

Net-Zero Basque Industrial SuperCluster



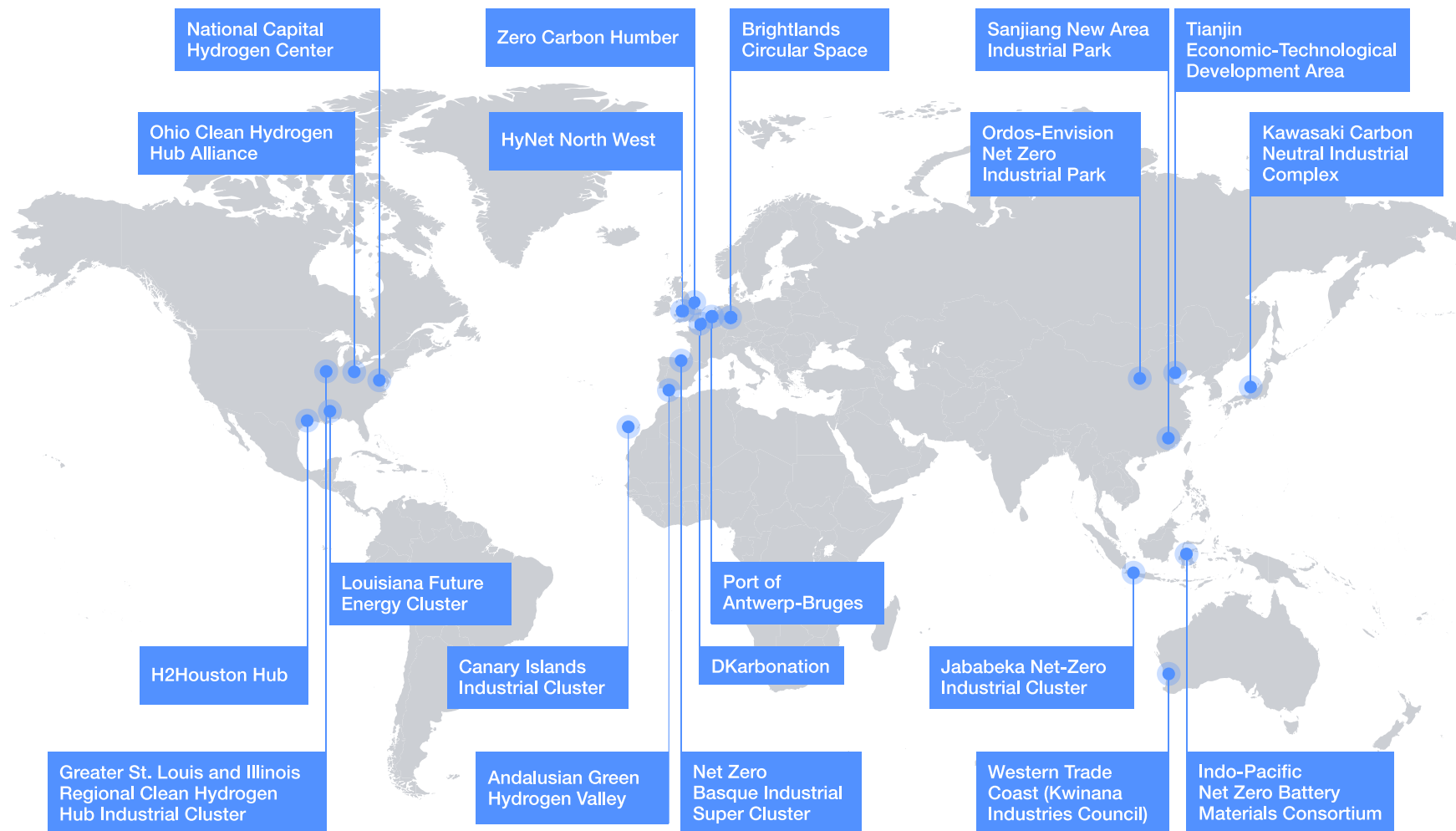
EKONOMIAREN GARAPEN,
JASANGARRITASUN
ETA INGURUMEN SAILA
DEPARTAMENTO DE DESARROLLO
ECONÓMICO, SOSTENIBILIDAD
Y MEDIO AMBIENTE



November 2023

The decarbonization strategy for industrial activity in the Basque Country joins the World Economic Forum's Transitioning Industrial Clusters towards Net-zero project with the creation of the Net-Zero Basque Industrial SuperCluster

The initiative currently involves 20 industrial clusters and is expected to reach 100 regional industrial clusters in the coming years.



626 Mt CO₂

Abated emissions represented



3.4 million

Direct/indirect job represented



\$362 billion

GDP contribution represented



[Transitioning Industrial Clusters towards Net Zero - World Economic Forum \(weforum.org\)](https://www.weforum.org/projects/transitioning-industrial-clusters-towards-net-zero)

The Net-Zero Basque Industrial SuperCluster aims to accelerate the path to net zero emissions in the Basque Country, fostering energy supply decarbonization and energy efficiency in the industrial sectors and creating market opportunities based on the scale-up of the new technologies and innovative services

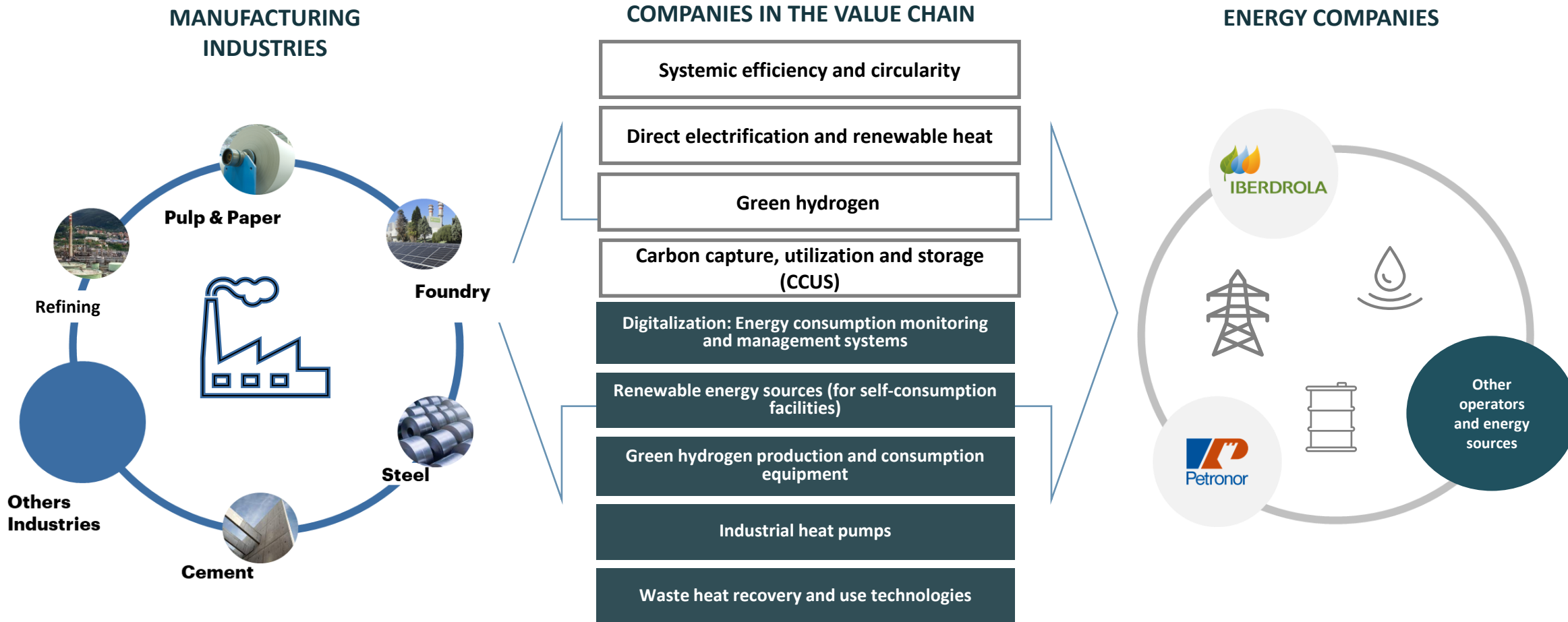
- Super Cluster because it will **integrate the industrial clusters** (industrial associations) already operating in the Basque Country, enabling and facilitating **coordination and synergies within the key Industries**
- Collaboration and commitment** between the government and **the key energy companies** operating in the geographic area, to develop and implement roadmaps on an industry basis to reduce industrial emissions and achieve net-zero targets.
- With an initial focus to **target five Industries up to 68% of total GHG emissions** in the following sectors: pulp & paper, cement, refining, steel and foundry. Other industries where **decarbonization opportunities can be achievable in the short term** will also be considered.
- Search for **common objectives** to enable the **development of zero balance technologies** through the development of cluster-specific roadmaps to achieve zero balance targets.



