Energy recovery technology for EAFs

Improving over-all energy efficiency of the EAF process by generation and usage of steam

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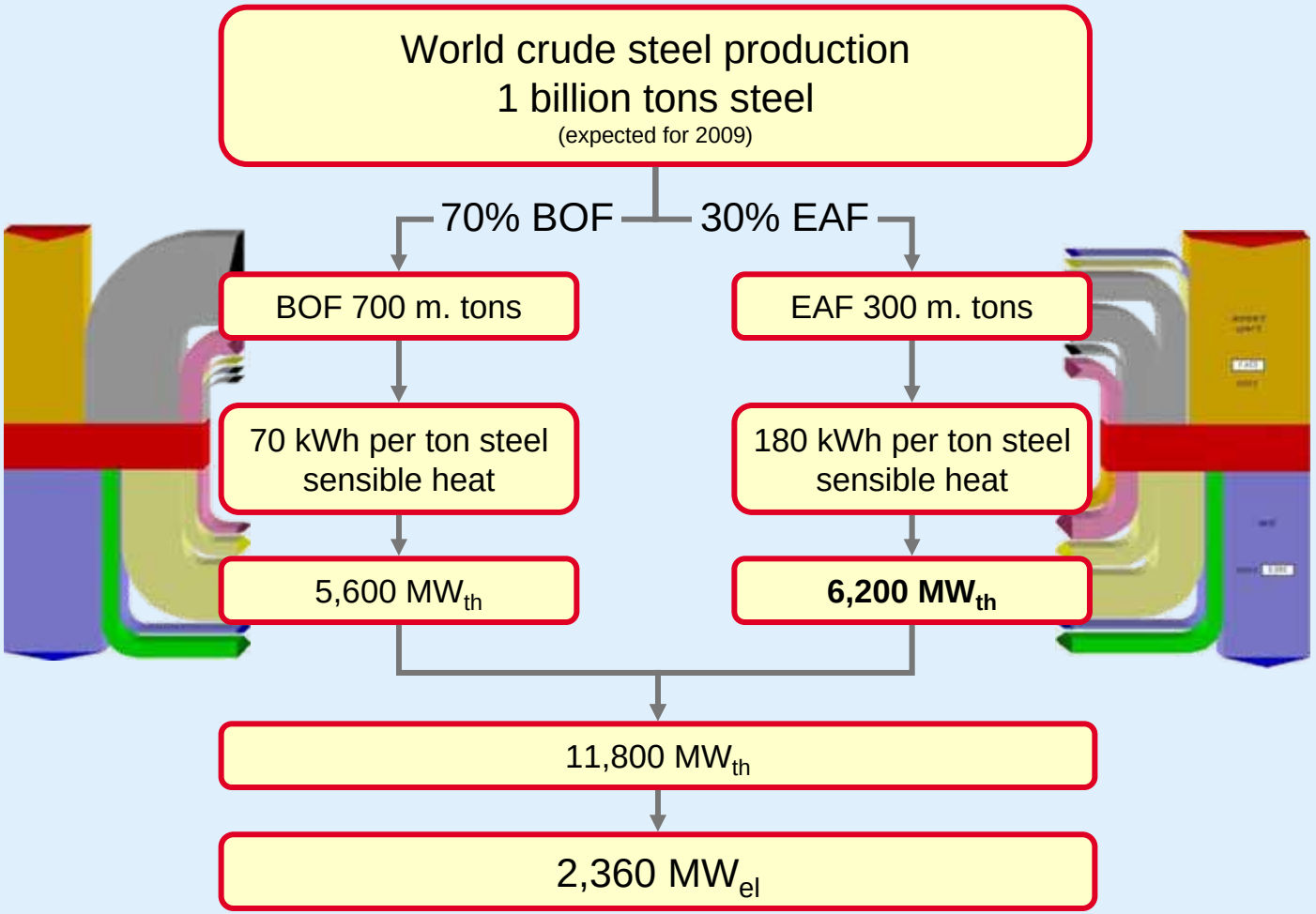
Steam generation – Introduction

