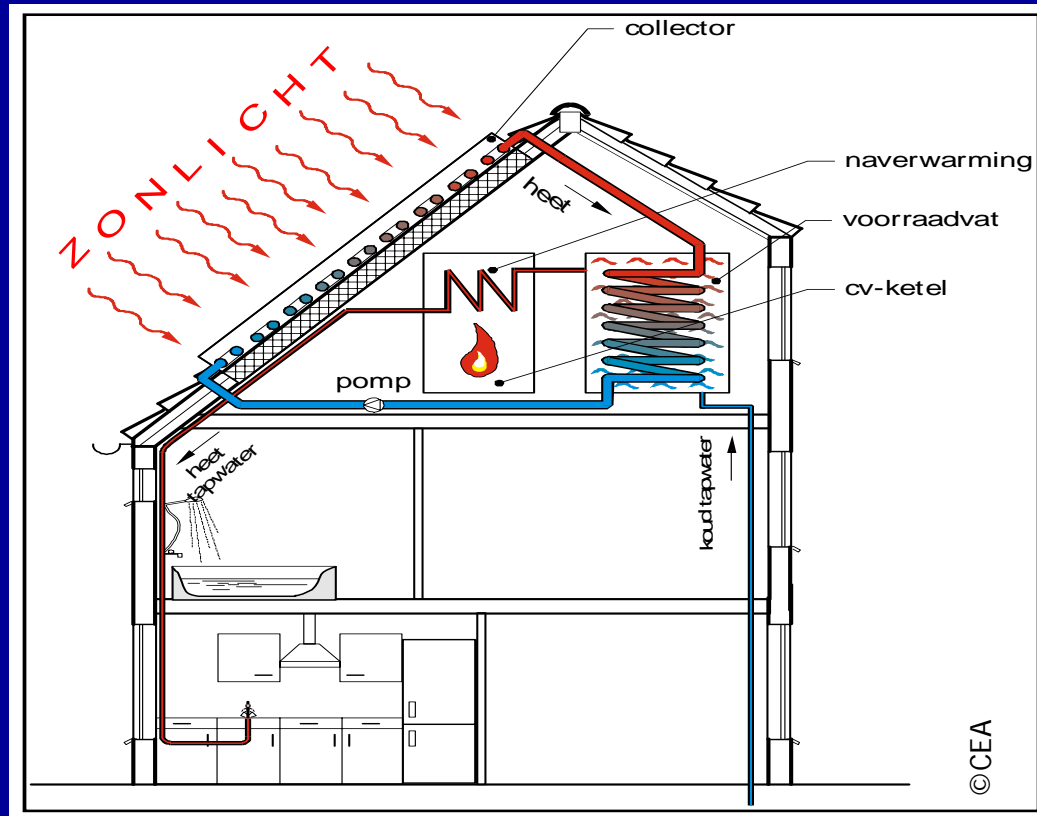
- Started in 2002
- Target 80% reduction of fossil fuel
- Covers all energy using sectors: transport, factories, buildings, etc.
- All stakeholders are involved
- High priority for housing sector
- Many new and innovative developments
- Several technologies are already in large scale implementation phase

Regional energy planning

Look to the whole energy chain, consider measures at the building level together with options for the energy production and distribution system



Thermal solar energy in the Netherlands



Solar boilers for hot water and space heating

- 50% of energy for hot water is provided by the sun
- Use of solar heat for space heating is limited, not enough sunshine

Solar panels on multi apartment buildings 1



- Solar system for 80 apartments
- 24 solar panels with a surface of 34 m²
- 2 m³ hot water storage
- 50 % energy saving on hot water