 <p>GDP 2B€ to 3B€ (>2030) (3%-5% of GDP 2021)</p>	 <p>Jobs 20k to 30k (>2030) (2-3% of Jobs 2021)</p>	 <p>Emissions reduction 100% emissions reduction generated by industrial sector energy consumption by 2050</p>
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The SuperCluster aims at developing a robust, innovative industrial ecosystem where technology innovations serve as key driver of the energy transition and decarbonization

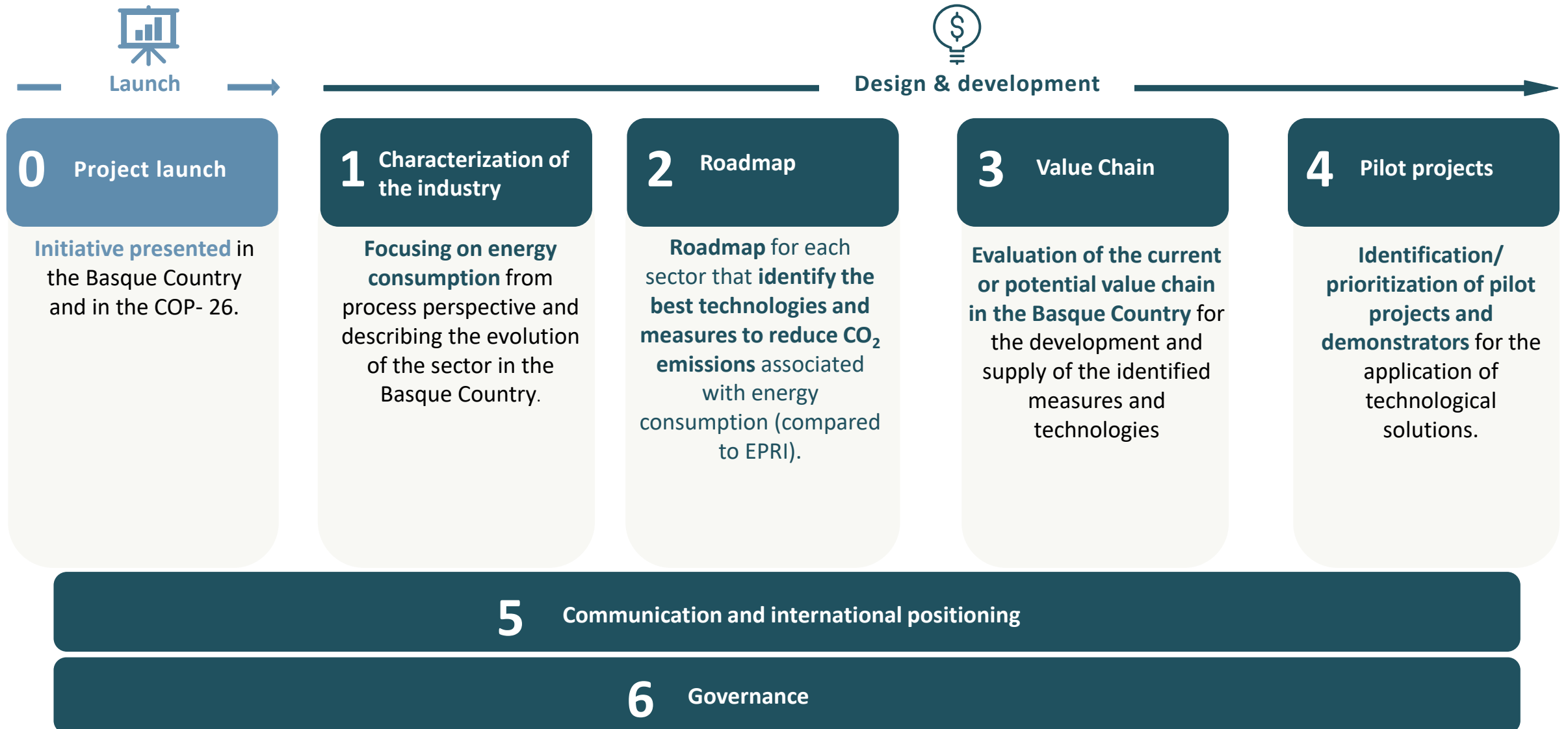
TECHNOLOGIES AND INNOVATIVE SERVICES DELIVERED BY COMPANIES IN THE VALUE CHAIN



Basque Science, Technology and Innovation Network

International alliances (WEF, EPRI, MIT...)


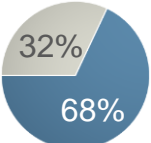





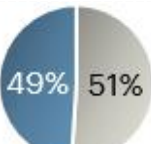

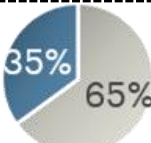
The SuperCluster's activity is based on a four-phase technical development project and two continuous lines of work that allow for its deployment in local and international collaboration



Characterization of the industry

The characterization has focused on energy consumption and the processes that concentrate higher emissions

● Thermic consumption ● Electric consumption

	Production plants	Energy consumption	GHG emissions [kt CO ₂ eq./year]	Emission factor [Kt CO ₂ eq/Kt product]
 Pulp&Paper	10		462	0,34*
 Refining	1		2.144	0,22
 Cement	3		1.002	0,44
 Steel	8		862	0,28
 Foundry	49		212	0,50

* Aggregated for Pulp & paper production

Roadmaps

Measures have been classified according to the level of technological readiness and the WEF methodology

Technological measures:



- Based on technologies with a low level of maturity that will require development in the coming years. Identification of technological challenges together with EPRI.



- Based on technologies with a certain level of technological maturity, already available in the industry.

Non-technological measures:

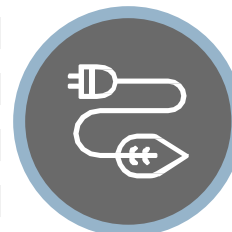


- Based on different solutions for management, regulation, procurement, etc. that can contribute directly and indirectly.

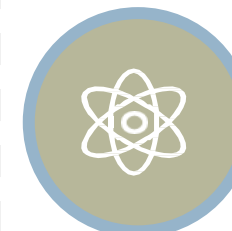
Strategic lines based on the WEF pillars



Energy efficiency and circularity



Electrification and alternative sources



Green hydrogen

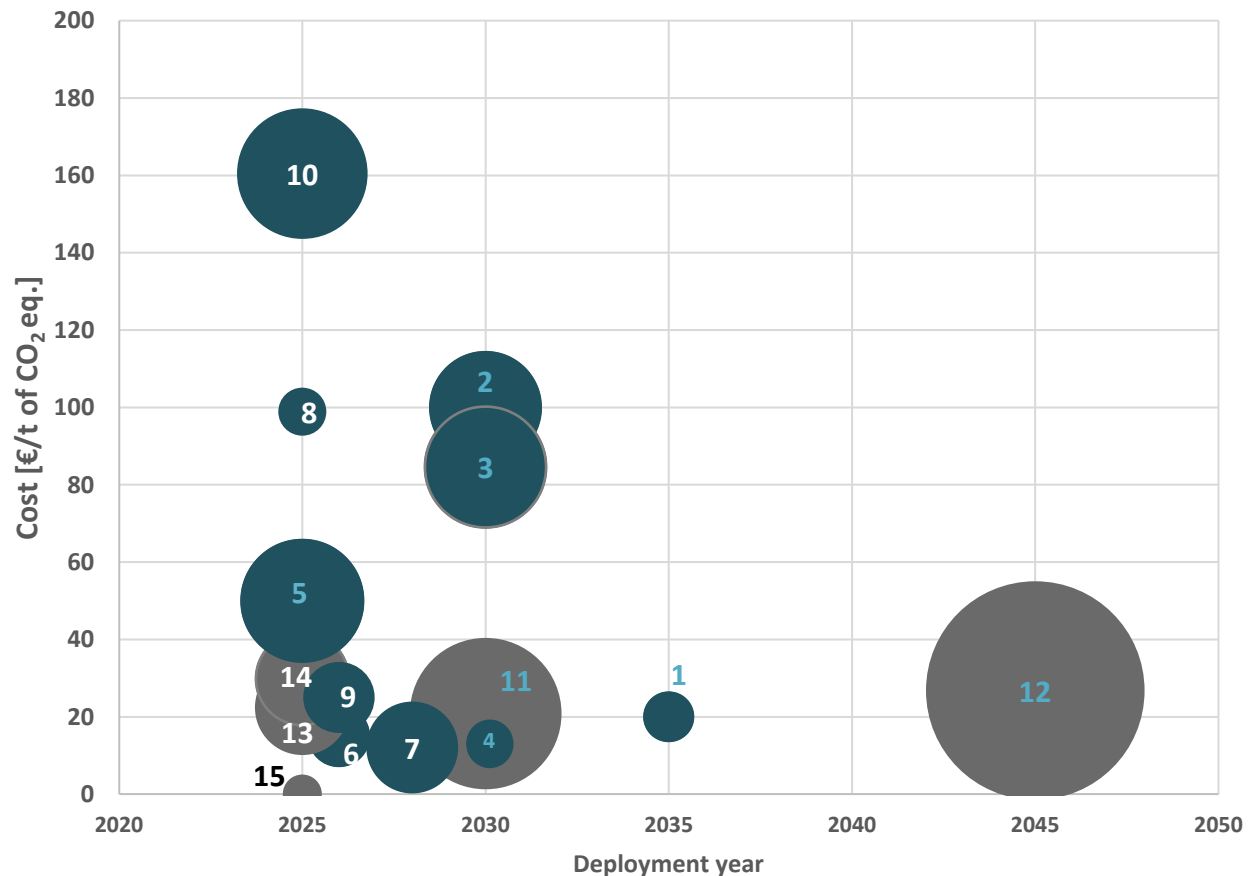


Carbon Capture, Use and Storage (CCUS)

