



An FTI Consulting white paper

Energy Transition – How to design and justify sector-specific public financial support for decarbonization?

An analytical framework for designing and justifying cost-effective support for decarbonization

1. Background: How to bridge the green premium gap?

2. Public authorities have established ways to justify and design interventions

3. Our analytical framework

3.A Diagnose

3.B Design

3.C Quantify



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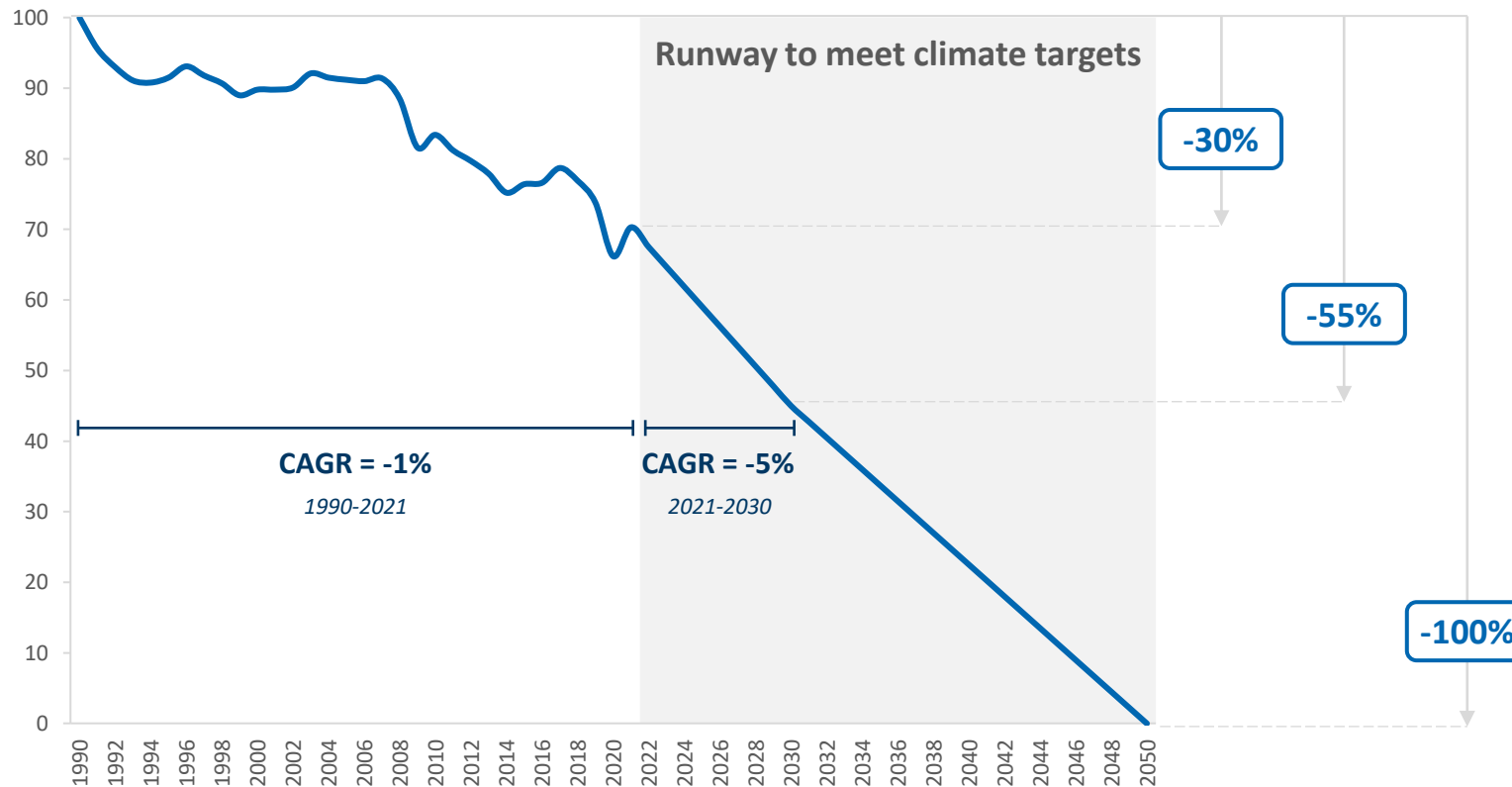


To meet the European Union’s climate targets, Member States must accelerate the GHG emissions abatement pace

EU GHG emission reduction compared to EU targets in 2030 and 2050

EU emissions development index, 1990-2050

Index, 1990 = 100

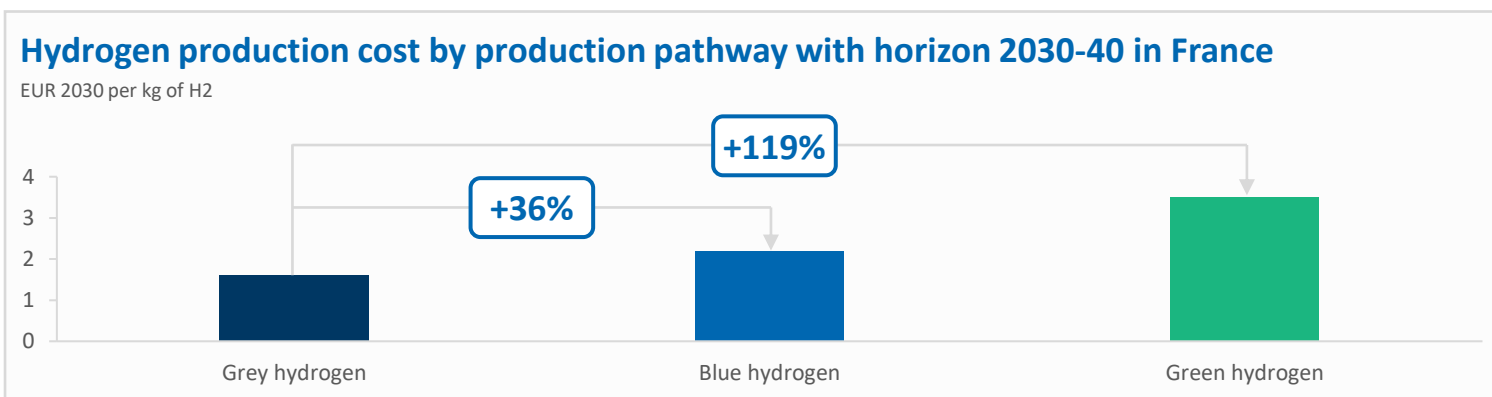
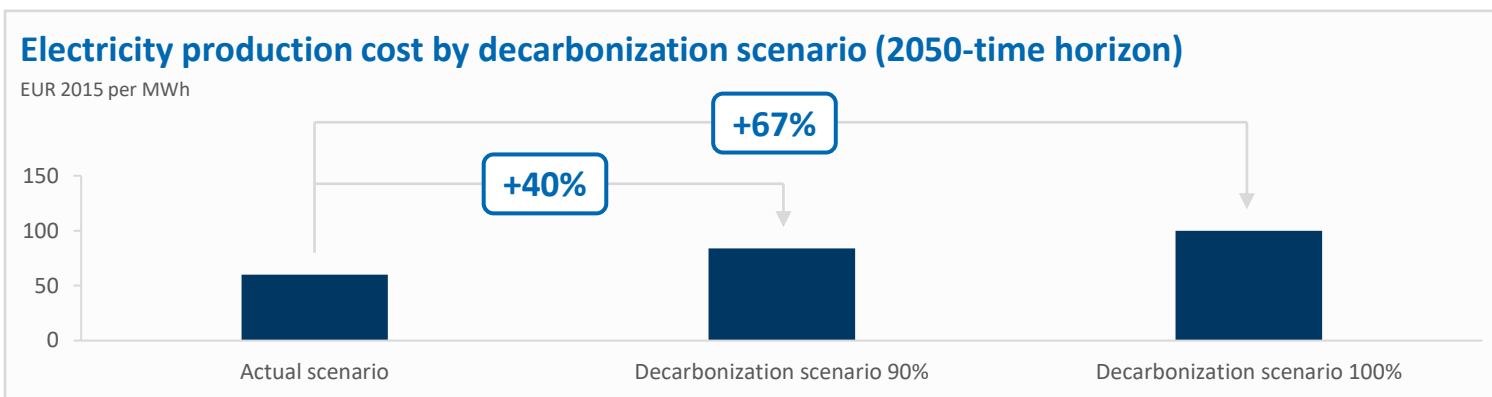


