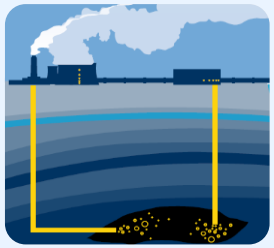

European funds for industrial CCS clusters

ZEP Advisory Council Meeting

16th June 2017

elementenergy

i2 4C
INDUSTRIAL INNOVATION FOR COMPETITIVENESS

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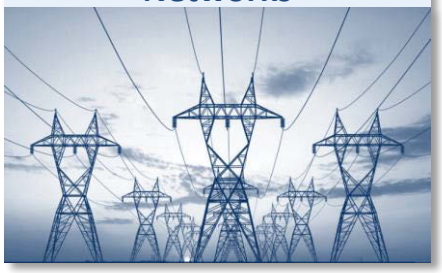
Element Energy is a leading low-carbon energy consultancy

- Element Energy is a **specialist energy consultancy**, with an excellent reputation for rigorous and insightful analysis in the area of low carbon energy
- We consult on both **technical and strategic issues** – our technical and engineering understanding of the real-world challenges support our strategic work and vice versa
- Element Energy covers all major low carbon energy sectors:

Smart Electricity and Gas Networks



Energy Storage

Carbon Capture and Storage

Hydrogen

Low Carbon Transport

Built Environment

I24C – PROMOTING EUROPEAN INDUSTRIAL LEADERSHIP

- i24c, the **Industrial Innovation for Competitiveness** initiative, is the European Climate Foundation's platform dedicated to developing and promoting an industrial strategy that secures European industry's competitive advantage through innovation.
- The initiative communicates an **evidence based narrative** to inform the critical debate on industrial policy. The approach of i24c is twofold:
  - ❑ I24c focuses on the extent to which Europe and EU member states can define industrial strategies that would in turn help Europe into an 'Entrepreneurial Union' capable of leading the world and stimulating purposeful innovation to meet "grand challenges."
  - ❑ Together with its partners, i24c undertakes holistic value chain analyses to **identify innovation and competitiveness potentials** along the complete value chain. Previous studies have taken an end-user approach and amongst others looked at the innovation potential in the energy, mobility and shelter value chains.

Project background

Project objectives

- To develop a **funding pathway for the use of existing EU funds and other financing instruments to leverage private investment and successfully deliver one industrial CCS cluster in Europe**.
- The funding pathway should address the **funding gaps and eligibility constraints** that have been highlighted by our work, and should include a **action list to align future funds to the project requirements** and **enable an industrial CCS cluster in Europe**

Acknowledgements

The project is led by Element Energy with valuable support from i24c. We gratefully acknowledge the following stakeholders for their support and comments:

- Andy Read (ROAD), Caterina De Matteis (IOGB), Chris Gittins (TAQA), Dominique Copin (Total), Keith Whiriskey (Bellona), Luke Warren (CCSA), Maria Velkova (DG CLIMA), Michael Schuetz (DG ENER), Randolf Weterings (Port of Rotterdam), Silvia Vaghi (GCCSI), Theo Mitchell (CCSA), Thomas Berly (IEA), Thomas Briggs (EIB), Vassilios Kougionas (DG Research), Wim Vanderstricthand (ArcelorMittal), and ZEP Network Policy and Economics members.

Agenda

- Development of an industrial CCS cluster in Rotterdam
- Funding and financing options
- Funding pathway and key actions

A variety of financial instruments and subsidies are required for different phases of industrial CCS cluster development

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PRE-FID (3-10 yrs)

- **Grants** for storage appraisal, feasibility studies and front-end engineering design
- **Funds and subsidies for all phases** defined and allocated
- **Investable business model**, regulatory framework and contractual arrangements

CONSTRUCTION (3-5 yrs)

- **Equity** from sponsors
- **Debt** from e.g. banks, EIB
- **Loan guarantees**, for parties with credit rating below investment grade*
- **Grants,** required if equity and debt insufficient to cover all costs

OPERATION (10-40 yrs)

- Reduced **carbon cost**
- Operating **revenues** to complement the above
- **Storage guarantees** to emitters
- **Volume guarantees** to T&S operator(s)

POST-CLOSURE (20+ yrs)

- **Cap** on storage liability and potential liability fund
- Sufficient revenues in the operation phase to cover **decommissioning costs**

A **single party** in charge of coordinating the cluster

*Loan guarantees are particularly important for first-of-a-kind projects, and may not be required in the future.