Roadmap - PULP & PAPER

Maximum potential for abatement of technological measures in need of development and commercially available

Maximum abatement potential (t of CO₂ eq./year)



Systemic efficiency and circularity

1. Mild repulping process
2. Deep eutetic solvent
3. Innovative mechanical drying systems
4. Use of pulping enzymes.
5. Cellulose micro-nanofibers.
6. Use of non-wood fibres
7. Digitalization and AI for process control
8. Use of conical refining techniques
9. Higher use of recycled pulp.
10. Heat recovery from the process



Direct electrification and renewable heat

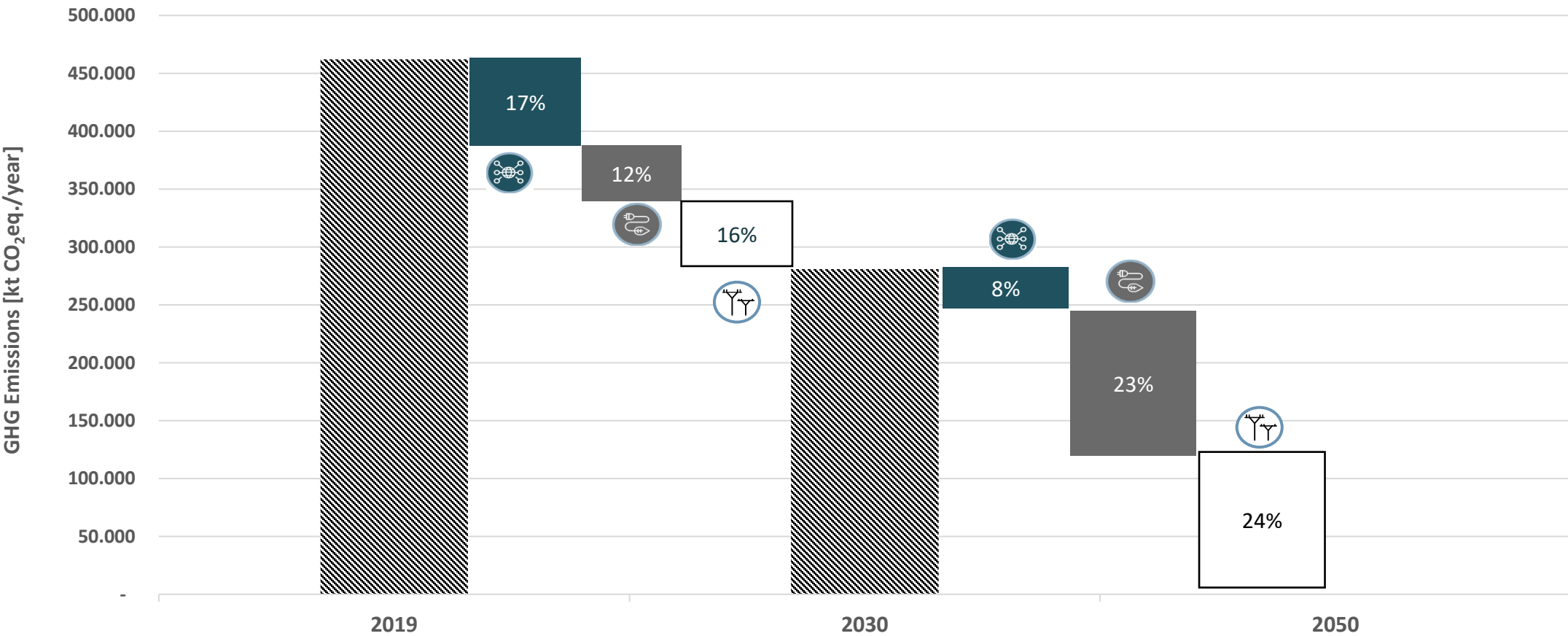
11. Electrification of the process through heat pumps
12. Drying by electrical forces
13. Waste and sludge gasification at the water treatment plant
14. Pyrolysis of by-products
15. Renewable energy generation on site



Technological measures in need of development

Roadmap - PULP & PAPER

The cumulative contribution of each of the decarbonization axes has been plotted in each of the time periods



Energy efficiency and circularity



Electrification and alternative fuels



Green hydrogen



CCU

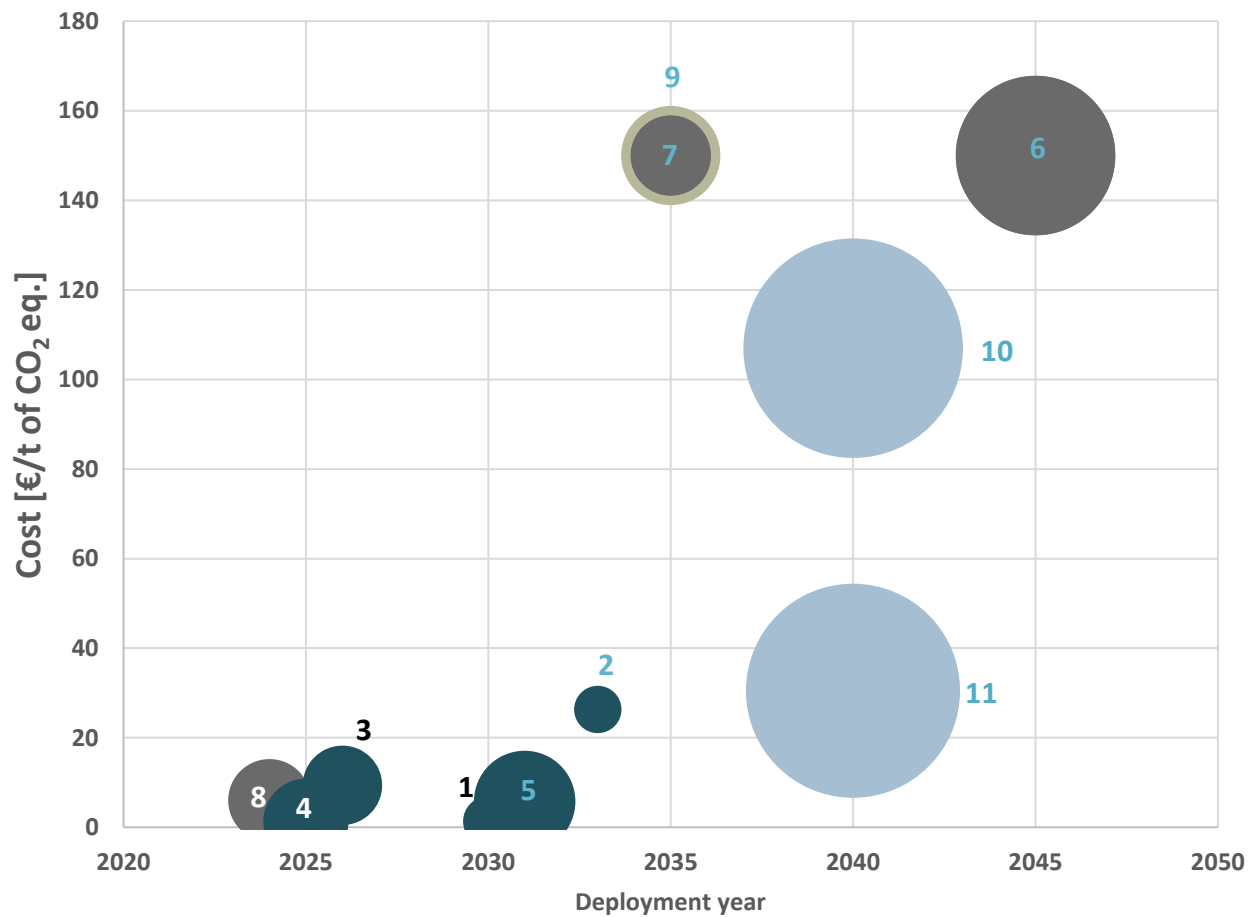


Increase of renewables in the energy mix

Roadmap - CEMENT

Maximum potential for abatement of technological measures in need of development and commercially available