Comments

- From 1990 to 2021, the EU experienced a modest yet steady decrease in GHG emissions, averaging 1% annually
- This trend, while positive, signals a need for a more aggressive approach to meet future EU GHG reduction targets
- To stay on course with the ambitious EU 2030 climate goals, a significant uptick in efforts is required
- Specifically, Member States must aim for a minimum annual reduction of 5% in GHG emissions from 2021 to 2030, a substantial increase from past rates, to achieve the targeted 55% reduction compared to 1990 levels
- Maintaining this increased pace of emission reduction is not just a short-term challenge but a sustained commitment necessary to reach the EU’s overarching goal of net zero emissions by 2050

Yet, decarbonization efforts are challenged by the green premium – the extra cost of opting for clean energy over fossil alternatives

Forecasts of electricity production costs (by decarbonization scenario) and of H2 production costs (by pathway)



Comments

- Achieving the emissions reduction trajectory will prove challenging because of several headwinds
- One of them is the green premium – the additional costs of opting for clean energy over fossil alternatives
- The green premium should make decarbonized electricity and hydrogen production much more expensive than today:
 - **Decarbonized electricity generation:** By 2050, the average cost of electricity production would be around €100/MWh in the fully decarbonized scenario, significantly higher than the current average production cost (€60/MWh)
 - **Green hydrogen production costs:** The production of green H2 in France implies an increase in production costs of +119% by 2030-2040

Notes: (1) France Stratégie is a department of the Prime Minister responsible for "contributing to the determination of the major orientations for the future of the nation and the medium- and long-term objectives for its economic, social, cultural and environmental development, as well as the preparation of reforms" in France. (2) The green premium corresponds to the additional price consumers are willing to pay for a low-carbon good.
Sources: France Stratégie, FTI Consulting analysis.

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There are three theoretical dimensions worth considering when designing and justifying public financial support for decarbonization

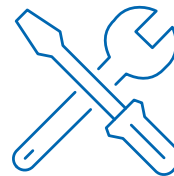
Theoretical dimensions for the design and justification of public financial support for decarbonization



1

What justifies public intervention?

A market failure must support intervention in private markets



2

What are the policy tools available?

A panel of tools are already recognised and can be applied



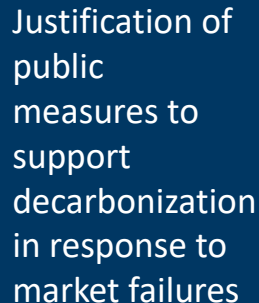
3

How to assess the possible concrete policies?

The same criteria are generally used by public authorities

Three main market failures justify the need for public intervention to support decarbonization efforts

Market failures justifying public intervention – OECD reference framework

Market failures	Temporality	Observations	Impact on public intervention
Negative externalities of GHG emissions	Short-term / Static vision (i.e. immediate)	One of the major market failures linked to excessive GHG emissions are negative externalities of GHG emissions. This creates a wedge between the marginal social costs and the private costs, resulting in product prices that do not reflect their climate damage.	
Insufficient innovation to reduce GHG emissions	Medium- and Long-term / Dynamic vision (i.e. towards the future)	A second market failure relates to private markets' under-provision of research and technological innovation to reduce emissions, due to knowledge being largely a public good. While true in most domains, this market failure is a fundamental challenge for decarbonization, where spillovers are larger than in other areas and where the deployment of new and affordable low-carbon technologies is key. Moreover, path-dependency may amplify the problem of insufficient investment in 'green' innovation as early investments in polluting industries strengthen their competitiveness, making it more difficult for low-carbon technologies to compete.	
Structural inefficiencies in GHG reduction actions	Short- to Long-term / Static and Dynamic visions	Other market failures can worsen the two main issues outlined above. For example: <ul style="list-style-type: none"> ▪ Unpriced co-benefits of reducing emissions resulting in improved health and biodiversity, weaken incentives to fight climate change; ▪ Financial frictions can increase the difficulty of financing investments in low-carbon technologies even when they are profitable; ▪ Network effects and coordination failures in relevant industries (e.g. electricity, transport, recycling) can hinder the adoption of new technologies; ▪ Split incentives in owner-tenant decisions slow down energy efficiency investments in buildings; ▪ Lack of information about energy efficiency and products' carbon content can hamper the purchase of low-carbon products; and ▪ Demand-side 'behavioral' effects (e.g. hyperbolic discounting, status quo bias, dynamic inconsistencies)⁽¹⁾ can cause excessive overconsumption of energy and polluting household goods. 	

Notes: Hyperbolic discounting refers to an agent's inclination to choose immediate rewards over rewards that come later in the future; Status quo bias describes our preference for the current state of affairs, resulting in a resistance to change; Dynamic inconsistency refers to a situation where a decision maker's preferences change over time preferences at one point in time are inconsistent preferences at another point in time.

Source: FTI Consulting analysis based OECD policy paper "A framework to decarbonize the economy".