An industrial CCS cluster in Rotterdam can be developed in phases

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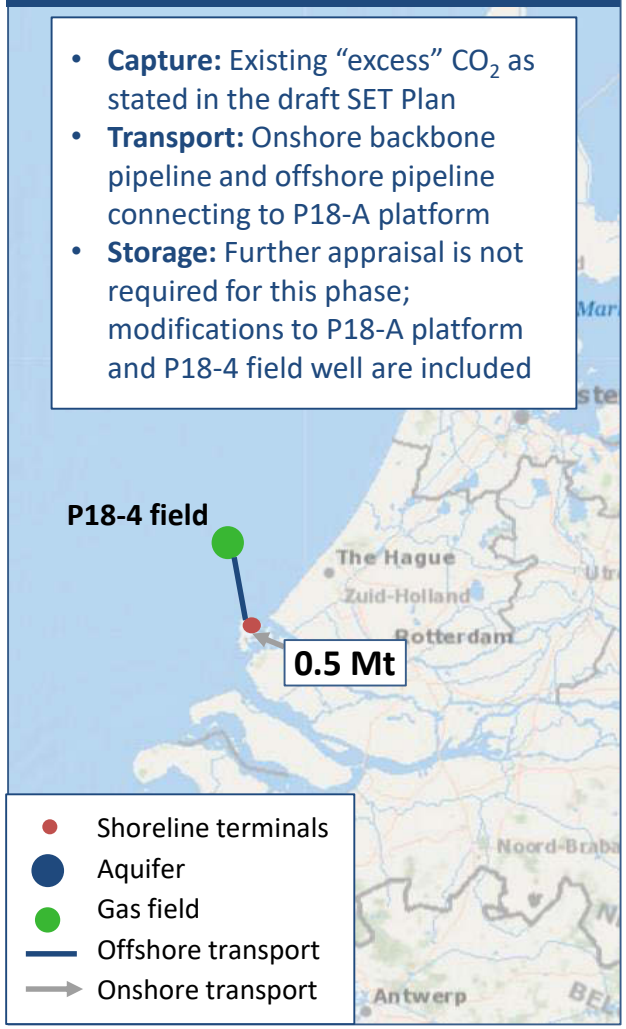
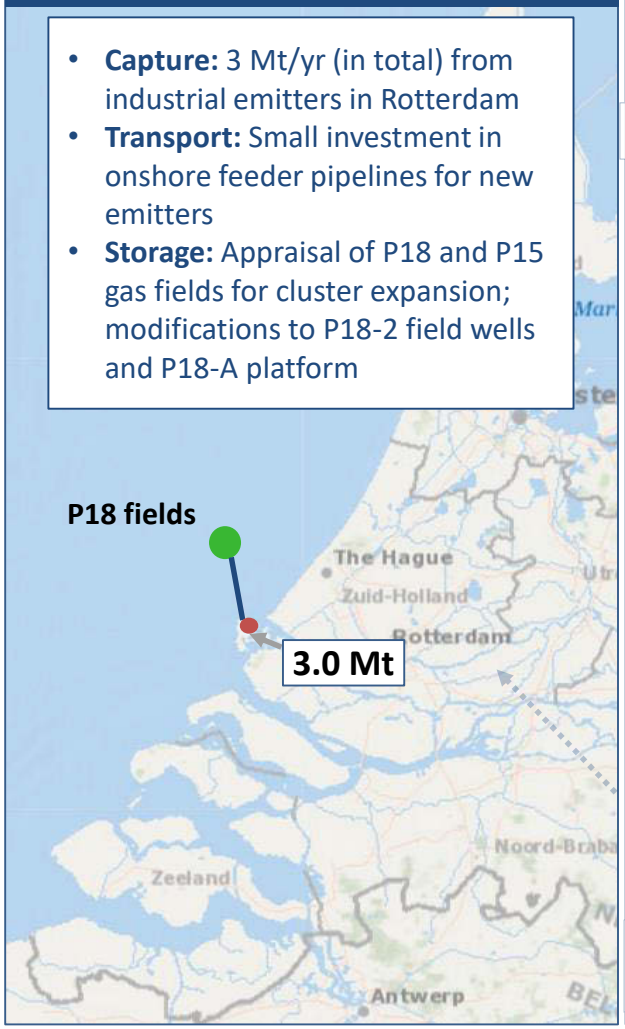
PHASE 1 (2021) *

- **Capture:** Existing "excess" CO_2 as stated in the draft SET Plan
- **Transport:** Onshore backbone pipeline and offshore pipeline connecting to P18-A platform
- **Storage:** Further appraisal is not required for this phase; modifications to P18-A platform and P18-4 field well are included

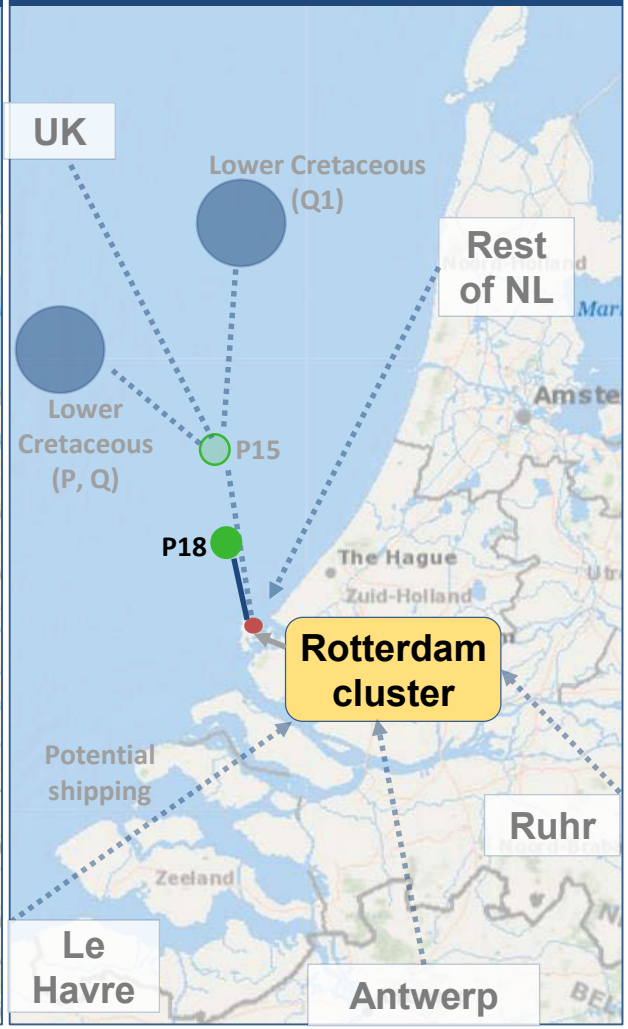


PHASE 2 (2026)

- **Capture:** 3 Mt/yr (in total) from industrial emitters in Rotterdam
- **Transport:** Small investment in onshore feeder pipelines for new emitters
- **Storage:** Appraisal of P18 and P15 gas fields for cluster expansion; modifications to P18-2 field wells and P18-A platform



PHASE 3 (2030 onwards)**



* Potential storage at Q16 is not shown as it is specifically part of ROAD and would not happen if ROAD does not go ahead.
**It should be noted that potential further expansion of the Rotterdam cluster in Phase 3 is not in scope.

Around €160million and €720million need to be secured for the first and second phases, respectively