Solar panels on multi apartment buildings 2



Solar collectors integrated in the roof 1



Solar collectors integrated in the roof 2



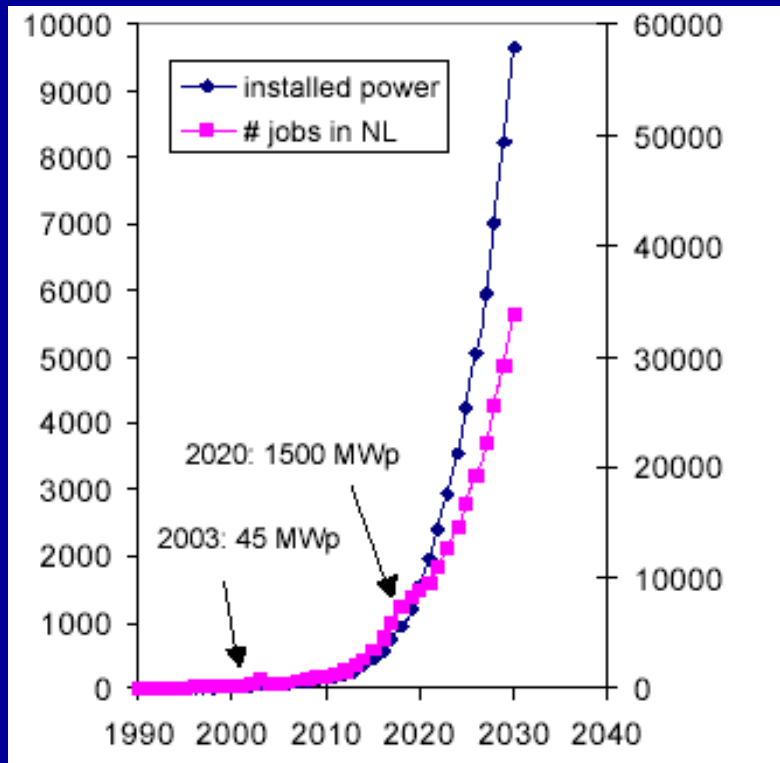
Solar electricity

Photo Voltaic cells



Photo voltaic in the Netherlands

Forecast installed power and jobs created



2010: 1 km²
2020: 10 km²
2030: 50 km²

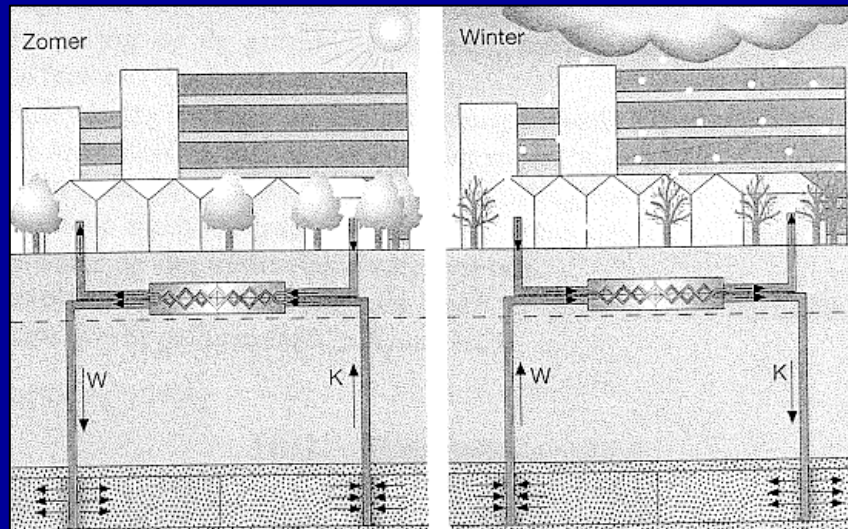


2009 Holland copied subsidy system from Germany

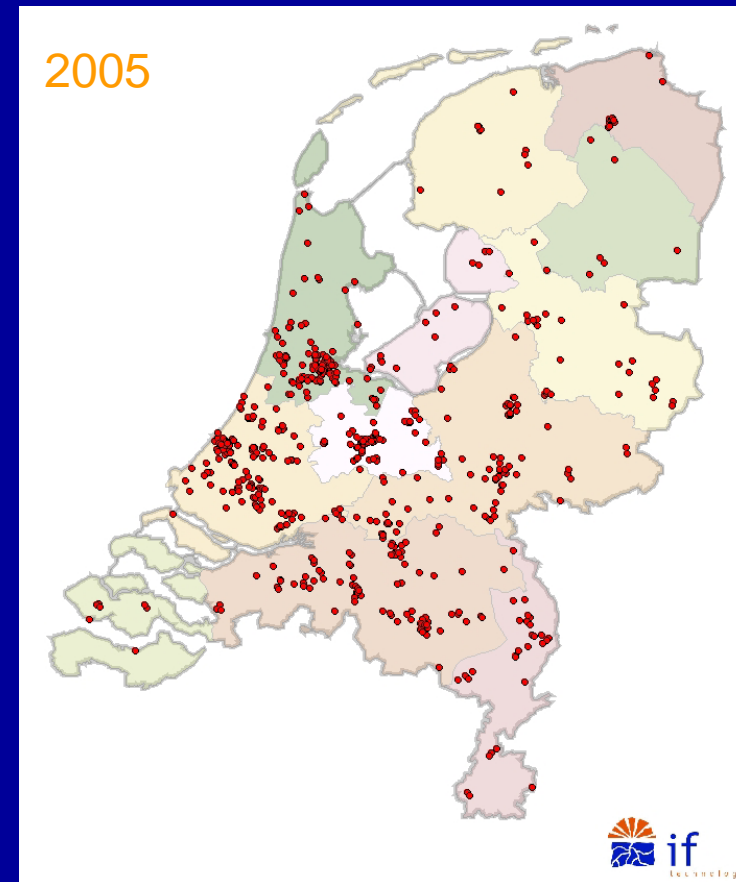
