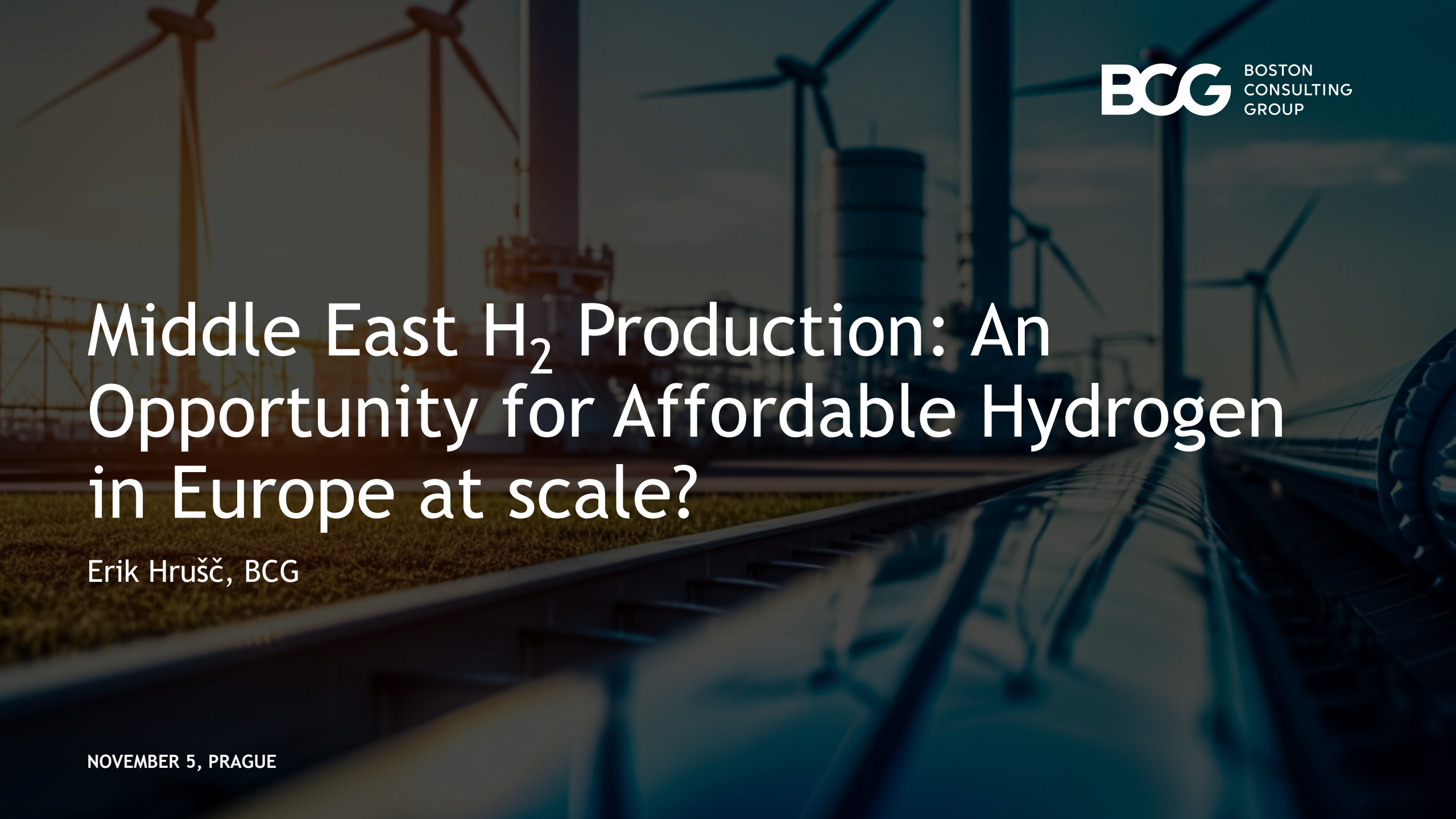

Middle East H_2 Production: An Opportunity for Affordable Hydrogen in Europe at scale?

