

MISSION INNOVATION **COUNTRY HIGHLIGHTS**

5TH MI MINISTERIAL 2020

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INTRODUCTION

Mission Innovation (MI) Members¹ agreed to provide information on strategies and plans for their respective governmental and/or state-directed clean energy research and development investment over five years. New investments are focused on transformational clean energy technology innovations that can be scaled to varying economic and energy market conditions that exist in participating countries and in the broader world.

Information-sharing promotes transparency and integrity. It allows for broad stakeholder engagement, gives rise to opportunities for collaboration, and can inspire and inform investment decisions by the private sector.

Accordingly, MI Members have shared narratives, available on the MI website, describing the nature of their clean energy research, development, and demonstration (RD&D) investments; current strategies and priorities for engagement in Mission Innovation.

MI Members initially submitted narrative and funding information prior to the Inaugural MI Ministerial in June 2016. They submitted updated information in November 2016, at the one-year anniversary of the MI launch in Paris then prior to the Second MI Ministerial (June 2017), Third MI Ministerial (May 2018) and Fourth MI Ministerial (May 2019). Once again, MI members have submitted information prior to the Fifth MI Ministerial hosted by the Kingdom of Saudi Arabia in September 2020. This updated information focuses on key highlights over the past year including recent developments in members plans, policies and strategies, innovation successes, activities delivered in support of the Innovation Challenges, public sector RD&D investment and new collaborations. For the first time members have provided information on the impact of their activities.

This document provides a compilation of the most recent information that has been submitted by each of the 25 MI Members. In addition to promoting transparency and integrity, it is hoped that the information shared in the document will facilitate collaboration among Members and encourage further private sector engagement.

All data is based on information submitted by members. Baselines are determined independently by each member based on national priorities and relevant activity under Mission Innovation, it therefore differs by member and, for International Energy Agency (IEA) member countries, is often a subset of the IEA datasets². All funding amounts presented in this report are in USD using a single set of foreign exchange rates³. There may be small differences in USD amounts compared to previous MI country highlights. Numbers denoted by “zero” in the following tables may indicate that no information has been provided for spend in that category.

¹ Mission Innovation Members, as of September 2020, include 24 countries and the European Commission on behalf of the European Union. A complete list is provided at: <http://mission-innovation.net/our-members/>

² Please see Annex A for full data set

³ The exchange rates used were taken from the OECD Monthly Monetary and Financial Statistics https://stats.oecd.org/Index.aspx?DataSetCode=MEI_FIN#



AUSTRALIA

High impact innovation activity triggered by MI

In 2019, a consortium of over 30 Australian industry, government and academic partners established the Affordable Heating and Cooling Innovation Hub (i-Hub). i-Hub supports Australia's engagement in Innovation Challenge 7 activities and aims to demonstrate how renewable energy technology can be integrated with heating, ventilation, air-conditioning and refrigeration equipment in commercial buildings.

Impact of your national clean energy innovation activity

In 2019, Australia installed a record estimated 6.3 gigawatts of new renewable capacity, 24% above the previous record set in 2018. This follows Australia's investment of AUD\$11.9 billion in renewable energy in 2018, the highest on record. These investments contributed to reduced emissions – lowest level of emissions per person in 29 years (in 2020) – without compromising on economic growth. Renewables are expected to contribute 27% of Australia's electricity in 2020 and 48% in 2030.

Update on clean energy innovation policies and strategies

Australia is taking a practical, technology-focused approach to the transition to a low emissions economy.

- In May 2020, Australia launched a **Technology Investment Roadmap** to reduce the cost of new and emerging low emissions technologies and accelerate their deployment. Annual Low Emissions Technology Statements will be released as an ongoing and important mechanism to ensure that Australia's investments deliver the strongest economic and emissions reductions outcomes.
- Australia announced its AUD\$3.5 billion **Climate Solutions Package** in February 2019. The package expands investments in clean energy generation projects, energy efficiency and other economy-wide emissions reductions measures. This includes targeted investments in hydro-electric generation and large-scale storage capabilities through the Snowy 2.0 project to improve the security and reliability of Australia's energy system.
- Australia released a **National Hydrogen Strategy**⁴ in November 2019. The strategy sets a vision for a clean, innovative, safe and competitive hydrogen industry, with the aim of positioning Australia's hydrogen industry as a major player by 2030.

These new policies complement Australia's existing suite of policies and project financing through the Australian Renewable Energy Agency and the Clean Energy Finance Corporation.

Major innovation initiatives and programmes in 2019/20

Following the release of Australia's National Hydrogen Strategy, the Government has announced AUD\$370 million funding to support new hydrogen projects. This includes:

- An AUD\$300 million Advancing Hydrogen Fund from the Clean Energy Finance Corporation, which will support the growth of a clean, innovative, safe and competitive Australian hydrogen industry.
- Australian Renewable Energy Agency's Renewable Hydrogen Deployment Funding Round of up to AUD\$70 million to help fast track the development of renewable hydrogen in Australia. The round is expected to play a material role in supporting commercial-scale deployments of renewable hydrogen in Australia.

⁴ <https://www.industry.gov.au/data-and-publications/australias-national-hydrogen-strategy>

Private sector engagement in 2019/20

- In November 2019, Australia joined the Leadership Group for Industry Transition, which aims to bring together government and industry leaders to develop sectoral roadmaps. These roadmaps will cover innovation, policy and finance, promoting public-private collaboration on critical challenges across hard-to-abate sectors.
- In 2019 and 2020, the Australian Government announced funding for industry-led research collaborations in clean energy through Cooperative Research Centres (CRCs). These include:

- 1 AUD\$70 million to establish the Blue Economy CRC, which brings together over 40 participants from aquaculture and renewable energy sectors to address the challenges of offshore food and energy production.
- 2 AUD\$25 million to the Future Battery Industry CRC to help tackle gaps in the battery industry's value chain, support battery deployment and optimise the circular economy for battery waste recycling.
- 3 AUD\$40 million to the Future Energy Exports CRC, which will explore ways to apply Australia's extensive LNG export knowledge to establish a global leading position in the nascent hydrogen export industry.
- 4 AUD\$68.5 million to establish the Reliable Affordable Clean Energy for 2030 CRC, which will facilitate research collaborations between universities and the energy industry with the aim of reducing emissions, improving network reliability and reducing energy costs across Australia.

Major activities in support of the Innovation Challenges in 2019/20

Australia participates in all eight Innovation Challenges and co-leads IC8. Our key activities between 2019 and 2020 include:

IC1: Smart Grids Challenge

- In partnership with IC1, Australia hosted a Smart Grids Pitch Competition at the World Solar Challenge in October 2019. The competition helped raise awareness of the wide-ranging potential for smart grid technologies in the investment community and with a broader audience.

IC5: Converting Sunlight Challenge

- In partnership with IC5, Australia hosted the second International Forum on Zero Carbon High Temperature Minerals Processing (HiTeMP) in March 2020. The forum brought together global leaders in research, industry and businesses to foster the transformation of heavy industries that relies on heat.

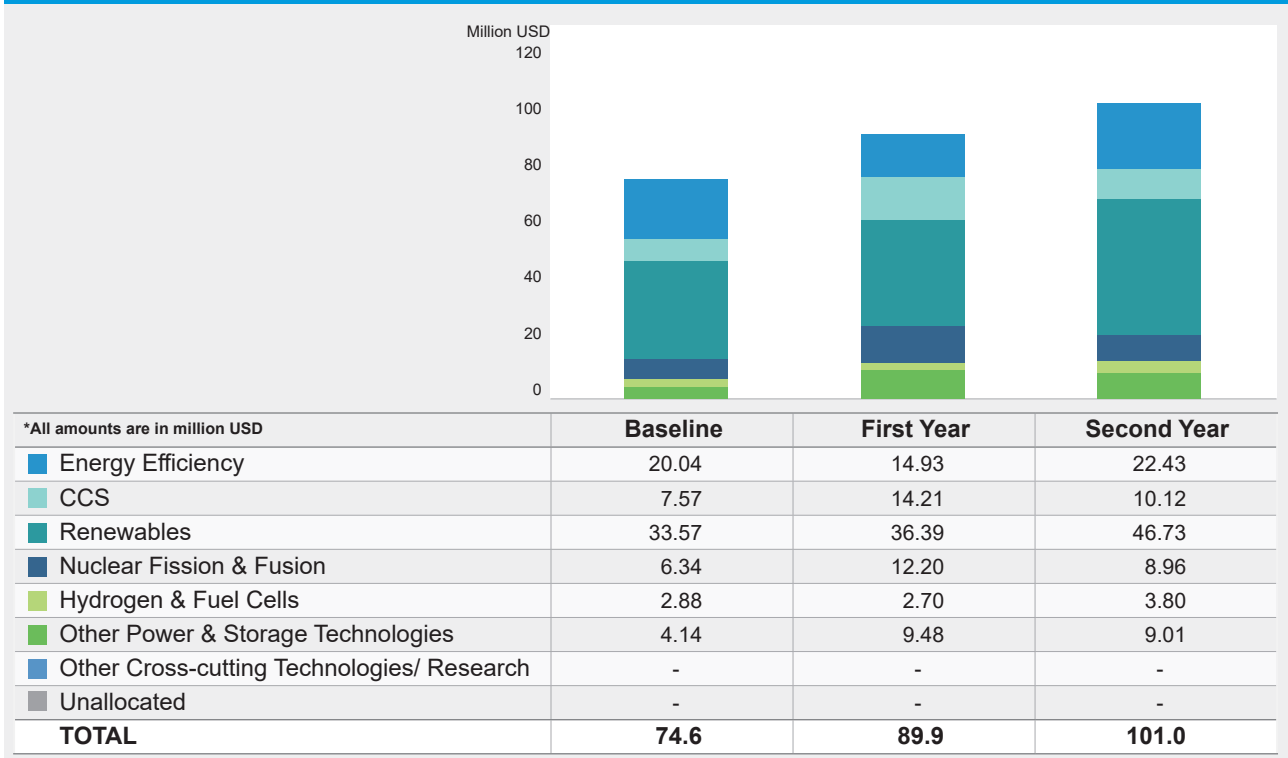
IC8: Renewable and Clean Hydrogen Challenge

- In November 2019, International Partnerships for Hydrogen and Fuel Cells in the Economy (IPHE) and IC8 co-leads (Australia, Germany and the European Commission) jointly held a workshop on Hydrogen in the Gas Grid in the UK. Participants exchanged knowledge on the regulations, codes and standards for using hydrogen in the gas grid.

National plans and priorities for clean energy innovation

- Australia’s Technology Investment Roadmap provides strategic and system-wide view to future investments in low emissions technologies. The roadmap includes annual Low Emissions Technology Statements, which are vehicles to articulate our priority technologies set economic stretch goals – realistic but ambitious pathways to bring new technologies to economic parity with high emissions alternatives.
- Australia is developing a Long Term Emissions Reduction Strategy ahead of the UN climate summit in Glasgow. The Strategy will be informed by the Technology Investment Roadmap, and outline how Australia can benefit from advances in technology as we transition our economies in the decades ahead. It will highlight technology pathways for key sectors and opportunities to boost productivity, create jobs and new export industries, and remain competitive in a world where markets increasingly value low emissions. The Strategy will show how Australia can contribute, alongside other parties to the Paris Agreement, to achieving the collective goal of net-zero globally in the second half of the century.
- The Australian Renewable Energy Agency (ARENA), on behalf of the Australian Government, is developing a bioenergy roadmap to identify the role that the bioenergy sector can play in Australia’s energy transition. The roadmap will help enable bioenergy applications to be de-risked, particularly as an industry feedstock and as fuel for heavy transport, aviation and shipping.
- The Australian Government is developing a National Electric Vehicle Strategy to transition to ensure the transition to electric vehicle technology and infrastructure is planned and managed, and that the energy grid is prepared for increased electric vehicle uptake.

Public sector RD&D investment



Australia’s MI baseline includes research and development but not demonstration.



AUSTRIA

Impact of your national clean energy innovation activity

Since the beginning of the Austrian MI membership in 2018, activities of the energy research and innovation community were bundled, and collaborations were intensified. The highlight of the MI Austria activities is the annual Mission Innovation Austria week, the platform for all drivers and shapers of innovation in the energy system of the future.

In the first edition in 2019, 400 participants from 16 countries met in Stegersbach and Oberwart, (south of Vienna) in May 2019 to discuss current developments with stakeholder from industry, policy and research in a series of parallel events. The Mission Innovation Week 2020/21 takes place in Hall & Innsbruck.

Update on clean energy innovation policies and strategies

In 2020, the Austrian government⁵ has committed itself in the framework of the new government agreement (2020 – 2024) to a fast track to decarbonisation with the overall goal to reach climate neutrality by 2040. A corresponding reduction path of CO₂ emissions will be elaborated in the near future. Energy research and technology development will be key elements of this roadmap.

The current framework of the clean energy innovation policies in Austria are the Climate and Energy Strategy #mission2030 (published in 2018) and its implementation plan (National Climate- and Energy Plan; submitted to the European Commission in 2019). By 2030, Austria pursues ambitious goals including:

- reduction of CO₂ emissions by 36% compared to 2005.
- providing 100% of its total electricity consumption (national balance) from renewable energy sources.
- increase in the share of renewable energy in the gross final energy demand to 45-50%.

Major innovation initiatives and programmes in 2019/20

Flagship Region Energy (national)⁶

In 2018 the programme launched three 8-year pilot regions for the testing, demonstration and implementation of integral energy solutions in real time. In the context of the first call for projects, in 2018 a first tranche of 20 R&D projects of the regions NEFI – New Energy for Industry⁷, GreenEnergyLab⁸ and WIVA P&G⁹ – Hydrogen Initiative Flagship Region Austria Power & Gas received funding of €30 million, making a total investment of almost €55 million. In 2019, a second tranche of 7 demonstration projects received funding of €11.5 million making a total investment of more than €34 million.

In 2019, the second call for projects opened with an additional budget of €15 million. The objective is to provide €40 million funding with additional funds from the 2020 budget. Decision on the new research and innovation projects is expected in Q4 2020.

⁵ <https://www.bmk.gv.at/en.html>

⁶ www.vorzeigeregion-energie.at

⁷ www.nefi.at

⁸ www.greenenergylab.at

⁹ www.wiva.at

Transnational/International

IEA research cooperation – Austria is a member of 21 TCPs and one expert Group (EGRD) and currently runs 80 national projects (tasks, annexes and Exco projects).

MICall19 on storage solutions – at MI-4 the first multilateral MI call for projects was launched with a total budget of €22.5 million. 16 countries participated and are involved in 58 projects. The funding decision was made in May; 13 projects received a share of €14.2 million (Austrian funding: €2.7 million for 4 projects). The MICall series was initiated by Austria and Sweden and was built upon the existing funding mechanisms of the Joint Programming Platform ERA-NET Smart Energy Systems and JPI Urban Europe.

Private sector engagement in 2019/20

The engagement of the private sector in clean energy innovation and research policies and projects has a long tradition in Austria. For more than ten years, the Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (former Ministry for Mobility, Innovation and Technology) as well as the Climate and Energy Fund of the Austrian Federal Government focused on collaborations between industry and the research community in their programmes. This led to a significant private sector contribution to new programmes such as the Flagship Regions Energy where more than doubling of public money by the private sector is expected. As a consequence, leading industries were involved in Austrian Mission Innovation activities from the very beginning. This was manifested in the cooperation with an industrial advisory board of CEOs and a cooperation between the Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, the Climate and Energy Fund and the Austrian Chamber of Commerce who are joint promoters of prominent MI activities such as the Mission Innovation Austria Week 2019 & 2020/21.

Major activities in support of the Innovation Challenges in 2019/20

Initiation of the MICall series for cooperative RDI projects. The scope of the MICalls was designed in a co-creation process with IC1, IC6, IC7 and IC8 during the Mission Innovation Austria Week 2019 and a side event at the MI-4 Ministerial.

Collaboration with the ICs

Austria participates in IC1, IC7 & IC8. The main activities were the participation in workshops of all challenges:

- IC1: public and deep-dive workshop at MI-4 and in Paris in autumn 2019. Austria enhanced its activities in this area due to the improved cooperation between IC1 and IEA (ISGAN TCP and annexes).
- IC7: participation in the combined workshop for IC6 and IC7 in Germany.
- IC8: participation in a workshop on IC8 in Antwerp (Netherlands) in March 2019 and presentation of WIVA P&G – Hydrogen Initiative Flagship Region Austria Power & Gas. Participation in and contribution to IC8 Platform for exchange between worldwide initiatives of hydrogen valleys coordinated by the European Commission.

Other Mission Innovation related activity in 2019/20**Mission Innovation Austria – Energy Research Initiative: Stakeholder dialogue in focus groups**

The Austrian Energy Innovation Initiative is based on three main pillars.

- Plus Energy Quarters focus on districts of cities that are able to cover all their energy needs from renewable sources. This will be enabled by the optimization of the building infrastructure, measures for highest efficiency in all areas of energy end-use as well as integrated business models and optimisation of local energy consumption and storage.

