Large Scale Solar Europe 2020 Digital Summit

How to make Utility scale PV with H2 generation attractive in Portugal

SMARTENERGY

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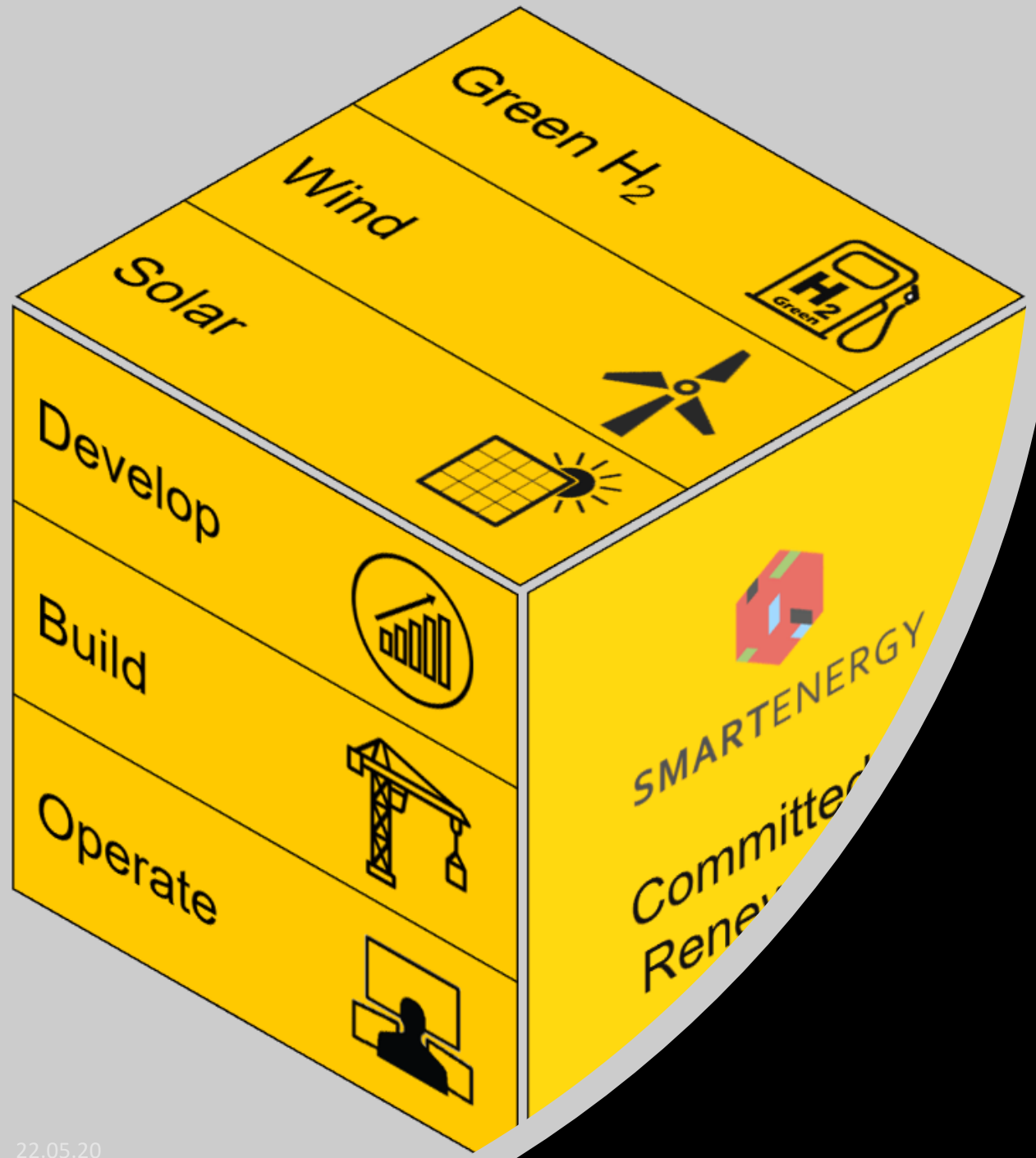

Smartenergy in Portugal

- 1 GW PV development pipeline
- 7 Projects for H2

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Smartenergy engaged Roland Berger and Vontobel to support its H2 deployment strategy at industrial scale in Portugal

Roland Berger

Vontobel

Smartenergy H2 strategy is based on a mature PV pipeline, adding H2 generation is not only a business opportunity but a risk mitigation and hedging mechanism

Overview: Categories of projects with potential for hydrogen application

1 Planned PV projects with secured grid connection

On-site electrolysis for hydrogen production as "add-on" to planned PV power generation plants

Switch to hydrogen production business model

- > Projects will be implemented
- > H_2 case as potential add-on model
- > Project economics of H_2 case need to provide upside over PPA business model

