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Investing in industrial clusters

A U.S. perspective on financing industrial decarbonization

Industrial emissions account for almost a quarter of emissions in the United States. They also represent some of the hardest emissions to abate.

One approach catalyzing success around the world is the creation of industrial clusters or hubs—where co-located industries collaborate to meet decarbonization goals. A **report** by Accenture, in collaboration with the World Economic Forum, focused on the transition towards net-zero industrial clusters.[1] The report included a framework for developing industrial clusters and identified four key enablers to support success: policy, partnership, technology and financing.

The fourth, financing, will be critical to scaling success. In the United States, the Bipartisan Infrastructure Law (BIL)[2] and the Inflation Reduction Act (IRA)[3] provide an opportunity to leverage federal dollars to stimulate industrial decarbonization. However, while historic volumes of funding are being made available, they are not yet enough to tackle the scale of the challenge. As a result, these funds would need to be strategically leveraged to de-risk the market and unlock additional private sector capital required to bridge the gap.

This report outlines key financing considerations and opportunities for industrial clusters as public and private sectors in the United States collaborate to accelerate the path to industrial decarbonization.

All eyes on industrial decarbonization

According to the U.S. Environmental Protection Agency, industrial emissions account for 24% of U.S. emissions, making them the third-largest contributor to the country's greenhouse gas (GHG) emissions behind the transportation and electric power sectors.[4]

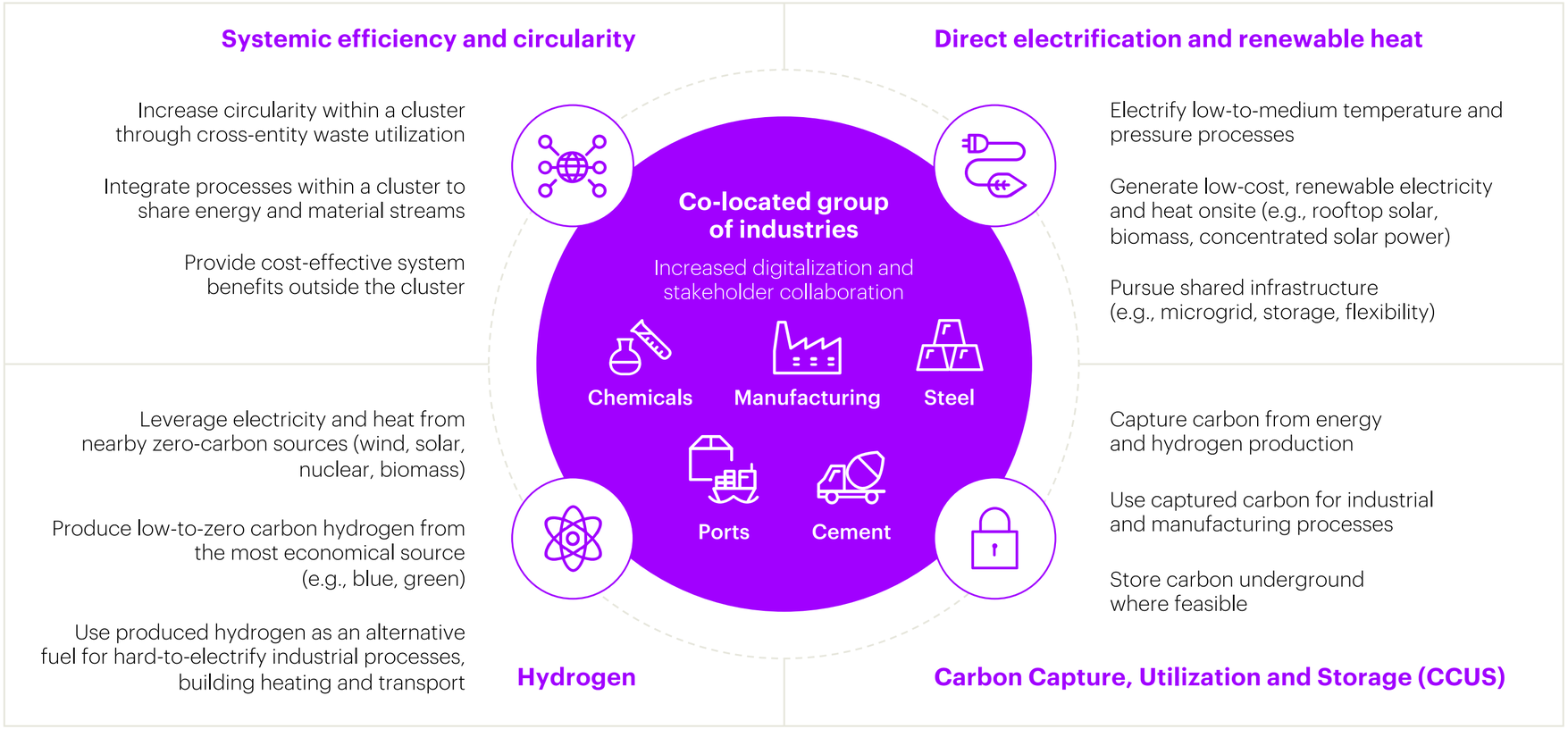
The industrial sector represents some of the most difficult emissions to abate. Economic and technical challenges make industrial decarbonization uniquely challenging:

- Economically, heavy industry represents often low-margin commodity businesses, making any "green" premium borne by the producers financially difficult without supportive policy mechanisms or incentives in place.
- Technically, heavy industry requires retrofits of end-use equipment and changes to industrial processes to utilize decarbonized fuels. This differs from the electricity industry's decarbonization efforts, which still rely on the electrons moving through the same distribution system.

