

CLOSUR

Technology Services and Latest Improvement in product portfolio

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engineering.tomorrow.together.



thyssenkrupp

thyssenkrupp Uhde Chlorine Engineers – a reliable partner

Building on a strong past

- UHDENORA founded as JV 2001 between DeNora (founded 1923) and Uhde (founded 1921)
- Chlorine Engineers founded 1973, acquired in 2011 by Industrie de Nora S.p.A., the parent holding company of De Nora
- ThyssenKrupp Electrolysis GmbH (former Uhde Product Unit Electrolysis, founded in 1960)



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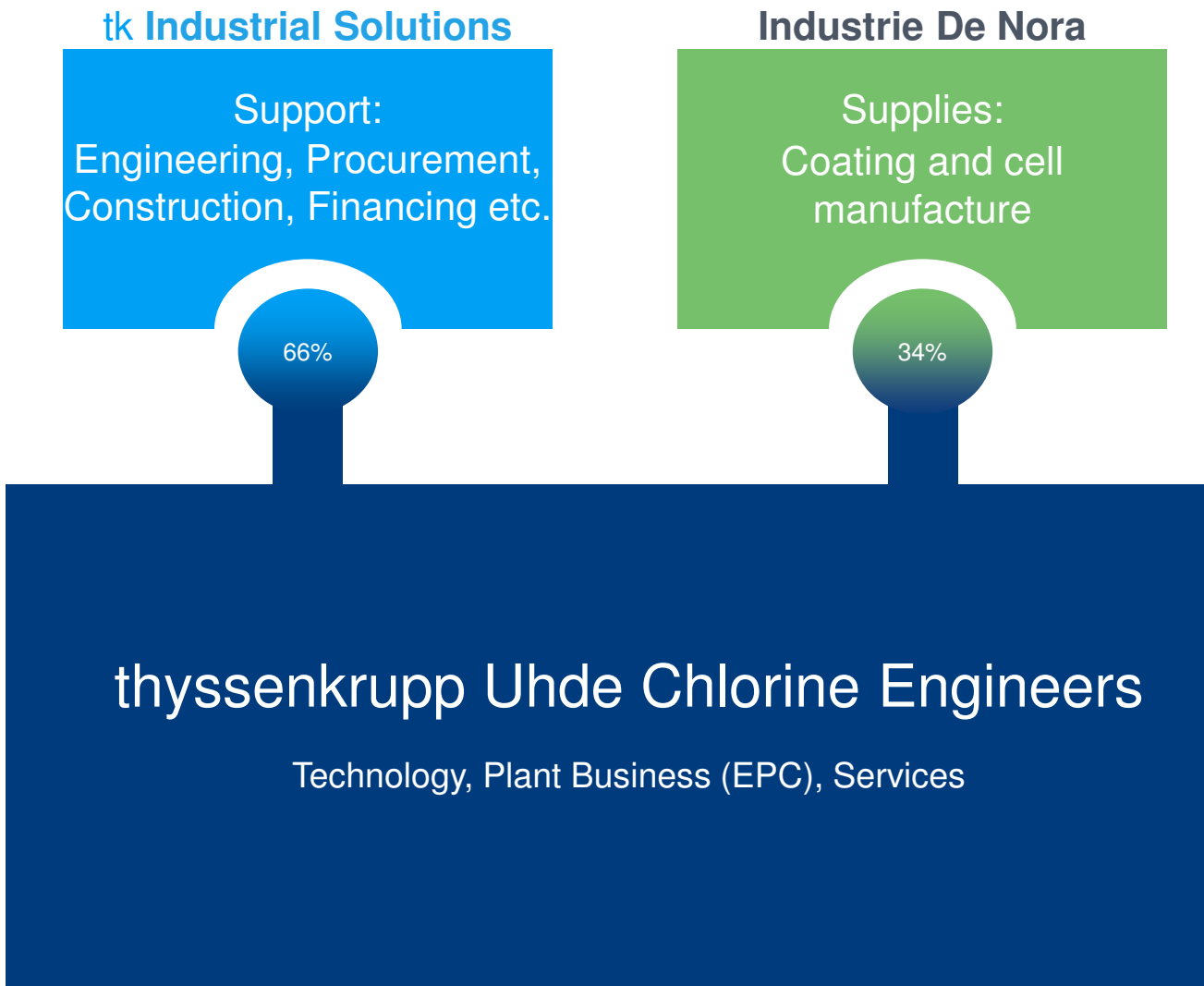
ThyssenKrupp Electrolysis

Since 1.4.2015 =

**thyssenkrupp Uhde Chlorine
Engineers**

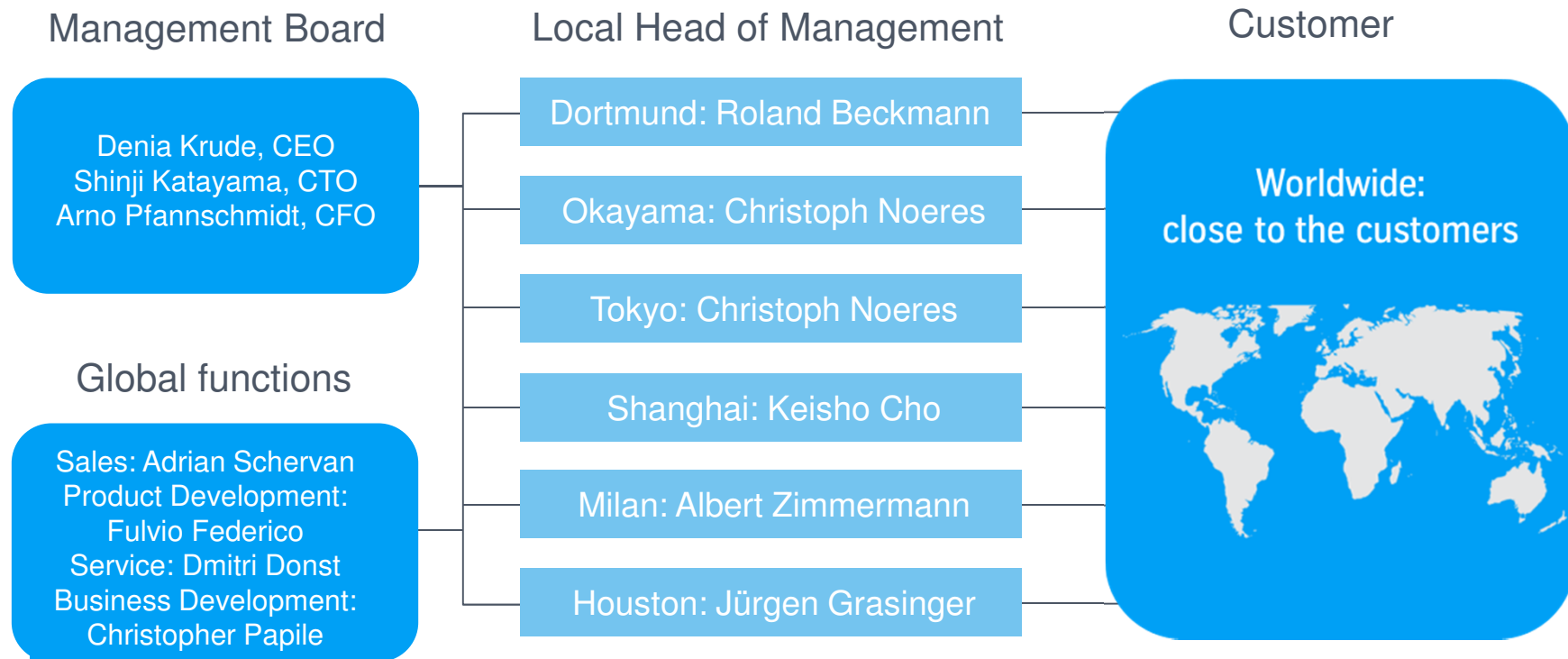


To ensure excellent support on a global scale
thyssenkrupp Industrial Solutions and Industrie De Nora joined forces

