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Insights into the global hydrogen industry

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The hydrogen industry emerges amidst an evolving landscape



Gaining momentum

Project pipeline

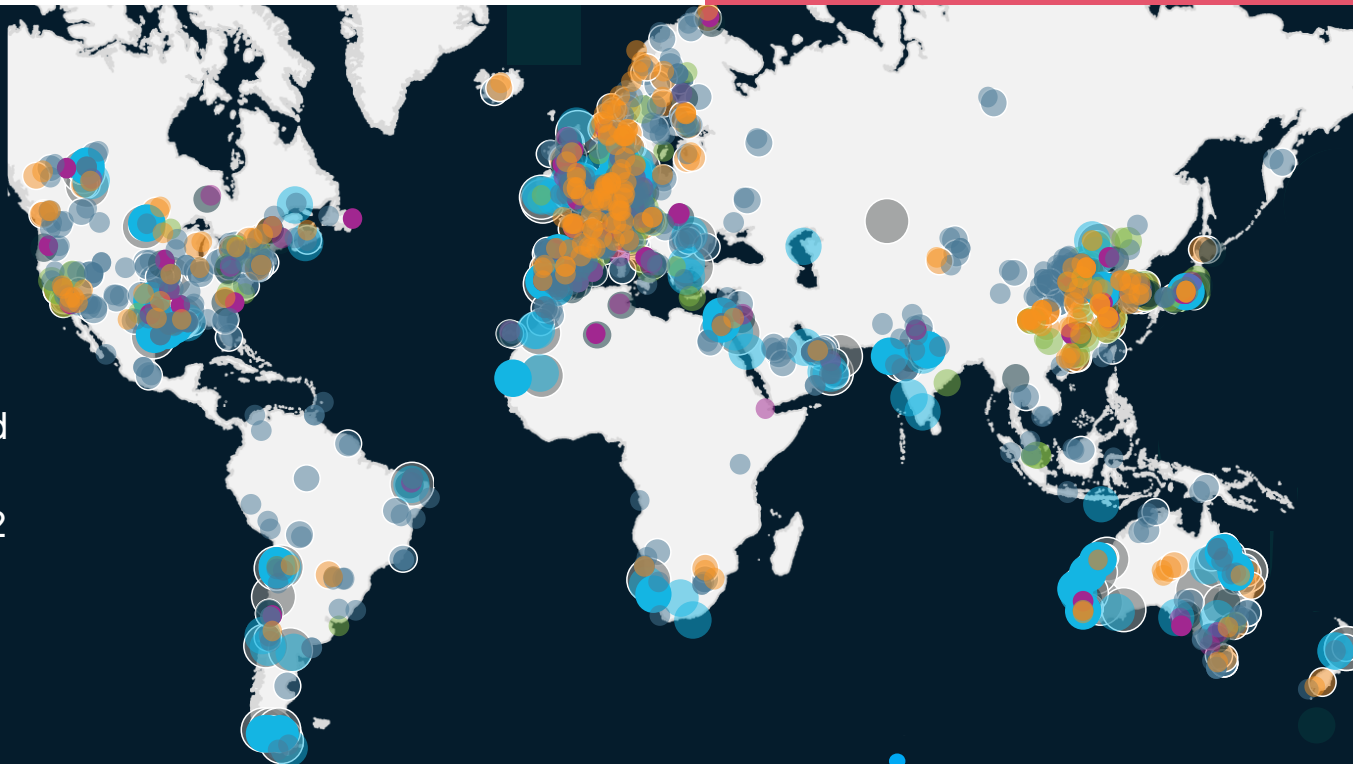
- 38 Mtpa of clean H₂ announced by 2030
- + 50% announcements compared to 2021

Investment funnel

- 66 projects have reached FID
- + 30% compared to 2022

Active policy

- Supporting with \$100-200 B currently, doubling of support over past 12 months



1,040+ projects

684 in 2022

Existing hurdles

Offtake lagging

- Several MoU but few long-term agreements
- Willingness to pay driven by mandatory quotas

Execution cost

- + 30% LCOH (higher EPC, financing)