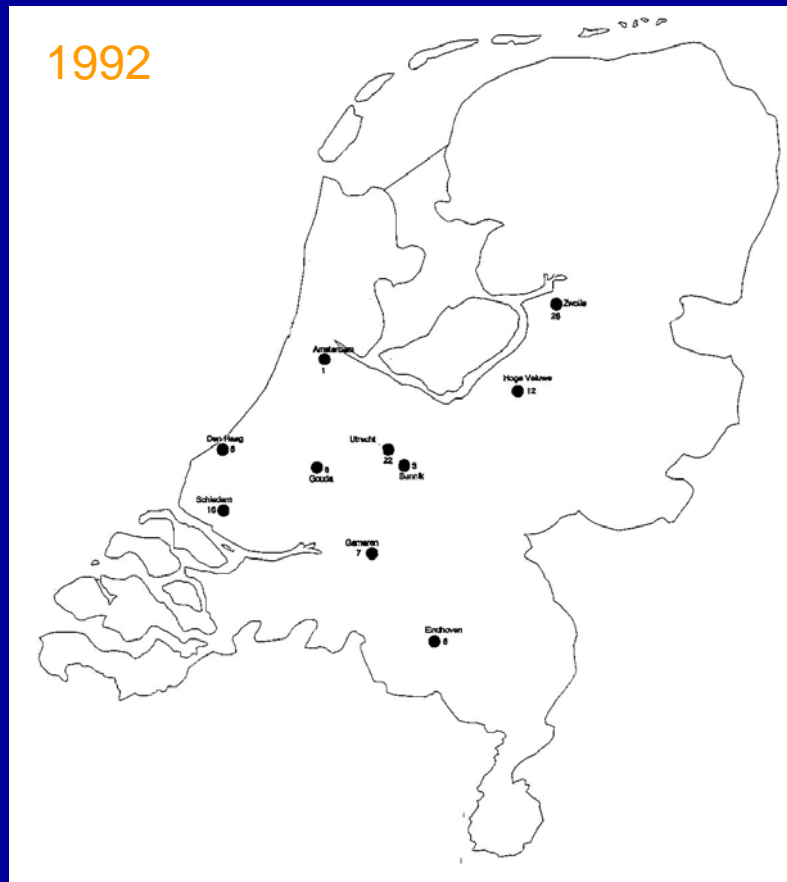
- In Germany the programme for solar panels on the roofs were doing very well because people get a very high price for the produced electricity
- In Holland it was going very slow with subsidies on the investments
- This year we adopted the German system: during 15 years the government pays €0.54 for every kWh produced with solar panels, while the actual price of electricity is €0.18 / kWh