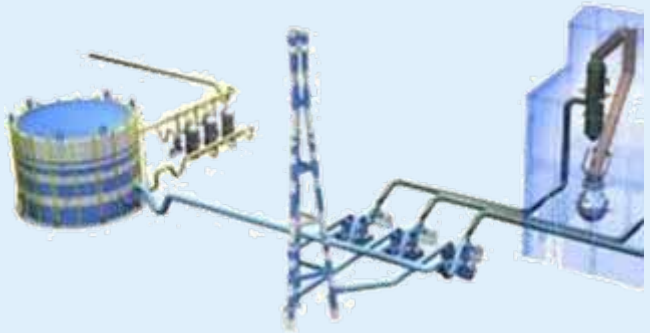
Potential of waste heat recovery from steelmaking



Steam generation – Introduction

Converter gas recovery technology

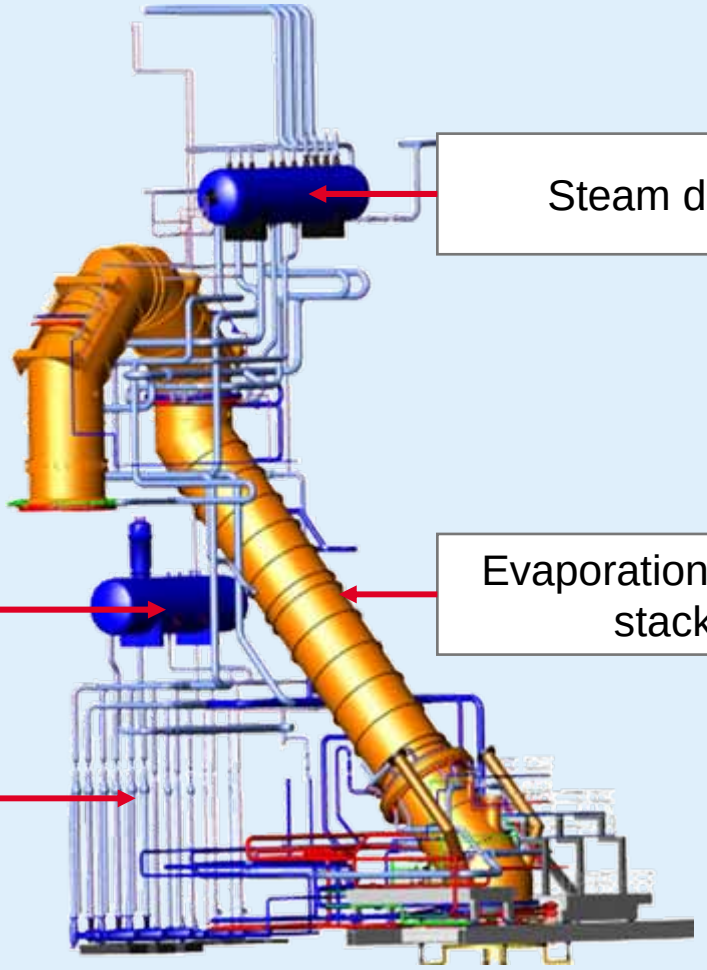
Details	
Task	▪ Collect and store CO from BOF converter or SAF
Applications	▪ BOF steelmaking, SAF non ferrous materials
Function principle	▪ Concentration of CO in off-gas is measured ▪ When blowing in BOF starts, CO is burnt via flare ▪ As soon as concentration is high enough, CO is collected in gas holder ▪ SAF has to be fitted with closed roof ▪ Prior to usage of gas, gas receives final Cleaning via electric filter
Components	▪ Switch-over-station, flare, gas holder, fan, ESP
Customer benefit	▪ Recovery of chemical energy from process ▪ Cost saving: CO can replace conventional fuels (e.g. for power generation)



Converter gas recovery plants collect the valuable CO gas from the BOF off-gas and store it for future thermal use