NEW Developments

2 Planned PV projects without secured grid connection

Combine PV generation capacity with on-site electrolysis

Develop business model around hydrogen production

- > Project viability uncertain due to missing grid connections
- > H_2 production could be game-changer by enabling implementation off-grid

NEW Developments

3 Retrofit existing PV assets for H_2

Retrofit operational PV plant with on-site electrolysis capacities

One-time "buy-out" of remaining feed-in duration (NPV-based)

- > Project economics of H_2 case need to provide upside over existing (low-risk) PV-feed-in business model

EXISTING Plants

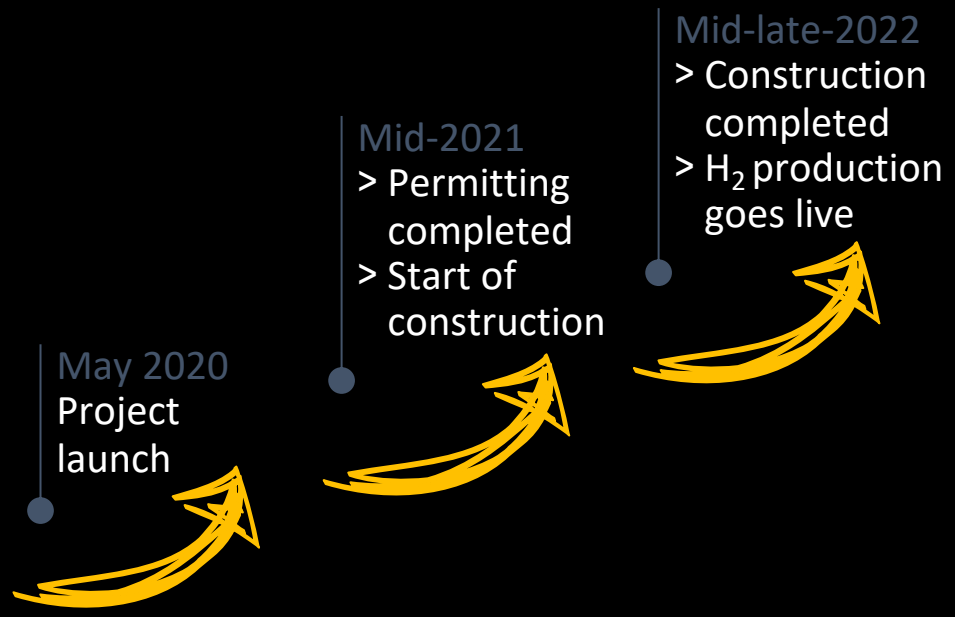
Overview on commercial lead project – 14 such projects required to secure 5% of Green H2 gas grid injection in Portugal

Overview: Smartenergy's commercial lead project

Parameters Commercial Lead Project

> Project location: Portugal
> H_2 production method: Electrolysis from PV electricity
> PV solar capacity: approximately 50 MWp
> Green H_2 output: ~1.5 million kg p.a.