Maximum abatement potential (t of CO₂ eq./year)



Energy efficiency and circularity

1. Digitalization and AI for process control
2. Ordinary portland cement from new non-carbonate limestone sources
3. Use of oxycombustion
4. Fuel properties optimization
5. Alternative additions and their activation



Electrification and alternative sources

6. Electrolyser for CaO decarbonation of calcium carbonate prior to clinker production in the kiln
7. Electrification of the clinkering process using microwaves
8. Co-processing of refuse-derived fuel (RDF)



Green hydrogen

9. Partial use of hydrogen as a fuel in the kilns



Carbon capture, use and storage

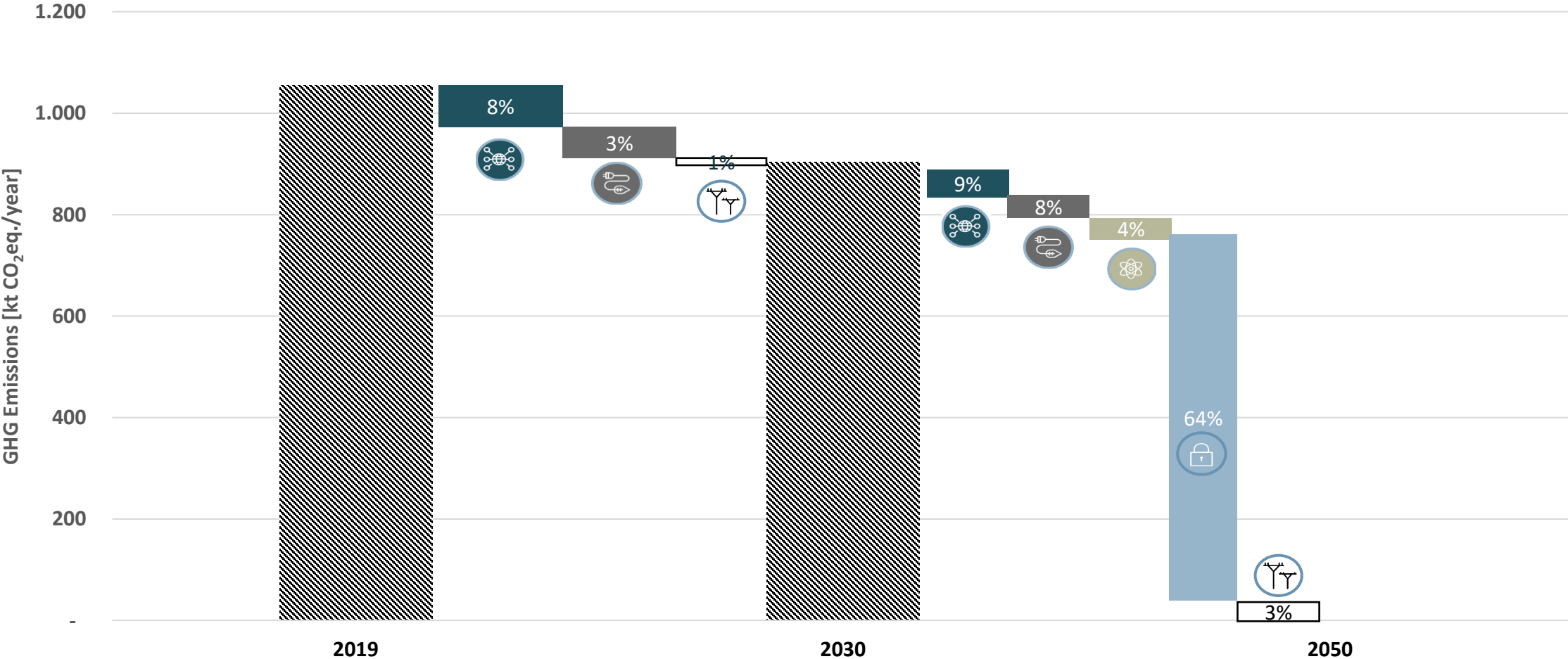
10. Carbon capture
11. Indirect heating (split-stream furnace) with carbon capture



Technological measures in need of development

Roadmap - CEMENT

The cumulative contribution of each of the decarbonization axes has been plotted in each of the time periods



- Energy efficiency and circularity
- Electrification and alternative fuels

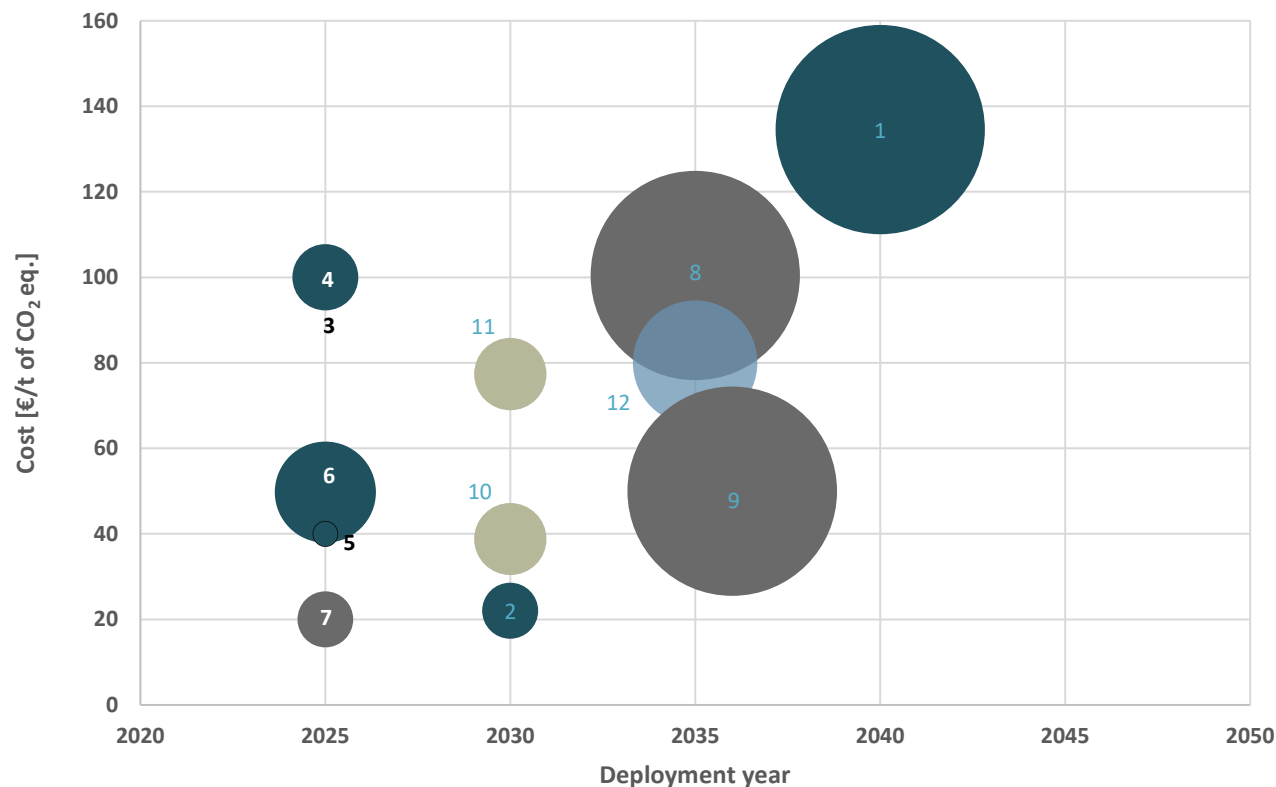
- Green hydrogen
- CCU

- Increase of renewables in the energy mix

Roadmap - REFINING

Maximum potential for abatement of technological measures in need of development and commercially available

Maximum abatement potential (t of CO₂ eq./year)



Energy efficiency and circularity

1. Generation of advanced biofuels from waste.
2. Digitalization and AI for process control.
3. Heat recovery from excess gas or process waste heat.
4. Energy recovery in pressure jumps
5. Combined AC/DC fields to desalinate crude oil
6. Generation of biogas from urban waste



Electrification and alternative sources

7. Electrification of heat through heat pumps and absorption machines
8. Generation of synthetic fuels from green hydrogen and CO₂.
9. Second and third generation ethanol production.