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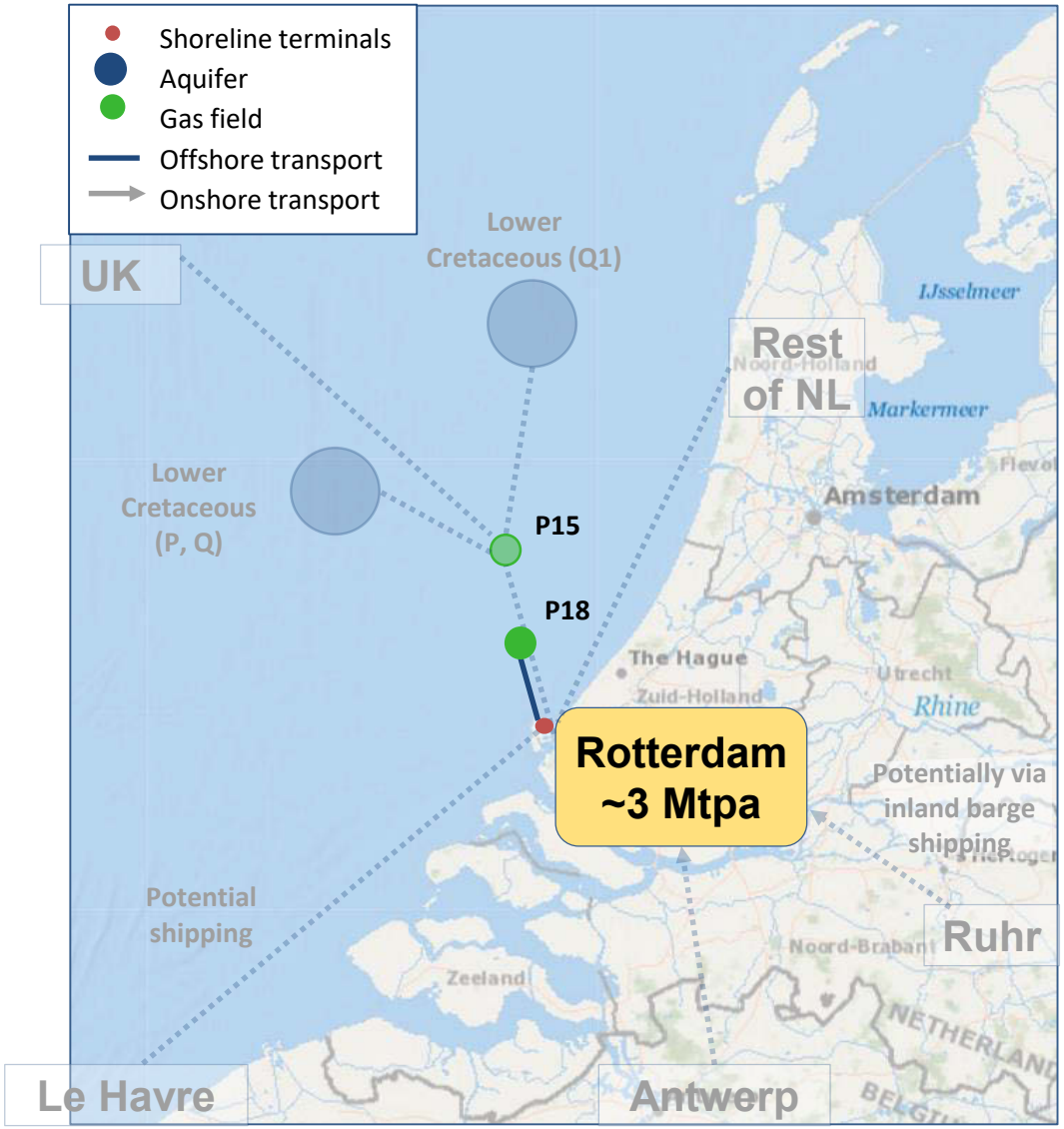

Representative emitters	Capture rate (Mtpa)	
	Phase 1	Phase 2
Existing CO_2	0.5	0.5
Refinery	-	0.5
Chemicals	-	1.0
Bio-ethanol	-	0.5
Hydrogen	-	0.5
Total	**0.5**	**3.0**

Phase 1 costs

	Pre-FID	*Construction*	*Operation*
Capture	-	-	€10m/y
Transport	€5m	€115m	
Storage	€5m	€35m	

Phase 2 costs

	Pre-FID	*Construction*	*Operation*
Capture	€20m	€570m	€120m/y
Transport	-	€50m	
Storage	€40m	€40m	

[1] 4% discount rate (€90-€120/t undiscounted). Low-end applies if operations last 20 years, high-end if only 10 years.

Small-scale Phase 1 project can be operational by 2021 and enable development of further phases

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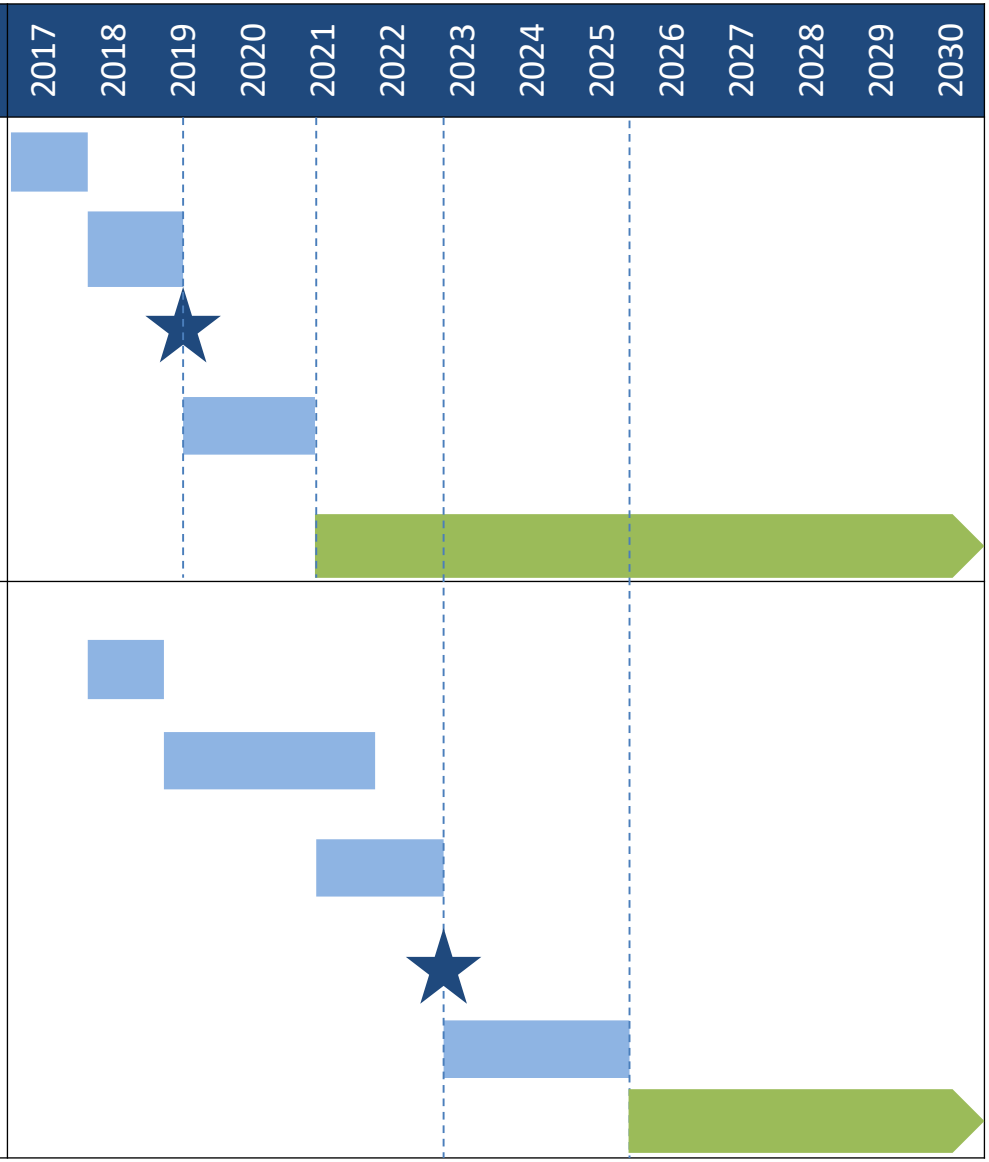
Illustrative timeline	
Phase 1	Secure 100% grant (€160million) for the pilot project
	Pre-FID
	Final investment decision
	Construction (Backbone onshore pipeline; offshore pipeline; mods to P18-A and P18-4 field)
	Pilot project is operational (0.5 Mt/yr)
Phase 2	Secure €60 million for appraisal of P18 and P15, and other pre-FID work for cluster expansion
	Pre-FID including appraisal
	Secure construction funds (ca. €660 million), operational revenues/ subsidies and guarantees
	Final investment decision
	Construction work
	Phase 2 is operational (3 Mt/yr)