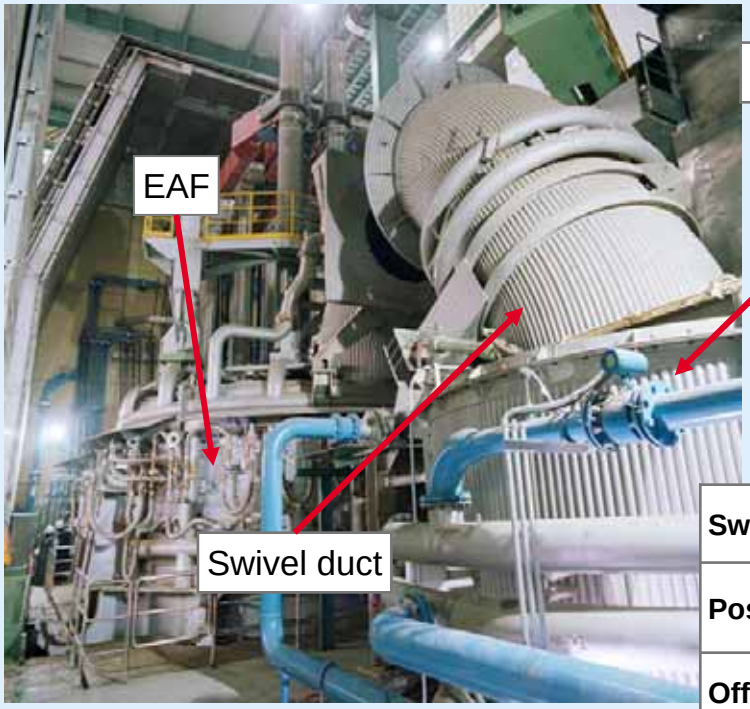
Steam generation – Introduction

Proven technology: Steam generation at BOF converters



Steam generation – Introduction

Temperature levels at the EAF off-gas system



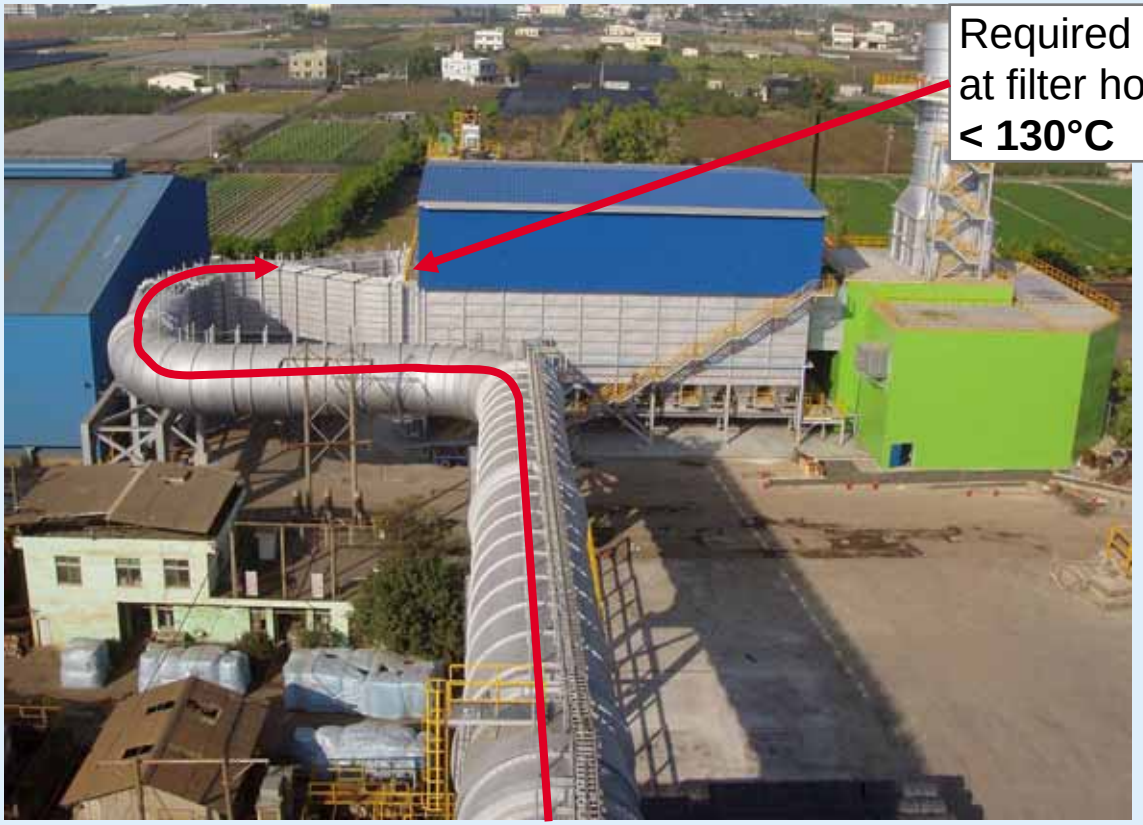
Typical temperatures (Solution A)

Swivel duct	**1,250°C**
Post-combustion chamber	**1,000°C**
Off-gas duct	**600°C**
Required at filter house inlet	**130°C**

