RAMBOLL

Bright ideas.
Sustainable change.

PtX integration tool

5th European Hydrogen & P2X Conference

19th-20th June 2024

Crowne Plaza Copenhagen Towers

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01. Introduction

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Ramboll PtX Integration Tool

WHY
PtX projects require a tool for optimal investment decisions under uncertainty.

HOW
Modelling and optimization of different e-fuels designs.

WHAT
Analytics on energy flows and feasibility KPIs. Providing a solid ground for decision-making.

02. Description of the model

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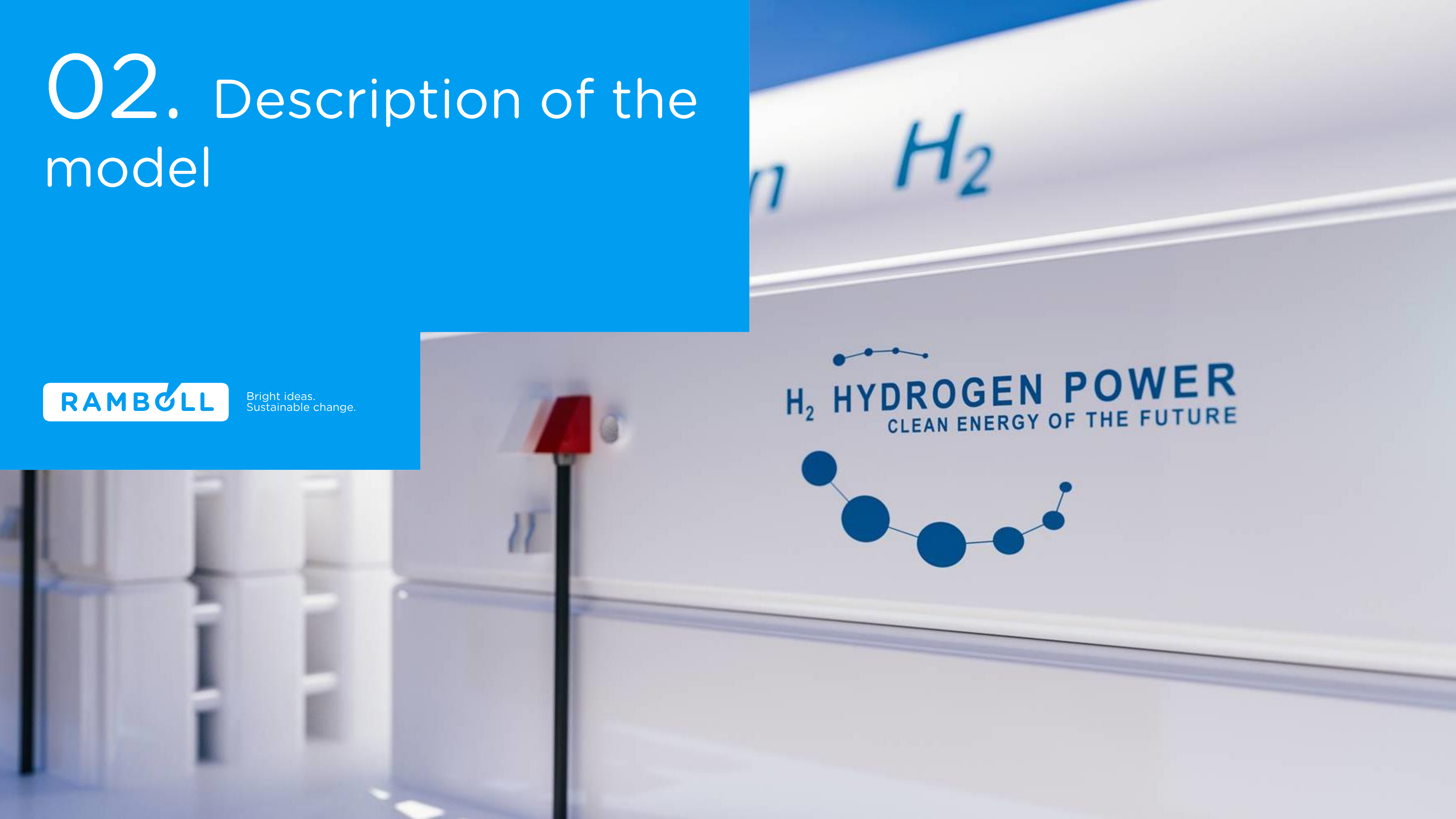
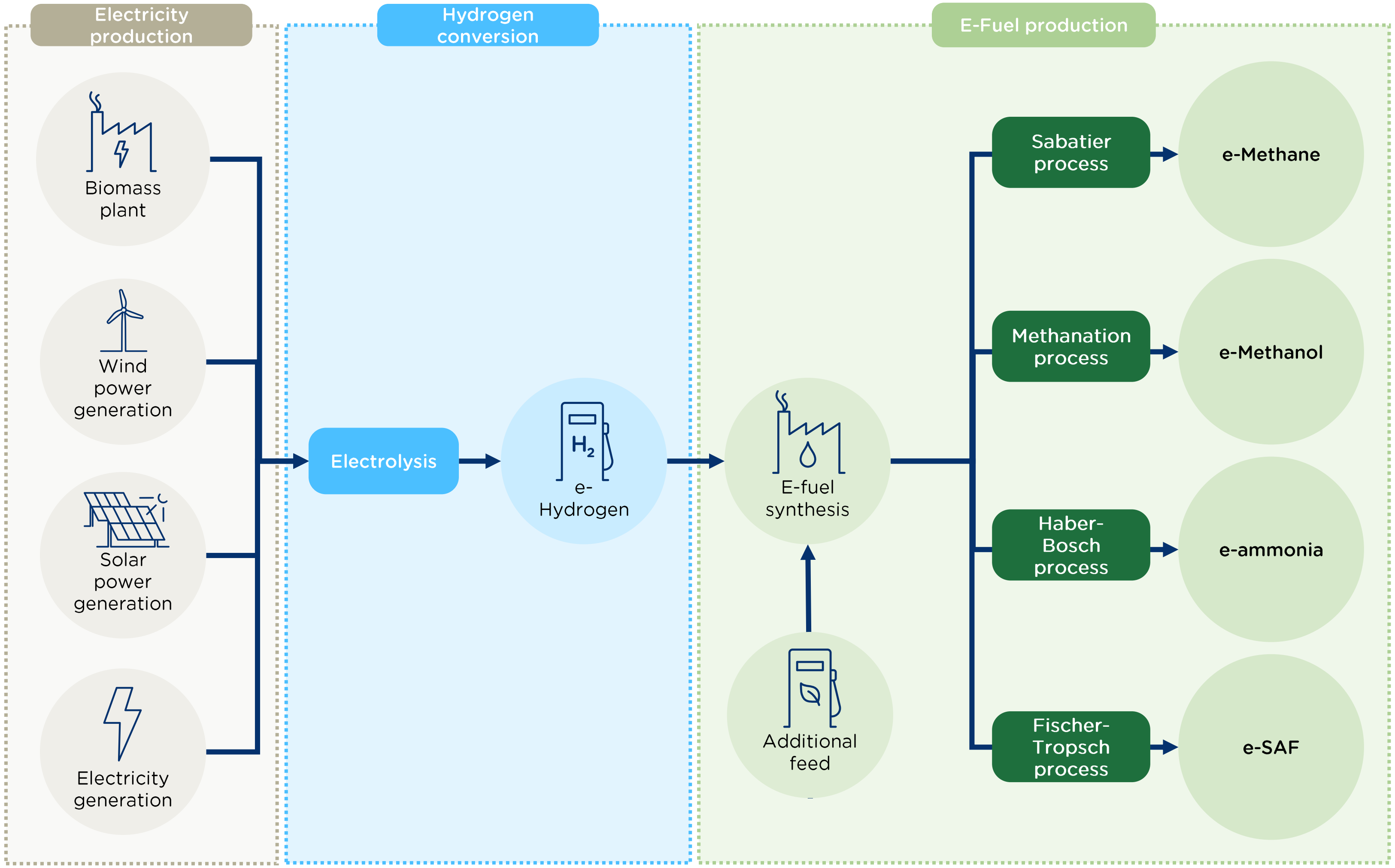
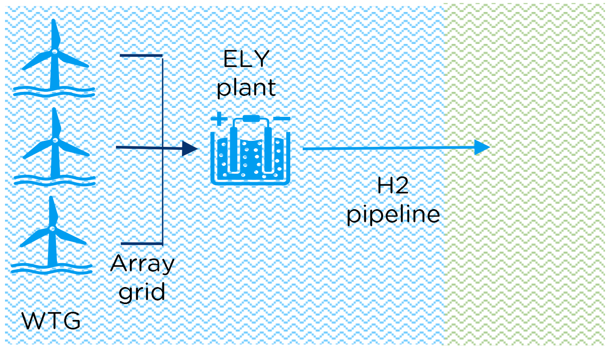