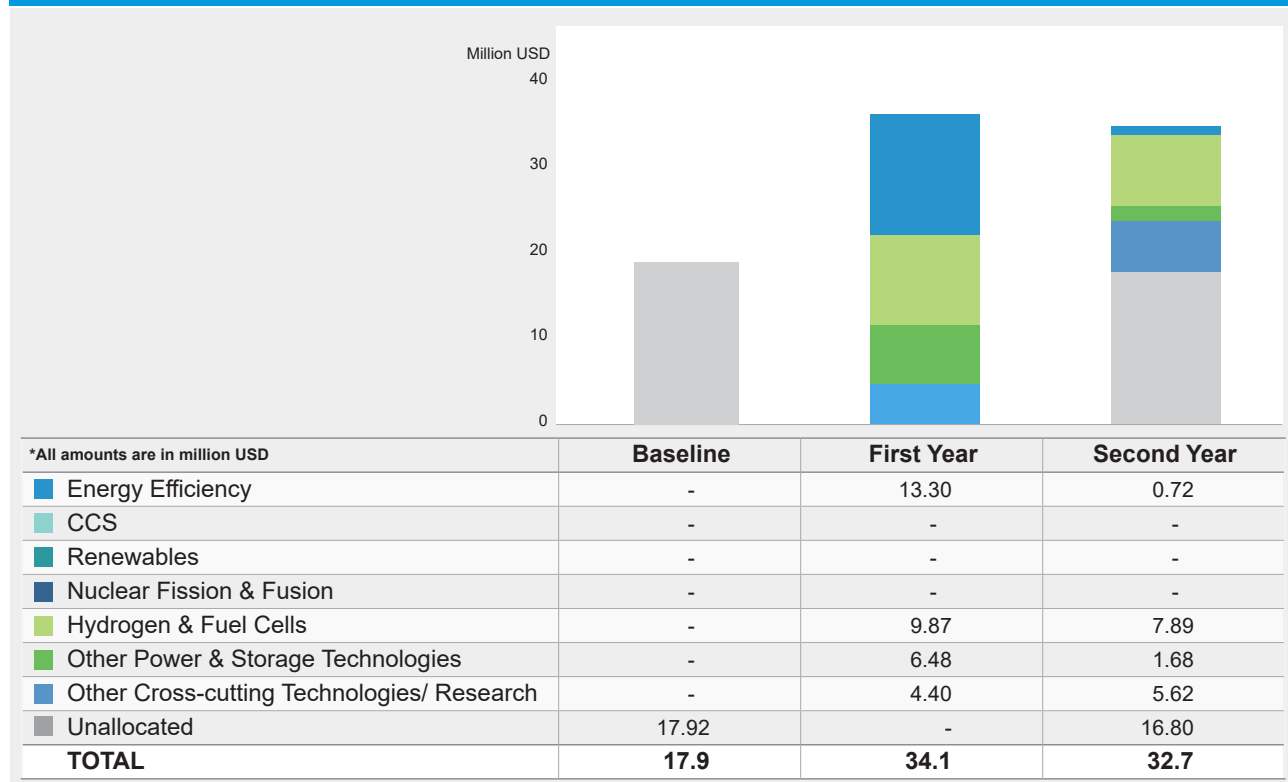
- Smart Systems and Grids are a prerequisite in order to reach a 100% renewable energy system.
- Breakthrough Technologies for Industry are necessary to enable decarbonisation of industrial processes especially in energy intensive industries.

The content¹⁰ was developed in a stakeholder dialogue between participants from policy, industry, funding agencies and research institutions.

National plans and priorities for clean energy innovation

Impact Assessment on Greenhouse Gas Emissions: The new governmental programme foresees an advanced impact assessment. For RDI policy this means that the impact on greenhouse gas emissions reduction need to be estimated ex-ante for R&D calls.

Public sector RD&D investment



The baseline is calculated by averaging the budget for project funding of the Flagship Projects in the national programmes for energy research (City of Tomorrow and Energy Research Programme). On average €16 million of funding have been granted each year between 2014 and 2016 for flagship projects. An allocation of R&D expenditures was not foreseen in the calculation of the baseline.

¹⁰ <https://nachhaltigwirtschaften.at/up-efi>

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
~40 IEA and partner countries	IEA Research Cooperation Call 2018	Funding of collaborations in Tasks and Annexes and Executive Committees of IEA Technology Collaborations Programmes, research & development, dissemination and networking	Public-public	Research	2018 to 2021	2.8 M€	https://nachhaltigwirtschaften.at/en/iea/
23 European Countries including MI members: Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden	ERA-NET Smart Energy Systems Call 2018 – Integrated regional Energy Systems	A Transnational Joint Programming Platform to Initiate Co-Creation and Promote Energy System Innovation	Public-public	Research, development and demonstration	2018 to 2021	6 M€	https://www.eranet-smartenergy systems.eu/
14 European Countries including MI Members: Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, UK	JPI Urban Europe Call 2018 - Sustainable and Liveable Cities and Urban Areas	JPI Urban Europe was created in 2010 to address the global urban challenges of today with the ambition to develop a European research and innovation hub on urban matters and create European solutions by means of coordinated research.	Public-public	Research, development and demonstration	2018 to 2021	2.5 M€	https://jpi-urbaneurope.eu/calls/sustainable-urbanisation-china-europe/
7 European countries including MI members: Austria, Finland, Germany, Netherlands, Sweden	ERA-NET Bioenergy	A transnational cooperation of programme owners and programme managers in the area of bioenergy R&D.	Public-private	Research, development	2018 to 2022	1 M€	https://www.eranetbioenergy.net/
18 European Countries and Regions including MI members: Austria, Finland, France, Germany, Italy, Netherlands, Sweden, UK	SOLAR-ERA.NET Cofund 2	A European network of national and regional funding organisations in the field of solar electricity generational.	Public-public	Research, development	2018 to 2022	1.3 M€	http://www.solar-era.net/



BRAZIL

Update on clean energy innovation policies and strategies

According to the IEA (2018), Brazil has the greenest energy mix amongst large economies. In 2017, the proportion of renewables in the Brazilian energy matrix was around 43% and 80% in its electricity mix. In line with its goal to expand the use of renewable energy sources, it is expected to reach a share of 47% from renewable sources (electricity and biofuels) by 2027, according to the 2027 Ten Year Energy Expansion Plan.

In the transportation sector, Brazil has strong biofuels mandates (27.5% ethanol mix in gasoline and 12% biodiesel mix in diesel) and it aims to increase biofuels in the energy mix to 18% by 2030 (RenovaBio). The Rota 2030 programme, announced in 2018, requires vehicle manufacturers to increase energy efficiency of their fleet by 11% by 2022, and grants tax cuts on the purchase and import of electric and hybrid vehicles.

The Science, Technology and Innovation Plan for Renewable Energies and Biofuels 2018-2022 is a strategic orientation document of the Ministry of Science, Technology, Innovation and Communications to operate in the areas of renewable energies and biofuels, being part of the National Science, Technology and Innovation Strategy (ENCTI 2016-2022).

In energy efficiency, given the current structure of our economy, a combination of policies has driven efficiency gains of 14% between 2005 and 2018, with emphasis on the residential and transport sector.

In the power sector, auction design has led Brazil to the addition of 30 GW renewables (wind, solar and biomass) in 15 years, using effective planning tools to combine hydropower, gas power, biomass and a continental-size transmission infrastructure to maximize integration of renewables.

Nuclear is also part of the solution. Brazil is developing efforts to make new nuclear plants viable, seeking synergies and externalities in other uses of nuclear technology, as well as assessing the sharing of costs and benefits and paying attention to the communication process with society.

Major innovation initiatives and programmes in 2019/20

Participation in MI provided an inspiring environment for improving Brazil's database on clean energy innovation investments. The existing experiences have helped accelerate the design of more effective reporting and use it as a tool for improving policies and strategies. One example is the collaboration between Brazil and the International Energy Agency (IEA) aiming at capacity building and methodological development to support a national platform for clean energy innovation spending reports and indicators. Various collaborators have joined this initiative since the last Ministerial Meeting. Third MI Ministerial (MI-3) side events and networking were useful to create links that proved effective to help Brazil build a strategy for improving the data governance on innovation investments for advancing clean energy.

In Brazil the governmental support for research and development activities in the energy sector is fragmented between several institutions. There are programs managed by regulatory agencies, investments by public banks, funding agencies and different public funds. It is understood that the design of a tool capable of concentrating information and classifying it according to international best practices is fundamental to optimize the use of resources and enable greater integration between research and development (R&D) activities with other countries. This is expected to improve the quality of investments, boost public-private collaboration, strengthen innovation networks and accelerate development of clean energy technologies.

A set of programmed activities took place in 2019, including joint work on the development of a data management tool to support tracking clean energy R&D and innovation spending in the Brazil and a fact-finding mission.

With Brazil's National Policy for Biofuels (RenovaBio) full implementation in 2020, Brazil now has a competitive carbon mechanism in the fuel sector, focused on efficiency and sustainable biofuels. Also, mandatory biodiesel mix has reached 12% by volume (B12) in 2020. Brazil is world's second largest biodiesel producer, using soybean oil as the main raw material.

The **National Agency for Petroleum, Natural Gas and Biofuels (ANP)** and the **National Electric Energy Agency (ANEEL)**, responsible for sector regulation, have been active in supporting energy innovation, supervising legal obligations of investments for private companies in research, development and innovation projects in the energy sector.

Other public institutions have been active in financing or offering grants for R&D in clean energy, including the National Development Bank (BNDES) and FINEP (that manages a national fund for R&D, including energy).

Major activities in support of the Innovation Challenges in 2019/20

IC4 (Sustainable Biofuels): Last April, the Brazilian National Biofuels Policy (RenovaBio), became fully operational with the program's decarbonization credits (CBIO) available for purchase on the Brazilian stock exchange. Certified national and foreign biofuel producers can now sell tradable certificate, each unit corresponding to a total savings of one ton of CO₂ equivalent in comparison to fossil fuel emissions. Around 200 production units are now certified with carbon life cycle and sustainability criteria scores, and domestic fossil fuel distributors must start complying with yearly targets for transport fuel matrix carbon intensity reduction with CBIOs.

The effort to take Renovabio from paper to reality started with its approval and publishing on December 2017. Aiming to reduce the carbon footprint of the transport sector and to ensure a long-term demand for low-carbon fuels, RenovaBio was operationalized with the creation of a new and complex regulatory framework.

The overall goals of RenovaBio are to provide consumers with more sustainable fuel choices, foster the continued diversification of Brazil's energy matrix and promote investment in more efficient and lower carbon feed stock production and conversion processes.

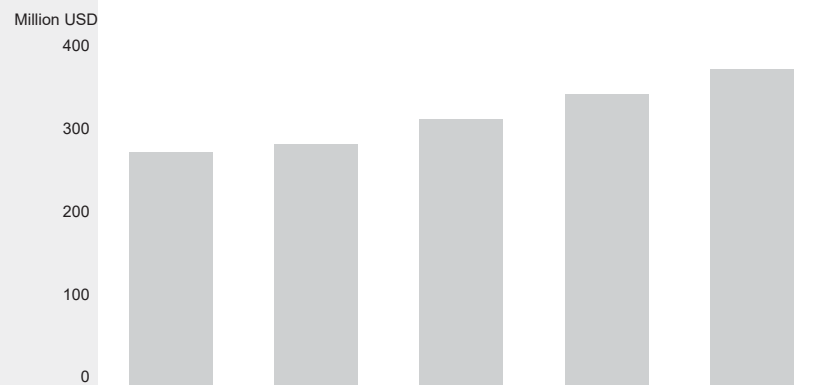
National plans and priorities for clean energy innovation

Brazil seeks to double its government and/or state directed investment in clean energy technology innovation in five years, focusing on renewable and clean energy technologies with the potential to reduce the cost, accelerate public and private partnerships for research, development, demonstration and deployment, and achieve meaningful scale to meet our energy security, economic prosperity, environment sustainability and climate change challenges.

The proportion of clean energy in the Brazilian energy matrix is around 47.5% (renewables and nuclear), with the most important sources being sugar-cane ethanol and hydropower. The share of renewable energy sources in its electricity mix varies between 70% and 90%. This includes hydropower, biomass, wind power, and more recently, solar PV. In line with its goal to expand the use of renewable energy sources, Brazil intends that its total energy matrix reaches, by 2030, a share of 28% to 33% from renewable sources (electricity and biofuels) other than hydropower. Brazil also intends to increase the share of renewables – beyond hydropower – in its electricity generation mix to the level of at least 23% by 2030, from around 13% in 2015.

In 2015 the Brazilian Government spent approximately R\$ 1 billion (US\$ 270 million) on clean energy technology research, development and demonstration activities. Brazil will seek to double this figure over the next five years. The full suite of low carbon technologies will be considered, including end use energy efficiency, renewable energy, biofuels, nuclear energy, electric grid technologies, carbon capture and storage and advanced transportation systems.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	-	-	-	-	-
CCS	-	-	-	-	-
Renewables	-	-	-	-	-
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	-	-	-	-	-
Other Power & Storage Technologies	-	-	-	-	-
Other Cross-cutting Technologies/ Research	-	-	-	-	-
Unallocated	273.83	280.17	310.09	318.46	366.89
TOTAL	273.8	280.2	310.1	318.5	366.9



CANADA

High impact innovation activity triggered by MI

Launched in May 2019, under a new stream of the Energy Innovation Program¹¹ delivered through Natural Resources Canada in partnership with Breakthrough Energy and BDC, Breakthrough Energy Solutions Canada (BESC)¹² builds on the shared objectives of advancing a sustainable and resilient clean energy future. BESC is a first-of-its-kind public-private initiative aimed at accelerating the development of clean energy technologies in the electricity, transportation, buildings and manufacturing sectors with the potential for substantial GHG reductions globally. As part of the competitive process, shortlisted companies were invited to pitch their breakthrough solutions in Ottawa on January 14, 2020. Following this pitch event, 10 Canadian firms were selected to receive up to \$40 million total, as well as participate in yearly accelerator events in order to gain further exposure and valuable business insights from leading clean tech investors such as Breakthrough Energy, BDC, EDC and others. The selected companies are:

- Electricity: Smarter Alloys Inc, e-Zn Inc, Biome Renewables
- Buildings: Evercloak Inc., Intelligent City
- Manufacturing: Ekona Power, CERT Systems Inc, CarbonCure Technologies
- Transportation: Havelaar Canada, GBatteries Inc

Impact of your national clean energy innovation activity

Canada's inclusive clean energy innovation programming has triggered meaningful collaborations between entrepreneurs, small and medium sized enterprises, large businesses, communities, government, and academia across the country. The impact of Canada's national clean energy innovation activity has increased significantly, as shown in the following areas: from 2016-17 to 2018-19, the Energy Innovation Program¹³ showed a reduction in GHG emissions from 0.8 Mt/year to 1.32 Mt/year; from 2016-17 to 2018-19, the ratio of leveraged investments in energy innovation projects increased from 0.8:1 to 3.12:1; and, in 2018-19, 90% of the funded clean energy innovation projects with completed projects advanced one technology readiness level.

Update on clean energy innovation policies and strategies

In keeping with best-in-class approaches to energy innovation policy and programs, the Government of Canada is embracing outcomes-oriented approaches for greater impact. This includes enhanced collaboration and coordination to better leverage resources and enable inclusive innovation; involving industry, civil society, and innovators in program co-design; using adopter-driven innovation; and introducing innovative funding approaches such as public/private co-investment. A diverse set of tools, including prize challenges, technology demonstrations, R&D funding, and regulatory sandboxes is applied in order to mobilize all segments of society towards ambitious but achievable innovation targets defined with experts and stakeholders.

Through the Pan-Canadian Framework on Clean Growth and Climate Change¹⁴, the Government of Canada is strengthening greenhouse gas reducing measures to exceed Canada's 2030 emissions reduction goal and working to achieve net-zero emissions by 2050.

¹¹ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/18876>

¹² <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/breakthrough-energy-solutions-canada/21913>

¹³ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/18876>

¹⁴ <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html>

Major innovation initiatives and programmes in 2019/20

Energy technology innovation is critical to Canada meeting its climate targets and realizing its potential as a clean energy leader. New ideas and technological advances are at the foundation of the transition to a low carbon economy, supporting the transformation of Canada's energy systems to be as clean and efficient as possible while increasing Canada's competitiveness in new and existing industries.

In 2019-20, Natural Resources Canada's flagship, the Energy Innovation Program¹⁵ (EIP) launched two new initiatives:

- \$6 million for the Canadian Emission Reduction Innovation Network¹⁶(CERIN) initiative, a collaboration between NRCan and Alberta Innovates to support the innovation needed to bring clean tech to market in order to help the oil and gas industry meet emission regulations in a cost-effective way.
- \$20 million for Breakthrough Energy Solutions Canada¹⁷ (BESC), a first of its kind public-private initiative of Natural Resources Canada; Breakthrough Energy, led by Bill Gates and influential global investors; and the Business Development Bank of Canada. BESC will provide up to \$40 million to help Canadian firms develop and commercialize clean energy technologies with potential for significant GHG emissions reductions (0.5GT/year globally)

As part of the **Clean Technology stream of the Impact Canada initiative**¹⁸, the federal government has now successfully launched six clean technology challenges. The original five have all selected finalists that are driving toward impactful, innovative solutions to the issues the Challenges. The new, \$4.5 million Charging the Future Challenge, focused on breakthrough energy storage solutions, was launched in July 2019, representing the sixth challenge in the suite. The program is expected to announce its five finalists in spring 2020, who will be developing a prototype of their solution over the next year and pitching their solutions to a jury in Summer 2021. A grand prize winner is expected to be announced in Fall 2021.

Under Stream 1 of the **Strategic Innovation Fund**¹⁹(SIF) led through **Innovation, Science and Economic Development Canada**, funding was made available to support R&D that will accelerate technology transfer and commercialization of innovative products, processes and services. To date, the SIF has funded 26 cleantech projects with \$927 million in contributions.

Private sector engagement in 2019/20

The Government of Canada works alongside the private sector, including with industry associations, private-sector incubators, post-secondary educational institutions, and with private companies through flagship programs such as the Clean Growth Program²⁰, the Energy Innovation Program²¹, the Impact Canada Initiative²², and Breakthrough Energy Solutions Canada (BESC²³).

In January 2020, NRCan hosted the BESC Forum, which brought together senior representatives from Gates Ventures, Breakthrough Energy, and other key stakeholders in the clean energy innovation ecosystem and presented an opportunity for twenty-two finalists from across Canada to pitch their innovations to investors. Following the pitch event, 10 winners were selected and announced at GLOBE 2020.

