



Challenges in energy system transformation

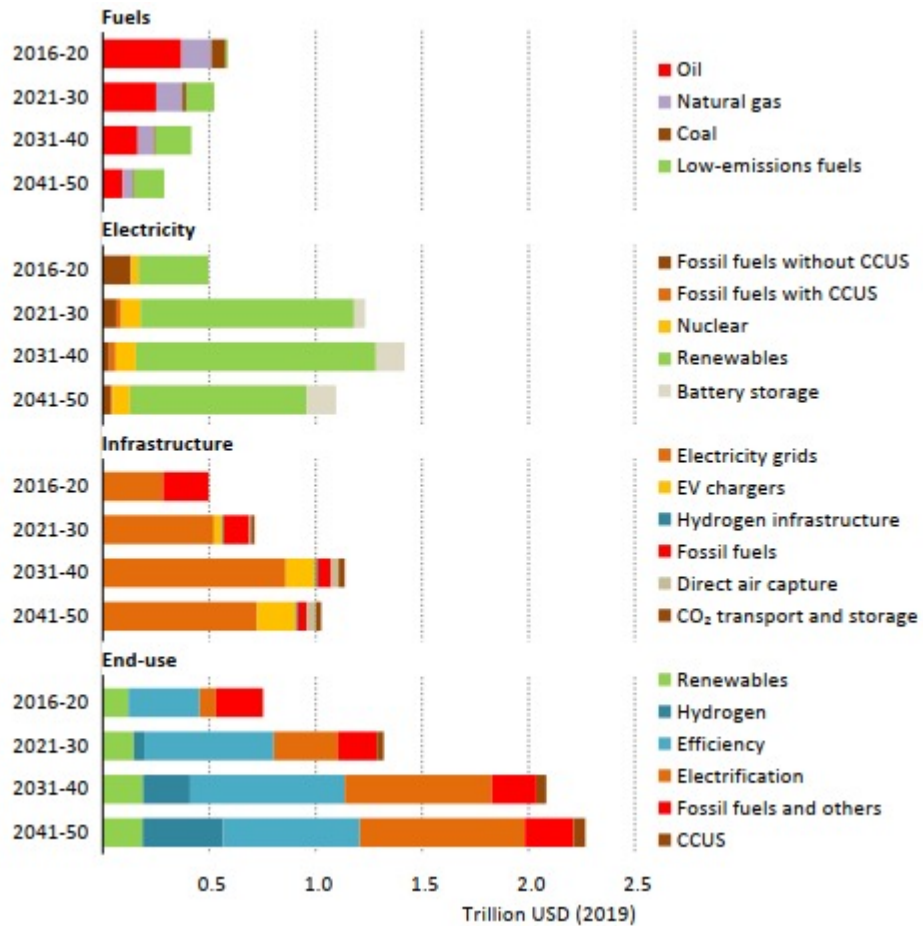
Westminster Energy Forum, October 13th 2021

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KEY CHALLENGES

Delivering a Net Zero energy system raises many challenges

ANNUAL AVERAGE ENERGY INVESTMENT NEEDS (NZE 2050)



- Encouraging **Investment**

- Policy frameworks and market designs will need to signal commitment to, and value of, net zero investments