To solve these failures, a standard set of tools are internationally recognised from which to derive concrete policies

Decarbonization framework of policy instruments adapted to the decarbonization economy

High-level policy tool	GHG Abatement Primary Target	Policy Tool	Policy Options	Concrete policies
GHG Emissions pricing	Cost	GHG Tax		GHG Tax
	Quantity	GHG Emission Trading Schemes		EU ETS
Production regulations decreasing undesirable effects	Cost	Production incentives decreasing undesirable effects	Bonus	Subsidies to eliminate undesirable effect
			Malus	Taxes on activities / goods causing undesirable effect
			Bonus/Malus	Feebates ⁽¹⁾
	Quantity	Production requirements decreasing undesirable effects	Output-focused	Tradeable perf. standards
				Non-tradeable perf. Standards
		Input-focused	Input requirements	
		Process-focused	Technological standards	
Information on undesirable effects	Efficiency	Information sharing (including signalling)		Information and voluntary approaches



Observations

- The OECD framework for decarbonization encompasses three main policy tools, each designed to address different challenges:
 - GHG emissions pricing
 - Production regulations decreasing undesirable effects,
 - Information on undesirable effects
- These tools can be further differentiated based on their primary focus – cost, quantity, or efficiency – resulting in a diverse array of instruments

Notes: (1) System of charges and rebates whereby energy-efficient or environmentally-friendly practices are rewarded while failure to adhere to such practices is penalized.
Sources: OECD, FTI Consulting

Public authorities assess decarbonization policies along standard dimensions, to ensure cost-effectiveness and align with other policy objectives

Climate policy assessment criteria

 Several criteria can be used to assess climate policies...	 ...each criterion answers a set of key questions for public authorities
Short term minimization of abatement costs	<i>How can the decarbonization measure provide the most flexibility lower emissions in the short-term while achieving the lowest short-term abatement cost?</i>
Medium/Long term minimization of abatement costs	<i>How can public authorities ensure that investments in innovation today will lead to reduced abatement costs in the medium to long term?</i>
Administrative costs minimization	<i>What are the potential administrative costs of implementing this decarbonization policy?</i>
Ability to deal with uncertainty	<i>How can the decarbonization measure account for uncertainties in abatement cost and climate damage estimates to remain cost-effective?</i>
Desirability of reallocation & distributional effects	<i>What will be the income-distributional impacts? How can the measure be complemented to mitigate effects on firms and households?</i>
Political economy & public acceptability	<i>How can the decarbonization be designed and communicated such that it is perceived as fair, and gain public support?</i>
Fiscal revenues & expenditures impact	<i>How dependent is the decarbonization measure to annual budgets?</i>

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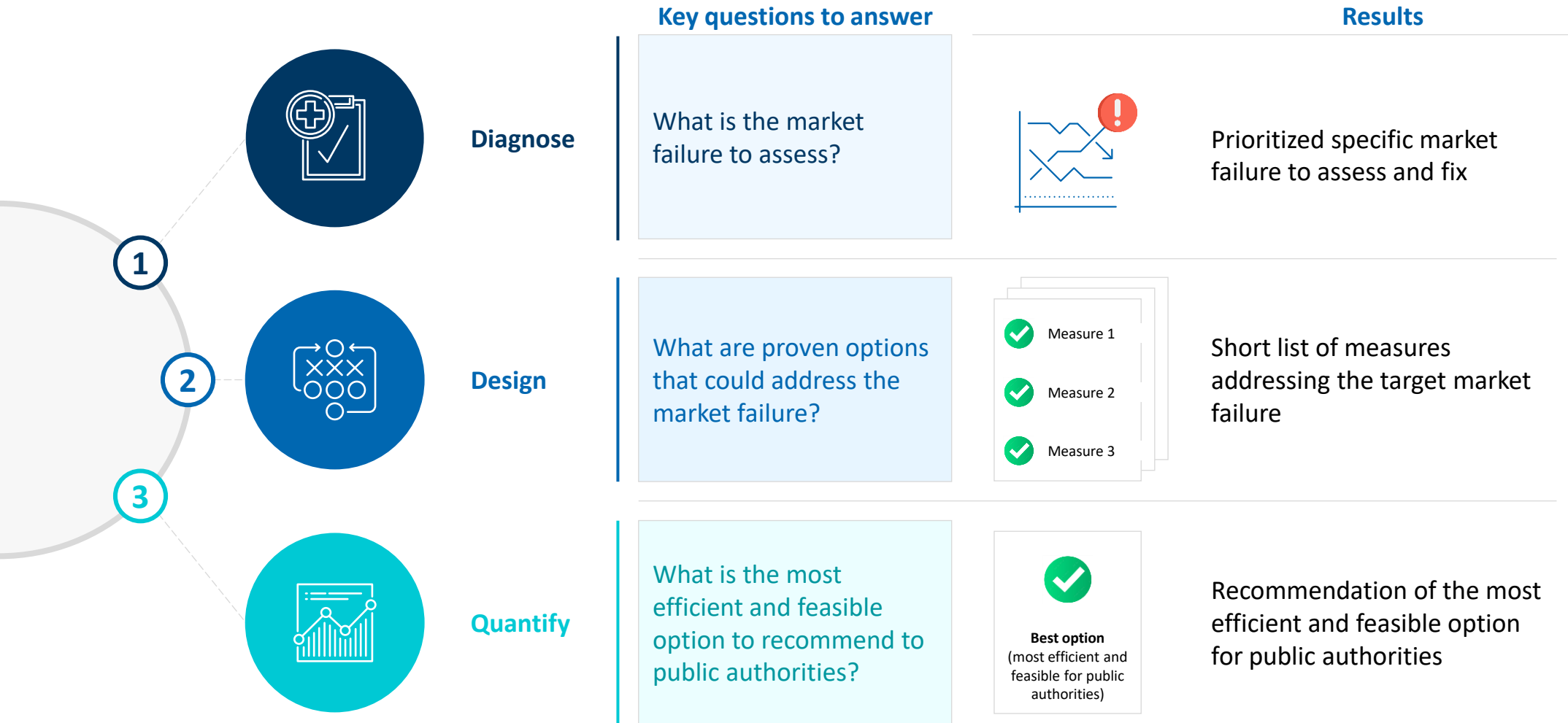
3.B Design

3.C Quantify



Our three-step analytical framework guides applicants in crafting compelling, well-supported cases for public support

