



# Hydrogen: a worldview

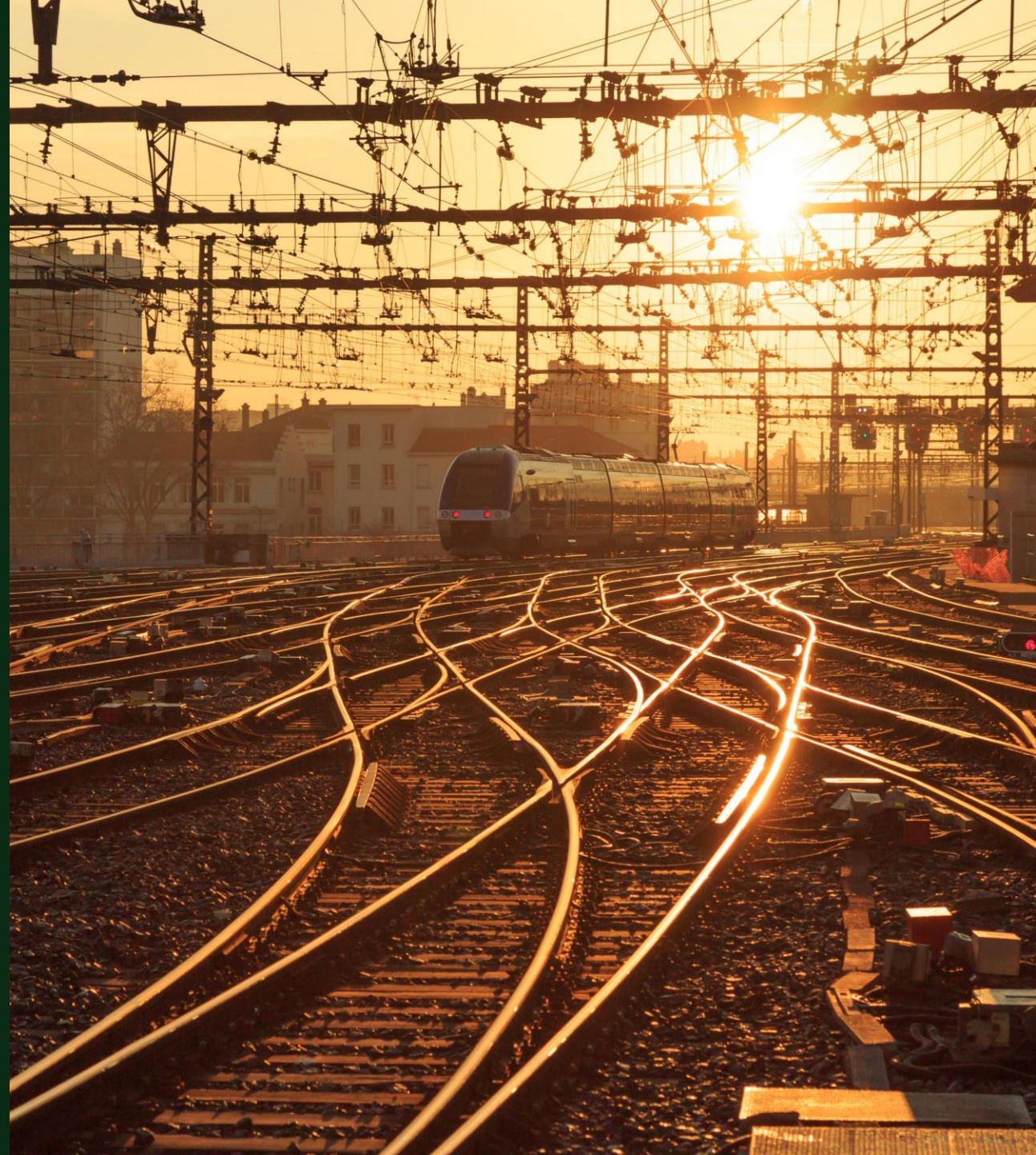
DR DAVID HART, GLOBAL HYDROGEN LEAD

FOR NEDBANK

CAPE TOWN, 6 NOVEMBER 2024

Sustainability is our business

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# Agenda

- 1 ERM
- 2 A hydrogen stocktake
- 3 A step back: transition
- 4 What is working?
- 5 What happens next?

# Introducing ERM

# Sustainability is our business

## We are the world's largest specialist sustainability consultancy

Founded in 1971, we are the largest advisory firm in the world focusing solely on sustainability, offering unparalleled depth and breadth of expertise.

### We shape a sustainable future with the world's leading organizations

Our purpose guides everything we do. We create a better future by helping the world's biggest brands address today's sustainability imperatives.

### We are the recognized market leader in sustainability services

Numerous industry benchmarks attest to our market leadership and the majority of our work is sole-sourced, reflecting trusted partnerships we build with our clients.

#### ERM OVERVIEW

8000+

Professionals

40

Countries & territories

**ESG & Sustainability consulting leader**

Verdantix Green Quadrant 2024

140+

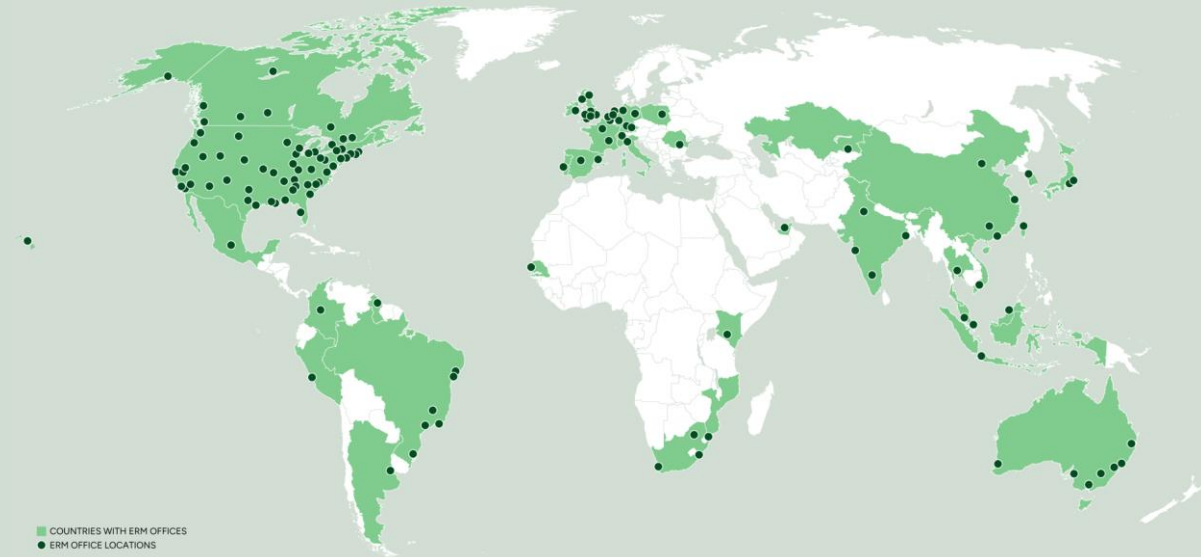
Offices

50+

Years of experience

**#1**

Sustainability service provider – HFS 2022



We partner with...