- Supporting **Innovation**

- Anticipated reliance on emerging or unproven technologies to meet future needs

- Coordinating **Infrastructure**

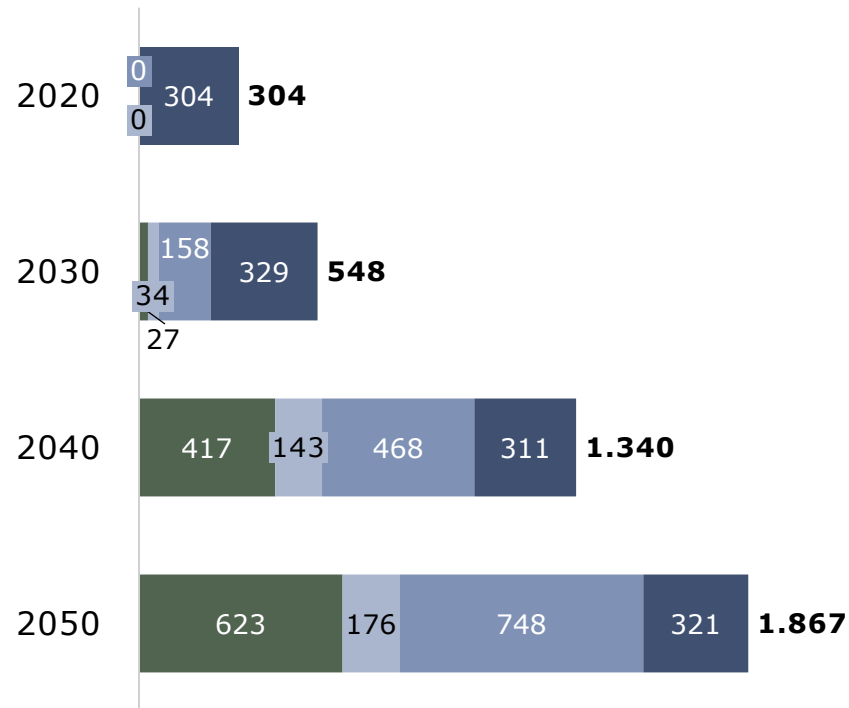
- Facilitating investment in infrastructure will need to be coordinated across the value chain and promote new business models to realise the potential

- Ensuring **Inclusion**

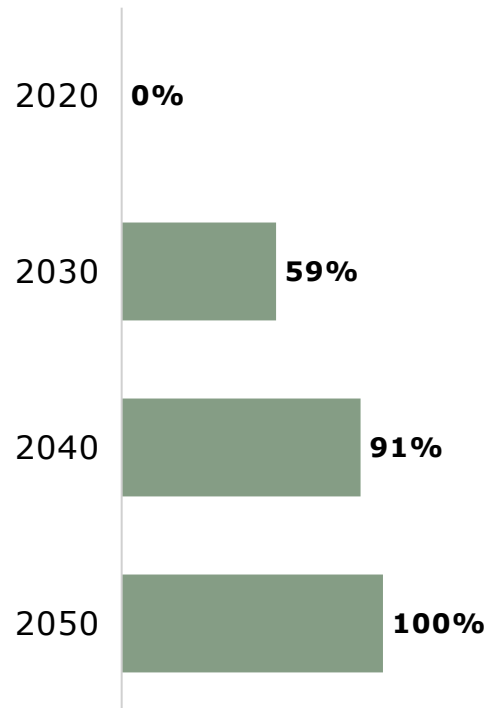
- Behavioural change is a critical component of a net zero society. Distributional effects across sectors and regions will need to be acknowledged and managed

European hydrogen ambitions will require over €450bn in investment, but is there an appetite to invest?

EU HYDROGEN DEMAND PROJECTIONS – CENTRAL SCENARIO (TWH, HHV)



H₂ DEMAND MET BY RENEWABLE/LOW-CARBON H₂



THREE QUESTIONS TO INVESTORS

1. Which type of hydrogen projects do you consider?
2. Which operational, economic and financial conditions would you impose on hydrogen projects?
3. When would you make first investments?