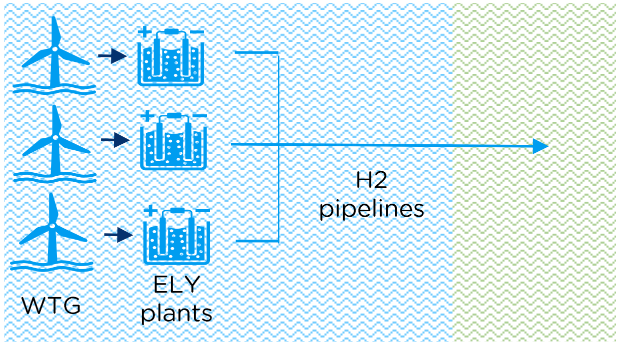
Possible e-fuel productions



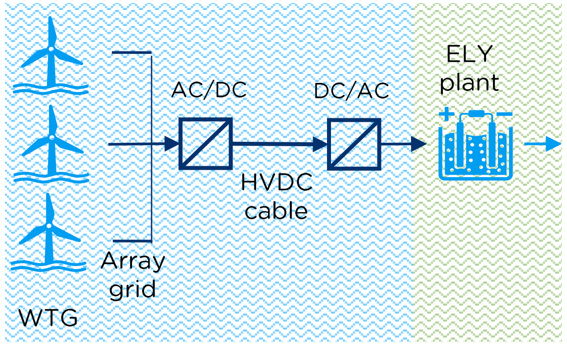
PtX systems can assume different system designs



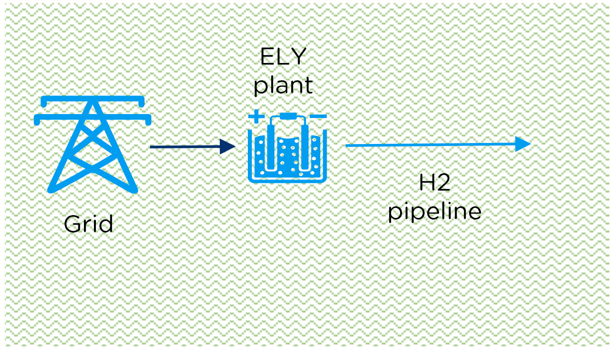
Power source	**Offshore wind**
H_2 production	**Offshore Central**



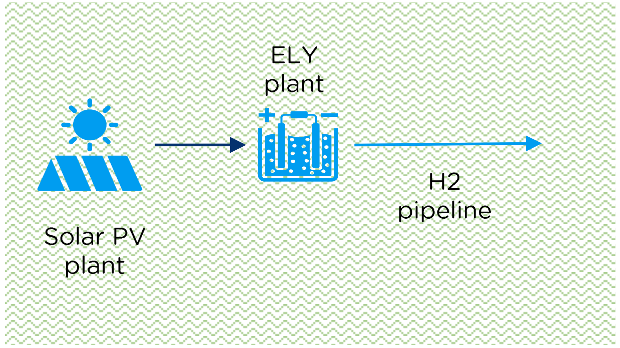
Power source	**Offshore wind**
H_2 production	**Offshore Decentral**



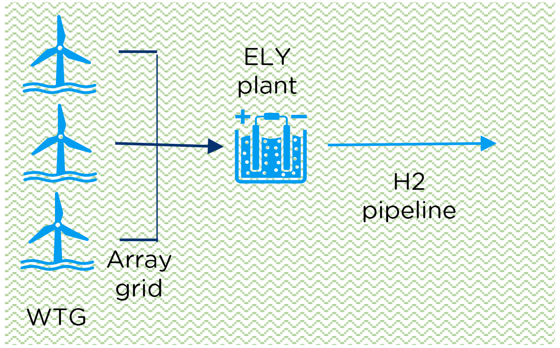
Power source	**Offshore wind**
H_2 production	**Onshore Central**



