

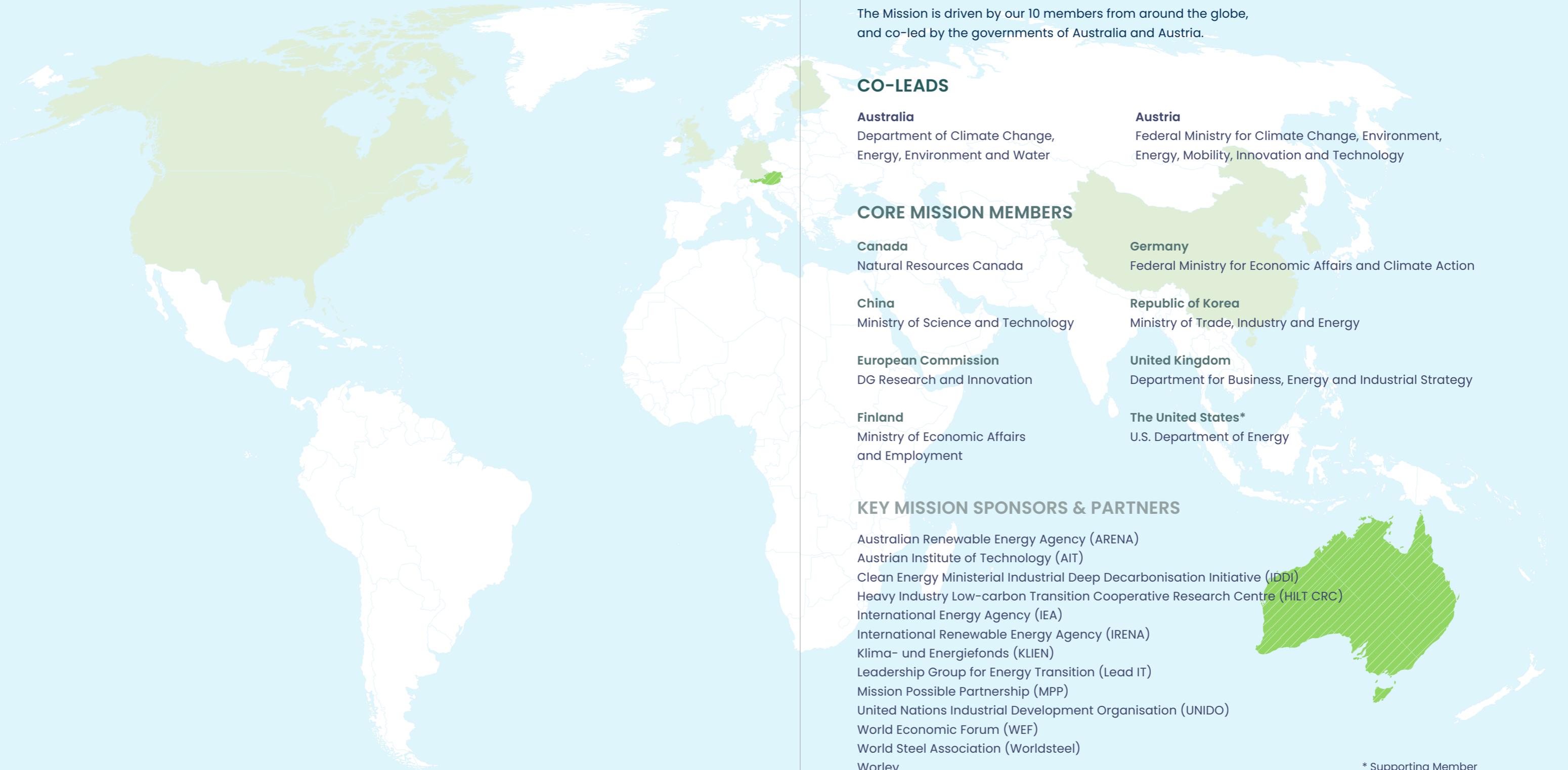


**NET-ZERO
INDUSTRIES**
MISSION

Action Plan for the Net-Zero Industries Mission



1st Edition
March 2023



MEMBERS

The Mission is driven by our 10 members from around the globe, and co-led by the governments of Australia and Austria.

CO-LEADS

Australia
Department of Climate Change, Energy, Environment and Water

Austria
Federal Ministry for Climate Change, Environment, Energy, Mobility, Innovation and Technology

CORE MISSION MEMBERS

Canada
Natural Resources Canada

Germany
Federal Ministry for Economic Affairs and Climate Action

China
Ministry of Science and Technology

Republic of Korea
Ministry of Trade, Industry and Energy

European Commission
DG Research and Innovation

United Kingdom
Department for Business, Energy and Industrial Strategy

Finland
Ministry of Economic Affairs and Employment

The United States*
U.S. Department of Energy

KEY MISSION SPONSORS & PARTNERS

- Australian Renewable Energy Agency (ARENA)
- Austrian Institute of Technology (AIT)
- Clean Energy Ministerial Industrial Deep Decarbonisation Initiative (IDDI)
- Heavy Industry Low-carbon Transition Cooperative Research Centre (HILT CRC)
- International Energy Agency (IEA)
- International Renewable Energy Agency (IRENA)
- Klima- und Energiefonds (KLIEN)
- Leadership Group for Energy Transition (Lead IT)
- Mission Possible Partnership (MPP)
- United Nations Industrial Development Organisation (UNIDO)
- World Economic Forum (WEF)
- World Steel Association (Worldsteel)
- Worley

* Supporting Member

About the Mission

The Net-Zero Industries Mission has been launched¹ as a highly pragmatic collaboration across countries, non- and intra-governmental organisations, and industry to drive and accelerate the adoption of decarbonisation technologies by the hard-to-abate energy intensive industries. Whether it be iron & steelmaking, production of cement & lime, the chemicals & refining industry,

or other industries like alumina & aluminium, decarbonisation requires multiple technical solutions, and a new way of supporting these industries if they are to meet the targets society demands for 2030 and 2050 in achieving Net Zero.

Read more: explore.mission-innovation.net/mission/net-zero-industries

Ministerial Statements

“The Net-Zero Industries Mission will accelerate the development and deployment of emissions reduction technologies in industry, crucial to reaching net zero by 2050. We are excited to co-lead this Mission and work together with our international partners. Australia brings to the Mission world-leading expertise from researchers and private sector in renewable energy and industry innovation.” **Chris Bowen MP, Minister for Climate Change and Energy, Australia**

“The development and accelerated deployment of breakthrough technologies are prerequisites for decarbonizing heavy industry and for achieving climate neutrality. I am delighted that, together with Australia as co-lead, alongside a significant number of Mission Innovation members, we will be working together to make the Net-Zero Industries Mission possible.” **Leonore Gewessler, Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology, Austria**

“To reduce emissions and fight climate change, it is imperative that we develop and deploy clean technology, especially in heavy and hard-to-abate industries. Through initiatives like the Net-Zero Industries Mission, we can align both national and multinational efforts to scale up emerging technologies, share best practices, and implement low-carbon solutions across our economies. I look forward to working with member countries to make real progress towards achieving our climate goals.” **The Honourable Jonathan Wilkinson, Minister of Natural Resources, Canada**

“Finland has prepared sectoral climate roadmaps showing the way of various industries towards climate neutrality. Finland is committed to the Net-Zero Industries Mission.” **Mika Lintilä, Minister of Economic Affairs and Employment, Finland**

¹ Launched at the 7th Mission Innovation Ministerial, convened as part of the Global Clean Energy Action Forum, Pittsburgh, US in September 2022

Executive Summary

Following the Mission Roadmap², **this Action Plan outlines the actions needed, with their respective timescales and required stakeholder participation, to reach Mission goals.**

This Action Plan aims to focus on the establishment of key resources and actions that will ultimately accelerate the development, demonstration, and adoption of cost competitive solutions for the efficient decarbonization of hard-to-abate energy intensive industries worldwide by 2030. This initial version of the Action Plan will describe the overall scope of the Mission, with a priority focus on the first two years of actions until 2025.

The activities in this Action Plan were identified through extensive engagement with Mission partners. They provide a clear focus on structuring and resourcing a mission team that provides the greatest value in supporting our members and industry stakeholders in their validation and investment in the major decarbonisation technology pathways. The priority actions focus on building the foundations for demonstrations and wider deployment.

The purpose of the Action Plan is two-fold. Firstly, it identifies actions that the Mission will lead on, that add significant value to the projects where the Mission has a role as supporter to key government and industry stakeholders (Mission-led actions). Our internal actions are heavily focused on the generation and transfer of knowledge in the stakeholder groups. These actions will bring accelerated levels of confidence in further investment and uptake of the decarbonisation technology pathways required by our industry

stakeholders. Our support of external projects, including demonstrations, is focused on the generation of this knowledge for our stakeholder groups.

Secondly, this Action Plan should be viewed as a call to action from stakeholders across the hard-to-abate energy intensive industries value chain; both stakeholders who have been involved in the development of this Action Plan, and others who have not been involved but can play a part in the transition to a decarbonised industry. For each action, a suggested stakeholder group is identified. In these actions, the Mission’s role will be to inform and encourage their development and progression (Mission-supported actions).

No matter who leads the action, all must be delivered through collaboration across all stakeholder groups.

This Action Plan, the actions and projects identified within it, create a path to achieving outcomes that coincide with the Mission’s 2030 goals. The three major phases of our Mission are described in Figure 1, across the immediate, intermediate, and primary focus stages of the Mission action execution. **The primary value of the Mission is three-fold, across pillar & program management, stakeholder management and knowledge management.**

This Action Plan is a living document and provides a focus on the initial two-year period for the Mission. The Mission will conduct regular reviews and refinement to make sure that it is adapted to emerging needs and new opportunities from across the sector as markets and technologies evolve.



Figure 1: Mission focus on actions between now and our 2030 target

² explore.mission-innovation.net/wp-content/uploads/2022/09/NZIM_Roadmap_final.pdf

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1 The NET-ZERO INDUSTRIES Mission

The Net-Zero Industries Mission ('the Mission') brings together a high-ambition alliance of countries, the private sector, supporting partners,

research institutes and members of the civil society to accelerate adoption of decarbonisation by the hard-to-abate energy intensive industries by 2030.