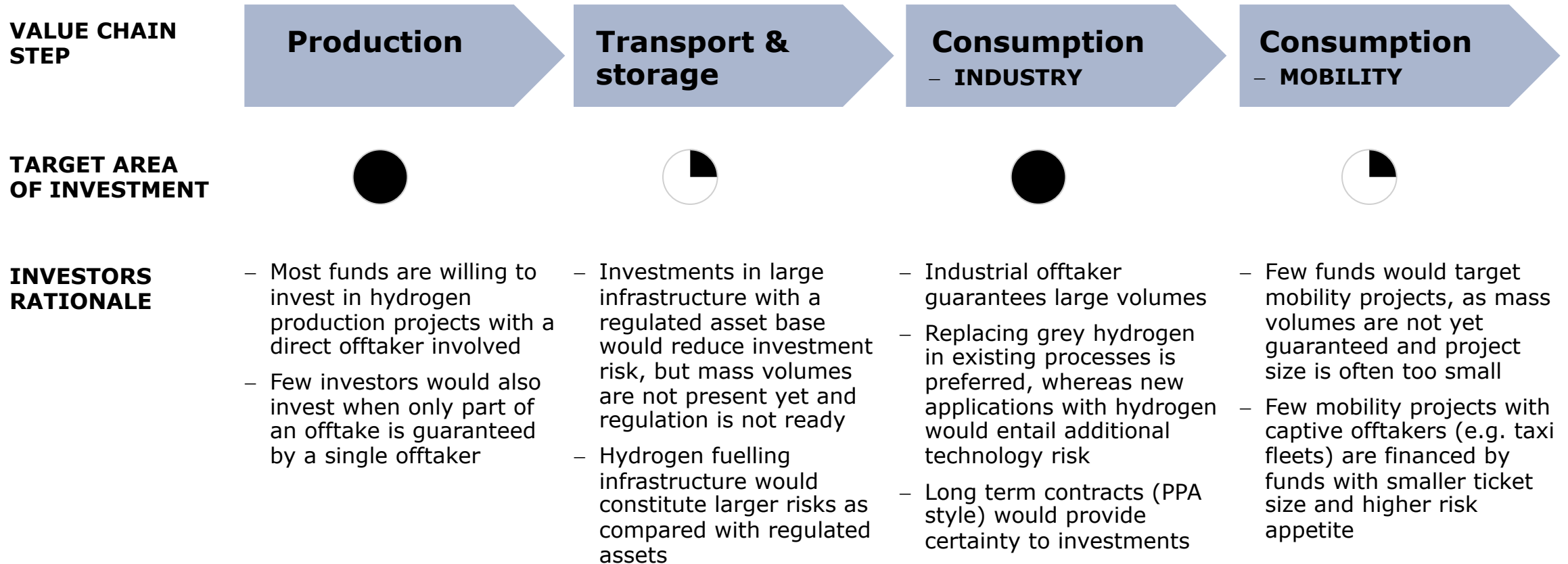
■ Heat (Residential, commercial, industrial) ■ Transport ■ Power ■ Industry (feedstock)

Sources: AFRY analysis based on Q2 2021 modelling and AFRY & Agora Energiewende No Regret Hydrogen study 2020

1 HYDROGEN PROJECTS

Current interest is focused on replacing 'grey' hydrogen with low-carbon 'blue' and renewable 'green' hydrogen in the industrial sector

INVESTMENT FUND FOCUS FOR PROJECTS IN HYDROGEN VALUE CHAIN WITHIN NEXT 5 YEARS



Low investment potential High investment potential

2 CONDITIONS

Investors will assess projects according to a number of criteria

INVESTMENT CRITERIA

SUBSIDIES



Subsidies will be required for a profitable project

- No preference for subsidy type (CAPEX subsidy, CFD type or feed in tariff)
- Subsidies should not cover too large a share of the cash flows, in case government's retrospectively change subsidy levels

Regulatory environment



Country has track-record of stable regulation

- No history of retroactively changing subsidy schemes and reducing amounts

Technology risk



Use of proven technology is required

- Technology needs to have demonstrated to be scalable and a potential for cost reduction
- The EPC contractor needs to assume the technology and construction risk

Sustainability



Hydrogen needs to qualify as 'green'

- Guarantees that the hydrogen can earn a premium in the long run

Counterparty risk



Secured revenues with few off-takers

- Strong preference for industrial offtaker of hydrogen (to replace grey hydrogen)
- Investors would challenge the creditworthiness of the counterparty of the offtake contract (based on their PPA experience)
- Offtaker needs to have experience in hydrogen (not a 'first-timer')
- Counterparty needs to have a stable business outlook

