Bridging the gap: Mobilizing investments in hydrogen infrastructure

Report launch webinar
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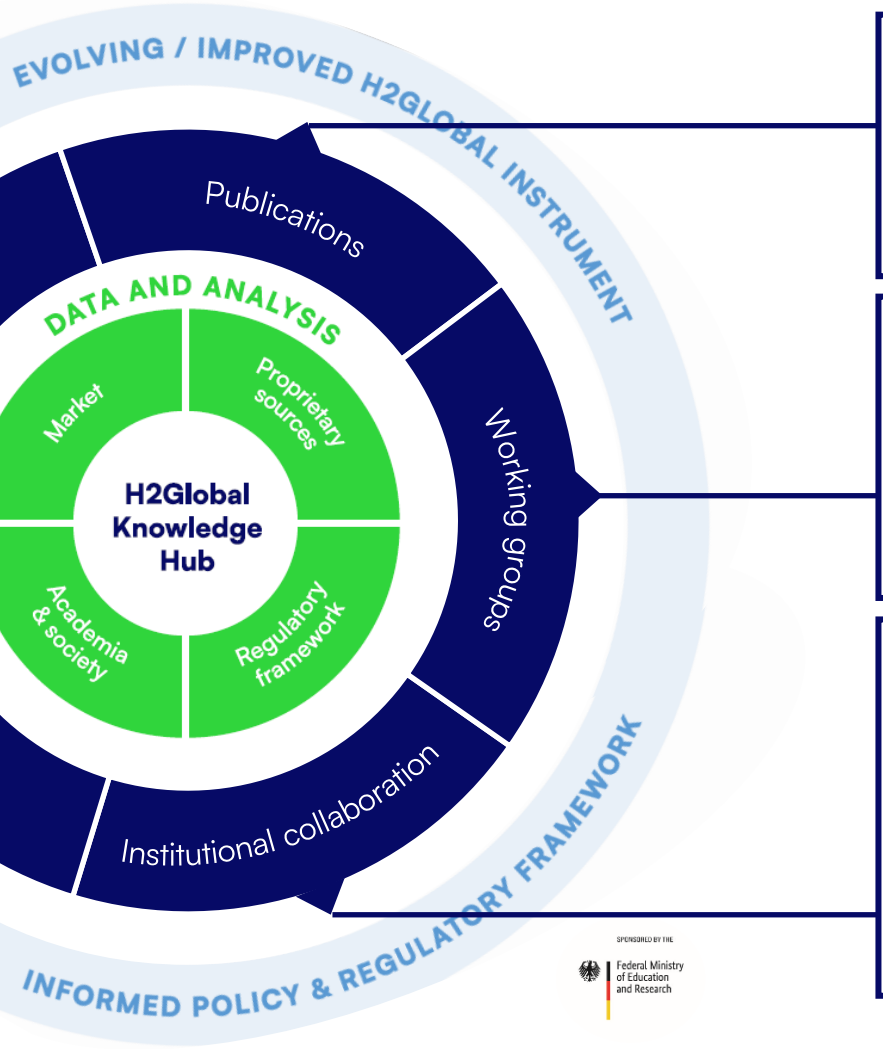
The report is part of the H2Global Knowledge Hub



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THREE PUBLICATIONS IN 2024

- Bridging the gap: Mobilizing investments in hydrogen infrastructure
- Unlocking potential: Scaling demand through hydrogen hubs
- Keep it simple: Aligning auction objectives for success

CONTRIBUTION OF INDUSTRY EXPERTS COVERING THE WHOLE HYDROGEN VALUE CHAIN

- Regular virtual knowledge exchanges and in-person workshops
- Representation from finance, supply, infrastructure, demand, and manufacturing

COLLABORATION WITH KNOWLEDGE PARTNERS FROM:

- Center on Global Energy Policies at Columbia University
- IRENA
- OECD
- Oxford Institute for Energy Studies
- World Bank

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Agenda

1 Challenge

- Bridging the investment gap

2 Analysis

- Identification and assessment of risks informed by industry
- Identification of alternative financial support instruments
- Modeling of archetypal infrastructure projects
- Multi-dimensional assessment of support instruments