70%

of Fortune 100

55%

of Fortune 500

# ERM's hydrogen services

SUPPORT THROUGHOUT THE VALUE CHAIN



# ERM has unrivalled end-to-end decarbonization capabilities

With a focus on driving profitable commercial outcomes through practical, deliverable strategy and on-the-ground project execution

**Strategy, planning & disclosure:**

**1. Framing of risk & opportunity**

**2. Setting ambition, goal & target**

**3. Designing detailed strategy**

**4. Enabling compelling disclosures**

**Delivery:  
Using a combination of opportunities**

**5. Decarbonizing your operations & value chain**

- Digital solutions and AI
- Low carbon technologies
- Market solutions (renewable energy procurement, offsets)

**6. Rethinking your products & services**

- Product/service development
- Demonstrating & verifying credentials

**7. Addressing major capital projects**

- Low carbon technology project development & operation
- Asset repurposing or retirement

**8. Adjusting the portfolio**

- Accessing finance
- Mergers & acquisitions

**Supported by:**

**Data & Digital Optimization**

**Business Transformation**

**Fully informed by technology expertise across all the key low carbon technology options:**



Renewable Electricity



Energy systems and networks



Hydrogen and fuel cells



Low carbon transportation



CCUS



Industrial decarbonization



Low carbon fuels



Low carbon chemicals



Building energy systems



Energy storage










Nature-based solutions



Engineered GHG removals

# Our Hydrogen capabilities span the value chain

ERM works in all the below categories and our deep expertise helps clients take decisions, win funding and speed project delivery

 <b>Roadmap to Hydrogen</b>	 <b>Policy &amp; Regulation</b>	 <b>Due Diligence</b>	 <b>Production, Distribution &amp; End Use</b>	 <b>Project Realisation</b>	 <b>Process Safety &amp; Design</b>	 <b>Operations, Compliance, Finance</b>
Market Demand, Supply Chain & Competitor analysis	Emerging policies worldwide	Levelized Cost of H2 modelling (LCoH)	Electrolysis and other Technology & Supplier Landscapes	Site selection	Hazard Analysis, O&M Impacts	Management Systems
Technology and Industry Landscaping	Supply-side funding including for hubs	Technology, commercial, ESG Analysis	Water Impacts, Consumption, Availability	Scoping	Independent & Owners Engineering	Certification, Compliance, GhG accounting
Stakeholder Engagement	US Federal & State Regulations & Incentives	Techno-economic assessment	Storage, Compression & Liquefaction Technologies	Environmental & Social Impact Assessment	Equipment Specifications	Catalyst Recycling, Mobility-as-a-Service, Circular Economy
Business Case and Strategy development	Emerging Political & Advocacy Priorities	GHG Lifecycle & CO2e analysis	H2 Transport & Derivatives (Ammonia, Methanol, LOHCs...)	Stakeholder engagement	Purification & Separation Technology	CSRD, TNFD, TCFD
Network Modelling	EU & Member State Policy	Social, Environmental, & Biological	CCUS, Natural Gas Blending, Turbines	Planning and permitting approvals	Materials compatibility, leak & flame detection	Technical, Functional and holistic Health & Safety

# Taking stock



# Good, bad, ugly?

OCT 10, 2024  
UAE, Oman, Morocco to surpass 2030 hydrogen goals: IEA

Vale. GEP eye major green hydrogen plant for low-carbon steel production in Brazil

OCT 15, 2024  
Algerian green hydrogen project to boost European imports via South H2 Corridor

OCT 15, 2024  
LONGi ships 20MW of electrolyzers to Uzbek green ammonia project

OCT 11, 2024  
Ground broken on Australian 10MW green hydrogen blending project

OCT 09, 2024  
Stadler's leap into the US hydrogen rail market

OCT 15, 2024  
DNV lowers hydrogen demand forecast, citing high costs and policy gaps

OCT 11, 2024  
Ørsted backs out of green hydrogen projects in shift away from e-fuels

OCT 10, 2024  
Uniper and Sasol cancel 200MW hydrogen project amid market hurdles

OCT 09, 2024  
Green Hydrogen Systems undergoes major restructure to cut costs by 50%

OCT 08, 2024  
Denmark-Germany hydrogen pipeline faces three-year delay

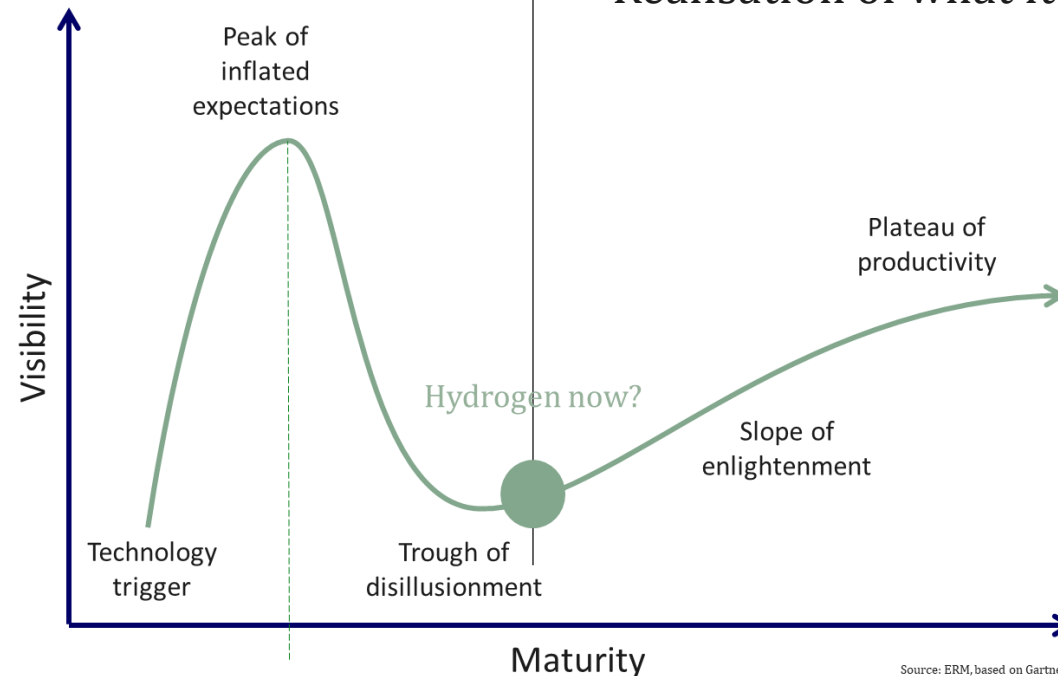
# So what is up with hydrogen?

## Then (2020)

- Greater appreciation of the climate crisis
- Massive deployment of low-cost renewables
- 'Free' money with no good home
- Limited understanding of supply chains and scaling
- Race to make the biggest announcement!

## Now (2024)

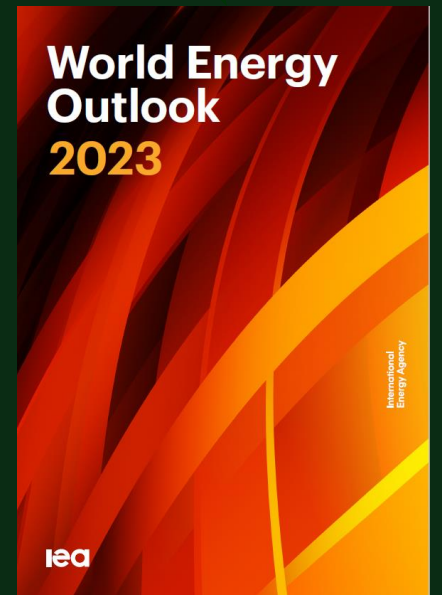
- Interest rate spike
- COVID-19
- Ukraine war
- Supply chain geopolitics
- Unclear regulations
- Realisation of what it takes to scale...