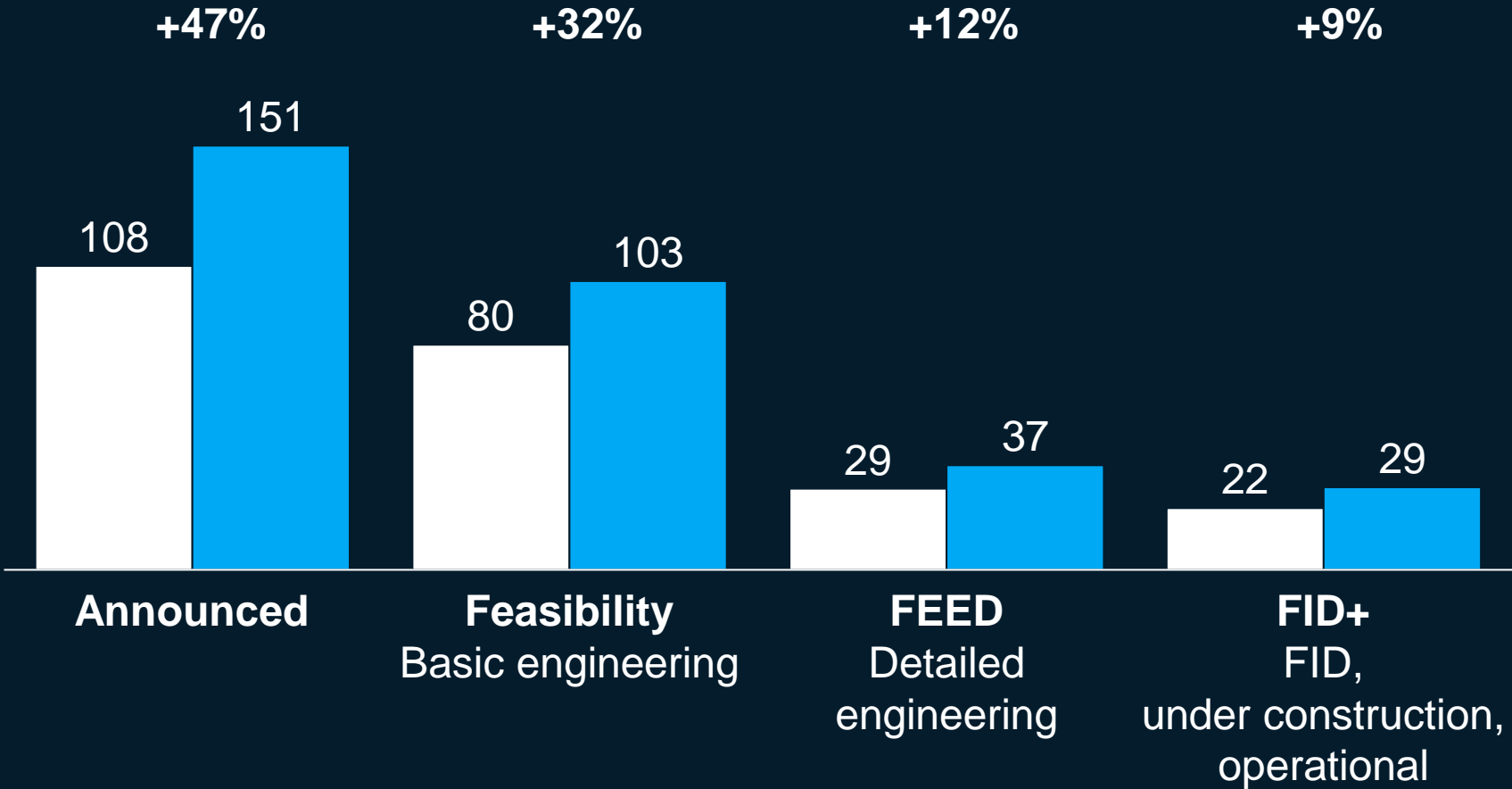
Low FID at scale

- Only 3 low carbon H₂
- 3 renewable H₂ 100+ ktpa

The project funnel continues to expand and mature

Direct hydrogen investments until 2030, \$B

2022 2023



\$320B

Investments announced to 2030