Getting to the U.S. net-zero goal by 2050[5] will require tackling these challenges head on. As a result, the wide range of stakeholders involved are focusing their energy and resources on uncovering solutions. The creation of industrial clusters or hubs that collaborate to meet decarbonization goals is one approach gaining traction.

While each cluster will need to develop its own net-zero roadmap based on its existing industry, asset base and natural resources, four net-zero solutions should be considered (see Figure 1).

Figure 1 | **Net-zero solutions for industrial clusters**

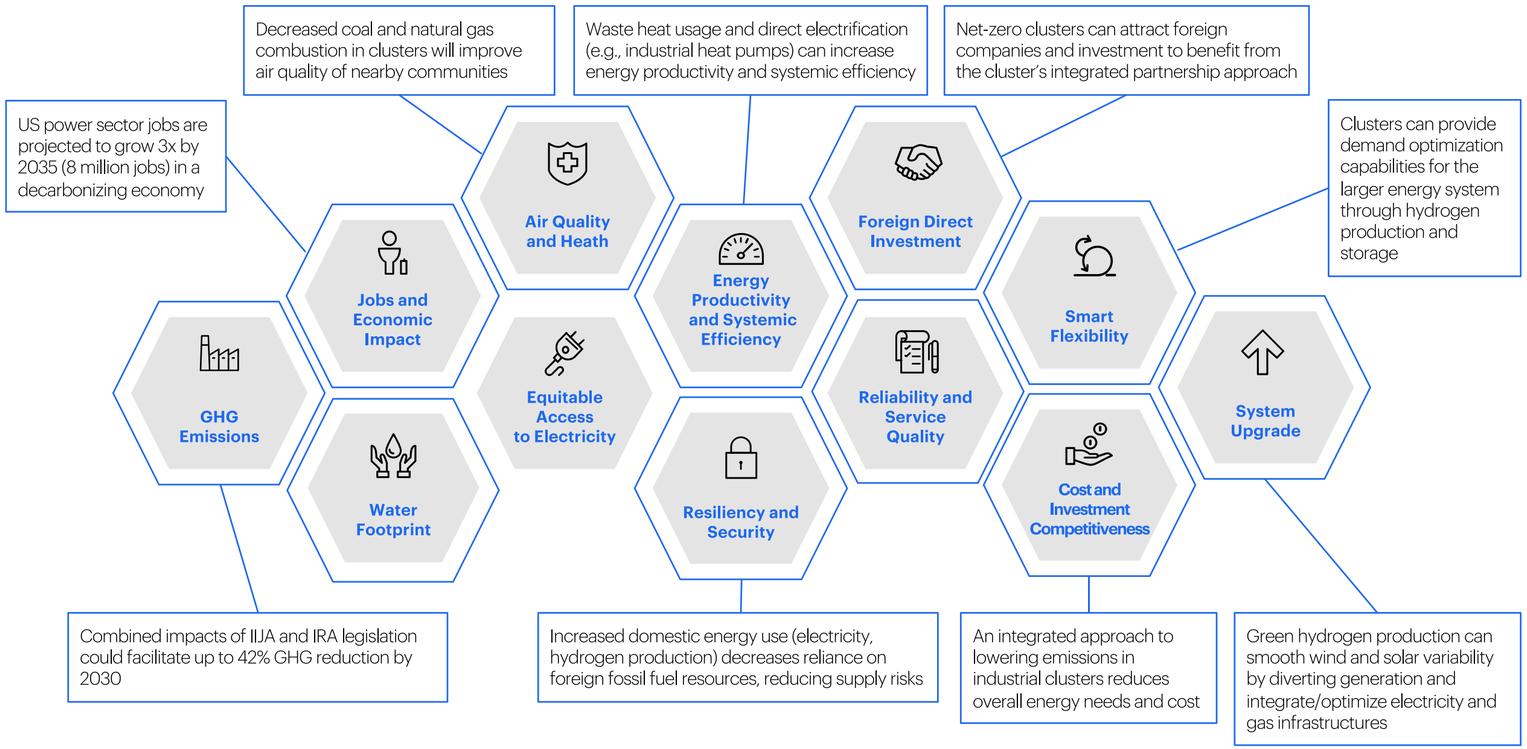


Source: Industrial clusters: Working together to achieve net zero, Accenture in collaboration with the World Economic Forum, 2021, https://www.accenture.com/us-en/insights/utilities/industrial-clusters-net-zero-future.

These roadmaps should consider the appropriate combination of key solutions and included technologies to optimize for cost while maximizing system value outcomes: from reducing GHG emissions to resiliency and security to equitable energy access. Figure 2 maps the potential benefits of net-zero industrial clusters against the **system value framework** developed by the World Economic Forum, in collaboration with Accenture.

Four key enablers will support the success of industrial clusters as they continue to develop past the early stages: policy, partnership, technology, and financing; the last is the focus of this report.