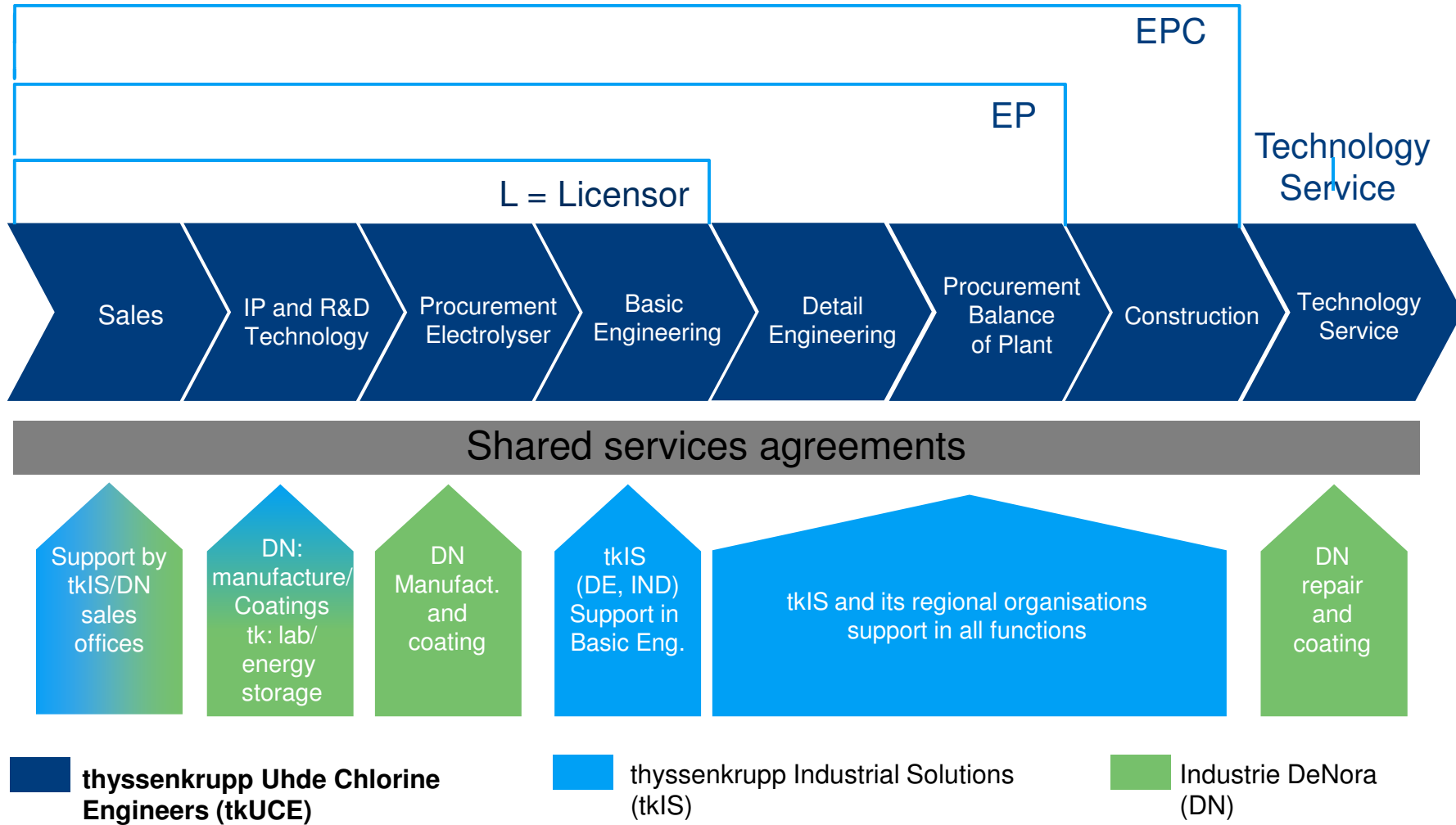


Being closer to our customers

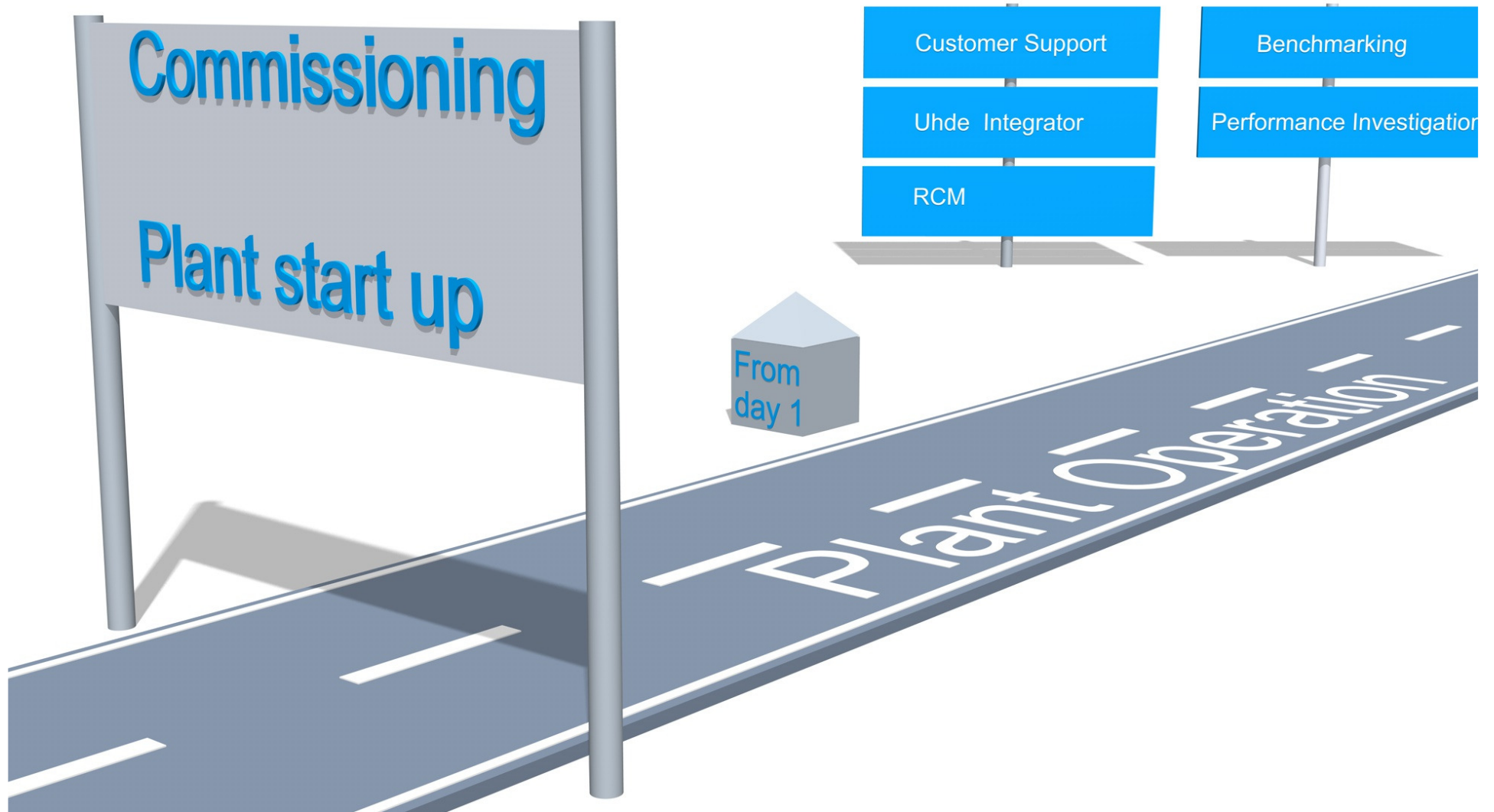
Together with more than 300 experts and strong shareholders we provide technological and execution power



