



# Bilfinger in CCUS

## Costs & Energy optimised integrated solutions

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# BILFINGER

Leading international engineering, construction and service provider



## Key characteristics

- About **30,000** employees
- in **27** countries
- **>90%** of our customers purchase our services more than once
- **>140** years of engineering expertise
- **Headquarter** in Mannheim and **listed** in Germany

## Regional footprint



Consultancy



Engineering



New builds & Modifications

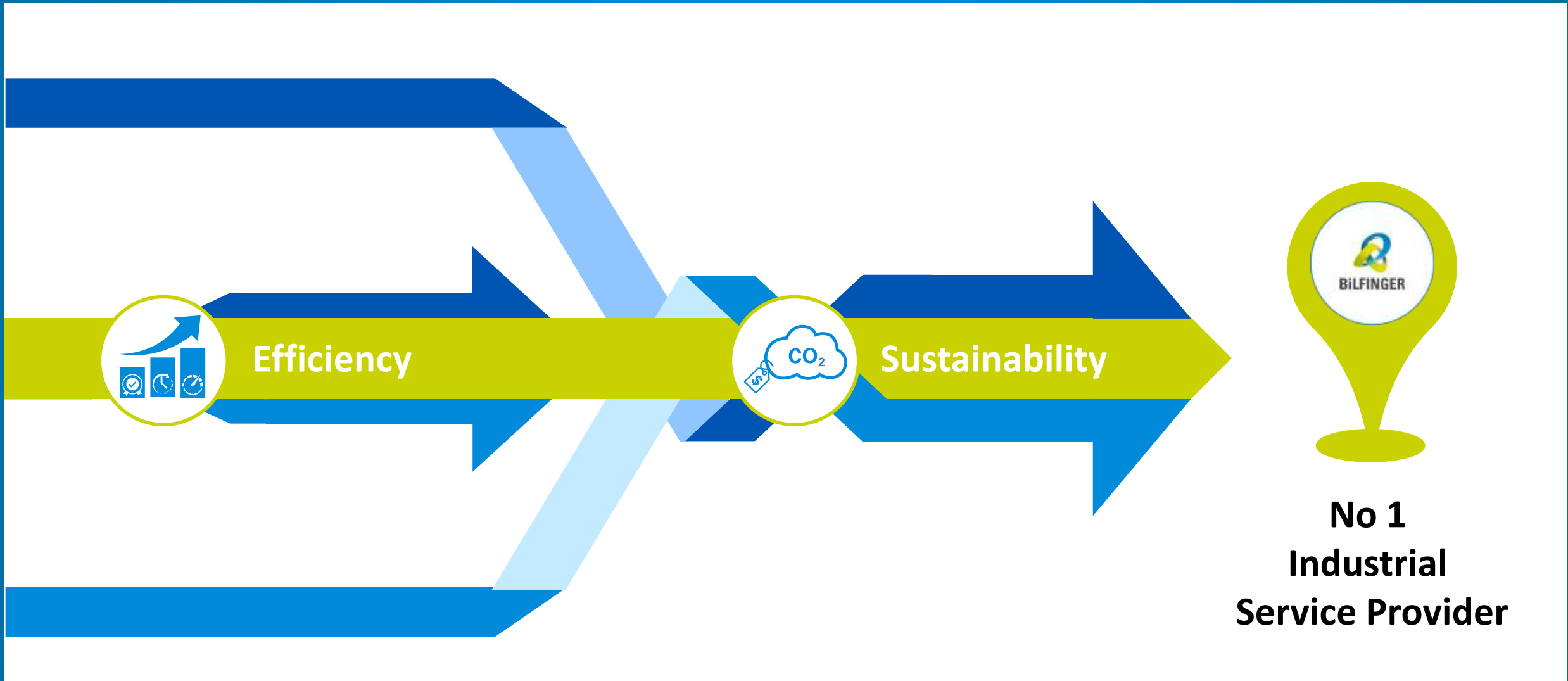


Maintenance & Turnarounds

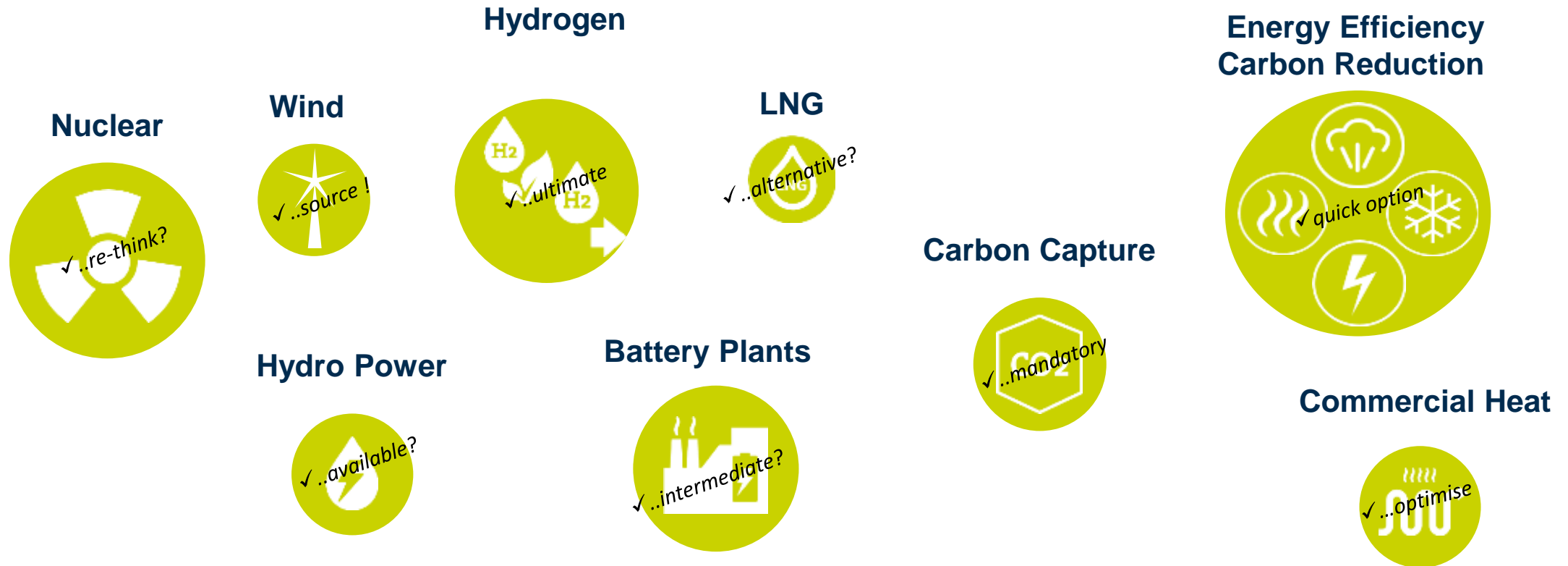


# Bilfinger Vision

Improving efficiency and sustainability for our customers



### THE ENERGY PATH



What's going on in CCUS ?