¹⁵ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/18876>

¹⁶ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/canadian-emissions-reduction-innovation-network/21778>

¹⁷ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/breakthrough-energy-solutions-canada/21913>

¹⁸ <https://impact.canada.ca/en/challenges/clean-tech-impact>

¹⁹ <https://www.ic.gc.ca/eic/site/125.nsf/eng/home>

²⁰ <https://www.nrcan.gc.ca/climate-change/canadas-green-future/clean-growth-programs/20254>

²¹ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/18876>

²² <https://www.canada.ca/en/innovation-hub/topics/impact-canada-initiative.html>

²³ <https://www.nrcan.gc.ca/science-data/funding-partnerships/funding-opportunities/funding-grants-incentives/energy-innovation-program/breakthrough-energy-solutions-canada/21913>

Major activities in support of the Innovation Challenges in 2019/20

Canada participates in all eight Innovation Challenges (IC) and co-leads IC4 and IC6. As a co-lead of the Analysis and Joint Research (AJR) Sub-Group, Canada worked with partners on the development of the IC Impact Report, which assesses the outcomes and impact of the ICs over the initial five-year mandate of MI. Canadian representatives contribute by lending expertise, engaging stakeholders, and attending international workshops and meetings. A few highlights are illustrated below.

IC1: Smart Grids

Canada hosted the first joint workshop between IC1 and the CEM initiative IEA International Smart Grids Action Network (ISGAN) on May 29, 2019. Canada also hosted the fifth IC1 deep-dive workshop (May 30-31, 2019) in Vancouver, Canada and participated in the sixth IC1 deep-dive workshop in Paris, France (November 12-14, 2010). Canada is contributing to IC1's Smart Grids Innovation Accelerator (SGIA) platform, providing publicly available documents on Canadian policy and RD&D activities related to smart grids to facilitate knowledge sharing. Canada contributed to planning discussions for MI 2.0, exploring opportunities to amplify members' impact in smart grid research under MI's next mandate.

IC2: Off-Grid Access to Electricity

Canada is working with an IEC joint working group²⁴ to revise the international standard for renewable energy and hybrid systems for rural electrification (IEC TS 62257 series). These updates will help to ensure that standards are internationally referenceable and relevant in light of progress in off-grid electrification.

IC4: Sustainable Biofuels

Canada hosted a workshop, "Advanced Biofuels: Pathways to Market," in Vancouver, Canada (May 30-31, 2019). Over 140 representatives from the biofuels industry, academia, and government attended the workshop, exploring strategies for connecting stakeholders, facilitating large-scale supply of biological feedstocks, and overcoming barriers to technology demonstration in order to reach commercial scale production. Canada and other IC4 co-leads presented country reports on the state of sustainable biofuels in their respective countries.

IC6: Clean Energy Materials

Canada continues to play a leading role in IC6 activities, representing IC6 at international conferences and engaging stakeholders on areas of mutual interest. Canada:

- Hosted a side event at MI-4 on Global Program Strategies for the Creation of Materials Acceleration Platforms (MAPs) (May 27, 2019);
- Announced funding this year for MAP infrastructure and two new MAPs focused on thermal energy and CO₂ conversion; and
- Rallied the leads and scientific community associated with IC7 to co-develop new thermal energy storage materials for heating and cooling of buildings. Canada is also leading the engagement of IC3, IC5, and IC8, which have strong materials dependencies.

IC8: Renewable and Clean Hydrogen

Canadian representatives on IC8 are working with IC6 to develop materials for clean fuels.

Other Mission Innovation related activity in 2019/20

Canada continues to play a leadership role within MI as a member of the Steering Committee, co-leading the AJR Sub-Group, participating in the Business and Investor Engagement Sub-Group, and supporting the Secretariat (leading the Communications workstream and participating in the Ideas and Innovators and Beyond 2020 workstreams). As co-lead of the AJR Sub-group, Canada is providing feedback and advice to the MI Steering Committee and the MI Secretariat on the framing, structure, and governance of MI beyond 2020. Additionally, as the host of MI-4, Canada participates in the Ministerial Planning Team, working to support the Kingdom of Saudi Arabia in developing the programme for MI-5.

²⁴ Joint Working Group 1 (JWG1) under the IEC Technical Committee 82 on Photovoltaic Solar Standards.

Canada is also a participating member of the MI Champions program and developed a fulsome program for the first cohort of Champions at MI-4. Since MI-4, Canada's Champion, Sean Monkman of CarbonCure Technologies, has made a number of presentations at international conferences on the use of CO₂ to produce concrete. In January 2020, CarbonCure Technologies secured its spot in the Global Cleantech 100²⁵ list for a fifth consecutive year and was the first Canadian company to be awarded North American Cleantech Company of the Year. Mr. Monkman was the first MI Champion featured in the "Champions Corner" of the MI Newsletter, published in January 2020.

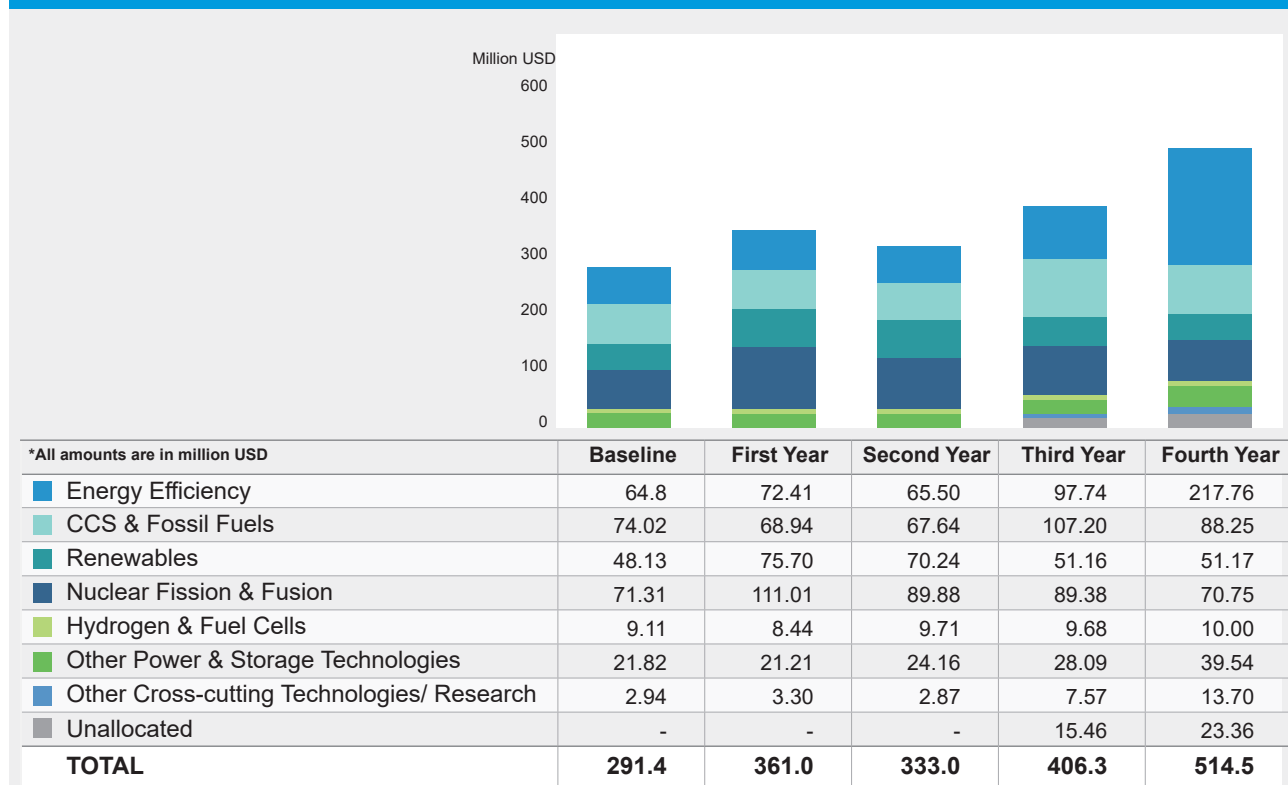
National plans and priorities for clean energy innovation

The Government of Canada is supporting the development of high-potential value chains in emerging tech areas of strategic importance:

- **Hydrogen:** A hydrogen strategy to leverage Canada's advantage to drive a globally competitive hydrogen economy, enabled through alignment of policies, technologies and strategic partnerships.
- **CCUS:** Investments to drive down costs, as well as collaboration with domestic and international partners to advance adoption.
- **Batteries:** Canadian battery innovations embedded within a national minerals strategy to increase Canadian participation in global battery supply chains.

The development of several new tools will enable benchmarking and monitoring the progress of RD&D towards addressing specific innovation gaps.

Public sector RD&D investment



Canada is on track to meet or exceed our doubling target. Data on Canada's expenditures in Fiscal Year 2019-20 are not yet available, but are expected to show a significant further increase in spending as the initiatives announced in Budget 2017 continue to be implemented.

²⁵ https://www.cleantech.com/the-global-cleantech-100/?utm_campaign=GCT100_2020&utm_medium=PRKIT&utm_source=3rd%20party%20press%20release



CHILE

High impact innovation activity triggered by MI

In 2019 Chile launched a call for the first Chilean Clean Technology Institute that will be the largest research initiative of Chile and will be focused on solar energy, green hydrogen and energy storage based on lithium solutions. In partnership between public institutions, national and international companies and universities, this initiative is a result of the shared issues discussed under the framework of MI and national priorities

Impact of your national clean energy innovation activity

From the beginning of Mission Innovation in 2015 Chile has started its energy transition process. From then Chile has increased its renewable energy generation, electromobility has played an important role, and hydrogen and batteries based on lithium were identified as the most important energy carriers for the next years. Chile has also committed to two relevant challenges: decarbonization of the electrical matrix by 2040 and carbon neutrality by 2050. To accomplish those national goals, the innovation is the key enabler for Chile's economic and social progress and Mission Innovation the hub for cooperation and sharing experiences.

Update on clean energy innovation policies and strategies

Last year the Chilean Ministry of Energy launched both a long-term Energy Policy by 2050 and a short-term Energy Roadmap by 2022. These are the guidelines for the Chilean energy transition model, moving forward to the carbon neutrality. It recognizes that scientific and technological progress is one of the keys for this process by taking advantage of innovative solutions, as new clean sources for electricity and heat, energy storage alternatives, green hydrogen, electromobility, electricity demand side management, and a number of options that will be available to contribute to Chile's economic and social progress.

The Chilean strategy is to continue with the most relevant energy innovations programs. In 2019 a call was launched for the first Chilean Clean Technology Institute, including solar energy, storage and hydrogen applied research in a partnership with the government, private companies and research groups. Chile is also given the continuity to technology developments by researching in new photovoltaic solar panels specially designed for high radiation conditions and also in new hydrogen solutions as an energy carrier for mining transportation.

Major activities in support of the Innovation Challenges in 2019/20

One of the Chilean innovation key initiative is the development of a new photovoltaic system so-called AtaMoS-TeC (Atacama Module and System Technology Center). The AtaMoS-TeC brings together the government and in partnership national and international companies and technology centres, a portfolio of research, development and innovation projects, to adapt a new photovoltaic system designed specifically for high radiation and desert conditions, covering a gap between the knowledge of its own features for solar power generation and the needs of the Chilean desert.

Another initiative started in 2018 is focused on the use of hydrogen as an energy vector, produced by clean sources as wind and solar power for mining transportation. Two international consortia are researching new low emissions mining extraction trucks powered by mixing hydrogen and diesel and by powering others mining vehicles incorporating fuel cells to significantly decrease diesel consumption.

In 2019 the Chilean government launched a call for the Chilean Clean Technology Institute. The focus of the Institute will be energy and green mining, including applied research in solar energy, green hydrogen and energy storage based on lithium solutions. This will be the largest research initiative fostered by the country.

Private sector engagement in 2019/20

Chile has decided to engage the private sector by implementing a model that includes funds managed by the government to promote the creation of private consortiums focused on applied research for solutions leading to the carbon neutrality.

The initiatives are the establishment of the Chilean Clean Technology Institute, focused on solar energy, green hydrogen and energy storage based on lithium solutions; and the first Technology Program focused on electromobility developments emphasizing on inter-operability solutions.

Both programs are expected to be awarded by 2020.

Major activities in support of the Innovation Challenges in 2019/20

In 2019 Chile participated in the workshop of Hydrogen (IC8) with the presence of the Chilean Economic Development Agency and the Chilean Hydrogen Association, in order to present the potential of Chile to become a “Hydrogen Valley”. Chile has worked closely with companies to identify projects to implement the Hydrogen Valley approach, what will be part of the Chilean strategy for Hydrogen development that will be launched by 2020.

During COP25 Chile organized the Energy Day in which a “MI focused” panel on Hydrogen (IC8) was held featuring representatives from Australia, Chile, and Germany (strong links to IC8). In the same day the Ministerial Plenary was held with the participation of the Chilean Minister of Energy.

Other Mission Innovation related activity in 2019/20

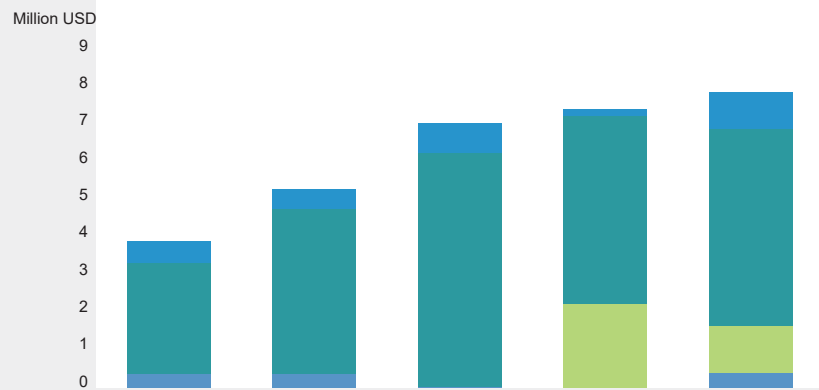
In 2019 a coordination between StartUp Chile Programme and the Solar and Energy Innovation Committee launched a call to accelerate innovative projects with a special focus on clean energy technologies. The call was made in the frame of Mission Innovation and all applications from MI countries were welcome, having more than ten clean energy start-ups from all over the world awarded to start the program by 2020.

Also in July 2019, Chile organized an event called “Time for innovation on our way to COP 25” with the MI partner Swedish institution RISE, as a preparation for COP25. The StartUp Chile call was launched and also the first start-ups that have been evaluated under the RISE’s 1.5 Compatible Solution Framework were announced.

National plans and priorities for clean energy innovation

Chile has recently announced two national challenges in the energy sector: the decarbonisation of the electricity matrix by 2040 and the carbon neutrality by 2050. Both challenges will need innovative solutions to achieve them, fostering a massive deployment of electromobility, hydrogen for transportation and industrial processes, more photovoltaics and concentrated solar power, bulk energy storage to allow renewables a major participation in the energy matrix maintaining the stability of the system, among other clean energy solutions.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	0.59	0.55	0.84	0.16	0.93
CCS	-	-	-	-	-
Renewables	2.91	4.33	6.06	4.92	5.19
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	-	-	-	2.23	1.22
Other Power & Storage Technologies	-	-	-	-	0.02
Other Cross-cutting Technologies/ Research	0.38	0.36	0.07	-	0.40
Unallocated	-	-	-	-	-
TOTAL	3.9	5.2	7.0	7.3	7.8



CHINA

High impact innovation activity triggered by MI

Firstly, every year the Institute of Electrical Engineering, Chinese Academy of Sciences (IEE CAS) holds workshops for Ministry of Science and Technology (MoST) and the Chinese participating institutes/companies in MI IC groups to promote the academic exchanges and cooperation in IC fields. Secondly, IEE CAS is in charge of editing strategic research reports, providing suggestions for technology development and international cooperation concerning MI ICs. Thirdly, IEE CAS sets up MI WeChat Official Account and website in China to enhance the promotion of MI domestically.

Impact of your national clean energy innovation activity

The Chinese government attaches great importance to clean energy innovation, gradually increases the investment in clean energy R&D since 2016, and actively promotes to realize the “Doubling Plan”.

Update on clean energy innovation policies and strategies

China actively promotes grid parity of wind power and photovoltaic power generation. On January 9, 2019, the National Development and Reform Commission and National Energy Administration jointly issued “Notice on Actively Promoting Non-subsidized Internet Access for Wind Power and Photovoltaic Power Generation” and laid out a range of requirements and support policy measures.

In June 2019, China released the “Green and High-Efficiency Cooling Action Plan”. The key tasks include: raising space cooling Minimum Energy Performance Standards to or above developed standards levels, supporting the development of more efficient cooling technologies and enhancing cooling-related energy-saving retrofits.

Financial Subsidy Policy for the Promotion and Application of New Energy Vehicles. This notice lays out the five areas of improvement to strengthen financial subsidy policy to further promote and accelerate deployment of New Energy Vehicles (NEV) in China. The objective is to further adjust the policy framework to the development of the NEV market and create enabling conditions for further scale up of the NEV market.

GB/T 50378-2019 Assessment standard for green buildings (revision). The assessment standard for green buildings was updated in 2019. Definition updates for green buildings has been expanded to cover life-cycle resource considerations, including embodied energy, recyclability characteristics etc.

Major innovation initiatives and programmes in 2019/20

In 2019, the “Renewable Energy and Hydrogen Energy Technology” Project and the “Nuclear Safety and Advanced Nuclear Energy Technology” Project were launched by MoST in China to support 40 innovation projects, with total public support of 0.6 billion RMB.

In 2019, MoST funded 20 innovation projects to support Chinese entities joining the IEA TCPs, including these areas – fossil energy clean technology; renewable energy research, development and application; energy efficiency; hydrogen and fuel cells; fusion energy technology; and building energy optimization; with total public support of 60 million RMB.