Figure 2 | System value framework overview



Note: Hexagons represent desired outcomes; specific applicability and importance of each element may vary by market and timeframe of analysis.
Source: World Economic Forum, System Value Framework, https://www3.weforum.org/docs/WEF_Overview_Path_to_Maximise_System_Value_2020.pdf

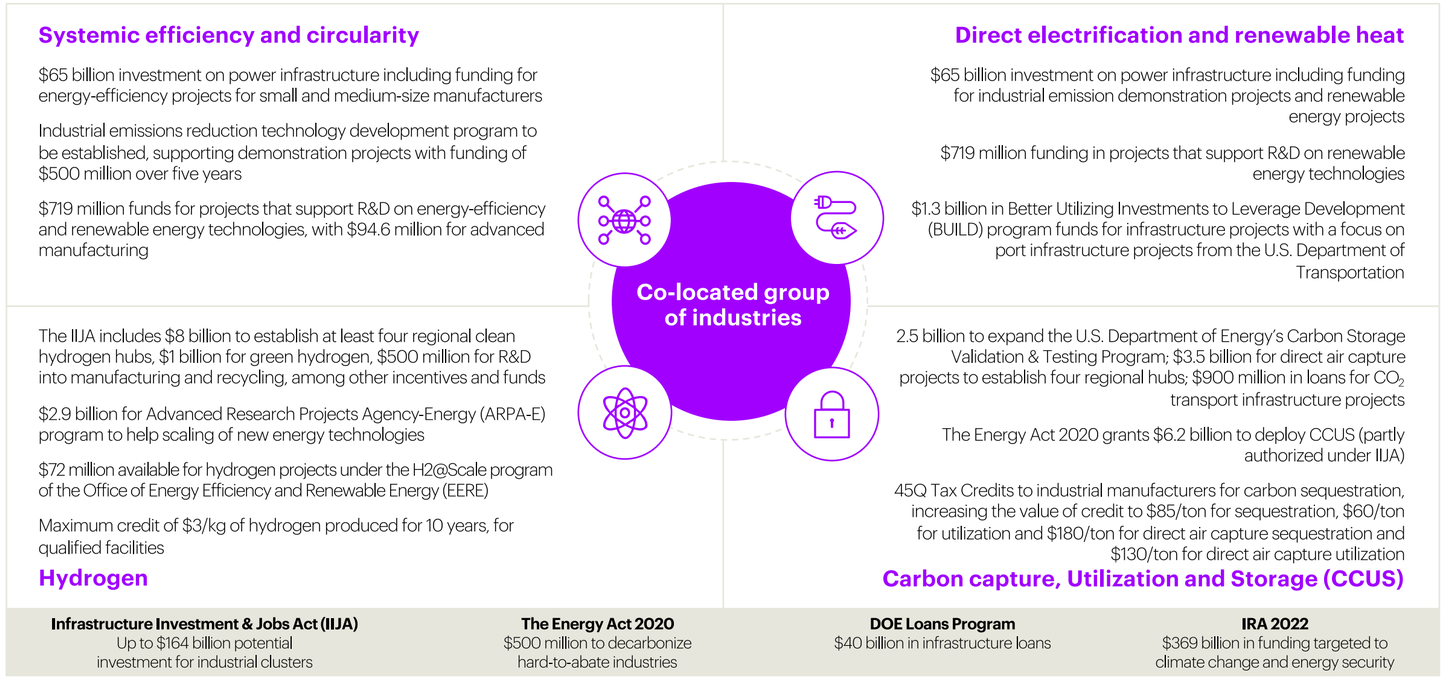
Addressing the financing challenges

In the United States, the Bipartisan Infrastructure Law (BIL) provides an opportunity to leverage historic volumes of federal dollars toward industrial decarbonization through the creation of clusters (also referred to as hubs). The Inflation Reduction Act (IRA) provides additional funding opportunities to target industrial emissions, including through the $5.8 billion Advanced Industrial Facilities Deployment Program. This program will provide industrial facilities—such as ports and chemical, steel, and cement plants—funding to switch to clean fuels, carbon capture, and electrification. In addition, the IRA leverages the purchasing power of the federal government by financing procurement of clean cement, steel, and other industrial materials, thus stabilizing and scaling "green" industrial markets.

As the BIL emphasizes, "One key pathway to achieving large-scale, commercially viable deployment of clean hydrogen is through matching the scale-up of clean hydrogen supplies with a concomitant and growing regional demand. Co-locating large-scale clean hydrogen production with multiple end-uses can foster the development of low-cost hydrogen and the necessary supporting infrastructure to jumpstart the hydrogen economy in various market segments, create both near-term and long-term jobs and tax revenues for regional economies, and realize emissions reduction benefits."[6]

While this federal funding is being made available and supplementing existing public resources (see Figure 3), more is needed to effectively tackle the scale of the challenge.

Figure 3 | U.S. funding opportunities by industrial cluster pillar



Source: Accenture Strategy analysis.

Globally, more than US$100 trillion will be required to decarbonize society by 2050,[7] equating to $3 trillion to $4 trillion annually. In the United States, an estimated $2.5 trillion will be needed by 2030 to be on trend for net zero by 2050.[8] As a result, federal funds will need to be strategically leveraged to mitigate risk to the market and reduce cost to unlock additional private sector capital to bridge the gap.

While public clean energy financing structures have often followed a 50:50 cost-share through grant programs, creative financing mechanisms across the value chain should be considered to make the most of available federal dollars.

Here are three key steps to consider in determining which creative financing mechanisms will have the greatest impact in accelerating industrial decarbonization:

1 **Take a whole systems approach to understand the unique challenges and needs across the value chain**

2 **Explore a range of creative financing mechanisms to target specific challenges, de-risk the market and unlock additional capital**

3 **Stack these mechanisms (existing and new) to enable decarbonization of not just one project, but industry at large**

1 Take a whole systems approach to understand the unique challenges and needs across the value chain

Taking a whole systems approach requires mapping the various players and perspectives across the value chain and understand the key barriers each are facing to participate in the market. For example, the BIL and IRA have combined to support multiple parts of the clean hydrogen value chain, as the BIL provides capital support for hydrogen hubs and the IRA now provides a hydrogen production tax credit to ensure operational viability. Figure 4 details these players and the relevant financing questions.