[1] Pre-2020 availability conditional on early call in 2018.

[2] Horizon 2020 relevance depended on scope of future calls under current framework programme.

Levelised cost of delivering a 3Mt/yr industrial CCS cluster in Rotterdam could be less than €50/tCO_2 (abated) depending on project lifetime

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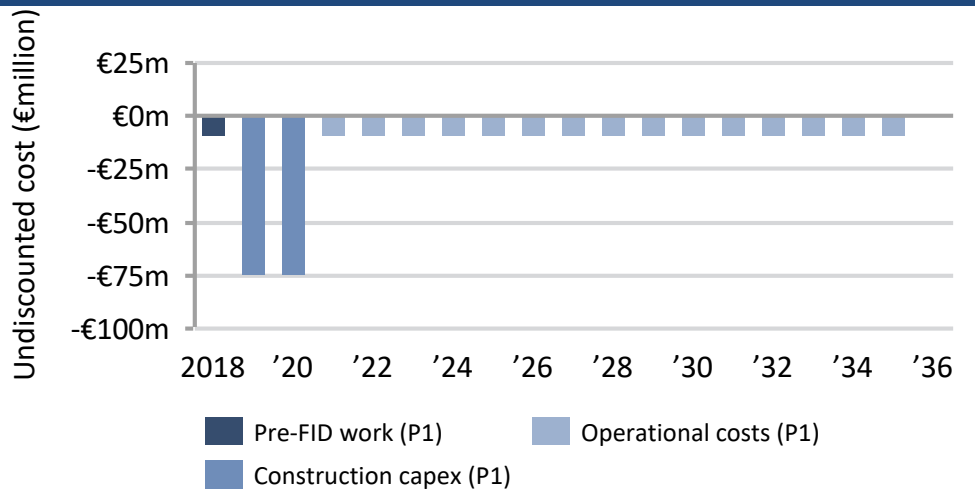
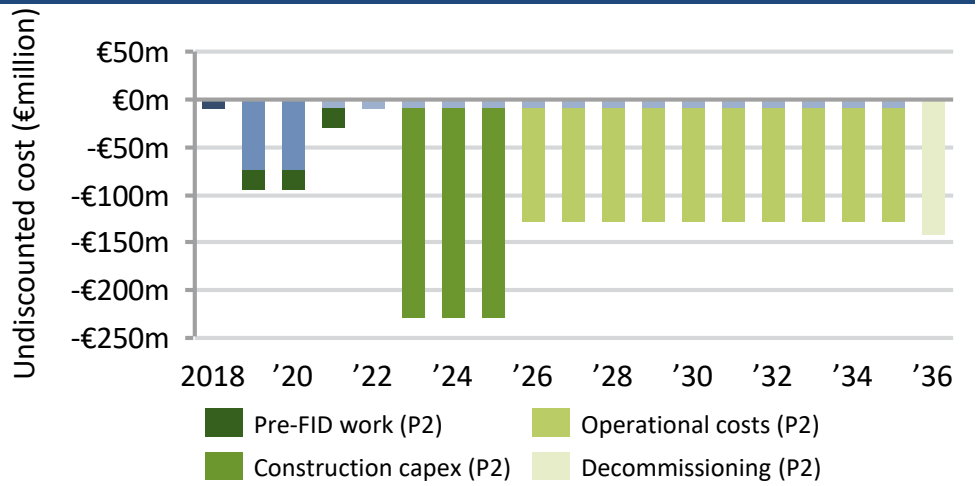
Phase 1 costs (annual)



Phases 1 and 2 combined costs (annual)



Levelised cost of abatement

Assuming CO_2 storage until 2035	Phase 1	All project
Discounted lifetime costs	€240m	€1,580m
CO_2 storage (Mt, undiscounted)	7.5	32.5
CO_2 abatement (Mt, discounted)	4.7	22.9
Unit cost (€/t$CO_{2\ stored}$)	€32	€49
Levelised cost of abatement (€/tCO_2)	€51	€69

Assuming CO_2 storage until 2045		
Discounted lifetime costs	€270m	€1,850m
CO_2 storage (Mt, undiscounted)	12.5	62.5
CO_2 abatement (Mt, discounted)	6.6	37.2
Unit cost (€/t$CO_{2\ stored}$)	€22	€30
Levelised cost of abatement (€/tCO_2)	**€41**	**€50**

[1] Pre-2020 availability conditional on early call in 2018.

[2] Horizon 2020 relevance depended on scope of future calls under current framework programme.

Agenda

- Development of an industrial CCS cluster in Rotterdam
- Funding and financing options
- Funding pathway and key actions