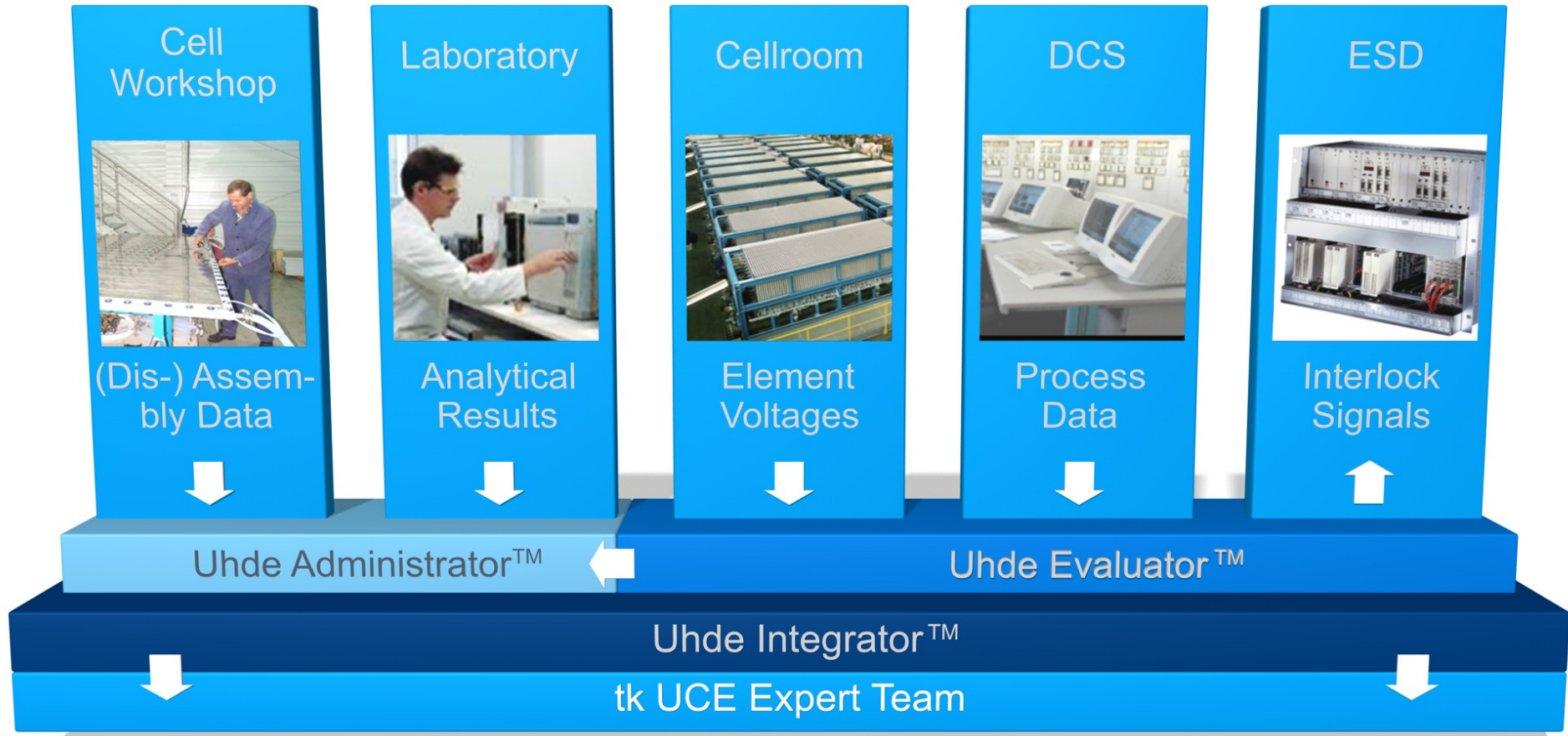
We offer complete scope from Sales to EP/EPC and Technology Service



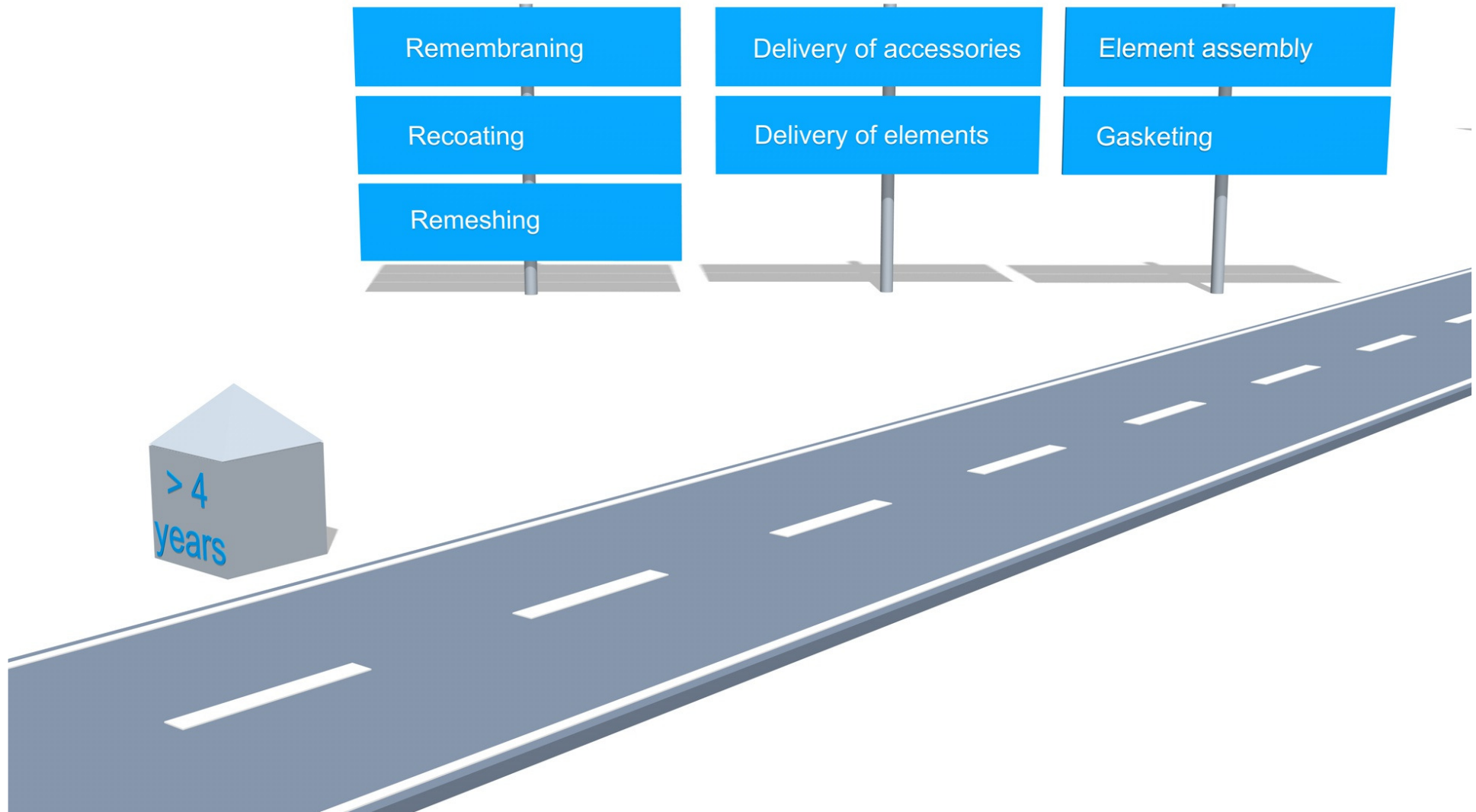
Some Technology service products can be used immediately after commissioning of the plant



