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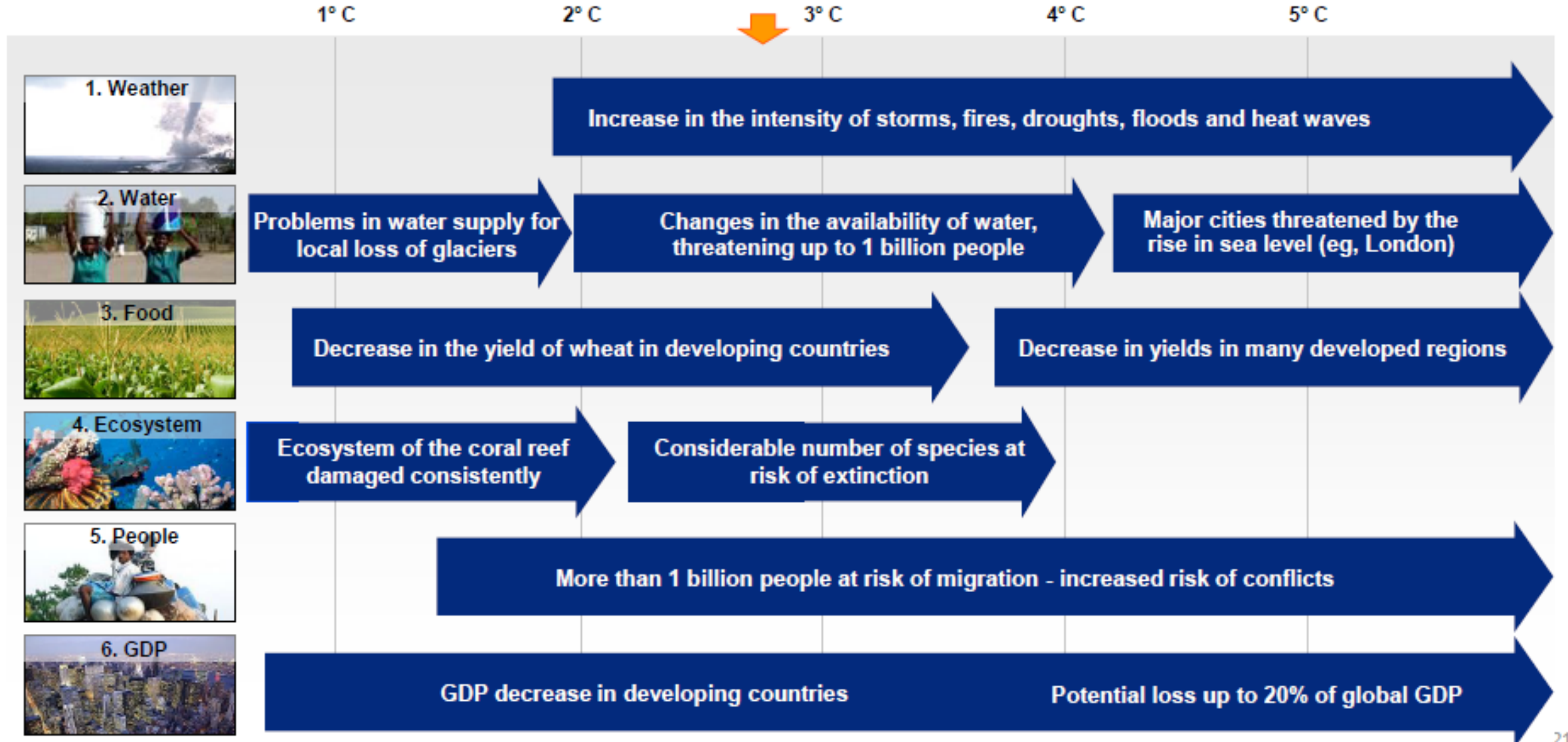
## Hydrogen: The Future of Electricity Storage

### Content Overview

- Why Should we Care about Climate Change?
- State of Global Hydrogen Policy Development
- Market Outlook for Hydrogen Decarbonization
- South Africa's Power Landscape
- Challenges and Opportunities
- Key Policy Aspects for a Successful Buildout
- About Vestas & Our Key projects and Partners in PtX

# Environmental Impacts - Climate change adaptation

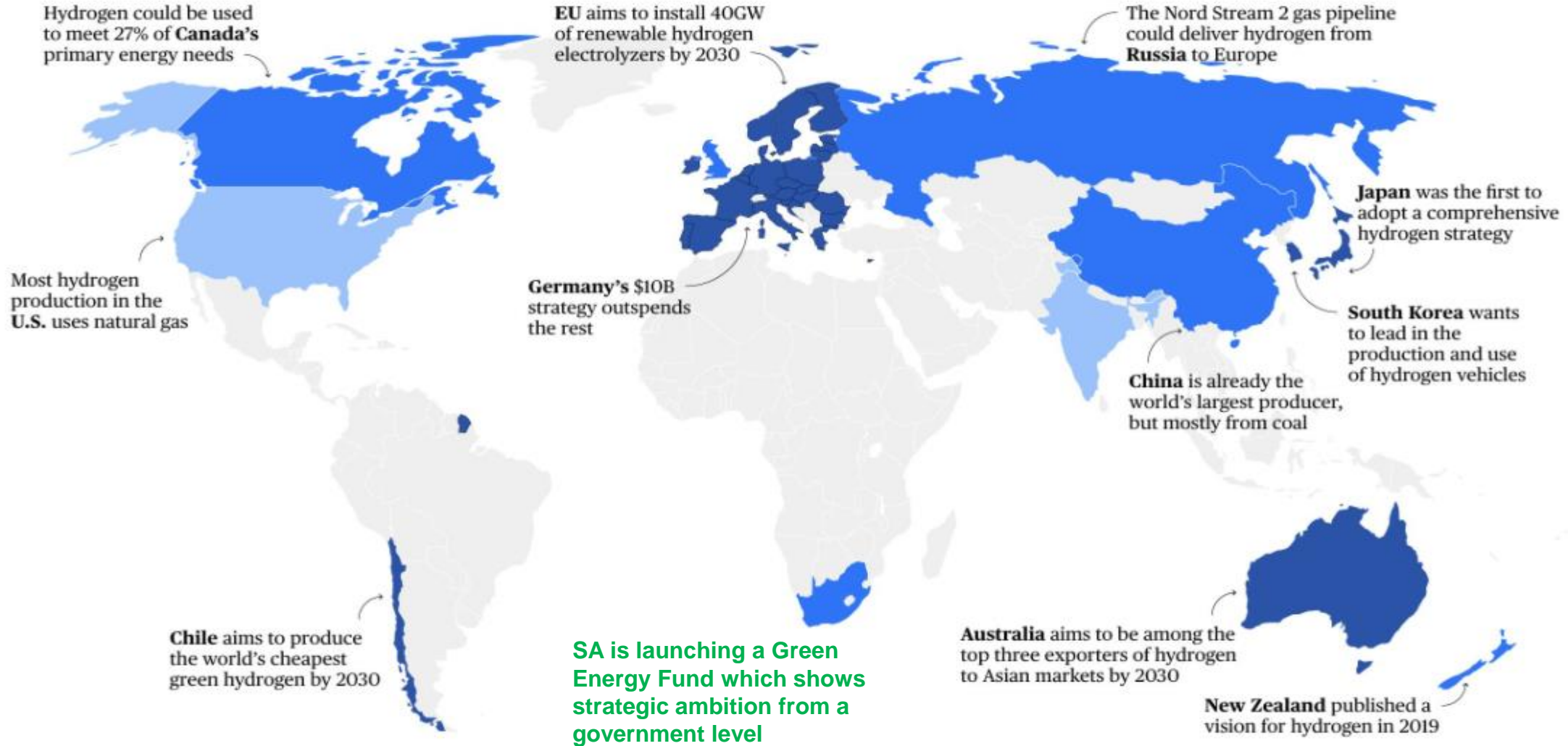
Climate change is already causing environmental and social disasters