## Need for optimized Heat Integration

Project financing vs. funding programs

Low Energy Capturing solutions developments

Infrastructure paths not defined yet

**Technologies ask for strong and experienced System Integrator**

# Sustainable Industrial Services

## Key Words



**System  
Integration**



**Low Energy  
Low Costs**

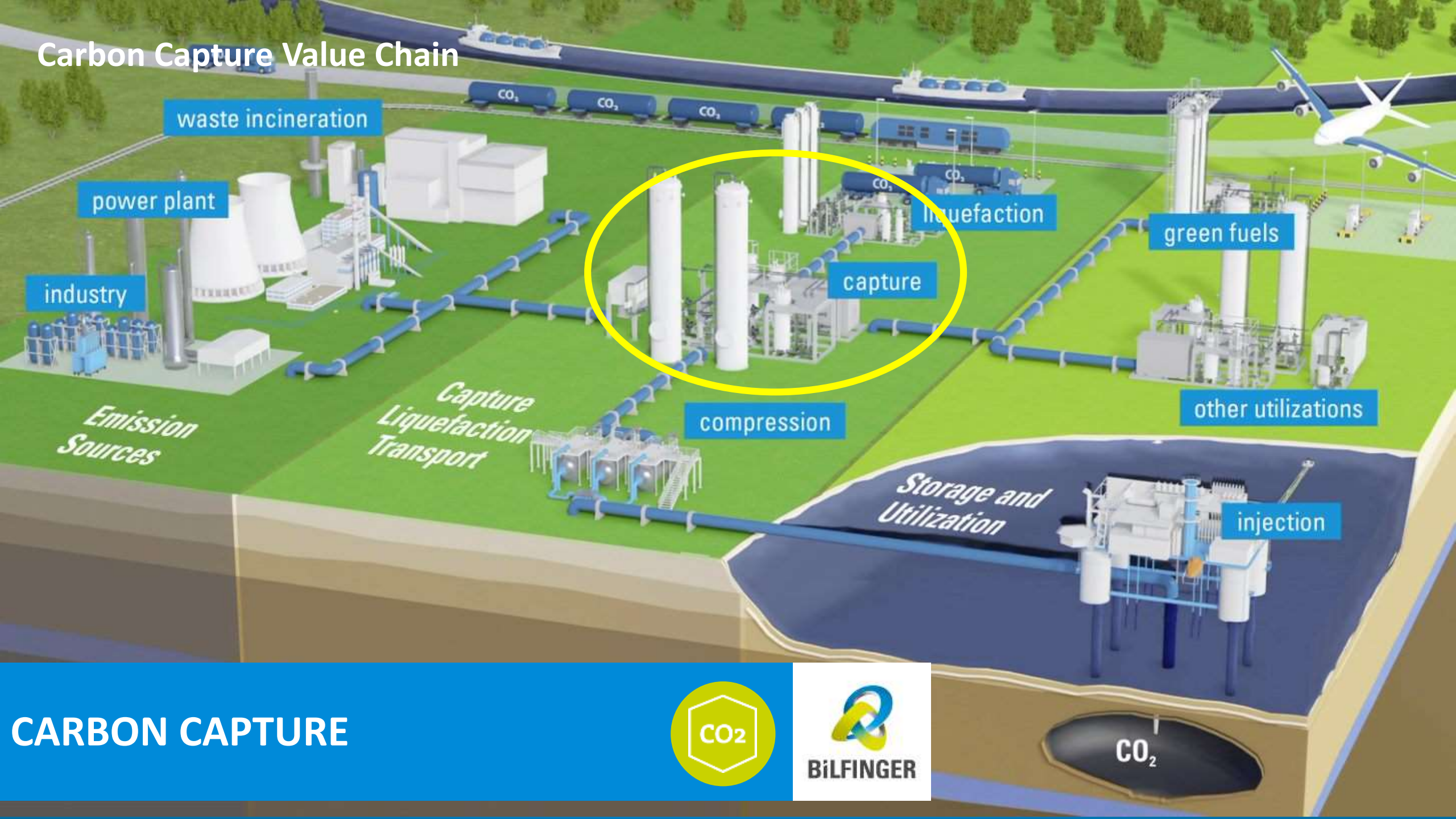


**Industrial  
Hubs**



**Infrastructure**

# Carbon Capture Value Chain



CARBON CAPTURE



# Key developments

## Combining Eco-systems & System Integration



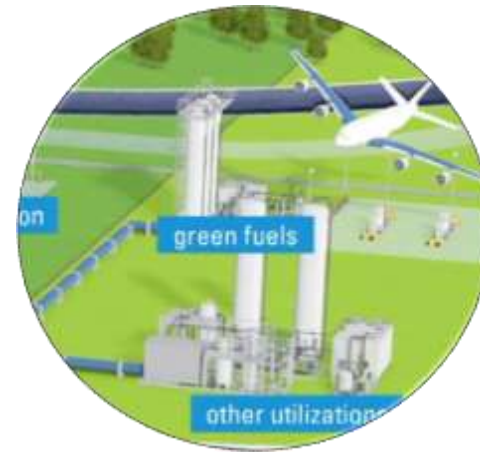
### Changing Industry drivers

#### Waste-to-Energy market is the leading market

- developing towards a new eco-system
- Combining waste handling and new process plants
- Green CO<sub>2</sub> as new carbon source