3 Recommendations

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The challenge

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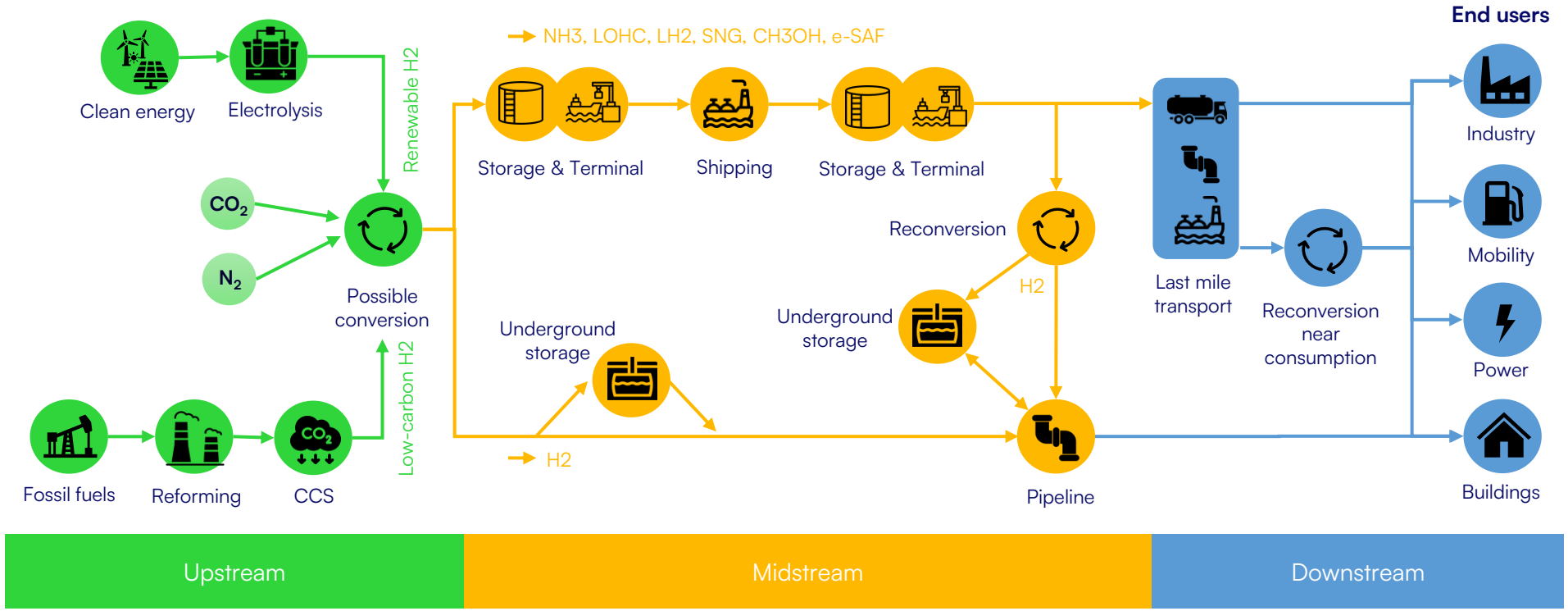
Hydrogen infrastructure is essential
for enabling global hydrogen trade



NH3: Ammonia, LOHC: Liquid organic hydrogen carrier, LH2: Liquid hydrogen, SNG: synthetic natural gas, CH3OH: methanol, e-SAF: Synthetic aviation fuel

Midstream hydrogen infrastructure—including **pipelines, import terminals, reconversion facilities,** and **underground hydrogen storage**—will be the backbone of a global clean hydrogen trade.