# Green Goals

Many more countries have announced full hydrogen strategies in 2020

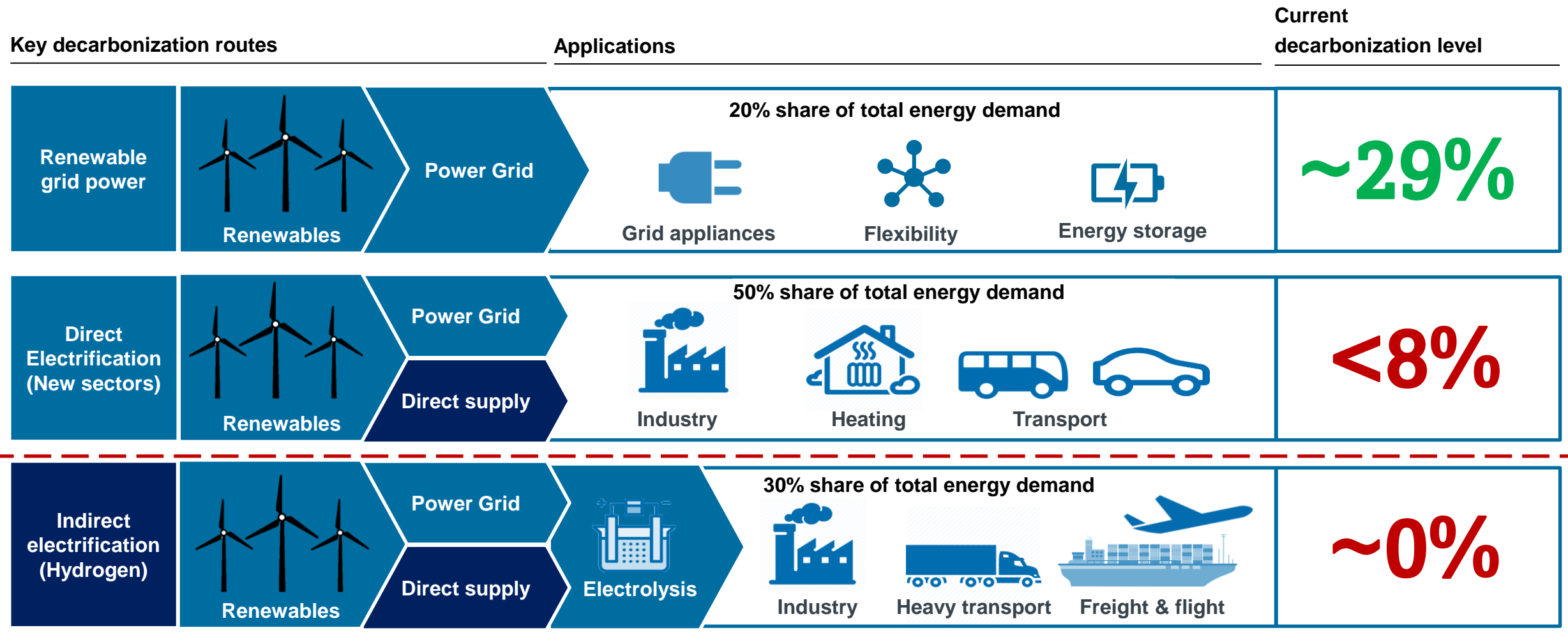
National hydrogen strategy, more robust plans →



Sources: Eurasia Group; International Energy Agency; Bloomberg  
Note: Black outlines demarcate EU countries, and don't necessarily indicate a national strategy exists.