Figure 4 | Key challenges faced by value chain players

				Government/Policymaker	
	Off-taker	**Developer/Asset owner**	**Parts supplier**	**Labor & community stakeholders**	**Financier**
Key technology	Industrial processes, fuel-cell, storage tank	Electrolyzer, pipeline, end-to-end project	Electrolyzer, fuel-cell, BOS	N/A	N/A
Primary challenges	**Adjusting operational processes** to conform to new tech requirements Implementing **new energy consumption** tech equipment **Certificates** for claims	Achieving **economies of scale** to reduce unit-cost Simultaneously s**olving supply and demand** matching	**Reducing cost for electrolyzers** in early stages of tech maturity cycle Achieving **scaled production** and reduced unit economics	**Upskilling workforce** to develop technical expertise in new technologies Local government **permitting process** for new techs Buy-in from NGOs	**Alleviating key risks:** technology, off-taker, operational, and market Hedging products for nascent markets
Example financing mechanism	**Tax credit/rebate** for fuel use to offset high transition cost **Grant** payment to fully amortize and replace existing equipment **PTC/ITC** to reduce capital costs of new fuel equipment **Price support/quota** to guarantee demand	**Concessionary loan/loan pooling** within larger capital stack to incentive private lenders to offset new technology risk **Grant/part subsidy** payment to subsidize electrolyzer cost in order to improve project economics **Contract for Difference** to attract more capital and improve project economics	**Grant/part subsidy** to develop the ecosystem to increase supply/demand partners **Concessionary loan** for supply chain pipeline build out to mature supply chain and improve unit economics	**Grants** to provide training funding to unions and upskill local workforces **Grant** to establish hydrogen hubs/industrial clusters and break down initial funding barriers	**Contract for Difference** after initial power purchase agreement (PPA) contract term ends with off-taker to reduce long-term risk and enable shorter-term PPAs **Concessionary loan** within larger capital stack to incentive private lenders to offset new technology and credit risk

Bold blue indicates new applications/mechanisms in the United States

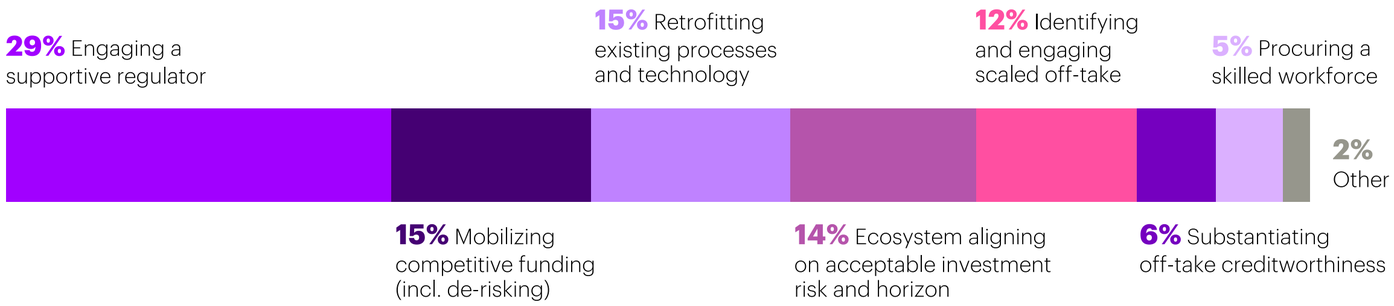
Source: Accenture Strategy analysis.

For example, identifying the reasons developers have not built large-scale hydrogen infrastructure can provide insight into the mechanisms to alleviate those challenges. If a developer is faced with financing challenges due to technology risk, then government can focus its attention on the financier. If a developer cannot secure scaled off-take agreements to build a large system, then subsidies could be focused on either enabling collaboration (such as the industrial cluster model) and/or on assisting the off-taker to transition equipment and processes to consume hydrogen cost-effectively. Understanding these perspectives could better enable identification of the incentives needed to drive broad market participation and create a sustainable ecosystem.

In a 2022 workshop on financing U.S. industrial clusters, held by Accenture, the World Economic Forum and EPRI, representatives from industry and government were surveyed on the greatest financing challenges their organizations were facing. Figure 5 summarizes the results. While engaging a supportive regulator came out as the top challenge, the fairly even spread across the other challenges reflects the breadth of perspectives and issues to be addressed moving forward.

Figure 5 | The greatest financing challenges organizations in the United States are facing

When asked to indicate the **greatest financing challenges for their organizations**, workshop participants indicated a **holistic value chain perspective** when considering initial asset development through to scale-ready off takers and regulators:



66 Responses Reflected

Source: Accenture Strategy analysis.

2 Explore a range of creative financing mechanisms to target specific challenges, de-risk the market and unlock additional capital

The U.S. government has a suite of financing mechanisms at its disposal—from guarantees to price support/consumption quotes to contract design and grants (see Figure 6).