Source: ERM, based on Gartner

“The transition to clean energy is happening worldwide and it’s unstoppable. It’s not a question of ‘if’, it’s just a matter of ‘how soon’ – and the sooner the better for all of us,”  
*Fatih Birol, IEA ED, Oct 2023*

# An energy transition



# This energy transition is different, and it's started

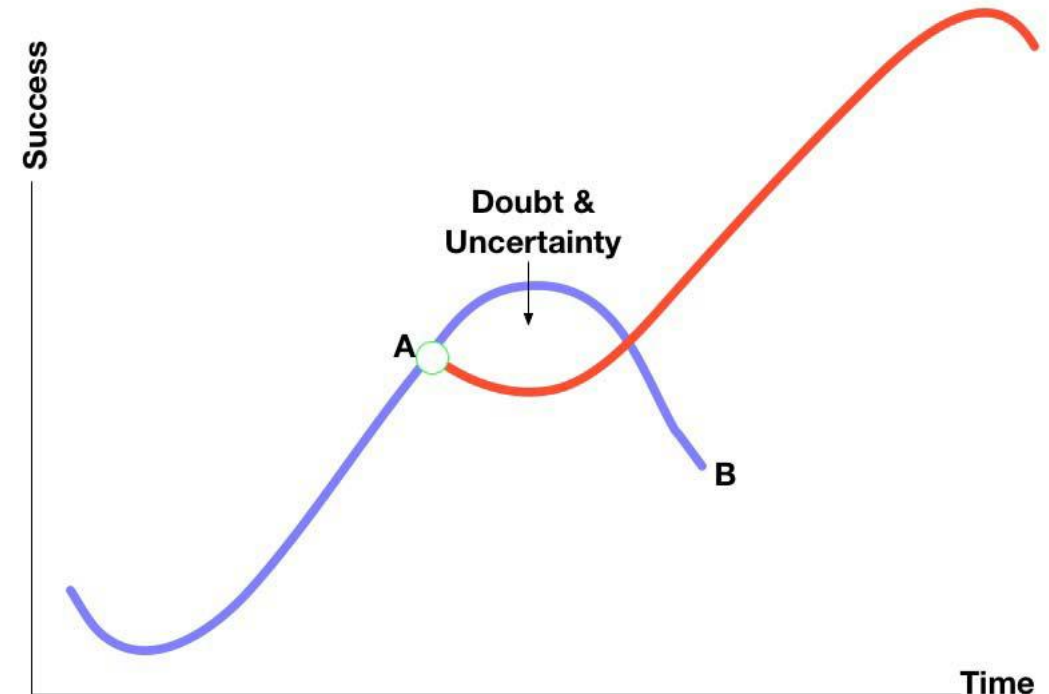
- Unlike previous transitions, this one is driven by policy and necessity
  - Long-term, nobody wins with *Business as Usual*
  - Benefits and costs separated in time and space
  - Solution requires re-engineering of the whole system:
    - Resource exploitation
    - Demand
    - Supply
    - Regulation...
  - But there is no 'system architect'
  - Applications overlap, markets blend into each other
  - Non-traditional entrants – countries AND companies – may come to dominate
  - (Infighting over the 'perfect' solution slows us down)
- The uncertainty is playing out globally:
    - China is pushing forward – mainly for energy security
    - The Middle East can use legacy resources to develop new ones
    - India sees opportunity
    - 'New' energy players seek to emerge:
      - Brazil
      - Namibia
      - S Africa?
    - Geopolitical risk and supply chain dislocation remain significant

# Hydrogen: an important tool in the zero emissions toolbox, but where, how much and how fast depend on a bigger transition

- Global energy is starting a systemic change
- Hydrogen has been through cycles of extreme (and unrealistic) optimism and pessimism
- No one solution answers all questions
- As system clusters grow, opposing forces will collide:
  - Reinforcement of existing solutions
  - Inability to scale them sufficiently fast



- The system will take time to approach stability
- We are in a time of classic creative destruction
- Managing risk will require multiple **bets**



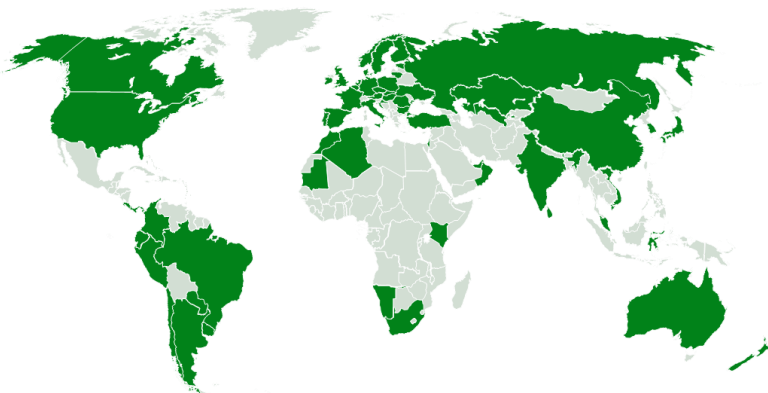
Schumpeter: *Creative destruction cycles*  
Graphic: Charles Handy *The Empty Raincoat*

# Hydrogen activity and opportunity are distributed widely

- Dozens of countries – and regions – have roadmaps and strategies
- All regions are implicated in hydrogen developments
- Some have major investments, plans, and natural advantages
- Others may struggle to deploy at scale or pace