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NOVEMBER 5, PRAGUE

H_2 is an upcoming lever in the future energy mix – and an opportunity for the EU

H_2 Demand & Supply

What is projected hydrogen uptake & how to meet the demand with H_2 production?

Potential of Middle East

What is the role & potential of the Middle East in the hydrogen ecosystem?

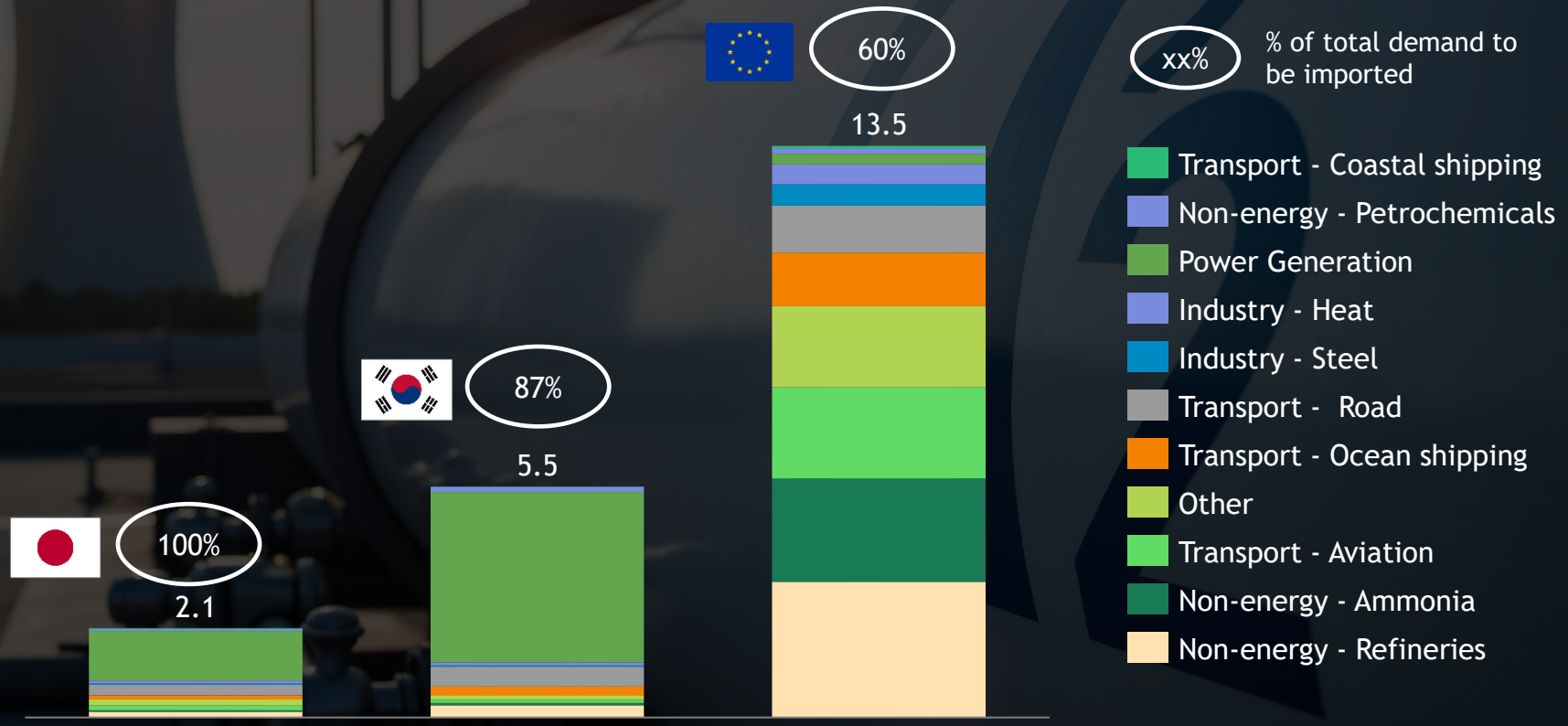
Required infrastructure

What are the required costs & transport infrastructure to cover the needs of CZ/EU?

