

The important early phases of Power-to-X projects

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RAMBOLL



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M.Sc. Chem. Eng., Ph.D. from DTU
Certified Senior Project Manager, IPMA-B

- 14 years in industry as project manager
- 10 years as Centre Manager for Fuel Cell and Hydrogen Technologies at DTU
- Ramboll since 2020



Outline

- Ramboll in brief
- Early phases in PTX projects

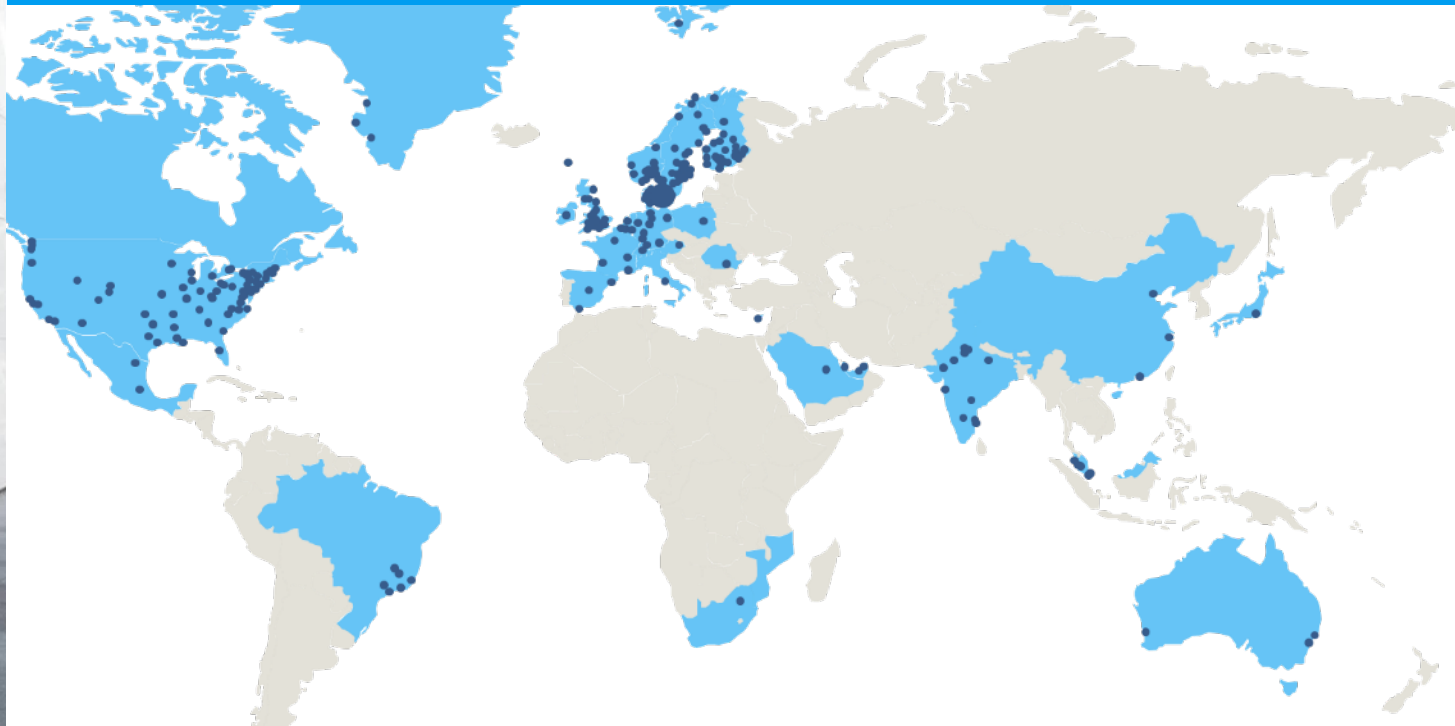


Who we are



Ramboll in brief

- Independent engineering, architecture and consultancy company
- 16,000 experts in 35 countries



Create sustainable societies where people and nature flourish

- Founded in 1945 in Denmark
- Owned by Rambøll Fonden
- Strong principles and philosophy

The Partner for Sustainable Change



Børge J. Rambøll and Johan G. Hannemann

Markets



Buildings



Transport



Water



Architecture &
Landscape



Environment &
Health



Energy



Management
Consulting

Energy and sustainability

- 50 years in energy solutions
- 1,600 specialists
- Top 10 energy consultancy in Europe