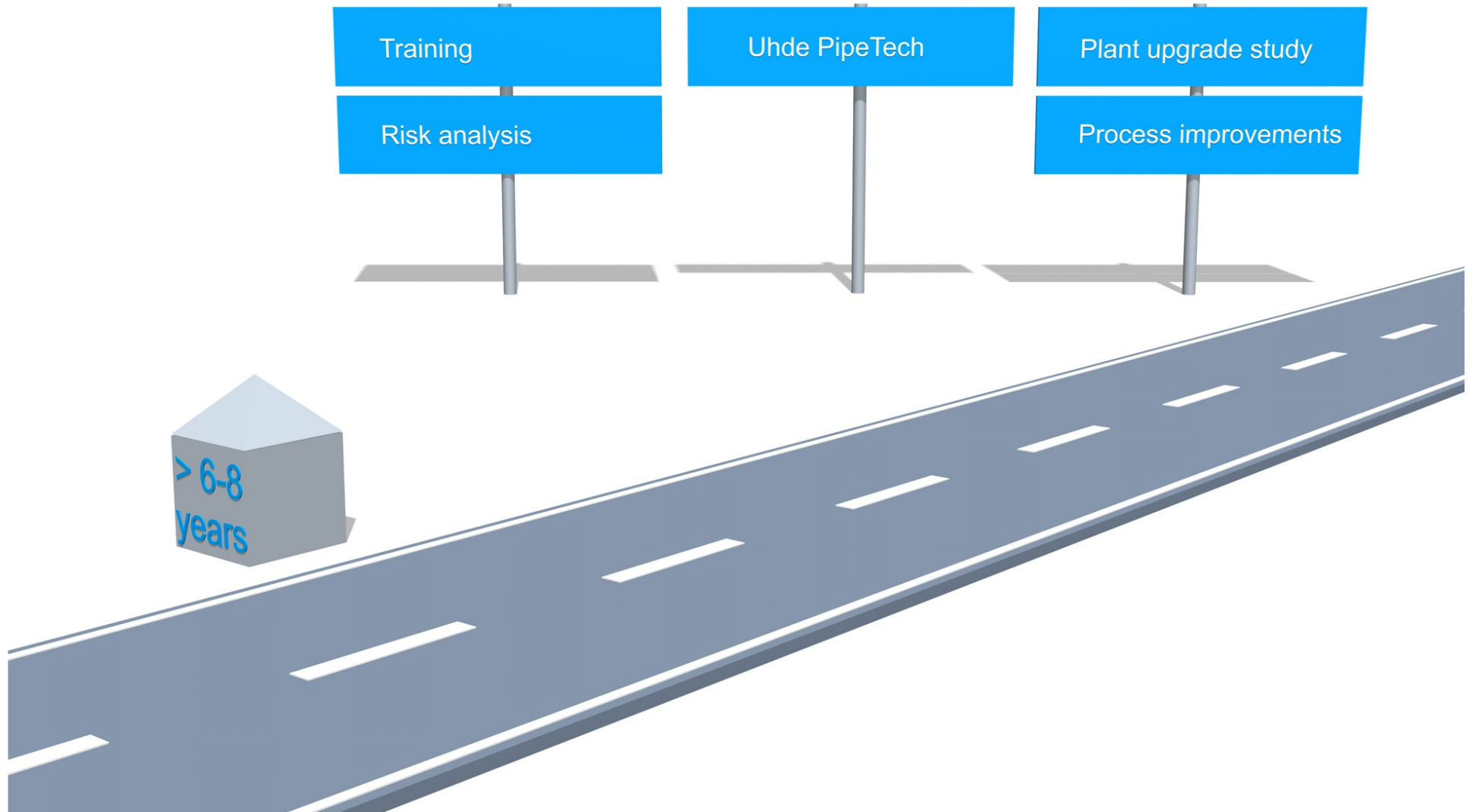
Uhde Integrator™ is a system for comprehensive data recording and analysis



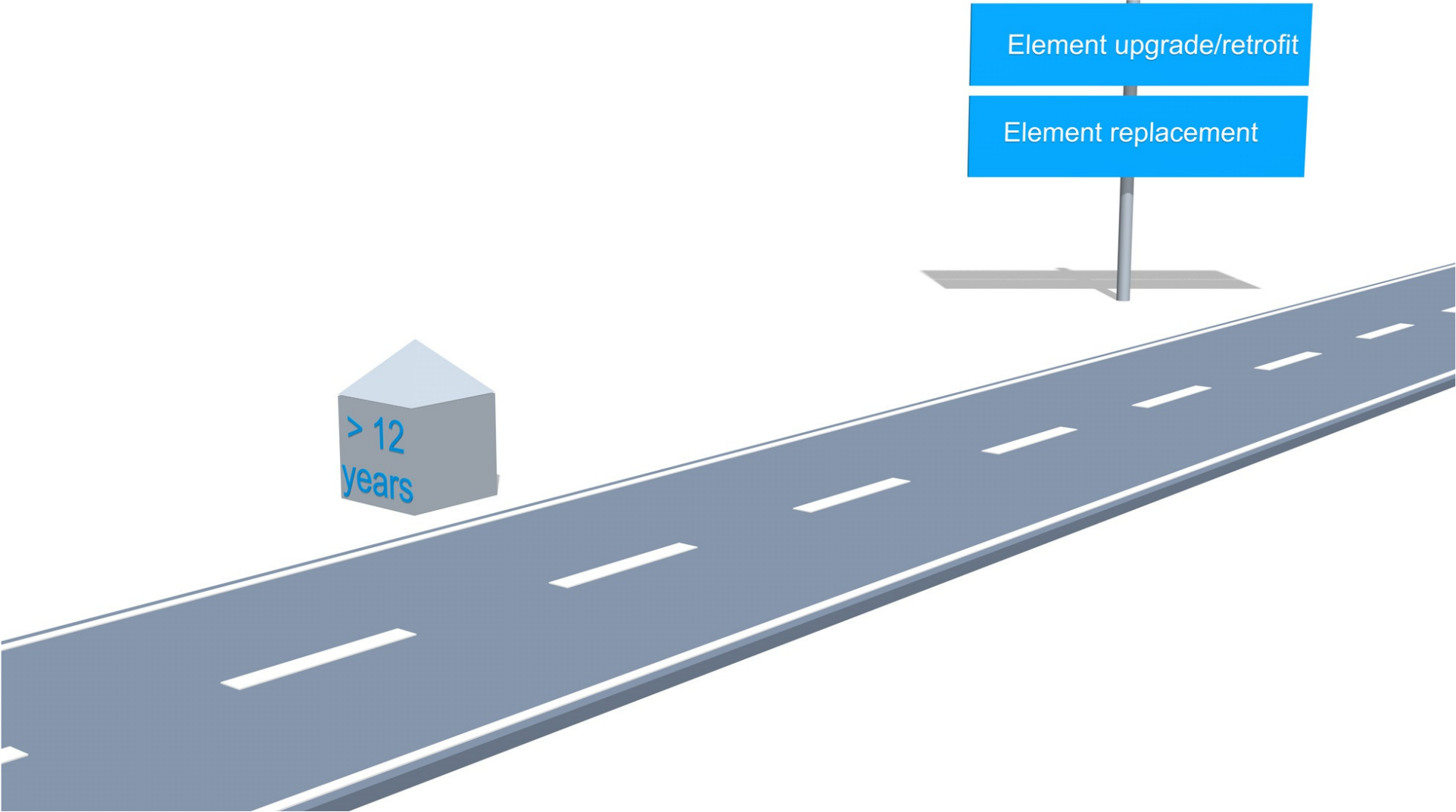
Remembraning/recoating/remeshing campaigns and associated services are points of intense cooperation client/tk UCE



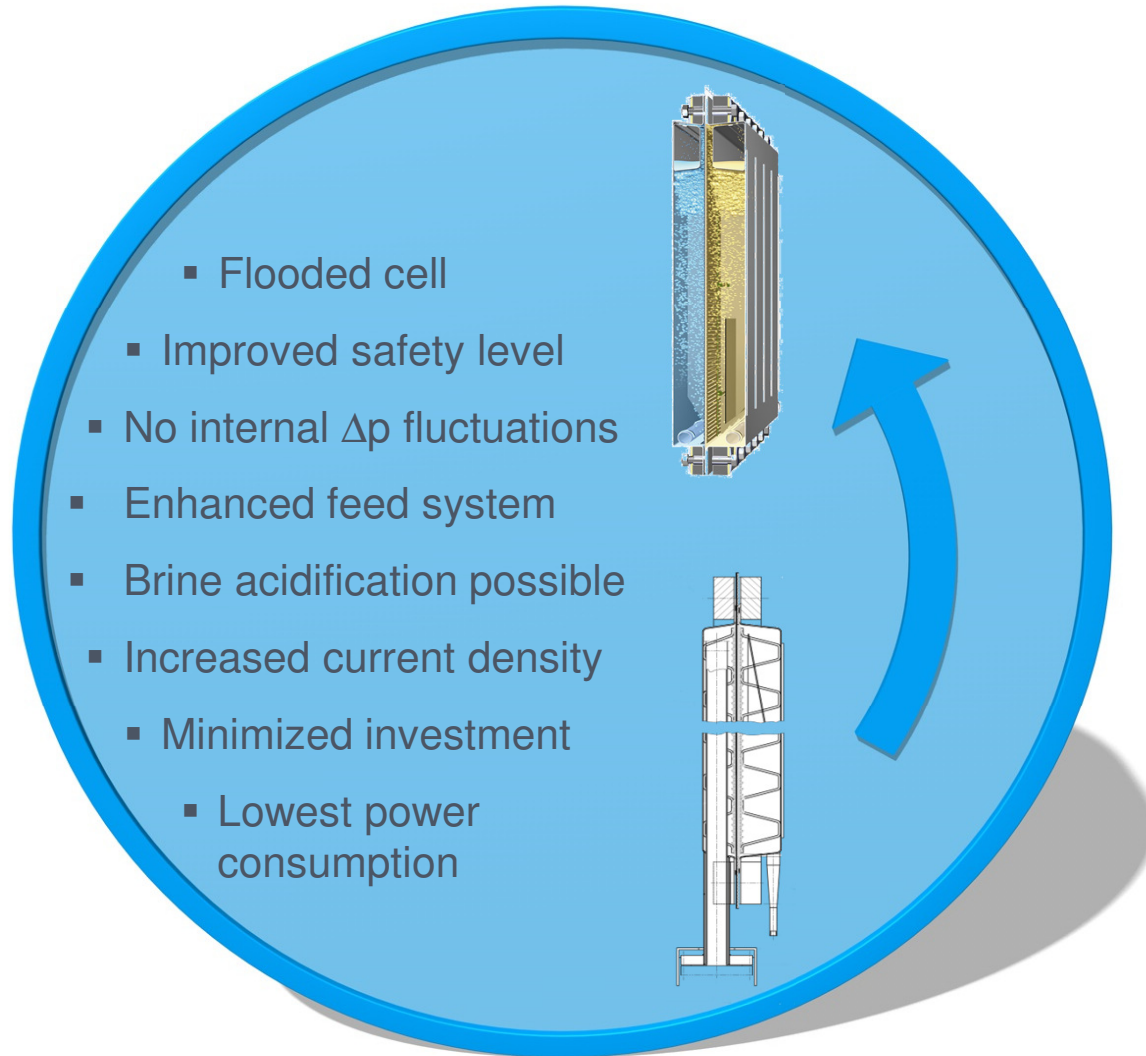
Some technology service products are especially interesting for plants being already in operation for a longer time