H_2 demand | Europe, Japan and Korea will be key markets

2035 Low-carbon H_2 demand by application (Mtpa)

BCG STEPS



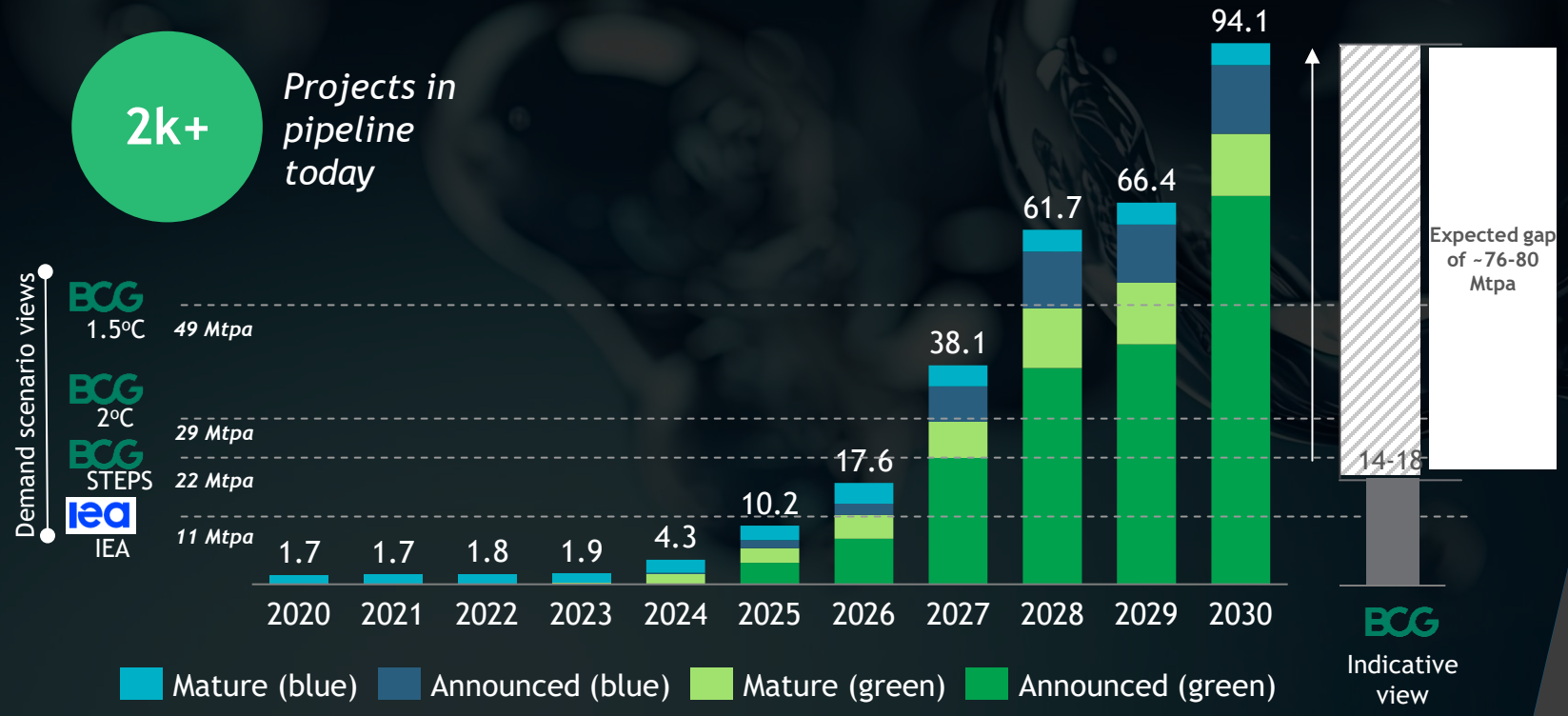
1. H_2 derivatives are normalized to H_2 input required
Source: IEA World Energy Balances; IEA WEO; GlobalData; Nexant; BCG Global H_2 Demand Model; BCG H2 Supply Model – Apr2024

Europe expected to emerge as the biggest import market region

Few specific sectors expected to lead as demand pools by 2035 (green fertilizers, aviation, refineries etc.)