#### Industry taking over position of Power Plants

- for large scale Carbon Capture Plants
- In Steel, Cement and Paper



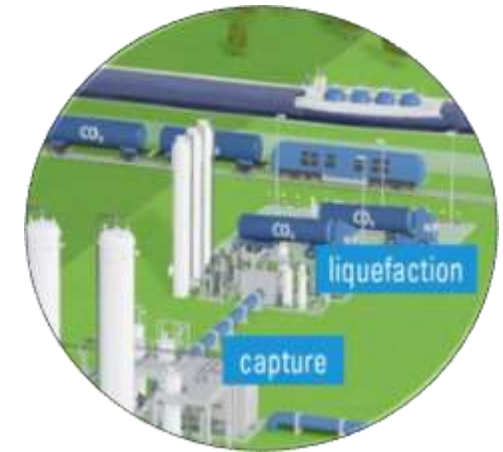
### Green CO<sub>2</sub> as the new golden Oil

#### CO<sub>2</sub> + H<sub>2</sub> = SAF

- Knowledge of different processes
- System integration is Key
- Scaling of new technologies

#### CO<sub>2</sub> + H<sub>2</sub> = Methanol (building block)

- System integration & Technology agnostic are Key
- Combining technologies with different TRL



### CO<sub>2</sub> pathways

#### Liquid CO<sub>2</sub> as new commodity

- Road transport
- Train transport – example UK
- Ship transport

#### Major new Infrastructure

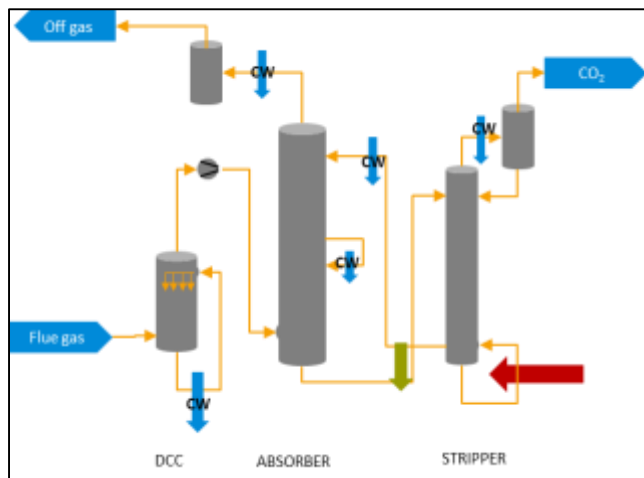
- Large dense phase CO<sub>2</sub> grids
- Large scale CO<sub>2</sub> terminals