Storage of heat and cold in the soil

- Heat or cold can be stored in the soil or in water layers at a depth of 25 – 100 meter
- Waste heat or solar heat can be stored in summer and used in winter
- Cold can be used in summer for cooling purposes
- A heat pump can be used to increase the temperature if it is too low

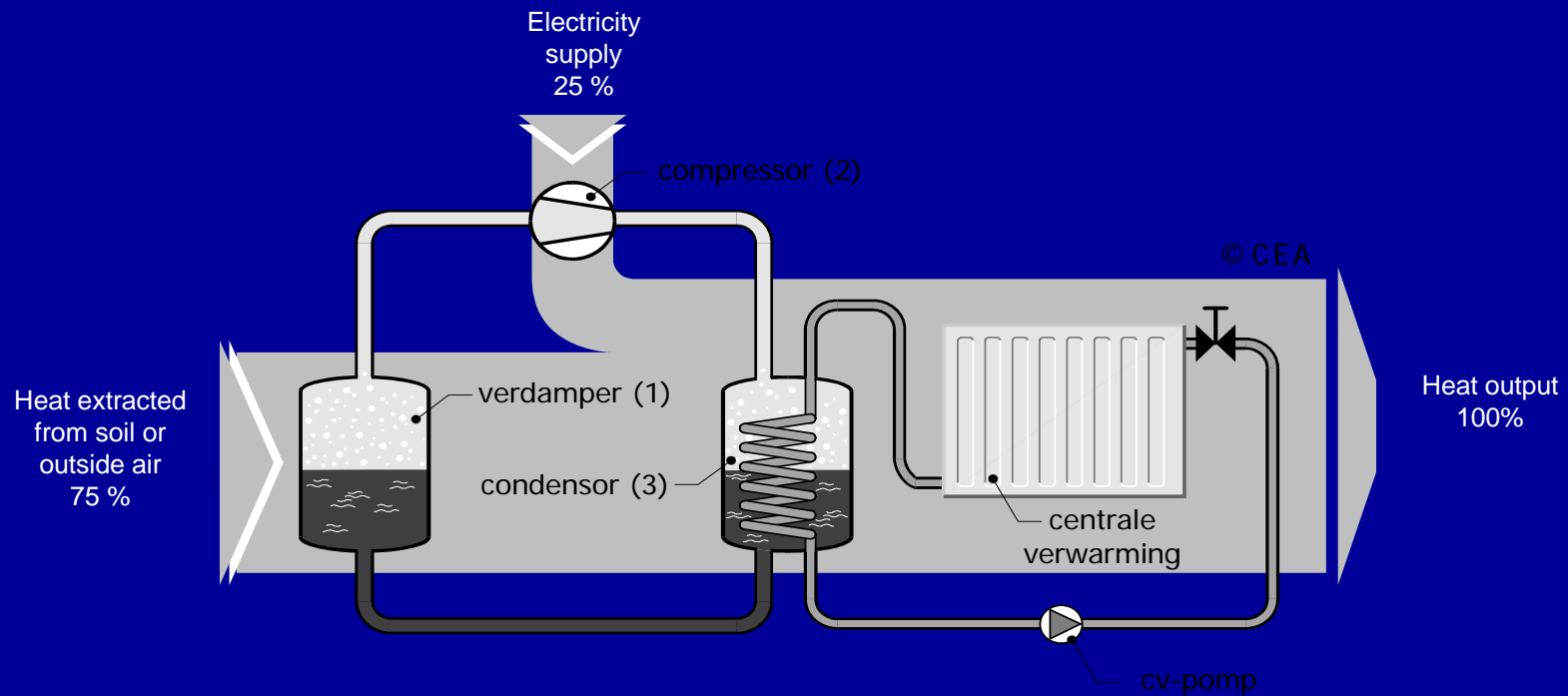


Storage of heat and cold is booming business



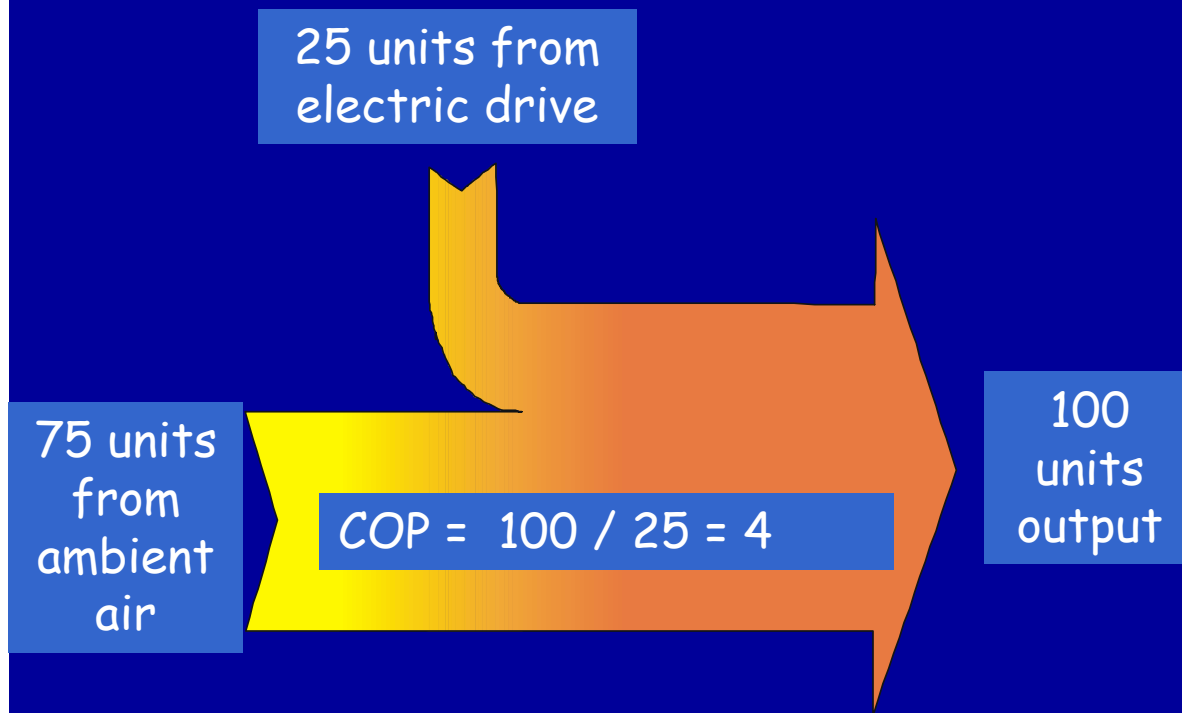
Heat Pump

Multiplier of energy, efficiency up to 500%!!



Heat Pump

Coefficient Of Performance (COP)