MISSION GOAL

To catalyse the development and demonstration of cost competitive solutions for the efficient decarbonisation of hard-to-abate energy intensive industries worldwide by 2030.

Targets to achieve the Mission goal:

- > **Implement** at least two large-scale demonstration projects for each of the Mission's key innovation fields and sectors
- > **Fast-track** the development to TRL 8 of new and radical breakthrough low emission technologies
- > **Target** a reduction of more than 15% in the Capex of low emission innovative technologies.

Figure 2: Mission goal and targets

1.1 Introduction

Energy intensive industries are responsible for around 25% of global greenhouse gas emissions. RD&D over the next decade will be critical to develop and validate innovative industrial processes and technologies that enable radical emission cuts beyond 2030 at lowest costs.

The Mission aims to demonstrate the required technologies for decarbonising energy intensive industries. The current investment from industry is falling behind the rate of change required to meet global emission targets for 2030, let alone 2050. The time required to demonstrate and gain industry acceptance of these technologies is significant and requires immediate action if we are to make

a positive change in the industry understanding, confidence and investability of decarbonisation technologies in time for 2030. In building this global industrial confidence in the feasibility and demonstrated costs & benefits of decarbonisation technologies to motivate and accelerate the uptake and investment in decarbonisation, a collaborative approach is required. One that maximises the shared learnings and opportunities across the talent and investment initiatives of our core member nations. It is most efficient to connect and align both national and multinational RD&D efforts into a challenge driven initiative to showcase net-zero emission industry model solutions.

Table 1: Mission scope, potential demonstrations across industry sectors and technology pathways

TECHNOLOGY PATHWAYS		INDUSTRIAL SECTORS			
		IRON & STEEL	CEMENT & LIME	CHEMICALS & REFINING	OTHER ENERGY INTENSIVE & HARD TO ABATE
Fuel switch	Alternative fuels and feedstocks	Use of alternative fuels (bioenergy & waste)	Alternative fuels (incl. biomass)	Biomass, H ₂ , Ammonia and plastic waste as an alternative feedstock	Alternative fuels (incl. biomass)
	Low-carbon hydrogen	Direct reduction using H ₂	Integrated H ₂ production for CCU	Integrated production of Hydrogen	Replacing NG with H ₂
Electrification of production and processes		Direct reduction using electricity, adaptation of electric arc furnaces	Electrification of sintering and calcination processes. Electrochemical formation of calcium hydroxide	Electrification of crackers and chemical processes	Steam electrification and furnace/kiln/calcliner conversion
Digitalisation & flexibilisation		Process control and automation, digital twins and simulation, temperature upgrade of excess heat, smart management of variable energy resources such as PV and wind power, hybridisation of different sources, excess heat to power or cold, flexibility in power generation/utilisation including bottleneck management and redispatch			
Carbon capture & storage/utilisation		Direct capture and separation, and adsorption/absorption of CO ₂ process and combustion emissions and its storage The capture, purification, and valorisation of CO ₂ into chemicals, polymers synthetic/alternative fuels and raw materials, and also the use of CO ₂ exhaust gases in other processes			
Alternative materials and more efficient processes		Improved thermal efficiency, waste heat recovery, regenerative burners, process efficiency, alternative binding materials in cements and alternatives to carbon based feedstocks such as coking coal			
Materials efficiency & industrial symbiosis		Harnessing by-products from one industry as alternative inputs to another industry and technical upgrading of by-products, industrial symbiosis, carbonation of mineral residues			

In response to this need, the Mission is pursuing decarbonisation pathways for energy intensive industries. This Mission will ensure that key technical solutions are developed and demonstrated by 2030, to enable an effective and efficient decarbonisation of energy intensive industries by 2050, in multiple regions of the world.

To reach this ambitious goal, a joint roadmap has been developed by the Mission member states and associations, aligned with a common vision and strategic objectives. Based on this vision (mission statement), the most promising RD&D themes and technology pathways within specific sectors and cross-sectorial areas are identified along with specific technologies for investigation (ref. Table 1). Our Action Plan identifies the timeline & pathways, investment scale required, and framework conditions & measures which enable the development and deployment of technologies.

The Mission focuses on the sectors Iron & Steel, Cement & Lime, Chemicals & Refining, and also provides linkages to other sectors of energy intensive and hard-to-abate industry (e.g. for aluminium). In addition, potential cross-sectoral topics and technological options are within our scope.

Based on the pillars and pathways as defined in the roadmap the Action Plan will define more specific activities with a short-term perspective

for the next 2 years. The exchange of knowledge and best practices and the alignment and coordination of ongoing or planned activities between different member countries is a key objective for the initial Action Plan. Participation in the proposed actions and activities is voluntary by the Mission members and prioritised by member and industry needs. The progress of the Mission will be monitored by a set of defined key performance indicators (KPIs).

1.2 Mission Scope

The work of the Mission is organized into three pillars, each playing a pivotal role in the Mission goals for 2030. To achieve our ambitious goals of demonstrating and building industry confidence in the feasibility of key decarbonisation technologies, it is crucial that our Action Plan includes all key areas of work effort and critical stakeholder roles required. In achieving this strategy, we must ensure we include all critical path activities and knowledge generation requirements to cover the development, engineering and deployment, and performance evaluation of technologies at relevant industrial scales and in real industrial applications. To ensure there are no gaps in this Action Plan, we have divided the workload between three collaborative pillars, each of which contributes towards key areas of the overall mission goals.

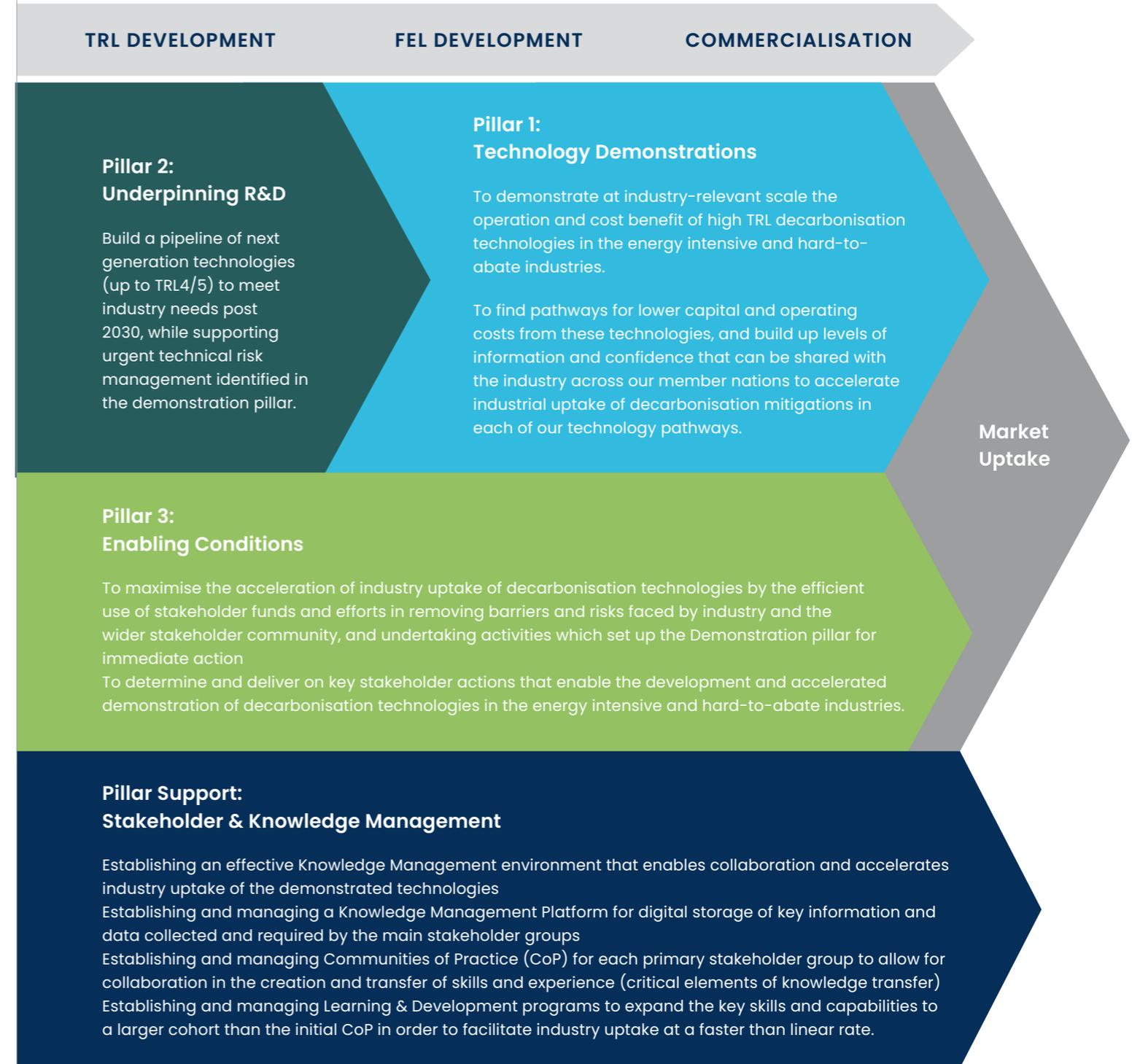


Figure 3: Mission Pillars, supporting our delivery framework

1.2.1 Pillar 1: Technology Demonstrations

The alignment and support of the technology demonstration projects is the key aim of the Mission. The exchange of information and learning, including by sharing showcase best practices and discussing innovative solutions, is an important first activity and milestone. The aim of this pillar is to collect, analyse and disseminate knowledge from demonstration projects and the set-up of a data exchange and learning platform for stakeholders. The activities will facilitate a dialogue between stakeholders and joint learning across countries, sectors and technology pathways.

A portfolio of coordinated national and joint multi-national calls for project proposals should present solutions for net-zero industrial-scale demonstration projects for energy intensive industries. These Government led calls in cooperation with the private sector in different countries would create the opportunity for demonstrations of technologies globally.