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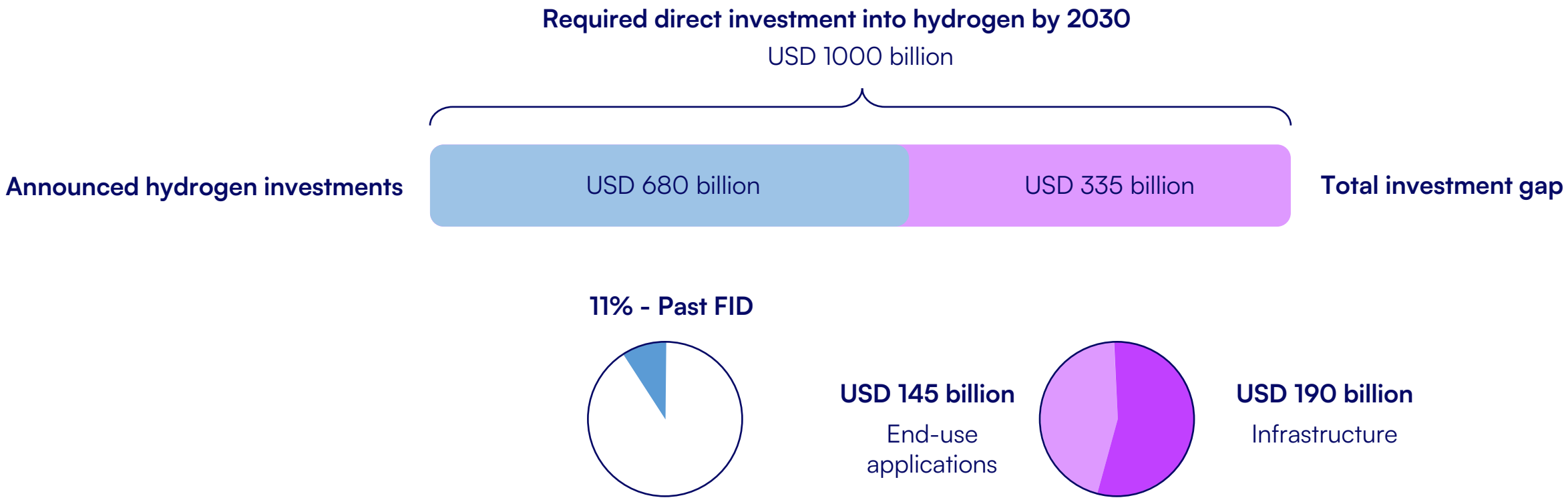
Hydrogen infrastructure faces a major investment gap of USD 190 billion by 2030



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Analysis

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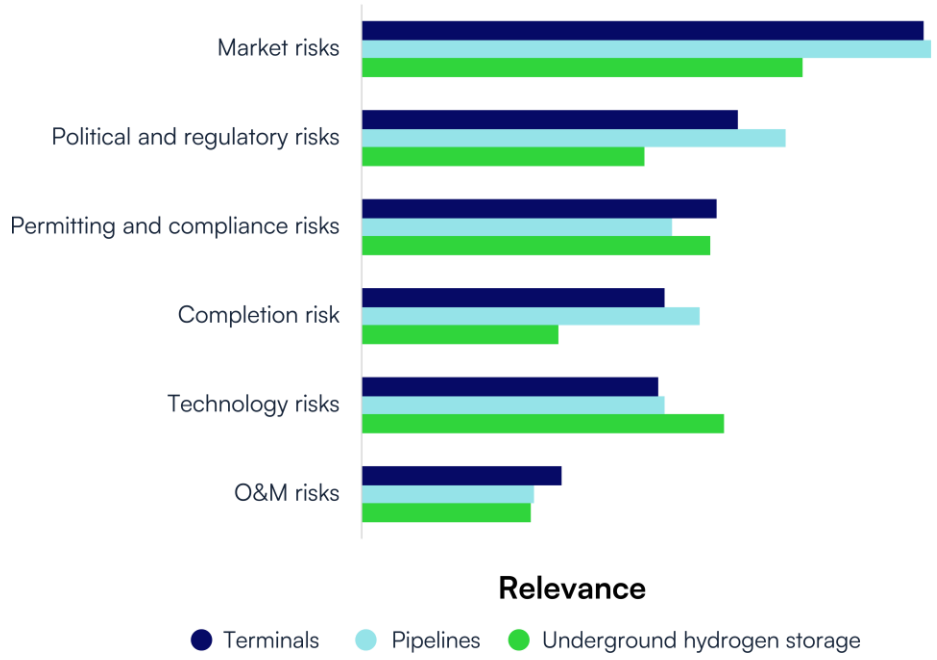
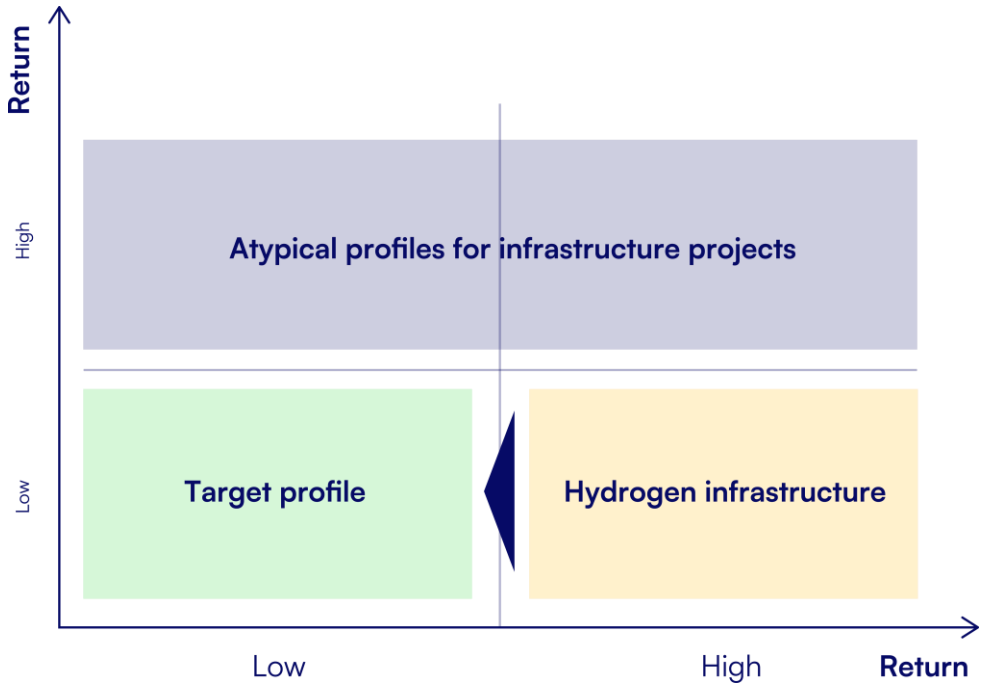
Identification and assessment of infrastructure projects' risk-return ratios