Green hydrogen

10. H₂ production plant by electrolysis.
11. H₂ production and alternative fuels through biomass gasification



Carbon capture, use and storage

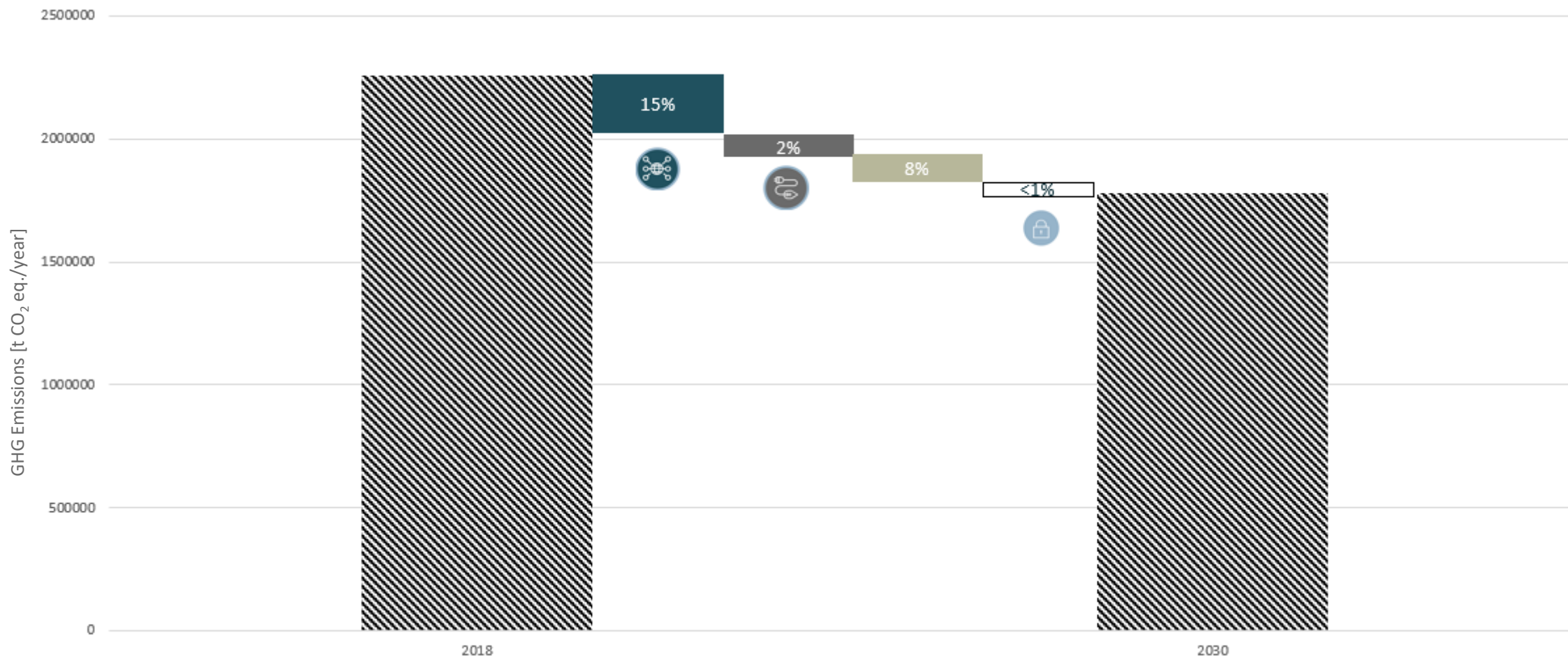
12. Carbon capture process



Technological measures in need of development

Roadmap - REFINING

The cumulative contribution of each of the decarbonization axes has been plotted in each of the time periods