Element upgrade/retrofit and element replacement reduce power consumption significantly

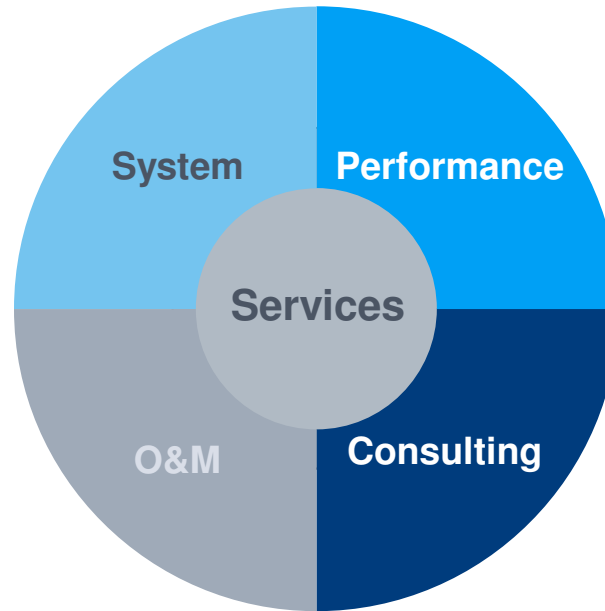


Replacement of old elements by latest generations reduces power consumption



thyssenkrupp Uhde Chlorine Engineers service concept allows to use modules or full service packages

System Service
Customer Support
Benchmarking
Performance Investigation
Delivery of Elements
Delivery of Accessories
Training
Element Assembly
RCM, Uhde Integrator™
Remembr./Recoat./Remesh.
Uhde PipeTech™
Gasketing



Performance Service
Element Replacement
Element Upgrade/Retrofit
Process Improvements

Consulting Service
Plant Upgrade Study
Risk Analysis
Project Management



Technology Service - Full Service reference

Conventional Chlor-Alkali Electrolysis



Customer: Confidential
Location: Western Europe
Capacity: Confidential
Process: tk UCE
Speciality: EPCm

Key Highlights of Full Service 2014/2015:

Scope of Supply: New v5 anode halfshells and cathode recoating for 6 electrolyzers
Recoating of anode and cathode electrodes for 12 electrolyzers
Element accessories

Scope of Services: Removal of elements from electrolyzers
Disassembly and reassembly of elements
Installation of recoated/upgraded elements in electrolyzers



Latest Improvement in product portfolio

Electrolyzers

- Uhde BM 2.7 Single Element electrolyzers
- BiTAC filter press electrolyzers

NaCl – Oxygen Depolarised Cathode (ODC) Technology

- Uhde Single Element BM 2.7 - ODC Technology

HCl - ODC Electrolysis

- HCl recycle through HCl electrolysis from MDI/TDI and other sources

Skid Mounted Chlorine Plants

- Cost competitive plants for reduced chlorine production

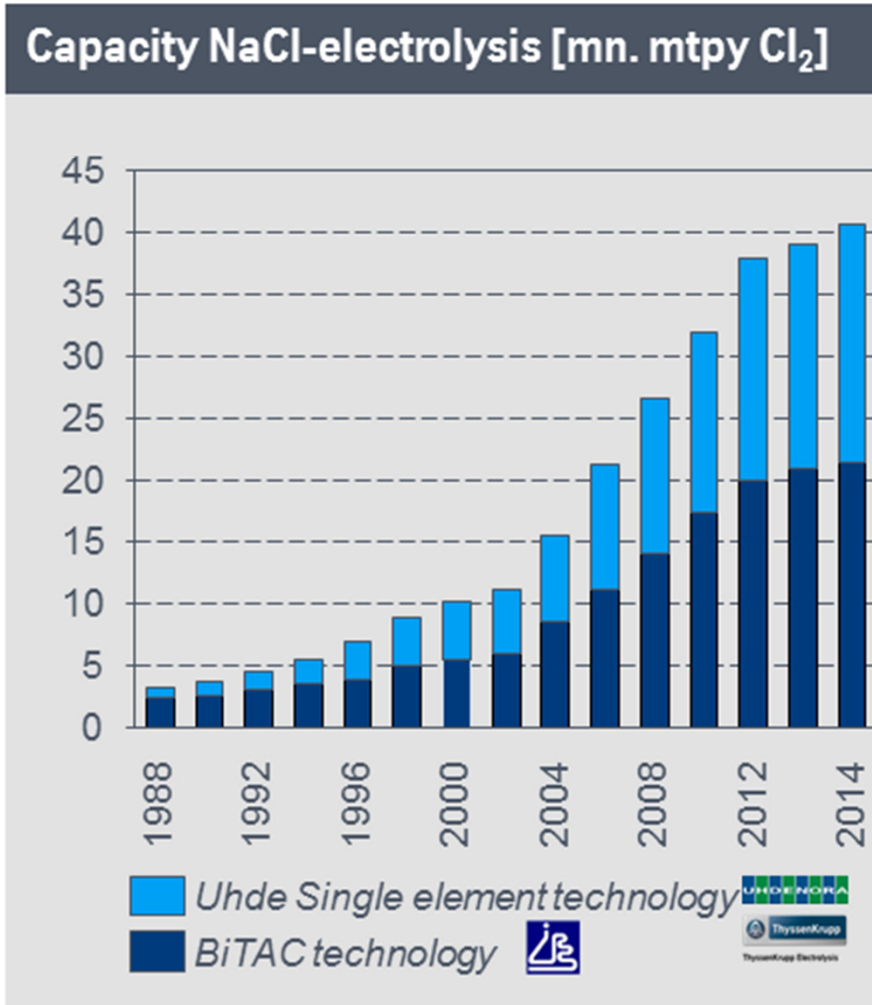
Water electrolysis and Electrochemical energy storage systems