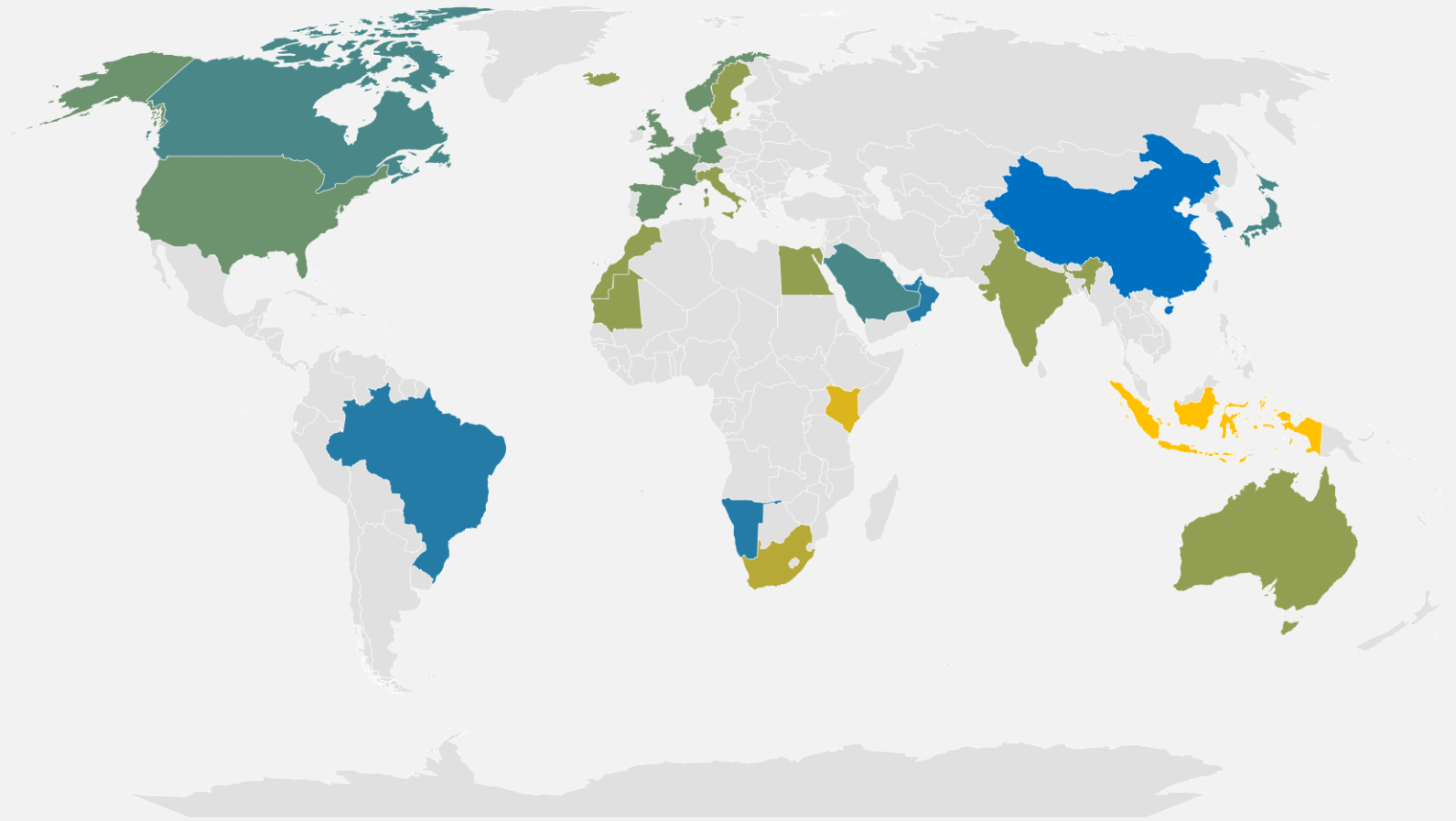
## Hydrogen roadmaps and strategies

● Countries with national hydrogen strategies



## Hydrogen opportunity and development

Low - High



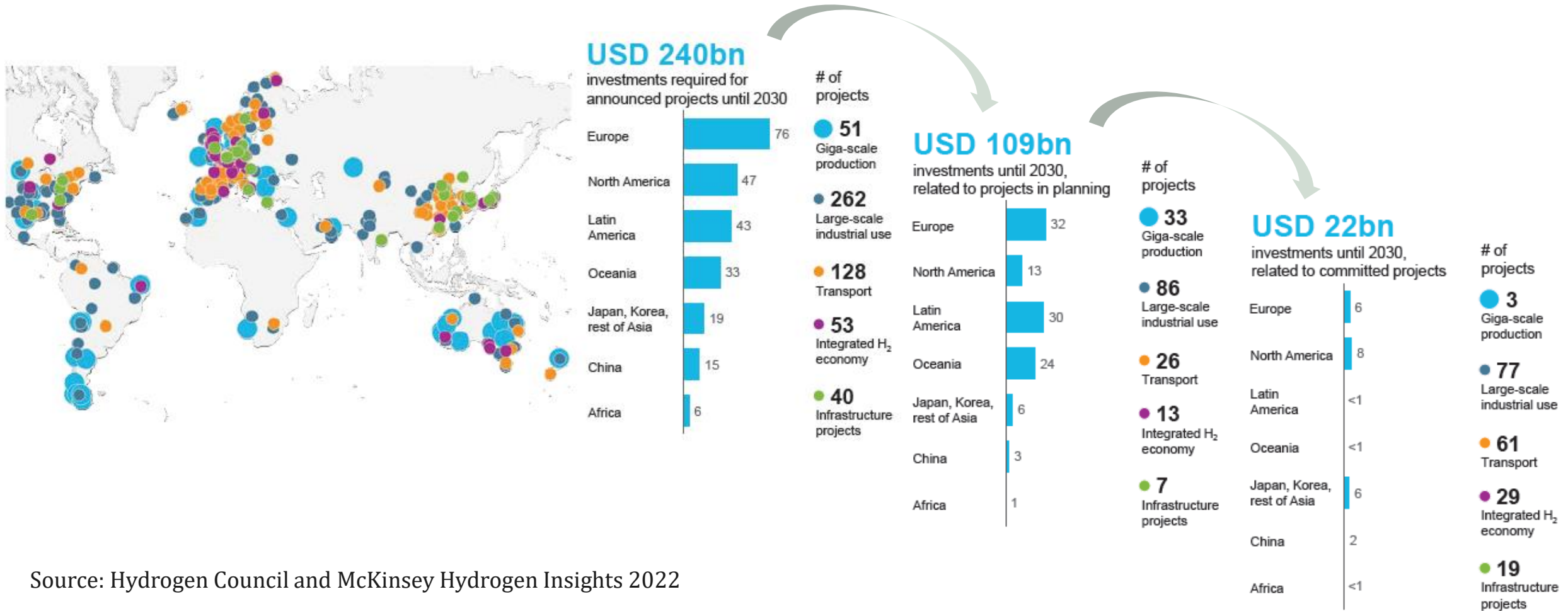
- CAVEAT – this is indicative, not exhaustive or even fully objective!



# There IS progress

# May 2022

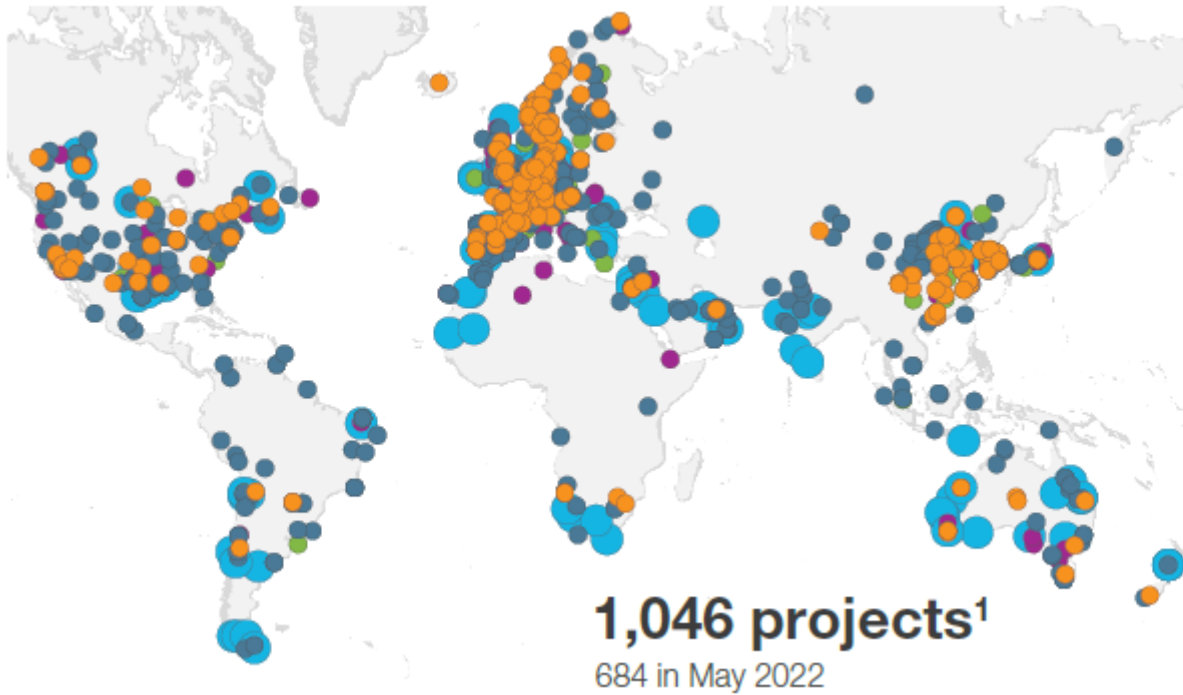
Over 680 'large' hydrogen projects announced globally | 534 planned for 2030 | 10% at FID