Our knowledge sharing from this pillar is prioritised to provide the confidence required for industry stakeholders to make technology selections and invest in decarbonisation solutions as soon as practical. This will leverage the global collaboration and alignment of efforts to ensure we act collectively in the most expeditious path in decarbonising the global heavy industries.

1.2.2 Pillar 2: Underpinning R&D

This pillar will include R&D projects on new and radical breakthrough technologies which can be demonstrated and implemented beyond 2030. These R&D projects are intended to enable alternative and more affordable routes to decarbonise industry.

These joint bilateral and multilateral R&D projects should be (co-)funded by public sources both targeting early development stages, i.e., TRL up to 5, and also developing the engineering deliverables and knowledge needed to lower the risk for technologies higher than TRL 5.

The Pillar will coordinate the review and alignment between different R&D projects and programs at both the national and international levels. This is an important first activity to identify gaps and opportunities for organising future joint R&D calls and collaboration.

This Pillar will also be on call to support targeted high-priority R&D activities that attempt to resolve new technical challenges and risks discovered in the Demonstrating Technologies Pillar projects, in order to help accelerate their management and mitigation, removing barriers for the critical demonstrations.

1.2.3 Pillar 3: Enabling Conditions

In addition to supporting our R&D and Demonstration Pillars, activities that address business, organisational and policy issues and challenges in decarbonising industry are relevant. The aim is to collect, analyse and disseminate non-technical information related to the decarbonisation of industry and to identify common barriers and enablers that can be acted upon.

Actions include conducting joint studies, sharing best practices in RD&D policies, designing the regulatory framework and creating market incentives. The lack of coordination between different policies and regions could be a major barrier to global implementation of low-emission technologies in global industrial value chains. These measures can reduce the large uncertainties surrounding the development and implementation of low-carbon technologies. As with the other two pillars, promoting the exchange of know-how and knowledge transfer between the various stakeholders from science, industry and politics at the global level is of key importance and is supported by the Mission.

1.2.4 Pillar Support:

Stakeholder & Knowledge Management

The three Pillars are interconnected and not silos, that together enable the Mission objectives to be achieved. The pillars will be managed in a systematic way, using state-of-the-art knowledge management tools and clear strategy implementation processes.

In this way, communication between the different stakeholders (e.g. government, researchers, industry, technology & service providers, commercialisation partners, etc) is coordinated effectively throughout the innovation process. A critical element of achieving this knowledge management is the focus on the stakeholders who will best identify, capture, control and disseminate the knowledge in their respective communities of practice. These critical communities and the knowledge they generate, hold and communicate to each stakeholder group is potentially the greatest value deliverable of the Net-Zero Industries Mission, and key to achieving every one of the Mission Goals past 2030.

Each Pillar will be developing a more detailed execution plan within their scope boundaries and collaborative requirements in assisting the Mission to achieve its overall goals.

The initial establishment period of two years of the Action Plan detail is presented in the following sections for each Pillar and for the supporting stakeholder and knowledge management frameworks and systems.

PILLAR & PROGRAM MANAGEMENT	STAKEHOLDER MANAGEMENT	KNOWLEDGE MANAGEMENT
<ul style="list-style-type: none"> – Leadership and Deputy Leadership of the Pillars – Leadership of each Technology Pathway across multiple industries in the Pillars – Program Management & Reporting, and linkages into Knowledge Management for key stakeholder groups – Coordination and sequencing of Projects (in each Pillar) to maximise acceleration of industry uptake of the technologies and sharing of risks and knowledge generation amongst stakeholders 	<ul style="list-style-type: none"> – Establishment of Communities of Practice (CoP) to facilitate collaboration and knowledge management for key stakeholder groups – Facilitation of stakeholder interactions and collaborations to identify Projects and Demonstrations, and research required to assist the success of the demonstration Pillar Projects 	<ul style="list-style-type: none"> – Establishing and managing a Knowledge Management Platform for digital storage of key information and data collected and required by the main stakeholder groups – Establishing and managing Communities of Practice for each primary stakeholder group to allow for collaboration in the creation and transfer of skills and experience (critical elements of knowledge transfer) – Establishing and managing Learning & Development programs to expand the key skills and capabilities to a larger cohort than the initial CoP, to be able to facilitate industry uptake in a faster than linear rate. – Knowledge identification and collection, including separation and negotiation on knowledge versus Intellectual Property Rights, to maximise the value harnessed in the Mission from the projects under coordination

Figure 4: Primary Mission Value Contributions

1.3 The Mission's role in driving change

The initial efforts of the Mission are focused on adding substantial value to the extensive body of work already underway and planned in this sector. Significant project calls and investment incentives are in play globally, and significant research and roadmapping on technologies have been undertaken by industry bodies and operations. **The primary value of the Mission is three-fold, across pillar & program management, stakeholder management and knowledge management.**

Figure 4 summarises the scope of our value contributions in these areas. Our Mission will also support further multinational collaboration and funding of research and demonstration projects and expand the industrial cooperation on sharing and accelerating the adoption of decarbonisation technologies. Our actions are focussed on adding value to the projects currently planned and potentially delivered in the decarbonisation of the hard-to-abate energy intensive industries. As the Mission matures, this scope will expand to influencing and steering both member and industry investment in filling technology and knowledge gaps required to deliver on the overall mission goals of accelerating industry uptake of decarbonisation technologies.

There are high level activities which will be undertaken by the extended Mission team (ref. Table 5) that are essential for each of our Pillars to successfully deliver against our ambitious goals. The Mission differentiates these activities as either Actions or Projects as per the definitions below. Resources are also defined in order to support delivery of the Actions. Figure 5 graphically describes the definitions of Actions and Projects that make the overall scope of the Mission Action Plan.

The establishment of the core activities in this Action Plan is a priority for the first two years of the Mission, along with the initial group of Projects under our scope.

Actions:

In this Action Plan, a distinction is made between mission-led and mission-supported actions, which are therefore briefly defined below.

Mission-led actions are initiated and completed where possible by the wider Mission team (subject to availability and on a voluntary basis), with resources provided by Mission members, key Mission sponsors and partners, and seconded industry stakeholders to achieve Mission objectives. **Mission-supported actions** promote and contribute to actions already underway and rely on the proactivity and leadership of other groups. For most of the Mission-supported Actions, the Mission has identified the stakeholders whose cooperation is crucial for taking the actions forward and has established a basis for future cooperation (see: key partners of the Mission)

Projects:

Sets of tasks, typically completed by industry, engineering, technology providers and researchers, funded by industry and MI partners (e.g., technology demonstration projects, R&D projects, feasibility studies etc.)

Resources:

Appropriately skilled people provided by MI partners and industry stakeholders (operational, engineering, technology provider, etc) to deliver Actions and support Projects.

ACTION PLAN

All activities under Mission Scope

Actions (Mission Led)

Key activities led by the Mission team that help manage the pillars and their own execution plans, and the knowledge and the stakeholders of critical interest to the Mission.

e.g. Technology Demonstrations, R&D projects, Enabling Condition Projects, Stakeholder and Knowledge Management

Actions (Mission Supported)

Key activities led by related bodies and mission partners that help deliver the Mission objectives.

e.g. industry roadmaps, technology development pathways, stakeholder engagement activities, funding and incentive programs

Projects

Externally funded and managed activities that provide knowledge and skills that benefit the Mission objectives

e.g. Technology Demonstrations, R&D Projects, Technology development, Enabling Condition Projects

Figure 5: Separation of Actions and Projects in the Mission Action Plan

The primary efforts of the Mission can be summarised as follows:

- **Undertaking Mission-led actions** – the Mission will launch new public-private actions in urgent and impactful areas, as presented below, that leverage our strengths as a group.
- **Boosting the coordination of technology feasibility** – there is no one silver bullet technology to decarbonise the hard-to-abate industries and this means that efforts to develop and commercialise multiple pathways must take place simultaneously. Through engagement across the value chain, the Mission will build a holistic view of action taking place in sectors, so it can identify and direct stakeholders towards ‘innovation blind spots’, reduce duplication of efforts, and accelerate compounding benefits through sequencing projects and sharing of knowledge.
- **Collecting, analysing, and disseminating learnings from demonstrations** – over 50 industry scale decarbonisation technology demonstrations will yield valuable learnings which can inform policymakers, industry investment, and guide both areas of technology understanding for prioritisation and the market uptake of proven technology. The Mission will look to collate these learnings and help them reach relevant stakeholders and decision-makers through the effective ownership and involvement of key stakeholder groups.

With the Mission-led actions and coordination efforts the Mission helps to grow the value and knowledge transfer of these technology demonstrations. Meanwhile, the learnings that are generated by these demonstration projects are collected, synthesised, and disseminated to key decision-makers. Through these multiple waves of input and iteration, the Mission will accelerate progress towards its 2030 goals together with stakeholders across industry sectors.

1.4 Mission stakeholders’ role in driving change

The Mission will accelerate and enable research and demonstration, coordinate knowledge sharing and support dialogues across policy and industry stakeholders to enable activity, inform and collaboratively close the gaps. However, not all the actions within the Action Plan are well-suited for the scope and resources of the Mission team. For example, while new policy and regulations are required to decarbonise industry, the Mission can only contribute to the definition of such policies.

The actions listed in this Action Plan require collaboration with other entities outside of the Mission members. The Mission does not act in a vacuum, and the following stakeholder categories have been used to show where other agents of change are necessary to meet both the Mission goals and international targets for 2050.

Each of these stakeholder groups has an important role to play in the Mission goals, and as such it is a Mission priority to establish key Communities of Practice (CoP) for the most critical stakeholder groups (ref. Figure 6). These CoP will be both the natural owner of the knowledge management processes of the Mission, and the enduring legacy in how this knowledge becomes the influential trust in the industry uptake of decarbonisation technologies past 2030.



Figure 6: Mission Stakeholders

2 Action Plan

2.1 Pillar Specific Actions

In September 2022, the Mission published a [Roadmap to Net-Zero Industries](#), which identified **over 100 barriers and enablers to be addressed to meet the Mission's goals**, which are spread across the three pillars – Technology Demonstrations, Underpinning R&D, and Enabling Conditions. The relevant technology maturity in each industry sector is also mapped out, with key indications of potential technology demonstrations from member countries.