Electrical energy is turned into heat in the EAF ⇨ Hot off-gas
Cooling the hot EAF off-gas is necessary

Steam generation – Introduction

Necessitiy of EAF off-gas cooling



EAF off-gas duct to filterhouse

Steam generation – Introduction

Options for EAF off-gas cooling

Required temperature
at filter house inlet
< 130°C

Cooling the EAF off-gas is necessary

Two options

Water cooling

Steam generation

Steam generation – Introduction

Standard solution: Off-gas duct is cooled by water

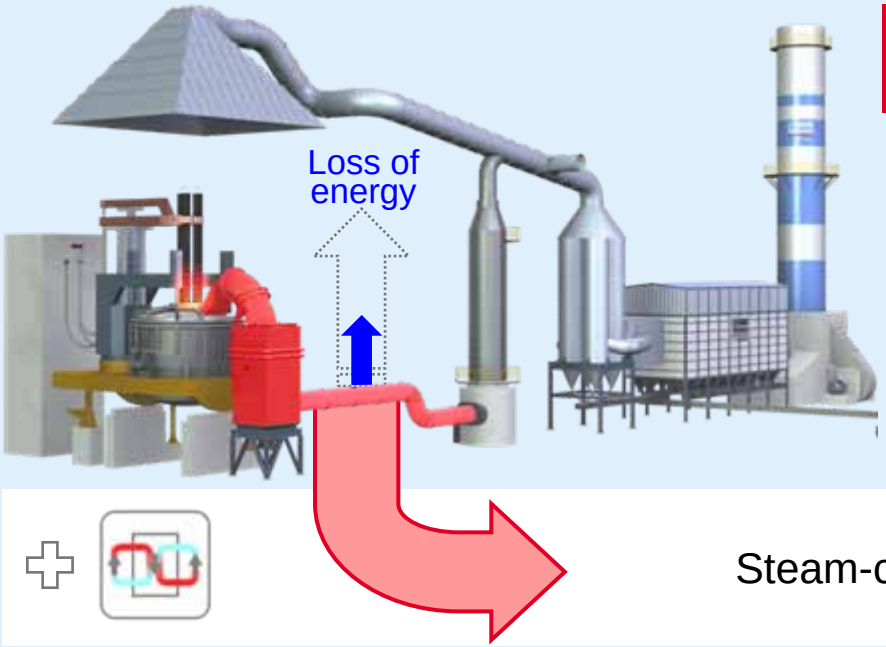
Water cooling

Water-cooled primary gas duct

✘ Thermal energy remains unused

Steam generation – Introduction

Economic solution: Off-gas duct is cooled by steam



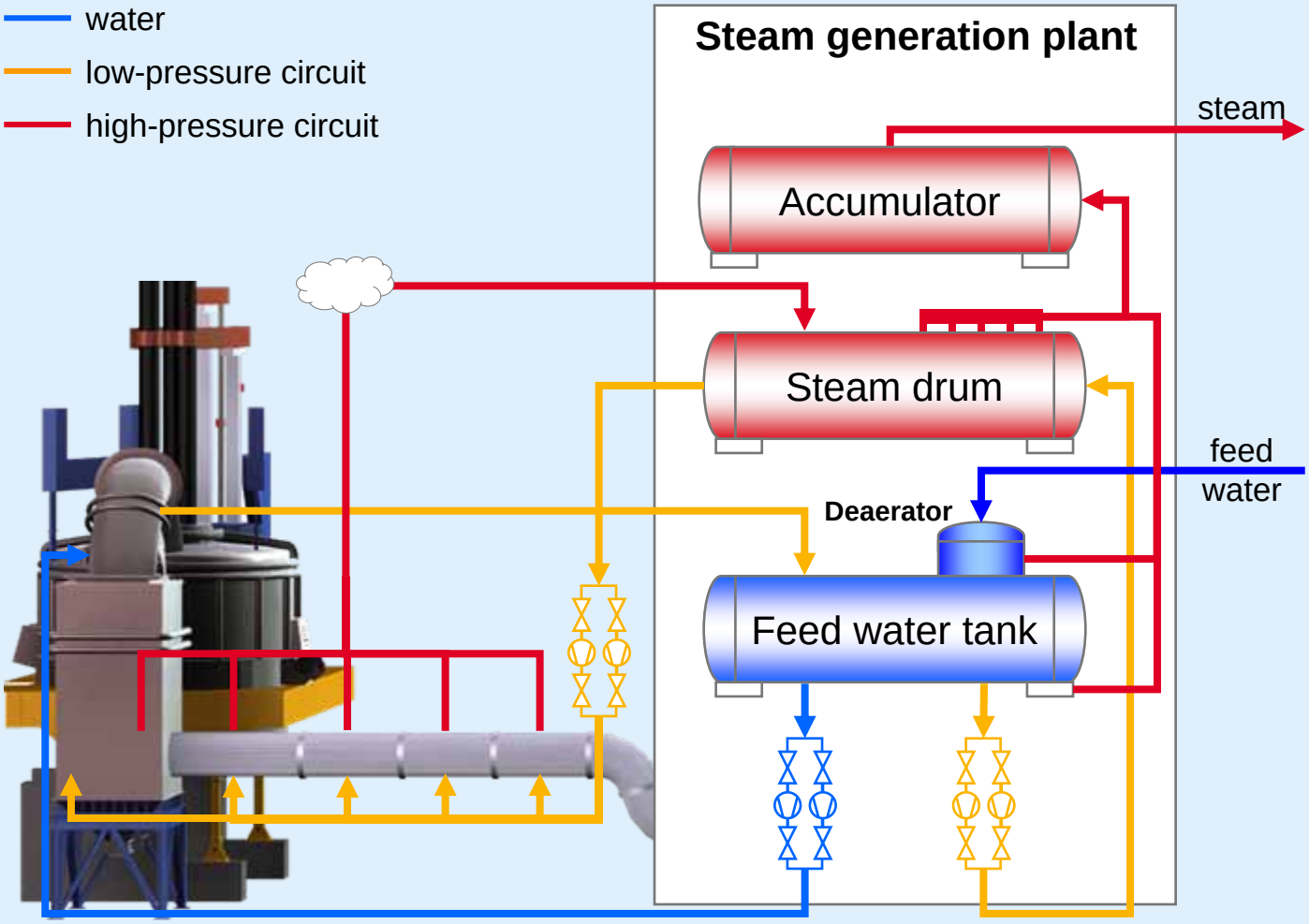
Steam generation

Steam-cooled primary gas duct

✓ Thermal energy is turned into steam

Technical details

Flow chart – Process (animated)