Supply | Momentum strong in project pipeline, but share of mature ones still low, signaling risks

Global clean H_2 production capacity by project status[1] (Mtpa)



Strong momentum, but only ~15% of 94 Mtpa announced capacity ('30) in mature stage

BCG view that by '30 supply could be ~14-18 Mtpa based on likelihood of pipeline

Critical limiting factor is offtake cautiousness: only 6 Mtpa under offtake today, 1.6 firm

Most firm commitments are from sectors with strong regulatory push / captive use, e.g., chemicals, shipping)

Note: Only includes green & blue H_2 projects with known capacity until 2030 (i.e., 73% of total low-carbon hydrogen production capacity, excludes the GHI project in Canada of 43ktpa). 1. "Mature" refers to projects that are in operation/commissioning/under construction/late approval. "Announced" projects are projects in feasibility/FEED/early approval stage.
Source: GlobalData – July 2024; BCG analysis

Potential of Middle East | ME ahead of curve with mature projects

Select examples

Example 1: NEOM Green Hydrogen Project

- Built an equal joint venture between ACWA Power, Air Products and NEOM
- Integrates 4GW of solar and wind to produce 1.2 Mtpa green-ammonia by 2026
- Closed $8.4B financing from a consortia of 23 local & international banks
- Secured exclusive 30-year off-take from Air Products for 100% of production

Example 2: Oman Hydrogen Auctions

- Concluded two rounds of a first-of-a-kind auction for large-scale H2 projects
- Secured $50B committed investments over >45 years of contruction & production
- Integrated offtake discussions in the bidding process, joining stakeholders
- Awarded bids to >8 consortia, aiming for >1.4 Mtpa H2 production by 2030

Source: IEA Hydrogen Production Projects Database; BCG

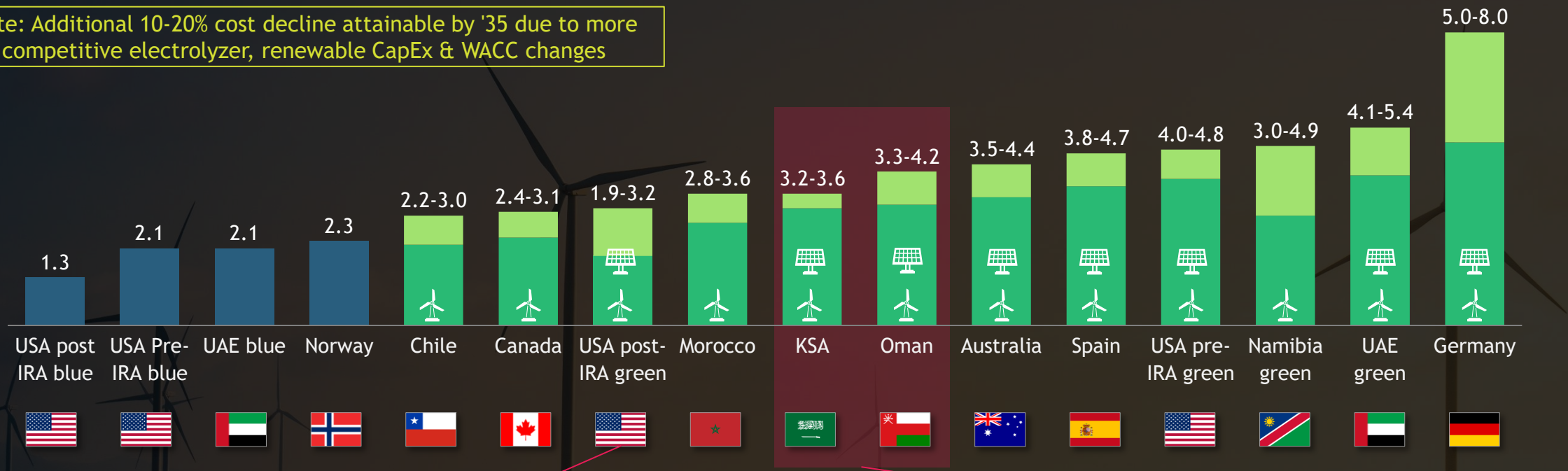
Middle East can be globally competitive producer of H2 with ample RES...