The technology related barriers and enablers are grouped by our seven technology pathways, and our four industry sectors. These technology groupings and industry sectors span the TRL range from 1 to 9, and both the Underpinning R&D and Technology Demonstration Pillars.

This Action Plan describes initial steps needed in the first two years to reach the Mission's goals and address some of the high-priority barriers and enablers identified in the Roadmap.



Figure 7: Industry Sectors within Mission Scope



Figure 8: Technology Pathways to be researched and demonstrated across our industry sectors

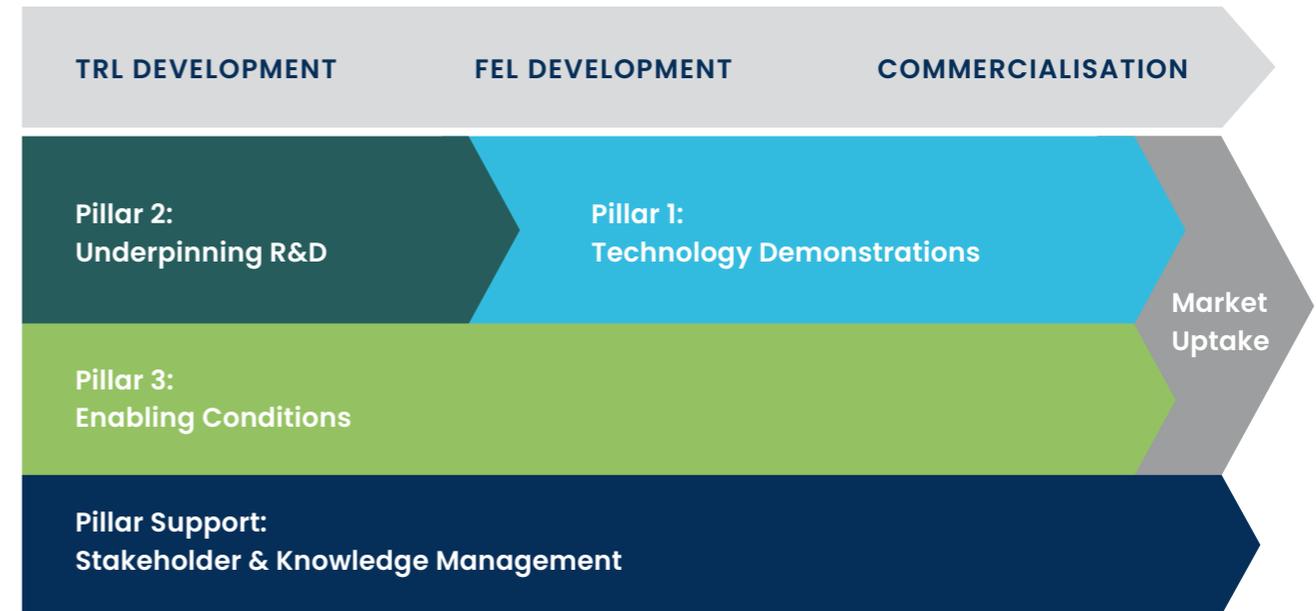


Figure 9: Mission Pillars, supporting the path from research to industry uptake

2.2 Pillar 1: Technology Demonstrations

PURPOSE		
<p>To demonstrate at industry-relevant scale the operation and cost benefit of high TRL decarbonisation technologies in the energy intensive and hard-to-abate industries.</p> <p>To find pathways for lower capital and operating costs from these technologies, and build up levels of information and confidence that can be shared with the industry across our member nations to accelerate industrial uptake of decarbonisation mitigations in each of our technology pathways.</p>		
SCOPE OF WORK (MISSION LED ACTIONS)		
<p>Overall program management of all demonstration projects</p> <p>Coordination of all stakeholder knowledge and cohort interactions, including community of practice and prequalification of suppliers</p> <p>Reporting on project/program progress, success and learnings</p> <p>Participation in global project coordination and scheduling/planning to minimise effort duplication and maximise collaboration on findings</p> <p>Onboarding programs for projects and stakeholders to engage in knowledge sharing platforms and processes</p>		
KEY OUTPUTS	TARGETS 2030	KPIs
<p>Knowledge exchange and learning between existing demonstration projects in relation to different pathways and sectors</p> <p>Provide incentives for the establishment of new demonstration projects</p>	<p>> 2 industrial-scale demonstration or pilot plants per technology pathway and sector</p>	<p>Number of first-of-its kind industry scale demonstration plants (TRL 8/9)</p> <p>Number of demonstration plants (TRL 7)</p> <p>CO₂ emission reduction per technology pathway measured through a relevant number of pilot projects and demo plants</p> <p>Capital cost improvement of 15% over benchmark estimates</p>

Based on a consultation process with the Mission members a prioritisation of demonstration projects for the pathways and sectors have been conducted (see Table 2 for an KPIs exemplar of how we will identify and include demonstration projects against our selection criteria and Table 3 for more detailed information).

For these technology demonstrations four possible activities are planned as first important steps for the next year, i.e.:

- Establishing Pillar Leadership and Program Management to support the coordination of Projects, project reporting and Knowledge Management (Action 2)
- Establishment of Communities of Practice in key stakeholder groups (Industry, Technology Provider, Government, Financiers, Researchers, Service Providers and Engineers) to enable Knowledge Management and Technology Demonstration Project Identification & Coordination (Action 3)
- Knowledge sharing between existing demonstration Projects (Actions 1, 3, 10, 14)
- Set-up of data exchange platforms (Action 1)

The potential exists for further collaboration and alignment on these global initiatives with a scheduling coordination and prioritisation on demonstration project findings, to ensure duplication of effort is avoided, and opportunities for cross-nation collaborations to accelerate key demonstrations with pivotal impacts for our industry partners.

For an overview of the technology demonstration projects with potential for common action see the Appendix.

Table 2: Overview of technology demonstration Projects identified or required (Projects listed are examples only)

TECHNOLOGY PATHWAYS		INDUSTRIAL SECTORS			
		IRON & STEEL	CEMENT & LIME	CHEMICALS & REFINING	OTHER ENERGY INTENSIVE & HARD TO ABATE
Fuel Switch	Alternative fuels and feedstocks	Use of biocarbon in an industrial blast furnace (CAN)	Demonstration and optimization of low carbon fuel (LCF) use in cement manufacturing (CAN)SALCOS & CemSol (GER)		
	Low-carbon hydrogen	HYFOR (AUT) SALCOS (GER) IPCEI Hydrogen (GER/EU)		IPCEI Hydrogen (GER/EU)	IPCEI Hydrogen (GER/EU)
Electrification of production and processes			Calix/Adbri Carbon Abatement Lime (AUS)		Alcoa/ARENA renewables for MVR in the Bayer-process (AUS)
Digitalisation & flexibilisation					INDUSTRY4-REDISPATCH (AUT)
CCUS	Carbon capture and storage		Calix/Adbri Carbon Abatement Lime (AUS)Carbon Clean – CEMEX Rüdersdorf (GER & UK)		XLR8 CCS (Low-cost carbon capture solution for hard-to-abate industries) (UK)
	Carbon capture and utilization	OXYSTEEL (AUT)	Calix/Boral Carbon Abatement Lime (AUS)MCI Mineral Carbonation (AUS)	CO ₂ capture by novel organic amine solvent and by solid adsorbent from flue gas (China)INDUSTRY4-REDISPATCH (AUT)	
Alternative materials and more efficient processes			Demo Project Cement-free construction materials (Finland)		INDUSTRY4-REDISPATCH (AUT)
Materials efficiency, use of secondary resources & industrial symbiosis			FIRES – first-zero-emissions-cement (UK)		Demo Project Textile recycling (Finland)

2.3 Pillar 2: Underpinning R&D

PURPOSE		
<p>The Pillar aims to build a pipeline of next generation technologies for the decarbonisation of our target industry applications and pathways, leveraging public and private investment collaboration to develop and assess early-stage technologies (up to TRL 4/5) against industry needs.</p> <p>This assessed pipeline of next generation technologies will form the starting point of future generational demonstration programs as we progress the Mission past 2030 towards 2050 targets in the energy intensive and hard-to-abate industries.</p>		
SCOPE OF WORK (MISSION LED ACTIONS)		
<p>Overall program management of all research projects</p> <p>Bilateral and multilateral R&D collaborative projects which are funded by national institutions and aim to conduct R&D projects involving partners from different countries</p> <p>European R&D programs open for non-EU and overseas members states</p> <p>International programs (such as the IEA or UNIDO) supporting international R&D projects</p> <p>Prioritised R&D on key technical issues identified as barriers in the Technology Demonstration Pillar Projects</p>		
KEY OUTPUTS	TARGETS 2030	KPIs
<p>New bilateral and multilateral R&D projects which become possible due to aligned NZIM activities.</p> <p>Generation of scientific and technological knowledge for signification decarbonisation innovations up to TRL 6.</p> <p>Feasibility studies.</p>	<p>> 100 significant innovations reaching TRL 6, of which a substantial part will lead to first-of-its-kind-demo plants</p> <p>Leverage factor > 3 to accelerate industry uptake of technology</p>	<p>Number of significant innovations developed (reaching high TRLs)</p> <p>Number of laboratories and research institutes represented in the network</p> <p>Private investment level (leverage)</p> <p>CAPEX reductions through the innovations</p> <p>Percentage of SMEs involved in the projects</p> <p>Number of advances in validated numerical models for use of hydrogen or electrification instead of fossil fuels</p>

The Net-Zero Industries Mission aims to encourage initiation of joint R&D projects which are co-funded by public institutions.

The medium to long-term goal is to launch specific R&D calls related to decarbonisation of industry. As an initial activity and first objective, R&D funding agencies share knowledge to identify gaps, identify best practices and learn about instruments.

Table 7 gives an overview of current R&D programs on the national, and international level showing the base from which the Mission can align their activities.