Investment risks



Risk-return ratio



Unfavorable risk-return ratios require financial support instruments to de-risk investments in hydrogen infrastructure.

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Four financial support instruments
that can help unlock infrastructure investment

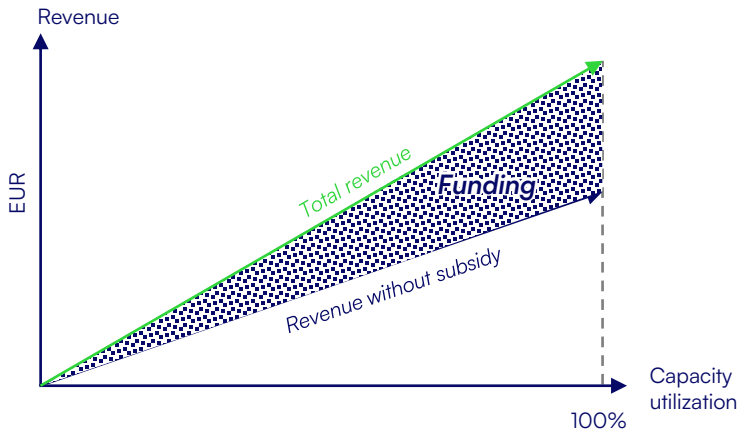
Fixed subsidy tools

CAPEX support Upfront one-time payment to reduce initial investment costs.

Dynamic subsidy tools

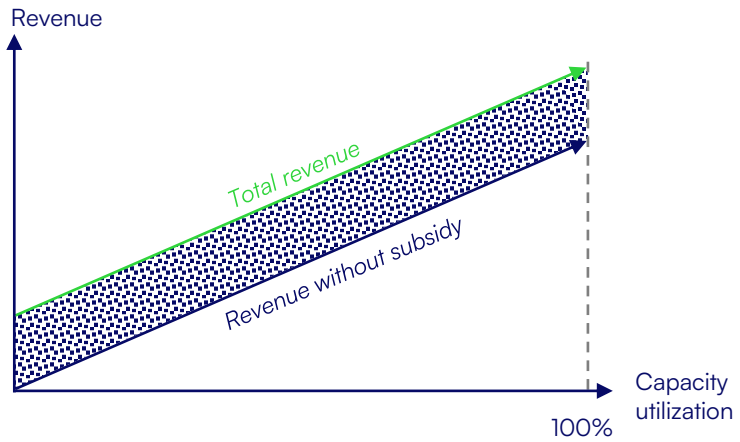
Fixed premium

Unit-price based premium linked to capacity utilization.