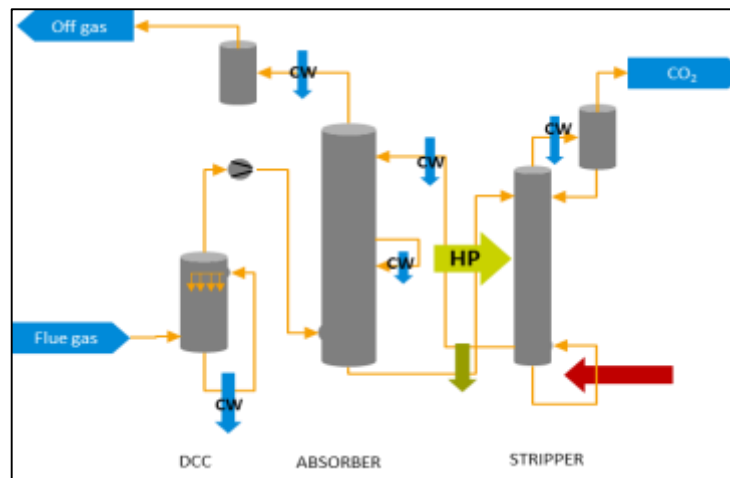
# Low Energy Capture technologies developments

## Heat Integration in Amine Adsorption Process: OPEX aspects



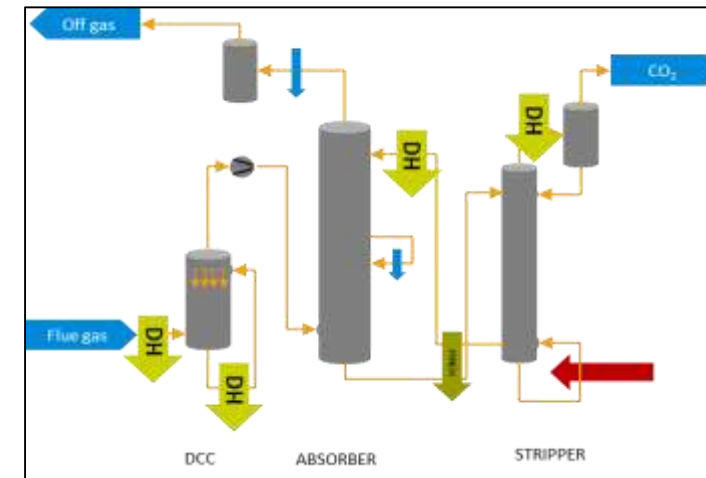
Base Case: Heat source LP Steam  
Cooling Water <35°C  
Valid for most Amine based solvents

- Base line values



Advanced Cycle with **internal heat pump**  
Best performing amine process and  
internal heat optimization. Saving up to  
40% steam consumption.

- % CAPEX + **10%** (heat pump)
- % OPEX savings **15%** overall (Less steam/more power)



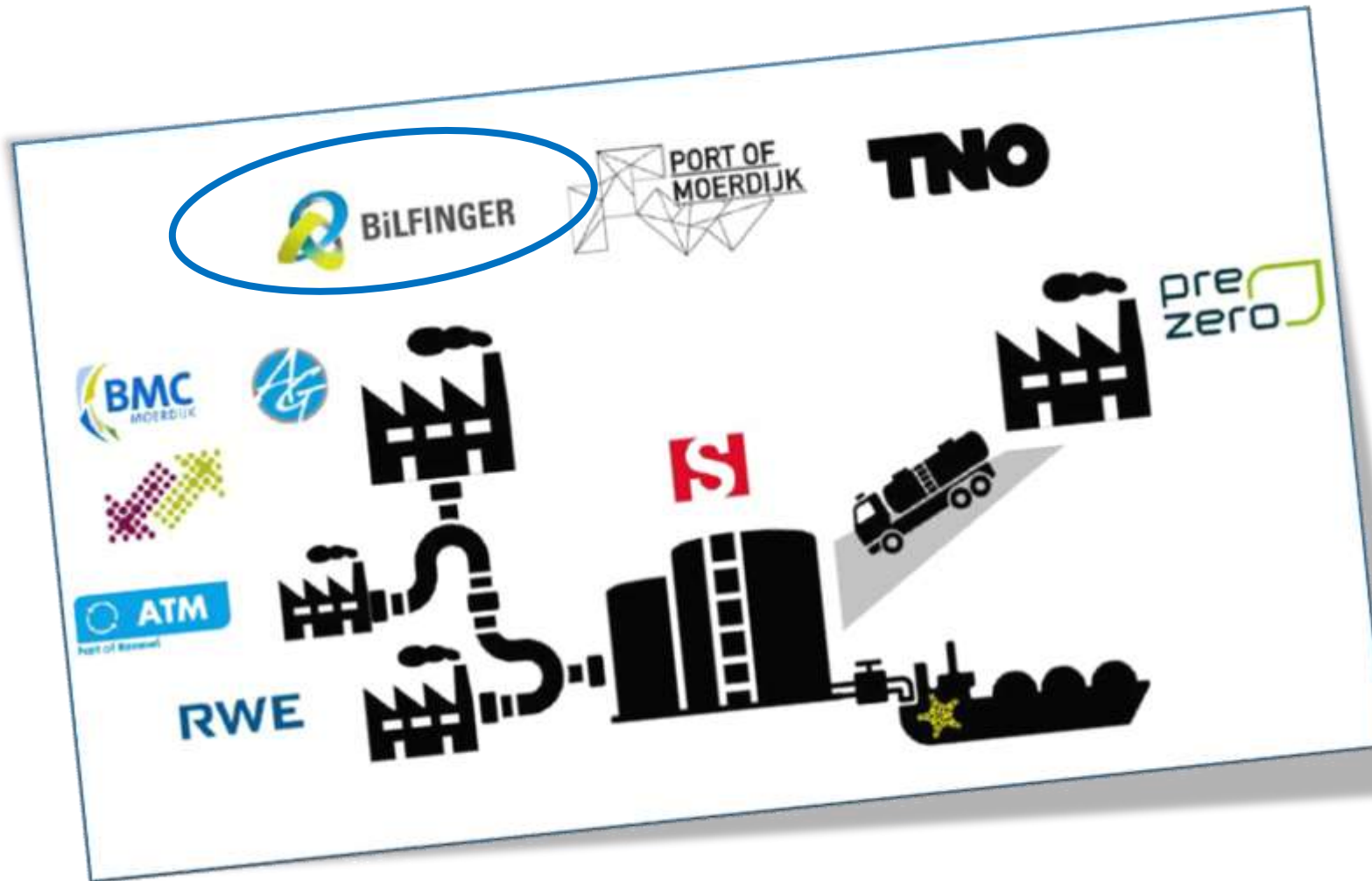
Advanced Cycle with **external heat integration** (District heating system)  
Best performing amine process and  
external heat utilization up to 80% waste  
heat recovery.