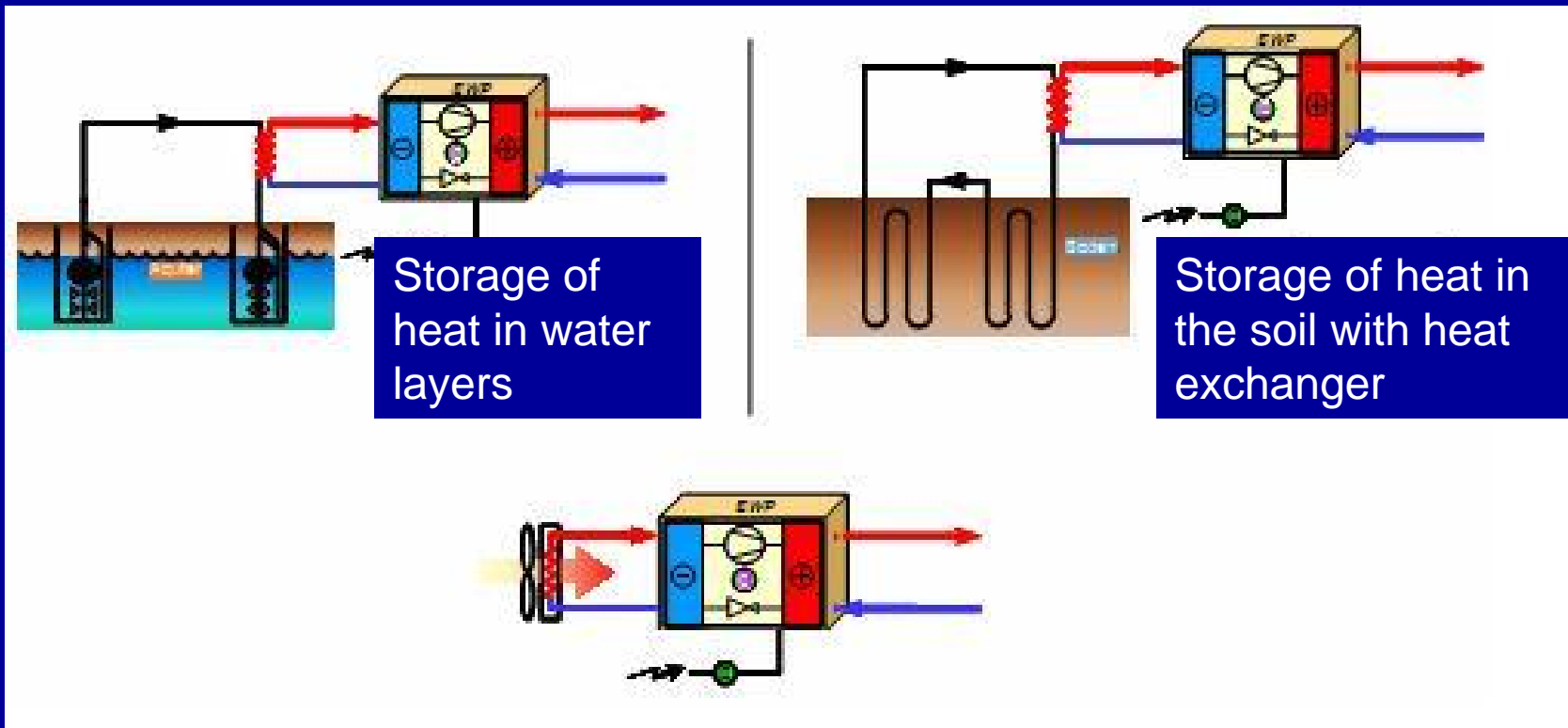


Coefficient Of Performance (COP)

$$COP = \frac{\text{output energy}}{\text{input energy}}$$

- Electric heat pump
COP = 2,5 - 5
- Gas heat pump
COP = 1,2 - 2
- Absorption heat pump
COP = 1 - 1,5.