We drive innovation and implement new technologies



Early phases in PTX projects

Steps in successful projects

Idea. Prefeasibility

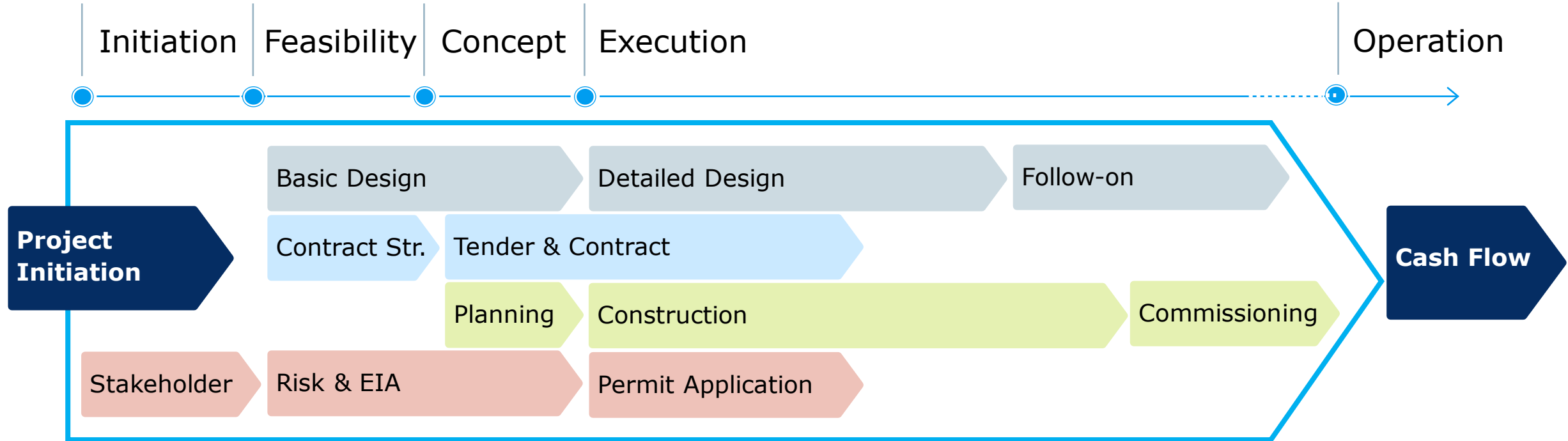
Concept study.
Development

Design. Planning

Construction

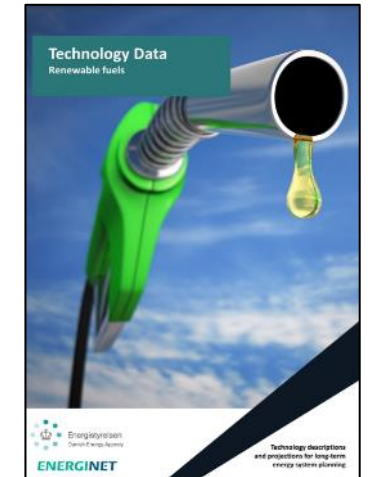
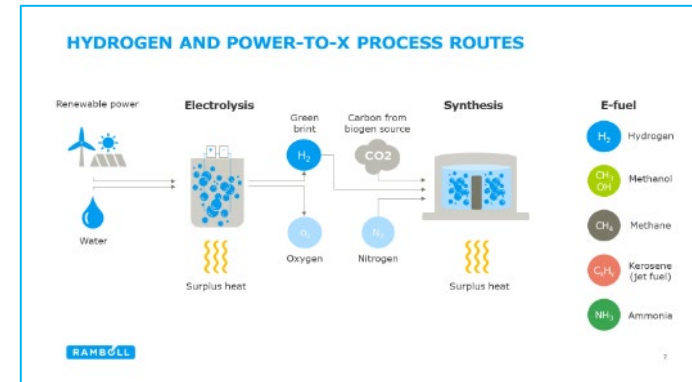
Operation