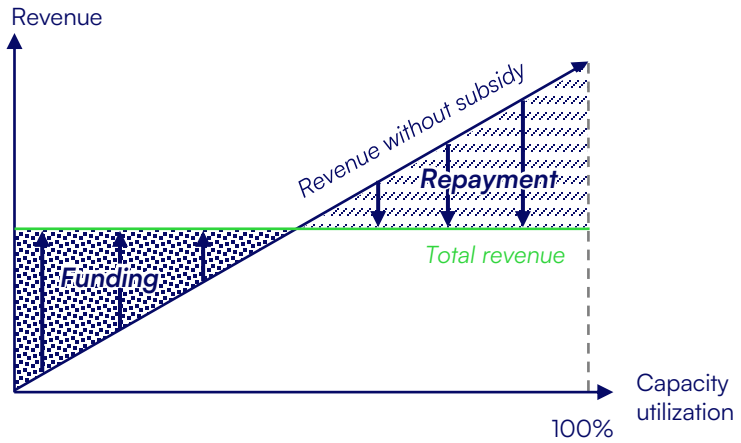
Anchor capacity bookings

Annual payments to guarantee a revenue floor.



Contracts-for-difference

Revenue-based tariff to guarantee a revenue floor + claw back mechanism in case of excess revenue.



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A multi-dimensional evaluation was conducted
to analyze the diverse impact of alternative financial support instruments

Funding efficiency

How **effectively** does the instrument **increase the net present value (NPV)** relative to the total amount of funding received?

Well-known & established instrument

Has this instrument been **successfully used in financing hydrogen infrastructure** or related projects?

Market risk mitigation

To what extent does the instrument **protect investors from market uncertainties and fluctuations**?

Admini-strative ease

How simple is it for the funding authority to **develop, implement, and manage** the instrument?

Mitigation of stranded funding resources

How well does the instrument **minimize the risk of funding being lost due to stranded assets or limited infrastructure utilization** throughout its operational phase?

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Testing the financial support instruments' efficiency using archetypal hydrogen infrastructure projects

Definition of archetypal hydrogen infrastructure projects

Hydrogen pipeline
- Length: 1,500 km
- Capacity: 9,200 t-H2 per day

Underground hydrogen storage
- Capacity salt cavern: 25 GWh
- Capacity depleted gas field: 145 GWh

Import terminal
- Types: NH3, LH2, SNG, LOHC
- Import capacity: 5 TWh-H2-equ. per year

Reconversion
- Types: NH3, SNG, LOHC
- Import capacity: 5 TWh-H2-equ. per year

Assessment of the projects' economic viability and of the financial efficiency of each funding instrument, using discounted cashflow analysis and Monte-Carlo simulation under three different pricing scenarios.

Pricing scenarios:
1. Base scenario: Pricing aligns with levelized costs resulting in a NPV ≈ 0
2. Reduced fee scenario
3. Increased fee scenario

Funding scenarios:
- CAPEX support
- CfD
- Anchor capacity bookings
- Fixed premium

Financial funding efficiency:

$$\frac{\Delta \text{ Net-present value}}{\text{Total funding}}$$

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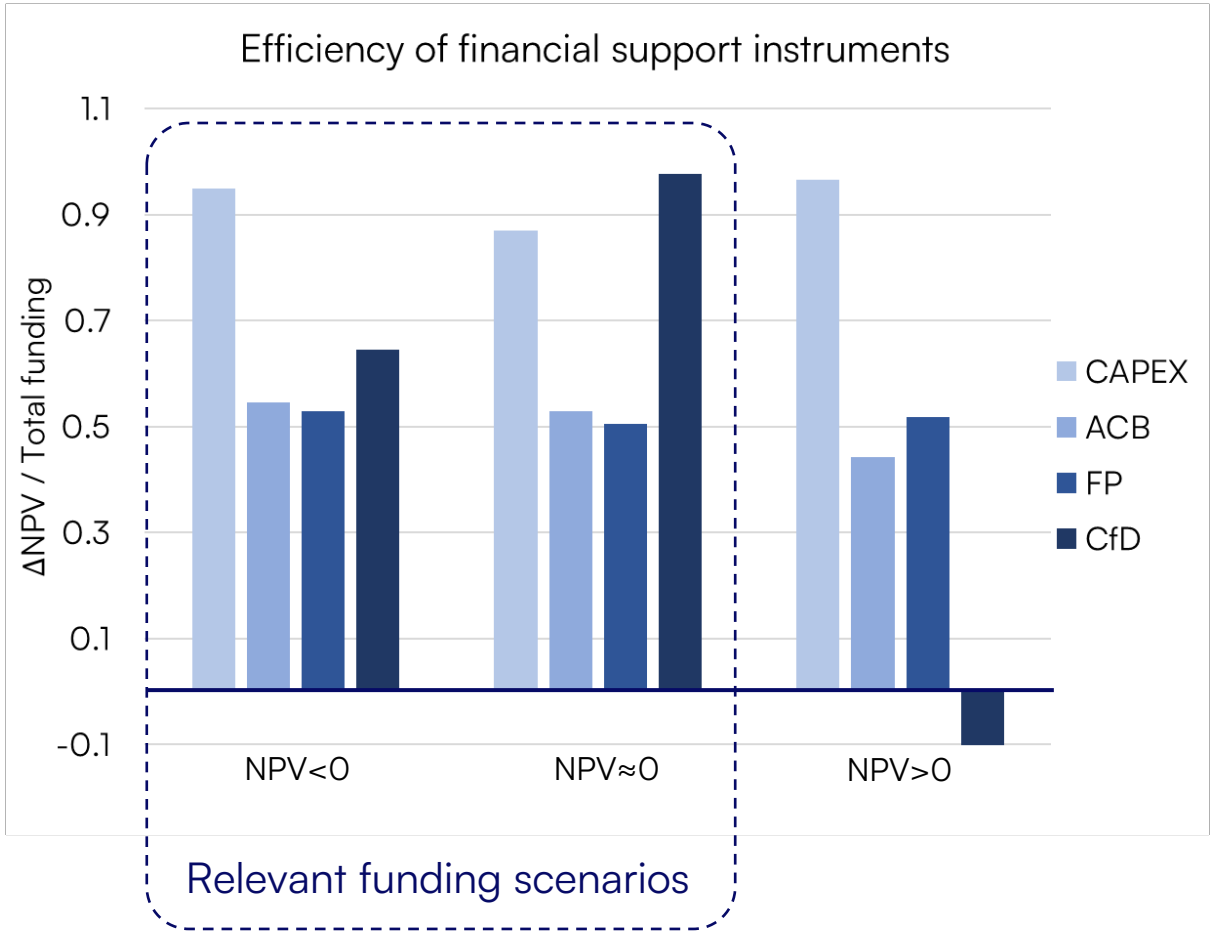
Testing the financial support instruments' efficiency:
CAPEX support and CfD instruments have highest financial efficiency



- **CAPEX support and CfD instruments use available funds most efficiently** in scenarios where the NPV of a project is below or close to zero.
- **Anchor capacity bookings and fixed premiums have the lowest funding efficiency** in these scenarios, with anchor capacity bookings performing slightly better.
- **The efficiency of CfD instruments turns negative in scenarios where the project's NPV is significantly positive.** This is because the clawback paid to the funding authority exceeds received funds.

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Results of the multi-dimensional evaluation

	CAPEX support	Fixed premium	Contracts-for-difference	Anchor capacity bookings	
Funding efficiency	1	4	2	3	
Market risk mitigation	3	4	1	2	**CfDs** ensure guaranteed revenue, providing full mitigation of market risks. **Fixed premium** instruments do not cover market risk.
Mitigation of stranded funding resources	3	1	4	2	**Fixed premium** schemes provide support proportional to utilization, reducing the risk of loss of funds in case of stranded assets. **CfDs** guarantee revenue even for stranded assets, leading to a higher risk of loss of funds since the clawback mechanism applies only to high-utilization rates.
Administrative ease for funding authority	1	3	4	2	**CAPEX support** only requires the definition of support criteria. **CfDs** require the definition of support criteria and the continuous management of the two-way financial flows.
Well-known & established instrument	1	3	2	4	**CAPEX support** is a commonly used instrument. **Anchor capacity bookings** lack a standardized definition.

Legend: Ratings from 1 (highest) to 4 (lowest), ranked relative to one another, with unique scores for each instrument.