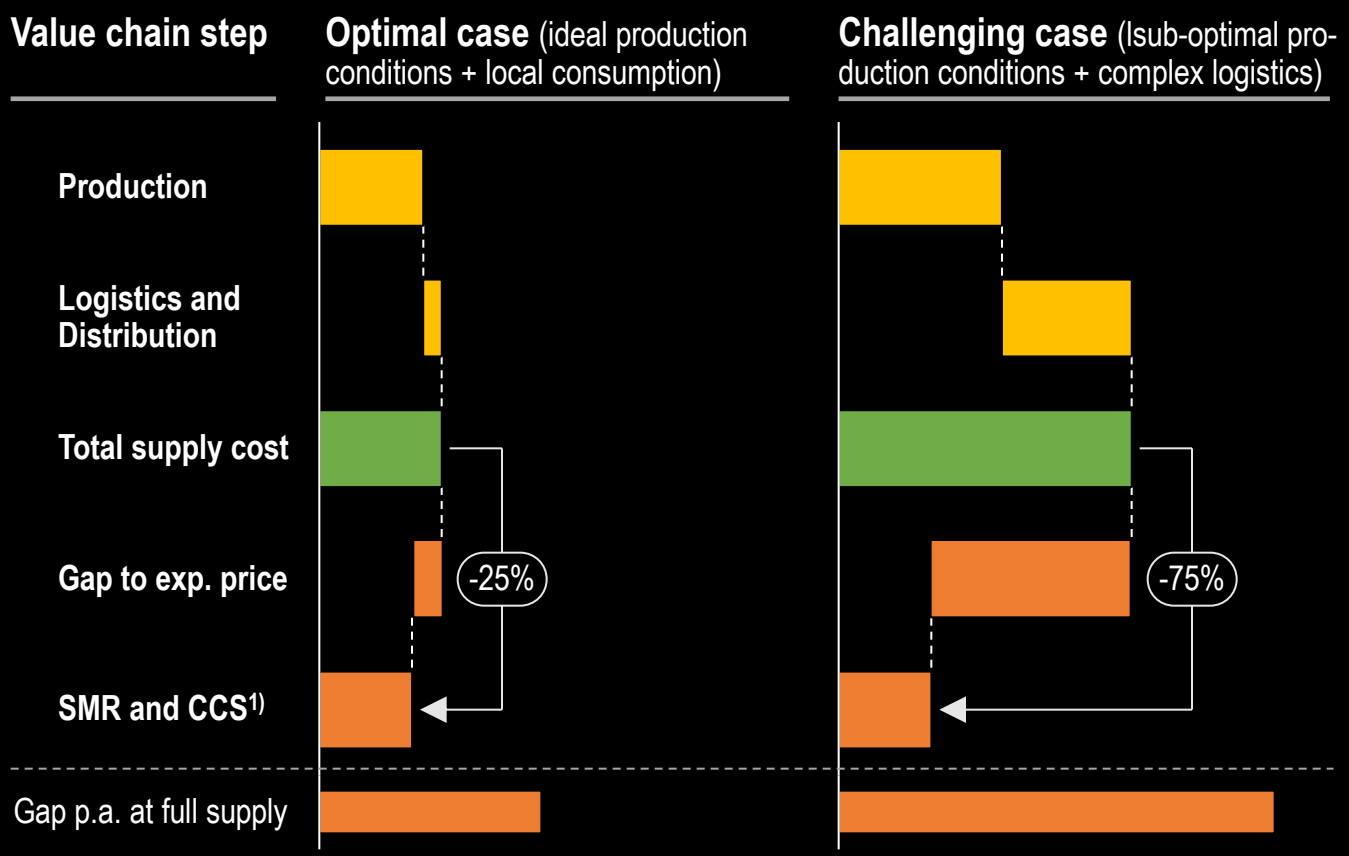
Indicative project timeline



Triangle to success: Balancing the parameters to reach feasibility

The business case gap on an individual project level can vary significantly – Support models need to reflect this to be effective

Total case-based cost assessment of hydrogen supply



Comments

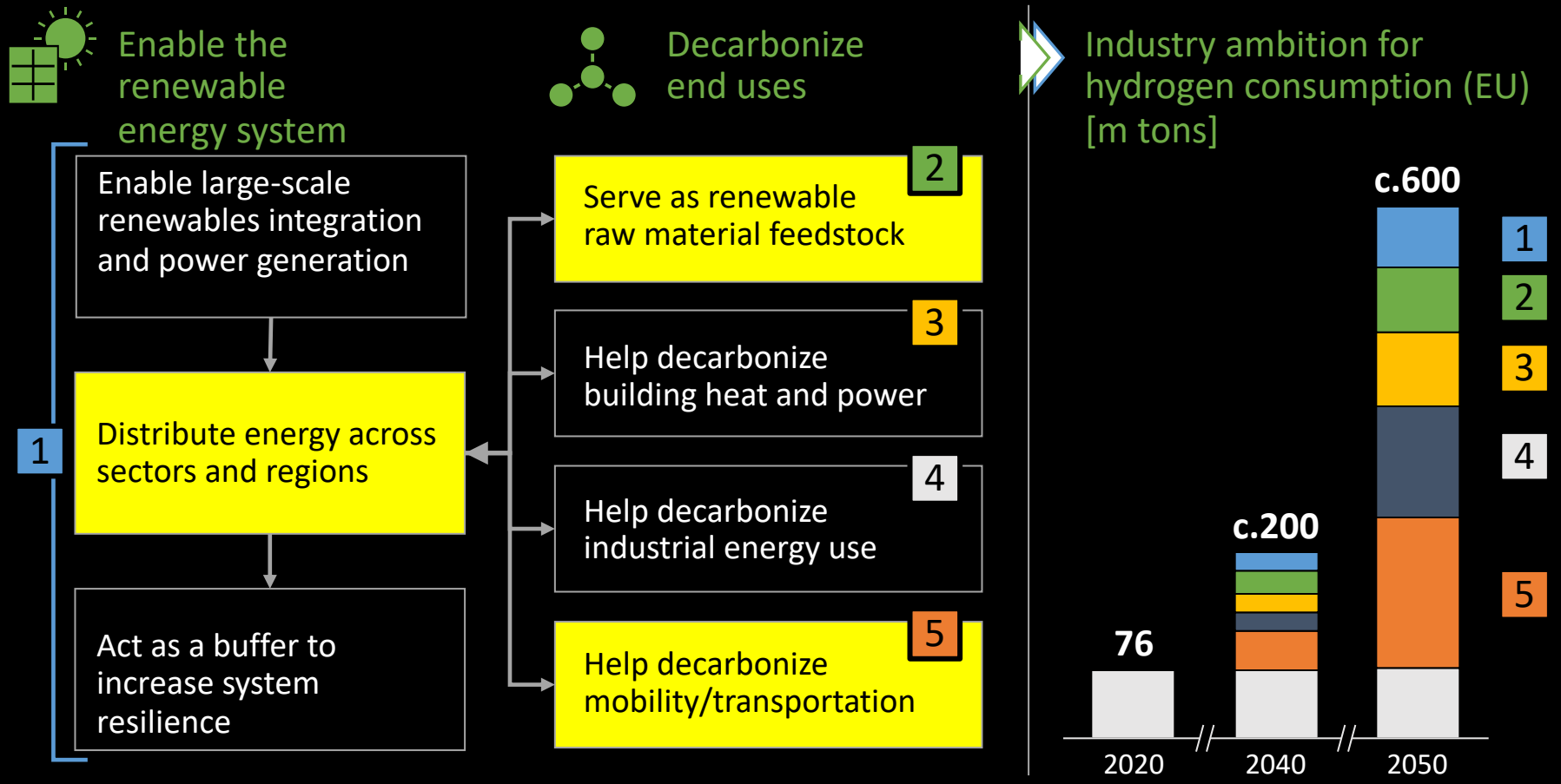
- **Business case gap** computed based on **price difference between green hydrogen** at point of consumption and **"blue" hydrogen**
- Specific **business case gap** that needs to be bridged via public support **varies considerably depending on project characteristics**
- **Main drivers** are **power and H_2 production levels on-site**, as well as **complexity** of the **conversion and transport** value chain
- Public **support schemes** must be highly flexible and allow **tailoring to individual project characteristics** to be effective and make projects commercially viable