Key findings – Fund blending options

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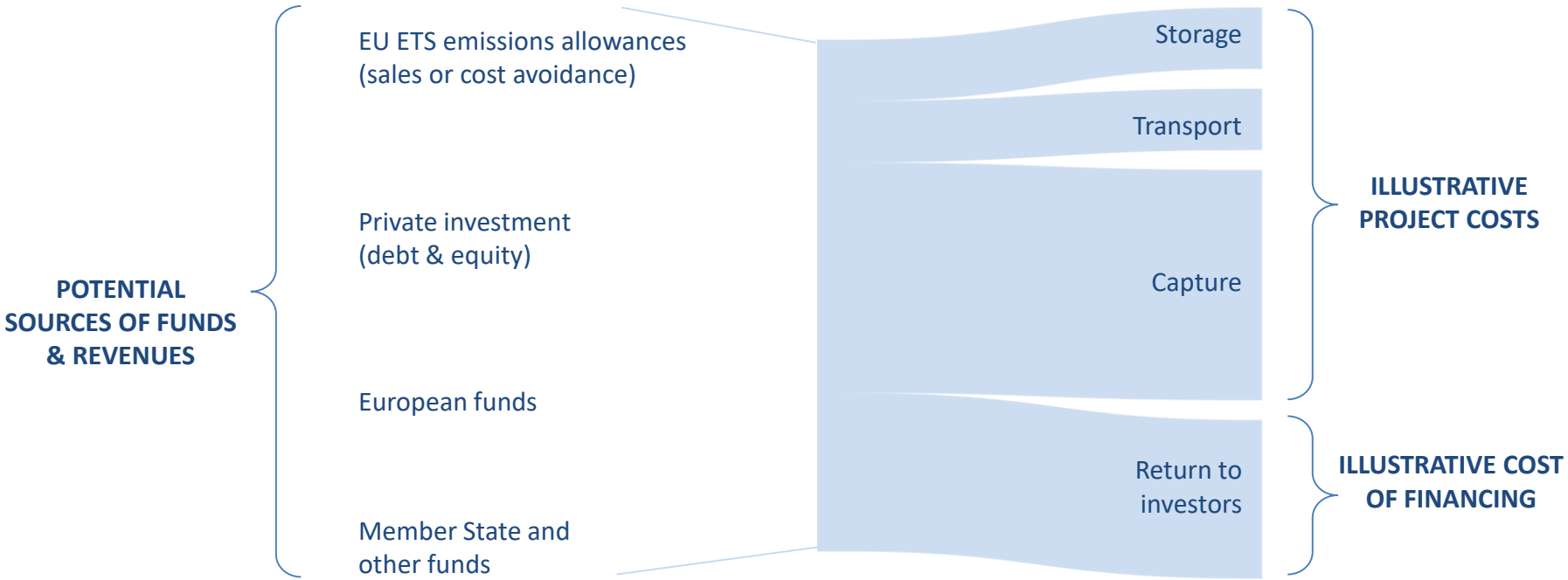

Although industrial grants that are privately funded may exist, none of potential relevance was found.

Over €1bn of ETS-related revenues can be bankable, if accompanied by guarantees

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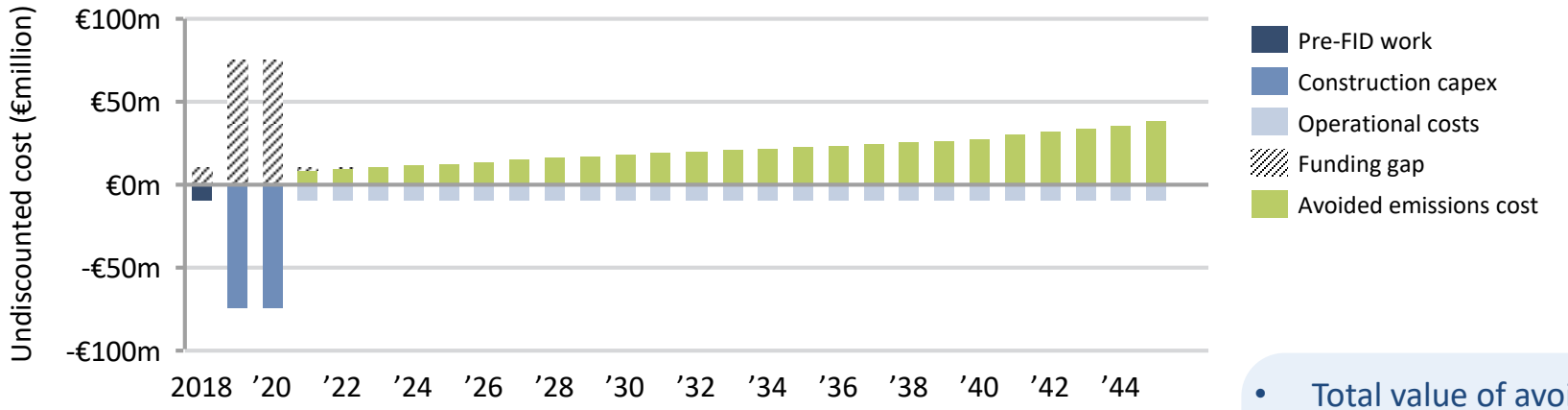
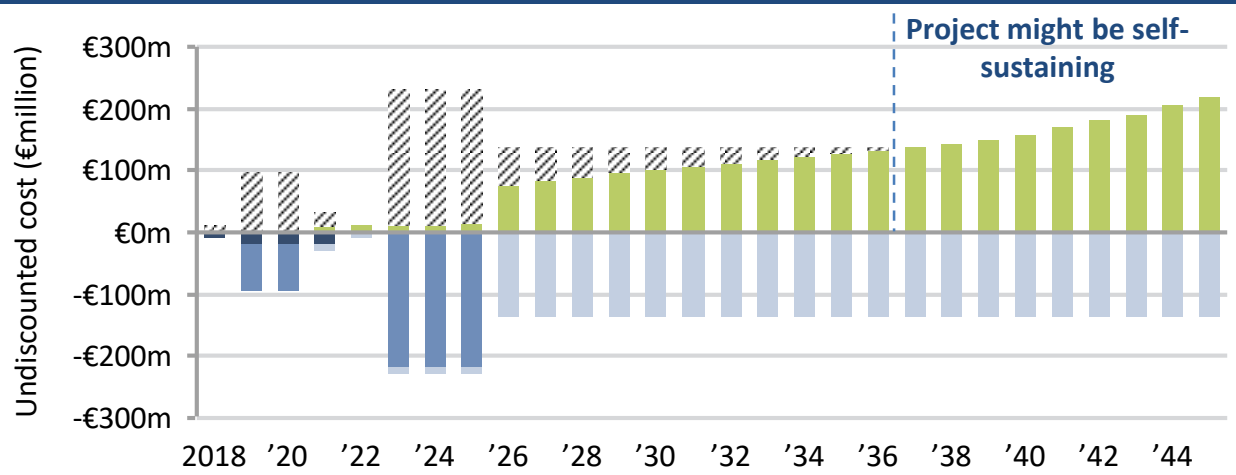
Funding gap for Phase 1 is ~€160m



Funding gap for Phases 1 and 2 combined is ~€1.2bn



- Total value of avoided CO_2 emissions could be ~€1bn until 2035 and more than €2.5bn until 2045; however, these revenues should be accompanied by guarantees.
- A funding gap exists until the late '30s based on the EU ETS price forecast used, which is based on EU 2016 Reference Scenario, updated to 2017 values.