# Hydrogen required for ~30% of primary decarbonization needs going forward

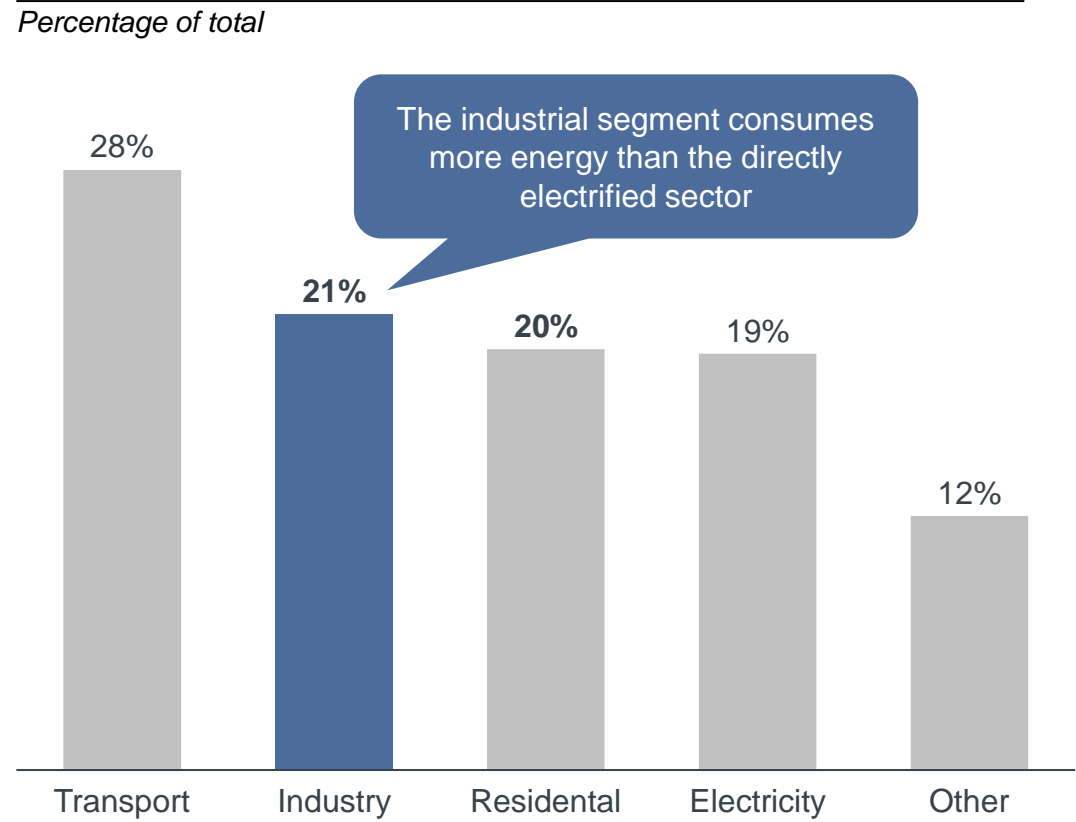
Direct renewable electrification preferred solution where possible, but in many cases hydrogen or derivative is the only feasible alternative



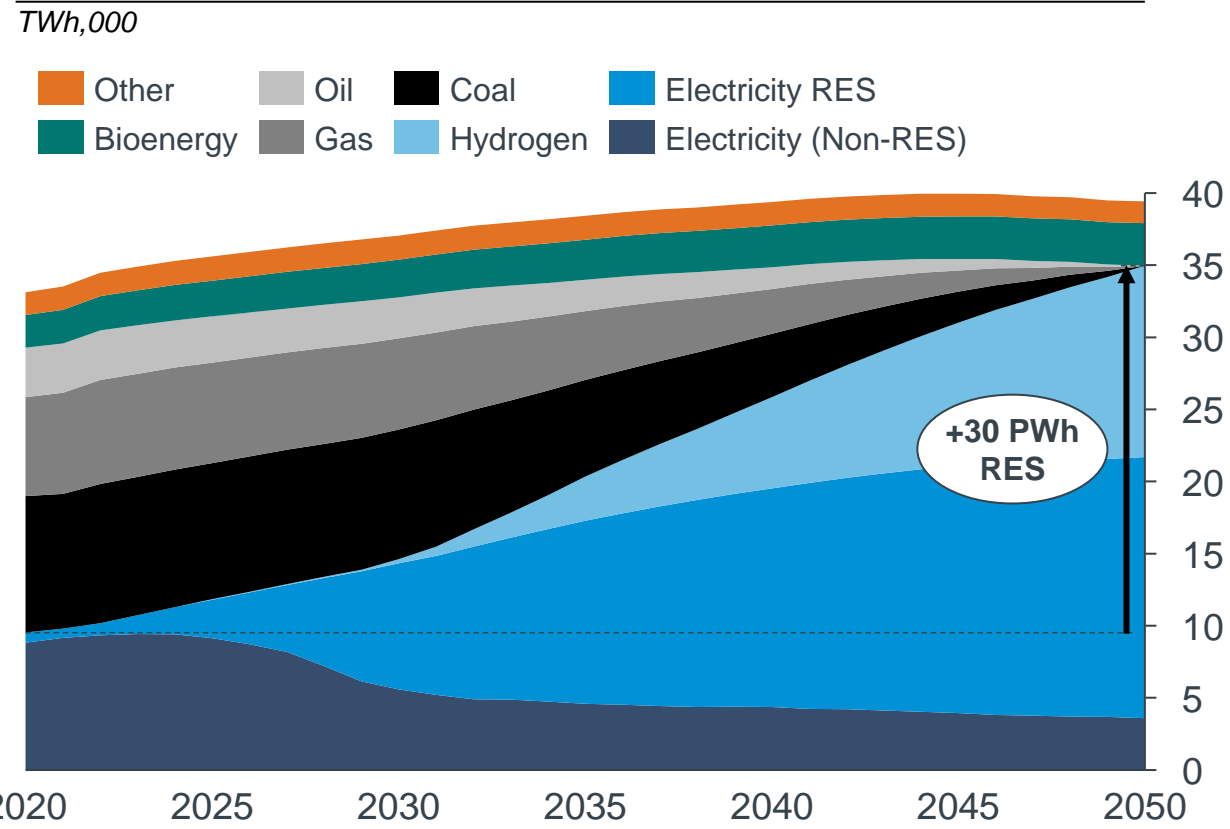
# Industrial demand for renewable hydrogen expected to increase substantially

Industrial segment is already the second largest consumer of energy globally, and entail major decarbonization potential from hydrogen