Source: Hydrogen Council and McKinsey Hydrogen Insights 2022

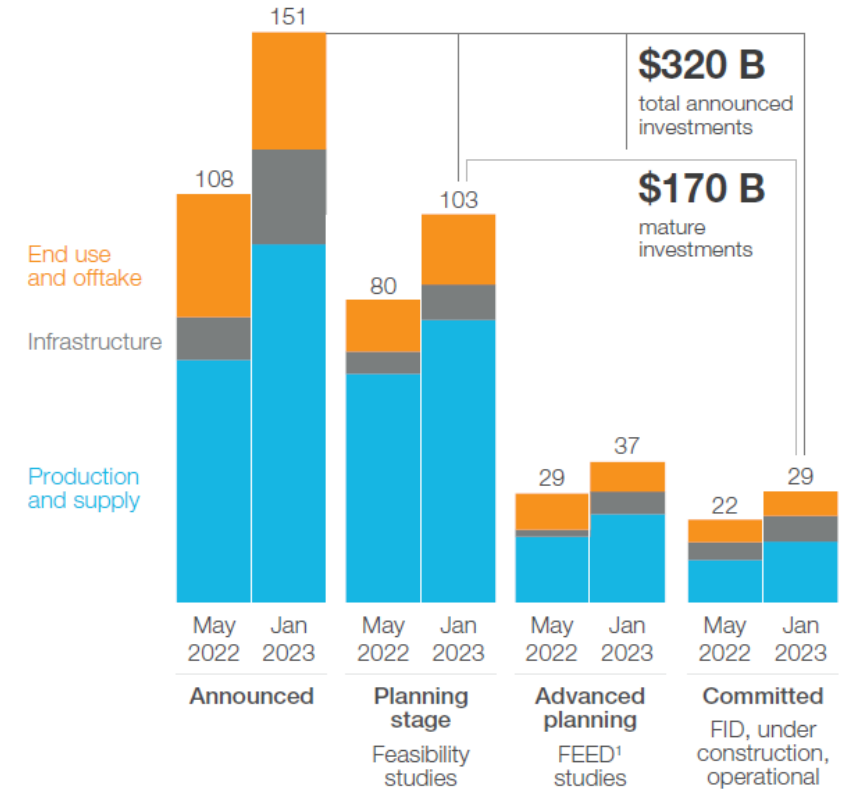
# January 2023

Over 1040 'large' hydrogen projects announced globally | \$320bn | 10% at FID



- **112**  
Giga-scale production
- **553**  
Large-scale industrial use
- **191**  
Mobility
- **94**  
Integrated H<sub>2</sub> economy
- **96**  
Infrastructure projects

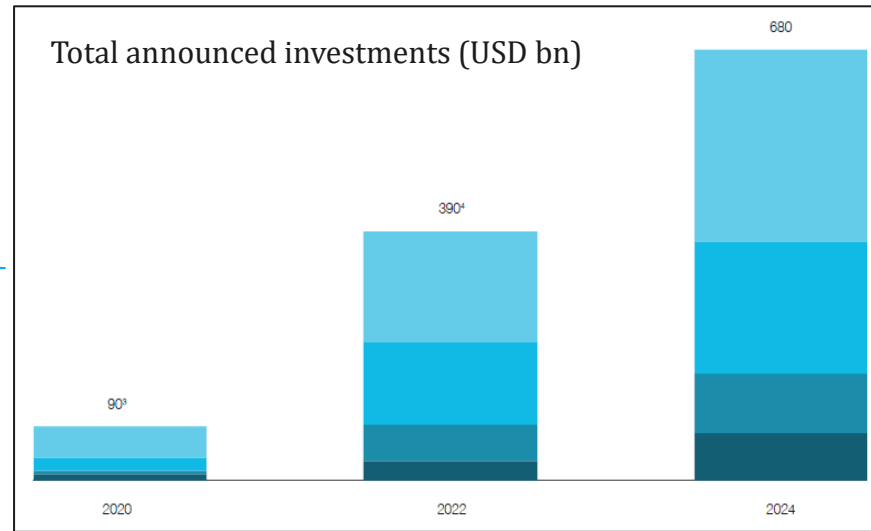
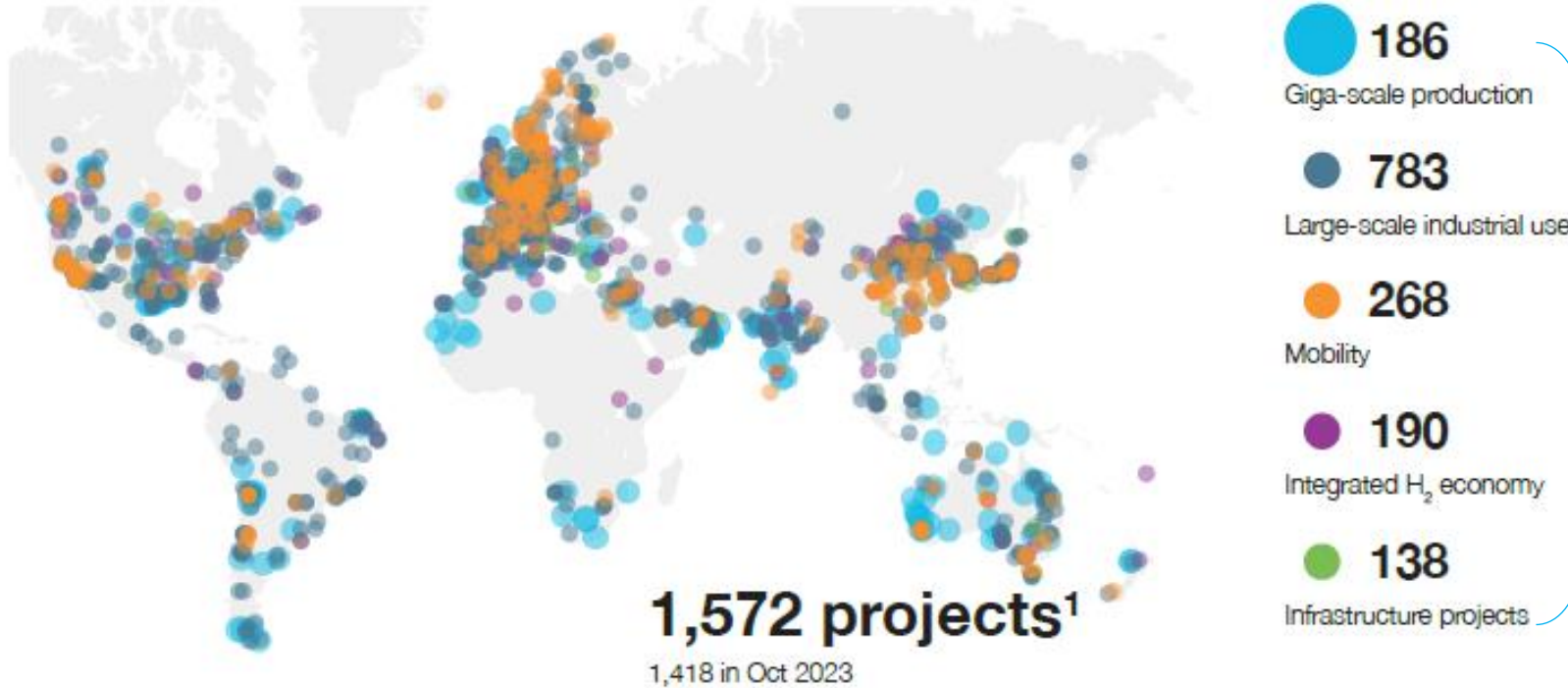
Direct hydrogen investments until 2030, \$B