2.4 Pillar 3: Enabling Conditions

PURPOSE		
<p>To deliver activities that address business, organisational and policy issues and challenges in decarbonising industry are relevant. The aim is to collect, analyse and disseminate non-technical information related to the decarbonisation of industry.</p> <p>To maximise the acceleration of industry uptake of decarbonisation technologies by the efficient use of stakeholder funds and efforts in removing barriers and risks faced by industry and the wider stakeholder community, and undertaking activities which set up the Demonstration pillar for immediate action.</p>		
SCOPE OF WORK (MISSION LED ACTIONS)		
<p>Overall program management of all supporting projects</p> <p>Targeted efforts to underpin or mitigate risk in technology demonstration investment, both operating and capital</p> <p>Social, environmental and regulatory frameworks that bring forward or accelerate key actions and permissions in achieving mission goals</p> <p>Key stakeholder alignment activities, including needs and capabilities matching for technology demonstration project acceleration</p>		
KEY OUTPUTS	TARGETS 2030	KPIs
<p>Contributions to policy development on the international level aiming to remove barriers for the development, demonstration and diffusion of decarbonisation technologies</p> <p>Knowledge sharing activities in relation to organisational, institutional, education, and policy related topics</p>	<p>Improving the conditions for the realisation of demonstration projects and the knowledge sharing and learning on the international level aiming to reduce risk, accelerate the development and reduction of costs</p> <p>Minimize duplications and maximize additionalities between demonstration projects</p>	<p>Number of briefing papers (co-)authored by NZIM members</p> <p>Number of contributions to policy and standardisation related activities on the international level</p> <p>Number of activities aiming to share knowledge on enabling frameworks between research and demonstration projects</p>

In addition to addressing the technological challenges, various non-technical issues need to be addressed to ensure the transformation of the industry, which include organisational, institutional and policy aspects. The partners of the Mission have suggested a number of activities which can be categorized into different

main areas, which are i) Policy and regulation, ii) Policy toolbox, iii) Best Practice, knowledge sharing and learning, iv) infrastructure, and v) Education. These activities will ultimately seek to identify major common blockers/enablers to projects and how these can be resolved.

2.5 Pillar Support: Stakeholder & Knowledge Management

PURPOSE

To coordinate key stakeholder actions that enable the effective capture and dissemination of knowledge to all key stakeholder communities of practice, in order to build industry wide confidence in adoption of decarbonisation technologies in the energy intensive and hard-to-abate industries.

Manage and support the systems and processes to underpin the stakeholder needs in knowledge management (from capture through to learning and development) in the stakeholder Communities of Practice.

SCOPE OF WORK (MISSION LED ACTIONS)

- Overall program management of all stakeholder and knowledge management actions
- Coordinate key stakeholder Communities of Practice (CoP) as owners and validators of key knowledge to capture, store and communicate within the relevant CoP
- Establish and manage digital storage and access systems for knowledge and learnings generated by key stakeholder Communities of Practice
- Coordinate learning and development programs to promote effective knowledge transfer into the wider industry and stakeholder communities

KEY OUTPUTS	TARGETS 2030	KPIs
<ul style="list-style-type: none"> Established key Communities of Practice Established Knowledge Management Systems Effective Management of Stakeholder management of Project knowledge 	<ul style="list-style-type: none"> Six key CoP established NZI Knowledge Systems recognised as valuable asset by industry and regulatory stakeholders 	<ul style="list-style-type: none"> KM Systems capable of knowledge capture, knowledge dissemination, learning and development dissemination, peer to peer interactions and introductions Stakeholder utilisation of KM systems Industry investment in decarbonisation technologies leveraging our communities and systems for uptake of decarbonisation technology

Knowledge management is a cornerstone of all Mission Innovation activities, and the goals of achieving industry uptake of technologies demonstrated in this Mission. Knowledge isn't a single defined document, nor is it constrained to a single stakeholder or group of stakeholders. The collaboration between stakeholders required during the Mission is representative of the scale of the technology and knowledge transfer that is required to pass this knowledge (and levels of understanding and trust required for industry) to confidently invest in and adopt the technologies.

To effectively deliver knowledge management, we must understand and manage knowledge in each of its forms and across each of its major collaborative stakeholder groups. Nothing in this process is a threat to the ownership rights or disclosure controls for registered Intellectual Property Rights (IPR). Where there are elements

of key IPR, it is highly irregular for there not to be essential adjacent intellectual property and know-how (encapsulating the knowledge required to implement, scale and deliver the IPR) that can add significant value in the overall purpose of the Mission and the roll out of knowledge regarding the demonstration of the decarbonisation technologies.

The Mission will draw heavily on the existing knowledge management systems and experience of the Mission Innovation Secretariat, and supplement where required to ensure we have the four key elements for knowledge management, storage, and information transfer available and accessible for the member nations and major stakeholder groups, including materials and information that will be available for public access.



Figure 10: Primary Knowledge Management information transfer pathways

Knowledge Management Basic Requirements

Knowledge is, by definition, a higher value subset of information. All stakeholder groups generate and discover information in the development, engineering design, project delivery, commissioning, and operation of a new technology, or even a new application of an existing technology. The Mission will require a knowledge management system scaled to cope with the diversity of technologies (over 50 to be demonstrated at industrial scale) and across each of our three Pillars.

Not all information will be valuable knowledge, but given the context specific nature of the value of Knowledge Management (KM), it will be more valuable to over capture than exclude information in our solution. The NZI KM solution will require key elements to be addressed, namely the creation and capture of information and its classification and storage as knowledge, as well as the retrieval and distribution systems to allow transfer of the knowledge to assist in the technology uptake by industry.

Our processes and systems will expand pure document management systems to include accreditations and skills development and recognition, as there are four key transfer mechanisms that must be supported in order to recognise and transfer the key tangible and intangible elements of the knowledge:

- Person to person transfer of skills, information, and experience (similar to the master/apprentice relationship), including the reuse of personal experience on multiple projects (incumbency, project experience and history, etc both at an individual and corporate level). This will extend into the Communities of Practice we support, as these valuable interactions will outlast the life of the Mission.
- Person to tangible capture (a method of codifying and systemising knowledge into a reusable training and reference material, such as procedures, training materials, business processes, etc)
- Accessible and editable documentation and information captured from typical project activities (e.g. reports, drawings, findings, etc)
- Reusable fixed information for distribution/publication (specifications, design elements, selection criteria, performance data, scientific publications, training materials, etc)

Figure 10 depicts the Mission's primary knowledge management information transfer pathways.

2.6 Mission-led & Mission-supported Actions

The following two sections illustrate that there are actions the Mission will directly lead, and others where the Mission will provide a supporting role. These actions will be led by other stakeholders as illustrated in the tables below. The Mission will seek to support every activity set out in this Action Plan, noting that some of the activities identified in this version of the Action Plan are intentions and not at this stage funded projects from the Mission members.

From research and mapping to framework and demonstrations, the Mission will play a vital role in enabling these activities to come to fruition.³

2.6.1 Mission-led Actions

The Actions that the Mission will lead on are described in Table 3. Each action is associated with a Mission Pillar, and the industry sector or sectors to which they are directed. Several actions are strategically aimed at enabling dialogue and collaboration between the stakeholders, promoting knowledge sharing and shaping the research with the aim of aligning stakeholders, enabling public-private partnerships, and unlocking synergies between actors. There are also actions focused on enabling meaningful demonstrations to provide early market acceleration and bring the (in many cases) high-TRL technologies into wider industry acceptance.

2.6.2 Mission-supported Actions

Whilst the Mission is well placed to lead the actions described in the previous section, there are several prioritized actions that require capabilities and resources beyond the reach of the Mission. This highlights the need for cross-sector, worldwide collaboration. These actions will rely on the proactiveness and leadership of other groups. The overarching role will be to inform those stakeholder groups on the need for these actions to come to fruition and to encourage them to drive them forward, helping coordinate and share knowledge whenever possible. Table 4 lists the actions and identifies the stakeholder groups whose collaboration would be key to drive them forward. While Table 4 also suggests which groups are best suited to lead, the Mission encourages all stakeholders to take a leading role in any of the actions they can support.

³ Refer to section 1.3 or 4.2 for definitions of activities, actions and projects as described in this Action Plan

Table 3: List of Mission Led Actions

Pillar	ID	Action	NZIM Country Lead/ external Lead	Sector(s)	TIMESCALE			SUPPORTING STAKEHOLDERS					
					2023 – 2025	2025 – 2027	2027 – 2030	Energy Intensive industry R&D	Government/Regulators/Funders	Energy intensive industry operators/associations	Technology Providers	Knowledge Community	Electricity & Fuel Providers
Cross Pillar: Stakeholder and Knowledge Management	1	Designing an umbrella KM & SM framework to align and coordinate all KM and SM projects	AUS CAN	all	x			S	S			S	
	2	Identify and Appoint Pillar and Team Leader positions	AUS AUT	all	x				S	S			
	3	Establish Stakeholder and Technology Pathway Communities of practice and engage on knowledge needs	AUS CAN	all	x					S			
	4	Standardising best practice on Project Knowledge Sharing	AUS CAN	all	x							S	
	5	Engaging a Knowledge Management Partner to supply and support a KM System	AUS MI Sec	all	x				S				
	6	Mapping of activities of the potential cooperation partner organisations, stakeholder mapping, gap analysis	AUS WEF	all	x			S	S	S		S	
	7	Management strategies for the barriers of IPR and commercial in confidence issues	AUS CAN	all		x				S	S		
	8	Expand Industry engagement and mission involvement	AUS AUT	all	x			S		S	S	S	S
	9	Incentivisation and recognition program rewarding key contributions to the mission goals	AUS AUT	all	x	x	x		S	S			
	10	Continued stakeholder engagement on prioritising Projects	AUS AUT	all	x	x	x		S	S		S	