Figure 6 | A suite of available financing mechanisms

Type of policy	Policy instrument	Support area	Applicability to IIJA	Example infrastructure projects

Guarantees	Minimum payment	Supply	• Instruments such as PPAs will guarantee returns on investments and reduce investor revenue risks	• DoE "Title XVII" loan guarantees of $24 billion, including:
				  • $10.9 billion for innovative nuclear energy project
				  • $4.5 billion for innovative renewable energy and efficient energy project

	Guarantee in case of default			
	Guarantee in case of refinancing			
	Exchange rate guarantees		• Low applicability unless exporting	
Price support/ Consumption quotas	Consumption quotas	Demand	• High suitability, but targets may have to be set at a state or local level • Guarantees demand by setting the appropriate energy mix	• Typically use for solar or wind (e.g., Germany) • Hybrid mechanisms such as UK ETS with carbon floor price where the UK GHG allowance trading scheme is supplemented by a levy on fossil fuels for power generation that varies with carbon content of the fuels
Contract design	Availability payment mechanisms	Supply	• Suitable for large-scale producers (e.g., hydrogen) who are unsure about robustness of demand • Guarantee the producer a set price to ensure stability of cash flow • Similar to off-takes, CfDs use government funding to guarantee a financial strike price to the developer	• Feed-in-tariffs for utility companies in the US and Europe
	Feed-in tariffs			
	Off-take contracts			
	Government-sponsored Contract-for-differences (CfDs)			

Grants	Lump sum capital grant and part subsidy	Supply	• Strongly suited to nascent or emerging technologies with higher risks to investors (e.g., can accelerate retrofits or replacement rates)	• Post-GFC, tax credits and grant seed funding via ARRA provided ~USD 25 billion in funding to support renewable power installation:
				  • 104k wind, solar, geothermal, and biomass projects
				  • Provided over 33 GW of power

	Revenue grant			
	Grant on debt interests			
	Favorable taxation schemes for SPV			
	Favorable taxation schemes for equity investors (PTC, ITC, 45Q, 45X)			
	Rebates	Demand	• Highly applicable e.g., can accelerate retrofits or replacement rates	• EV rebates to incentivise switching from ICE • 2009 "Cash for Clunkers"' program with $3 billion of funding to accelerate transition away from inefficient and heavily polluting vehicles

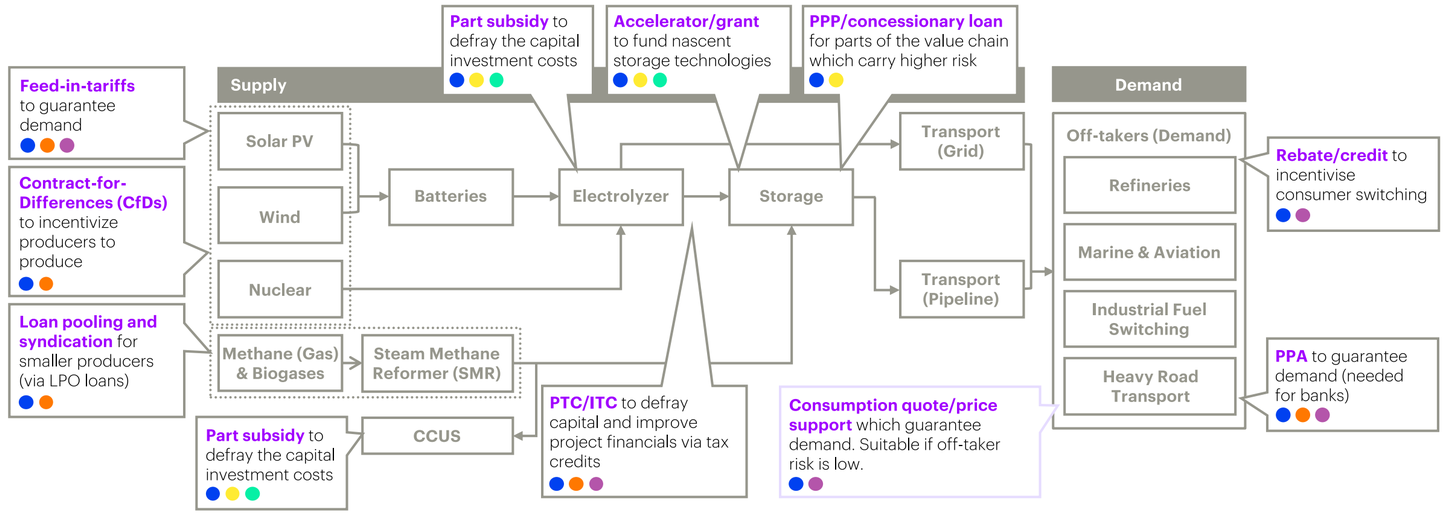
Source: OECD, Accenture Strategy analysis.

To bring about the highest-impact result, a mechanism should be chosen to overcome specific challenges, which will vary by stakeholder group, technology, and market maturity phase. The illustrative clean hydrogen value chain in Figure 7 highlights the variety of financing mechanisms which can be utilized at various points in the value chain at key intervention moments in the market's maturity.

For example, if an off-taker faces high costs in transitioning equipment or processes to consume hydrogen fuel, then a grant could provide the funding to allow them to sign a long-term off-take agreement that enables project development. A rebate or credit paid to the off-taker could also potentially achieve a similar goal of reducing per-unit costs for fuel switching to hydrogen.

If the main project hurdle is a developer facing financing challenges due to technology risk, a concessionary loan could potentially shift a portion of that risk from the financier to the government. This could enable financing at a reasonable cost of capital, which could make the unit economics attractive to an off-taker.

Figure 7 | Various financing mechanisms across a clean hydrogen value chain (illustrative)



Source: Accenture Strategy analysis.