**Current yearly global final energy consumption (2019)**



**Forecasted change in global industrial final energy use**



Power demand from RES expected with increase 30,000 TWh per annum demand

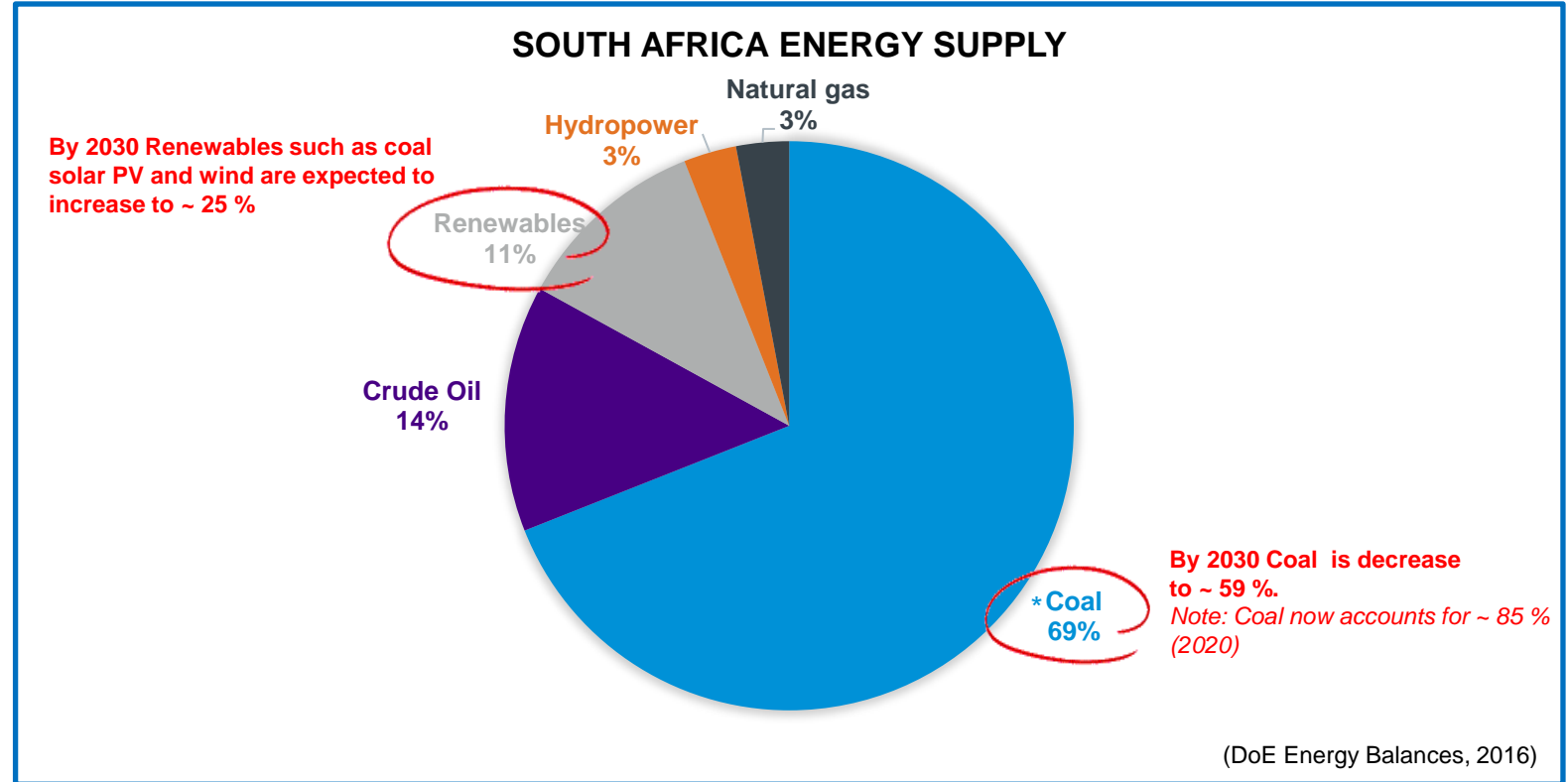
# South Africa's Power Landscape

## The State of the RSA Power Landscape

### SA Overview:

- Total population → 59.3 million people (Gini index = 0.65)
- South Africa is the **largest producer of electricity in Sub-Saharan Africa**
  - RSA contributes ~ 53 % (~45 GW) towards the installed capacity in Sub-Saharan Africa
- It has achieved 85 % electrification. A 2 % improvement from the past 10 years
- **Vertically intergrated**
- **RSA inhabitants procure their power from Eskom**, a state-owned utility enterprise that supplies ~90 % of the power in the country.
  - Eskom's energy availability → 71.9 % (2018), thereafter 65.0 % (2021) ↓

The decline has been evident in the **increased scheduled load shedding**



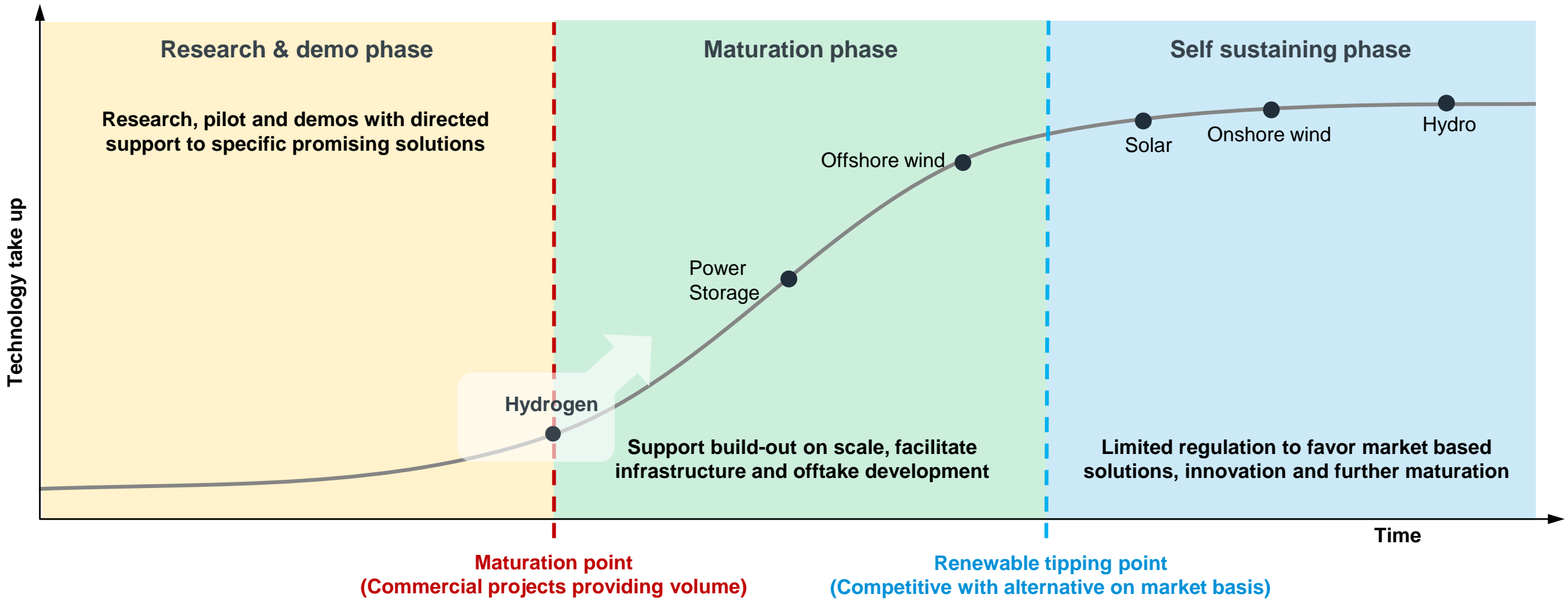
\*Eskom owns 13 coal-fired power stations in RSA