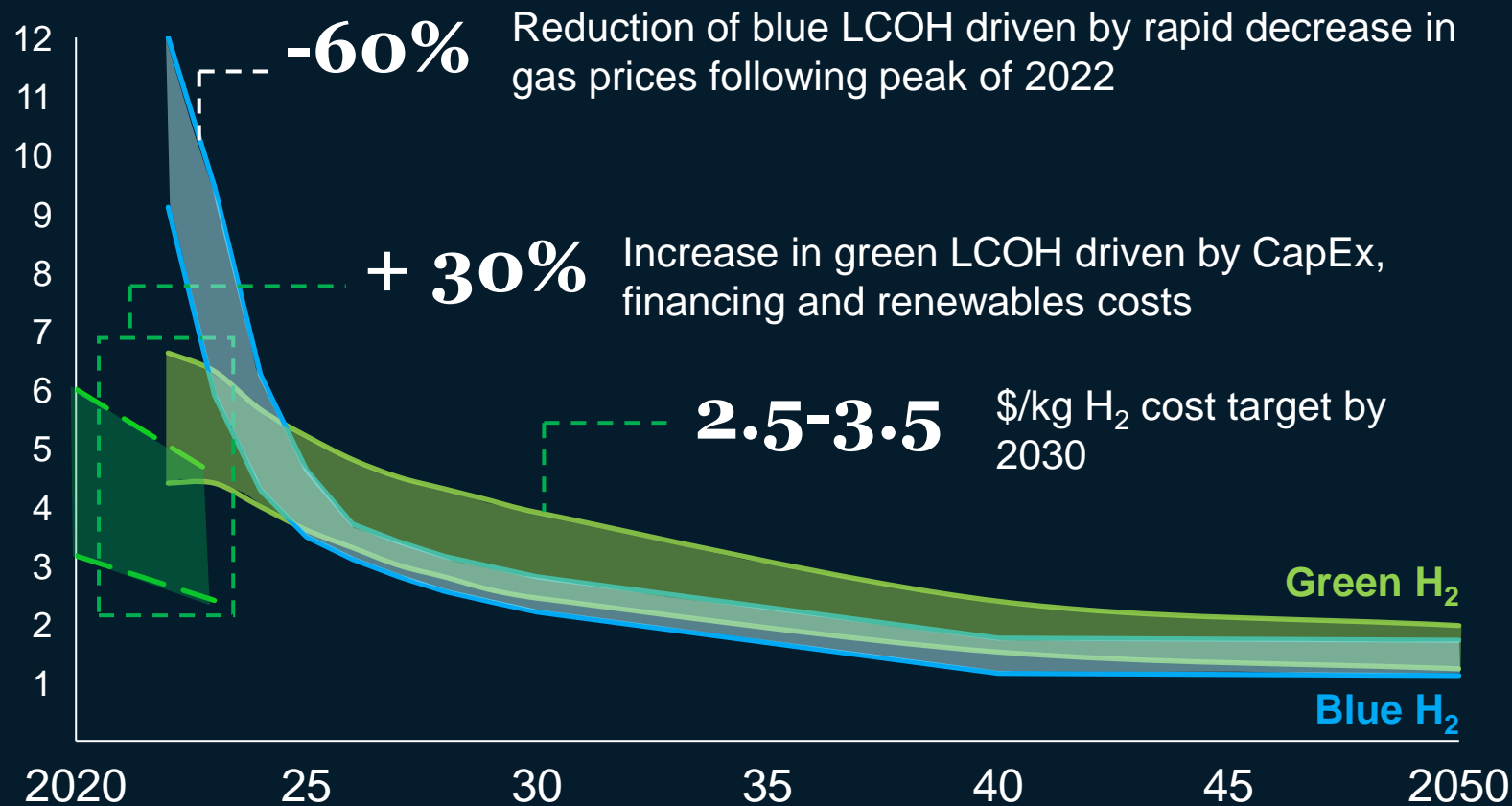
3 mtpa

clean hydrogen at or past FID

1. Range from 1.8 achieved commitments to 1.5 net zero demand scenario

Hydrogen cost increases globally

Global hydrogen production cost, 2023 \$/kg



Short term