- Electrochemical Renewable Products



Our technologies and competencies have been attractive

Accumulated contract awards



BiTAC



Uhde BM 2.7

Single Element



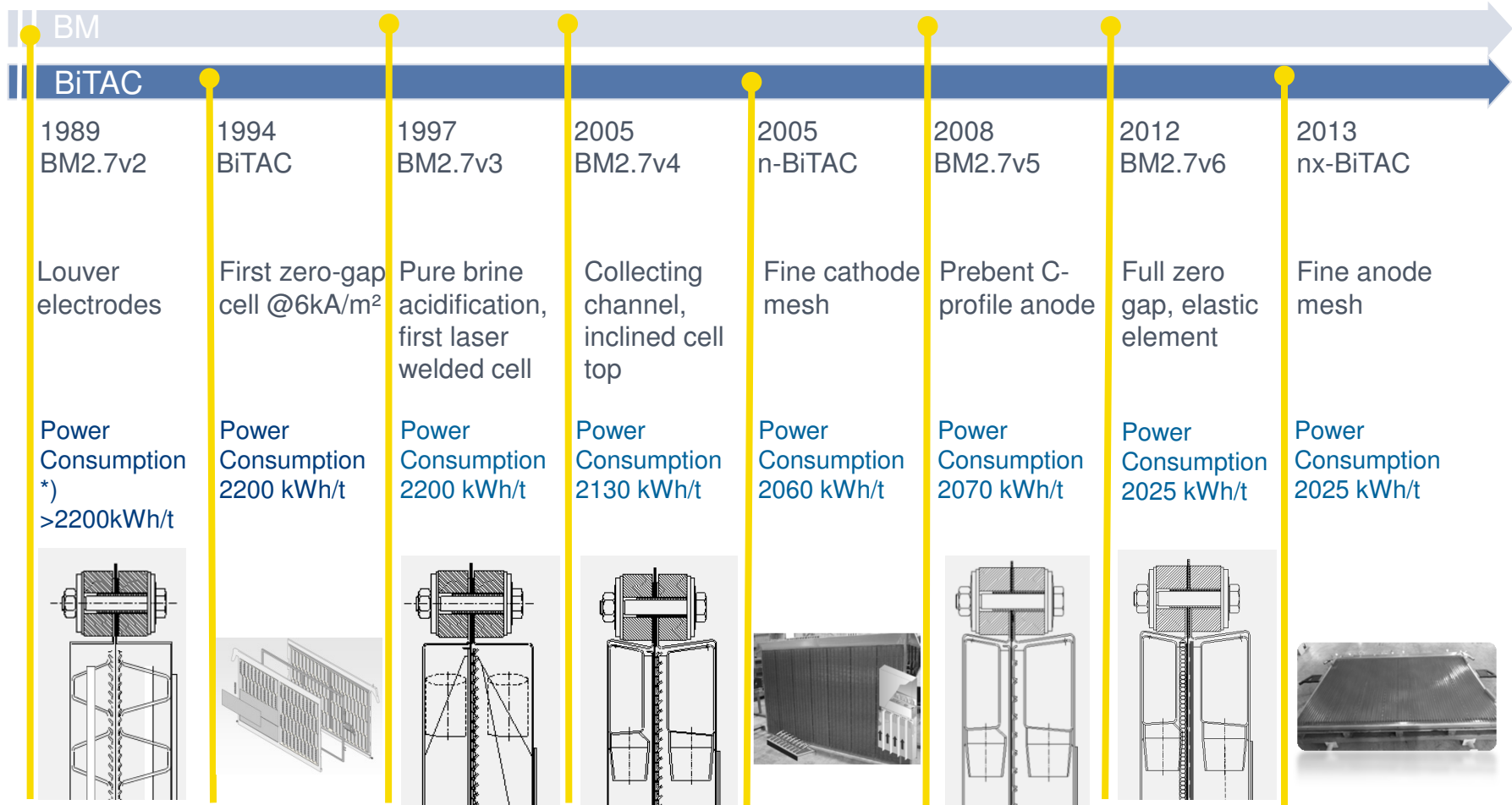
ThyssenKrupp Electrolysis

About 50% of world installed capacity with over 400 projects in 48 different countries



BiTAC (Chlorine Engineers) and BM (Uhde)