Start early and work in parallel

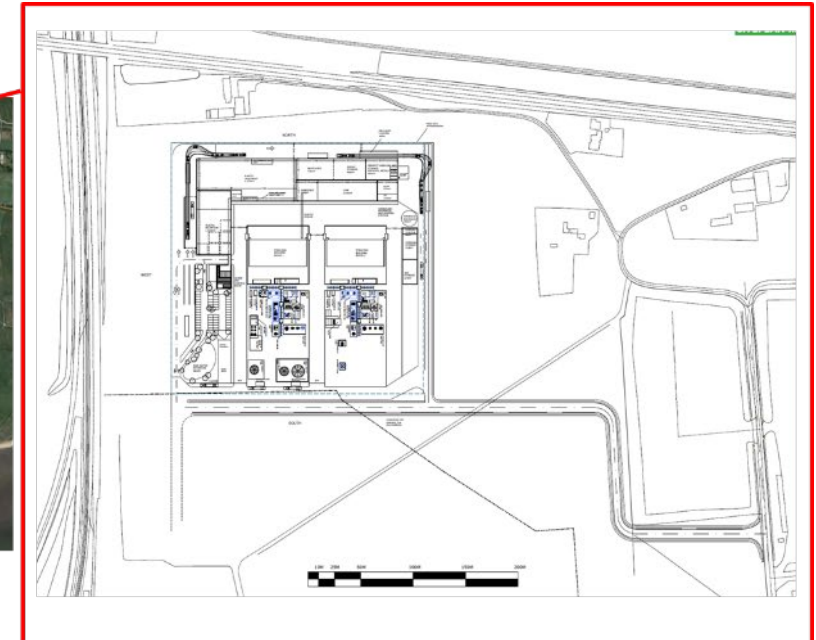
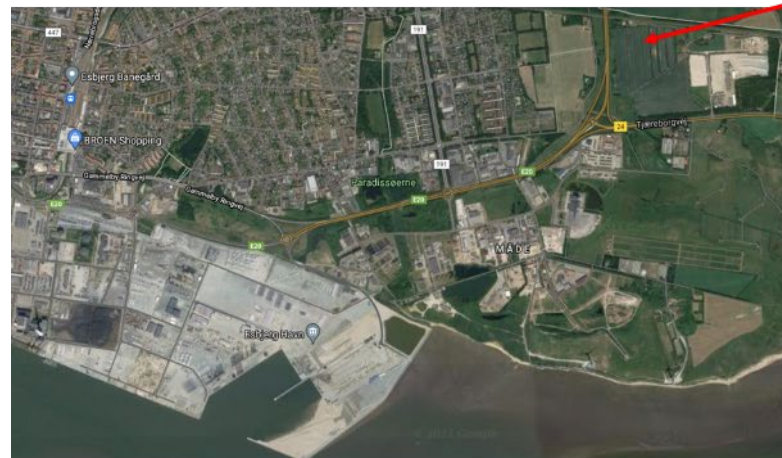
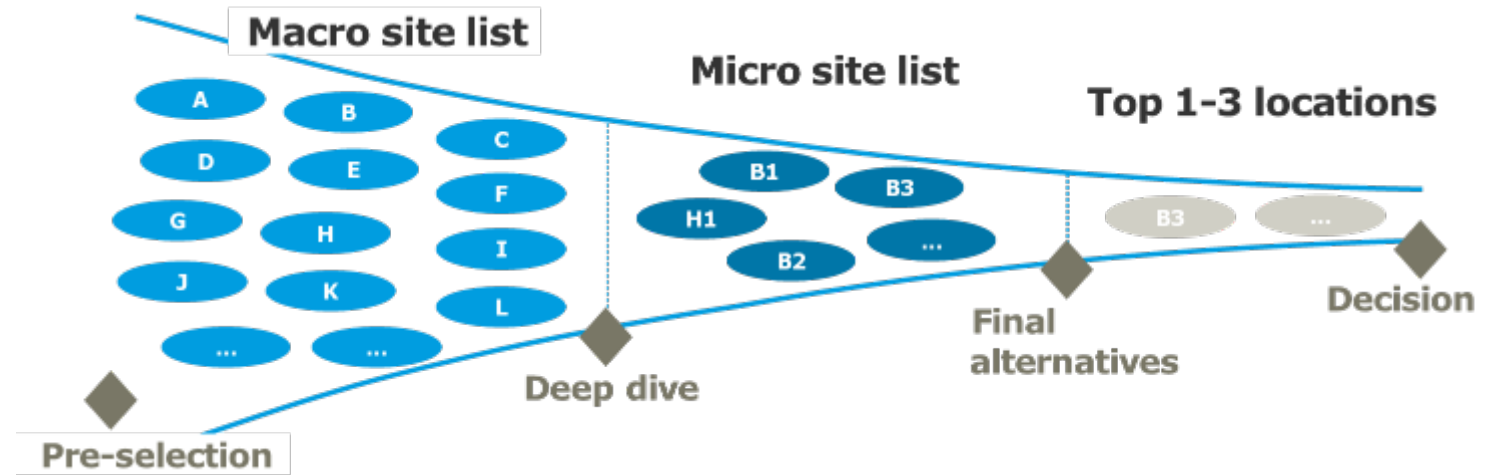