- % CAPEX + **2%** (Excluding District heating, 100% cooling as back up remains)
- % OPEX savings **25%** on overall

# Solutions for industrial hubs

Case story of industrial hub Moerdijk

Bilfinger as System Integrator and Partner in DIMMER Consortium



## DIMMER

A study program to get insight in best technical set-up for optimal integrated Carbon Capture and CO2 Transport solution for an Industrial Hub

- **1** Port: Moerdijk HUB
- **5** Industrial emitters
- **1** Terminal operator
- **1** CO2 Shipping company
- **1** System Integrator
- **1** Knowledge Institute



# Solutions for industrial hubs

## Case story of industrial hub Moerdijk

### 4 Main CO2 capture Integration Cases & 3 CO2 conditioning and transport Cases



#### 3 Conditioning Transport and Storage Cases

- Medium P, refrigerated T ship transport to Terminal
- High P, ambient T tugs and barges transport to offshore injection
- Supercritical pipeline transport to offshore injection



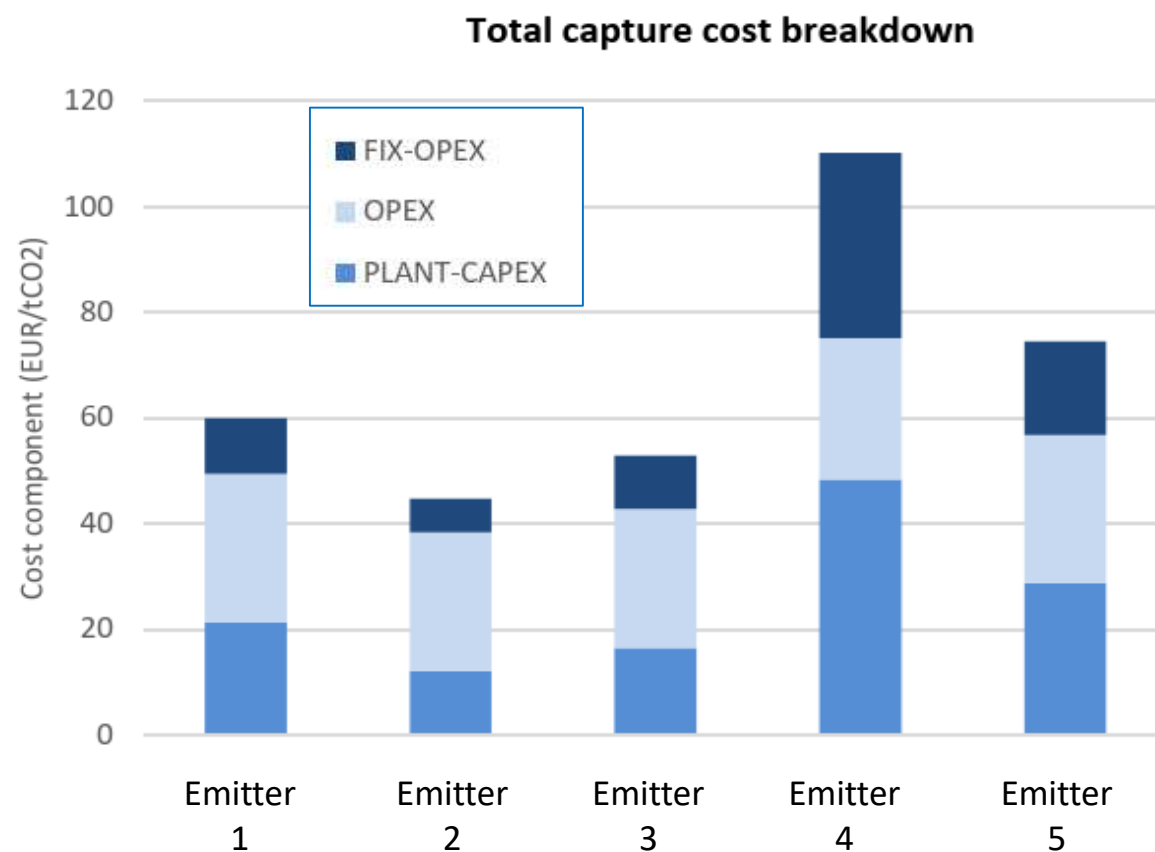