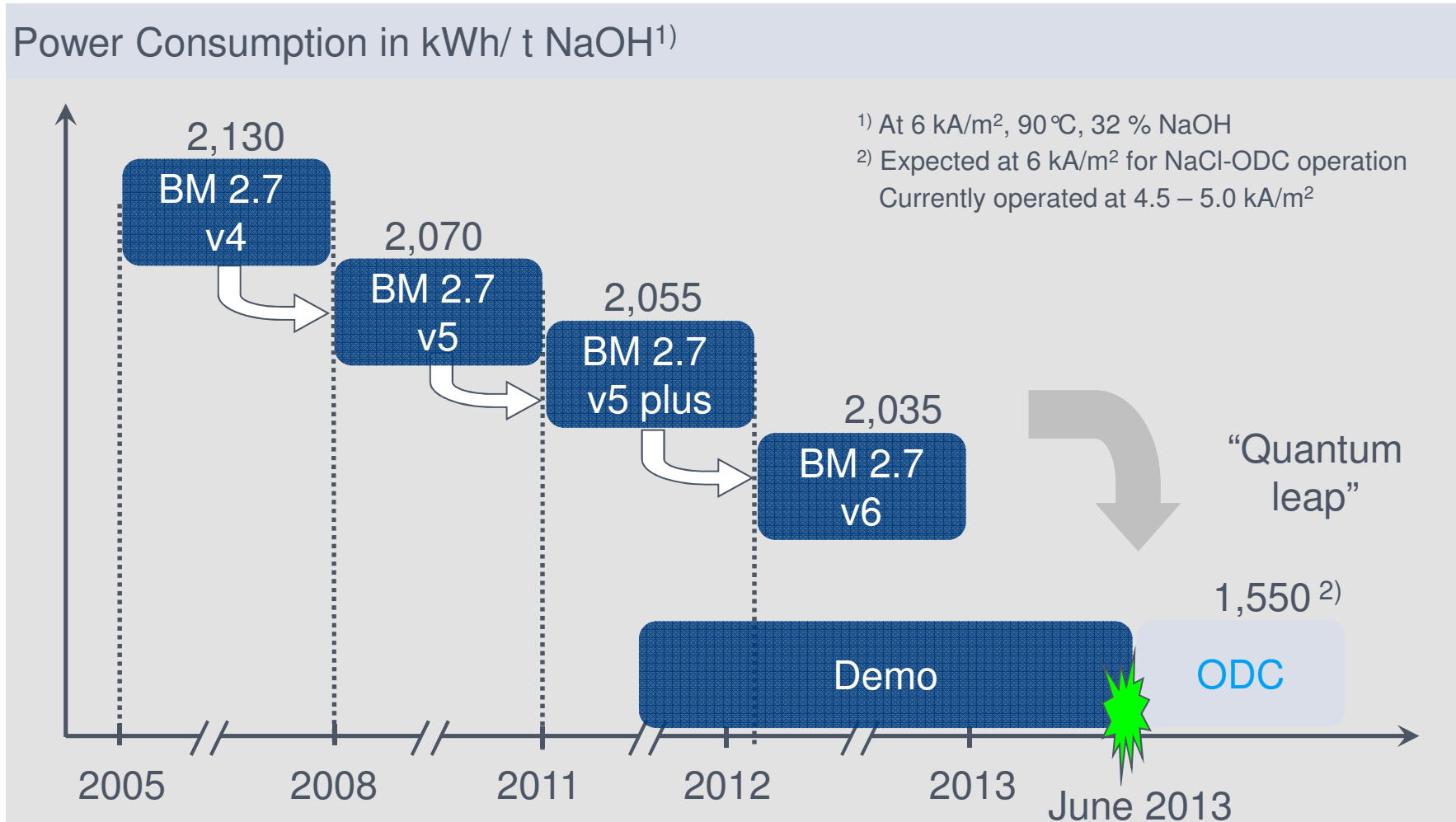
– two success stories



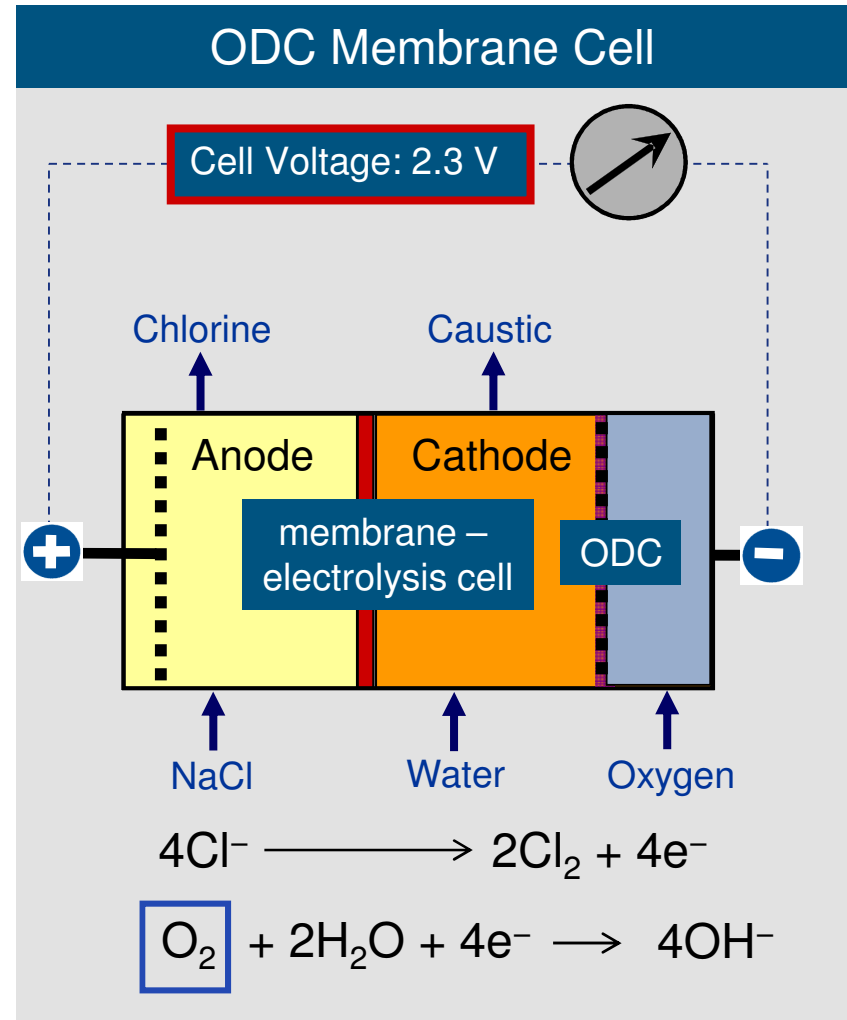
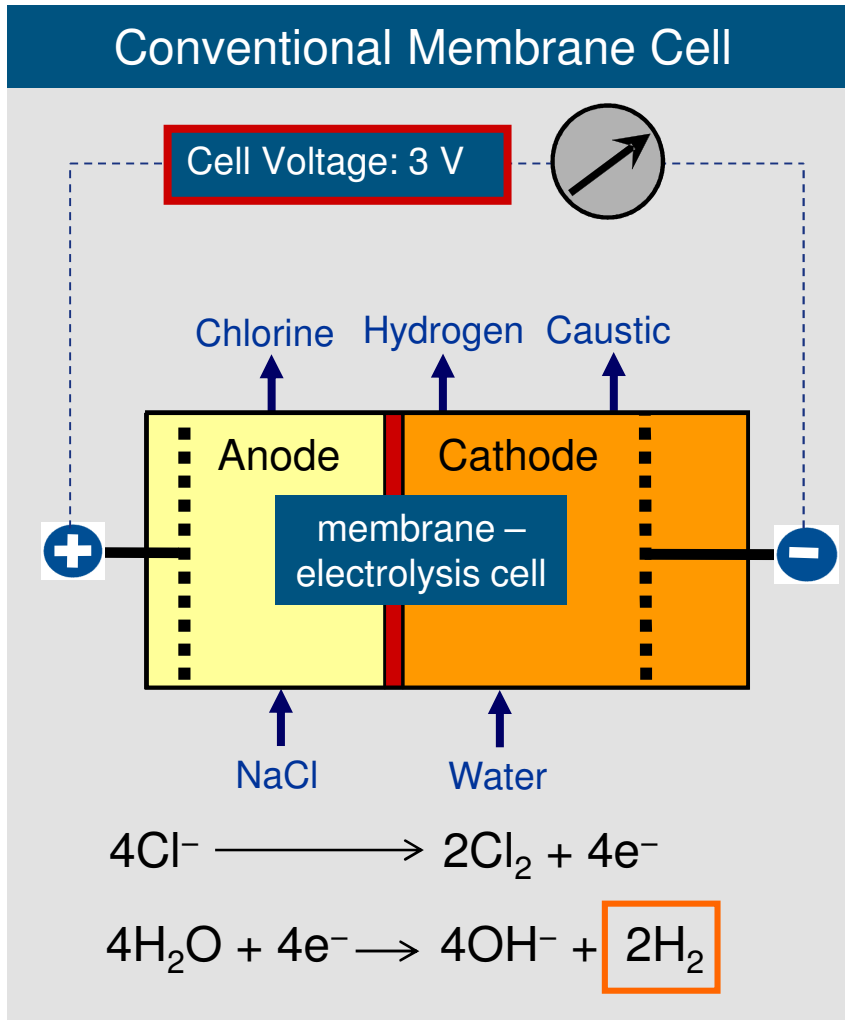
*) At 6 kA/m², 90°C, 32 % NaOH



Our newest product was launched in June 2013... the tk Uhde Chlorine Engineers NaCl-ODC technology

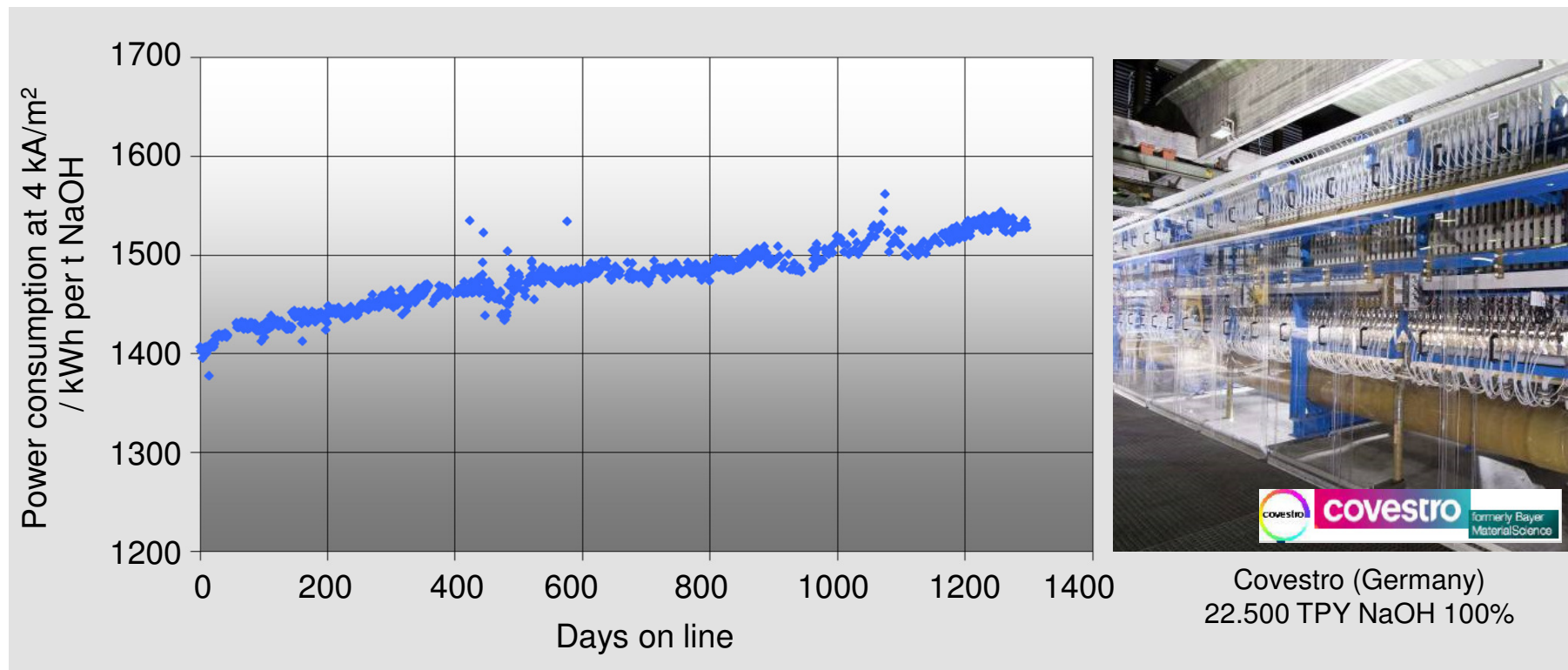


NaCl – ODC: 25% reduction of electrical energy consumption



The NaCl-ODC Technology is Demonstrated for 4 years by now

- **Over 25% Energy Saving** Vs Conventional Electrolysis
- Operation up to **5 kA/m²**
- Stable operation proofs a **robust technology**



Selected References

Oxygen Depolarized Cathode (NaCl-ODC) Chlor-Alkali Electrolysis



Customer: Befar Group Co, Ltd
Location: P.R. China
Capacity: 40,000 t/year of NaOH
35,500 t/year of Cl₂
Process: tkUCE / Bayer
Commissioning: 2015
Specialty: First commercial NaCl – ODC plant worldwide

Key Highlights:

Technology: NaCl-ODC (Oxygen Depolarized Cathode)
Project: Plant Expansion
Scope of Supply: BM 2.7 –ODC Electrolyzers
Electrolysis Room Accessories
Key Catholyte Circulation Equipment
Uhde EVALUATOR Monitoring System