Energy efficiency and circularity

Electrification and alternative fuels

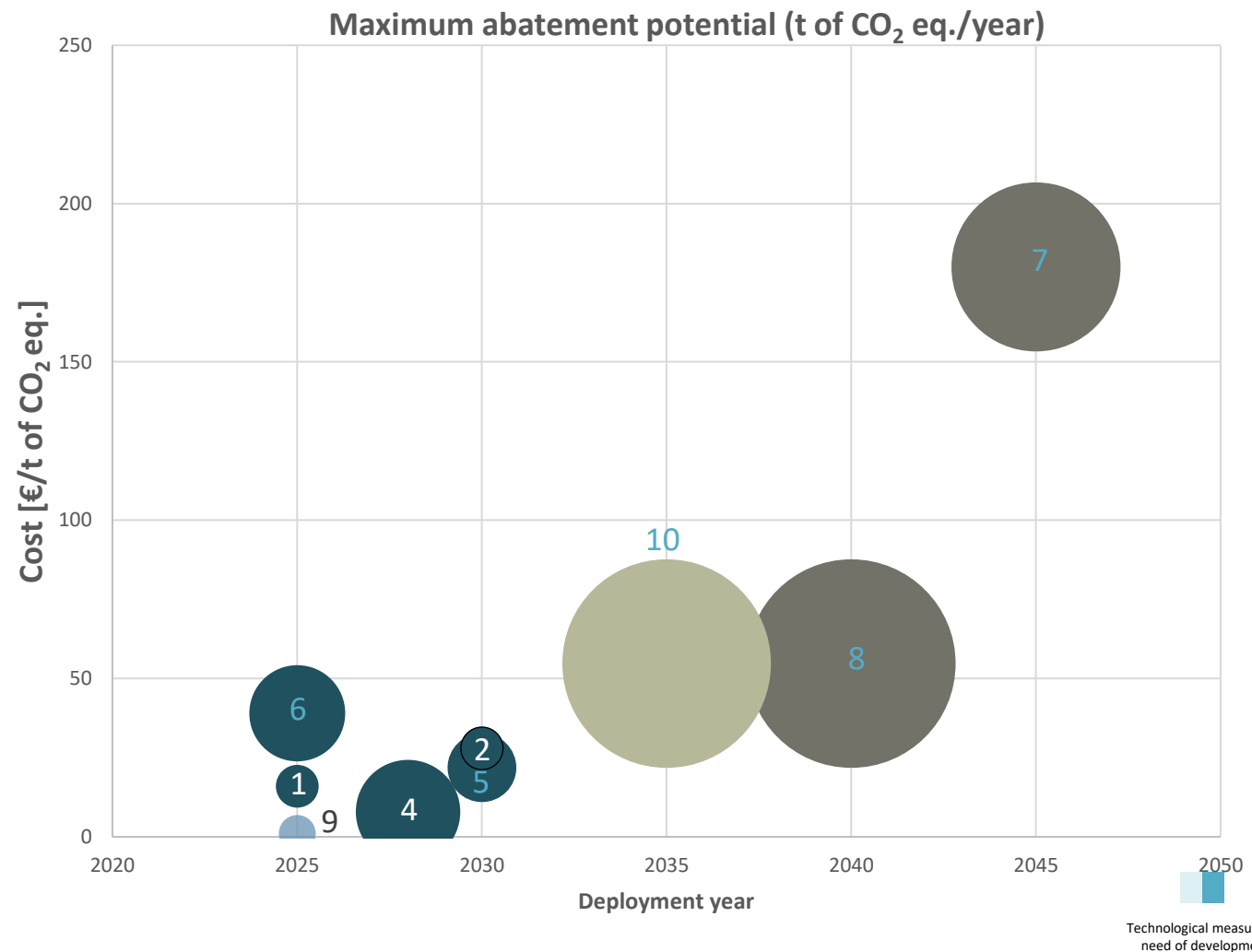
Green hydrogen

CCU

Increase of renewables in the energy mix

Roadmap - STEEL

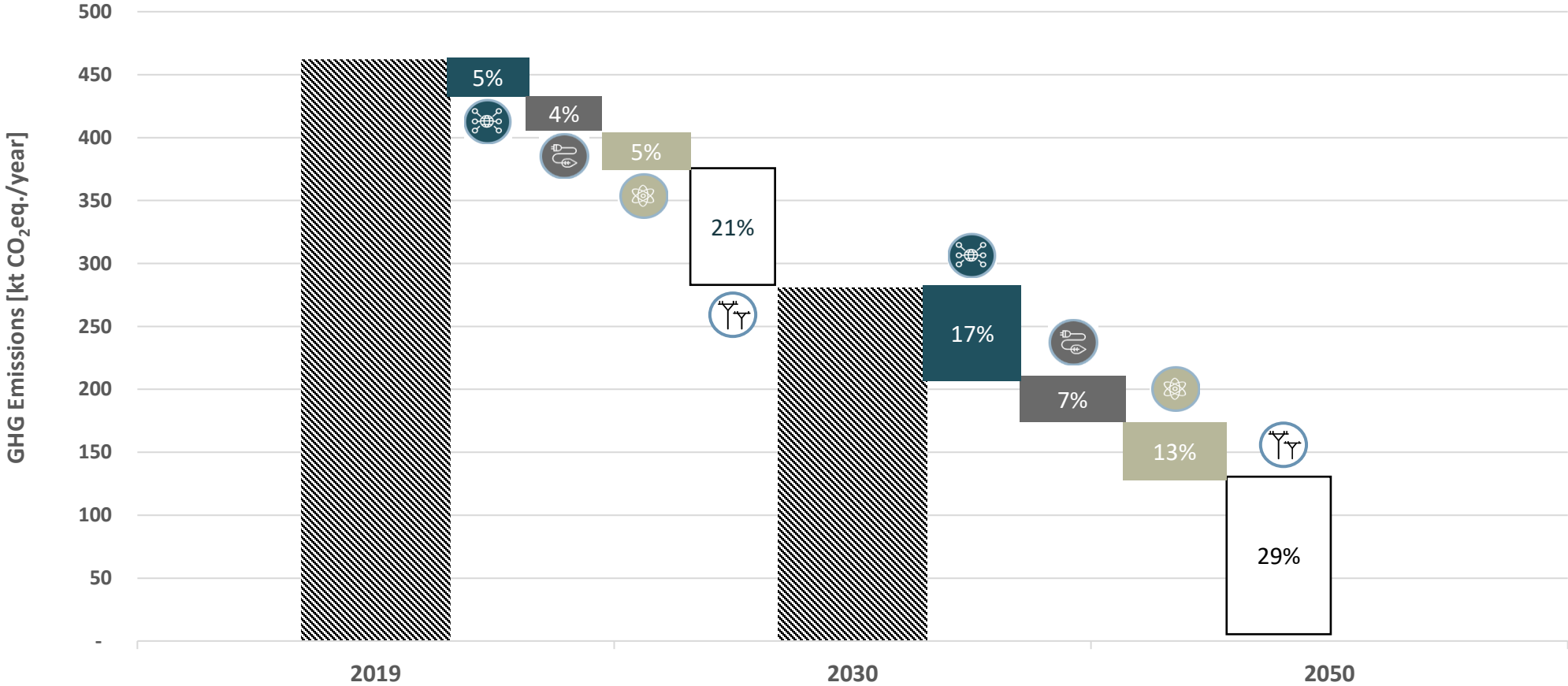
Maximum potential for abatement of technological measures in need of development and commercially available



- Energy efficiency and circularity**
 - Scrap shredding
 - Digitization and AI for process control
 - Digitization and intelligent control of scrap
 - Oxy-combustion
 - Ultra high voltage transformers
 - Heat recovery from furnace exhaust gases
- Electrification and alternative sources**
 - Electrification of thermal processes
 - Use of biogas
 - Self-consumption of renewable electricity
- Green hydrogen**
 - Green hydrogen consumption

Roadmap - STEEL

The cumulative contribution of each of the decarbonization axes has been plotted in each of the time periods



- Energy efficiency and circularity
- Electrification and alternative fuels

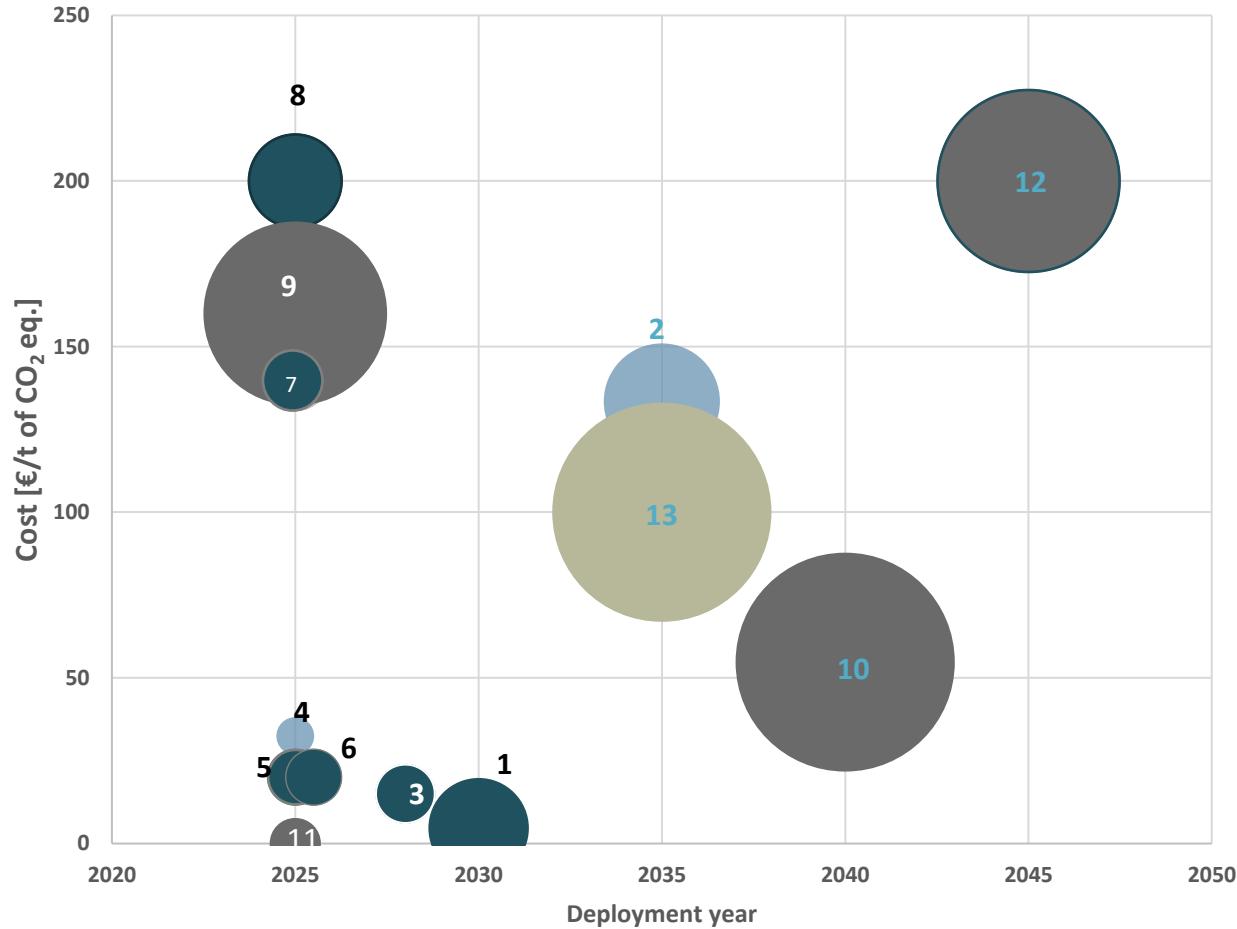
- Green hydrogen
- CCU

- Increase of renewables in the energy mix

Roadmap - FOUNDRY

Maximum potential for abatement of technological measures in need of development and commercially available

Maximum abatement potential (t of CO₂ eq./year)



Energy efficiency and circularity

1. Digitization and AI for process control
2. Heat recovery from exhaust gases and other waste heat.
3. Oxy-combustion.
4. Optimization of combustion through gas control and flame visualization.
5. Digitization for better sorting and increased utilization of recycled raw materials.
6. Recovery of metals in the production process.
7. High efficiency burner.
8. Additive manufacturing.