Power source	**Grid.**
H_2 production	**Onshore Decentral**

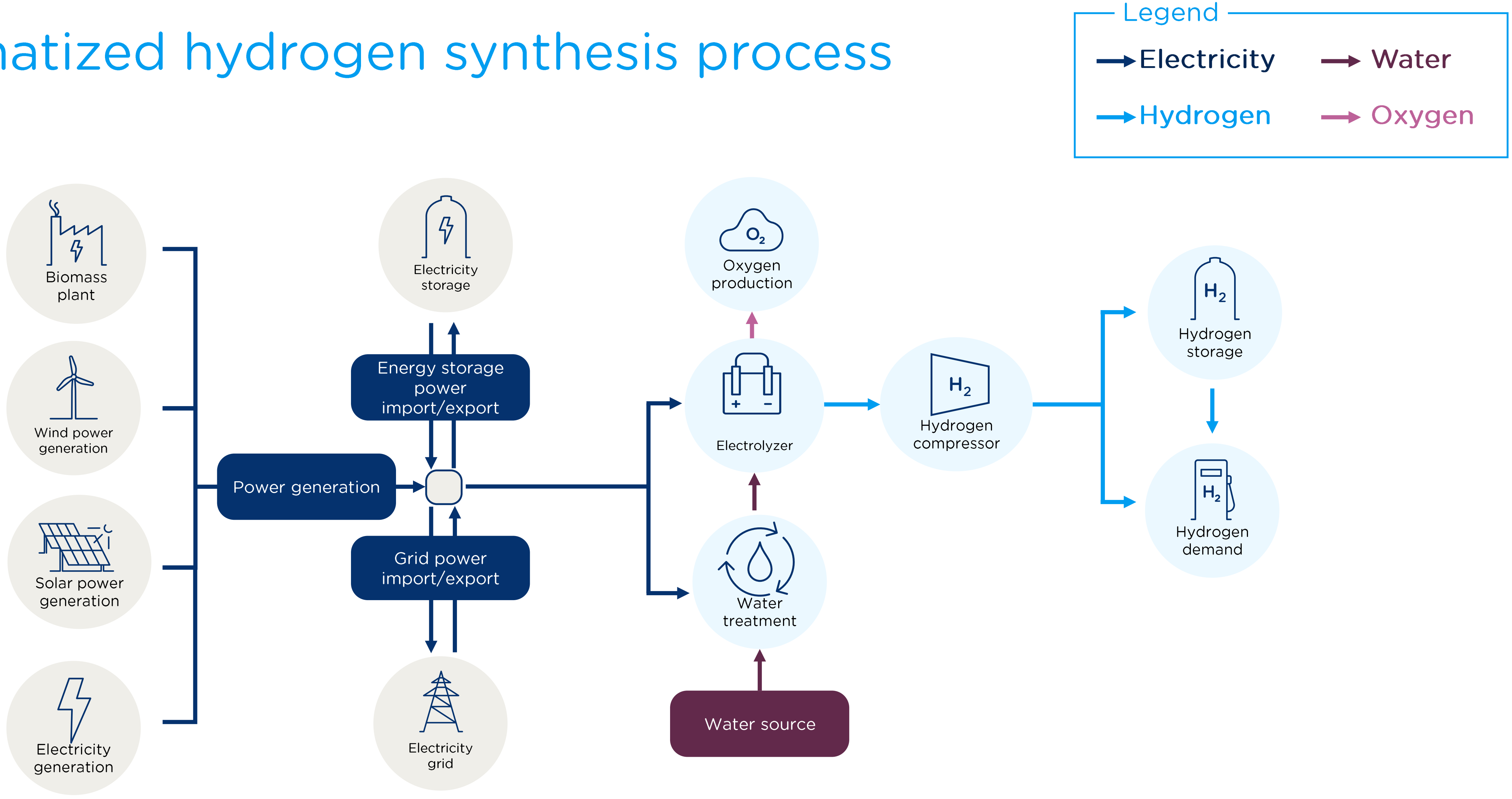


Power source	**Solar PV**
H_2 production	**Onshore Decentral**



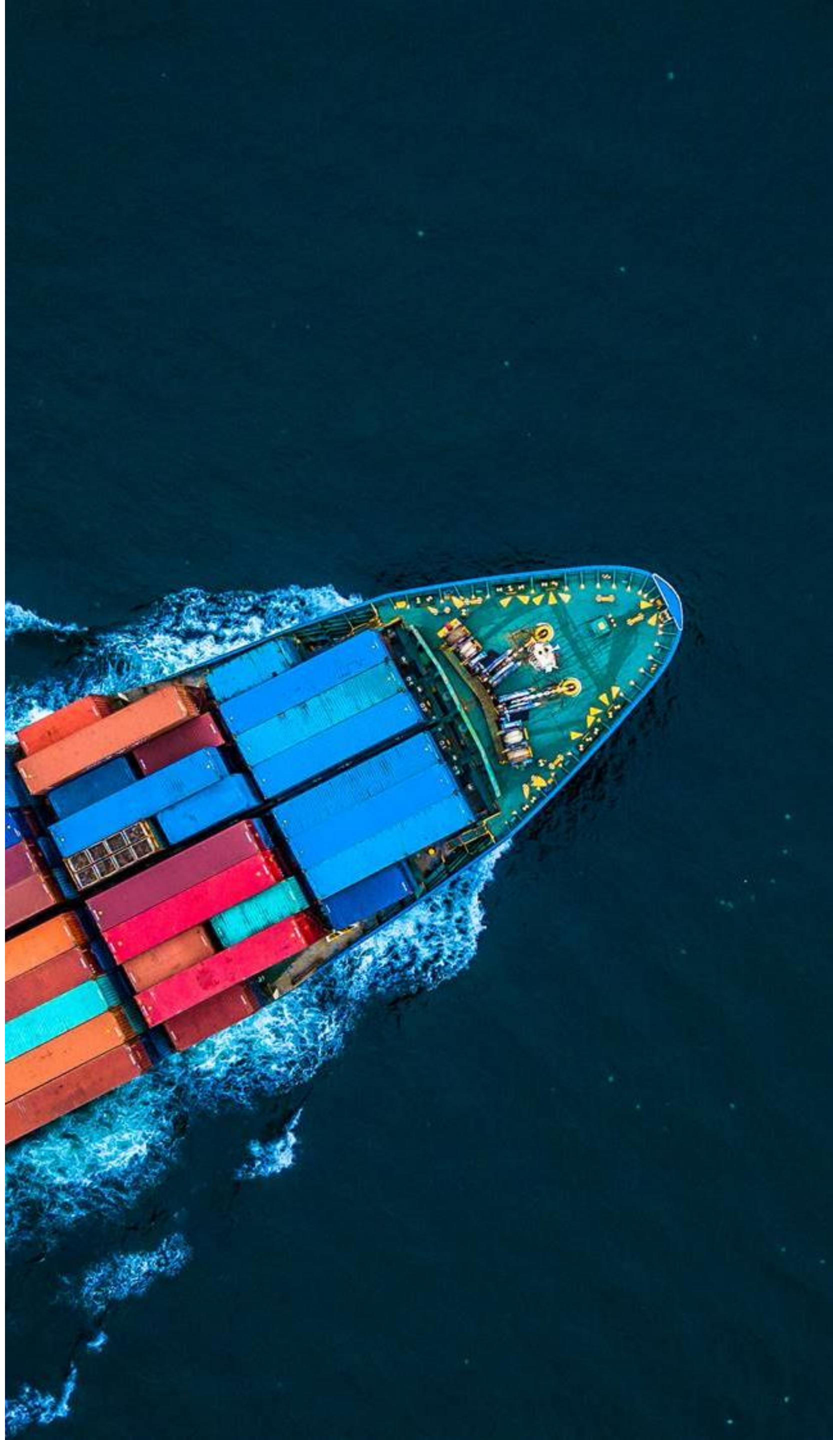
Power source	**Onshore wind**
H_2 production	**Onshore Central**