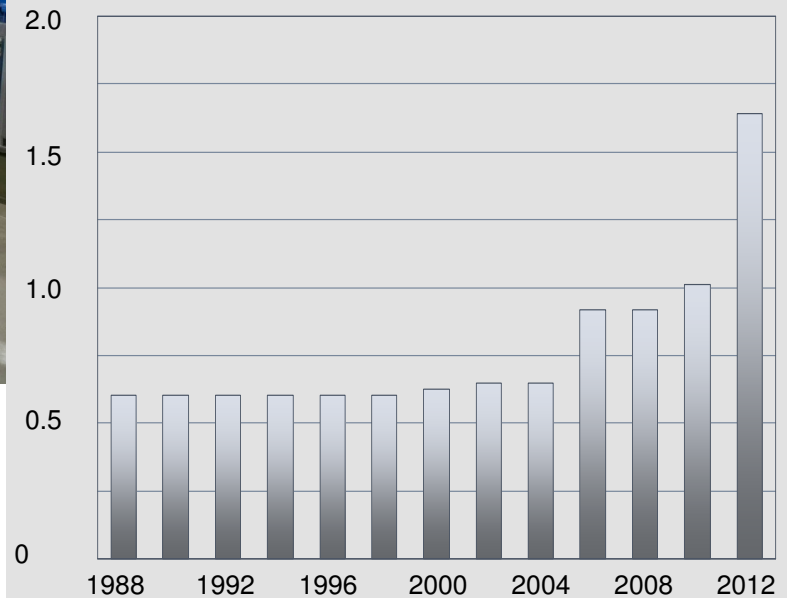


Growing HCl-ODC market due to growing isocyanate business



Customer:	Yantai Juli
Location:	Laiyang, China
Capacity:	100,000 t/year of Cl ₂
Process:	ODC Technology
License:	tkUCE/Bayer
Commissioning:	1 st quarter 2012

Accumulated contract awards
HCl Capacity [Mio. tpy Cl₂ 100 %]



- Sustainability, careful use of resources and ecological responsibility.
- Generation of Cl₂ with very high purity (99.8 % vol., O₂ (20 ppm/wt.).
- ~100 % conversion rate (HCl/Cl₂) at flexible plant operating



Skid Mounted Chlorine Plants

Cost competitive plants for reduced chlorine production



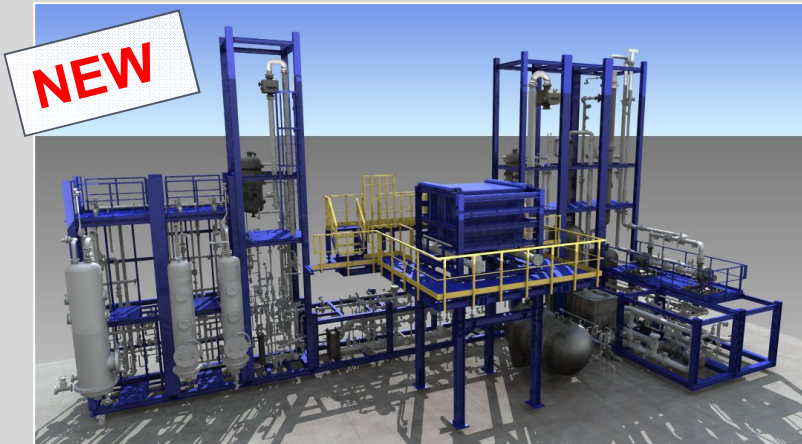
Pre assembled – skid mounted chlorine plant

Capacity up to **15.000** t/year of Cl_2

Standardized engineering and configuration

40” container transportation

Fast plant implementation



Pre assembled – skid mounted chlorine plant

Capacity up to **5.000** t/year of Cl_2

Standardized engineering and configuration

Designed for water purification inorganic chemicals production

Fast plant implementation



Selected References (EP – Skid mounted plants business)

Skid Mounted Chlorine Plants



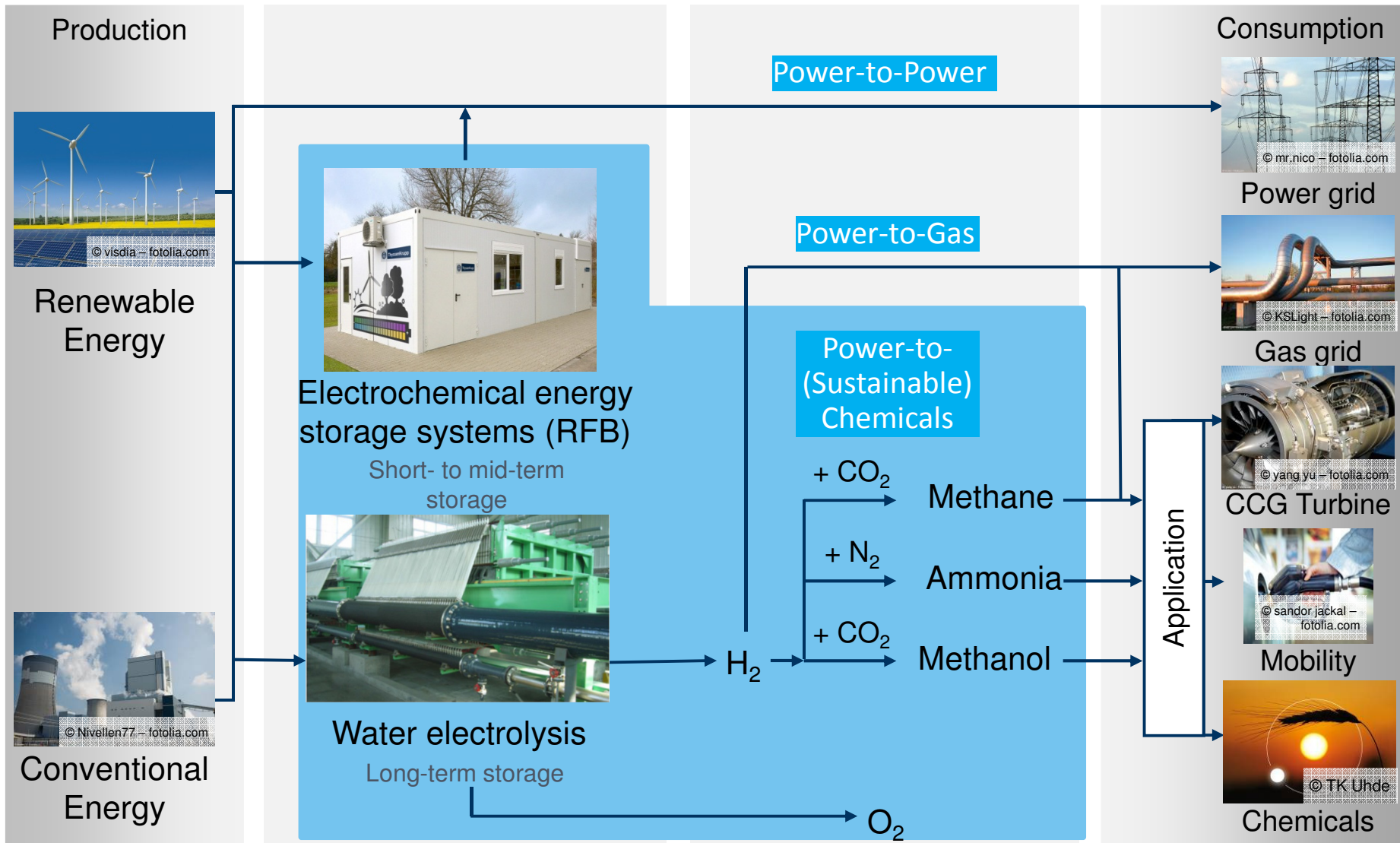
Customer: Produquímica Industria & Comercio
Location: Brazil
Capacity: 17,000 t/year of NaOH
15,000 t/year of Cl₂
Process: tk UCE
Commissioning: 2014
Specialty: EP

Key Highlights:

Project: Skid Mounted Chlorine Plant
(total 7 skid mounted process units)
Scope of Supply: Electrolysis, Catholyte Circulation,
Brine Dechlorination,
Cl₂ and H₂ Cooling and Filtration
Brine Filtration
Secondary Brine Purification
Waste Gas Dechlorination
Sodium Hypochlorite Production
Chlorine Drying



Portfolio of Electrochemical Renewable Products



Thank you for your attention!

For any information:

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engineering.tomorrow.together.



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