There is opportunity to accelerate South Africa's Renewable Energy Transition

# Hydrogen is on the verge of breaking into its maturation phase

Green hydrogen could reach its renewable tipping point within a decade - a game changer in on how to solve global warming

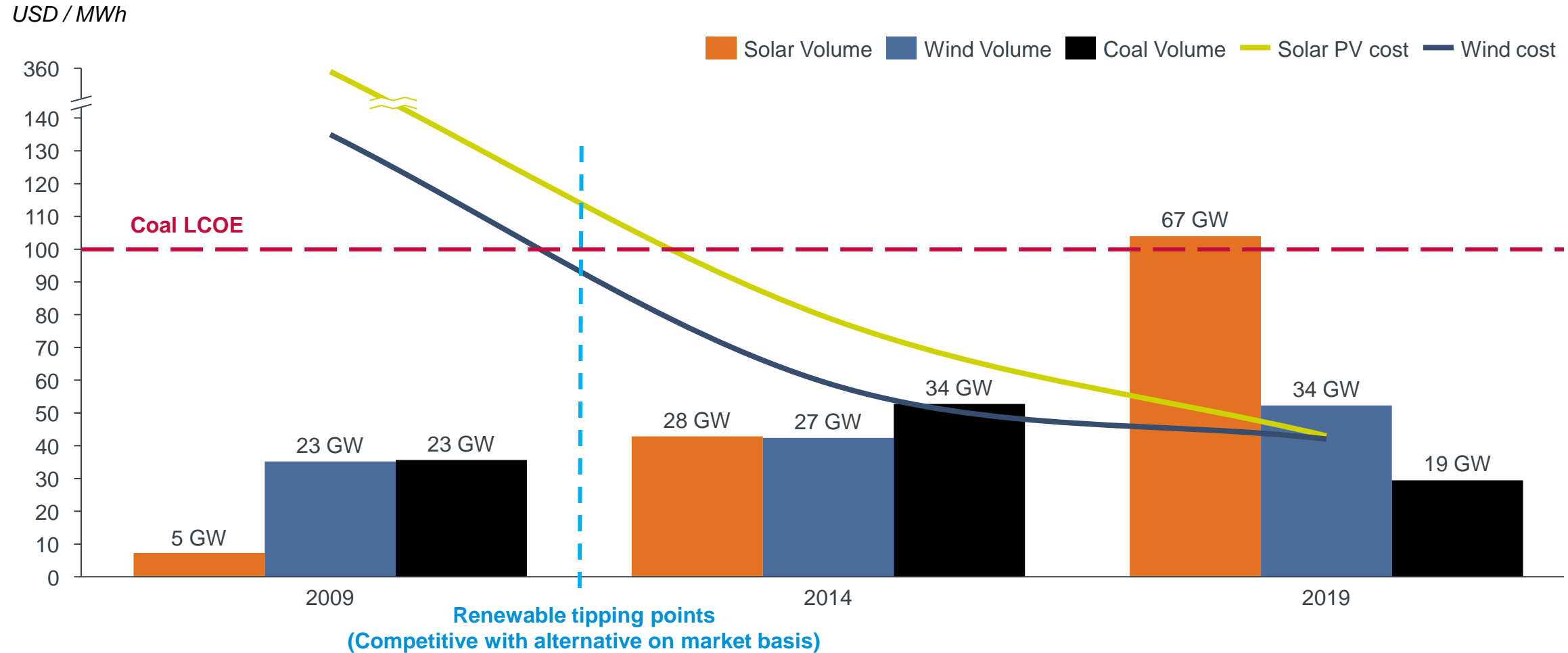
RES maturity technology curve – one to go



# Renewable tipping points - It has become cheaper to save the planet than to destroy it

Renewables such as wind and solar are competitive across most countries, and is outcompeting coal-fired generation on a global scale