Schematized hydrogen synthesis process



Designed to facilitate decision making for the green transition

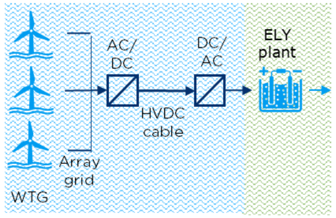
Focus Area		Description	
1 PtX system simulation	a	Energy system model	Model reproducing energy flows of the PtX system.
	b	Economic model	Financial figures of components of PtX system.
2 PtX design comparison	a	Concept comparison	Assessment of operations for different plant designs.
	b	Assumption sets	Financial assessment of different PtX configurations.
3 Feasibility analysis	a	Cashflow analysis	Yearly analysis of cashflow of the PtX plant.
	b	Feasibility report	Draft feasibility study for the profitability of the plant.



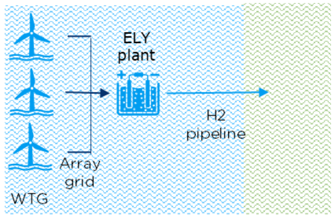
PtX system model for energy and financial analysis

	1. INPUT	2. MODEL	3. OUTPUT
DESCRIPTION	**PtX system data** • System design • Assets capacity • Plant lifetime	**Optimization energy model** • Python simulation PtX system • Optimization system operations	**Energy flow results** • Optimized energy flows • Import/export quantification
	Financial data • System's Economic figures • Probabilistic data	**Financial model** • Annual cashflows • Calculation financial figures	**Financial results** • Feasibility report • Economic KPIs : NPV, IRR, LCOH
DETAIL	2-3 WEEKS *	2-3 WEEKS *	2-3 WEEKS *

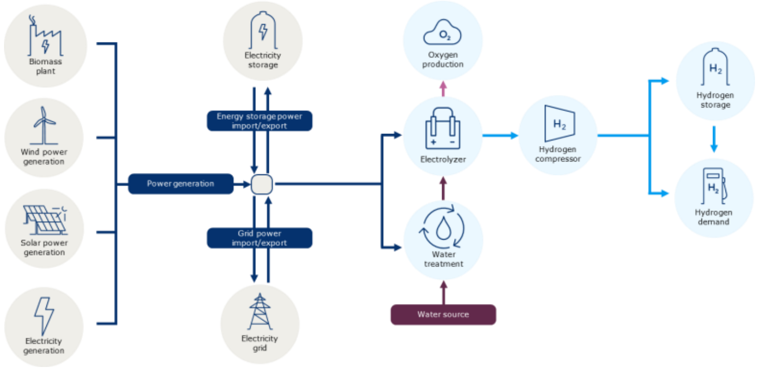
INFOGRAPHIC

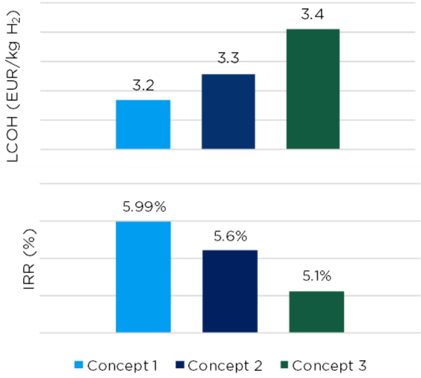


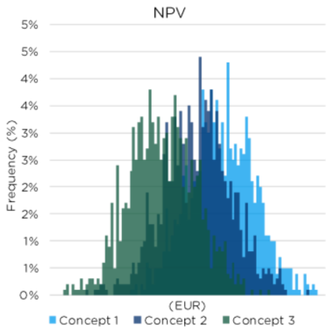
Concept 1



Concept 2







* = Timeline depends on the project scale.

The PtX tool returns maximum value between FEL-0 and FEL-2

Project timeline

DG	DG	DG	FID	
FEL-0	FEL-1	FEL-2	FEL-3	EXECUTION
PRE-FEASIBILITY STAGE	FEASIBILITY STAGE	CONCEPT DESIGN	FEED	
• Preliminary evaluation • Identification of the feasibility of the project	• Material balance • Energy balance • General Technology Selection • Business Case Assessment	• Project Execution Strategy • Preliminary layout • Preliminary schedule • Updated Project Schedule	• Purchase-ready major equipment specifications • Definitive estimate • Project execution plan • Preliminary 3-D model	• Execution • Detailed Engineering

Here the implementation of the PtX tool returns the maximum value

FEL	Front End Loading
DG	Decision Gate
FID	Final Investment Decision
FEED	Front End Engineering Design

03. Business case example

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Comparison of 2 scenarios

The general layout is to simulate a **Methanol production facility**, where the project is divided into two phases for a lifetime of 33 years.

The **first phase** coincides with the **initial** capacity installation of the assets, and the **second phase** with the **full deployment** of the total capacity of the plant.

CONCEPT 1

The capacity of phase one is initially deployed, gradually reaching half of the nominal value in **Year 5**.

Full capacity is deployed in **Year 10**.