Major activities in support of the Innovation Challenges in 2019/20

On 29 -31 May, 2019, as an important side event of the MI-4, the 5th MI IC1 Smart Grids Deep-Dive Workshop was jointly held in Vancouver, Canada, by the IEE CAS, Natural Resources Canada, Canadian National Research Council, Italy Ricerca Sistema Energetico, and the Ministry of Science and Technology of India. More than 100 representatives of international organizations, scientific research institutions and enterprises from more than 20 countries attended the meeting. "Smart Grids Innovation Challenge Country Report 2019: Strategies, Trends and Activities on Jointly Identified Research Topics (START)" was officially released in May 2019 during MI-4. As an important outcome of ICs, the book edited by IEE CAS and prepared by 14 members in the IC1 group.

China hosted the conference "Mission Innovation - The 2nd International Conference on Sustainable Biofuels" on April 2-4, 2019 in Yantai for IC4. The conference was organized by Guangzhou Institute of Energy Conversion CAS, Shandong Provincial Science and Technology Department and Yantai Municipal People's Government. More than 70 experts, scholars, representatives of governments and enterprises from 10 countries attended the conference.

Dalian Institute of Chemical Physics, CAS proposed "Liquid Sunshine" in China, which was named one of the best technical pathways for IC5.

Other Mission Innovation related activity in 2019/20

Mission Innovation-Chinese Secretariat was established in 2019 approved by MoST.

The main responsibilities of the "Mission Innovation-Chinese Secretariat" are as follows:

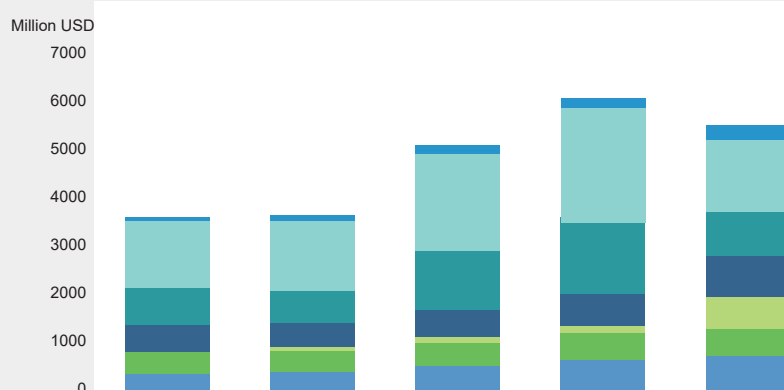
- To support and promote China's participation in beyond 2020 work under the MI framework, enhancing international participation;
- To establish a platform for MI promotion, expanding MI's domestic influence;
- To carry out MI strategic research work and organize the preparation of strategic research reports, providing suggestions for China's international scientific and technological cooperation plan under the framework of MI.

On January 16 2019, as the supporting institution for "Mission Innovation-Chinese Secretariat", Institute of Electrical Engineering, Chinese Academy of Sciences hosted the "Mission Innovation-2019 Chinese Annual Summary Meeting" in Beijing. Officials from MoST in China and representatives from institutes in charge of each ICs, Guangzhou Institute of Energy Conversion (GIEC), Chinese Academy of Sciences (CAS), Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Tianjin University etc.) participated in the meeting and discussed the MI Innovation Challenges work in China. "Mission Innovation-Chinese Secretariat" will continue to earnestly perform its duties.

National plans and priorities for clean energy innovation

In January 2020, MoST in China carried out collection work concerning major research and development needs of the National Key Research and Development Plan - "14th Five-Year Plan", including clean energy and other sectors. Guides for 2021-2025 key special projects on various sectors will be issued in the near future.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	75.28	88.30	117.26	140.42	295.31
Cleaner Fossil Fuels	1,323.10	1,462.07	2,026.64	2,431.96	1,443.25
Renewables	764.33	665.89	1,172.55	1,407.06	910.54
Nuclear Fission & Fusion	526.93	506.66	579.04	694.85	864.22
Hydrogen & Fuel Cells	17.37	43.43	101.33	121.60	651.42
Other Power & Storage Technologies	460.34	434.28	463.23	555.88	569.91
Other Cross-cutting Technologies/ Research	451.65	490.74	606.54	728.14	784.60
Unallocated	-	-	-	-	-
TOTAL	3,619.0	3,691.4	5,066.6	6,079.0	5,518.2



DENMARK

High impact innovation activity triggered by MI

Since the launch of MI, Denmark's specific budget lines for national research, development and demonstration of clean energy has increased from DKK 292 million to DKK 509.5 million in 2019.

Update on clean energy innovation policies and strategies

On 18 June 2020 a broad majority of the Danish Parliament adopted the Climate Act. The purpose of this Act is for Denmark to reduce greenhouse gas emissions in 2030 by 70% compared to the level of emissions in 1990, and for Denmark to achieve a climate-neutral society by 2050 at the latest, taking into account the Paris Agreement's target of limiting the global temperature rise to 1.5 degrees Celsius.

On 22 June 2020 a broad majority of the Danish Parliament has adopted a climate agreement on green transformation of industry and the energy sector. Combined with the Climate Agreement for Waste Management, the agreement will reduce emissions by 3.4 million tonnes of CO₂ equivalents in 2030.

The Climate Agreement for Energy and Industry 2020 comprises the following key initiatives:

- A new era: The world's first energy islands and more renewable energy
- Investment in green technologies of tomorrow – carbon capture and Power-to-X
- Green transition of industry
- Efficient use of energy and renovations
- Green heating for Danes
- Green transport
- Green tax reform (proposal to be developed by the Government)

Major innovation initiatives and programmes in 2019/20

The commitment to investment in green technologies of tomorrow – carbon capture and Power-to-X – is a key part of the Danish Climate Agreement for Energy and Industry 2020. Achieving the goal of a 70% reduction in emissions in 2030 goal will require innovative new tools and investments in the green technologies of the future. The agreement allocates the equivalent of DKK 800 million annually, to be phased in from 2024, for carbon capture and storage. These funds will reduce emissions of CO₂ equivalents by 0.9 tonnes in 2030 and will support the development and implementation of solutions that can capture carbon emissions from sources such as industry and put them to use. The agreement also includes a tender to support the establishment of large-scale Power-to-X plants with a total capacity of 100 MW. This is more than five times the capacity of the largest plants found in the world today. The Netherlands has decided to invest approximately DKK 1 billion in this project.

Private sector engagement in 2019/20

On November 13, 2019, the Danish Prime Minister Mette Frederiksen presented the Danish government's 13 "climate partnerships" at a meeting in Marienborg, the Prime Minister's residence. The 13 partnerships represent all branches of Danish business. The Danish business community has a central role in the green transition and with the climate partnerships, the government wants to work closely with the business community on solving the climate challenges. The climate partnerships put forward their recommendations and plans on March 16. Some of the key recommendations are reflected in the Danish Climate Agreement for Energy and Industry 2020, e.g. on Power-to-X.

Major activities in support of the Innovation Challenges in 2019/20

Leading national experts from Danish Universities have participated in four Mission Innovation challenges: IC1 Smart Grid, IC3 Carbon Capture Utilization and Storage, IC4 Biofuels and IC6 Materials.

Denmark has played a central role in advancing the smart grid challenge, e.g. by contributing to the IC 1 Smart Grids Innovation Challenge Country Report 2019 and by co-hosting a total of four events on Flexibility in the energy system, Smart grid solution sprints, Next generation city action and MI energy hack.

Denmark has played a role in establishing collaborations and securing European funding under Horizon 2020 for the BIG-MAP: Battery Interface Genome – Materials Acceleration Platform. The BIG-MAP Platform is a large (€20 million) collaborative research project, which builds upon the fundamental ideas and concepts developed under IC6.

Finally, Denmark has contributed towards the 2nd Mission Innovation conference on sustainable biofuels, Yantai China (2-4 April 2019); participated in the Mission Innovation face-to-face meeting, New Delhi, India (4-6 November 2019) and contributed to the planning of the Mission Innovation Ministers Meeting (round table) in Vancouver, Canada.

Other Mission Innovation related activity in 2019/20

At the 4th MI Ministerial meeting at Vancouver in May 2019, DTU Professor Tejs Vegge, an expert in computer based methods for developing novel energy materials, was appointed as Denmark's Innovation Champion. Tejs Vegge's field of research focuses on ways to develop new materials for energy storage much faster, which is a key innovation challenge for developing sustainable energy systems based on fluctuating renewable energy sources such as wind. The Innovation Fund Denmark supported the Mission Innovation activities, e.g. the MI Champions initiative.

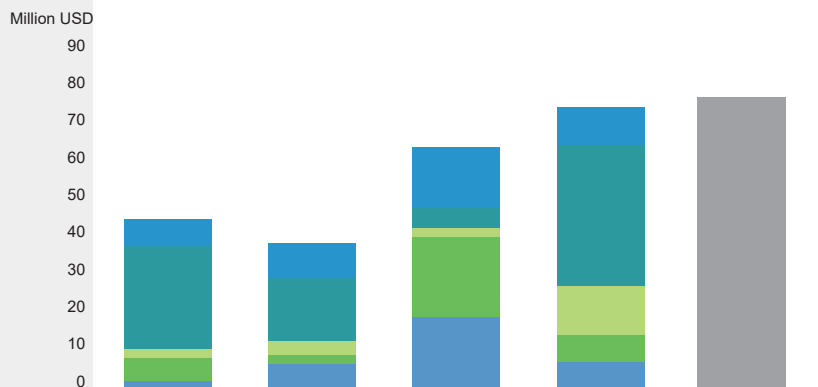
National plans and priorities for clean energy innovation

Denmark will show the world that climate action and economic recovery go hand in hand. A broad majority of the Danish Parliament has adopted a climate agreement on green transformation of industry and the energy sector (in June 2020). Combined with the Climate Agreement for Waste Management (also from June 2020), the agreement will reduce emissions by 3.4 million tonnes of CO₂ equivalents in 2030.

Focus the coming years will be on:

- The world's first energy islands and more renewable energy
- Investment in green technologies of tomorrow – carbon capture and Power-to-X
- Green transition of industry
- Efficient use of energy and renovations
- Green heating - support for phasing out of oil and gas boilers
- Green transport
- Green tax reform

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	6.49	9.09	16.30	10.12	-
CCS	-	-	-	-	-
Renewables	27.29	16.63	5.14	36.54	-
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	1.98	3.76	2.29	12.55	-
Other Power & Storage Technologies	6.24	2.91	21.43	6.63	-
Other Cross-cutting Technologies/ Research	1.77	5.67	18.11	7.03	-
Unallocated	-	-	-	-	76.40
TOTAL	43.8	38.1	63.3	72.9	76.4



EUROPEAN COMMISSION

Update on clean energy innovation policies and strategies

In December 2019, the European Commission adopted the European Green Deal Communication - Europe's new growth strategy for making the EU's economy sustainable. It is a roadmap for turning climate and environmental challenges into opportunities across all policy areas and making the transition just and inclusive for all. Boosting innovation in clean energy technologies is one of the objectives of the European Green Deal.

The European Green Deal Investment Plan (January 2020) is the investment pillar of the Green Deal. The Plan will mobilise at least €1 trillion in sustainable investments over the next decade. Part of the plan, the Just Transition Mechanism, will be targeted to a fair and just green transition. It will mobilise at least €100 billion in investments over the period 2021-2027 to support workers and citizens of the regions most impacted by the transition.

In July 2020, the EU strategies for energy system integration and hydrogen were adopted. The EU Strategy for Energy System Integration proposes concrete policy and legislative measures at EU level gradually to shape a new integrated energy system, while respecting the differing starting points of member countries. The parallel Communication 'A hydrogen strategy for a climate-neutral Europe' complements this Strategy with more detail on the opportunities and necessary measures to scale up the uptake of hydrogen in the context of an integrated energy system. This strategy includes the requirement of further research and innovation efforts to ensure a full hydrogen supply chain to serve the European economy.

To achieve the objectives set out in the European Green Deal, in March 2020 the Commission adopted a proposal for the first European Climate Law enshrining the 2050 climate neutrality objective. The Commission is also taking action on the clean, secure and affordable energy related initiatives that will be forthcoming in 2020, such as the Renovation Wave for the building sector and the strategy on offshore renewable energy. Furthermore, the Commission is working on a comprehensive plan to increase the EU 2030 climate target and on a strategic plan for reducing methane emissions.

The European Commission advanced towards adoption of Horizon Europe – an ambitious €90 billion research and innovation programme that will succeed Horizon 2020 and will run from 2021 to 2027. A meaningful part of the budget (minimum 35%) will be dedicated to projects that fight climate change including measures to improve the competitiveness of the energy and transport industries as well as the quality of the services that these sectors bring to society.

Partnerships under Horizon Europe with industry and member countries will support research and innovation on among others the clean energy transition, transport, batteries, clean hydrogen, climate neutral and circular industries and clean steel, and the built environment. The European Clean Hydrogen Alliance (launched in July 2020) will facilitate coordinated investments and policies along the hydrogen value chain.

Major innovation initiatives and programmes in 2019/20

The latest Horizon 2020 Work Programme, approved in 2019, funds collaborative activities with international organisations, local governments, industry and financial institutions. The Energy Work Programme for year 2020 has a budget of €821 million. In addition, to respond to the urgency and ambition of the European Green Deal objectives, Horizon 2020 will soon launch a European Green Deal call worth close to €1 billion.

The Strategic Energy Technology (SET) Plan represents the coordination mechanism in energy R&I with EU member countries and associated countries. It is the implementing pillar of the R&I priorities of the Energy Union in the sector of energy. The execution of the R&I priorities in the SET Plan remains highest priority for the coming years and will be managed by Implementation Working Groups (IWGs) set up under the leadership of SET Plan countries.

National Energy and Climate Plans (NECPs) were developed by EU member countries and submitted to the European Commission. The plans require each Member State to outline its 10-year plans for reducing emissions, increasing the take-up of renewables, improving energy efficiency (including in buildings), raising cross-border infrastructure/ interconnections, ensuring markets are fit for new technologies, and boosting research and innovation. The Commission is now carrying out a thorough assessment of the final NECPs. This analysis is due for publication in the autumn.

Private sector engagement in 2019/20

The EU adopted the Taxonomy Regulation (June 2020) – a key piece of legislation that will contribute to the European Green Deal by boosting private sector investment in green and sustainable projects. This Taxonomy creates the world's first-ever “green list” – a classification system for sustainable economic activities – that will create a common language investors/banks, industry and researchers can use when investing in projects and economic activities that have a substantial positive impact on the climate and the environment. By enabling investors to re-orient investments towards more sustainable technologies and businesses, this piece of legislation will be instrumental for the EU to become climate neutral by 2050.

In December 2020, EU criteria for economic activities to contribute substantially to climate change mitigation and adaptation will be adopted. The ambition of these criteria and their alignment with the goals of the Paris Agreement will strongly push for clean energy innovation. Moreover, commitments to use the EU taxonomy as guidance under the €1 trillion European Green Deal Investment Plan and the EU Recovery Plan will trigger additional incentives for partnering and collaborating with innovators and private investors in upscaling or early deployment of clean innovative technologies and solutions, as well as increasing private investment in related R&D.

Major activities in support of the Innovation Challenges in 2019/20

IC5 (Converting Sunlight) focused on the launch of internal exchanges towards the establishment of multilateral calls and on the refining of the actions to be effectuated via expert consultations. From the latter, a road mapping action has been initiated and continued in 2020.

IC7 (Heating and Cooling of Buildings) organised two workshops in 2019 and has been working on a number of projects, including the Comfort and Climate Box (Multifunctional devices that integrate varied energy inputs and optimise energy use for desired performance), the COMBIOTES (Compact Bio-Based Thermal Energy Storage for Buildings) and the Global Cooling Prize (the eight finalists were announced and received a \$200,000 award to develop two working prototypes).

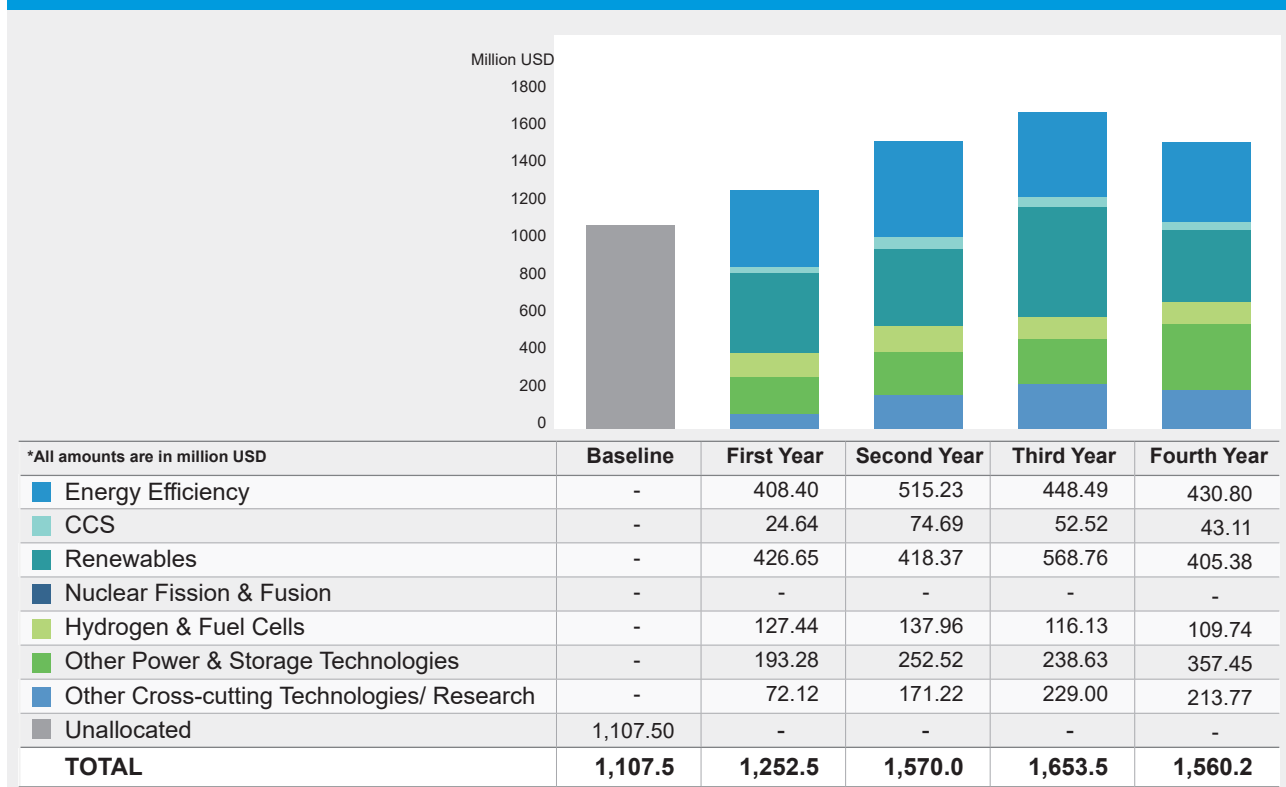
IC8 (Clean and Renewable Hydrogen) concentrated on the setting up of a hydrogen valleys platform (a “hydrogen valley” is a geographic area - e.g. a city, region, or industrial cluster - where several hydrogen applications are combined into an integrated hydrogen ecosystem). IC8 is developing an online information-sharing platform on hydrogen valley projects in MI countries. Information will be publicly available, but there will also be the possibility for private bilateral exchanges between the hydrogen valley projects on the platform. IC8 members anticipate that the platform will be fully operational by December 2020, with the project finished in June 2021. The project is running on track and data is currently being collected from 44 Hydrogen Valley projects across the MI countries. The EU is initially financing the platform with a €0.5 million contract through its Fuel Cells and Hydrogen Joint Undertaking programme.