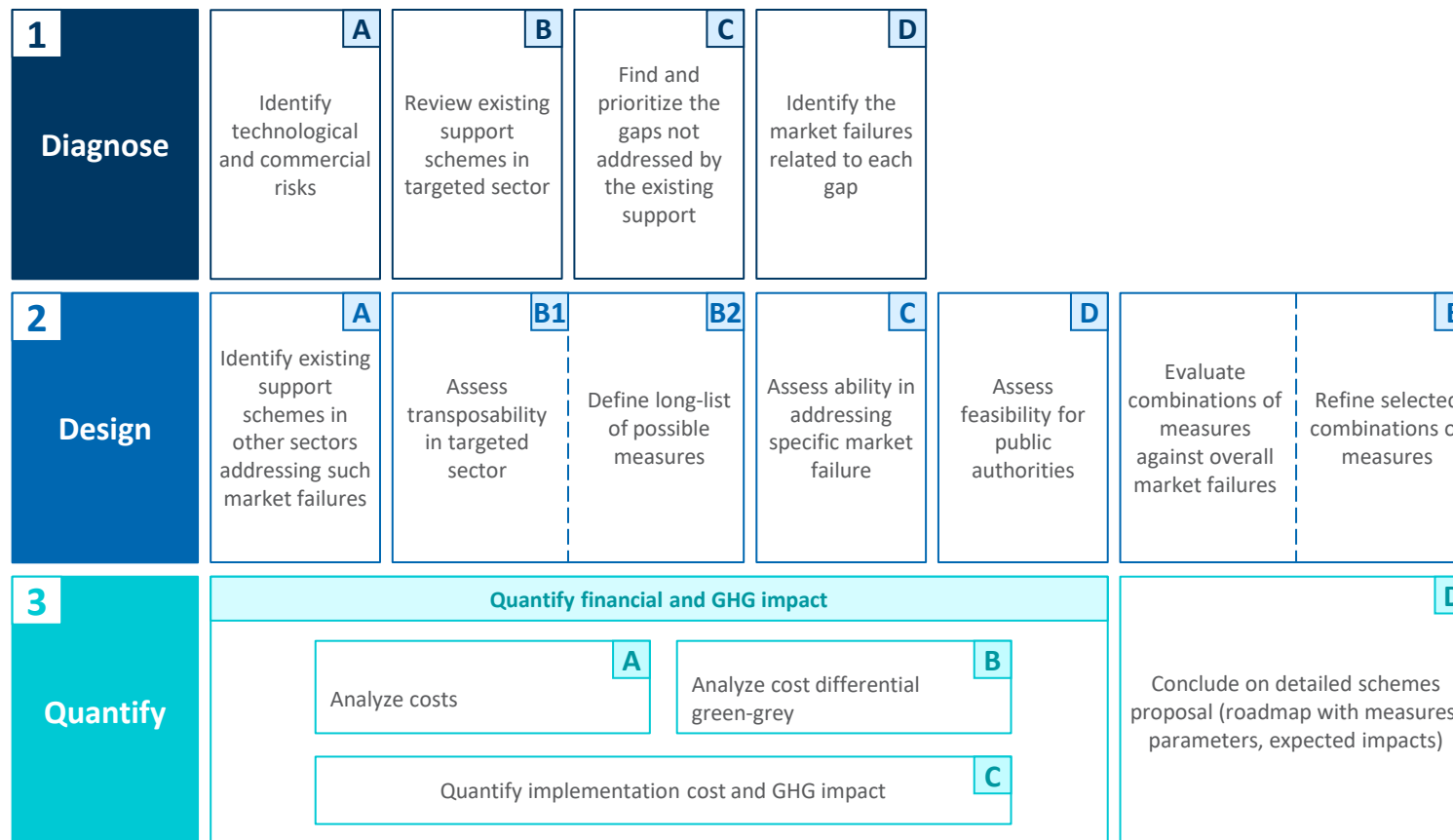
Our analytical framework to design and justify public financial support for decarbonization – Overview



Each step of this process encompasses several sub-steps, offering a detailed roadmap within our analytical framework

Our analytical framework to build public support for decarbonization – Breakdown

Comprehensive view of our analytical framework to build public support for decarbonization



Comments on approach

- This structure outlines the essential steps necessary for designing and justifying sector-specific public financial support for decarbonization for each of the three main components of our analytical framework
- In the following pages, we explore this roadmap in more depth and show what it means in practice
- We aim to shed some light on how to navigate the complexities of building robust sector-specific public financial support for decarbonization, highlighting critical considerations at every step of the way and providing an actionable roadmap

A diagnosis starts by identifying the technological and commercial risks in decarbonisation investment

Identify technological and commercial risks

Illustration of approach

Technological risk assessment

● High impact
○ Low impact

Technological risks	Risk	Impact	Impact rationale
Electrolyser	1. Interrupted supply of renewable electricity	●	Interruption of hydrogen production impacts off-take contracts and could entail additional costs
	2. Investment risk (high CAPEX) vs. uncertainty of public financial support	●	Driven by investors' reluctance to invest in CAPEX-intensive projects with uncertain public support (as support schemes are still taking shape) which could alter a business case
	3. Economic risks related to operational disruptions	○	Electrolysers' components are sensitive to damages (electrodes, cathodes, membranes, diaphragm) with potentially high replacement costs and long lead times creating a risk of one-off (high) costs and production disruptions

Comments on approach

- The initial step involves **pinpointing the technological and commercial risks** linked to green products, **assessing their impact** for a player and **evaluating to what extent the legislation covers these risks**
- **A technological risk analysis** (illustration shown on the left-hand side) aims to uncover **potential challenges in bringing green products to market from a technological perspective** (e.g. risks related to the production technology etc.)
- **Similarly, a commercial risk analysis aims to uncover and assess market-related challenges** such as cost variability, revenue uncertainty, and the competitiveness of green products compared to alternatives

To reveal gaps, i.e. which technological and commercial risks are not covered by the legislation, we then review the legislation in force

Review existing support

Illustration of approach

Review of the existing and proposed legislation

	Green Deal Industrial Plan	RePowerEU Plan	Proposal for Industrial Emissions Directive
Status	Proposed plan	Existing plan (communication)	Adopted
Applicability to green products	Not applicable	Applicable to some green products	Unknown
History Key dates and events	Published on Feb. 1, 2023	Presented in May 2022	Adopted on 5 April 2022
Type Relation to EU legislation	Plan (not binding)	Plan (communication)	Proposed Directive
Description	The plan offers green hydrogen producers a subsidy program as subsidies abroad are giving rise to unequal conditions of competition, according to the EC	The plan foresees 10 million tonnes of hydrogen domestic production & 10 million tonnes of imports by 2030, out of which, 40% in the form of ammonia, but no legislative proposal is attached.	Revision of the Best Available Technique Reference Documents (BREFs). As of now, it is unclear whether the BREFs will lead to more uptake of renewable production technology.
Relevance for gaps			