CONCEPT 2

The capacity of phase one is initially deployed, gradually reaching half of the nominal value in **Year 5**.

Full capacity is deployed in **Year 15**.

Assumptions for the methanol plant simulation

Assumption	Unit	Concept 1	Concept 2
Half capacity deployment	Year	5	10
Half capacity deployment	Year	5	15
Electrolyzer capacity	GW	6	
Wind power capacity	GW	6	
Grid cable connection	GW	4	
MeOH peak froduction	Ton	560	
H2 storage	Ton	20	
H2 storage max discharge	Ton/h	5	
Bidding zone	-	DK1	

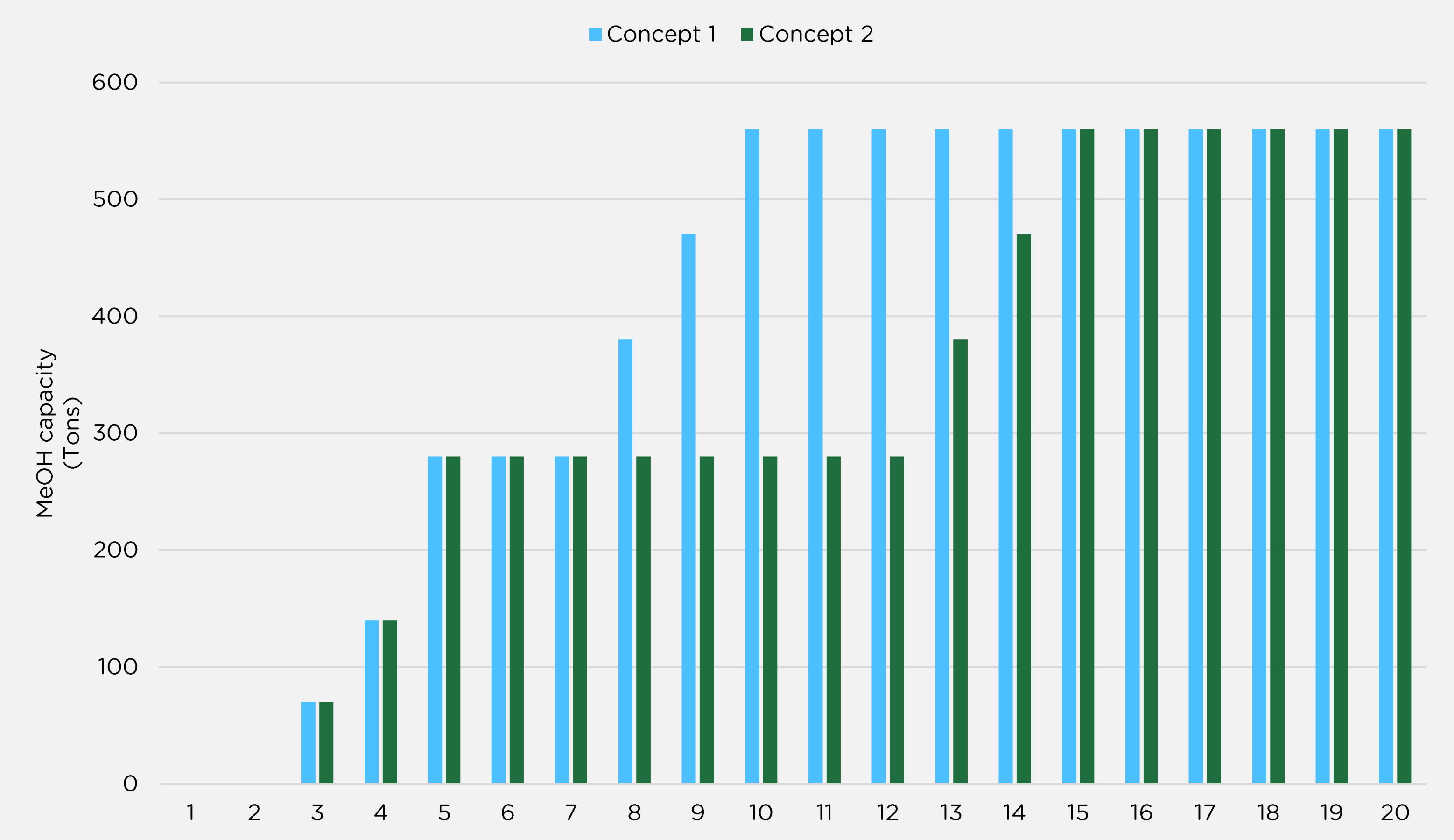
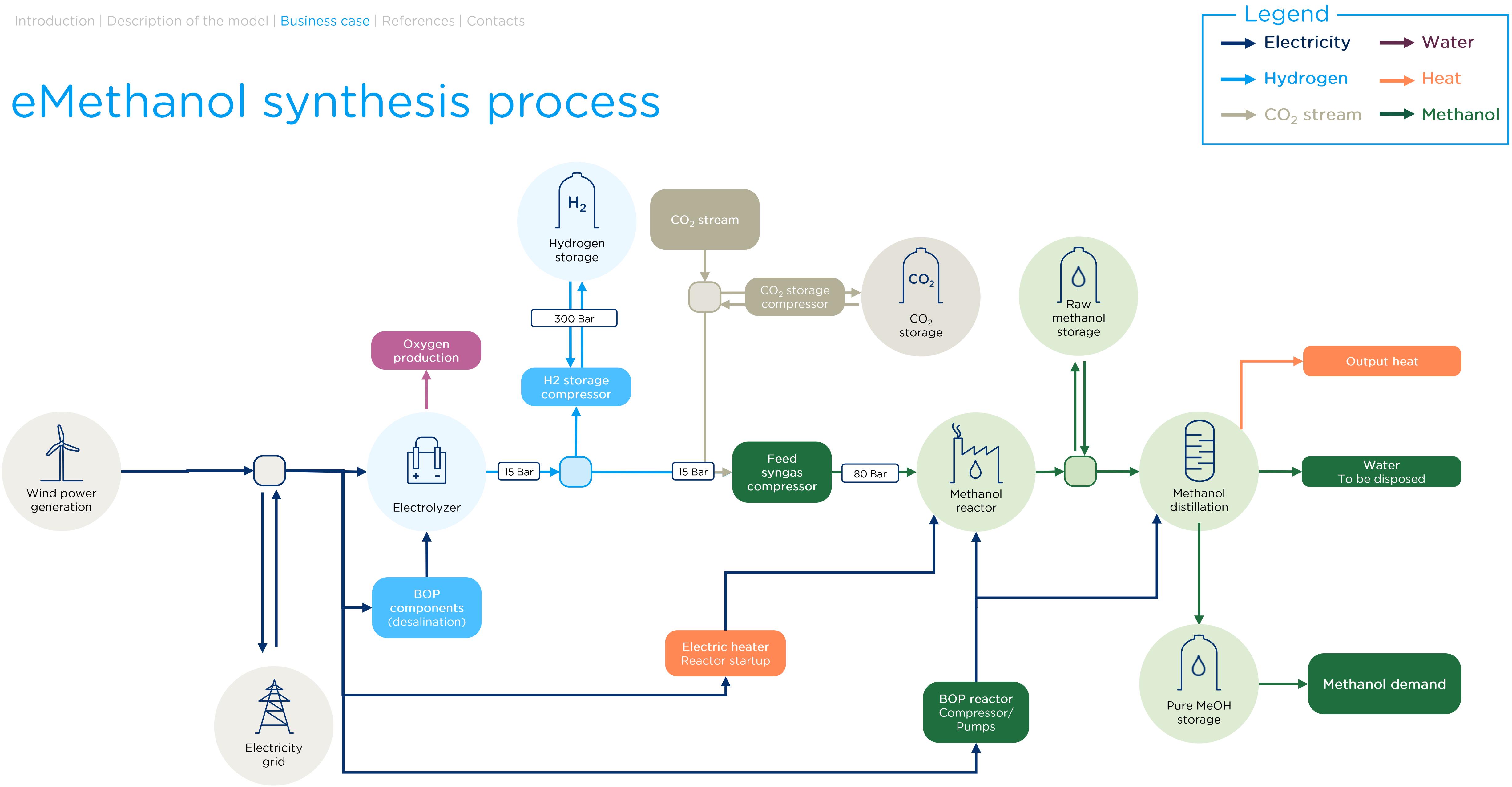