Other Mission Innovation related activity in 2019/20

The European Commission designed, developed and implemented the Mission Innovation Champions programme – a prize programme for recognizing and supporting innovative individuals who are accelerating the clean energy revolution by working on key clean energy research and technology developments. By supporting cross-border exchanges of ideas and talent, and by building a community of visionaries committed to the promise of clean energy research and development, the program activates and engages a new generation of researchers, inventors and leaders. The first cohort of MI Champions was announced in May 2019. The European Commission continued its leadership of the MI Champions programme by launching a second cohort of MI Champions programme in June 2020.

“The Clean Energy Innovation index” study was launched in 2019 with the objective to develop a composite indicator tracking innovation performance of EU member countries and main trade partners of the EU.

Public sector RD&D investment



Data is based on signed projects. For 2019 (Fourth Year), data is still preliminary because not all projects to be supported are signed at the time of analysis.

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
Australia, Germany	FCH/OP contract 249: Hydrogen Valleys global collaboration platform	Create go to platform for all information on Hydrogen valleys globally. Facilitate information sharing, collaboration, and roll out of new hydrogen projects. Coordinate stakeholder efforts. Demonstrate maturity and added value of integrated Hydrogen Valleys Raise awareness among policy makers.	Public and private sector	Collaborative Information platform, showcasing progress in hydrogen valley projects.	Dec 2019 to March 2021	€0.5 million. The EU pays entire amount.	https://www.h2v.eu
UK, China	COMBIOTES (Compact bio-based thermal energy storage for buildings), a Horizon 2020 project	COMBIOTES develops a modular compact thermal energy storage (TES) solution for heating, hot tap water and cooling fully adapted for electricity load shifting. As thermal end-uses in buildings are different regarding seasonal needs, COMBIOTES combines the advantage of a modular TES with the high volumetric energy density of a latent TES.	Public and private sector	Research and Development	Nov 2019 to Oct 2023	Total cost €4.2 million	https://cordis.europa.eu/project/id/864496



FINLAND

High impact innovation activity triggered by MI

- The MI ERA-Net call received 26 applications from Finland in 2019, and €3 million funding was reserved for the call. Funding decisions will be made in 2020.
- The Finnish parliament passed a bill banning the use of coal as an energy source by the end of 2029. This has activated a host of innovation activities, as large utility companies are racing to comply with the ban. A total of €90 million of financial support will be awarded to companies that successfully remove coal from energy production by the end of 2025.

Impact of your national clean energy innovation activity

Clean energy innovation projects funded by Business Finland since 2014 are estimated to have generated a total of almost 2900 jobs and almost €1.5 billion of revenue by the end of 2019. They have had a significant contribution to the emission reductions of the Finnish energy sector. Energy-sector GHG emissions have decreased from approximately 60 Mt CO₂e in 2010 to approximately 40 Mt CO₂e in 2017.

Update on clean energy innovation policies and strategies

Prime Minister Sanna Marin's Government Programme was published in December 2019. According to the Programme, The Government will decide on the additional actions needed to bring Finland's emissions reduction path in line with the goal of achieving carbon neutrality by 2035.

Finland submitted its integrated National Energy and Climate Plan (NECP) to the European Commission on 20 December 2019. The plan covers all five dimensions of the EU Energy Union, including research, innovation and competitiveness. The plan lays down the 2030 targets for these five dimensions, and the policy measures to achieve them.

Finland is currently preparing its long-term strategy on climate and energy (2050). According to the draft strategy, Finland aims to invest significant funding in climate innovations. Sector integration and digital solutions, among others, will be included in the priority sectors. The draft strategy also highlights the importance of finding solutions for hard-to-abate-sectors.

Major innovation initiatives and programmes in 2019/20

There are three major innovation initiatives and programmes up and running. Joint funding volume is over €200 million and the programmes are being implemented with private sector and other stakeholders.

- Smart Energy program (2017-21)
- Batteries from Finland campaign (2018-2020)
- Smart Mobility program (2018-22)

Private sector engagement in 2019/20

Public-private testbeds and innovation platforms are listed below. These public-private partnerships involve more than 100 companies in total. In addition, there are several business-led ecosystem initiatives ongoing.

- **Smart Otaniemi platform**²⁶, over 100 companies involved, joint initiatives involving companies, research organizations and other actors from the energy and high tech sphere. Several pilots operating in field including AI and blockchain, aggregator business models, smart EV charging infrastructure and 5G and IoT services.
- **Åland Island Smart Energy Platform**, over 20 companies and research entities are involved. The project aims to create a piloting area for new smart energy technologies and a 100 % renewable energy system on Åland Islands. The platform was awarded a capital loan from the State of Finland in 2019 and is now in implementation phase.
- **Power to X innovation ecosystem** spearheaded by the Lappeenranta University of Technology and VTT, and involving several companies. The aim is to produce an operating model for a dynamic ecosystem based on clean, affordable and unlimited resource of electricity. The cornerstone of the ecosystem is the rapid electrification of society, including Power to X to Power solutions combined with maximum utilization of digitalization. In addition to the ecosystem theme, the project aims to produce a road map for the commercialization and research activities of the topic for coming years.
- **BatCircle innovation ecosystem**, involving 30 companies and research organizations and focusing on sustainable primary resources, value addition in metal refining, battery recycling, precursor and active materials, circular business ecosystems. This ecosystem was recognized by EU Commission and Finland was asked to lead the Battery Recycling sub working group under the Battery Implementation plan.
- **BEI innovation ecosystem** focusing on research and production incl. machine learning, artificial intelligence and extensive automation, EV systems and energy storage solutions with modern design methods and tools.
- **Baltic Offshore innovation ecosystem** exploring the utilization of offshore wind power in the Baltic Sea.

Major activities in support of the Innovation Challenges in 2019/20

- Finland has been actively involved in the operation of the EU SET-Plan. The SET-Plan combines the promotion and better coordination of energy technology in the EU and the EEC countries. A total of 14 implementation plans have been prepared in the SET-Plan between 2016 and 2019. Finland has participated actively in the preparation and introduction of these implementation plans.
- SET-Plan key action no 7. "Batteries for e-Mobility and Stationary Storage" where Finland is leading WG related battery recycling. Finland has launched an innovation ecosystem named BatCicle, where over 30 companies, universities and research institutes are involved (see 1 b. for details).
- Finland – China (Business Finland – MoST) joint call related to clean energy collaboration was opened in the end of 2018 and five projects were initiated in 2019.

Other Mission Innovation related activity in 2019/20

- Acclaimed scientist and Power to X pioneer Pasi Vainikka was nominated as MI champion and participated in the MI conference in Vancouver.
- The annual Smart Energy Forum was held in Helsinki with representatives from 100 companies and research organizations participating.
- Finland hosted the SET-Plan conference.
- Cybersec in Energy side event in SLUSH startup event.

²⁶ <https://smartotaniemi.fi/>

National plans and priorities for clean energy innovation

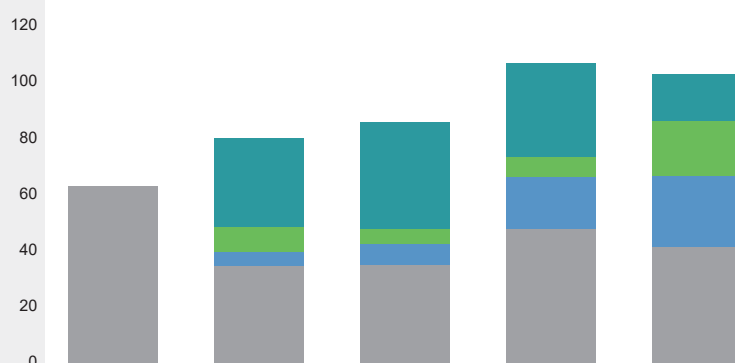
To meet the targets set in the Government Programme for climate neutral Finland by 2035, The Finnish Government, in cooperation with the major industries, is currently preparing the low-carbon roadmaps for different sectors. The roadmaps will be finalized in 2020. These roadmaps include also technology roadmaps regarding solutions needed to achieve climate targets. The Finnish Government will use the information when planning its next energy and climate strategy's clean energy innovation policies. The strategy will take into account and coordinate the Government Programme's energy and climate policies, the long and medium-term climate change policy plans referred to in the Climate Change Act, and the EU's energy and climate targets for 2030. The strategy will be published in 2021.

Currently the key innovation themes in the clean energy sector in Finland include the following:

- **Power-to-X** technology is the next step beyond hydrogen. It can be used to produce different raw-materials and products, such as synthetic methane, ammonia and even protein.
- **Electricity storage**
- Energy-sector **cybersecurity** and other **digital energy solutions**
- **Circular economy solutions**, such as **waste heat** from data centers

Public sector RD&D investment

Million USD



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	-	-	-	-	-
CCS	-	-	-	-	-
Renewables	-	30.24	35.83	32.03	15.79
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	-	-	-	-	-
Other Power & Storage Technologies	-	9.18	5.94	6.61	18.70
Other Cross-cutting Technologies/ Research	-	5.04	7.05	17.69	24.41
Unallocated	61.48	34.94	35.39	47.70	41.32
TOTAL	61.5	79.4	84.2	104.0	100.2

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
17 countries and regions in total	MI Call	Joint funding call under EU ERA-Net umbrella	Public-private	Research and development	2019 to 2020	€3M	https://www.eranet-smartenergy systems.eu/Calls/SG_Plus_Calls/SG_Joint_Call_2019



FRANCE

High impact innovation activity triggered by MI

The involvement of France in IC2 as co-lead has had a significant impact on the launching of support activities in the field of off-grid energy access. It enabled or at least accelerated the launch of the call for projects completed in 2018, making possible the funding of 9 projects targeting energy innovation on the African continent. It allows also to develop a close cooperation between France and India on off-grid access to energy innovation programs sharing objectives and projects accomplishments.

The international dimension of MI gives strong emphasis to all the activities performed under its umbrella. As an example, the calls for projects launched in the frame of IC2 obtained international visibility and the project nominees could have access to a worldwide audience (pitch at MI-3, presentation of the projects at the IC2 international workshops).

Update on clean energy innovation policies and strategies

To face climate change challenges and be collectively able to limit global warming under 2°C, innovation will be key. It will enable us to act simultaneously towards three major goals: reduction of greenhouse gas emissions, economic development and job creation, and energy security. These goals are at the heart of French energy transition for green growth act, which was passed in August 2015, a few months before COP 21 and the Paris Agreement.

At the end of 2019, the Energy and Climate Bill was adopted. The objective of the text is to enshrine in law the ecological and climatic emergency and the objective of carbon neutrality in 2050. In other words, France commits itself to achieving zero net emissions by 2050 which implies not emitting more greenhouse gases than we can absorb, thanks in particular to our forests.

As a follow-up to those political cornerstones which the green growth act and the climate plan represent, France is about to publish its multi-annual energy plan (MEP), that covers all aspects of energy policy and all forms of energy. The MEP sets out two fundamental priorities: reducing energy consumption, particularly fossil fuel consumption, and developing renewable energy sources. These will be the central tenets of our energy system as it evolves to meet the demands of the low-carbon economy.

In the same time frame, France published its National Low-Carbon Strategy (SNBC), which defines the trajectory to reduce greenhouse gas (GHG) emissions at the national level, and orchestrates the implementation of the transition towards a low-carbon economy. This strategy defines over different periods of time (2019-2023, 2024-2028) the upper limits for greenhouse gas emissions that should not be exceeded on average at the national level (carbon budget) and sets targets by sectors of activity.

France supports innovative R&D and demonstrators. In particular in 2019, 3 call for projects were launched to identify demonstrators; and these calls for projects were pursued by 2020.

Specific works were also pursued, such as hydrogen. Green hydrogen has a key role to play in the energy transition. Today, it is seen as one of the main vectors for limiting CO₂ emissions in transport and industry. The development of hydrogen technologies has a double challenge: economic in that they offer the opportunity to create an industrial sector and ecosystem; and environmental through the solutions they offer for decarbonising industry and transport and improving air quality. After initial actions undertaken in 2018, the support program for the Hydrogen sector in preparation aims to initiate an ambitious territorial dynamic and to allow the French ecosystem (industrialists, communities, research laboratories, etc.) to be more structured, in order to position in the future markets of hydrogen production and distribution, both for industry and mobility, in France and for export. In this context, more than €90 million were allocated by the French Government in 2019 to innovative projects focusing on the decarbonization of industrial uses of hydrogen and hydrogen mobility and call for proposals to identify key projects was launched.

Major innovation initiatives and programmes in 2019/20

Regarding the actual financing of clean energy innovation projects, a new round of the French programme of investments for the future (PIA) was launched by the end of 2016, with a total amount of funding of €10 billion over 2017-2025. Around two thirds of this sum is dedicated to the ecology and energy transition in general, including clean energy innovation in particular.

In this framework, the different actions operated by the French environment & energy management agency (ADEME) supported since 2010, more than 750 projects for a total amount of aid of round €2.5 billion (budget overall projects: round €7.5 billion). The targeted sectors were energy transition, transportation for the future, circular economy, eco-efficient buildings, industry and agriculture.

The third strand of the PIA, launched in 2018, has confirmed to the ADEME an envelope amounting €1 billion for the energy transition. Among which, namely:

- €300 million State aids (grants and repayable advances) for the action demonstrators of the energy and ecological transition.
- €400 million in equity for innovative infrastructure investments of the " First Of A Kind" commercial type.
- €150 million for the so-called Innovation Contest, a call for projects dedicated to SMEs and start-ups.
- €150 million for innovative projects in the field of transportation and mobility to accelerate innovation from public labs to the market.

In addition, ADEME launched in 2019 year two calls for projects to enhance hydrogen innovation and its scale up, targeting two sectors, hydrogen transportation and mobility and industrial processes for a total funding of more than €90 million.

In parallel, the PIA enabled the setting-up of the Energy transition institutes (ITE), multi-disciplinary platforms addressing topics focussed on the energetic transition. They bring together the know-how of the industry and the academic world and are based on a public-private co-investing partnership. Round ten ITE's were recognized, covering various sectors (renewable marine energy, solar energy, geothermal energy, smart electric grids, energy efficiency, sustainable buildings, decarbonised vehicles and innovative mobility). The whole programme is provided with a budget envelope amounting circa €450 million, financing up to 50% of the activities of the institutes.

Private sector engagement in 2019/20

In the frame of the PIA the French environment & energy management agency (ADEME) supported since 2010, 745 projects for a total amount of aid of €2.5 billion, the private sector co-investing €5 billion. In 2019, this dynamic continued with the selection of more than 20 demonstration projects in the field of the ecological and energy transition as well as innovative transportation. These projects received €100 million of public funds on a total amount of €170 million. These investments highlight the will of France to accelerate the energy transition thanks to a close cooperation between the private and the public sectors.

In other respect, ADEME Investissement, a public equity financing tool 100% owned by the State and chaired by ADEME was created in 2019. The company operates alongside private investors, for innovative infrastructure projects serving the Energy and Environmental Transition. Ademe Investissement supports French innovations both in France and abroad, during their construction and operating phases. The company invests according to the same rules as a private investor. The investments tackle projects that are part of the Energy and Ecological Transition: Energy (production, development, storage of renewable energy, renewable heat, wind, wind, solar, marine energy, geothermal, cogeneration, industrial hydrogen, energy efficiency, smart electricity networks etc.), Sustainable mobility (road, rail, river and maritime transport, electromobility, hydrogen mobility, gas mobility, logistics), circular economy and renewable gas (treatment and recovery of waste, methanisation and renewable gas, pyrogasification, Power-to-gas), fight against greenhouse gases (CCUS), environment and biodiversity (green chemistry, eco-efficiency in the building, industry, agriculture, industrial ecology, agroecology, biodiversity protection). Its investment envelope is €400 million.

Major activities in support of the Innovation Challenges in 2019/20

France participates to the 8 innovation challenges, all considered very relevant to contribute to accelerate the deployment of innovative low-carbon solutions to tackle the energy transition. Among all the activities performed may be highlighted several specific actions. Namely:

IC2: Among the 8 Challenges identified by Mission Innovation, the Challenge on “innovation for off-grid electricity access from renewable” is co-led by France and India.