Source: Hydrogen Council and McKinsey Hydrogen Insights 2023

# May 2024: for a nascent 'industry', it's actually doing 'okay'

## Global project overview



228  
Projects pipeline in December 2020, 102 have passed FID

1,572<sup>1</sup>  
Projects pipeline as of May 2024, 434 have passed FID

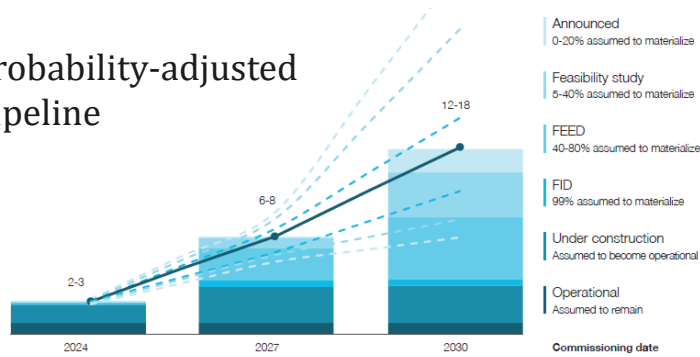
7x  
increase in the number of projects in the pipeline

4 Mt p.a.  
increase in 2030 hydrogen capacity that has passed FID



# The H2 foundation: *announced* production projects continue to grow, *likely* production also

## Probability-adjusted pipeline

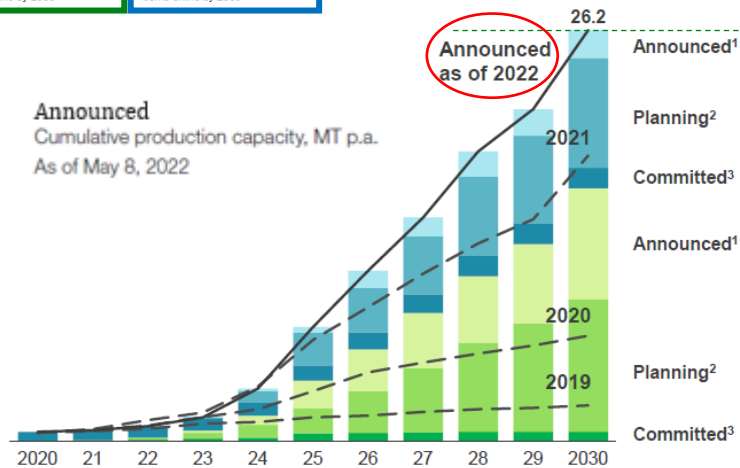


**12-18 Mt p.a.** = **7-11 Mt p.a.** **5-7 Mt p.a.**

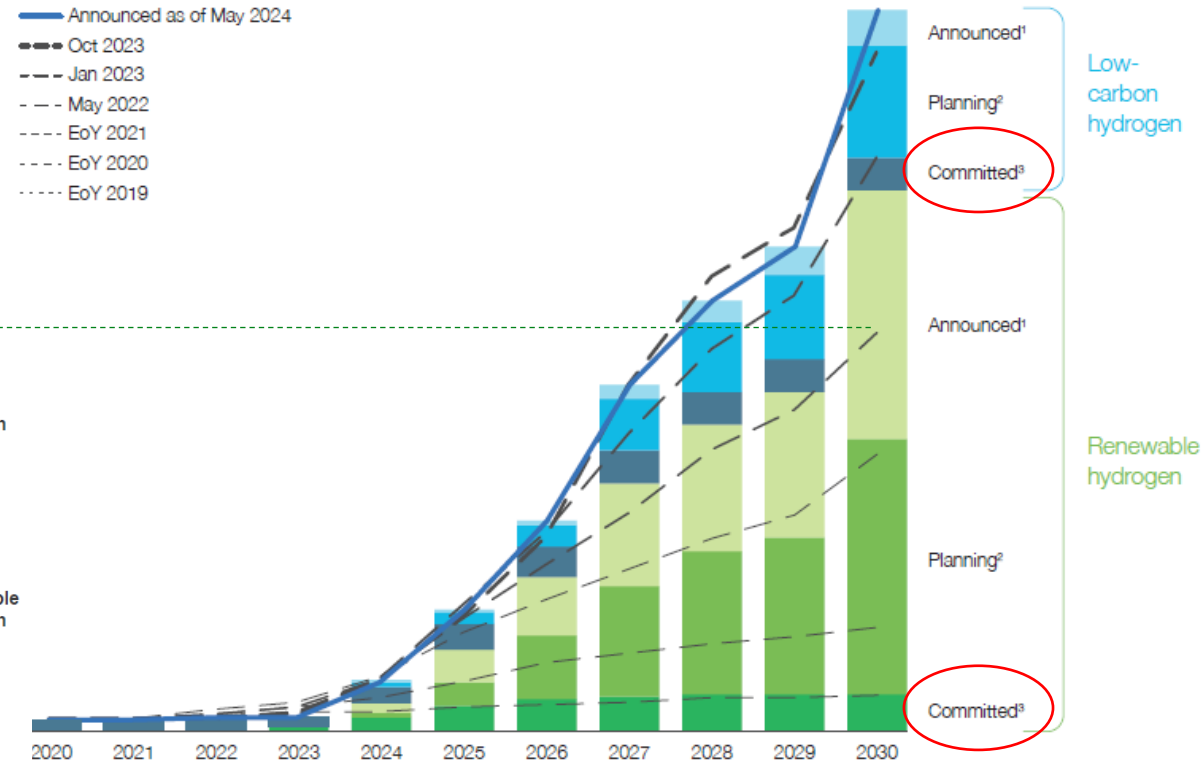
Clean hydrogen production likely to come online by 2030 – based on current pipeline of publicly announced projects