Levelized Cost of Hydrogen (LCOH) in selected countries (excluding infrastructure costs)

2030 in USD/kg

Indicative ranges

Note: Additional 10-20% cost decline attainable by '35 due to more competitive electrolyzer, renewable CapEx & WACC changes



Significant uncertainty persists on blue H2 projects' ability to cope with carbon intensity levels of evolving regulations

Production tax credits of up to 3 USD/kg H transforms US to top competitor[1]

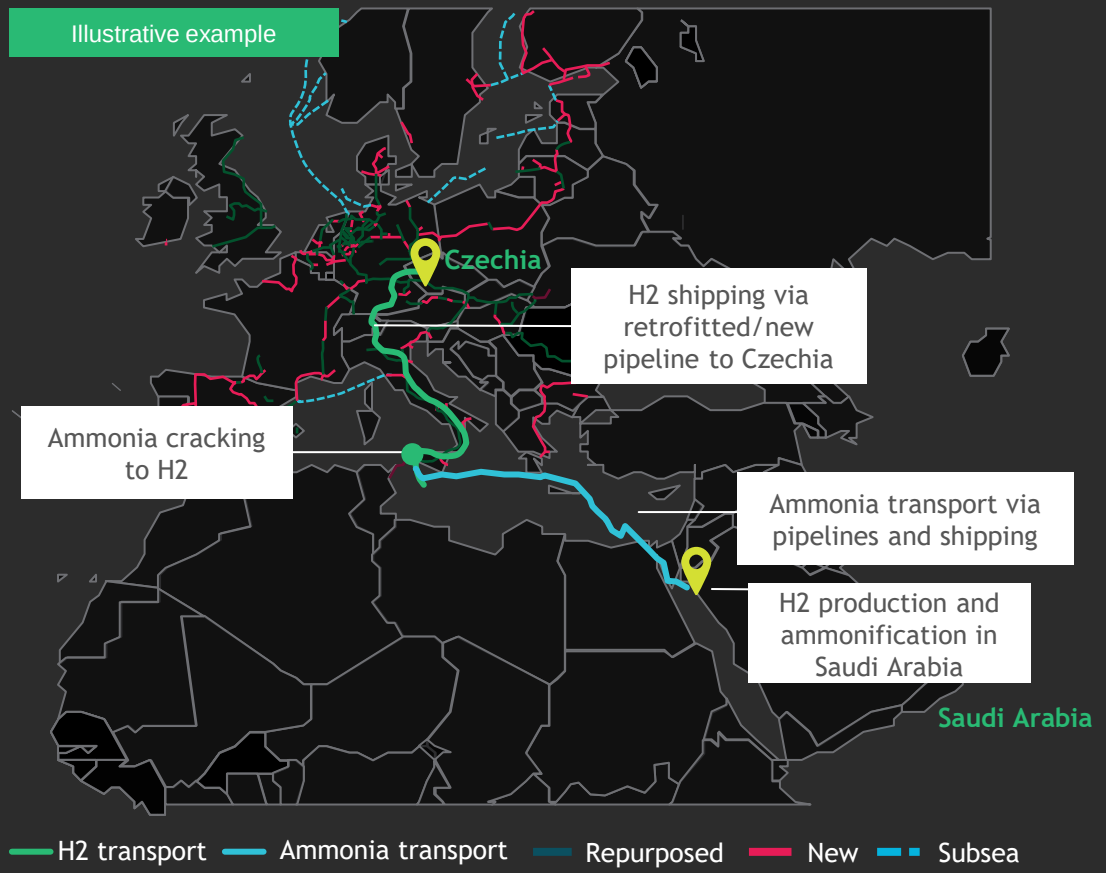
Avg. LCOH from submitted public auction bids in Phase A in Oman (Hydrom) – 3.3 $/kg