Figure: Capacity deployment for the electrolyzer, wind power and methanol plant capacity displayed for the first 20 year of the project.

eMethanol synthesis process



CAPEX for concept 1 are accounted earlier due to capacity deployment scheme

CONCEPT 1

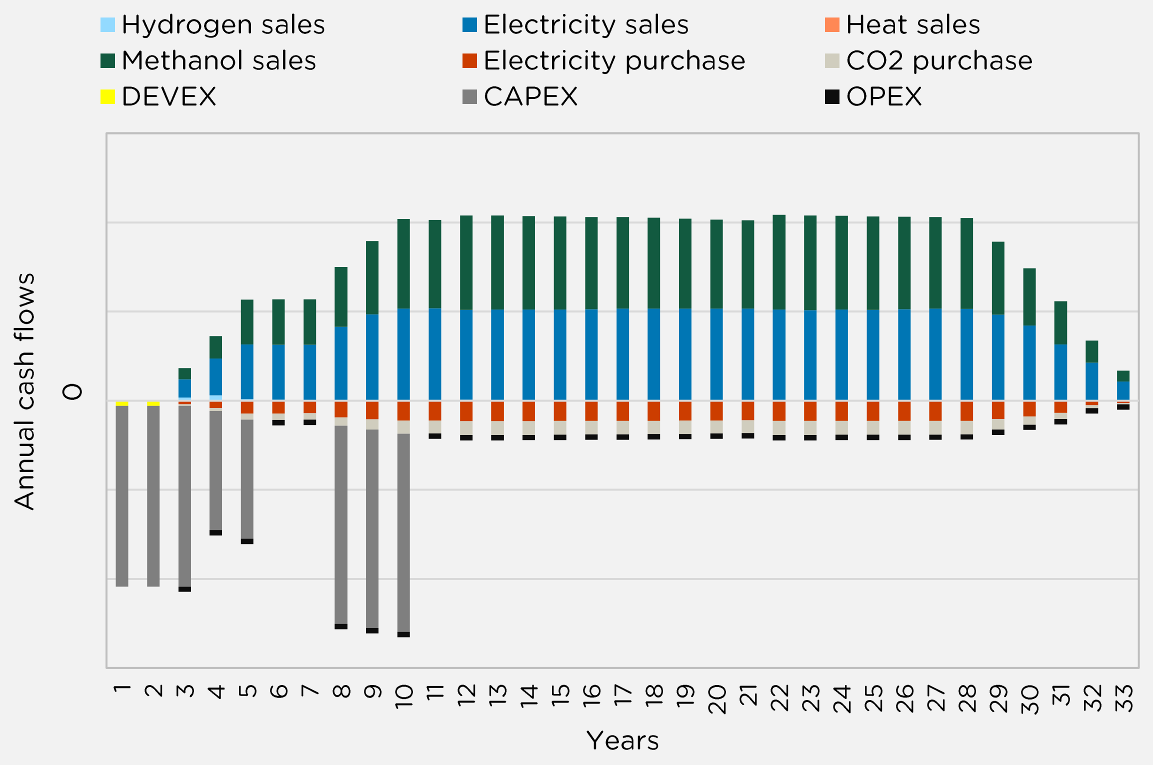


Figure: Cashflow diagram for concept 1 for 33-years plant lifetime.