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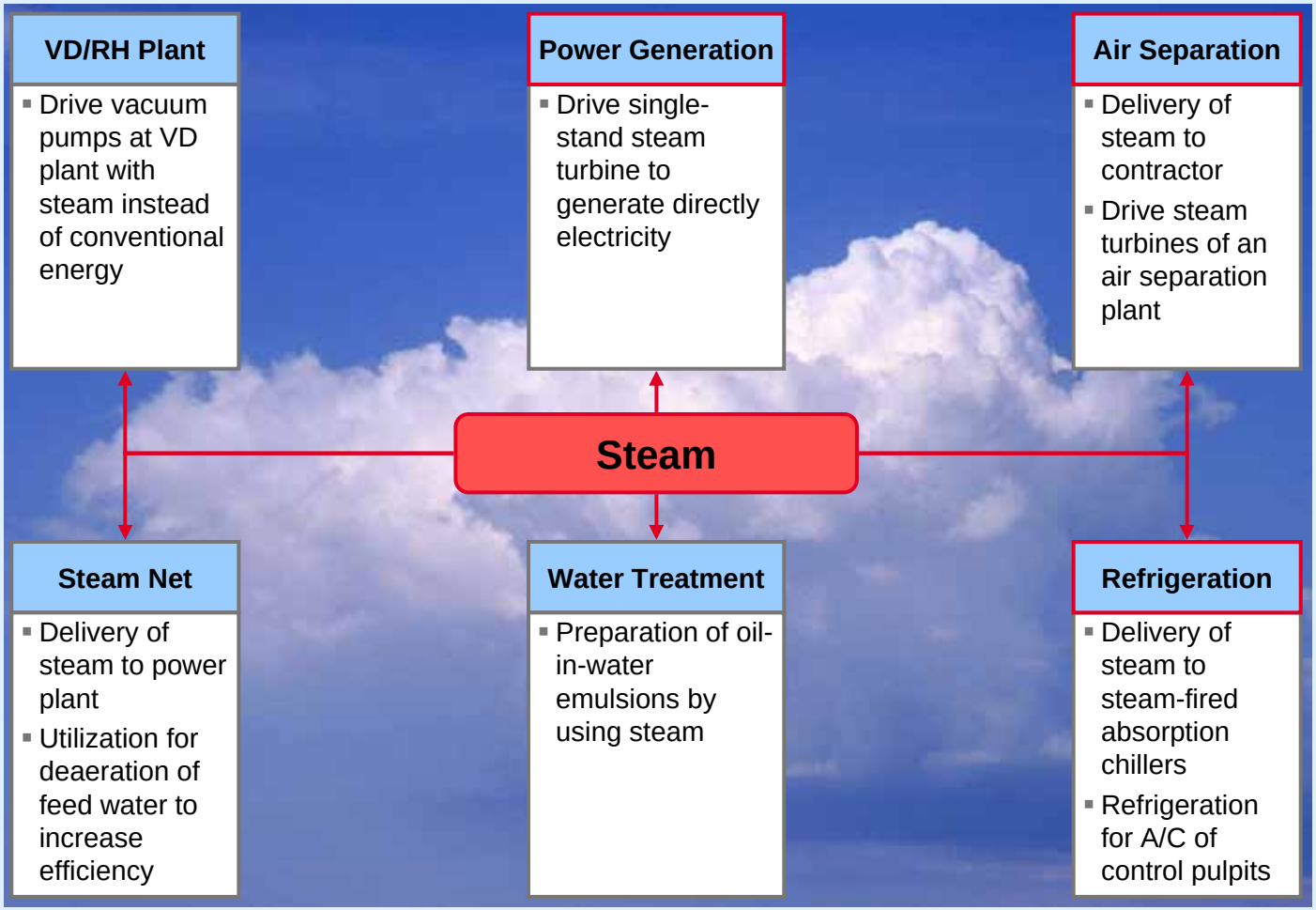