Note 1: Range in green LCOH for a co-located dedicated renewable archetype (incl. optimization of renewables oversize) for different project sizes and WACCs (Low range, low ELY CAPEX and low WACC; high range, high ELY CAPEX and high WACC). Blue hydrogen in high WACC range. LCOH doesn't include HV interconnection, storage or compression costs (+1.0-2.0USD/kg). Source: BCG H2 Cost Model and BCG Analysis

...and even with cost of complex logistics could reach 6-8 USD/kg

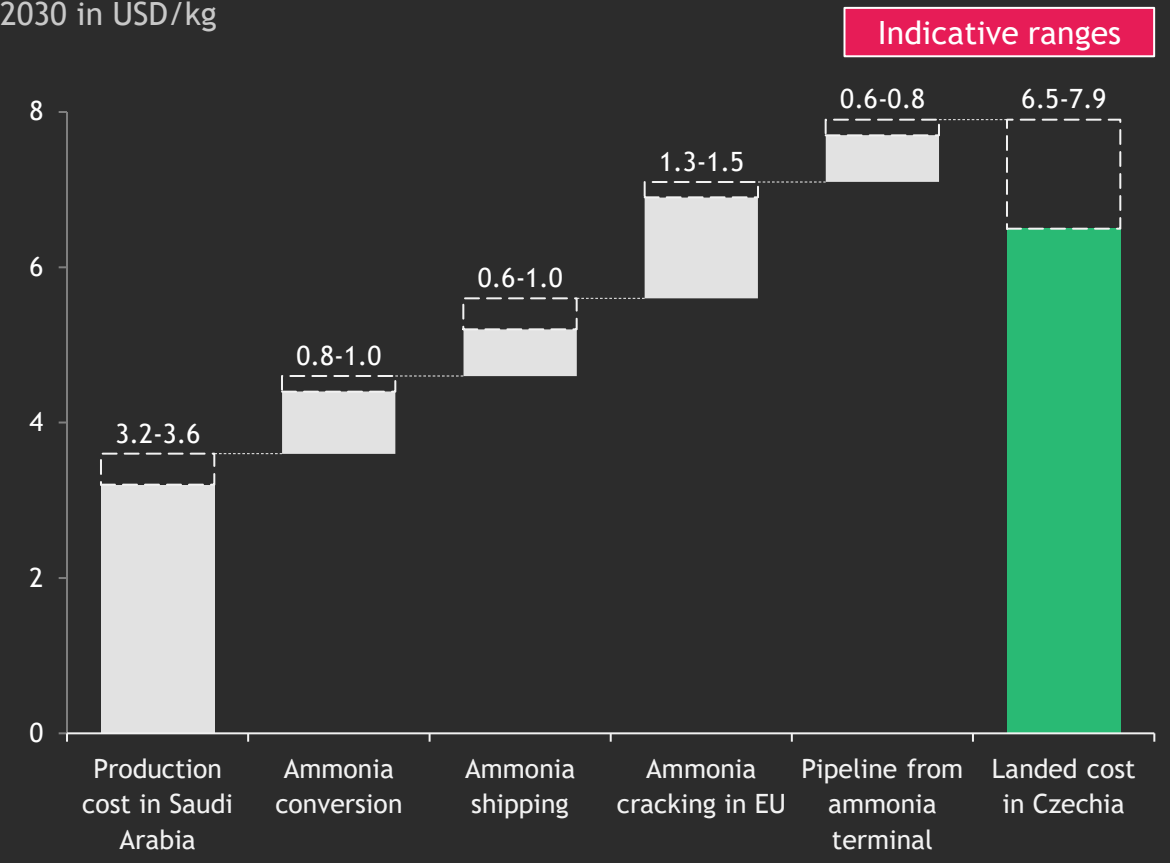
For global flows of hydrogen ammonia route (synthesis and cracking) anticipated as primary solution...

Illustrative global import flow to Czechia via Southern route



...but it adds significantly to the landed cost into CZ from potential export hubs

Breakdown of projected landed cost of H2 from Saudi Arabia to CZ 2030 in USD/kg



Note: Additional 10-20% cost decline attainable by '35 due to more competitive electrolyzer, renewable CapEx & WACC changes; Sources: BCG expert input; BCG analysis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