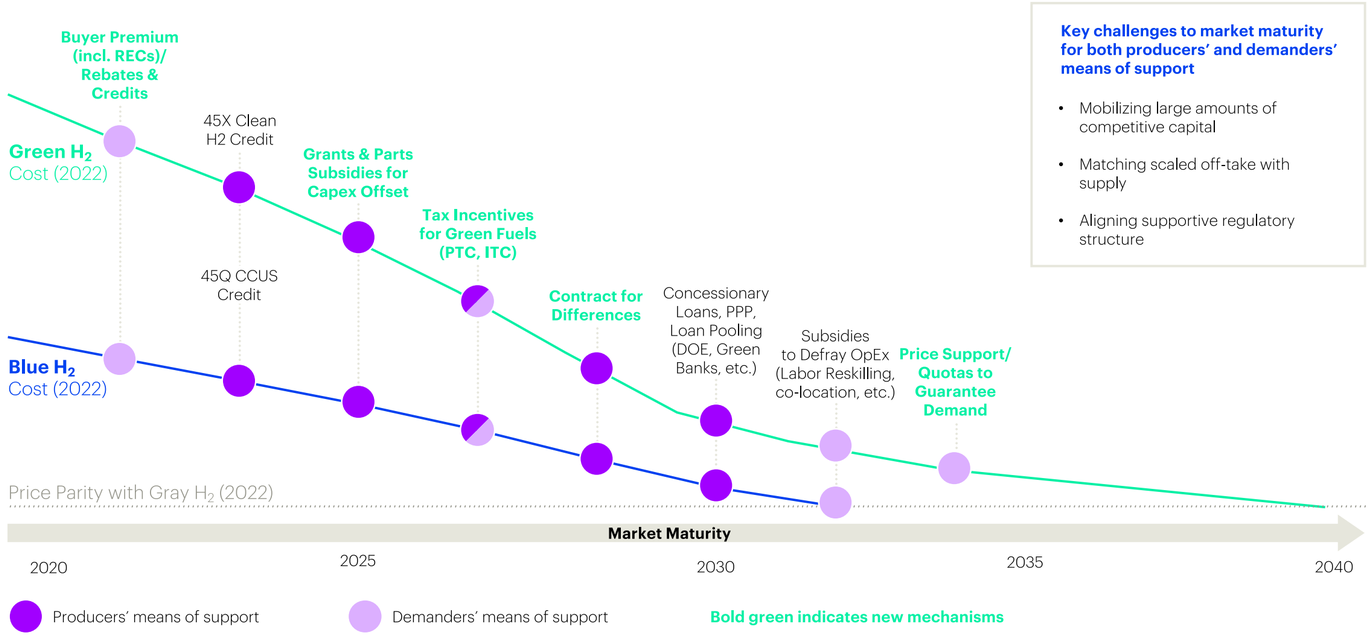
3 Stack these mechanisms (existing and new) to enable decarbonization of not just one project, but industry at large

To truly decarbonize an industry, leveraging all available tools is vital. Stacking these creative financing mechanisms—and existing financing mechanisms such as the Section 45 of the Clean Hydrogen Production and Investment Tax Credit Act of 2021[9] or the Carbon Capture and Sequestration Tax Credit (section 45Q)[10]—will be critical to help make the most of all the capital available.

To contextualize this concept, the illustrative roadmap in Figure 8 showcases how creative financing mechanisms can be applied over time as the hydrogen industry matures to drive down the cost of green and blue hydrogen.

While each mechanism's importance will ebb and flow as the industry evolves, the greatest cumulative impact will be most likely if they are strategically stacked at the most effective moments. Connecting back with the earlier funding example supporting the off-taker, if a grant is provided to retrofit existing equipment and processes to utilize clean hydrogen, that will alleviate a capital investment hurdle. However, the early-stage clean hydrogen industry may still require the buyer to pay a price premium over traditional fuels. As a result, a clean hydrogen fuel subsidy or rebate paid to the off-taker could make that ongoing premium more palatable. Each off-taker mechanism—a grant and a fuel subsidy—alone may not adequately support early off-takers, whereas both mechanisms stacked could enable an off-taker to sign a long-term agreement.

Figure 8 | Funding maturity curve for hydrogen (illustrative)



Source: Accenture Strategy analysis.

Spotlight: **Lessons learned from offshore wind development in the United Kingdom**

> **The development of the offshore wind industry in Europe offers an interesting example to consider, especially in the United Kingdom. Public investment in 2010 made up approximately 70% of funding for the UK's offshore wind fleet, it is currently at about 25% and trending towards 0%.[11]**

Renewable Obligation Certifications (ROCs) and later, auction-based Contracts for Difference (CfD) were the foundation of this development, though their characteristics have changed meaningfully over time as technology scaled and private investors engaged. To stimulate this market, it was critical that public financiers identified the target transition point to private investment from the start and deployed the right financing mechanisms at the appropriate time to enable this maturation.

Attracting generators with Renewable Obligation Certificates

The UK offshore wind market was first incentivized in the early 2000s by Renewable Obligation Certificates, or ROCs, which were awarded to generators for each MWh produced and could be sold into the marketplace. This subsidy focused on incentivizing electricity production to attract generators to join the market, which then created a spill over into growing suppliers and ultimately led to a robust new value chain. At the same time, by tying benefits to production amounts, the government incentivized production efficiency in the technology.

While ROCs were useful in attracting companies to expand to the offshore wind industry, this incentive mechanism did not reduce industry reliance on public investment over time. Therefore, Contracts for Difference (CfD) were introduced in 2015.