- **Electrolyzer CapEx increase**
- **Increase of cost of capital (WACC)**

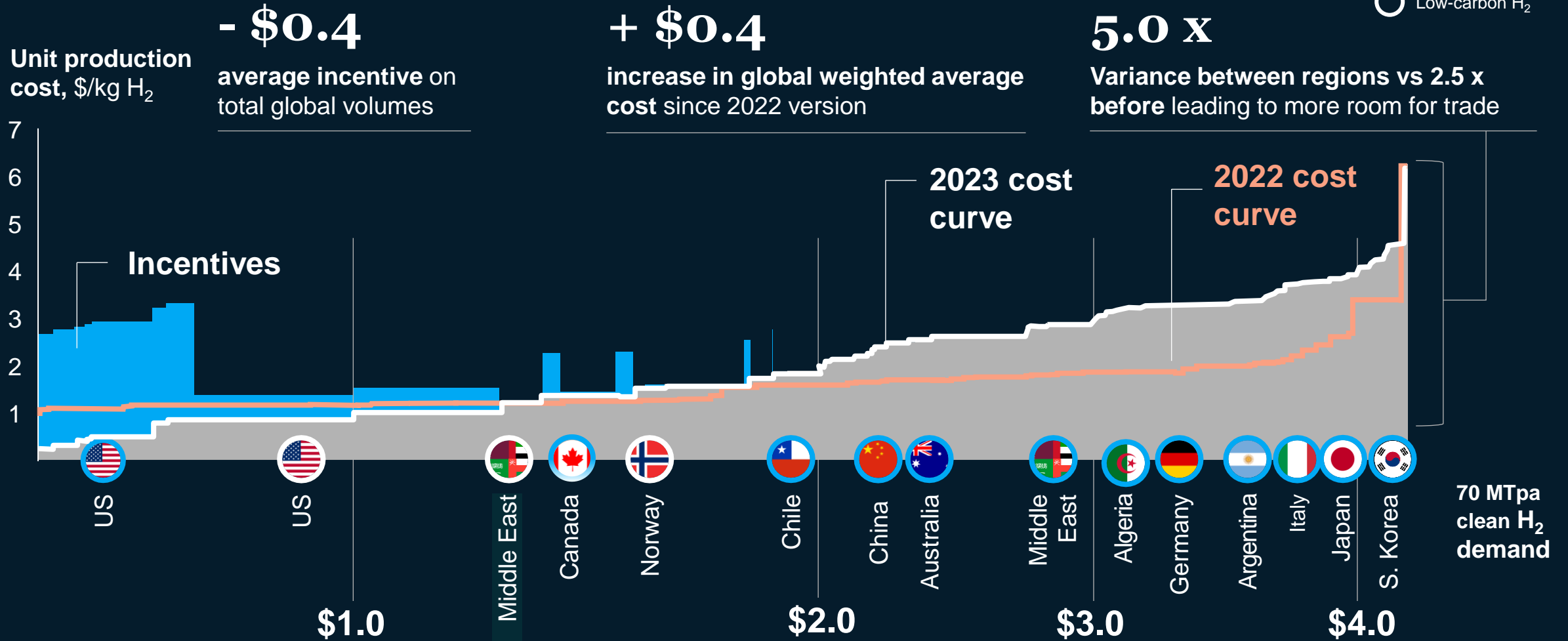
Long term

- **Electrolyzer cost reduction: -60% towards 2050**
- **Clean hydrogen cost decrease to \$1-2/kg by 2050** driven by RES and cost reductions