Project complexity



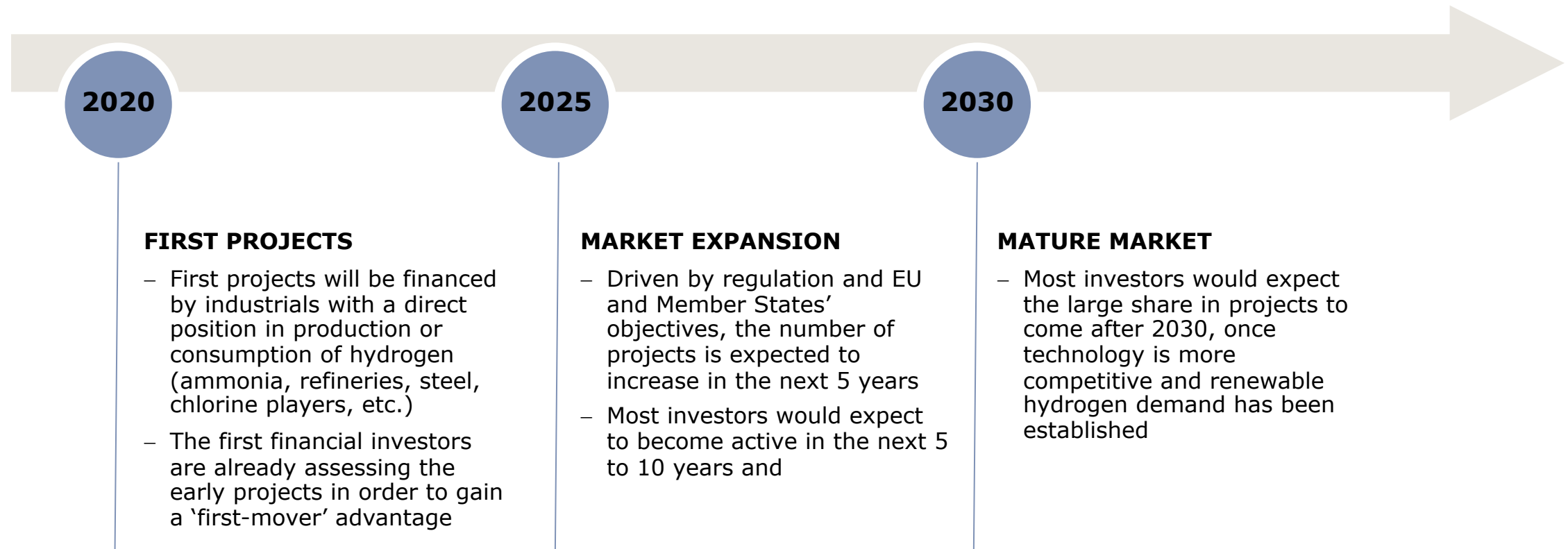
Fewer stakeholders are preferred

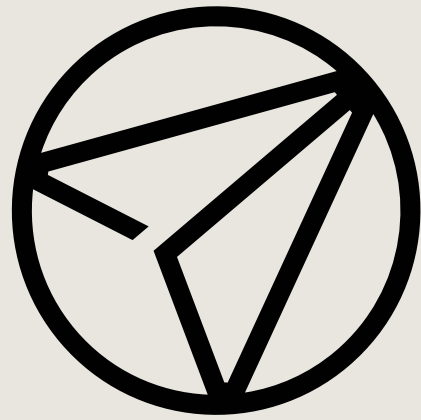
- Multisite projects or international projects add complexity and are excluded
- Large transport infrastructure would also lead to additional complexity due to multiple revenue sources
- CCU/S and blue hydrogen with the required CCS infrastructure would raise complexity as well

3 TIMING

Some financial investors already prepare now for first projects, while most financial investors expect to become more active after 2025

INVOLVEMENT OF FINANCIAL INVESTORS OVER TIME





AFRY

ÅF PÖYRY