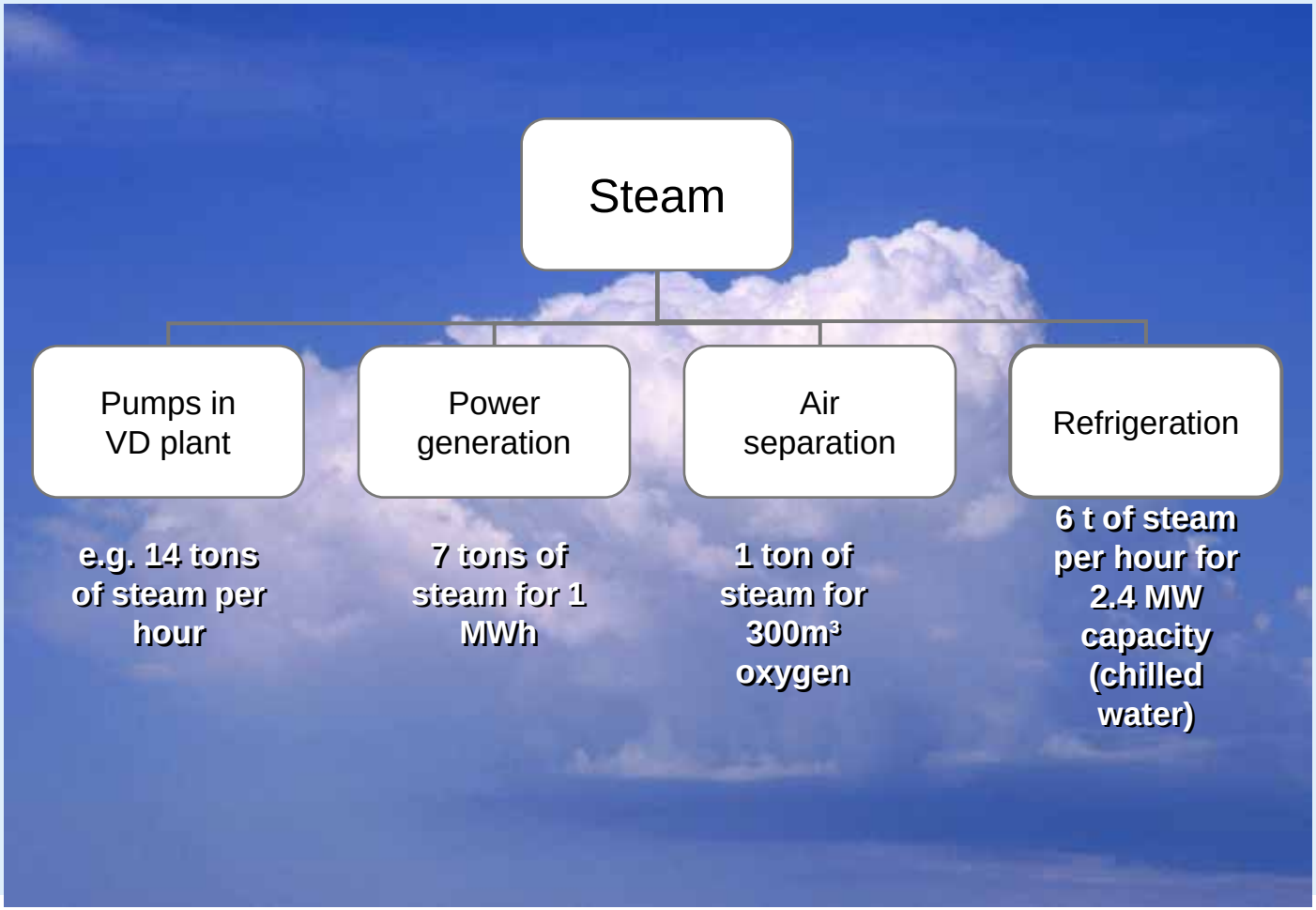
Economically reasonable usage of steam