*Operational costs included an annual fee for funding of decommissioning plan similar to "Funded Decommissioning Programme" for nuclear

Loan guarantees can unlock private investment, but this shifts the funding gap from construction to operation

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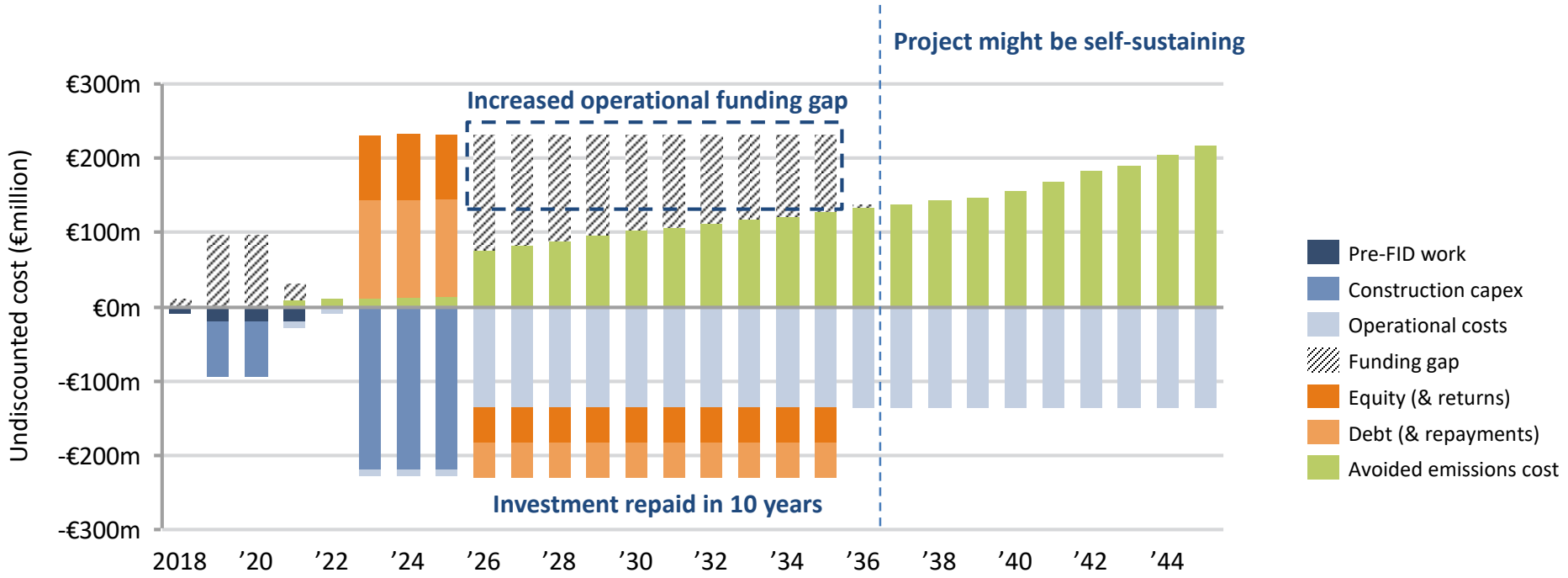

- **Debt:** Loans and other debt instruments from the EIB & commercial banks with long maturity (e.g. ~10-year) and low-interest rate (e.g. 3%) might be available for bankable projects with the right guarantees (i.e. loan guarantees);
- **Equity:** Depending on balance sheet capacity, it could be obtained from industrial shareholders or 3rd party sponsors - high cost of equity (target ROE of 10%-15%) means that, for each €1 invested, €2 of public funds needed.

EU funding options are limited at present but important funds are expected to become available in 2019-2021

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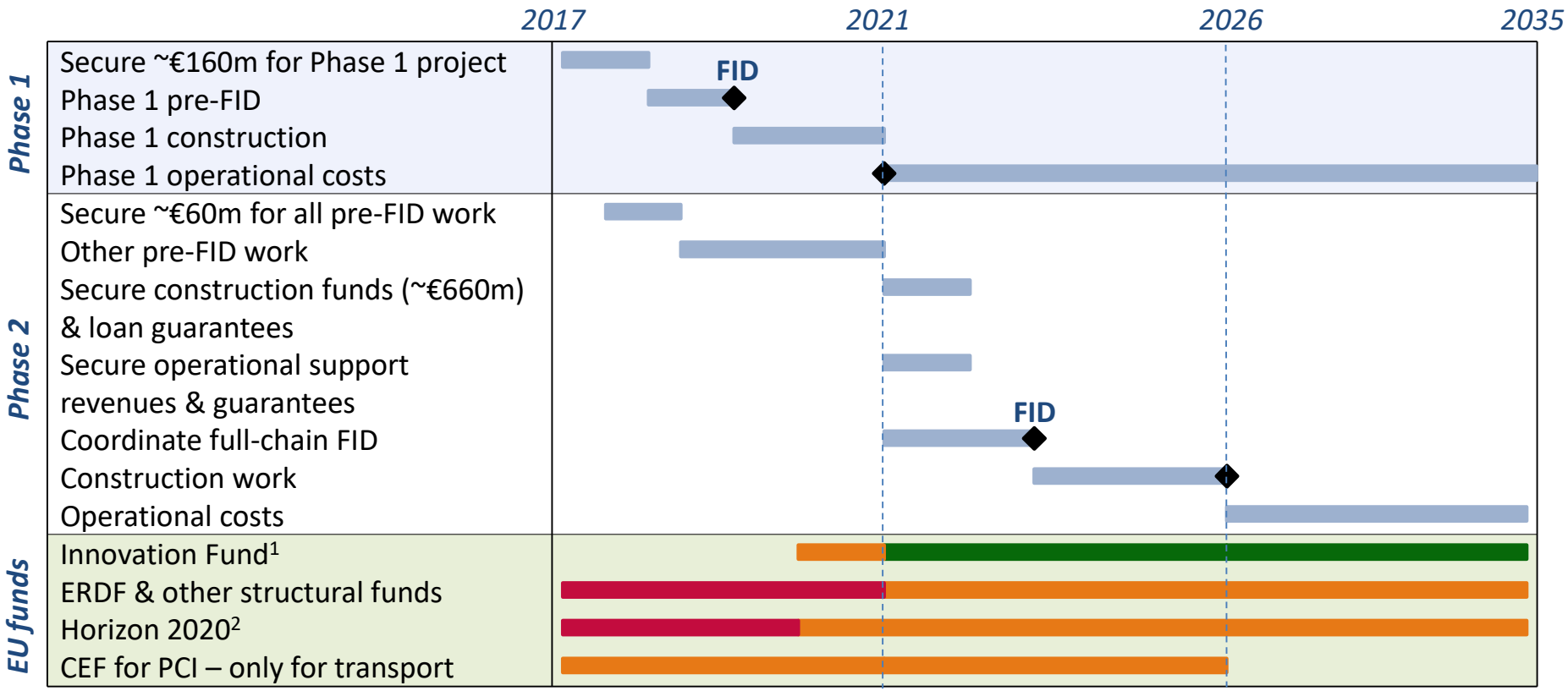
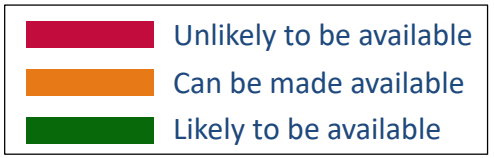