CONCEPT 2

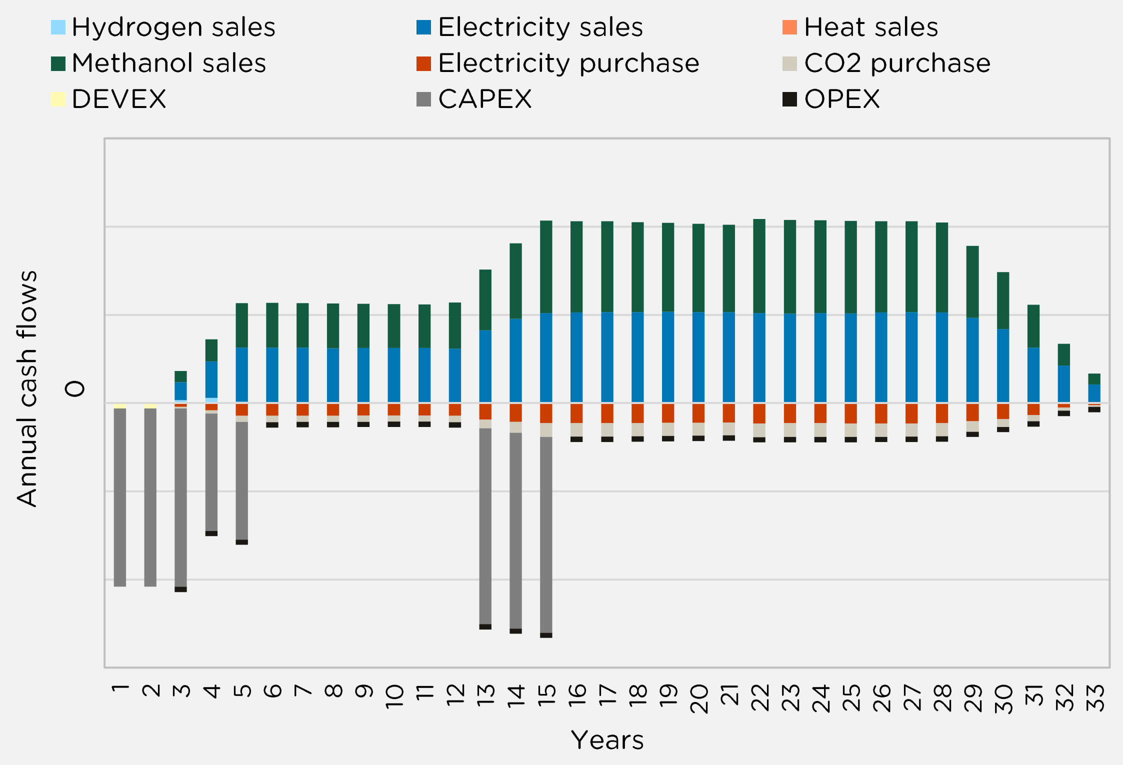


Figure: Cashflow diagram for concept 2 for 33-years plant lifetime.

NPV is higher in concept 1 as earlier revenues weights more in the discounted cashflows

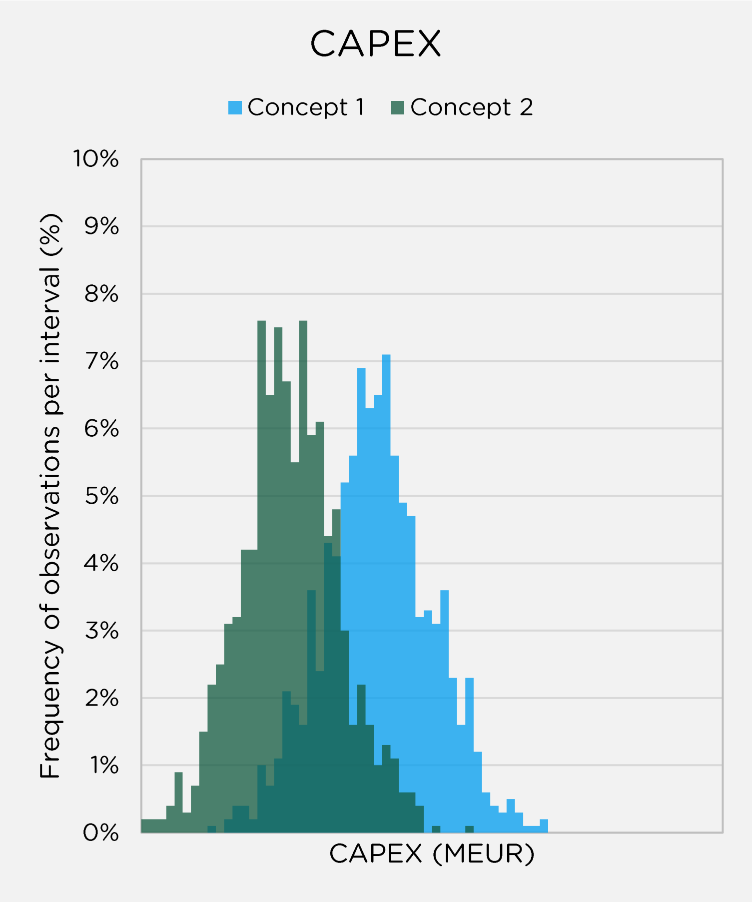


Figure: Montecarlo simulation for CAPEX.

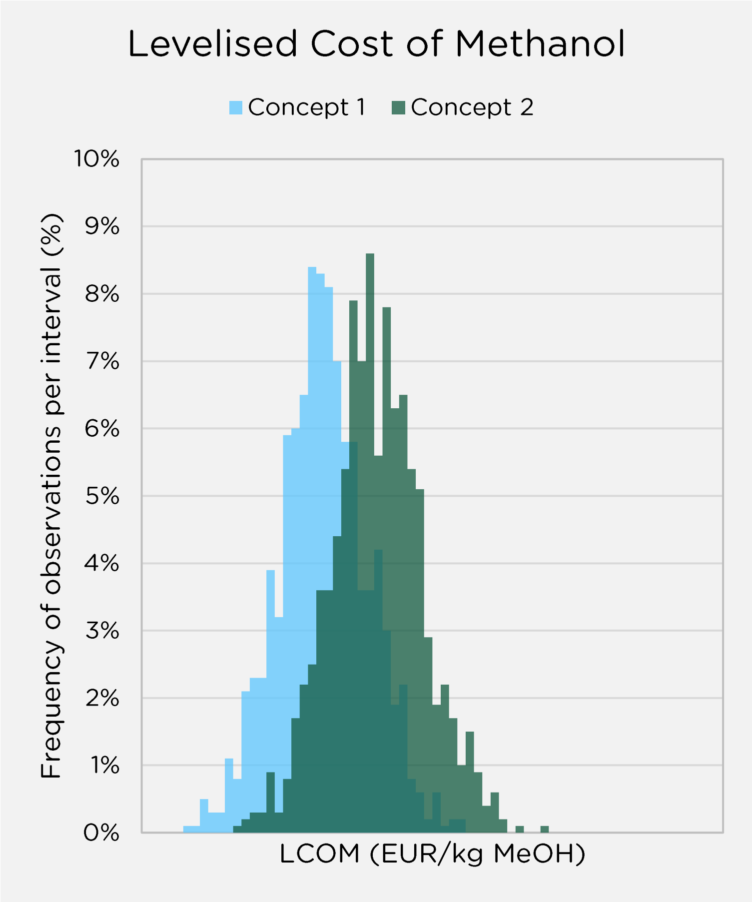


Figure: Montecarlo simulation for Levelized Cost of Methanol.