Comments on approach

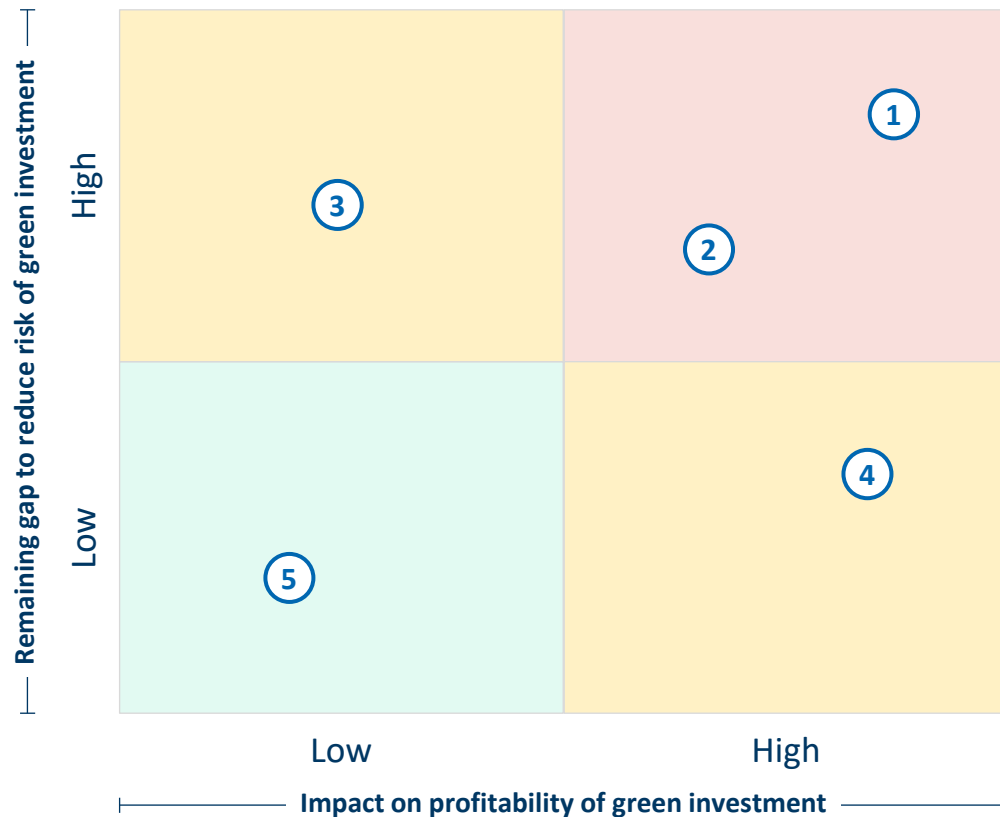
- By examining both existing and proposed legislation, we can pinpoint specific areas where the legislation falls short and where industry players are most exposed to technological and commercial risks – we call the latter legislative gaps
- Understanding these gaps is essential for the next step – prioritizing which uncovered risks need the most attention and resources
- In the next slide, we discuss why prioritizing these gaps is key and how it can be done in practice

For an efficient resource allocation, the key gaps not covered by the legislation can be prioritized using an impact-coverage matrix

Find and prioritize the gaps not addressed by the existing support

Illustration of approach

Mapping of gaps' impact on an energy player vs. risk coverage by the legislation



Key gaps not covered by legislation

Price competitiveness of green vs. grey product

1

Willingness to pay for green products

2

Renewable elec. price uncertainty

3

Investment attractiveness of a nascent technology

4

Investment risk

5

Comments on approach

- While typically, several gaps can be identified based on the technological / commercial risk analysis and the review of existing / proposed legislation, it is essential to prioritize them for an efficient resource allocation
- In practice, this prioritization results from the position of a gap in a two-dimension matrix evaluating:
 - Remaining gap to reduce risk of green investment
 - Impact on profitability of green investment
- Gaps located in the top right corner (e.g. 1 and 2) rank high on both dimensions and should thus be prioritized relative to other identified gaps (e.g. 3-5)

The last step of the diagnosis involves identifying the specific underlying market failure, revealing the root cause of the gap

Identify the market failures related to each gap

Illustration of approach

Priority (from previous step)	Identified gaps	General market failure	Specific market failure applicable to green product
1	Price competitiveness of green vs. grey product	Negative externalities of GHG emissions	Discrepancies in production costs between green and fossil alternatives
2	Low willingness to pay for green products	Structural inefficiencies in GHG emission reduction actions	Lack of incentive for less polluting choice (which is more costly)
3	Uncertainty about renewable electricity price	Structural inefficiencies in GHG emission reduction actions	Lack of stabilizing mechanisms hedging energy/CO2 price volatility
4	Investment attractiveness of a nascent technology	Insufficient innovation to reduce GHG emissions	Lack of market guarantees addressing technological risks
5	Investment risk in new production technology	Insufficient innovation to reduce GHG emissions	Lack of incentive for low-carbon choice (which is more costly) and lack of market guarantees addressing technological risks

What is the root cause explaining the need for a support mechanism?

High priority Low priority

Comments on approach

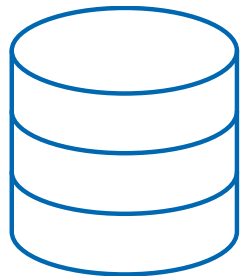
- For each prioritized gap, we then seek the root cause explaining it
- We do this in a two-step process:
 - First, we identify the general market failure based on the reference framework set out earlier in this white paper
 - Then, we identify the specific market failure applicable to the target green product to increase precision and ensure the effectiveness of the policy tools considered later
- This assessment is a key requirement to minimize the chances of considering misdirected support that would not solve the issue at its core

A realistic design requires to understand the relevant existing support schemes in other sectors to define a long list of measures

Identify existing support schemes in other sectors addressing such market failures

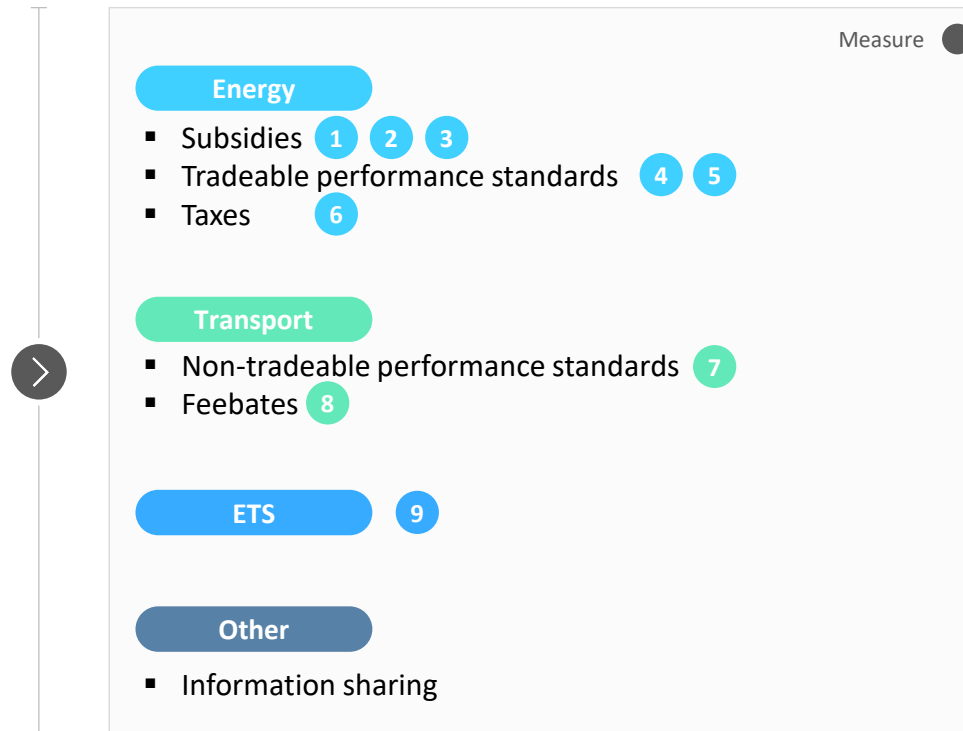
Illustration of approach

Mapping of existing support addressing the target market failure in other industries