The US has the lowest-cost clean hydrogen supply by 2030

Global clean H₂ production cost curve, 2030¹

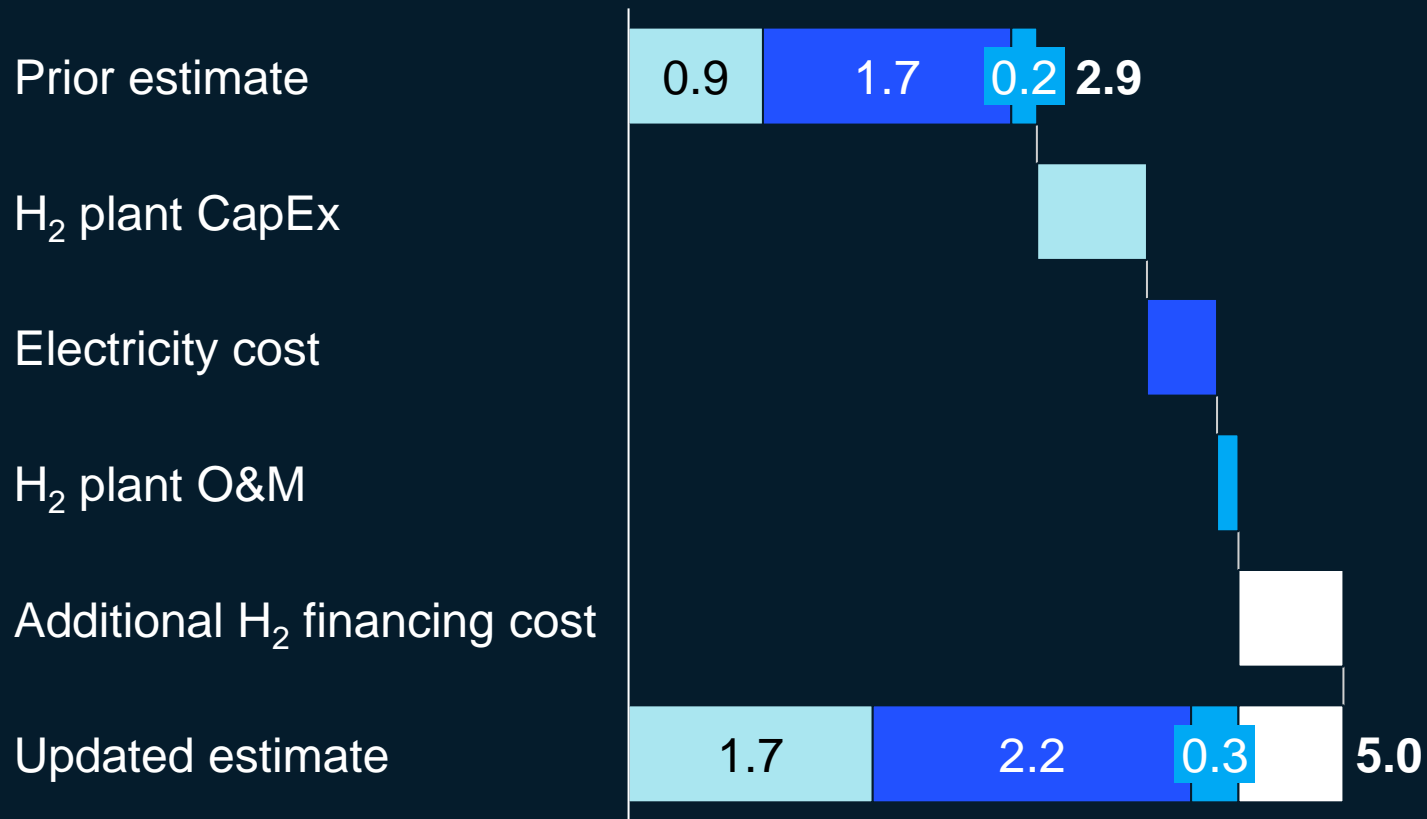
○ Renewable H₂
○ Low-carbon H₂



1. Note flags are representative of producers rather than exhaustive