Pillar	ID	Action	NZIM Country Lead/ external Lead	Sector(s)	TIMESCALE			SUPPORTING STAKEHOLDERS					
					2023-2025	2025-2027	2027-2030	Energy Intensive industry R&D	Government/ Regulators/ Funders	Energy intensive industry operators/ associations	Technology Providers	Knowledge Community	Electricity & Fuel Providers
Pillar 1: Demonstrations	11	Defining the Pillar Execution Plan	ref #2		x				S	S			
	12	Continued stakeholder engagement on prioritising Projects	ref #11		x	x	x		S	S			
	13	Establish an initial International Workshop on industrial decarbonization with a focus on industrial clusters, with the potential for an annual series	UK	all	x			S	S	S	S		S
	14	Organize MI demonstrations roundtables to kick-off cooperation	FI	all	x			S		S	S		
	15	Establish bi- or multilateral Funding Calls	AUS AUT	all	x	x	x	S	S	S	S		
Pillar 2: Underpinning R&D	16	Defining the Pillar Execution Plan	ref #2		x				S	S			
	17	Continued stakeholder engagement on prioritising Projects	ref #16		x	x	x		S	S			
	18	Liaising with and prioritizing fast track R&D projects to support the timely execution of demonstration pillar projects	tba	all	x	x	x	S		S	S	S	
	19	Showcase R&D funds available for NZ industries	AUT	all	x	x	x	S	S	S			
	20	Network of research infrastructure labs for system level validation of net-zero industry technologies	AUT FIN	all	x	x		S			S		
Pillar 3: Enabling conditions	21	Defining the Pillar Execution Plan	ref #2		x				S	S			
	22	Continued stakeholder engagement on prioritising Projects	ref #21		x	x	x		S	S			
	23	Environmental & Project approvals/permitting	tba	all	x	x			S	S			
	24	Infrastructure development/Availability of low carbon energy and suitable raw materials	tba	all	x	x		S	S	S		S	S

Table 4: List of Mission Supported Actions

Pillar	ID	Action	potential Lead/cooperation partner	Sector(s)	TIMESCALE			SUPPORTING STAKEHOLDERS					
					2023-2025	2025-2027	2027-2030	Energy Intensive industry R&D	Government/Regulators/Funders	Energy intensive industry operators/associations	Technology Providers	Knowledge Community	Electricity & Fuel Providers
Pillar 1: Demonstrations	25	Create Knowledge through sharing of experiences from large industrial projects for deep decarbonization, covering planning, implementation, and operational stages	IEA IETS/ World steel	all	x	x		S		S		S	
	26	Collaborate and integrate findings from MPP IEA IRENA CETP etc. to prioritise and populate our demonstration project portfolio	MPP IEA IRENA CETP etc.	all	x	x	x					S	
Pillar 2: Underpinning R&D	27	Collaborate and integrate findings from global R&D programs to prioritise and populate our R&D portfolio	TBC	all	x	x		S		S	S	S	
	28	Establish cooperation with the CET Partnership Impact Network	FIN	all	x	x	x	S	S	S	S	S	
Pillar 3: Enabling conditions	29	Ensure technology neutral policy	TBC	Steel	x	x	x		S	S	S	S	
	30	Taking a life cycle approach and support the circular economy	TBC/ IDDI, World steel	all	x	x	x	S		S		S	S
	31	Common definitions about near-zero steel and cement production	IDDI GER	Steel Cement	x	x			S			S	
	32	Harmonization of global standards, reporting frameworks and globally recognized targets for Green Public Procurement	TBC/IDDI	all	x	x			S				
	33	Demand signals and procurement commitments	IDDI	Steel Cement	x	x	x		S	S			
	34	Report and contribute to the G7 Industrial Decarbonisation Agenda (IDA)	GER IEA	All	x	x	x	S	S	S		S	S
	35	Support the creation of a Policy toolbox to foster industrial decarbonisation (containing KPI's, legal and regulatory framework, business models, innovative funding & financing instruments like carbon contracts for difference or the EU Taxonomy)	LeadIT GER/ World steel	All	x	x			S			S	
	36	Ensuring access to infrastructure	TBC	All	x	x	x		S				S
37	Exchange on skills and educational needs	TBC/ World steel	Steel	x	x	x		S	S	S	S		

3 Conclusions and Outlook

3.1 Summary of the Initial Action Plan

The first two years of the Net-Zero Industries Mission are indeed foundational, with a heavy focus on the establishment of both the human and informational networks required to enable our mission purpose.

The Mission will, in parallel, deliver on key internal actions that both establish our operating support frameworks and fast track capabilities and project findings that facilitate and accelerate the required actions and interactions between our key stakeholder groups.

Meanwhile, the world and our key stakeholders are not sitting still, and the existing initiatives that will provide the valuable knowledge, relationships, roadmaps and technical innovations will continue, and the Mission will build relationships to incorporate this wealth of experience and knowledge into the collective value proposition of our purpose and deliverables. This continuous engagement and incorporation of new actions and projects in each of our three Pillars will see this document quickly become dated, replaced with live status updates from our respective communications and website.

3.2 Outlook

Moving forward from the establishment phase and into more of a delivery and expansion mode, the true value and power of our established networks will become apparent. The Communities of Practice in each of our Key Stakeholder groups will be supported as they operate to share knowledge and experience with their peers and help control the flow and quality of knowledge that is captured and developed for further dissemination to help our goal, building the confidence and trust of industry to accelerate the investment and adoption of decarbonisation technologies in our focus sectors.

The Net-Zero Industries Mission will continue to regularly communicate the expansion of our activities across both the networks of stakeholders and projects we include in our coordination.

A formal update of this action plan will be released in time for early 2025, at which time a full definition of the Pillar 1 Demonstration Projects is expected to be communicated, and the portfolio of supporting activities across knowledge and stakeholder management will be well established, and a robust pipeline identified for our research and enabling condition projects.

4 Appendices

4.1 Governance Structure

Strategic decisions of the Mission are developed and proposed by the Mission Co-leads. For strategic steer of the mission, an Executive Committee (ExCo) was established which is composed of one representative from each Core Member country. The ExCo is the only body within the NZI with voting rights and will approve the mission roadmap and the Action Plans with simple majority. The ExCo chair will be appointed for 2 years and must be a representative of a Co-lead member country. The Rules of Procedure outline the decision-making steps for the ExCo.

In order to track progress of the mission, an independent advisory board could be established. Members of the advisory board must be composed of representatives from industry, academia, MI member countries and one developing country that is not an MI member. The advisory board would assess the mission progressions biennial and could be established in year 2 of the mission.

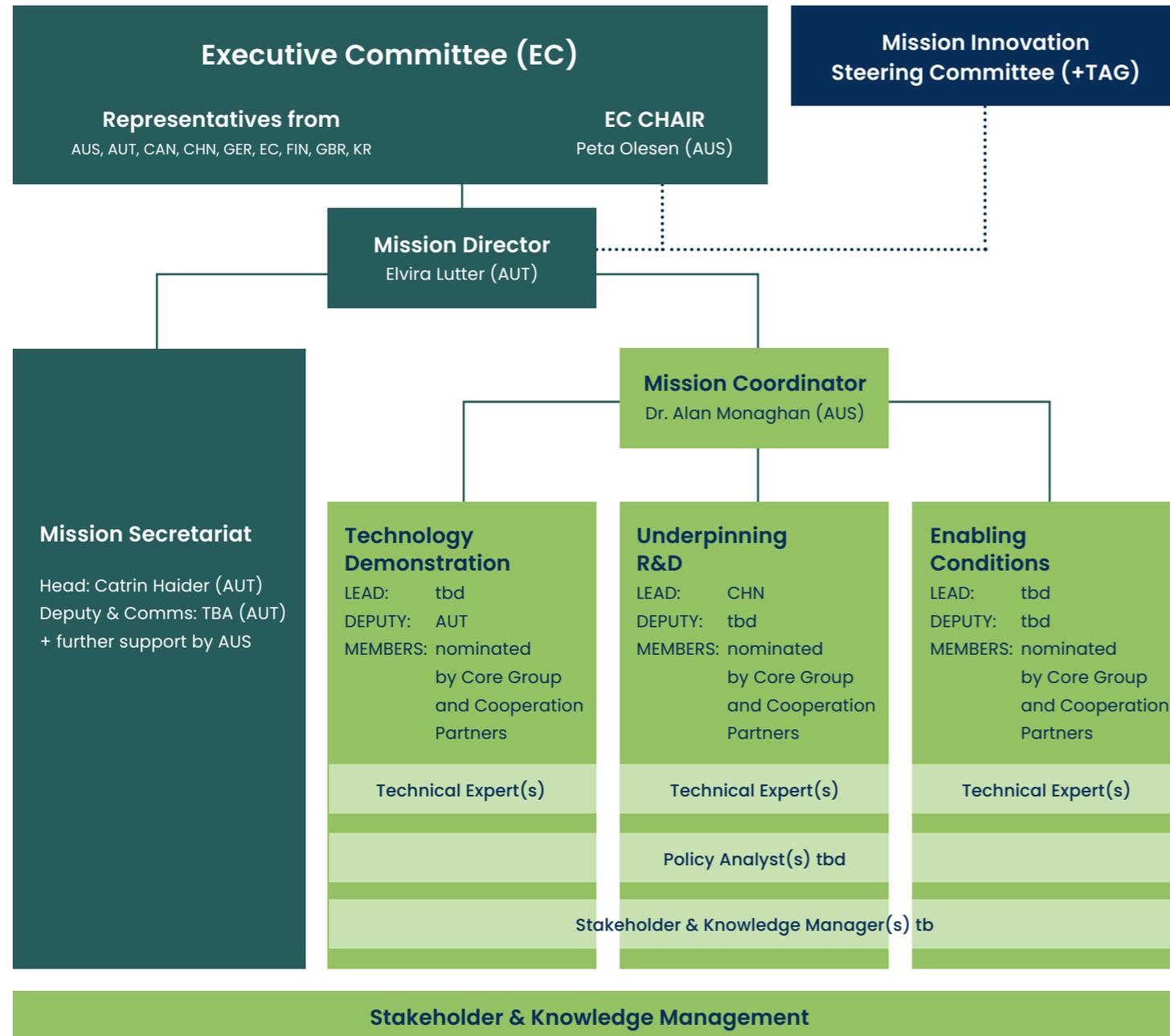


Figure 11: Governance Structure

Figure 11 illustrates the governance structure. The different roles within structure are defined as follows:

Mission Director

- Accountable for the day-to-day operations of the mission, reports to the Mission’s Executive Committee on Mission progress
- Responsible for strategy implementation and day-to-day operations
- Provides strategic leadership for the Mission based on input from Pillar Leads
- Manages and oversees Mission teams, chairs the Mission team meetings
- Represents the Mission at official events
- Drives engagement across MI and private sector to expand coalition
- Should provide stability for Mission (recommended that Director is appointed to the role for min. 2 years)
- Stakeholder/member engagement
- Maintain overview of mission landscape, identifying new and managing existing strategic partnerships and stakeholders

Mission Coordinator

- Reports to Mission Director
- Provides strategic leadership for the Mission based on input from Pillar Leads
- Manages and oversees the Pillar Leads and coordinates activities across all Pillars
- Represents the Mission at official events
- Drives engagement across MI and private sector to expand coalition
- Support development of new activities and projects
- Responsible for programme management and progress
- Lead team of technical and policy experts
- Stakeholder/member engagement

Pillar Lead

- Reports to Mission Coordinator
- Responsible for Pillar’s strategy and delivery of activities
- Manage team of stakeholder, knowledge, technical and policy experts
- Engage with relevant stakeholders (Core Group members and mission support members)

Community of Practice Leaders

- Reports to Mission Coordinator
- Manages key stakeholder groups (Government, Industry, Service Provider, Researchers, Finance, etc)
- Coordinates with Pillar Leaders
- Manages knowledge capture, and inter-project coordination between pillars for key stakeholder groups
- Key interface with learning & development support for the CoP.