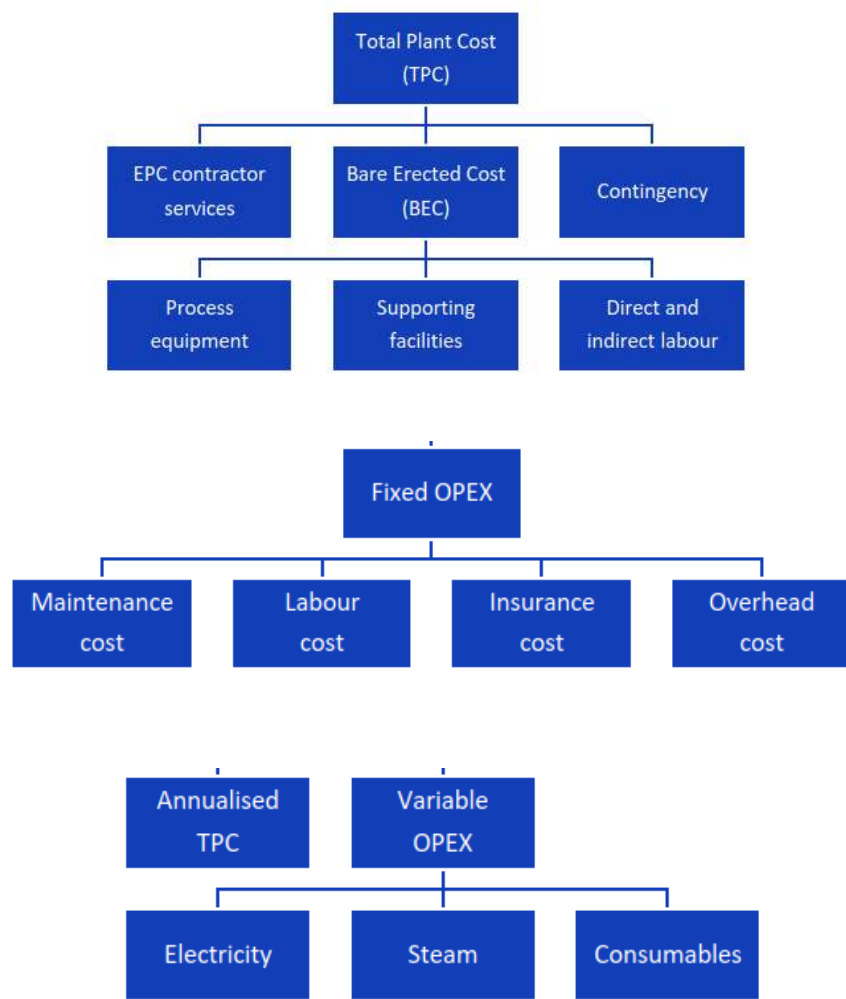
#### 4 Capture Cases

- Distributed case: RWE, Attero-4, Ardagh, ATM
- Semi collective Flue gas integration: Attero-4, Ardagh, ATM
- Collective solvent Stripper (quench+absorber distributed)
- Collective Compression (quench+absorber+stripper distributed)

# Solutions for industrial hubs

## Case story of industrial hub Moerdijk

### Standardized Cost build-up & Potential for Capture Cost optimization



# Solutions for industrial hubs

Case story of industrial hub Moerdijk

Standardized Cost build-up & Potential for Capture Cost optimization



## Preliminary Results

- Large Potential for Cost reduction of CO2 capture
- Biggest potential for Integrated Solvent Case
- Major Cost saving potential for mid-sized emitters:
  - 50 -- 100 -- 200 KTPA
- Major Cost saving potential when central steam available

## Next Steps

- Pilot Test set-up for Integrated Solvent case
- Capture as a Service developments
- Study on legal & regulation barriers