Before we even start: Pre-feasibility study

- Strategy for decarbonisation
- Technology review
- Market analysis – business case
- Funding opportunities
- Consortia formation
- Red flag analysis, including risk assessment

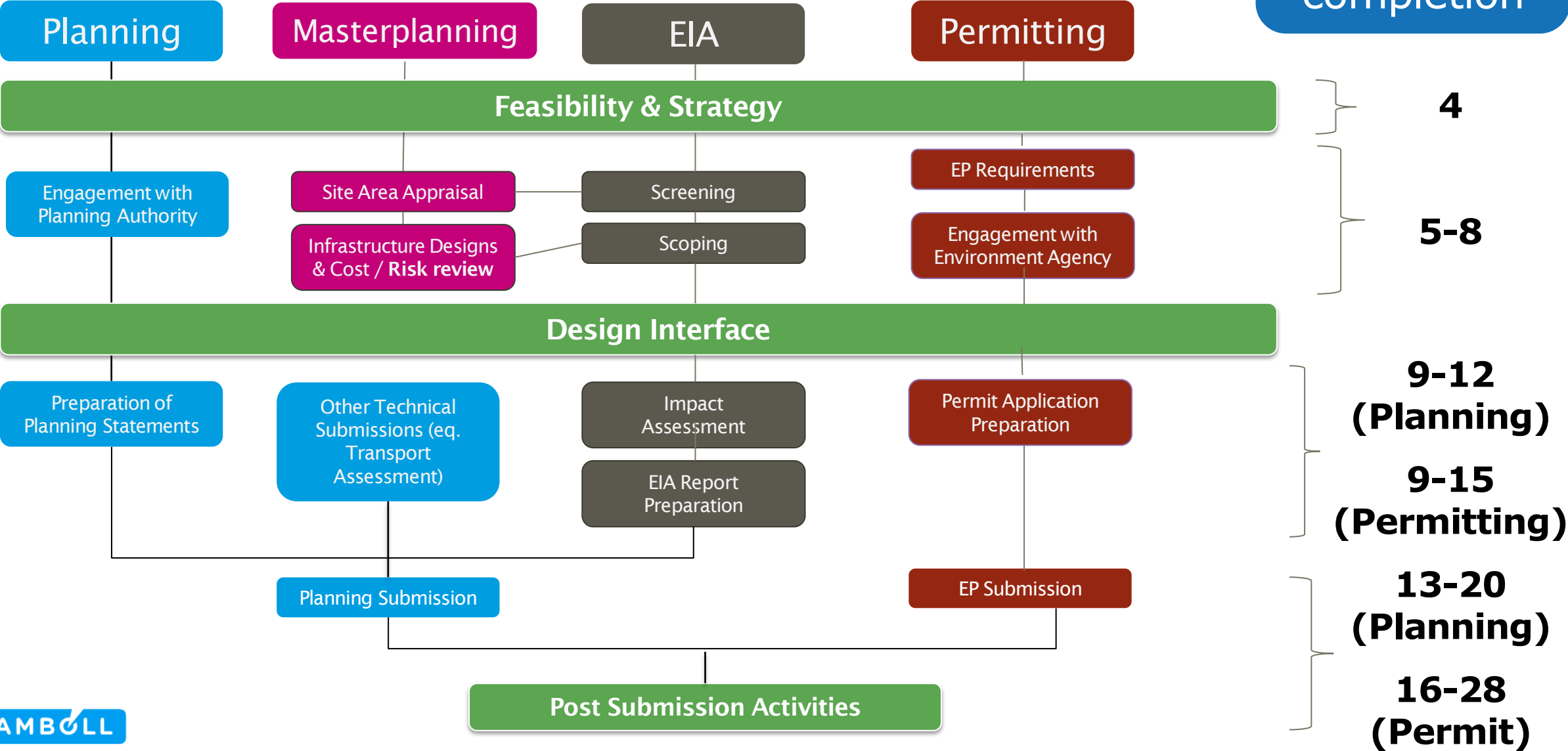


Site selection process



Regulatory planning - permitting timeline

Months from
start to
completion



Operation & Maintenance strategy

- Integrate O&M in the early phases
- Policies, strategies, workflows, systems,
- Spare part evaluation