Technology Pathway Leaders

- Reports to Mission Coordinator
- Manages knowledge collection and transfer across industry sectors within their decarbonisation technology pathway (Electrification, Green H₂, Alternate Fuels, CCU, CCS, Alternative Materials, Materials Efficiency)
- Coordinates with Pillar Leaders
- Key interface with the Community of Practice Leaders.
- Key interface with learning & development support for the technology pathway.

Policy Analysts

- Reports to Pillar lead
- Analyse policy trends & advise members
- Policy expertise to Pillar activities
- Prepare content for Ministerial
- Draft reports, briefing, and other comments for comms

Technical experts

- Reports to Pillar leads
- Conduct technical analysis on tech. Trends etc.
- Sets up rules and framework for data-exchange and monitoring of projects
- Track progress of Mission activities
- Input into scoping of pillar activities
- Draft reports, briefings and other content for comms etc.

4.2 Glossary

Table 5: Glossary of terms

TERM	DEFINITION
Actions	Activities to be completed by the extended Mission team with Resources provided by partners and industry stakeholders on secondment that enable and support the Projects completed by the wider mission stakeholders, separated in both Mission-led and Mission-supported Actions
Activities	All activities that compromise the scope of the Mission Action Plan, separated into Mission-led and Mission-supported Actions, and Projects externally delivered but with key knowledge and value that contributes to the mission objectives (e.g. industrial scale technology demonstration projects)
ARENA	Australian Renewable Energy Agency
CCS	Carbon Capture & Storage
CCU	Carbon Capture & Utilisation
CCUS	Carbon Capture, Utilisation & Storage
CETP	Clean Energy Transition Partnership is a multilateral and strategic partnership of national and regional research, development, and innovation (RDI) programmes in European Member States and Associated Countries aiming to boost and accelerate the energy transition and to support the implementation of the European Strategic Energy Technology Plan (SET Plan).
CoP	Community of Practice
Extended Mission Team	The Mission Team and additional resources working on this Action Plan
FEED	Front End Engineering Design – early engineering design works before FID

FEL	Front End Loading, the engineering process used by industry to validate and determine the financial viability of capital projects. Typically progressing through a range of financial investment decision points (FID) from concept or pre-feasibility studies (PFS), feasibilities studies (FS), front end engineering and design (FEED), project execution, and commissioning.
FID	Final Investment Decision (Sometimes also refers to an interim Financial Investment Decision, that leads to the Final Investment Decision) that approves the capital investment in project execution and construction of a capital project.
FS	Feasibility Study, an engineering study to determine the interim technical, social, and economic feasibility for a FEED project.
IPR	Intellectual Property Rights, registered Intellectual Property Rights permitted in national geographies, recognized by international law and treaties.
IRENA	International Renewable Energy Agency
Mission-led Actions	Actions initiated and completed where possible by the mission team to support the mission objectives in our Pillars
Mission-supported Actions	Actions initiated and completed by external partners and entities that support the mission objectives in our Pillars
Mission Team	Resources seconded to Mission Innovation Net-Zero Industries from members or industry partners
MPP	Mission Possible Partnerships
PFS	Pre-Feasibility Study, an early-stage concept or lead in feasibility study efforts that lead to approvals to undertake a Feasibility Study
Projects	Activities performed by external stakeholders that provide value and knowledge to the Pillars (including technology demonstrations and research projects). Typically completed by industry, engineering, technology provider and researchers, funded by industry and MIM partner funding.
Resources	Appropriately skilled people provided by MI partners and industry stakeholders (operational, engineering, technology provider, etc) to deliver Actions and support Projects
R&D	Research & Development
RD&D	Research, Development and Demonstration
TRL	Technology Readiness Level

4.3 Potential Demonstration Projects for Inclusion

The projects listed below represent examples of technology demonstrations that will be considered for inclusion in our Technology Demonstration

Pillar. The initial priority of the Pillar leadership will be to identify and prioritise the projects to be formally included in the overall Mission portfolio.

Table 6: Technology demonstration Projects with potential for common action

DEMONSTRATION PROJECT	COUNTRY	TOPIC/SECTOR AND AIMS	INVOLVED ORGANISATIONS	INVESTMENT VOLUME	DURATION	LOCATION
Boral Carbon Abatement	Australia	Carbon capture use and storage in the cement industry	Calix and Boral, Federal Government Funding	AU\$ 62.05 million		New South Wales Southern Highlands, Australia
Adbri – Carbon Abatement Lime	Australia	Carbon capture use and storage in the lime industry	Calix and Adbri, Carbon TP and HILT CRC, Federal Government Funding	AU\$ 40.4 million		Kwinana, Western Australia
Pilbara Minerals – Low Emissions Minerals Processing	Australia	Low emissions minerals processing in the lithium extraction industry	Pilbara Minerals and Calix, Federal Government Funding	AU\$ 66.8 million		Pilbara region, Western Australia
Renewable Bayer Process Heat – Mechanical Vapour Recompression	Australia	Mechanical Vapour Recompression/Alumina	Alcoa, ARENA	AU\$ 28.2 million		Western Australia
Alcoa Renewable Powered Electric Calcination Pilot	Australia	Alcoa Renewable Powered Electric Calcination Pilot	Alcoa, CSIRO	AU\$ 19.66 million		Western Australia
Australian CCU Flagship: Demonstrating decarbonisation for heavy industry	Australia	Mineral carbonation	MCI, Orica and Australian Government	AU\$ 14.6 million funding for \$ 30 million project	2021–2024	Newcastle, New South Wales
HYFOR® – HYDROGEN-BASED FINE-ORE REDUCTION	Austria	Decarbonization of the Iron & Steel Industry, Worlds first direct reduction process for iron ore concentrates that does not require any prior iron ore treatment	Primetals, voestalpine, K1 Met	€ 5.0 million	2019–2023	Donawitz
oxysteel	Austria	Energy efficiency and demand side management in steel production by the use of oxyfuel and CCU technology	Breitenfeld Edelstahl, Messer, Montanuniversität Leoben	€ 2.6 million	2018–2022	Kapfenberg

DEMONSTRATION PROJECT	COUNTRY	TOPIC/SECTOR AND AIMS	INVOLVED ORGANISATIONS	INVESTMENT VOLUME	DURATION	LOCATION
INDUSTRY4REDISPATCH	Austria	Enable provision of redispatch from industrial and large commercial customers	voestalpine, mondi, wiesbauer, Siemens, Netz OÖ, EVN, APG, evon, kleinkraft, AIT, TU Wien	€ 5.0 million	2021–2025	Several sites across Austria
SOLPART(H2020)/CemSol(BMWK)	Europe	Low-CO ₂ cement production, by the development of calcination reactor run by concentrated solar power, and high-temperature processing of particles for cement production	research organizations companies from Germany, Switzerland, France, Spain, UK, Belgium, Morocco	€4.5 million	2016–2020 resp. 2021–2024	testing of reactor in France, follow-up testing in Germany
SALCOS	Germany	Low-CO ₂ primary steel production: - hydrogen generation and conversion of steel production from blast furnaces to direct reduction (initially based on natural gas but later hydrogen) - first stage: Brownfield transformation of Salzgitter steel works is to be implemented, which can save right from the beginning in 2026 more than 2 million and up to 3.6 million tons of CO ₂ /year after a complete H ₂ -ramp-up	Salzgitter	>€1 billion	2022–2025	Salzgitter, Lower Saxony
IPCEI Hydrogen	Germany/Europe	Hydrogen technologies and systems (electrolysis plants, innovations in steel and chemical industry, hydrogen infrastructure and transport)	more than 400 projects from 22 EU countries and Norway – 62 demonstration projects in Germany	€33 million (Germany)	started 2021	across Europe
CO ₂ capture by organic amine solvent (150000 ton/year) and by solid adsorbent from flue gas (1000 ton/year) (China)	China					
Lafarge Canada Low Carbon Fuel Technology Expansion	Canada	Demonstration and optimization of low carbon fuel (LCF) use in cement manufacturing, through two distinct technologies and in two cement plant technology vintages	Lafarge Canada, Dalhousie University, Natural Resources Canada	total project funding – \$18.5 million CAD; NRCan funding – \$1.9 million CAD		Richmond, British Columbia and Brookfield, Nova Scotia

DEMONSTRATION PROJECT	COUNTRY	TOPIC/SECTOR AND AIMS	INVOLVED ORGANISATIONS	INVESTMENT VOLUME	DURATION	LOCATION
Biocarbon Injection at ArcelorMittal Dofasco	Canada	Demonstrate the ability to use biocarbon in an industrial blast furnace in support of future commercial technology demonstration at the ArcelorMittal Dofasco (AMD) plant	ArcelorMittal Dofasco, Natural Resources Canada	NRCan Clean Growth Program \$1.4 million CAD; CanmetENERGY \$0.45 million; Project total \$ 7.6 million		Hamilton, Ontario
Carbon Clean – CEMEX Rüdersdorf (GER & UK)	UK & Germany	CEMEX will be using Carbon Clean's breakthrough technology, CycloneCC to reduce the overall cost of carbon capture by up to 50%	Carbon Celan, CEMEX	Former funding of the project by BEIS		Rüdersdorf (GER)
XLR8 CCS	UK	Accelerating the deployment of a low-cost carbon capture solution for hard-to-abate industries	C-Capture, Wood, BIG's Energy Works Hull, Hanson Cement, NSG/Glass Futures	£1.7 million BEIS funding from the £1 billion Net Zero Innovation Portfolio (NZIP)	2023–2026	3 sites in UK
Cement-free construction materials (Finland)	Finland	Low carbon and sustainable alternative to cement. This solution creates cement-free construction materials out of industrial side streams.	Betolar Oyj, Customer, e.g.IBF			Finland
Textile recycling	Finland	Textile recycling pilot plant. Used business textiles are turned into new textile fibre and quality raw material	Rester Oy, Business Finland (Funding)	<€10 million		Paimio, Finland

4.4 Potential Underpinning R&D Projects for Inclusion

The projects listed below represent examples of R&D projects that will be considered for inclusion in our Underpinning R&D Pillar. The initial priority of

the Pillar leadership will be to identify and prioritise the projects to be formally included in the overall Mission portfolio.