- **Innovation Fund** can fill ~60% of the funding gap, but its CCS budget might be constrained by both competition and emission allowances auction price.
- **Member States** are expected to address the funding gap, and could part-fund their budget via the emission allowances' auction and via ESI funds.
- **The ESI funds** could help address this remaining funding gap if CCS eligibility is not limited to R&I projects.



[1] Pre-2020 availability conditional on early call in 2018.

[2] Horizon 2020 relevance depended on scope of future calls under current framework programme.

With support from Member State (possibly part-funded via ESI funds), the project could be fully funded

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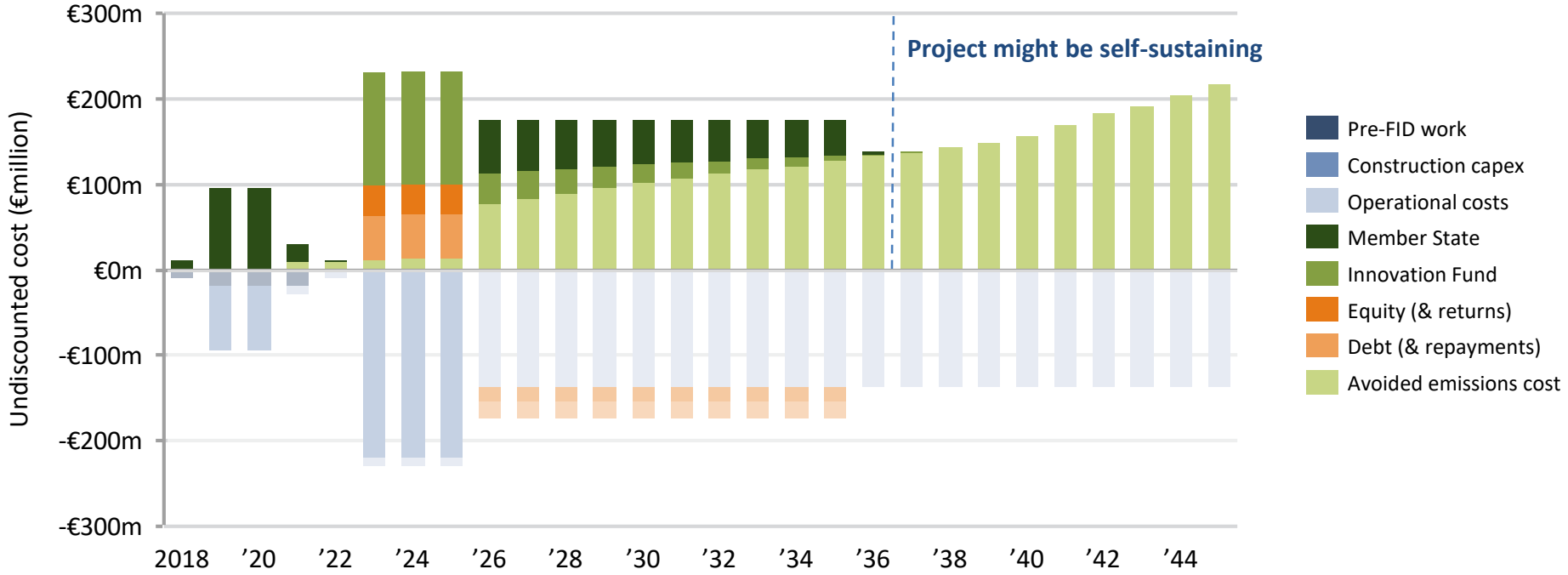

Split of funds until 2035

€million (undiscounted)	Pre-FID	Constr.	Ops.	Total
Carbon savings	0	0	1,070	**1,070**
Private investment	0	260	0	**260**
EU via Innovation Fund	0	400	210	**610**
MS contribution	70*	150**	510***	**730**
TOTAL	**70**	**810**	**1,790**	**2,670**

- ~€600m in EU Funds could lead to additional investments of €1.3bn from private sector and member states, a **3x leverage factor.**
- Member States are expected to provide the required guarantees as well as a cap on storage liability, and their budget can be part-funded via the auction of emission allowances and Structural Funds.

*Pre-FID can be part-funded by potential H2020 funding on storage appraisal; **Can be part-funded by CEF if project achieves PCI status; ***Can be part-funded by Structural Funds as explained above

Agenda

- Development of an industrial CCS cluster in Rotterdam
- Funding and financing options
- Funding pathway and key actions

Summary of key actions to deliver an industrial CCS cluster in Rotterdam

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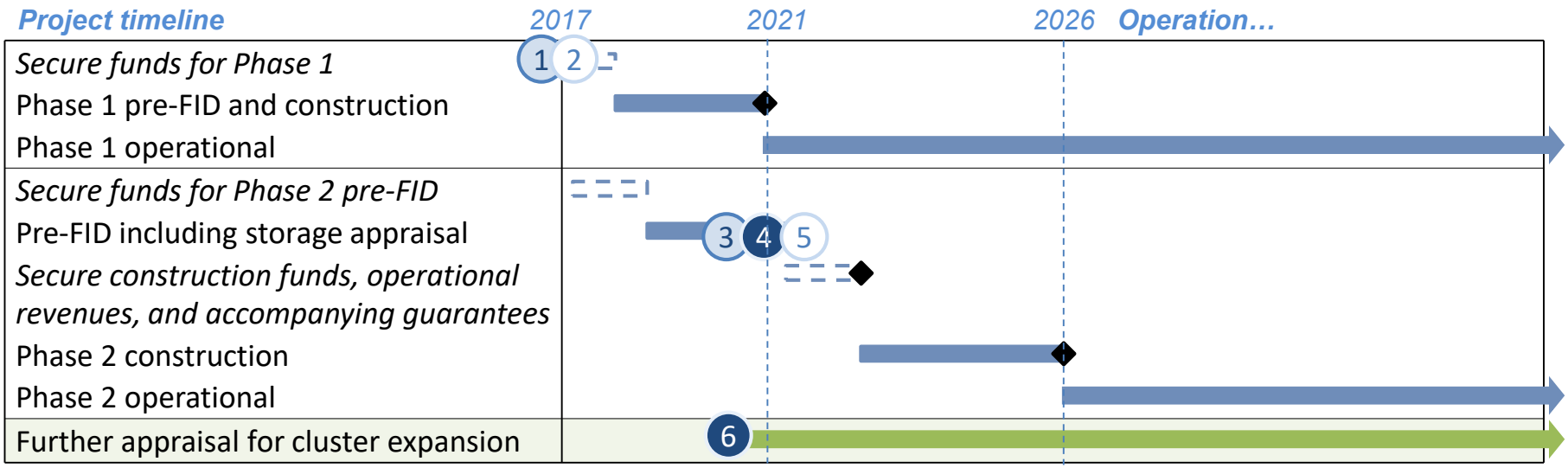