Contracts for Difference change the market

In the CfD model, a fixed price is established through competitive auction. This government-guaranteed price pays the generator the difference between the fixed CfD price (set at the auction) and the variable, real-time market price. This functions similarly to the renewable energy fixed price power purchase agreement (PPA) market in the United States, although without the need for deal-by-deal bilateral negotiations. In a CfD, the generator still sells its generation to the market on normal terms.

CfDs have been the main mechanism for the UK's most recent four auctions, and variations have been used in other European markets. If we consider the variations we are seeing in the UK and Europe, some of the popular characteristics of newer CfDs can considerably reduce public investment. For example, in dual-sided CfDs the generator must pay the public in the event of high power prices above the strike price. In addition, dual-sided CfDs include measures to determine strike prices that incentivize production patterns to limit public grid balancing costs and require additional local community investments.

Industry impacts of these financing mechanisms

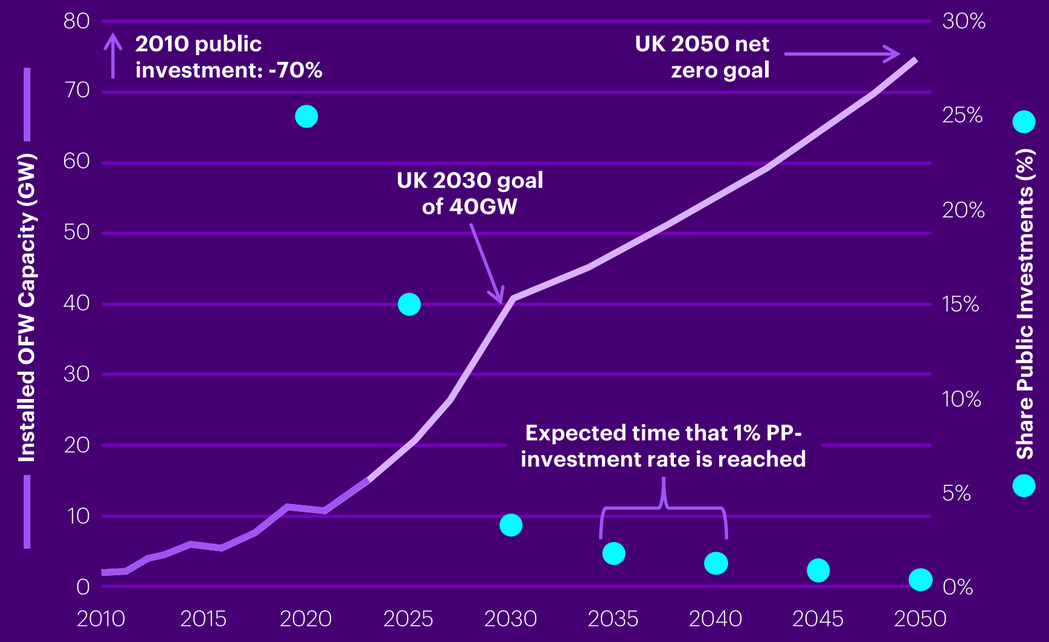
As the UK offshore wind market came from the ROC model, provider premiums in the UK did not change much for a long time, and the improved cost efficiency was not well reflected in the support granted by the public. The introduction of CfDs changed this.

CfDs are more customizable in terms of value, so they can push down prices and do so in a transparent manner. They are a great platform for increasing private investor competition, reducing the need for public investment, which is good news for public budgets. While the first CfDs had a high strike price, there has since been a rapid fall in their price. In fact, the most recent sites have gained CfDs at prices so low that, as they are dual-sided, there are likely to be very limited or even negative public costs from these sites going forward. This means future capacity could be close to free for the government.

On the investor side, even very low CfDs offer the security of a fixed price. This can help industry players address many of their challenges, rendering it attractive to continue to make significant local infrastructure investments. Therefore, it is reasonable to believe the accelerated investment trend will continue.

These rapidly falling CfD prices, happening simultaneously with accelerating capacity, mean that the amount of public investment would continue to diminish over the next 15 years (see Figure 9).

Figure 9 | **Public vs. private investment of UK offshore wind**



Source: Accenture Strategy analysis.

Summary of key lessons learned from the evolution of the UK offshore wind market

1

Plan funding to attract the most relevant market players and incentivize the appropriate improvement behavior

2

Plan to draw down public investment needs by inciting competition

3

Work on variations for both retaining investor appetite and innovation while incentivizing investments in the appropriate place, from a geographical and value chain perspective