Three system concepts for heat pumps



Storage of heat in water layers

Storage of heat in the soil with heat exchanger

Outside air is used as heat source

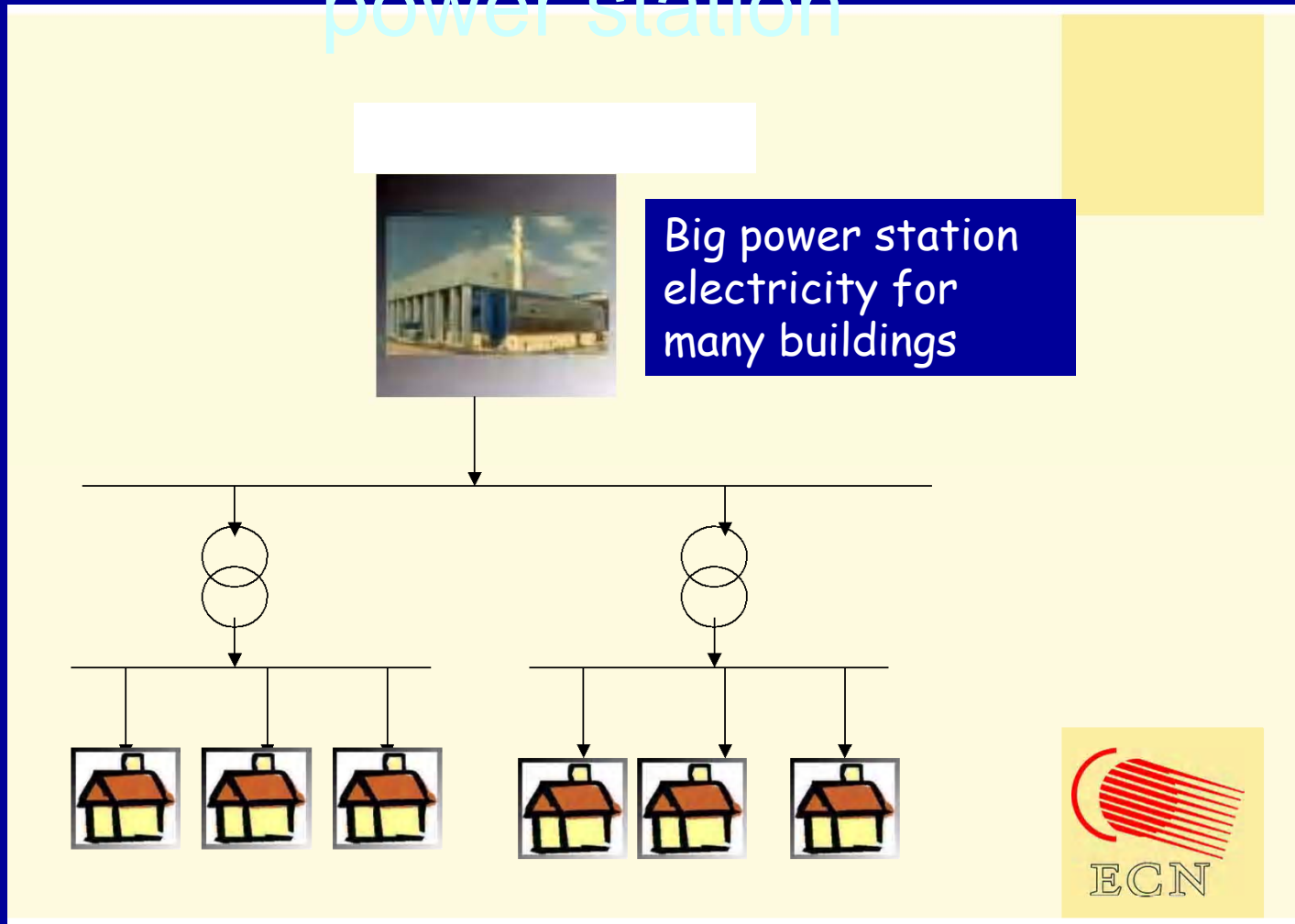
Drilling a well for heat storage in water layers