- Two calls for proposals (CFP) on innovative solutions for off-grid access to energy were launched by France and India respectively, enabling the selection of round 10 projects in each country for a global budget beyond €10 million. The selected projects address various innovative technologies (hybrid electricity production, solar, river stream generator), different uses of electricity enhancing economic development (irrigation, agriculture, desalination, mobility) and electricity payment issues (pay as you go, leasing).
- This experience is repeated in France in 2020 with an additional CFP, within the frame of a collaboration between the ADEME and the French Development Agency (AFD).
- Two international workshops were held in Paris and New-Delhi (2017 and 2019 respectively). These events gave the opportunity to gather stakeholders, government representatives, entrepreneurs and researchers and exchange on projects related to innovation for off-grid energy access.

IC3: France joined the CCUS innovation challenge from its foundation in 2016. This topic is addressed by the French low-carbon national strategy as one of the levers to reach the goal of neutrality carbon, notably by coupling CCUS with biomass combustion. Hence, France:

- Pursues its participation to the ERA-NET ACT CCUS (European funding programme), which aims at supporting projects dealing with the priorities set by this innovation challenge.
- Took part in June 2019 in Trondheim, Norway at the MI IC3 workshop, chairing the sessions dealing with storage and utilization. The aim of the workshop was notably to follow up on the implementation of the priority research directions established during the 2017 CCUS Experts Workshop (Houston, US).
- Contributed in 2019 to the definition of the action plan of the challenge.

IC8: France joined the hydrogen innovation challenge from its foundation in 2018, this topic being considered as a major lever of the energy transition.

- France actively participates to the events organized by the challenge (workshops in Berlin - 2018 and Antwerp - 2019).
- Among others, France is looking forward to contribute to the actions which will be performed in the frame of the “Hydrogen valleys” initiative launched by the EC. The Zero Emission Valley (Auvergne Rhône-Alpes Region) is proposed to participate to the international cluster of hydrogen valleys.

Other Mission Innovation related activity in 2019/20

France participates from the beginning in the champions programme.

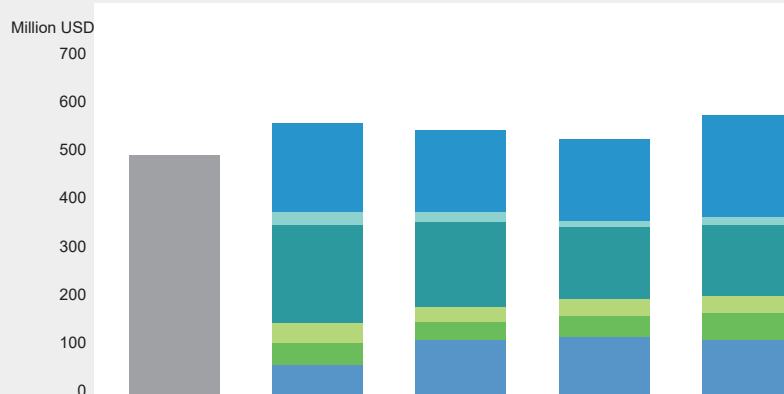
In 2019, an inspiring project “Energy observer” consisting in the designing and demonstrating the feasibility of operating an autonomous ship powered with hydrogen produced on board thanks to renewable energy.

National plans and priorities for clean energy innovation

The third strand of the PIA was launched in 2018. The French government is currently initiating the construction of the next generation of financing instruments dedicated to research and innovation. In the continuity of what has been set-up in the last decade, visibility and stability on the long term are the fundamentals of the reflexion launched by the Government. Investing to accelerate innovation for the Energy and Ecological Transition will be a cornerstone of the support mechanisms which will be set-up.

In this framework, it is planned to define priority sectors on which France will target the efforts. For the selected sectors, support will provide on the whole innovation channel, from basic research to demonstration and deployment.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	-	186.41	170.18	169.34	206.17
CCS	-	22.95	16.43	13.75	17.02
Renewables	-	206.13	175.78	146.72	147.59
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	-	34.90	31.87	31.39	31.52
Other Power & Storage Technologies	-	45.94	36.49	46.06	57.45
Other Cross-cutting Technologies/ Research	-	65.40	116.11	120.16	114.87
Unallocated	492.72	-	-	-	-
TOTAL	492.7	561.7	546.9	527.4	574.6

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
Germany	Joint call ANR-BMBF for collaborative research projects on smart grids and renewable energy storage	Collaborative projects between German and French partners that conduct application-oriented basic research (TRL 1-5) aiming at highly innovative, cross-sectoral solutions for economically, ecologically and socially sustainable and secure energy storage and distribution in France, Germany and Europe.	Public-private	Research	2018	20 M€	http://www.agence-nationale-recherche.fr/en/information/news/single/pre-announcement-opening-soon-a-bilateral-french-german-call-for-proposals-in-the-domain-of-sustainable-energy/
EU	ERANet Geothermica	Combination of 17 geothermal energy research and innovation programme owners and managers from 14 countries and their regions.	Public-Private	Demonstration and technology development projects to accelerate geothermal energy deployment	2 nd call is currently in preparation		http://www.geothermica.eu/
EU	ERANet Smart Energy Systems	The initiative deals with the key challenges and topics of the future energy system: <ul style="list-style-type: none"> •Smart Power Grids •Integrated Regional Energy Systems •Flexible Heating and Cooling Systems •Smart Services 	Public-Private	A Transnational Joint Programming Platform to Initiate Co-Creation and Promote Energy System Innovation			http://www.eranet-smartenergy-systems.eu/
EU, Norway, UK, US, Switzerland, Canada, Turkey	ERANET ACT (Accelerated CCUS Technologies)	The project aims to develop and implement the techniques and conditions for the deployment of CO ₂ capture, transport and storage. The use of CO ₂ is also part of the perimeter. This project follows the main directions of MI's IC3.	Public-private	Demonstration and technology development projects to accelerate CCUS deployment	2019 2 nd call and 2020 third call is currently in preparation	2019 Call - 20 M€	http://www.act-ccs.eu/about-us

EU, Israel, Turkey, Russia, Taiwan, Quebec, South Africa	M ERA. Net	Materials sciences and Batteries: Modeling for materials engineering and processing, Innovative surfaces, coatings and interfaces, High performance composites, Functional materials, New strategies for advanced material-based technologies in health applications, Materials for Additive Manufacturing Fuel cell	Public-private	Research TRL 2 -4	2020, 2nd call 2021 available 3rd call	2019 Call - 27 M€ 2020 Call - 21 M€ 2021 Call -15 M€, with 5 M€ for batteries	https://m-era.net/
EU, Turkey, Chile, Quebec, South Africa	Eramin 2	Raw Materials for Batteries: Supply of raw materials from exploration and mining (also for batteries, namely Li), Design, Processing, Production and Remanufacturing, Recycling and Re-use of End-of-life products (as well batteries), Cross-cutting topics	Public-private	Research and development	2019 Call 2021 Eramin 3 available	2019 Call - 10 M€	https://www.era-min.eu/



GERMANY

High impact innovation activity triggered by MI

Germany participated in the MI Champions Programme and the MICall19 funding programme as a direct result of Mission Innovation. In addition, the involvement in other innovation challenges, in particular IC5 and IC8 contributed to the shaping of energy research policy in Germany.

Impact of your national clean energy innovation activity

German energy research policy was completely geared towards the energy transition by the 7th Energy Research Programme published in September 2018. The topics emphasized within MI were considered in the design of the programme. For example, the research topic of artificial photosynthesis, as being explored within IC5, was included as an important research topic for the first time. In addition, the funding for clean energy research has increased substantially since the launch of MI.

Update on clean energy innovation policies and strategies

In June 2020 Germany published its National Hydrogen Strategy. "Green" hydrogen produced by the electrolysis of water using renewable energy is at the centre of this strategy. Research, development and demonstration are key elements of this strategy, which will also strengthen international partnerships on hydrogen. In line with this strategy, Germany focuses on the inherently global topic of hydrogen within Mission Innovation. In addition, in 2019 Germany published the Energy Efficiency Strategy 2050. Regarding research and innovation, this strategy aims to strengthen research into energy efficiency, particularly for industrial processes and buildings.

Major innovation initiatives and programmes in 2019/20

- In July 2019 the German Government announced the first round of Living Labs for the Energy Transition. 21 projects were selected to demonstrate the technologies needed for the energy transition. The projects take a systemic approach and focus on the topics hydrogen and neighbourhoods. €100 million per year are being made available for these projects, the first projects kicked-off in early 2020.
- In the area of applied research, two additional funding calls were announced in 2019. One addressed socio-economic questions and the societal context of the energy transition. The other addressed the effects of the digital revolution on energy technologies and the energy system.
- A new phase of Kopernikus Projects was launched. Together, the Kopernikus projects are forming one of the biggest German research initiatives focusing on the energy system transformation. Industry, science and civil society are working together closely in all projects in order to advance science and technology for a secure, climate-neutral and affordable energy system.
- In April 2019 the NaMoSyn project tackling the complete process chain of synthetic fuels was started. The project is supported with €24 million and aims for CO₂-neutrality in the transport sector.
- 17 new projects have been started within the German-African Client II initiative focussing on options for a sustainable design of the energy system. Additionally the development of the "Atlas of Green Hydrogen Generation Potentials in Africa" was initiated in January 2020.

Private sector engagement in 2019/20

Cooperative projects with partners from research institutions and industry are an important element of public energy RD&D funding in Germany. Within such projects, companies contributed €223 million for energy research in 2018 alone. This funding approach ensures firstly that the research questions addressed by publicly funded research projects are relevant to industrial partners and secondly, the innovation transfer to practical solutions and products needed for the energy transition is already considered at the start of the research project. To accelerate the transfer of innovations, the German Federal Government has initiated eight Energy Research Networks. Currently around 4000 experts from industry and academia are organized in these open networks.

Major activities in support of the Innovation Challenges in 2019/20

In 2019/2020 representatives from Germany participated in different workshops, in particular with respect to the innovation challenges 5 and 8. Germany is promoting MI within its research communication activities, for example in the yearly Federal Government Report on Energy Research.

Other Mission Innovation related activity in 2019/20

Germany is participating in the second round of the MI Champions Programme and promoted it within the energy research networks. In addition, Germany is actively participating in the design of a potential new phase of Mission Innovation post 2020.

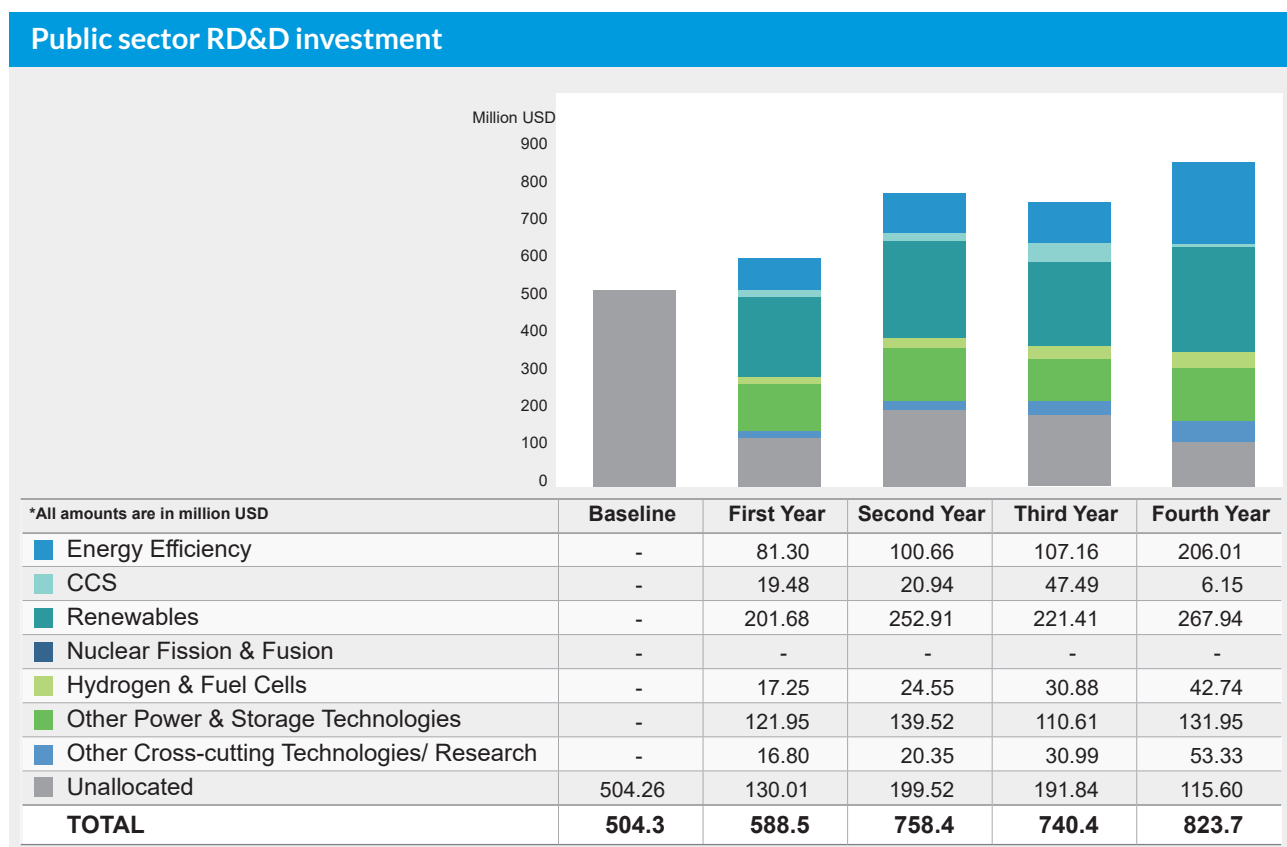
Germany was part of different activities supporting MI targets starting in 2019, specifically:

- The joint R&D call of the ERA-NET Smart Energy Systems and MI on energy storage. A total of 21 countries and regions worldwide are participating with a budget of more than €22 million.
- The Cofund Joint Call CSP ERA-NET. A total of 8 countries are participating with a budget of €13 million.
- The IEA TCP Heat Pumping Technologies in cooperation with MI IC7 via Annex 55 “Comfort and Climate Box”.
- Germany is initiating and leading within IEA TCP Solar Heating and Cooling in cooperation with MI IC7 the new task “Solar Cooling for Sunbelt Regions”.

Additionally, Germany participates in the second call of ACT (Accelerating CCS Technologies). This call addresses the Priority Research Directions (PRDs) developed during the 2017 Houston Mission Innovation Workshop. ACT now involves seven MI members (Norway, Germany, France, The Netherlands, UK, USA as well as the EU). The total budget of 12 projects selected in 2019 is €43.6 million. A third call was published in 2020.

National plans and priorities for clean energy innovation

German energy research policy is geared towards supporting the energy transition in Germany and worldwide. The limited time available until 2050 necessitates an increase in the speed of innovation transfer and the strengthening of applied energy research. With the living labs for the energy transition, the German government has introduced a new funding instrument that will demonstrate energy technologies on an industrial scale and in a real world environment.



Within the MI framework Germany reports project funding on clean energy technologies. In comparison to the data Germany reports to the IEA, this does not include institutional funding and project funding for nuclear safety research. It does include some programmes on clean energy technology (specifically SINTEG, EnEff. Gebäude.2050 and Wärmenetze 4.0) that were launched after the start of Mission Innovation and that are not included in the data reported to the IEA, as these programmes are not part of the Energy Research Programme of the Federal Government.

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
France	Sustainable Energy	Topics are batteries, power-to-X and hydrogen technologies as well as Smart Grids	Public-private	Research and development	2019 to 2022	€6M	https://www.fona.de/en/measures/funding-measures/cooperation_france_energy_research.php
Austria, Denmark, Finland, India, Italy, Norway, Sweden	MICall19 – 2019 Joint Call on Energy Storage	The 2019 joint call focuses on the development of integrated storage systems and will support solutions answering to identified challenges within this area.	Public-Private	Research and development	2019	€22M	https://www.eranet-smartenergy systems.eu/Calls/SG_Plus_Calls/SG_Joint_Call_2019
Spain, Italy, Portugal, Greece	Cofund Joint Call CSP ERA-NET	Strategic targets (based on priorities identified in the (SET) Plan: Short-term: > 40% cost reduction; Longer-term: develop the next generation of CSP/STE technology	Public-private	Research and development	2019 to 2023	€13M	https://csp-eranet.eu/calls
Norway, France, The Netherlands, UK, USA	ACT second and third calls	Advancing CCUS Technology: aimed at getting carbon capture und utilisation technology closer to being deployed	Public-private	Research and development	2019 to 2022 (second ACT call) 2021 to 2024 (third ACT call)	€31.5M	http://www.act-ccs.eu/calls



INDIA

High impact innovation activity triggered by MI

Funding Opportunity Announcements:

- Initiating large scale activity in the areas of Sustainable Biofuels, Carbon Dioxide Capture/ utilisation and in Storable Sun Fuels. By funding a large number of projects in close association with MI countries a strong research base and trained human resources will be established. These areas will get a boost because of Mission Innovation activities.
- India being a co-lead in IC1 launched nine smart grids R&D projects under the umbrella of Mission Innovation in collaboration with the nine MI IC1 member countries by investing \$5 million to financially support activities towards research, development and deployment. The nine projects helped to bring academia, utility and industry into a single platform in their respective topics. In this multilateral collaboration total Indian Institutes, Foreign Institutes, Industries involved are 17, 22 and 15 respectively. India also collaborated with several MI countries for off grid challenges. This could happen only as a result of the Mission Innovation platform.

Increased Private Sector Engagement & Investment:

- Under the Mission Innovation mandate, the Clean Energy International Incubation Centre launched a National Product Energy Challenge which resulted in 15 winning solutions/technologies for smart metering, energy-efficient heating and cooling systems, innovative EV solutions, clean cooking devices, innovative battery technologies, energy monitoring systems and hydro turbine technologies among others.

A Global Cooling Prize:

- This international innovation competition (announced by Hon'ble Minister of S&T ES and H&FW) led by the Government of India alongside the Rocky Mountain Institute (RMI) and Mission Innovation is spurring the development of super-efficient and climate-friendly residential cooling solutions for homes. This could only have been possible because of Mission Innovation Platform.