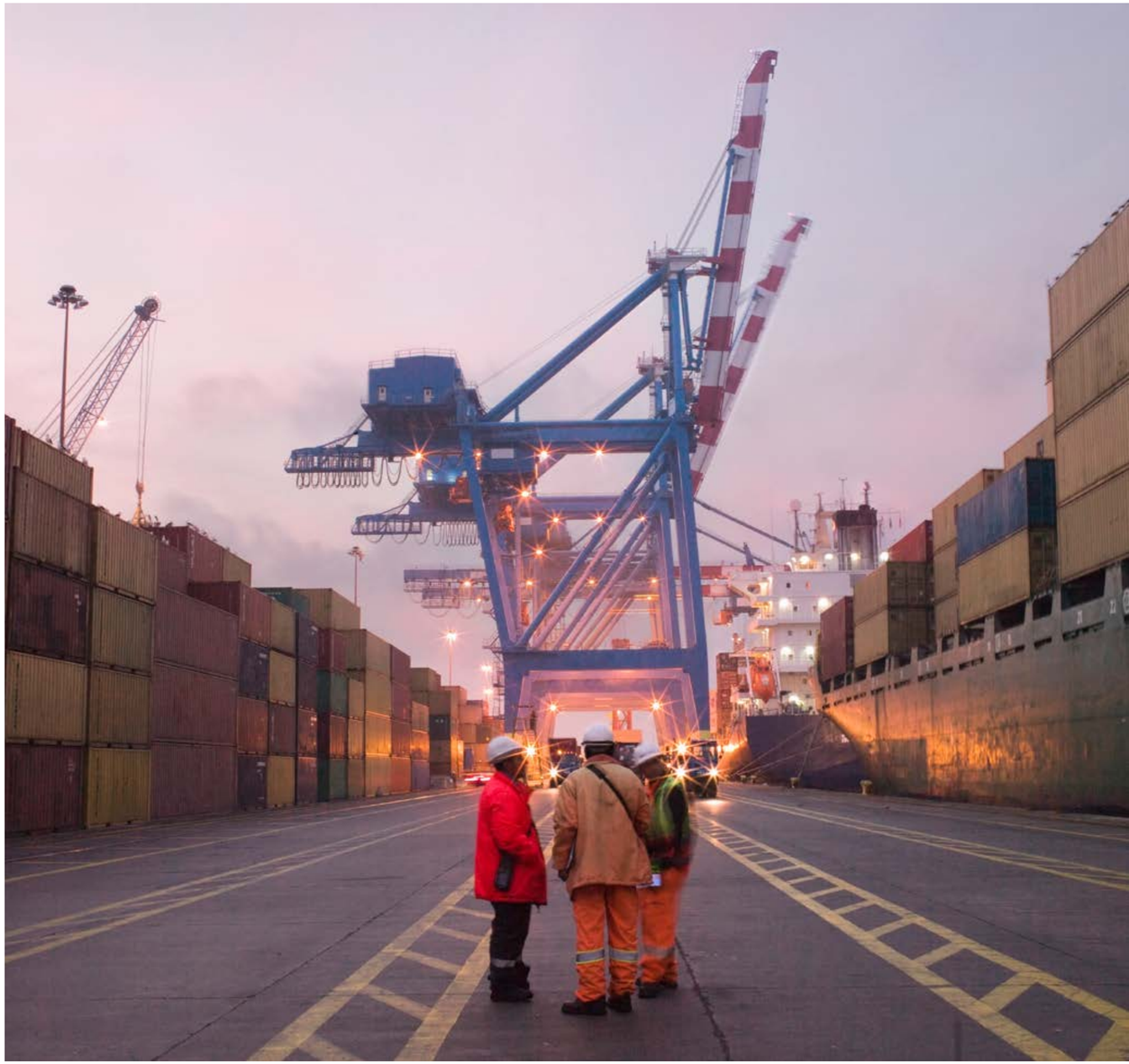
Looking outside the offshore wind industry to industrial stakeholders and public sector accelerators, there is considerable interest in applying the CfD model to other technologies to attain similar scale and cost-reduction effect. For emerging technologies such as hydrogen, new decisions such as the recent EU Commission's direction on establishing a European hydrogen market will make it possible to provide CfD-type incentive mechanisms more broadly.[12]

Partnering for the path forward

Careful selection and creative stacking of new and existing financing mechanisms will be needed if the U.S. Department of Energy and U.S. industry are the see the return on capital required to drive forward clean energy markets at scale.

The BIL and IRA provide an opportunity to catalyze this journey in the United States, but ongoing partnership between government and industry is needed to truly define the business models and market enablers required for continued development and scale.

Government agencies and legislators should continue to pursue open channels of communication with industry, seek to understand the breadth of current and future challenges and put forward supportive policies to empower the market to take hold. In turn, the onus is on industry to communicate their ongoing needs. As various clusters or hubs form, they should jointly define an optimal financing plan to support their vision which taps into public funds and existing financing mechanisms, but also identifies net-new mechanisms that would strengthen the business models they are shaping.



The partnership between the UK government and industry is one prime example. UK policy has been centered on creating an industrial decarbonization strategy as a whole—not just enabling project after project. This has required continued collaboration with industry to put in place a roadmap of emissions reduction and related government support programs to get clusters off the ground.

To help with planning, in March 2021 UK Research and Innovation (UKRI) put forward up to £171 million in R&D competition funding to support industrial clusters delivering significant emissions reduction—matched by £261 million from industry.[13] They have also put forward another £240 million through the Net Zero Hydrogen Fund to provide capital co-investment in a range of technologies through the Net Zero Innovation Portfolio.[14] These funds, along with their requirement for private sector matching or co-investment, has been an essential way to kickstart and help de-risk the market.

And they have continued this support by actively partnering with the private sector to get input on the business and financial models to support the scale-up of emerging technologies critical to industrial decarbonization, including hydrogen and carbon capture and storage. It is this partnership between industry and government that has created the appropriate conditions for increased market confidence and appetite for investment—making the most of the limited public funding available to create net-new markets.

> **While the BIL and IRA are monumental opportunities, it is just the beginning of the journey. The ability to tap into creative financing mechanisms will be a critical determinant to how this journey plays out.**

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About the Transitioning Industrial Clusters Towards Net Zero global initiative

The World Economic Forum, in collaboration with Accenture and EPRI, launched the global **"Transitioning industrial clusters towards Net Zero"** initiative at COP-26 in 2021 with four initial signatory clusters; the COP-26 **session recording** and **press release** are available publicly. This initiative is designed to bring together stakeholders to jumpstart industrial decarbonization through an integrated, systems approach. **Learn more**.