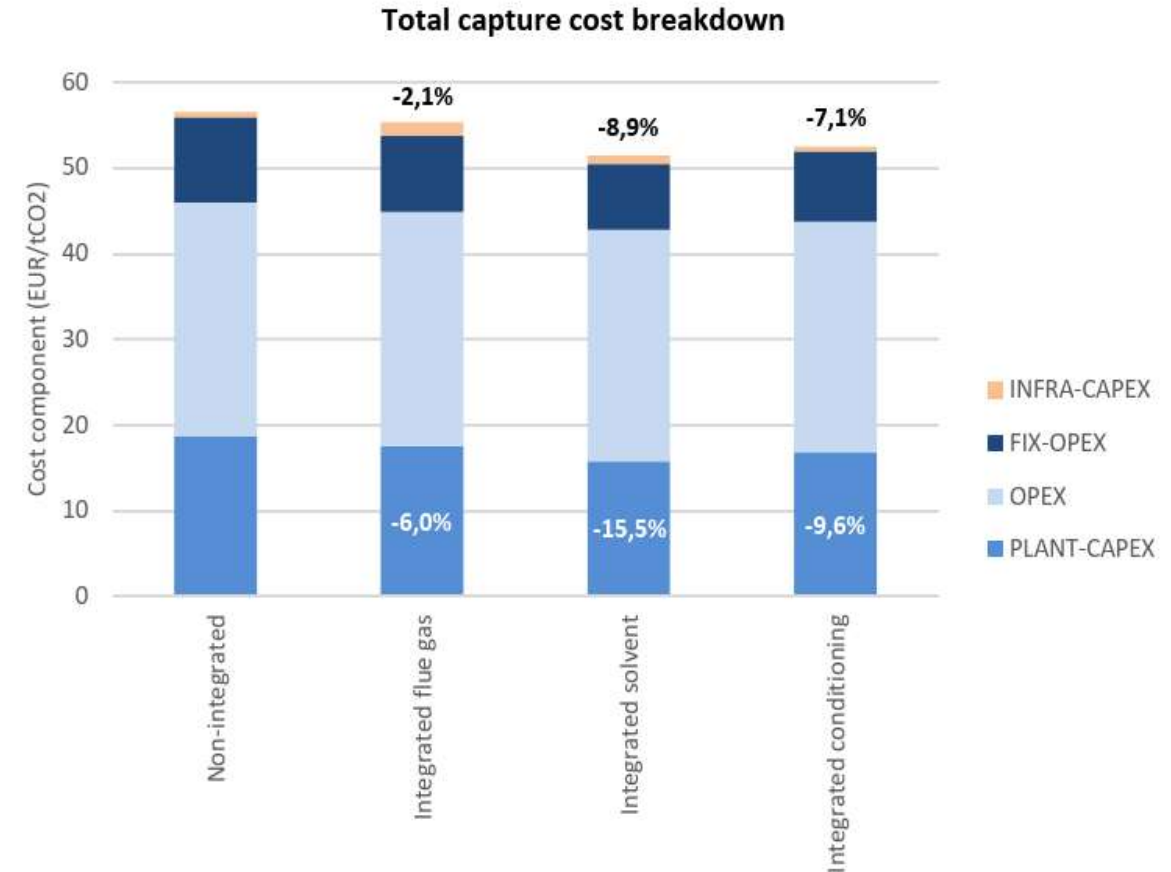


Figure 4.5: Total capture cost per ton of CO<sub>2</sub> for the different integration strategies



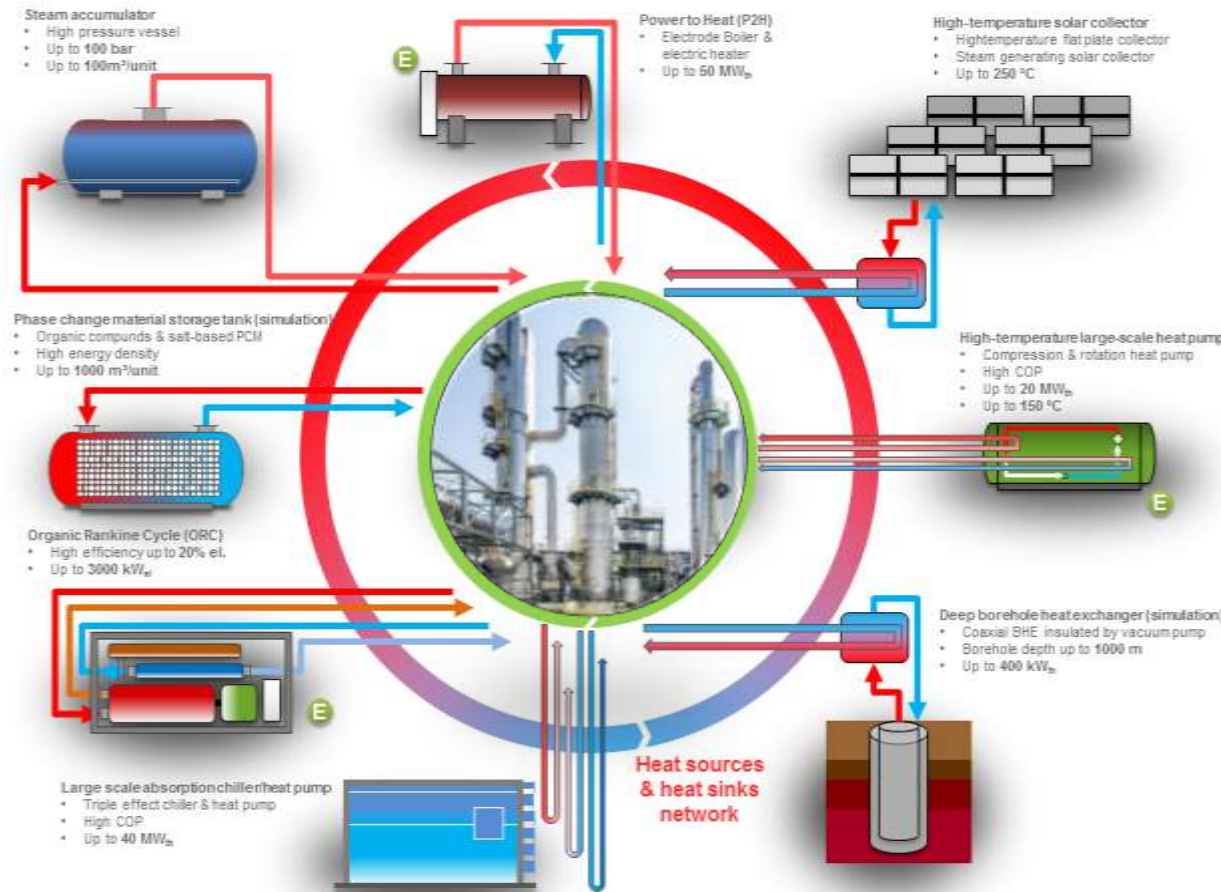
# Costs & Energy optimised integrated solutions