Dutch Government

1
- Set up funds for Phase 1 funds pre-FID work (€160m) and Phase 2 pre-FID work including appraisal (€60m)

3
- Establish a regulatory framework for industrial CCS
- Set up funding mechanism to offer subsidies, guarantees, and a cap on storage liability.

Rotterdam-based industrials & project developers

2
- Set up a project/cluster representative (e.g. via SPV)
- Secure grant funding for Phase 1 project and Phase 2 pre-FID work including storage appraisal

5
- Define cluster business model
- Apply for project finance, EU and government support

EU Institutions

4
Create sufficient budget for (commercial) industrial CCS by
- Option 1: Ring-fence large part of Innovation Fund & change ESI funds' eligibility criteria
- Option 2: set up new CCS fund & create market maker

6
Create funds for further storage appraisal in Europe

Recommendations for the European Commission

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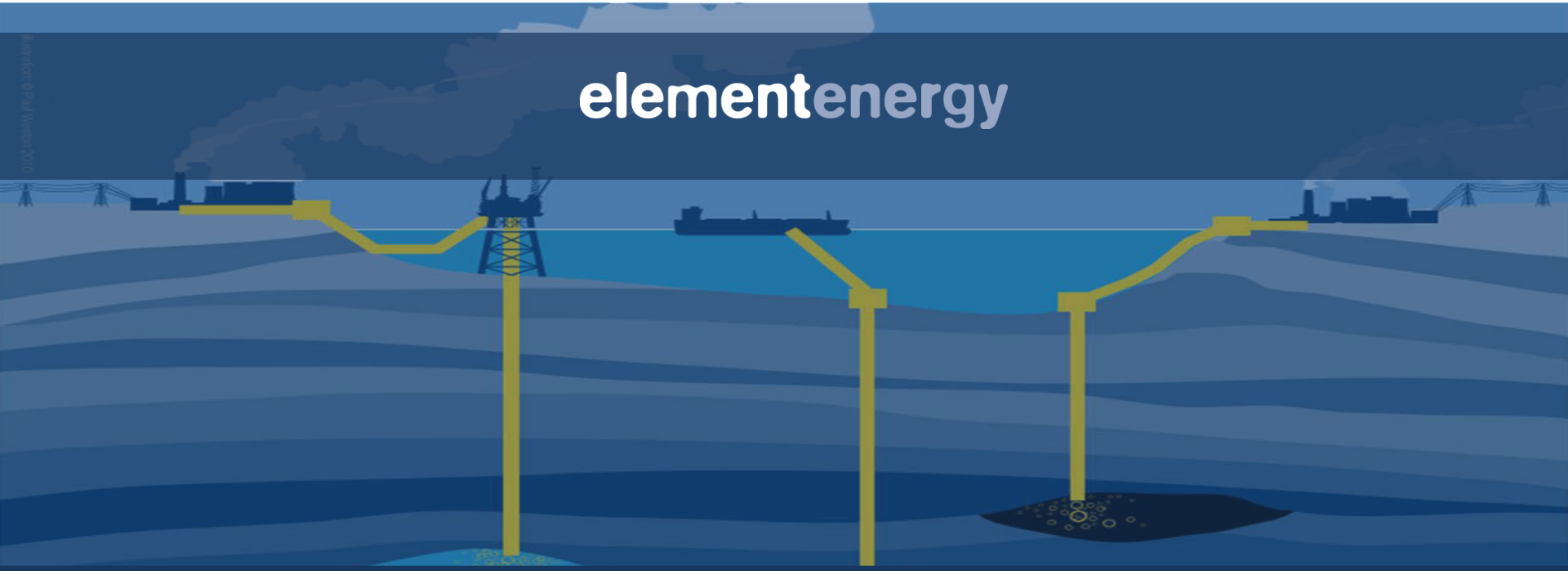
ADDRESSING FUNDING GAP FOR STORAGE APPRAISAL AND OTHER PRE-FID ACTIVITIES

- **No EU funds are available today for storage appraisal**, which undermines future project developments.
- **An initial funding of €40-50m now for storage appraisal** would suffice for an industrial CCS cluster in Rotterdam to progress.
- Each industrial CCS cluster in Europe might require **€50-100m** depending on the size of the cluster.

MAXIMISING EFFECTIVENESS OF INNOVATION FUND

- **Ring-fencing a substantial part of Innovation Fund budget for industrial CCS** might enable the deployment of several industrial CCS clusters.
- If ring-fencing is not possible, **eligibility and selection criteria** should be designed to allow industrial CCS clusters/projects to have access to sufficient funds.
- **Allowing upfront funding (pre-fid and construction)** and **creating funding mechanisms that match the typical project requirements** are crucial; however, funds should not be linked to strict FID and financial closure deadlines.

UNLOCKING EUROPEAN STRUCTURAL AND INVESTMENT FUNDS FOR INDUSTRIAL CCS

- Innovation Fund budget will depend on the ETS auction revenues so it might not be sufficient to deliver 3-5 clusters by 2030, and **ESI funds are not currently available for deployment of industrial CCS clusters**.
- Since the ESI funds could provide a large additional budget, **adding an exception to the ESI Funds eligibility rules for industrial CCS projects** could address regulatory constraints that exclude the support of activities listed in Annex I of the ETS directive (and consequently of high-TRL CCS applications). This could be justifiable considering the funding stall caused by the risk of carbon leakage.
- Member States could use ESI funds in part to provide the required **subsidies and guarantees**.

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