Electrification and alternative sources

9. Inductive furnaces
10. Use of biogas.
11. On-site renewable electricity generation



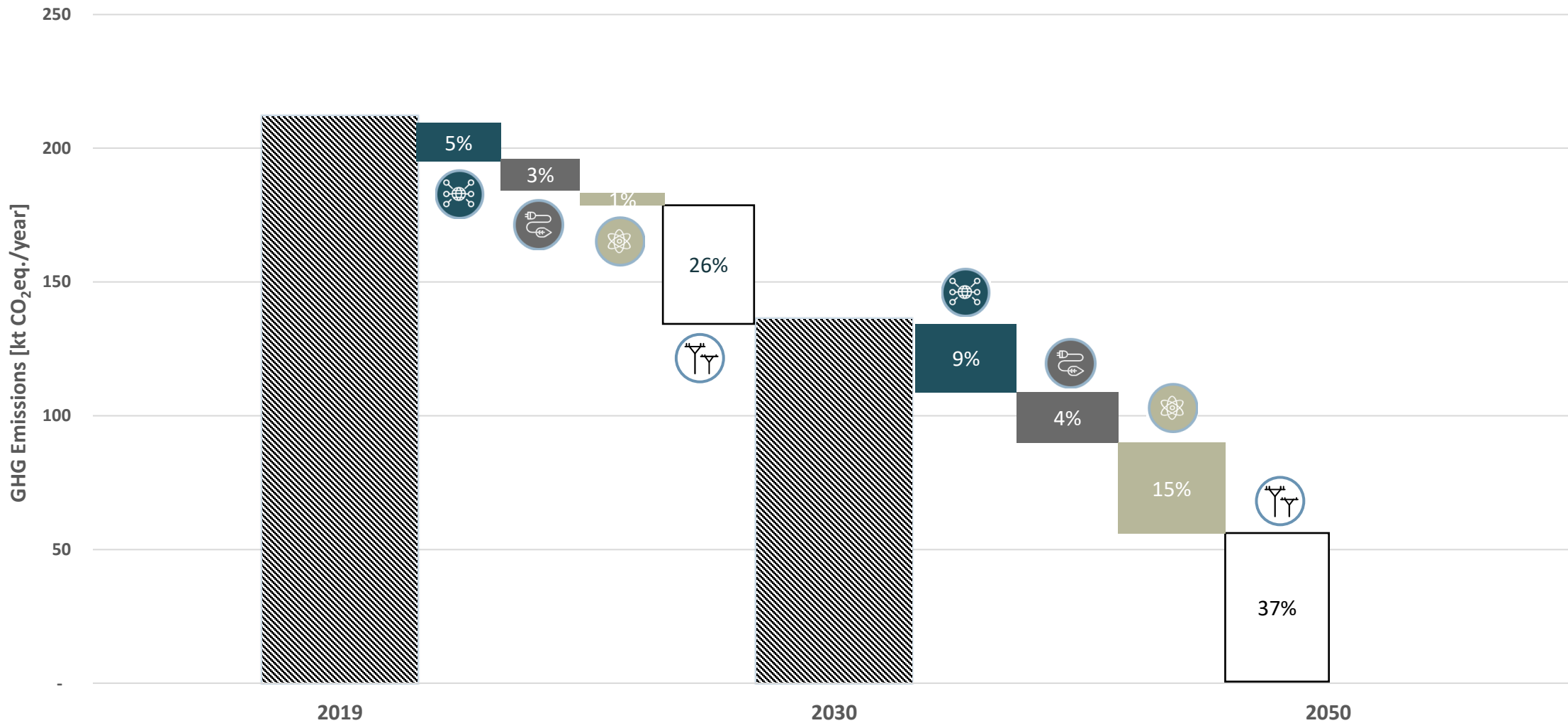
Green hydrogen

12. Use of microwaves for sand recovery and melting
13. Green hydrogen consumption.

Technological measures in need of development

Roadmap - FOUNDRY

The cumulative contribution of each of the decarbonization axes has been plotted in each of the time periods



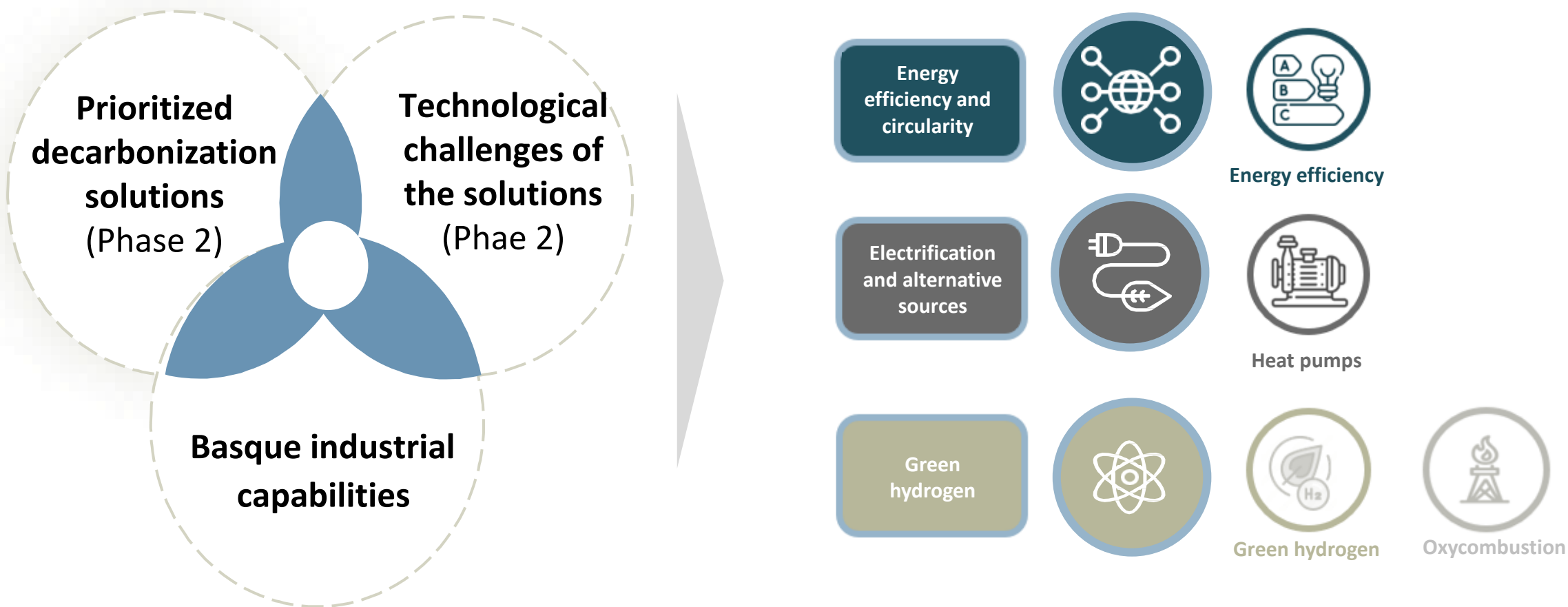
- Energy efficiency and circularity
- Electrification and alternative fuels

- Green hydrogen
- CCU

- Increase of renewables in the energy mix

Value chains

In PHASE 3, the value chains of the solutions prioritized in the previous phase have been characterized, preliminarily identifying the companies in the Basque business fabric that are part of them.