Average yearly new installations rolling 3 years & LCOE



Source: BNEF 2021

Classification: Restricted

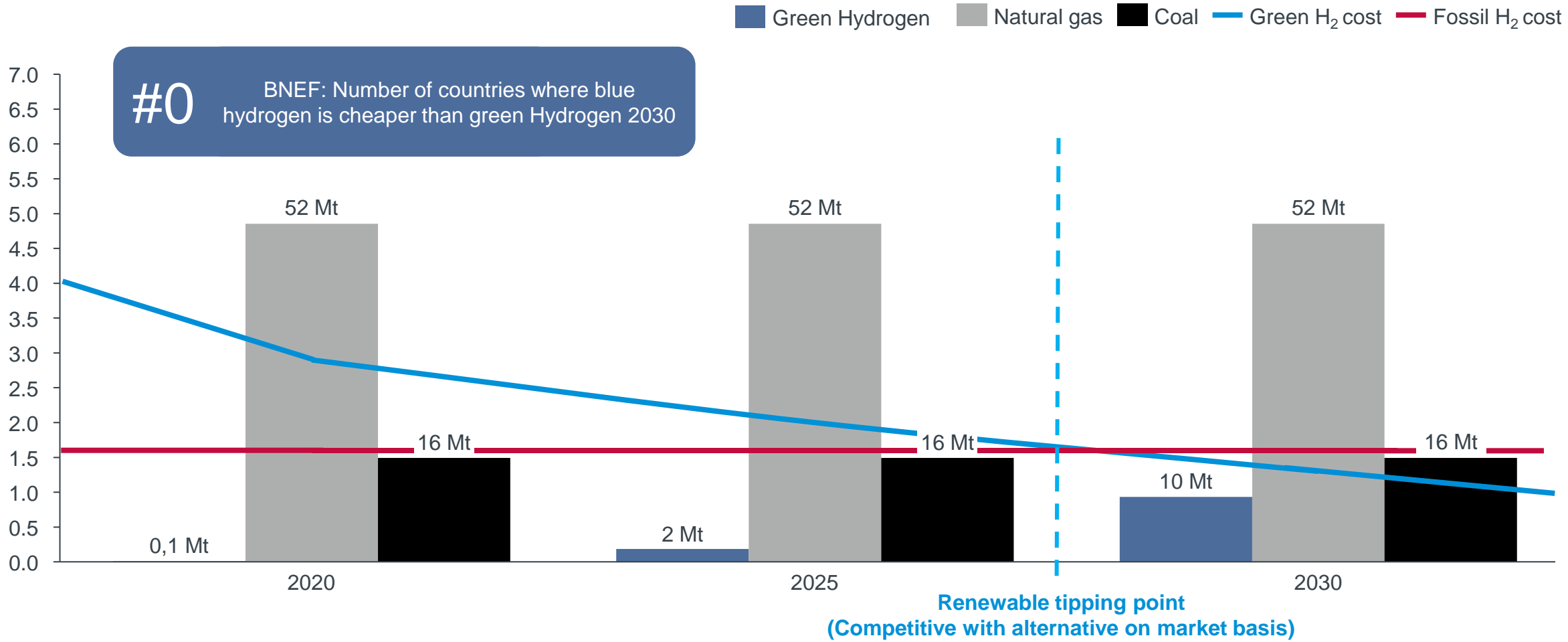


# Green hydrogen could become competitive within a decade with fossil alternatives

Today, Green hydrogen comprises of less than 0.2% of global hydrogen production – but if scale can be achieved, this will change

## Cost of new Hydrogen production and production forecast per source (excl distribution)

EUR / MWh & Volumes / annum

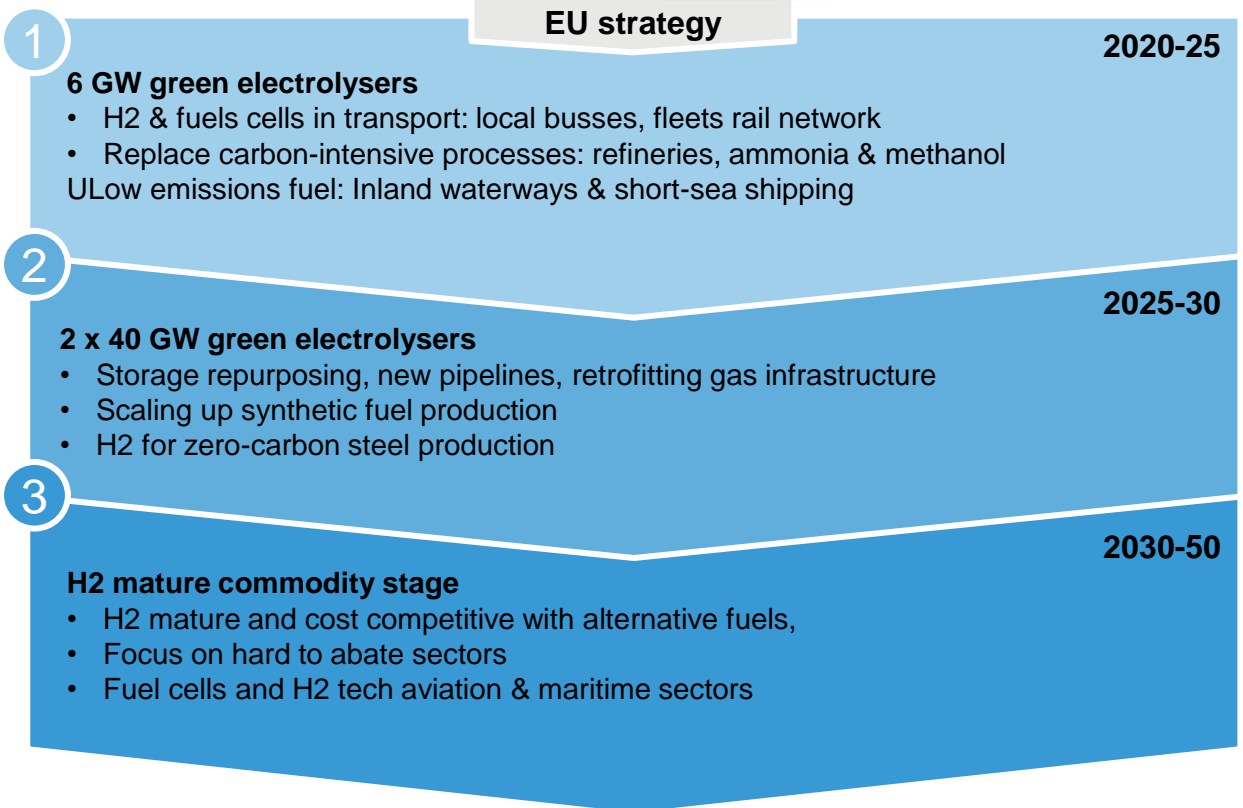
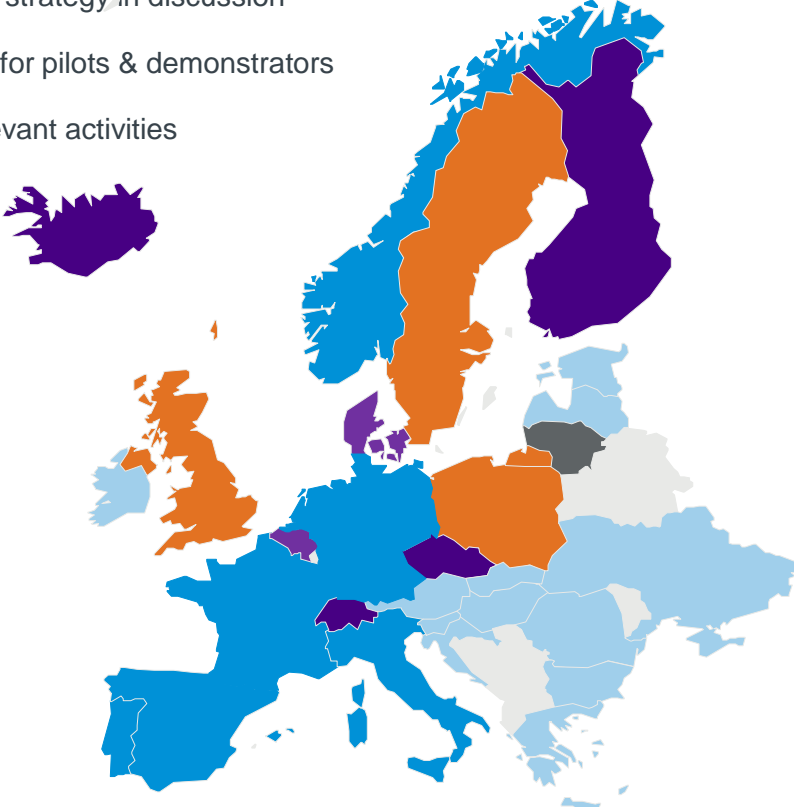