Steam can be used in different applications



Economically reasonable usage of steam

Example for the usage of steam



Economically reasonable usage of steam

Generation of electric power

Common method

Delivery of electric power from power plant

Disadvantages

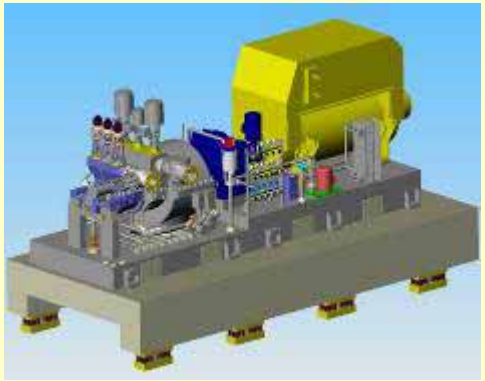
- Incalculable price trends for electric power
- Change in prices in dependency of carbon credit allocation
- Alternating security of energy supplies

New alternative method

Generation of electric power with steam-driven generator

Advantages

- 7 t/h of steam generate 1 MW of electric power
- Use the electric power e.g. for main drives at fans
- Sell electricity to the local power net
- Save carbon credits by CDM



Economically reasonable usage of steam

Air separation

Common method

Application of air separation equipment with electrical driven compressors

OR

Delivery of technical gases by external contractor

Disadvantages

- Dependency on incalculable price trends for electric power

New alternative method

Use steam for substitution of electric drives

Advantages

- Application of steam turbine instead of electric drives for compressors inside the air separation plant
- Delivery of steam from waste heat recovery to the contractor
- Reduce the price for supply of oxygen, nitrogen and argon
- Use remaining nitrogen instead of compressed air, reduce maintance costs for condensate removal from pipes

Photo: Linde AG

Economically reasonable usage of steam

Refrigeration

Common method

Application of single air conditioners or air conditioning system OR

Application of externally driven absorption chiller units

Disadvantages

- Equipment requires much electrical power
- Steam boiler is required (investment)
- Natural gas is required (operation costs)

New alternative method

Use steam-fired chill units

Advantages

- Use the steam from waste heat recovery (low costs)
- Required remaining electrical power is low
- Generation of cold water at 6°C for cooling purposes
- Example

5.4 t/h steam at 1 bar (behind turbine) generate a refrigeration capacity of 2.4 MW
at electric power of 7.3 kVA

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Summary

Ecological and economical aspects of energy recovery

- The reduction of CO2-emissions by using the waste heat for steam generation is a relevant contribution to environment protection
- For external generation of 1 ton of steam on the basis of natural gas an amount of about 0.13 t CO2 is emitted
- By substitution of 1 MWh electric power the generation of 0.6 t CO2 can be prevented
- An important economical effect is the saving of carbon credits
- Plant operation cost can be significantly reduced

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