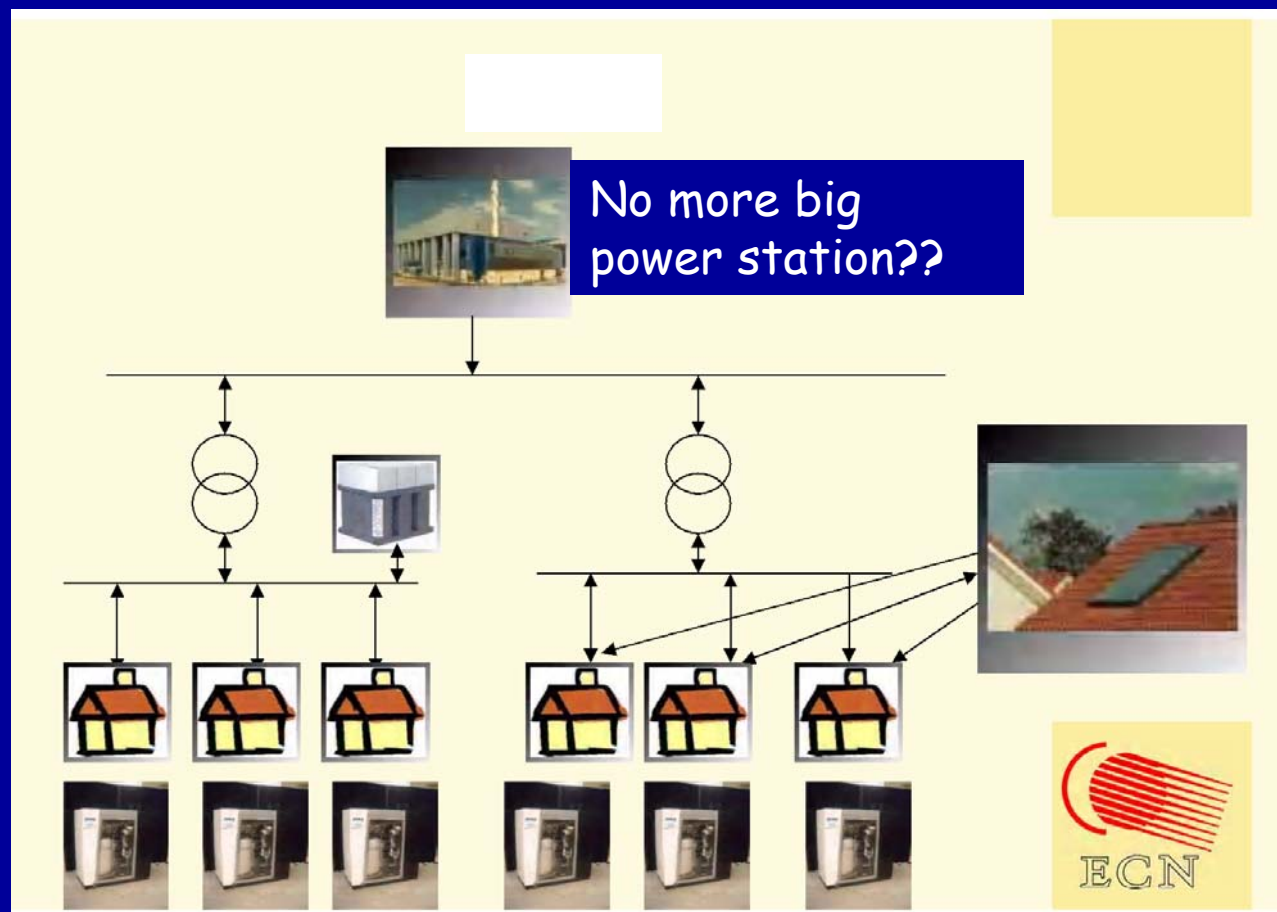
Storage of heat in the soil



Present situation with centralized power station



Future situation with micro power stations in every house that provides heat and electricity (Micro Combined Heat Power unit)



Conclusions and recommendations

Conclusions

- Lithuania can have a big advantage by adopting the best proven new technologies
- For the most energy efficient and cost effective solution the whole energy chain has to be considered: production-distribution-end use
- New proven energy options for buildings in Lithuania are;
 - Solar heating of water
 - Solar panels for electricity
 - Storage of heat and cold in the soil
 - Heat pumps
 - Mini CHP for apartment buildings, electricity and heat production
 - Micro CHP for single family homes

Recommendations

- Come to Holland
- Look which technologies provide the best solutions for Lithuania
- Start cooperation with the companies that can provide these new technologies
- Include these options in your housing modernisation programme and in the energy restructuring programme