Overall Impact:

A number of developments in the international clean energy RD&D space would not have happened without Mission innovation activities (ICs). The ICs activity under Mission Innovation have enabled MI members to:

- Fill gaps in the clean energy ecosystem
- Convene the international clean energy RD&D community
- Enhance bilateral and multilateral relationships
- Identify gaps and opportunities for innovation
- Leverage Resources and Expertise
- Deliver performance breakthroughs

Impact of your national clean energy innovation activity

- A trained pool of more than 100 scientists has been created in these advanced areas of research.
- The Clean Energy solutions so developed will have a significant effect on development of clean energy technologies. More number of researchers are now getting attracted toward working in clean energy sector.
- Specific funding programme has assisted to bridge the gap "from the lab to the market".
- Exchange of best practices and sharing of information on existing and perspective collaborative projects.

- Technology development through knowledge sharing among nine MI IC1 member countries.
- The involvement of Industry/Utility from its initiation have a practical impact of deployment of these developed technologies for social welfare.
- We expect a collaborative framework and network of researchers, innovators and industries to be developed as a result of these endeavours.
- This strategic planning would help foster long-term technology innovation growth, including in focus areas that may seem niche today (e.g. energy storage, net-zero buildings, CCUS, geothermal and marine energy).

Update on clean energy innovation policies and strategies

Atma Nirbhar Mission: Self Reliant India:2020: The intended objective of this plan launched in 2020, is two-fold, first, interim measures such as liquidity infusion and direct cash transfers for the poor and secondly long-term reforms in growth-critical sectors impacted by COVID19, to make them globally competitive & attractive and create new opportunities for growth in sectors like agriculture, micro, small and medium enterprises (MSMEs).

In line with **National Policy on Biofuels**, the Government of India revisited its Biofuel policy and has approved “Pradhan Mantri JI-VAN Yojana” for providing financial support to Integrated Bio-Ethanol Projects using lignocellulosic biomass & biomass & another renewable feedstock. In first phase, four commercial scale cellulosic ethanol plants, each with 100KL/day ethanol capacity and using agricultural residues have been selected for viability gap funding. This fund will also support setting up of 10 R&D scale up plants.

Science, Technology and Innovation Policy, 2020: The Government of India initiated the process of formulation of Science, Technology and Innovation policy with energy as a major pillar²⁷.

National Mission on Transformative Mobility and Battery Storage (2019). (IEA,2019a) was launched by the Government of India, in 2019 to promote Clean, Connected, Shared and Holistic Mobility Initiatives & Phased Manufacturing Programmes for batteries and electric vehicle components.

The Government of India in 2019, issued a notification with guidelines for sale of Biodiesel which can be later used for blending with high speed diesel for transportation purposes.

As part of the **SATAT (Sustainable Alternative Towards Affordable Transportation)** initiative scheme, Expression of Interest (EoI) have been requested for procurement of Compressed Bio-Gas (CBG) from the entrepreneurs at an assured price²⁸. A total of 5000 CBG plants are planned in five years.

The Ministry of New and Renewable Energy (MNRE) aimed to provide custom and excise duty benefits to the solar rooftop sector, which in turn will lower the cost of setting up as well as generate power, thus boosting growth.

Several major initiatives have been introduced to better target the subsidies, notably through the **PAHAL, Pradhan Mantri Ujjwala Yojana (PMUY)**. PAHAL, also known as the Direct Benefit Transfer of LPG scheme, one of the largest direct support schemes, sends the subsidy for the LPG purchased directly to a citizen’s bank account. Key to the scheme’s success has been the Aadhaar identity system, which links subsidy payments to bank accounts, and the better targeting of subsidies directly to women, which has increased women’s financial inclusion and access to clean cooking. As of June 2019, 247 million LPG consumers have joined the PAHAL²⁹.

Initiated by the Government of India in February 2019 (and followed by guidelines in July 2019), the **KUSUM scheme** aims to support farmers to replace existing diesel pumps with solar PV pumps (with both on-grid and off-grid features). The scheme aims to allow farmers to become prosumers and sell power to the DISCOMs at a predetermined price and aims to add solar and other renewable capacity of 28 GW by 2022.

²⁷ <https://www.mygov.in/campaigns/stip-2020/>

²⁸ <https://pib.gov.in/PressReleasePage.aspx?PRID=1593759>

²⁹ <https://pib.gov.in/PressReleasePage.aspx?PRID=1577742>

OMCs are now developing 2G ethanol and plan to invest in 12 bio-refineries in 11 states with a total investment volume of Rs 900 crores (USD 120 million). The Government of India aims to provide incentives for farmers to bring their waste to the refineries³⁰.

Net-metering policies are being implemented in 28 states aimed to enable faster expansion of distributed solar PV.

To encourage procurement of biodiesel produced from Used Cooking Oil (UCO), OMCs have floated **Expression of Interest (Eoi)** for setting up of biodiesel plants from UCO processing plants on 10.08.2019 across India for 100 locations. It was further extended to 200 locations on 10.10.2019.

The **Indian Cooling Action Plan (ICAP)** was launched in March 2019 by the MoEFCC. The ICAP provides a 20-year perspective and outlines actions needed to provide access to sustainable cooling. India is the first country in the world to have a Cooling Action Plan.

Major innovation initiatives and programmes in 2019/20

Increasing International RD&D Collaborations: To encourage and facilitate the leveraging of knowledge, capabilities, and resources among Mission Innovation members and other stakeholders, DBT (via Mission Innovation) has been coordinating (nationally and globally) to identify existing efforts and looking at opportunities for deeper collaboration with MI countries.

- Department of Biotechnology (DBT) and Department of Science and Technology (DST) launched the Funding Opportunity Announcement for Carbon Capture (IC3), Sustainable Biofuels (IC4) and Converting Sunlight (IC5) to provide an opportunity for Indian researchers to collaborate with researchers from MI members with a total budget of **Rs 1280 million** (17 million USD). A total of **47 collaborative R&D projects (27 from DST/20 from DBT)** were recommended from India for IC3 (carbon capture), IC4 (Sustainable Biofuels) and IC5 (Sunlight Innovation) funding support.
- The joint projects supported under the Sustainable Biofuels Innovation Challenge (**Collaborative support from 9 MI Member countries**), cover the key areas of production of sustainable advanced biofuels from agricultural residues, use of MSW for CNG/Methanol, advanced biofuel through microbial fermentation, high-value products, production of enzymes and yeasts by genetic manipulation and scale-up technologies, improvements of biological feedstocks, lignin valorization, heterotrophic algal production from waste stream and LCA for production of biofuels.
- Joint projects supported by DBT under the Carbon Capture (IC3) (**collaborative support from 17 MI Member countries**), include bioconversion of CO₂ by enzyme assisted solvent-mediated CO₂ capture based technologies to value-added products, efficient flue gas CO₂ Capture and its conversion to Energy fuels.
- The proposals supported under Sunlight Innovation (IC5) (**collaborative support from 7 MI Members**), includes the large-scale demonstration of cultivation systems, host engineering/strain improvement of microalgae & cyanobacteria for improved photosynthetic efficiency.
- India has taken the lead in developing a framework which is promoting the clean energy technologies with the active participation of scientists, researchers, universities, industries, utilities as well as private organisations across the world through the Mission Innovation platform.
- DST participated in MICall2019 on Energy Storage Solutions and made a commitment of €2 million.
- DST participated in ACT-3 call focussed on carbon capture, utilisation and storage with a commitment of €2 million. DST also approved setting up of two virtual centres on CCUS at IIT Bombay and JNCASR, Bangalore.
- DST announced a call on local energy systems with the European Commission committing an investment of €9 million.
- DST also launched a bilateral call with the Swedish Energy Agency on Smart Grids with an investment of €2 million.

³⁰ https://niti.gov.in/sites/default/files/2020-01/IEA-India%202020-In-depth-EnergyPolicy_0.pdf

IC1 Smart Grids:

- Under the MI mandate to support smart grids ISGAN MI IC1 collaboration has been initiated. A Letter of Intent (LOI) has been signed between IC1 and ISGAN, identifying common interests within R&D Tasks - Storage Integration and Flexibility Options. Two Joint factsheets were proposed and published at Vancouver workshop in 2019.
- IC1 Smart-Grids team developed Smart Grids Innovation Accelerator (SGIA) framework to foster and accelerate the deployment of the smart grid by providing access to critical documents in the smart grids field, such as policies, strategies, technical reports, case studies, best practices, roadmaps, implementation plans, and digital twin objects.
- IC1 team invited to be part of the Global Power System Transformation Consortium.
- Department of Science and technology (DST) announced call inviting letter of intents to set up Material Acceleration Platform (MAP) under IC6.

IC2: Off-Grid Access to electricity:

- Under the MI mandate India collaborated with following countries to support RD&D collaboration in Off-grid access to electricity.

- | | |
|---|--|
| <ul style="list-style-type: none"> • Australia: Solution for Pacific Island Countries | <ul style="list-style-type: none"> • European Commission: Horizon 2020 “Secure, Clean and Efficient Energy”- Island projects (€36 million) across Europe |
| <ul style="list-style-type: none"> • Canada: Canmet: Solar–Diesel –Storage Power plant; CERRC | <ul style="list-style-type: none"> • Netherlands: Results Based Financing (RBF)- Decentralized energy access in developing countries; Energizing Development; Dutch Coalition for Humanitarian Innovation |
| <ul style="list-style-type: none"> • China: Technologies & Equipment Development: 5 Projects worth USD1 Million (2019) | |

Raising awareness of the transformational potential of Energy Innovation: National and International Meetings:

A wide range of workshops and events were organized to bring together key stakeholders to agree on priorities, promote innovation, opportunities for innovators & investors and explore opportunities for further collaboration.

- Second MI Indian Stakeholders meeting on Clean Energy Innovations on 3 May 2019 in New Delhi which was attended by various international agencies (International Energy Agency, World Economic Forum, World Bank, AEF Sweden), senior advisors, technical experts, industry representatives, investors and broader public participation.
- 1st CEM/ISGAN - MI IC1 workshop at Vancouver 2019 was organised to highlight the contribution of 16 IC1 Countries and the European Commission on energy strategies, trends, projects and on-going activities in the field of smart grids.
- The Sixth MI IC1 Deep-Dive International Workshop was co-organized by the IC1 Co-Leads Italy, India and China and the French Ministry of Ecology, Sustainable Development and Energy and Think Smart Grids.
- In line with Analysis and Joint Research (AJR) subgroup mandate, of which India is an active member, the Mission innovation Face to Face meeting of all Innovation Challenges under Analysis and Joint Research (AJR) was held on 4 - 5 November 2019 in New Delhi. The major objective of the meeting was to assess impact and achievements on Innovation Challenges so far, cross-over learnings from the multilateral projects, identifying key trends, opportunities and technology gaps, and the need for continuation of Mission Innovation beyond the year 2020.
- The Mission Innovation Beyond 2020 Regional workshop was held on 6 November 2019 in New Delhi. The workshop facilitated discussion to identify transformative ideas and scenarios for a potential second phase of MI beyond 2020.

- In line with MI 2.0 mandate for B2020, “**Consultative and Collaborative**” approach has been followed to address Mission oriented approach via the proposed. Building on successes to date, strengthening the international platform for collaboration and stepping up the pace of innovation. The key meetings / consultations organised include:

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ National Consultative Meeting on Mission Beyond 2020 Framework: Video Conferencing (Virtual Platform): 23 March 2020 ▪ National Consultative Meeting on Missions Scoping: Video Conferencing (Virtual Platform): 21 April 2020 ▪ IC4 Sustainable Biofuel Meeting: Bioenergy in the Transport Sector: Mission Scoping: Teleconference (Virtual Platform): 21 April 2020 | <ul style="list-style-type: none"> ▪ Consultative Meeting: Private Sector/Industry Association: MI India: 24 June (Virtual) ▪ Women in Bioenergy Sciences: promoting the Bio economy in the post Covid era: Webinar: June 2020 -Talk by MI Global Champion: India: Dr Purnima Jalihal ▪ Consultative Meeting: “Mission Development”: Engaging IC4 MI members/Co-leads/partners and Private sector: Virtual Platform: July 2020 |
|--|---|

The meetings aimed at providing an overview of the key aspects of proposal development and to seek inputs from MI countries and knowledge partners for the preparation of scoping document. The meetings successfully addressed the MI 2.0 - Mission Oriented approach, key gap areas and at strengthening the international platform for collaboration and stepping up the pace of innovation via ambitious research, development and demonstration activities that can help members to unlock clean energy transition pathways in a measurable way.

- DBT-IEA joint Launch event: Accelerating clean energy innovation: global needs and opportunities for India’: Virtual Platform: July 2020
- Deep dive international workshop on thermal comfort along with UK, UAE and European Commission on 6 November, IIT Delhi, New Delhi. The meeting facilitated face-to-face meeting, technical interaction and networking in IC7 PAs with specific focus on Thermal Comfort. The workshop took cognizance of the synergies between Thermal Comfort, Predictive Maintenance & Optimization and Building Integration and ended with New Delhi.

Increased Private Sector Engagement and Investment:

- The Department of Biotechnology and its Public Sector Undertaking, BIRAC has joined hands with Tata Trusts in successfully setting up the **Clean Energy International Incubation Centre (CEIIC) in 2018**, to provide end-to-end support to start-ups, ranging from infrastructure, technology, angel funding, access to venture capitalists, mentorship, exposure to national and international organisations. Under Mission Innovation mandate, the Clean Energy International Incubation Centre launched:

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ National Product Energy Challenge (2019) which resulted in 15 winning solutions/technologies for smart metering, energy-efficient heating and cooling systems, innovative EV solutions, clean cooking devices, innovative battery technologies, energy monitoring systems and hydro turbine technologies among others. | <ul style="list-style-type: none"> ▪ CEIIC Incubation expanded its Portfolio to 24 start-ups in 2019-20. |
|--|--|

- **Avoided Emissions Framework:** India-Sweden Collaboration: India through Clean Energy International Incubation Centre (CEIIC) (a joint initiative of DBT and Tata Trusts) and Sweden through RISE has collaborated under Avoided Emissions Framework (AEF) to accelerate the Clean energy initiatives for a Sustainable Future. The Net-Zero Compatible Innovations Initiative was instrumental in identifying and supporting a new generation of solution providers. In a first step twelve start-ups were selected for initial estimations. After an initial vetting process assessment were conducted on eight start-ups. These **eight start-ups** incubated at CEIIC have a combined potential to help avoid more than 98 million tonnes of GHG emissions per year by 2030. The framework was again applied during the second edition of the **Energy Challenge 2020** to support in the shortlisting and finalization of compatible solutions to ensure specific targeting of high impact technologies in clean energy.

- **Clean Energy Investment and Technology Innovations:** IEA and the Ministry of Science and Technology, Government of India is currently focusing on assessment of R&D investments in clean energy in the country. A discussion paper entitled '**Clean energy transitions: Accelerating Innovation beyond 2020 Focus on India**' was released at the Mission Innovation meeting of all Innovation Challenges under AJR held during 4-5 November 2019 at New Delhi. This Discussion Paper draws on a recent analysis of the clean energy innovation landscape in India, which is becoming a key factor in the world's energy innovation landscape. The document provides an overview of Clean energy innovation as part of clean energy transitions, tapping into India's experiences and success stories, also considering aspects relevant to multilateral innovation partnerships and suggests ways forward for policy and decision-makers beyond 2020.
- Keeping in line with the Mission innovation mandate for information sharing, the Ministry of Science & Technology (DST and DBT) released a discussion paper with support from European Commission and MI countries, "**Collaborative models for International Co-operation in Clean Energy innovation**" during the MI-AJR meeting at New Delhi in 2019.

Prizes and other Initiatives:

- India has actively supported applications for MI Champions program and one of the applicants (Prof. SP GonChaudhuri) was selected to represent India at the 4th MI Ministerial. Additionally, In June 2020, **Dr Purnima Jaliha: NIOT: Ocean Energies** has been awarded as MI Global Champion 2020 working on Affordable Clean Energy via Oceans.
- **A Global Cooling Prize** - This international innovation competition (announced by Hon'ble Minister of S&T ES and H&FW) led by the Government of India alongside the Rocky Mountain Institute (RMI) and Mission Innovation is spurring the development of super-efficient and climate-friendly residential cooling solutions for homes. The **eight finalists** of the Global Cooling Prize were announced on 15 November 2019. The finalists have been awarded USD 200,000 each to develop and ship their prototypes to India for testing in the summer of 2020.

Private sector engagement in 2019/20

Increased Private Sector Engagement and Investment:

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- Under the Mission Innovation mandate, the Clean Energy International Incubation Centre launched a National Product Energy Challenge which **resulted in 15 winning solutions/technologies** for smart metering, energy-efficient heating and cooling systems, innovative EV solutions, clean cooking devices, innovative battery technologies, energy monitoring systems and hydro turbine technologies among others.
- A private sector company in India has obtained order for setting up of three large scale commercial plants of cellulosic ethanol based on utilisation of agricultural residues.
- Private sector companies significantly investing in solar and wind sector.
- Expression of Interest by private sector in setting up of compressed biogas plants based on agricultural residues.
- Private sector involvement in scaling up production of cellulase enzymes for Second generation ethanol.
- Design, engineering and fabrication of equipment by private sector companies on renewable energy projects.
- Public Private collaborative R&D projects initiated in various Clean Energy Areas.

Major activities in support of the Innovation Challenges in 2019/20

- India supported collaborative R&D projects for Carbon Capture (IC3), Sustainable Biofuels (IC4) and Converting Sunlight (IC5) MI Challenge.
- Keeping in line with the Mission innovation mandate for information sharing, Ministry of Science & Technology (DST and DBT) a discussion paper with support from European Commission and MI countries, “Collaborative models for International Co-operation in Clean Energy innovation” was released during the MI-AJR meeting at New Delhi in 2019.
- Synergy 2019: A global outreach report on Smart Grids was released under MI mandate of Information sharing in Smart grids.
- Off Grid Innovation Challenge Synthesis Report -2019 was released during MI-AJR meeting at New Delhi 2019, highlighting key initiatives taken by different MI countries to develop Off- Grid solutions.
- Sustainable Bioenergy and Biofuels Report 2019 was released during the MI-AJR meeting at New Delhi in 2019 highlighting the present status of various R&D projects on development of Sustainable Bioenergy and Biofuels, government policies thereon and future outlook.