Renewable likely to come online by 2030

Low-carbon likely to come online by 2030

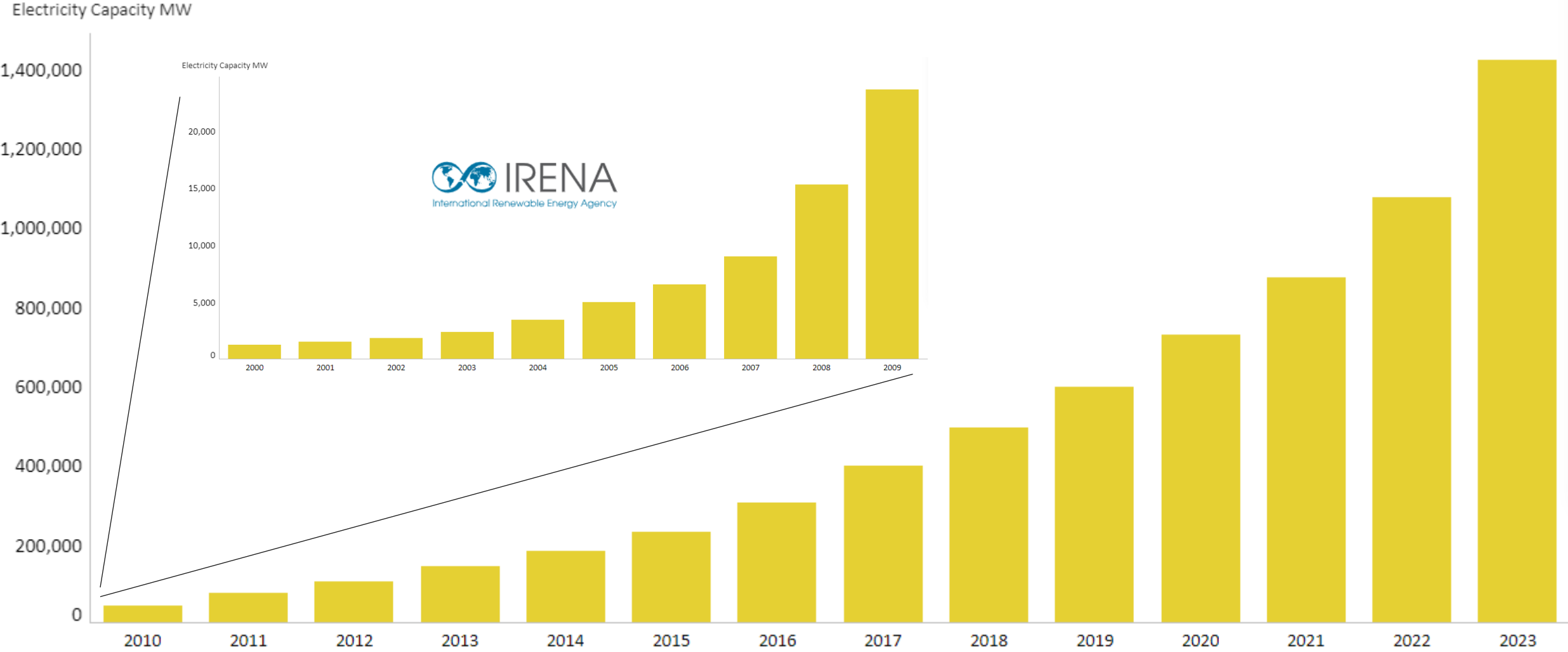


## Cumulative production capacity announced, Mt p.a.



1 Preliminary studies or at press announcement stage  
 2 Feasibility study or front-end engineering and design stage  
 3 Final investment decision has been taken, under construction, commissioned or operational

# Sense-check: solar took a long time to get started... and flip-flopping hurt it badly

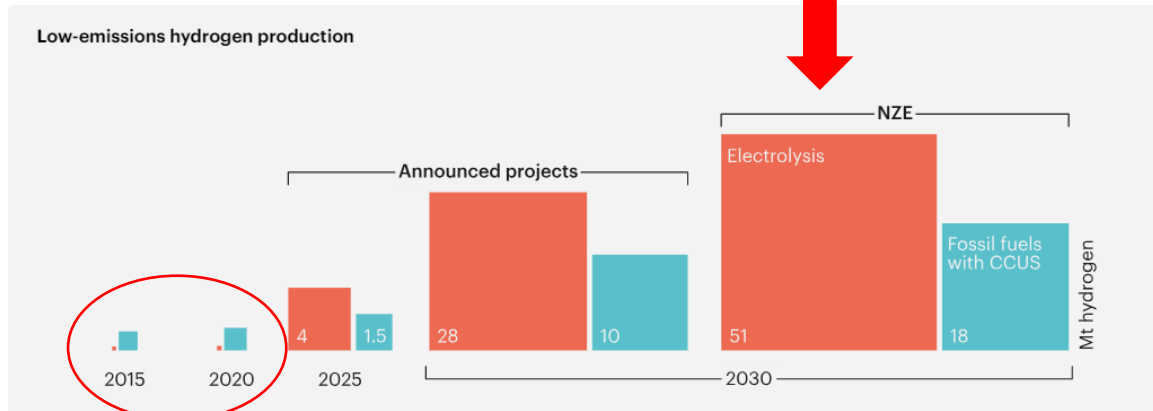




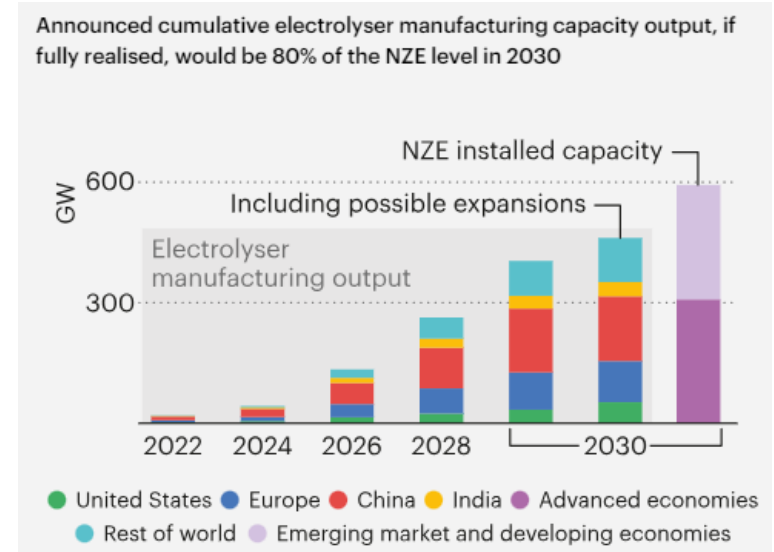
# But some thoughts from the IEA indicate the scale we need

Even to account for 4% of cumulative emissions reductions, low-emissions hydrogen use needs to grow by orders of magnitude (these are 2023 numbers)