100+

Decarbonization measures analyzed
by FTI team



Comments on approach

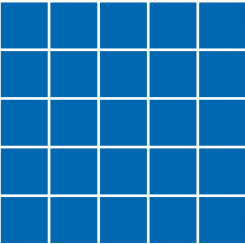

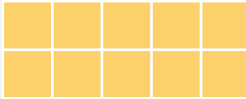

- With the problem now clearly defined and its root cause identified, it is time to move on to the design
- Designing sector-specific public financial support for decarbonization first requires an understanding of the existing support schemes in force in other sectors, and which address the same target market failure(s)
- To compile this body of concrete measures, we review the legislation in place at the different levels of government (ex. EU & Member States) and applicable to the target market failure
- Then, we segment the relevant pieces by type leveraging the typology set out earlier in the decarbonization framework (subsidies, performance standards, information sharing etc.)
- The outcome is a long-list of potential measures to solve the specific market failure and bridge the gap identified

Based on this long list, we assess the transposability of the measures and exclude those that cannot be adapted to the target

Assess transposability in targeted sector and define long list of possible measures

Illustration of approach

Transposability assessment of the identified measures addressing the market failure

Measure	Transposability	Result
		A version of the measure already exists in targeted sector
		The measure can be adapted to targeted sector
		The measure cannot be adapted to targeted sector

Transposability of measure to targeted sector

Comments on approach

- With a clear map of the relevant legislation applicable to the target green product, it is now important to assess transposability
- The reason for this is that adapting an already existing scheme from another industry is generally seen as more feasible than creating new designs
- For each specific market failure (root cause), we thus assess the transposability of the relevant support mechanisms and exclude instances where the measure cannot be adapted
- This assessment provides a clear list of which measures could be transposed or not, and how





We assess each short-listed schemes' ability to address the market failure in green production

Assess ability to address specific market failure

Illustration of approach

Ability assessment



Market failure	Support scheme	Ability to address market failure	Rationale
Discrepancies in production costs between green and fossil alternatives	1 European Hydrogen Bank – Purchasing guarantees for renewable hydrogen to support producers through a fixed price payment to producers		High ability – direct guarantee for investors and producers of green product
	2 Contract for Difference (CfD) for electricity prices		High ability – direct guarantee for green product producers
Lack of incentive for less polluting choice	9 EU Emissions Trading Scheme incl. coverage of new energy intensive sectors		Intermediate ability – strong incentive not to produce grey product due to carbon pricing
	7 Fuel Quality Directive – Greenhouse gas emissions reduction targets for green product producers and/or suppliers		Intermediate ability – does not necessarily incentivize the most low-carbon technology

Comments on approach

- Based on the long list of potential measures, relevant to bridge the identified gaps, the next step is to assess their ability to address the market failure and feasibility of implementation – here, we discuss the ability assessment
- We assess the relevant schemes' ability based on the scheme's capacity to fill the identified gap for a target green product
- We measure ability through a score ranging from one (least able) to four (most able)

Alongside ability, we assess the feasibility of short-listed schemes based on their relevance for public authorities

Assess feasibility for public authorities

Illustration of approach

Feasibility assessment

● Energy sector ● ETS ● Transport sector
● Average score **4** High feasibility
● **1** Low feasibility

Market failure	Measure	MT/LT min. of abatement costs	Political econ. & acceptability	Reallocation & distributional	Fiscal revenues & expenditures	Average score
Discrepancies in production costs between green and fossil alternatives	1 European Hydrogen Bank – Purchasing guarantees for renewable hydrogen to support producers through a fixed price payment to producers	4.0	3.5	4.0	1.0	3.1
	2 Contract for Difference (CfD) for electricity prices	4.0	3.0	4.0	1.0	3.0
Lack of incentive for less polluting choice	9 EU Emissions Trading Scheme (ETS) incl. coverage of new energy intensive sectors	4.0	2.5	3.0	4.0	3.4
	7 Fuel Quality Directive – Greenhouse gas emissions reduction targets for green product producers and/or suppliers	2.0	2.0	2.0	4.0	2.5

Comments on approach

- We assess feasibility of implementation based on a scheme's relevance to public authorities using a score ranging from one (least relevant) to four (most relevant)
- Relevance is assessed across several criteria, including but not limited to:
 - Short and medium/long-term minimization of abatement costs: How much financial support is considered, what is the impact?
 - Reallocation and distribution concerns: how fair will the support be perceived, what will be the income-distributional impacts?
 - Political economy & acceptability: how accepted will the measure be by stakeholders?
 - Fiscal revenues and expenditures: How dependent is the policy to annual budgets?

Finally, we consider combining the most able and feasible schemes to create hybrid mechanisms with enhanced effectiveness

Evaluate combinations of measures against overall market failures

Illustration of approach

Hybrid support scheme creation

Retained for combination 1

Retained for combination 2

Policy type	Subsidies to eliminate undesirable effect	Tradeable performance standards	Information sharing & voluntary approaches	Non-tradeable performance standards
Most able and feasible measures	Purchase guarantees for renewable H2	Incorporation targets of green energy in sectoral consumption	Tradeable voluntary certificates for green product	Incorporation targets for a green product specific to an industry
Rationale	Subsidies can be critical to kickstart uptake of green products in light of the green premium. As the competitiveness gap narrows, subsidies could be replaced by other mechanisms	Create an additional incentive for producers if incorp. Obligations can be traded and met with certificates	Demonstrate proof of sustainability. Ensure traceability of feedstock across the supply chain. Trading certificate can realize a subsidy for sellers in connection to incorp. obligations	Because of their non-tradeable nature, these should be complemented by other policy tools to enhance effectiveness

Hybrid scheme 1

Hybrid scheme 2



Comments on approach

- At this stage of the design phase, we have identified existing support schemes in other sectors addressing the target market failures, assessed transposability in the targeted sector resulting in a long-list of potential measures
- We then have assessed measures effectiveness and feasibility for public authorities resulting in a short list of potential measures for the targeted sector
- Now, we are evaluating the combination of measures to enhance their effectiveness towards eliminating the market failure
- Because there are generally no one-size-fits-all solution in this space, we recommend considering hybrid solutions combining different policy measures, that, together, mitigate their weakness and maximize their overall effectiveness in fill the identified gap to green production development