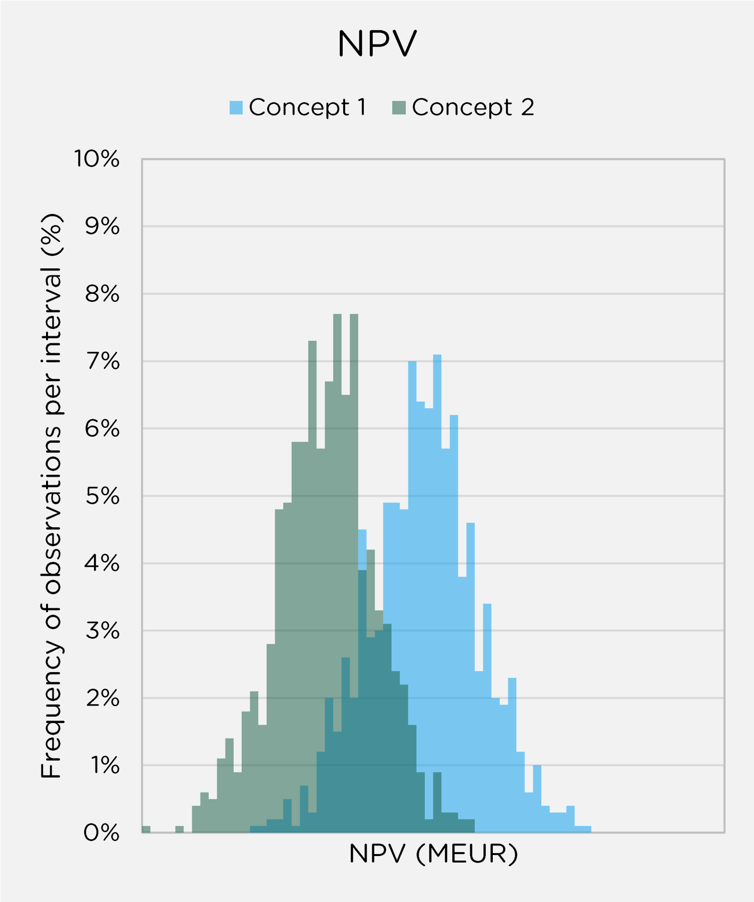


Figure: Montecarlo simulation for NPV of examined concepts.

04. Project examples

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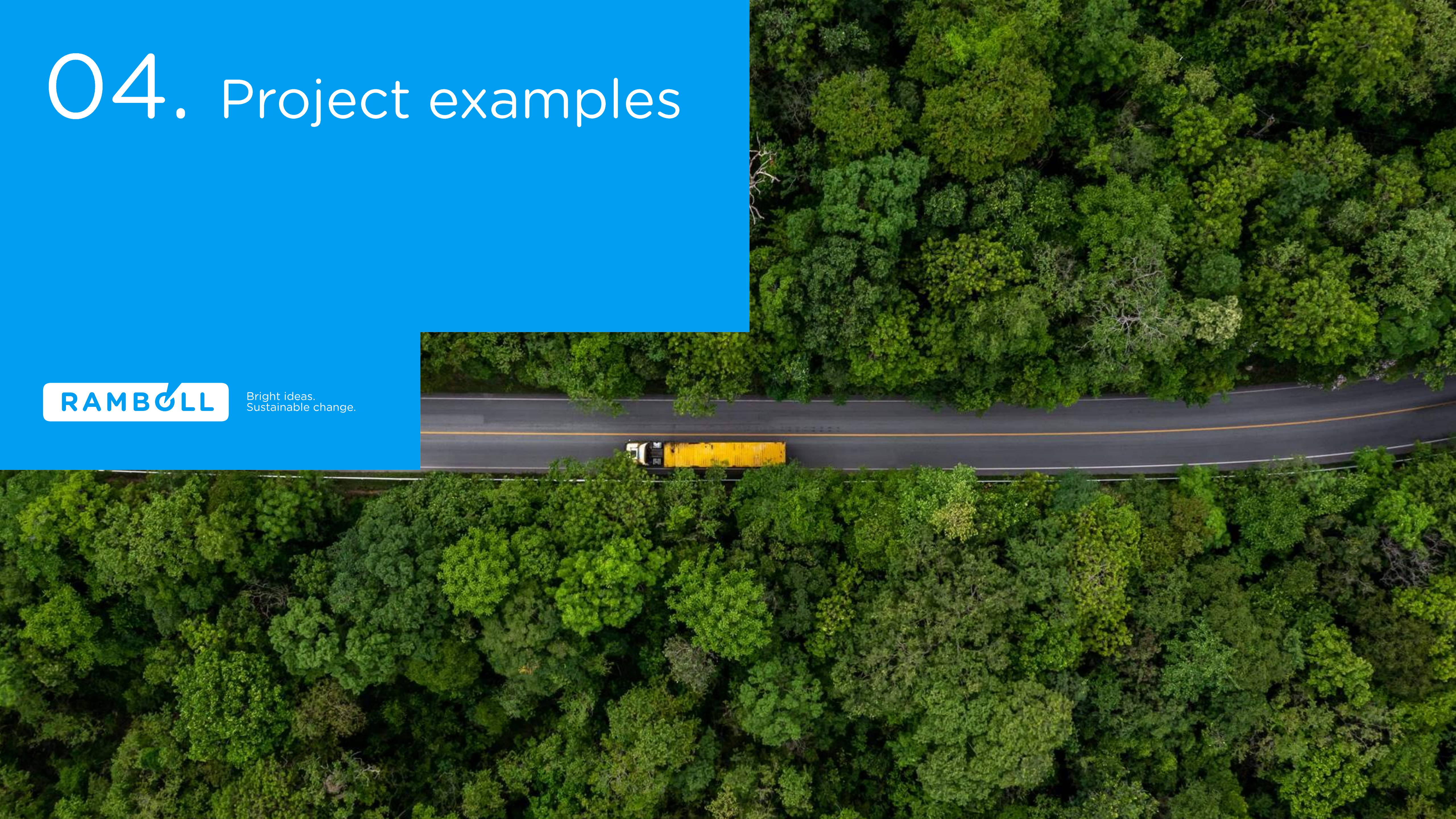

PtX Integration Tool project examples

05. Contacts

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Contacts

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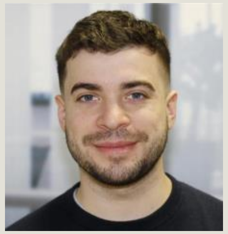

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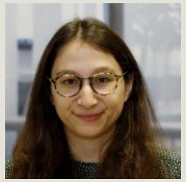

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