Cost increase breakdown

2023 levelized cost of hydrogen in US Gulf Coast,
2023 USD/kg



Drivers of cost increase

+80% increase in CapEx driven by financing, labor, and materials

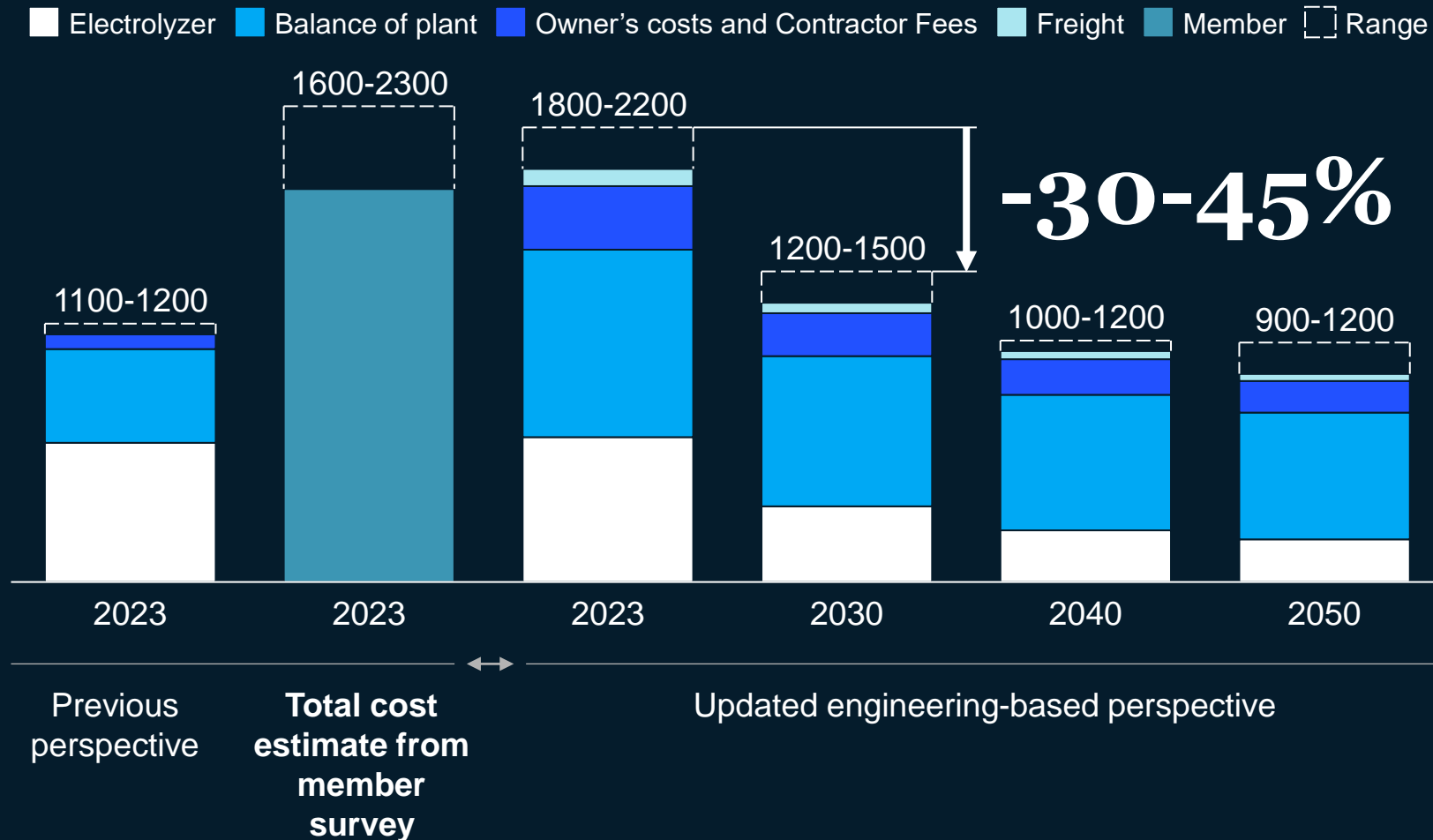
+30% increase in renewable electricity prices