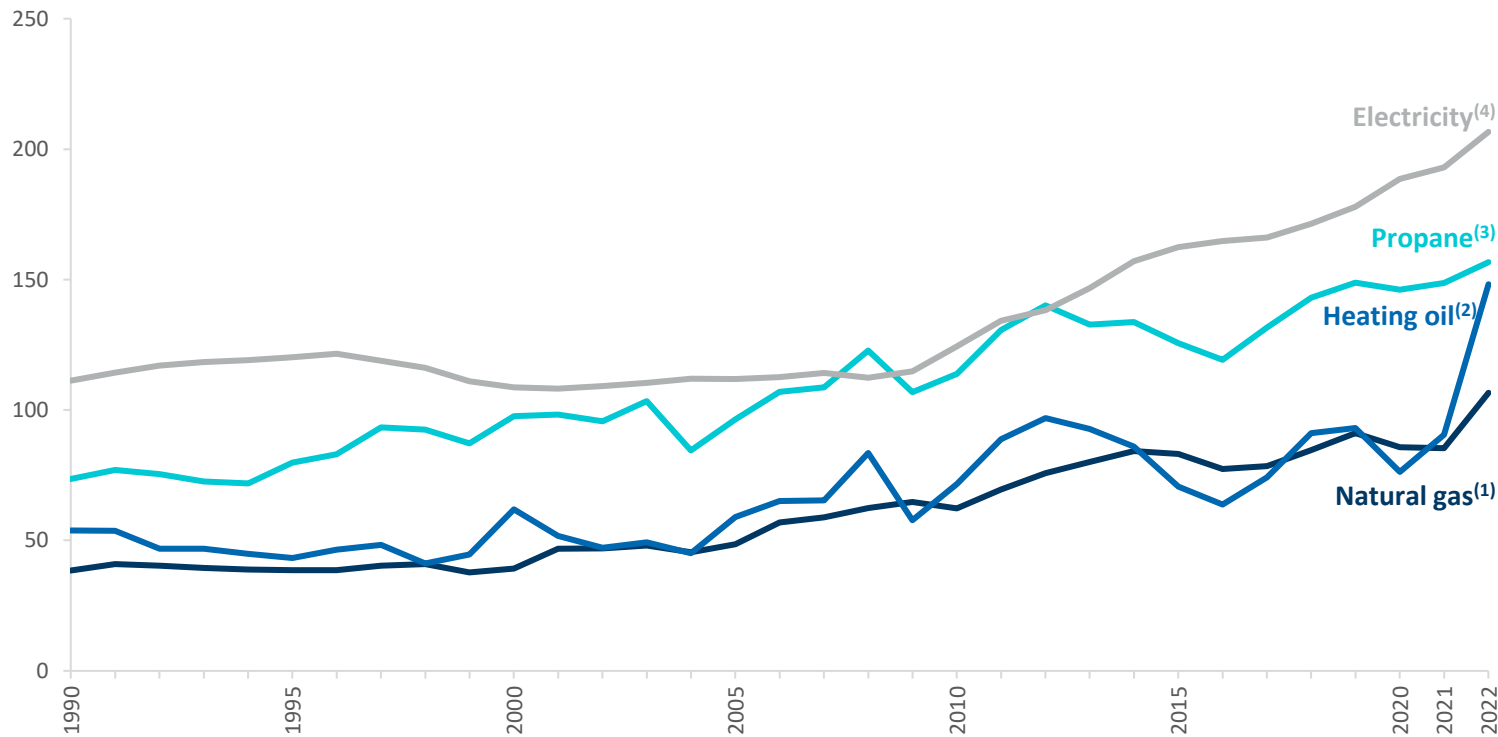
We review market prices and their future drivers to establish a baseline against which to measure change

Assess costs

Illustration

Price of energy for domestic heating per 1 MWh LCV, incl. VAT in France

EUR (current)



Price in 2022

EUR (current)

CAGR 2018-22

Percentage

207 EUR

+5%

157 EUR

+2%

148 EUR

+13%

107 EUR

+6%

Notes: LCV = Lower calorific value; VAT = Value-added tax; (1) and (4) Survey on the transparency of gas and electricity prices since 2007, natural gas consumption price index from 1990 to 2006; (2) Heating oil for deliveries between 2,000 and 4,999 liters.; (3) Propane in tankers.

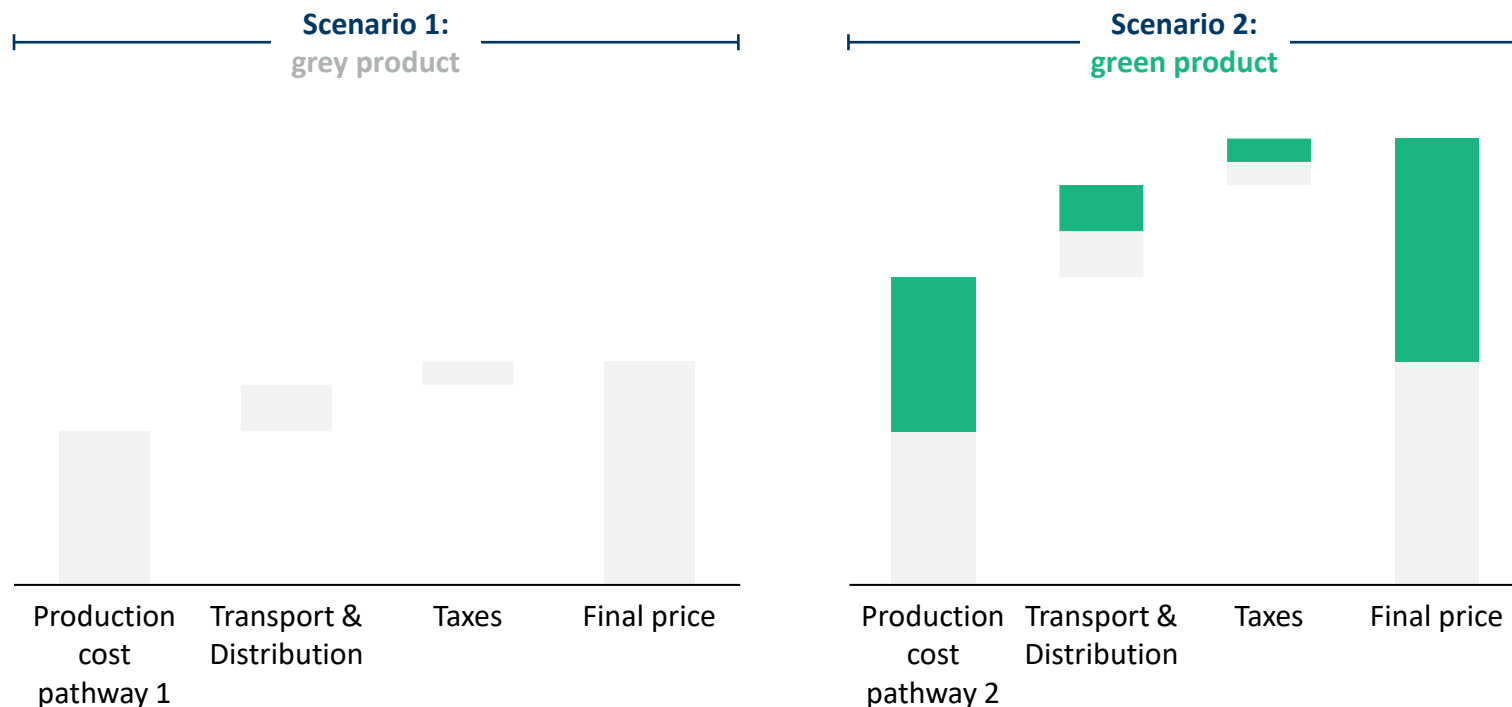
Source: French Ministry of the Ecological Transition.