Source: BNEF 2021

# EU has adopted clear ambitions and roadmap for green hydrogen and P2X

However, more specific support and clear offtake routes will be needed for all countries to accelerate the transition

- National strategy available
- National strategy in preparation
- National strategy in discussion
- Support for pilots & demonstrators
- Few relevant activities



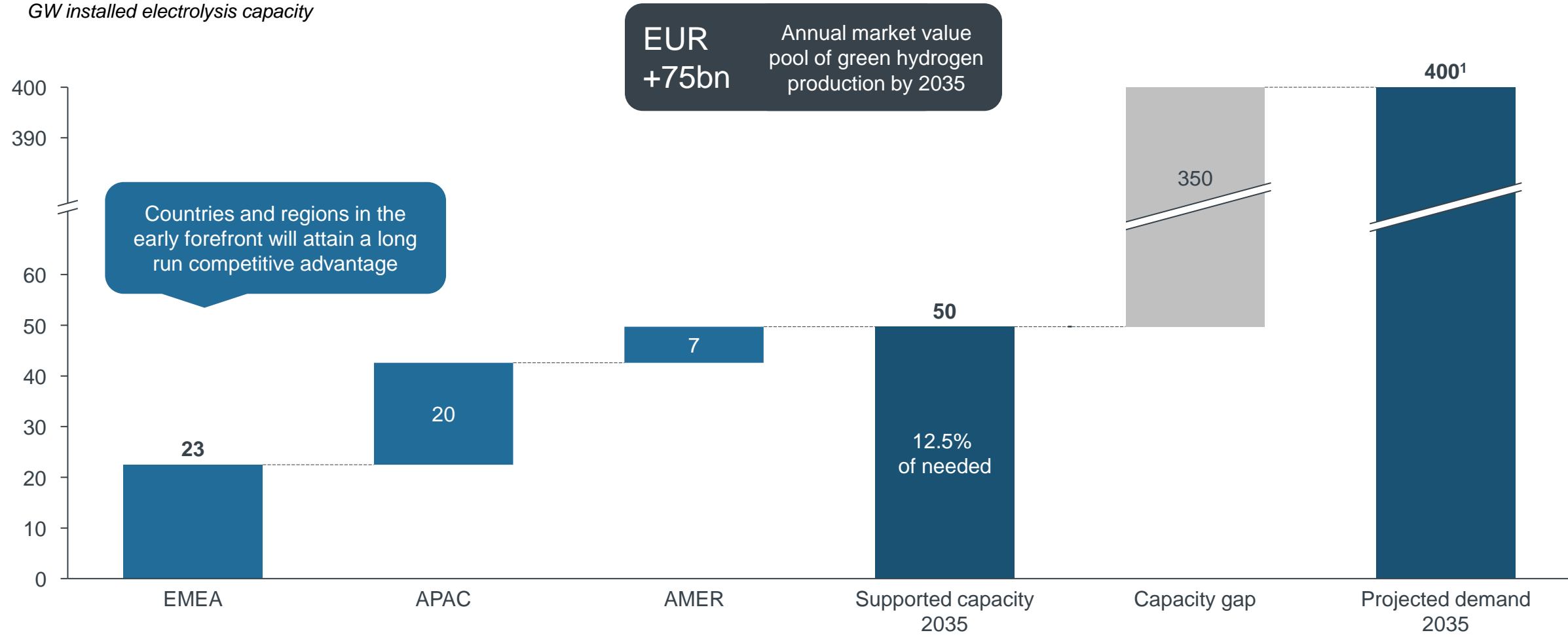
Investment projection		
<b>Production capacities:</b> €180-470bn	<b>Gas infrastructure</b> €77bn (Fuel stations €1bn)	<b>New power generation:</b> €220-240bn

# The race to become “The global energy supplier of the future” has started

Since projects up to 2030 will need policy support, key growth markets will be the ones that provide incubation for growth and infrastructure

**Announced hydrogen projects by region and current gap to projected demand**

*GW installed electrolysis capacity*



# Key success criteria for developing successful hydrogen economy

Overall: Garner public support for new strategic industry sector will be key to dedicate sites and build-out potential

## Area of policy

## Policy

### Ambitions and support mechanisms

**Set higher and firm ambitions backed up by clear policy tools** with market based mechanisms that can bridge current price / market gap towards competitive Green Hydrogen with emphasis on supply side support to drive maturation phase

- Learning rates and future competitiveness can only be achieved if sufficient certainty and volumes is created for the market

**Co-located hydrogen solutions key focus to conserve grid and not cannibalize other decarbonization efforts**, and ensure that grid connected generation in carbon heavy grids does not attain support, unless curtailment or restricted grid export capacity can be proven

- We should only produce green hydrogen if it lowers global CO<sub>2</sub> emissions, overall electrification cannibalization must be avoided to the highest extent