*How much???*

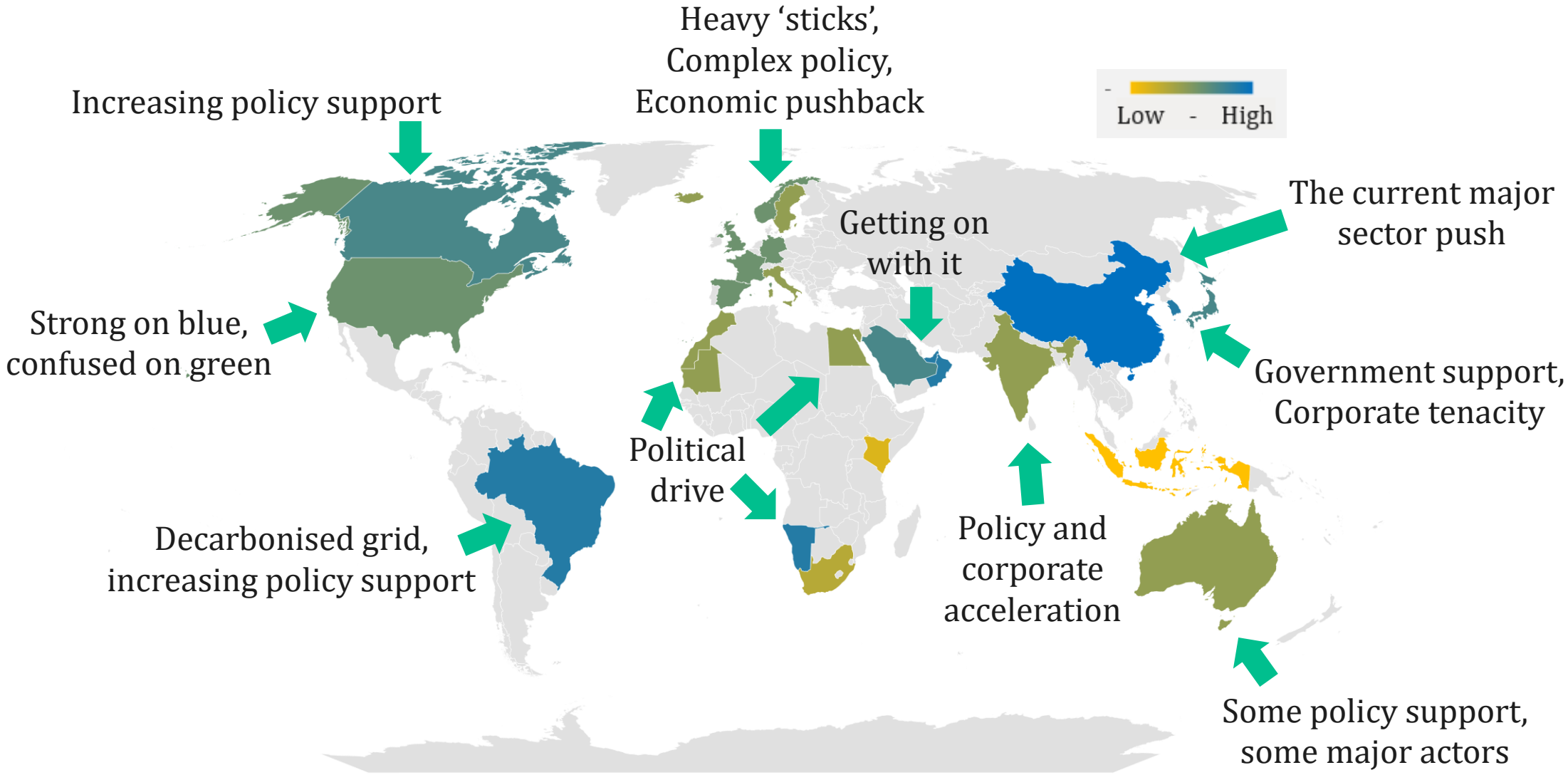


*The old reality*



# What have we learned?

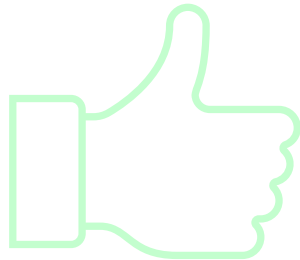
# Enthusiasm – and progress – varies by geography



# Positive trends are emerging, despite complications

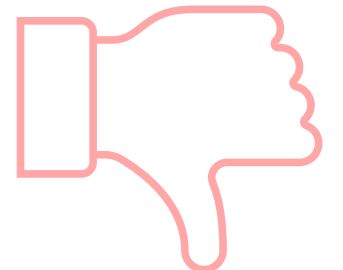
## Starting to work...

- Industrial decarbonisation is an important driver:
  - Clusters can optimise hydrogen use
  - Policies are increasingly strong and international
- Projects that work have:
  - Short value chains, committed offtakers, some price insensitivity
- Some countries can move faster:
  - China and the Middle East see opportunity and have funds
  - This will have knock-on effects
- Ammonia remains a major driver



## Still unresolved...

- Hydrogen price is not what was claimed...
- So offtakers are wary
- Regulatory uncertainty is rife
- The supply chain has major weaknesses
- Economics and geopolitics are acting against the energy transition
- The system is not evolving to connect demand and supply
- Different carriers bring different risks
- Failure to understand 'price', 'cost' and 'value'



# Where next?

# Interest in 'natural' hydrogen continues to grow

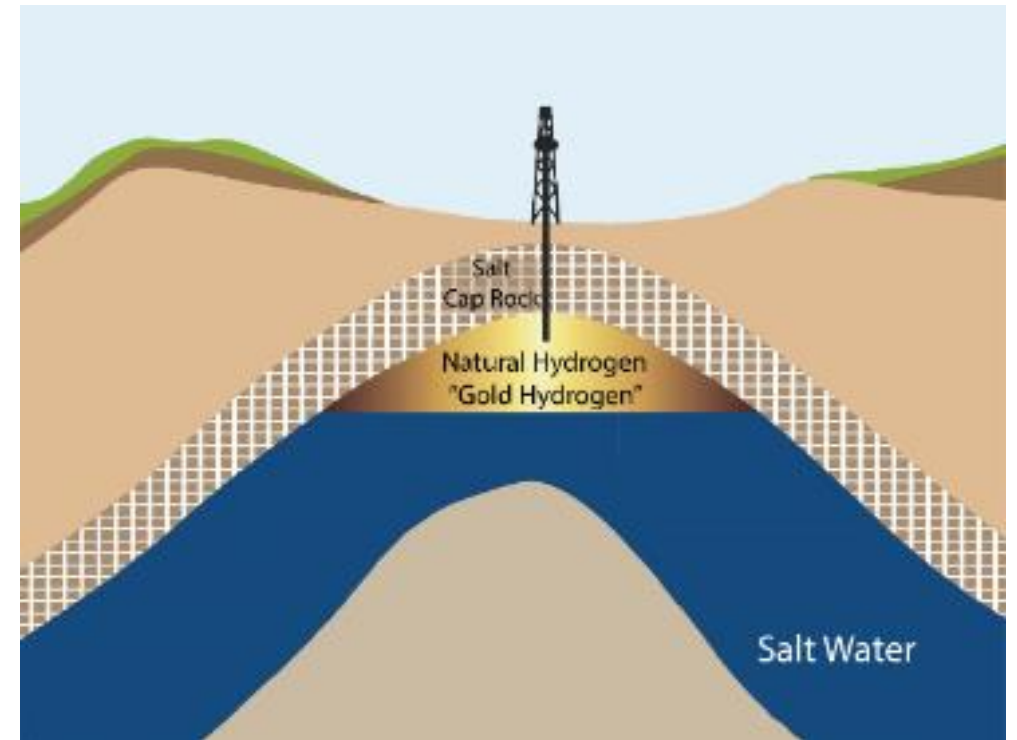
Japanese industrial giants invest in Bill Gates-backed natural hydrogen start-up

Natural hydrogen exploration to begin in Oman after deal between sector pioneer and Singaporean oil producer

Fortescue to buy 40% stake in natural hydrogen company HyTerra

Bluejay sets to work to confirm massive potential natural hydrogen deposits in Finland

Canada's largest natural hydrogen project almost triples in size days after it was first announced



Source: Durham University



# Pragmatism and consistent policy can help, but speed is essential, so risks must be taken

- We are emerging from the hype cycle, but this is an energy system transformation
  - All previous transformations have taken decades and been driven by competition
  - This time more embedded systems must change
  - Electrification and 'hydrogenification' need to be done as fast as we can
  - And yes, maybe this is partly a race...
- New business models, financial products and actors will emerge – and may overtake
  - “Electricity-only”, bio- and other low carbon solutions also face complexity and policy hurdles
  - (Policy-driven) markets will shape the system – if imperfectly
  - Moving fast means breaking things but learning – implementing the learning will help us accelerate

**China set to smash national hydrogen targets, solidifying lead in global electrolyzer market**

# Thank you

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