## Technical Options as one-stop-service



### BILFINGER ONE STOP SHOP

- Procedural potential analysis (process engineering)
- Modeling and optimization of energy generation and distribution
- Planning and implementation of technical measures to increase energy efficiency
- Business case calculation
- Project development and control
- Sustainability concept and strategic communication



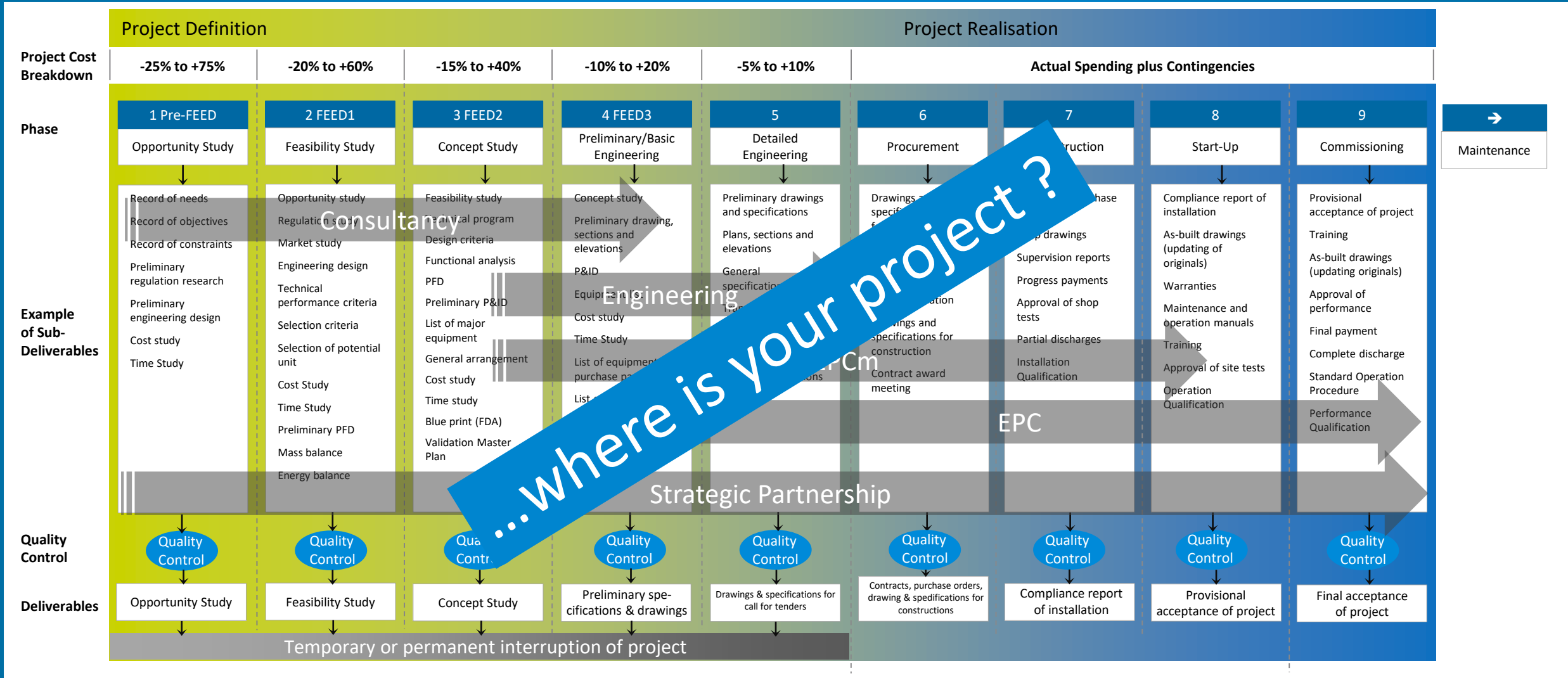
### BENEFITS FOR INDUSTRIAL PLAYERS

- Better financial evaluation of decarbonisation measures
- Innovative solutions and new strategic perspectives
- Cost reduction through increased energy efficiency
- Increased resilience of the location by reducing environmental pollution and networking with local stakeholders
- New business models through local circular economy

Early stage engagement for long term strategic relationship

# Costs & Energy optimised integrated solutions

## From Definition to Realisation



...where is your project?





**BILFINGER**

**WE  
MAKE  
IDEAS  
WORK**

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**ANY  
QUESTIONS?**