Our approach to sizing a scheme involves a bottom-up assessment of the green premium considering several scenarios

Analyze cost differential green-grey product

Illustration of approach

Green premium scenario analysis based on a bottom-up assessment



Comments on approach

- To accurately find the optimal size of the support scheme, a detailed bottom-up production cost analysis is important
- This approach enables us to accurately assess the cost difference between green and grey products over time
- Scenario analysis is key to understanding how green product prices vary depending on, for example, different incorporation/blending rates, production pathways, end market...
- This assessment is important for estimating the budgetary requirements to be expected from public authorities (or other payees – for instance, obligated buyers)
- It is also a crucial step in providing a strong justification to unlock public intervention

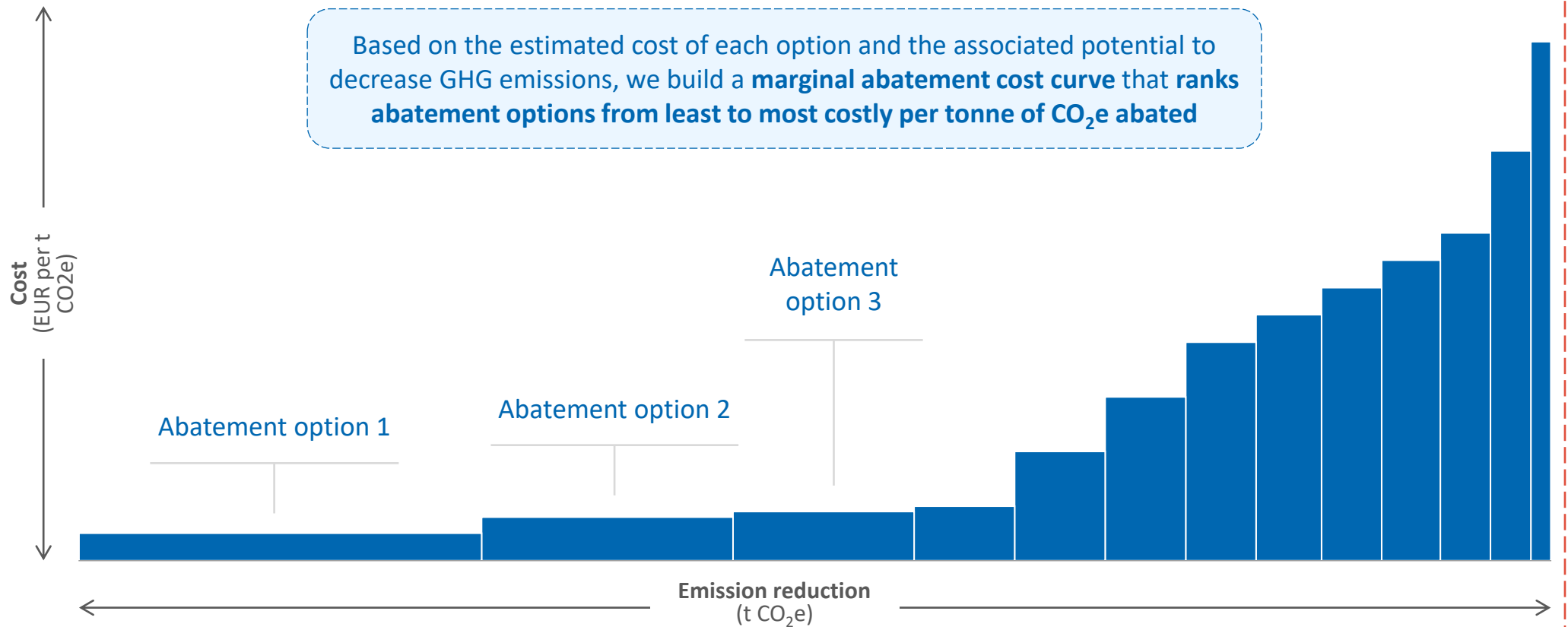
We test how prices vary depending on the production pathway or other changes in cost parameters

To create consensus and justify support, we quantify abatement costs to determine the most cost-effective way forward

Quantify implementation cost and GHG impact

Illustration of approach

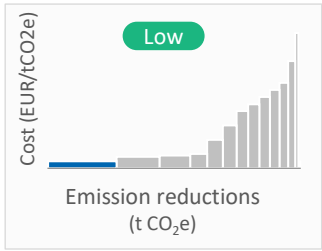
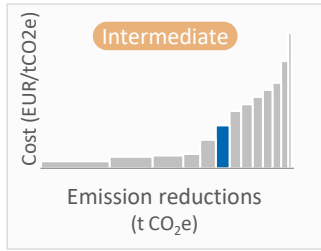
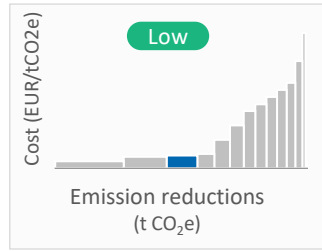
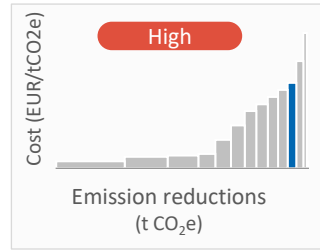




Marginal abatement cost curve



Finally, we build our recommendation based on shortlisted schemes, expected abatement cost, and implementation timeline

Conclusion on support schemes

Illustration of approach

	Hybrid scheme 1	Hybrid scheme 2	Hybrid scheme 3	Hybrid scheme 4
Support schemes that are feasible and address the market failure(s)	Purchase guarantees for renewable H2 Incorporation targets for a green product specific to an industry	Incorporation targets of green energy in sectoral Tradeable voluntary certificates for green product	<i>Combination 3</i>	<i>Combination 4</i>
Expected abatement cost				
Roadmap overview				
Ranking	1	3	2	4

Best feasibility and ability to address market failure, lowest abatement cost, and shortest implementation roadmap

Comments on approach

- At this stage, we have diagnosed the problem and identified the root cause creating a problem/gap that needs to be solved
- Then, we have explored transposing an existing scheme (or alternatively designing a new scheme), mapped the tools available to solve the market failure, and evaluated the best combinations of ability to fix the market failure and feasibility of implementation
- Finally, we have quantified the abatement costs to select the most cost-effective options and considered a high-level overview of the implementation roadmap
- Combining these three blocks, we're now able to make an informed recommendation that maximizes the chances of building cost-effective public support for decarbonization and justifies the need and proportionality of the support considered



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