+10% increase in O&M driven by CapEx and labor costs

+75% increase in cost of capital driven by 3-4% increase in risk free rate

CapEx costs could decline by 30-45% through 2030

Green H₂ CapEx, 1 GW alkaline facility in US Gulf Coast, 2023 USD/kW



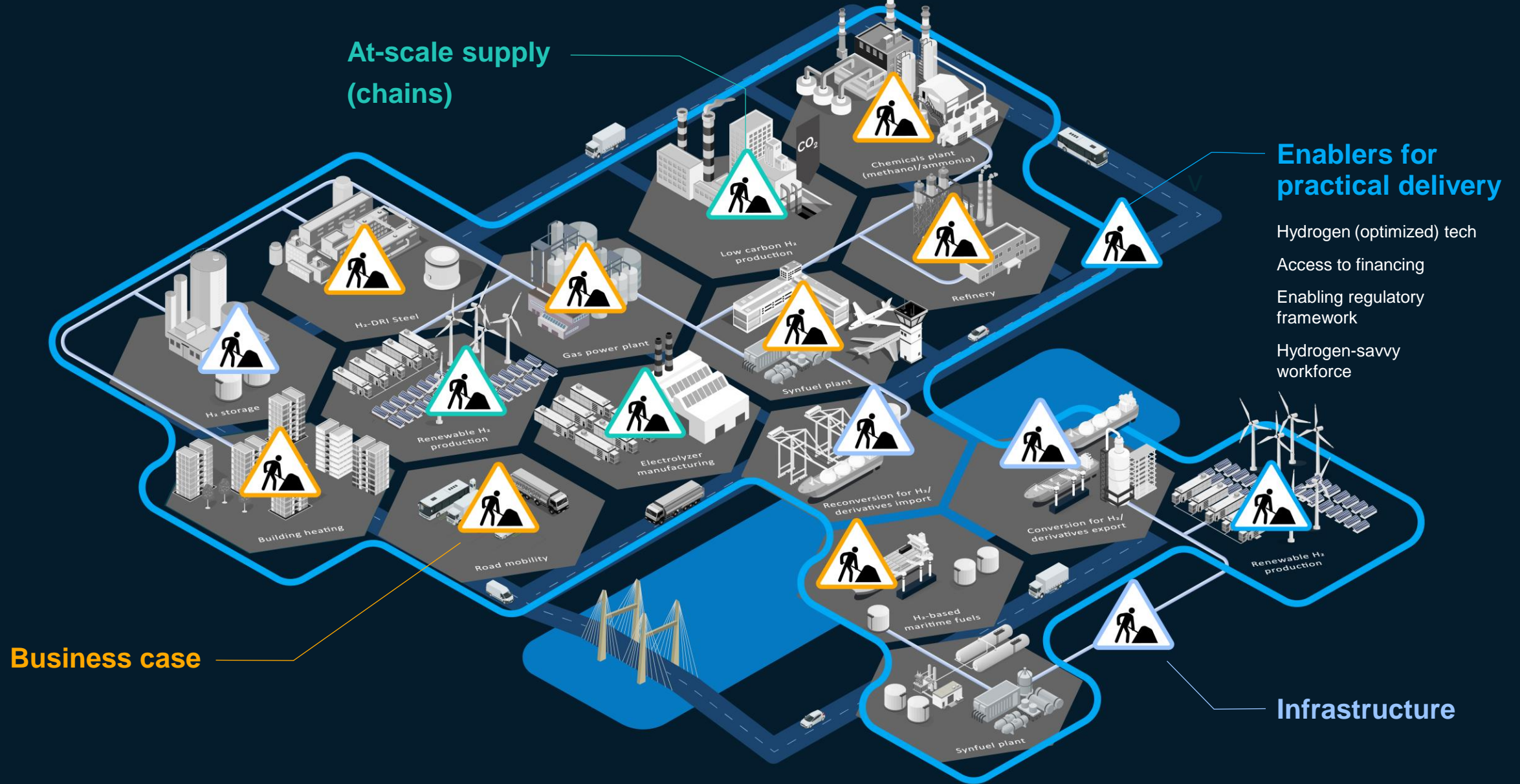
Capital cost decreases

Electrolyzer costs, power density, and efficiency improve over time, reducing system footprint

Reduced footprint drives balance of plant quantity reductions (e.g., concrete, piping, electrical)

Additional 10-25% cost-down potential for market leaders from economies of scale, learning effects & standardization

4 pre-requisites needed to accelerate deployment of clean hydrogen



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