### Supply chain

**Modern sustainability requirements in any support schemes**, life cycle carbon emission considerations and waste recycling plan should be taken into account, while transparent supply chain a license to play

- Need to ensure that hydrogen solves the carbon and sustainability issue from a life cycle perspective, the climate can only afford real solutions

**Supplier agnostic support, to ensure market competition for best solutions**

- Countries can only lead the way if the market can openly compete for the best solutions,

### Infrastructure and offtake

**Hydrogen infrastructure must be should be developed** to stimulate demand and ensure competitive production sites are utilized – dedicated hydrogen pipeline backbone, hydrogen refilling infrastructure for shipping, air and heavy transport must be developed for cost efficient utilization of P2X fuels

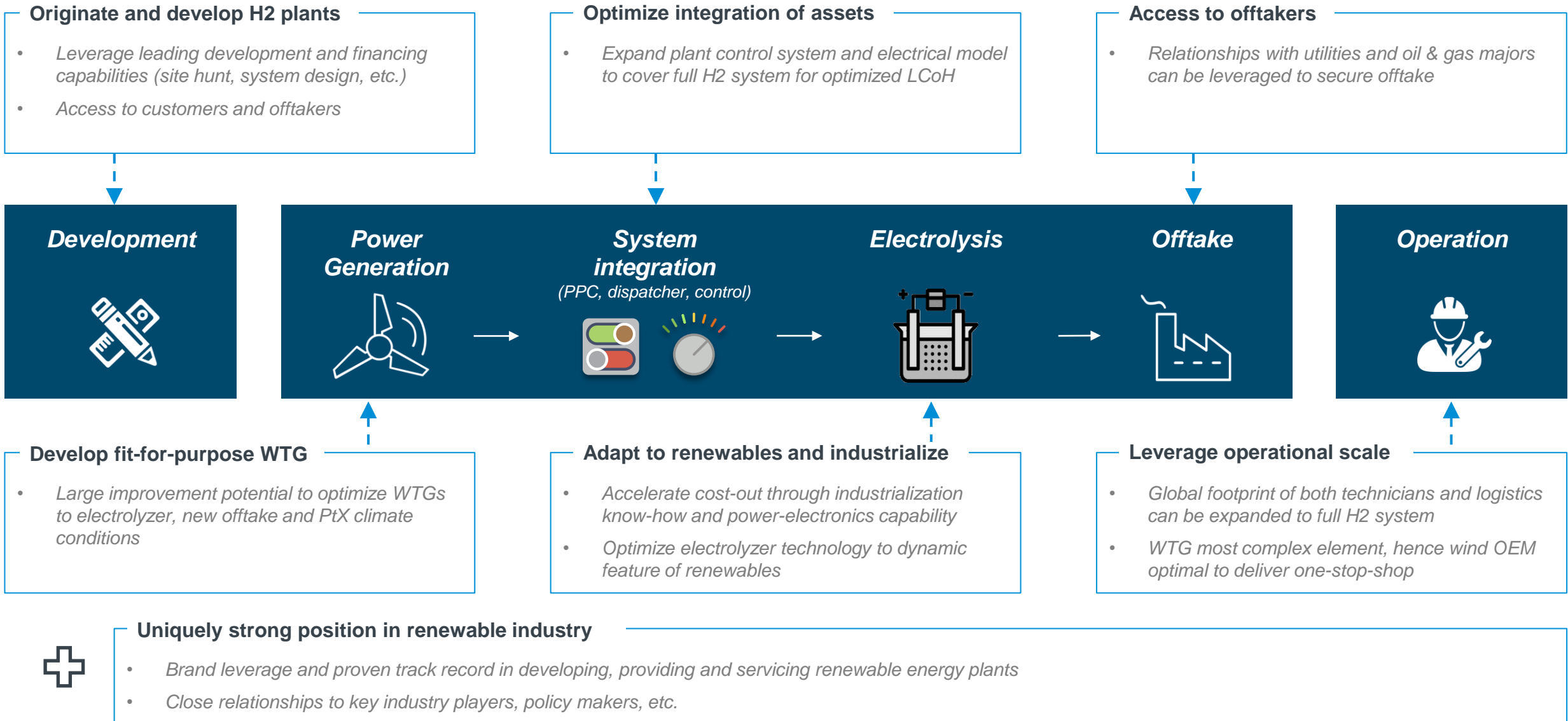
- Current hydrogen infrastructure not fit for purpose for large scale hydrogen distribution uptake, future competitiveness dependent on adequate build-out

**Stimulate hydrogen demand in nascent green industries**, to ensure that there is an offtake market that can actually use the renewable gas or P2X derivative – firm support on shipping, steel and other industrial sectors will be key to kick-start market

- There needs to be a clear offtake path for produced hydrogen into high potential sectors, once established the demand will grown on its own

# Vestas in advantaged **position to succeed** with integrated solutions

Strategic and committed partner for integrated wind-to-hydrogen plant solutions, covering entire value chain from site selection to hydrogen offtake



# Aiming to **develop, deliver and service full scope** RE-to-hydrogen solutions

Vestas is the key integrated partner for leading the hydrogen revolution

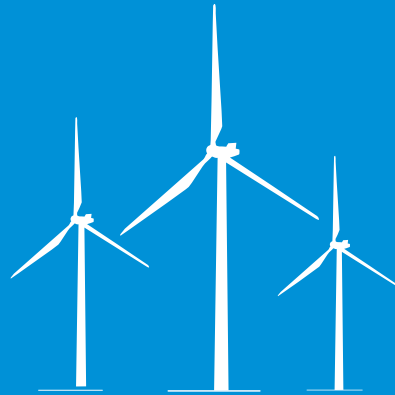


# Vestas is the energy industry's global partner on sustainable energy solutions



**+29,000**

We employ more than 29,000 people worldwide and have 40 years of experience with wind energy



**+51,000**

We have a total of **51,255** combined turbines under service, or more than **123 GW**



**+ 80,000**

We have a total of 80,567 turbines or more than **145 GW of installed wind power capacity in 85 countries** worldwide spanning five continents



**€ 15.6bn**

Vestas' revenue in 2021 was EUR 15.6bn