Table 7: Joint R&D activities (Projects)

PROGRAMS	COUNTRY/REGION	TOPIC/SECTOR AND AIMS	PARTICIPATION	VOLUME	DURATION	ADDITIONAL INFORMATION
BI- AND MULTILATERAL R&D PROGRAMS						
Heavy Industry Low Carbon transition cooperative research centre (HILT CRC)	Australia	Collaborative applied R&D between government, academia/research and industry		AU\$ 84 million cash + AU\$130 million in kind	10 years	www.hiltcrc.com.au
Australian Renewable Energy Agency (ARENA)	Australia	Support the global transition to net zero emissions by accelerating the pace of pre-commercial innovation, to the benefit of Australian consumers, businesses and workers				www.arena.gov.au
Researcher networks for Industrial low emissions technology (grants program tbc)	Australia			AU\$12.5 million	4 years	business.gov.au/grants-and-programs/international-clean-innovation-researcher-networks#key-documents
Industrial Energy Transformation Fund	UK	Improve industrial energy efficiency and decarbonise manufacturers by investing in the deployment of high-TRL solutions at commercial scales on UK manufacturing sites.		£ 315 million of grant, plus private match		www.gov.uk/government/publications/industrial-energy-transformation-fund-ietf-phase-2-spring-2022
ISCF Industrial Decarbonisation	UK	Supports development of low-carbon technologies and infrastructure, increasing industry competitiveness and contributing to the UK's clean growth. It will reduce the carbon emissions from energy intensive industries, such as iron and steel, cement, refining and chemicals		£ 210 million of grant		www.ukri.org/what-we-offer/browse-our-areas-of-investment-and-support/industrial-decarbonisation
ISCF Transforming Foundation Industries	UK	The challenge aims to transform the UK's foundation industries by (i) making them internationally competitive, (ii) securing more jobs throughout the UK, and (iii) growing the sector by 2024 in an environmentally sustainable way.		£ 66 million of grant, £ 83 million from other sources		www.ukri.org/what-we-offer/our-main-funds/industrial-strategy-challenge-fund/clean-growth/transforming-foundation-industries-challenge

PROGRAMS	COUNTRY/REGION	TOPIC/SECTOR AND AIMS	PARTICIPATION	VOLUME	DURATION	ADDITIONAL INFORMATION
CCUS Innovation 2.0	UK	Grant-funding from BEIS to develop and demonstrate next generation CCUS technology. Funding focusses on mid-stage (TRL 3-5) and late-stage (TRL 6-8) CCUS innovation.				www.gov.uk/government/collections/carbon-capture-usage-and-storage-ccus-innovation-20-programme
International R&D calls by Fed. Ministry of Research	Germany					
CLIENT II – International Partnerships for Sustainable Innovations	Germany					
Austrian Chinese Joint Call on Cooperative RTD Projects on Production & Materials	Austria					
Flagship Regions	Austria		Specific actions in existing programmes possible as funding of foreign partners up to 20% of total cost is always eligible, New Energy for Industry (NEFI)			www.vorzeigeregion-energie.at/wp-content/uploads/Folder-Vorzeigeregion-EN-screen-RZ.pdf
International cooperation projects supported by government	China					
EUROPEAN R&D PROGRAMS						
Important Projects of Common European Interest (IPCEI)	Europe	IPCEI Hydrogen (Hy2Tech): The IPCEI covers a wide part of the hydrogen technology value chain, including (i) the generation of hydrogen, (ii) fuel cells, (iii) storage, transportation and distribution of hydrogen, and (iv) end-users applications, in particular in the mobility sector.	The Member States will provide up to €5.4 billion in public funding, which is expected to unlock additional €8.8 billion in private investments. As part of this IPCEI, 35 companies with activities including SMEs and start-ups, will participate in 41 projects.	€5.4 billion of public support by fifteen Member States for an IPCEI in the hydrogen technology value chain		

PROGRAMS	COUNTRY/REGION	TOPIC/SECTOR AND AIMS	PARTICIPATION	VOLUME	DURATION	ADDITIONAL INFORMATION
Horizon Europe	Europe	<p>Horizon Europe is the EU's key funding programme for research and innovation with a budget of €95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth.</p> <p>Three important pillars are:</p> <p>I: Excellence Science (ERC, Marie Skłodowska-Curie, Research Infrastructures)</p> <p>II: Global Challenges and European Industrial Competitiveness (6 Clusters (CL 4 and 5 of particular relevance), JRC)</p> <p>III: Innovative Europe (EIC, European Innovation Ecocsystems, EIT)</p>	<p>Offers of opportunities along the entire TRL and value chain for international collaborative R&D to develop decarbonisation technologies among MS within Europe; e.g. Clean Steel Partnership, Processes4Planet Partnership;</p> <p>In general, participation is limited to legal entities established in MS only; however, there are some specific calls aiming to collaborate with Non-MS and countries outside Europe:</p> <p>e.g. HORIZON-CL4-2023/2024-RESILIENCE-01-02 (open for Canada)</p> <p>e.g. HORIZON-CL5-2023-DI-02 (international cooperation with China)</p>	<p>When it comes to planned investments in various partnerships under Horizon Europe with industry addressing net technologies (Processes4Planet, Clean Steel, Clean Hydrogen Joint Undertaking, etc.), these amount to about €6.5 billion up to 2027.</p>	2021-2027	<p>research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en</p>
Clean Energy Transition Partnership (CETP)	Europe	<p>The Clean Energy Transition Partnership is a transformative research, development and innovation programme across Europe boosting and accelerating a just energy transition in all its dimensions for Europe to become the first climate-neutral continent.</p> <p>In total, seven Transition Initiatives are launched, of relevance is: TRI 6: Integrated Industrial Energy Systems</p>		<p>CETP is a partnership of national and regional RDI programmes in European MS and Associated Countries with the aim to contribute substantially to the implementation of the Plan (SET Plan).</p>	First call in Sept. 2022	<p>cetpartnership.eu</p> <p>Alignment of the EU countries research programmes: Strategic Energy Technology Plan (SET Plan): setis.ec.europa.eu/index_en</p>
INTERNATIONAL PROGRAMS						
UNIDO's Global Programme for Green Hydrogen in Industry	UNIDO	<p>Recognizing the potential of Green Hydrogen, UNIDO has initiated a global Programme to foster the application of green hydrogen in industry in developing and emerging economies.</p>	<p>Collaborations between different stakeholders across the globe, including the public and private sectors, financial organizations, and academia, are crucial. IEA Technology Collaboration Programme (TCP), International Centre for Hydrogen Energy Technologies (ICHET), Global Network of Regional Sustainable Energy Centres (GN-SEC)</p>			

4.5 Technology Readiness Level Definition

Technology Readiness Levels

The three pillars of the NZI Mission are aligned with the definitions of technology readiness levels (TRL), and the resulting flow through of these TRL through the engineering and investment requirements of industry. These industry processes, often call the Front-End Loading (FEL) process, advances technical, commercial and change management information to build both trust and confidence in making final investment decisions (FID) to expend capital on technology an industrial project.

Our early-stage pillar of Underpinning R&D is focussed on supporting development of technologies to TRL 4 or 5, at pilot stage of demonstration. Our Technology Demonstration pillar has the goal of demonstrating a minimum of two decarbonisation technologies in each of the seven pathways, in each of the four heavy industry market sectors. This will usually require technology demonstrations at TRL 8, potentially via a development and demonstration of the technology at TRL 7 if required.

Note: If there is a gap with technologies at TRL 6 that the mission and its partners require to demonstrate at TRL 8, a means of supporting that development will be required in the Technology Demonstrations pillar.

TECHNOLOGY READINESS LEVEL

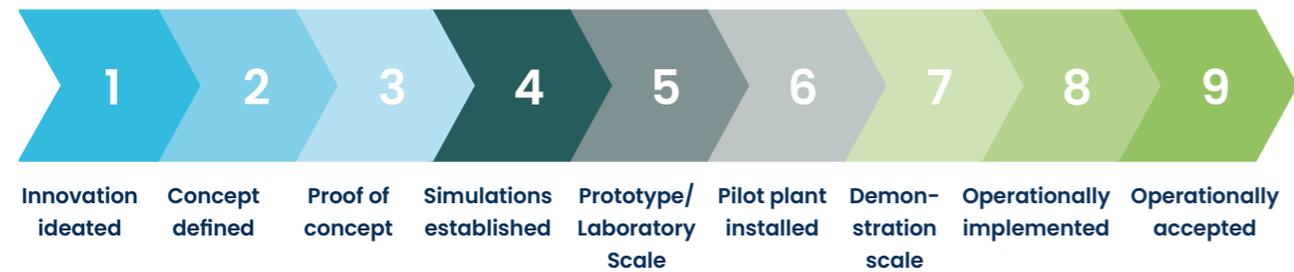


Figure 12: Definitions of Technology Readiness Level in the context of delivering Industry Scale demonstrations of decarbonisation technologies as part of Mission Innovation: Net Zero Industries

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