1) Hypothetical price for "blue hydrogen", i.e. hydrogen produced from natural gas via Steam Methane Reforming (SMR); resulting CO_2 deposited via Carbon Capture and Storage (CCS); specific reference price highly dependent on natural gas price and specific cost of CCS

Source: Smartenergy, Roland Berger

Hydrogen yields tremendous strategic potential for green energy transformation and drive sustainable value creation – Smartenergy selected focus areas for its H2 projects in Portugal

Hydrogen's roles in the energy transition



Source: Hydrogen Council, Roland Berger

At LCOE of EUR 40/MWh, only a combination of at least EUR 4.00/kg H2 offtake price (subsidized) and 50% Capex subsidy yields an acceptable IRR

Indicative assessment only – bottom-up business planning pending

Key assumptions

Project basics:

> **Project location:** Portugal

> **PV capacity:** > 50 MWp

> **Operational lifetime:** 25 years

> **Electrolyzer capacity:** 40 MWp

> **Distribution channel**: On-site offtake H2

LCOE:

> **LCOE from PV:** EUR 40/MWh

Project IRR for different Capex subsidy levels / H_2 offtake prices

Capex subsidy	2.5	3	3.5	4.00
50%	negative	negative	One digit positive	towards low double digit
20%	negative	negative	One digit positive	One digit positive
10%	negative	negative	One digit positive	One digit positive
0%	negative	negative	One digit positive	One digit positive

H_2 subsidized price (EUR/kg)

Portugal actively addresses the support need with its planned hydrogen strategy

5 key messages for Portugal's planned hydrogen strategy

Portugal's H_2 strategy

REPÚBLICA PORTUGUESA
AMBIENTE E TRANSIÇÃO ENERGÉTICA

Key requirements from our perspective

1	**Focus on green H_2**	Only H_2 from renewable energy sources will contribute to the sustainable transformation of the energy system and the economy. Therefore, the strategy should focus on promoting green H_2.
2	**Set ambitious market target**	Define clear target of overall green H_2 production capacity from renewable sources of at least 2 GW by 2030 to provide orientation to market actors and set clear commitment.
3	**Support H_2 production**	Provide support mechanism for CAPEX and production cost of green H_2 projects to stimulate investments and bridge the gap to commercial viability during the scaling phase of the infant H_2 sector. Secure water availability at competitive price.
4	**Stimulate H_2 demand**	Create incentives for increased green H_2 uptake in particular in the industry feedstock and energy) and mobility sector, in the building heat and power segment, and in centralized energy (gas grid injection)
5	**Promote H_2 in public sector**	Leverage the public sector's buying power to create anchor demand in particular in mobility applications (e.g. public transport FC bus fleets) and support infrastructure roll-out (HRS-network)

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Join our vision!

Contact us to discuss potential opportunities!

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Thank you !