Recommendations

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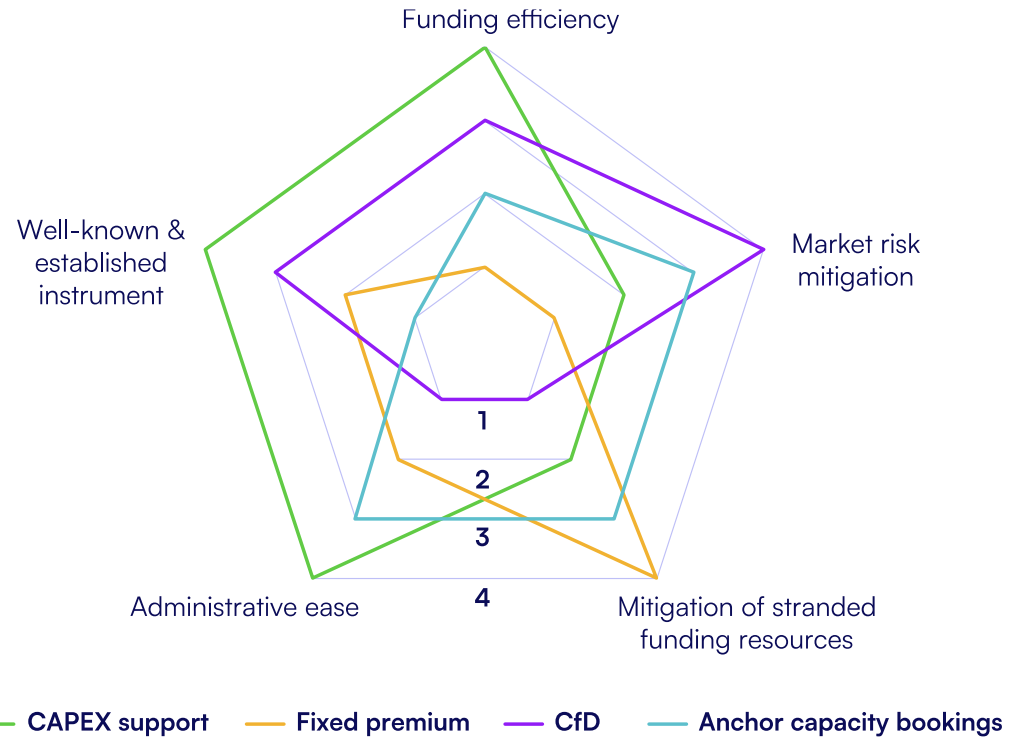
Recommendations

- Leverage **CAPEX support** to reduce initial investment costs but combine it with additional mechanisms to address future revenue risks.
- Deploy **CfDs** to guarantee stable returns and mitigate market risks for high-cost, high-risk infrastructure
- Introduce **anchor capacity bookings** to provide revenue floors during early operational phases, offering stability for investors while balancing simplicity and risk mitigation.
- Use **fixed-premium instruments** selectively when stranded funding concerns outweigh funding efficiency and market risk mitigation.

Evaluation of financial support instruments



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Recommendations

- Develop tailored funding mechanisms for specific types of infrastructure, prioritizing **CfDs** for high-risk, long-term projects like pipelines and underground storage, and **CAPEX support** for simpler, lower-cost projects like terminals and reconversion facilities.
- **Anchor capacity bookings** constitute a viable alternative for all types of infrastructure.

Suitability of financial support instruments by infrastructure

	CAPEX	Fixed premium	Contracts-for-difference	Anchor capacity bookings
Pipeline	Medium	Low	High	Medium
Terminal	High	Low	Medium	Medium
Reconversion	High	Low	Medium	Medium
UHS	Medium	Low	High	Medium

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Recommendations

Financial support instruments should be deployed alongside **other supportive measures** and in an environment that meets **several baseline conditions**:

- **Coordinate supply-chain activities and explore vertical integration** to mitigate market risks and compensate for lack of liquidity and market signals in the nascent hydrogen economy.
- **Explore centralized development of funding instruments** to streamline application processes, standardize eligibility criteria, and reduce administrative burden.
- **Link public financial support to demonstrable social and environmental benefits to enhance public acceptance.**
- **Enhance regulatory certainty through clear and practical frameworks** that address third-party access, unbundling rules, and permitting processes.

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