Energy efficiency value chain

AUDITORÍAS, MONITORIZACIÓN Y GESTIÓN ENERGÉTICA

AUDITORÍAS ENERGÉTICAS



MEDIDA Y VERIFICACIÓN DE CONSUMOS



GESTIÓN ENERGÉTICA



EMPRESAS DE SERVICIOS ENERGÉTICOS



MEDIDAS DE EFICIENCIA ENERGÉTICA

RECUPERACIÓN DE CALOR



EQUIPOS DE INTERCAMBIO



DIGITALIZACIÓN



INSTALACIONES AUXILIARES



AGUA CALIENTE / VAPOR



INSTALACIONES DE AUTOCONSUMO

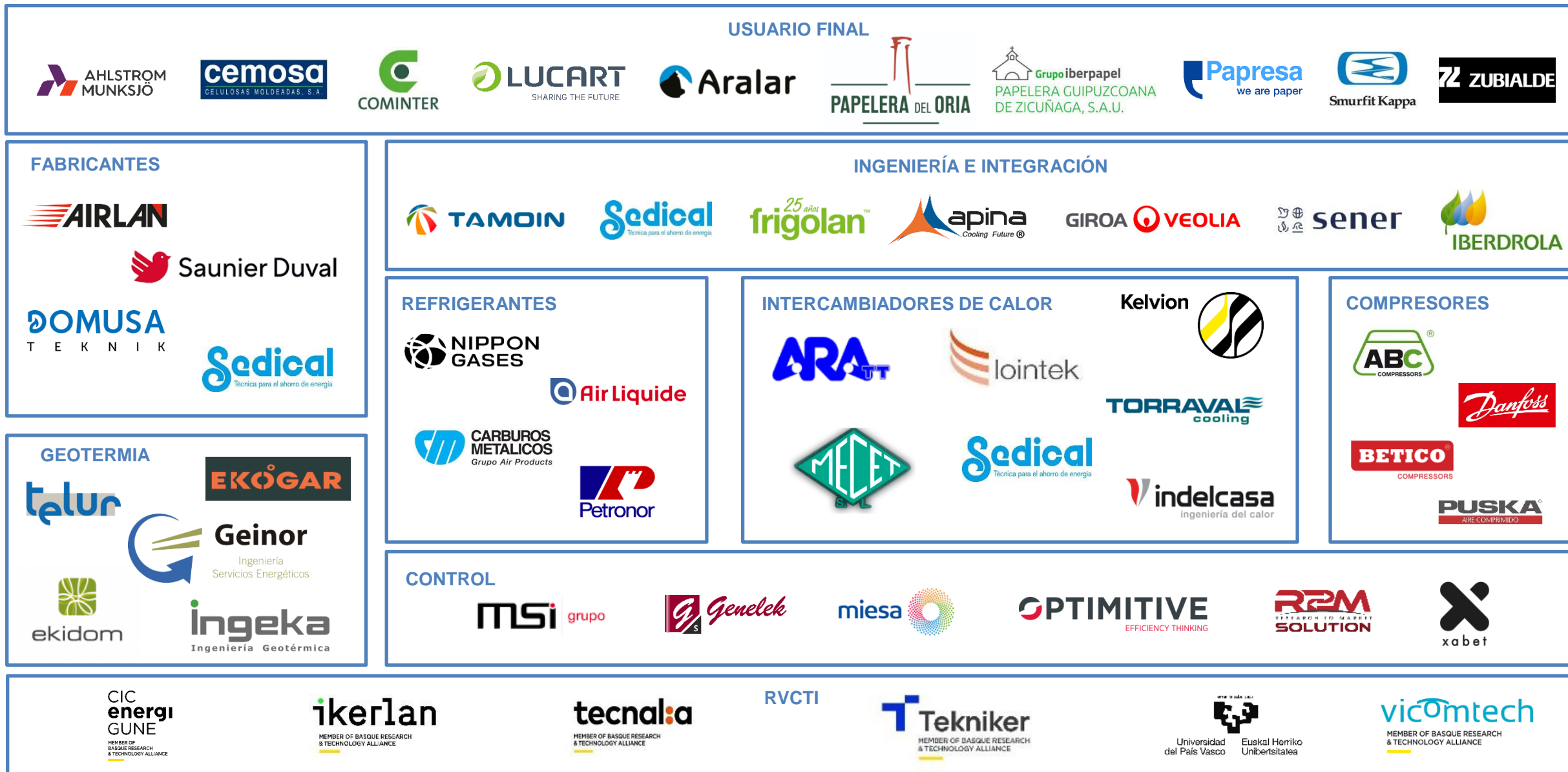
SOLAR FOTOVOLTAICA



GEOTERMIA



Heat pumps value chain



Oxycombustion value chain

PETRONOR **ArcelorMittal** **sidenor** **TUBACEX GROUP** **USUARIO FINAL** **ACEROS INOXIDABLES OIARRA** **TUBOS REUNIDOS GROUP** **CEMENTOS LEMONA** **A CRH COMPANY** **Cementos Rezola** **HEIDELBERGCEMENT Group** **Asociación de Fundidores País Vasco y Navarra**

ghi **SMART FURNACES** **insertec** **Furnaces & Refractories** **sarralle** **A Universe of Engineering** **HORNOS** **INDUCTOTHERM GROUP** **IBERIA** **ONDARLAN** **ARROLA** **fives** **Industry can do it**

OXÍGENO **Air Liquide** **NIPPON GASES** **CARBUROS METALICOS** **Grupo Air Products** **360gases**

QUEMADORES **sarralle** **A Universe of Engineering** **E & M COMBUSTIÓN** **fives** **Industry can do it** **TEKENER** **QUEMADORES** **DEGUISA** **Sedical** **Técnica para el ahorro de energía**

REFRACTARIOS **Calciner** **QUÍMICA NATURAL** **DEGUISA** **insertec** **Furnaces & Refractories** **Kelsen** **KROSAKI AMR** **REFRACTARIOS, S.A.** **DOMINION**

AZTERLAN **MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE** **ceit** **MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE** **RVCTI** **ikerlan** **MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE** **tecnal:a** **MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE** **Universidad del País Vasco** **Euskal Herriko Unibertsitatea**

Green Hydrogen value chain



ORGANIZACIONES DE I+D

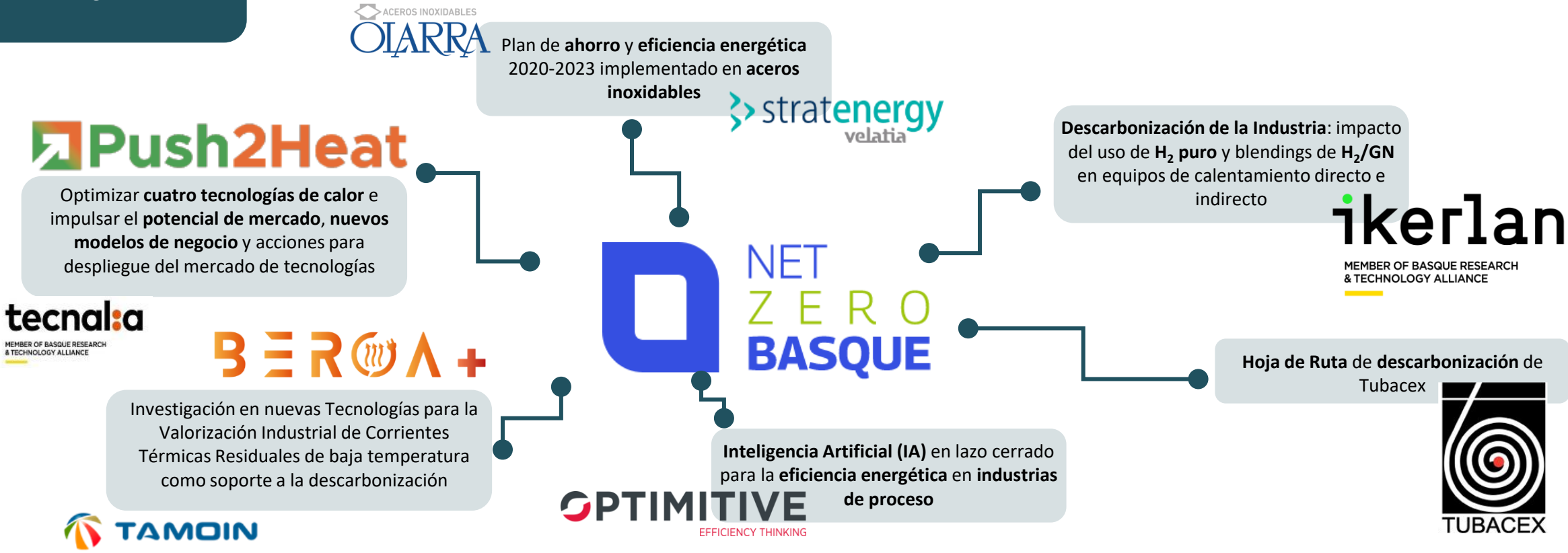
Tekniker MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE	tecnalía MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE	cidetec MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE	CIC energi GUNE MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE
ikerlan MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE	ceit MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE	CTA	
Mondragon Unibertsitatea	Goi Eskola Politetnikoa	Tknika	

RED DE APOYO

GRUPO spri	ENERGIAREN EUSKAL ERAKUNDA ENTE VASCO DE LA ENERGIA	Cluster Energia BASQUE ENERGY CLUSTER
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Projects

In PHASE 4, a total of 50 R&D&I projects developed by Basque agents and companies have been identified in terms of industrial decarbonization.



OTHER SINGULAR PROJECTS

COLLABORATION IN THE MIT RESEARCH PROJECT
“The case of demand management”

IS2H4C PROJECT
“From Industrial Symbiosis to Hubs for Circularity”

Projects

Support mechanisms for the decarbonization of the industry


BASQUE COUNTRY	Support by GRANTS	Support by TAX DEDUCTION
Support for R&D&I	HAZITEK + FAST-TRACK INNOBIDEAK (SMEs)	Technical Qualification Reports for Tax Effects for R&D and Innovation projects with technological advancement
Support for INVESTMENT	Industrial Decarbonization Program	Basque List of Clean Technologies tax deduction of 30% of the equipment investment cost

+ Strategic Project for Economic Recovery and Transformation for industry decarbonization from Spanish Government

Positioning

Since its launch at COP26, Net-Zero Basque Industrial SuperCluster has boosted its international positioning with its participation in different forums

November, 2021 (Glasgow)




Launch of the initiative during the celebration of the United Nations Climate Change Conference 2021-COP26

October, 2022 (Houston)



Euskadi presents the initiative at the event "Technology partnerships for decarbonization" in Houston (EEUU)

January, 2023 (Davos)



The NZBIS presented among one of the initiatives that are part of the WEF project "Transitioning Industrial Clusters Towards Net Zero"

April, 2023 (Antwerp)



NZBIS is presented at the "Global Industry Clusters Meeting", an event focused on exploring decarbonization policies and partnerships between members of the initiative

October, 2023 (Feneve)



Meeting and Visit to WEF Clean power & Electrification

2022

2023

April, 2022 (Basque Country)



First meeting of the global clusters of the World Economic Forum's Net Zero Emissions Initiative

December, 2022 (Basque Country)



Signing of the collaboration agreement between SPRI and EPRI

March, 2023 (Viena)



Signing of the collaboration agreement between SPRI and EPRI

June, 2023 (London)



NZBIS participates in IDRIC international event on industry decarbonization

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