↑ System availability

↓ Maintenance cost

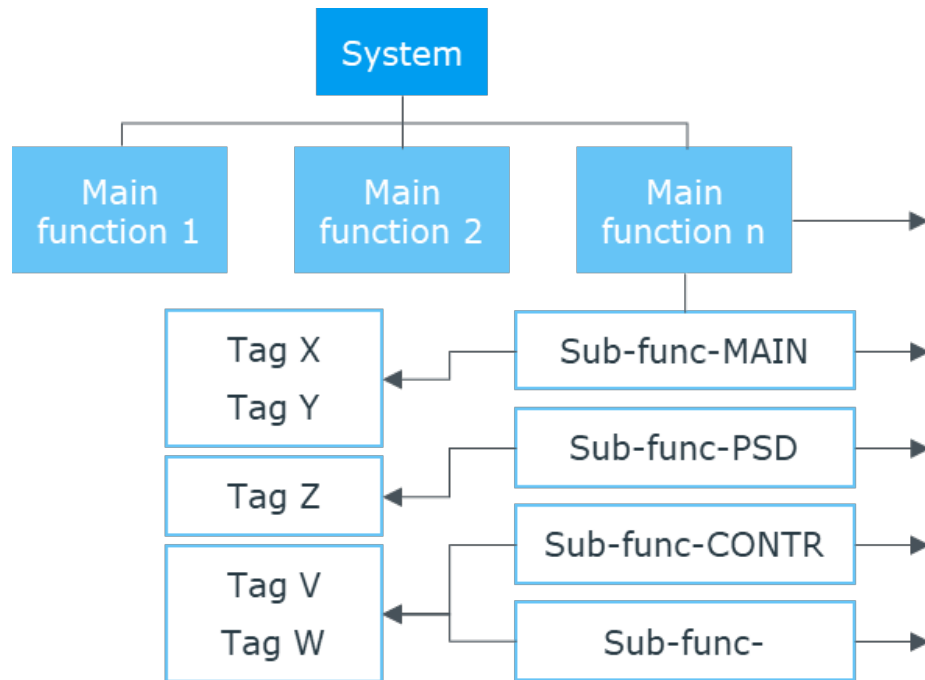


Criticality Assessment

Safety

Environmental

Economy



RAMBOLL FMECA Tool Risk Matrix

Consequence

Safety

Environ - Oil
Environ - Chem gp 1
Environ - Chem gp 2
Environ - Chem gp 3

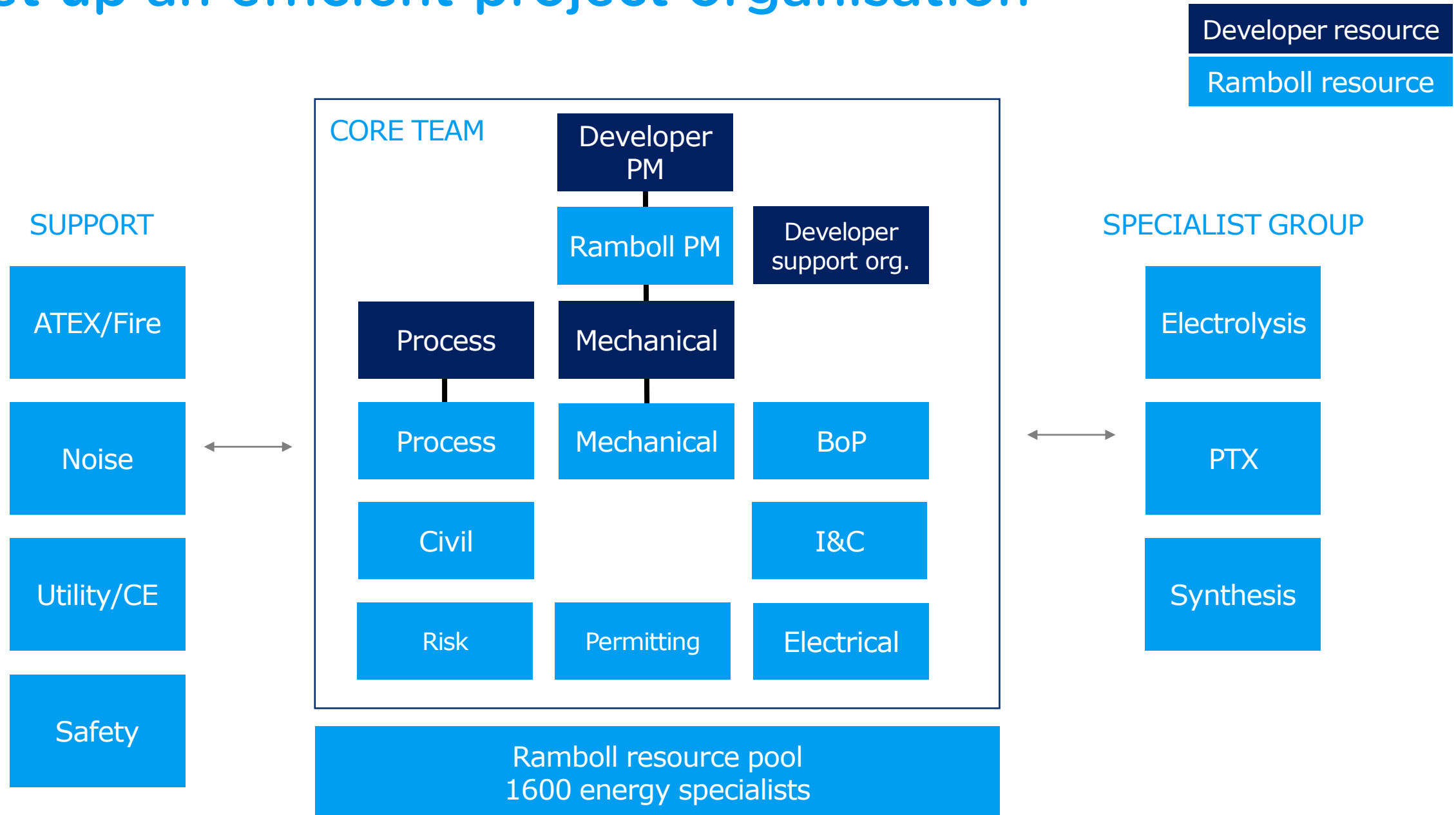
Production Cost

Repair Cost

Frequency

		1	2	3	4	5
		First aid	Medical Treatment	Serious injury	Single Fatality	Multiple Fatalities
	Environ - Oil	<1 bbl	1-10 bbl	10-100 bbl	100-1000bbl	>1000bbl
	Environ - Chem gp 1	<25 L	25-200 L	0,2-1m ³	1-10m ³	>10m ³
	Environ - Chem gp 2	<200 L	0,2-1m ³	1-10m ³	10-100m ³	>100m ³
	Environ - Chem gp 3	<1m ³	1-10m ³	10-100m ³	100 -1000m ³	>1000m ³
	Production Cost	<50k DKK	50-250k DKK	0,25-1M DKK	1-10M DKK	>10M DKK
	Repair Cost	<50k DKK	50-250k DKK	0,25-1M DKK	1-10M DKK	>10M DKK
	MTBF < 1M	D	C	C	B	B
	1M < MTBF < 1Y	D	D	C	C	B
	1Y < MTBF < 5Y	E	D	D	D	C
	5Y < MTBF < 30Y	E	E	E	D	D
	30Y < MTBF	F	F	E	E	E

Set up an efficient project organisation



Communicate!

More than 70 PTX projects completed in 2020-2021

Idea
Concept Development
Pre-feasibility Study



- Energy Island Vindø (CIP)
- Bornholm Bunker Hub
- PTX potential on Lolland

Funding



- DynAmmonia - project application
- Technical Advisor to European Investment Bank

Feasibility Study
Risk Assessment
Permitting



- Power-to-Ammonia (CIP)
- Hydrogen Refuelling Stations
- Windpark Kremsdorf
- PTX in Greenland

Engineering Design
Planning
Construction Management



- H2 Energy Esbjerg, 1 GW
- SSV Energipark (Ørsted)
- HySynergy (Everfuel)
- Green Hydrogen Hub

Explore with confidence

- World-class technical expertise on Hydrogen and Power-to-X
- Holistic and multi-disciplinary approach
- Excel in integration of complex systems
- Co-create the best solutions with and for our partners

Article and Guide to early phases of PTX projects:

<https://ramboll.com/net-zero-explorers>



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Bright ideas. Sustainable change.

Bright
ideas.
Sustainable
change.

The logo consists of a white rounded rectangle containing the word "RAMBOLL" in blue capital letters. A blue lightning bolt icon is positioned above the letter "O".