Other Mission Innovation related activity in 2019/20

- **Mission Innovations Champions: Scaling the Potential of Clean Energy Innovation: Turning Awareness into Action:** India has actively participated in Phase 1.0 of this initiative and supported one Global MI Champion and four National Clean Energy Champions via Research Innovation grants to scale-up innovation for societal good. India is now actively supporting the **new phase of MI 2.0 (B2020) through a mission-oriented approach**, which will act as a catalyst for bold, innovation alliances built around ambitious and inspirational goals that lead to tipping points in the development of tested, affordable, scalable, and cleaner energy solutions.
- **Outreach Activity:** The Mission Innovation India Unit with support from Department of Biotechnology has launched a dedicated website for Mission Innovation and related activities. Full details about recent workshops, Meetings, Country reports and Press releases can be found on the website³¹.
- **Centers of Excellence:** Support of five large bioenergy research centers by Department of Biotechnology, Ministry of Science and Technology, Government of India.
- **MI-IC7: Initiatives and outcomes** relating to MI IC7, global cooling prize and other Mission Innovation related activities of DST are exhibited at ACREX 19, Feb –March 2019, Mumbai and ACREX 2020, Feb 2020, Greater Noida in the DST technology pavilion of ACREX 2020.

National plans and priorities for clean energy innovation

- Call for proposals - Phase 2 under four MI challenges for Rs 1420 Million or \$20 million
- Monitoring of projects granted in Phase 1: Funding opportunity announcements
- Country Reports Update: Preparation of country report(s) on clean energy development and progress made in all innovation challenges
- Development of inputs work plan for delivery of a proposal for MI 2.0 to Ministers at MI-5
- Collaboration with World bank for a joint funding mechanism to support and accelerate Clean energy innovations
- International product Challenge under CEIIC

³¹ www.mission-innovation-india.net

- Participation in MI Call 19
- Participation in Phase 2.0 MI Champions
- Participation in MI-5 for Phase 2 continuation of MI
- Participation in comfort climate box for the topic's initiative of IEA
- The Government of India has set out eight national missions to promote India's sustainable development objectives, which are as follows:

- National Solar Mission
- National Biofuel Policy
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission for a Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change
- National Bioenergy Mission

Public sector RD&D investment

Million USD

Year	Investment (Million USD)
First Year	56.13
Second Year	81.26
Third Year	105.96
Fourth Year	70.82

*All amounts are in million USD	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	-	-	-	-
CCS	-	-	-	-
Renewables	-	-	-	-
Nuclear Fission & Fusion	-	-	-	-
Hydrogen & Fuel Cells	-	-	-	-
Other Power & Storage Technologies	-	-	-	-
Other Cross-cutting Technologies/ Research	-	-	-	-
Unallocated	56.13	81.26	105.96	70.82
TOTAL	56.1	81.3	106.0	70.8

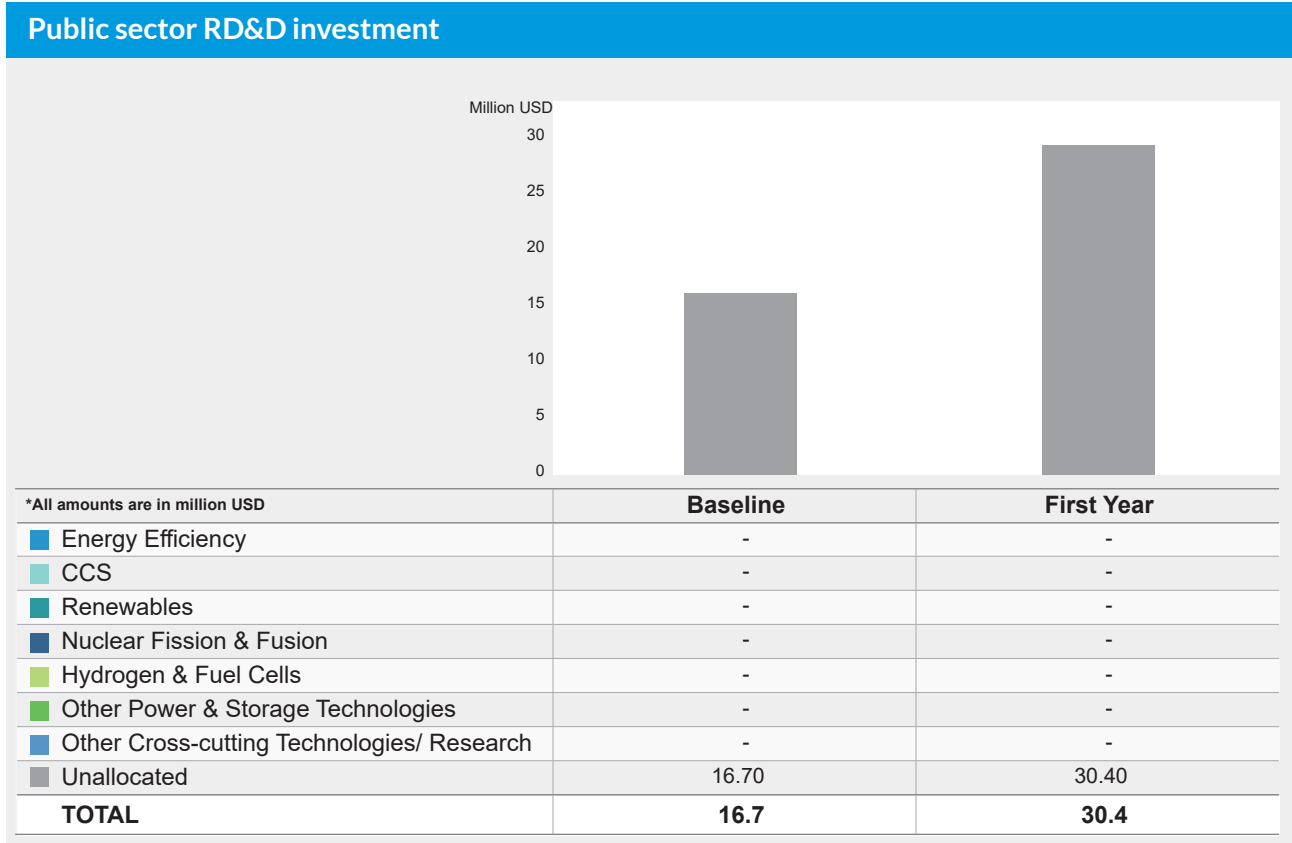
New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Additional information
International Energy Agency	IEA TCP Bioenergy	International Energy Agency's Technology Collaboration Programme on Bioenergy (IEA Bioenergy TCP) is an international platform for co-operation among countries with the aim of improving cooperation and information exchange between countries that have national programmes in bioenergy research, development and deployment.	Public-private	Bioenergy research, technology development, demonstration, and policy analysis	2019	https://pib.gov.in/Pressreleaseshare.aspx?PRID=1566787
IEA & Reliance Industries	IEA TCP H2	The Hydrogen TCP seeks to optimise environmental protection, improve energy security, transform global energy systems and grid management, and promote international economic development, as well as serving as the premier global resource for expertise in all aspects of hydrogen technology.	Public-private	Accelerate hydrogen implementation and widespread utilisation	2019	https://niti.gov.in/sites/default/files/2020-01/IEA-India-In-depth-review2020.pdf
International Energy Agency	IEA TCP Heat Pump Technologies	IEA HPT TCP intends to accelerate product development and market introduction of combined heat pump / storage packages: The Comfort and Climate Box (CCB)	Public-private	Heat pump technology, prototyping and demonstration	2020	https://heatpumpingtechnologies.org/annexes/65/



INDONESIA

Please view Indonesia's full narrative on the Mission Innovation website.





ITALY

High impact innovation activity triggered by MI

Mission Innovation has:

- allowed the development of new Bilateral agreements of Scientific and Technological Cooperation among international public research centers (i.e. Italy/India Cooperation agreement on Joint application for Strategic key programme for international scientific technological cooperation- RSE - Roorkee);
- facilitated the interaction among the National Research Centres involved in the development of cleantech technologies;
- favoured the synergy among the various Ministries involved in the research activities' support;
- given substance and resources to the Italian R&I activities planned under the 5th Dimension (R&I&C) of the National Plan for Energy and Climate (NPEC), together with the participation in the EU – Strategic Energy Technology - SET Plan in the frame of the European New Green Deal which foresees a strong effort on clean energy innovation activities;
- focused the attention of all stakeholders in Italy on the opportunities that hydrogen can offer as an energy carrier. To this end the Ministry of Economic Development set up The Hydrogen Table gathering the main national stakeholders in the value chain to encourage the development of hydrogen-related projects and allow Italian companies and research organisations to actively participate in the activities of IC8.

Impact of your national clean energy innovation activity

Italy's clean energy innovation activities are closely coordinated with the European Strategic Energy Technology Plan (SET Plan) in the perspective of the full implementation of the New Green Deal at European level. The conception of the Mission Innovation Challenges largely follows the SET Plan methodology and the synergies between the two exercises are significant. Italy from the launch of MI has therefore always considered it necessary to have an organic and integrated research management in the energy sector, both of the SET Plan and MI, in order to improve the efficiency and effectiveness of the resources allocated.

In the context of the definition of the National Energy and Climate Plan, Italy has taken the opportunity to define a long-term strategy (at least until 2030 with a perspective to 2050) that indicates objectives, priorities and measures to achieve the targets identified. The aim is to create the system conditions so that the participation of industries and public and private R&D centers in future research programs envisaged both in the SET Plan and in Mission Innovation is broader and less fragmented, and achieve a greater success than has happened in the past.

Update on clean energy innovation policies and strategies

The Italian Government published the official version of the National Energy and Climate Plan³² in 31/12/2019 (NECP), and sent it to the European Commission according to the Governance of the Energy Union and Climate Action. The Plan sets out measures to ensure the creation of a secure, sustainable and competitive energy system in order to achieve sustainable growth, promote fundamental role of research and innovation in the cleantech sector and reach the 2030 environmental targets at European level. The targets for RES are very significant and assume to cover more than 55% of the demand in the electricity field, 33% of the demand in the thermal sector and more than 21% in the transport sector, for an overall target of 30% of the gross energy consumption.

One of the five dimensions of the NECP proposal is represented by the research, innovation and competitiveness's pillar. The dimension includes and refers to the national participation to Mission Innovation which is committed to double public funds for R&D for clean energy from €222 million in 2013 to €444 million in 2021.

³² <https://www.mise.gov.it/index.php/it/198-notizie-stampa/2040668-pniec2030>

Major innovation initiatives and programmes in 2019/20

- In June 2019, the Italian Ministry of Economic Development set up The Hydrogen Table gathering the main national industrial players in the value chain to encourage the development of hydrogen-related projects. 35 companies and research bodies participated to the kick-off meeting. This initiative aims to define the priorities, the guidelines and to make a competitiveness assessment on the Italian hydrogen sector and to promote the development of hydrogen-related projects that can have positive impacts from the technological, economic and social point of views. In 2020 other important companies requested direct involvement and numerous projects were presented.
- The Ministry of Economic Development has launched in 2019. The 2019-2021 3-year plan of the National Electric System Research Fund. The resources allocated amount to €210 million. ENEA, CNR and RSE are the leading public research institutions involved. A call for proposals for the private sector is also foreseen on a co-funding basis before the end of 2020. The activities are aimed at innovating and improving the performance of the system in terms of economics, safety and the environment. The programme's coverage ranges from system governance to R&D and deployment of renewable technologies, smart grids and end-use. It is financed through a specific component of the end-user electricity tariff³³.
- The European Commission has approved an investment of approximately €3.2 billion for joint research and innovation projects and first industrial production for the construction of new generation of batteries and storage systems. It is a project that jointly involves Belgium, Finland, France, Germany, Italy, Poland and Sweden, and in which 17 European companies participate (some of them are Italian), as well as small and medium-sized enterprises and research bodies.
- In order to stimulate private spending on Research, Development and Technological Innovation to support the competitiveness of companies and encourage digital transition processes and within the circular economy and environmental sustainability, a new and significant tax credit regime for R&D projects has been set up in the framework of the Plan "Transizione 4.0" for the new industrial strategy launched by the Ministry of Economic Development³⁴.

Private sector engagement in 2019/20

- At the end of 2019, SNAM Spa (Italian gas Transmission System Operator) doubled the volume of the hydrogen blend, which was experimentally introduced into its natural gas transmission network in Contursi (Salerno), to 10%. This came just a few months after the 5% hydrogen blend was introduced into the network for the first time in Europe, directly supplying two companies, as part of an experiment carried out by SNAM in April 2019 in Contursi. The industries involved are the same as before: a pasta factory and a mineral water bottling company that both operate locally.
- ENEL Spa has started the Puglia Active Network (PAN), the €170 million project prepared in response to the European NER 300 call for improving performance and enabling innovative management of the electricity network in the Puglia region, with a high presence of plants for the production of energy from renewable sources. Thanks to Puglia Active Network, an intelligent network will cover the entire region, integrating the energy generated by renewable plants distributed throughout the territory and guaranteeing customers constant access to information on consumption trends.
- The Bolzano Hydrogen Valley is an example of excellence at European level: hydrogen is produced by electrolysis completely from renewable sources. To date, 5 hydrogen buses, 20 fuel cell cars have been added to the park in 2020, and some others are operating. 12 buses have been ordered and will circulate in the area soon.

³³ <http://www.ricercadisistema.it/#/page/Cos%E2%80%99%99%C3%A8>

³⁴ <https://www.mise.gov.it/index.php/it/transizione40>

Major activities in support of the Innovation Challenges in 2019/20

IC1: Italy as MI Innovation Challenge 1 co-lead, hosted on 16 January, 2020, a workshop in Rome in order to evaluate possible cooperation activities between IC1 and ISGAN - the International Energy Agency (IEA) Technology Collaboration Programme (TCP) for a Co-operative Programme on Smart Grids (ISGAN – International Smart Grids Action Network) launched in 2010 which currently has an Italian presidency. It is also an initiative of the Clean Energy Ministerial (CEM) and was formally established at CEM2 in Abu Dhabi, in 2011. ISGAN creates a strategic platform to support high-level government attention and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world. The workshop gathered IC1 representatives, smart grids experts and industry leaders to address smart grids research and innovation.

IC8: following the Mission innovation “Hydrogen Valleys” workshop organized in Antwerp on March 2019, the Ministry of Economic Development set up The Hydrogen Table gathering the main national stakeholders in the value chain to encourage the development of hydrogen-related projects and allow Italian companies and research organisations to actively participate in the activities of IC8.

Other Mission Innovation related activity in 2019/20

The Smart Grids Innovation Accelerator (SGIA) is a cloud-based online platform to share policy, regulatory, technical and financial knowledge related to smart grid solutions. By centralizing this information into one database, IC1 seeks to share best practices, promote replication, enhance public-private collaboration and information sharing, and foresees upcoming enabling technologies and business models.

IC1 launched the first phase of the SGIA Platform at the 4th IC1 Deep-Dive Workshop in November 2018 (Rome) and presented on phase one outcomes at the 1st IC1-ISGAN joint event in May 2019 (Vancouver). As of March 2020, the SGIA is under development by a team of companies led by IBM. The platform will have advanced search features and will provide semantic links between search results (including results from external public databases) in order to help users analyze results quickly and comprehensively. The SGIA will also be supported by artificial intelligence algorithms to translate documents from different languages, speech-to-text functionality for video and audio files, and options to personalize users' search results and notes. Italy is leading this initiative and has contributed to support phase one and phase two development of the project. Long-term maintenance of the SGIA platform is expected to be managed by one or more IC1 countries.

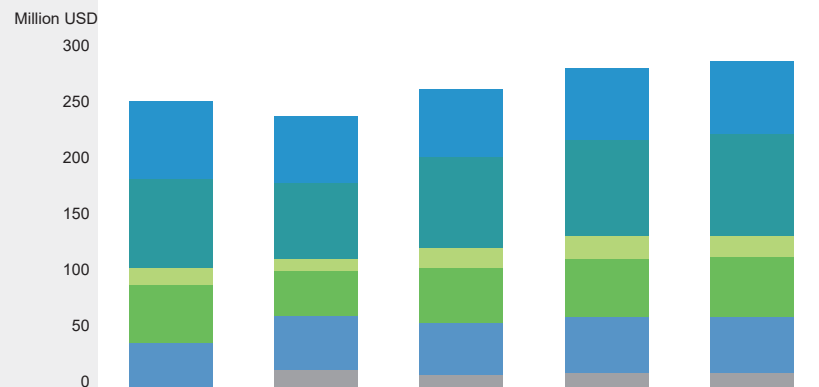
Through the development of this platform, IC1 members are strengthening cross-border networks: they are combining their expertise and experiences into a central repository and they are engaging stakeholders on opportunities to contribute to and benefit from the platform.

National plans and priorities for clean energy innovation

The achievement of the Energy and Climate Plan's decarbonisation objectives requires significant commitment in terms of additional investments. The Italian National Energy and Climate Plan estimates that, between 2017 and 2030, more than €180 billion in cumulative additional investments will be needed if we want to reach the ambitious 2030 targets. The Covid-19 crisis has dramatically changed the landscape and we do expect that the tools proposed by the European Commission, in the context of the Recovery Plan, would be able to restore the level investment already planned in order to keep the expected ambition towards climate and energy objectives in particular:

- Investments should be directed towards technology solutions aimed at having impact both on energy supply and end-use.
- We aim to promote innovative solutions on energy efficiency, smart grids, hydrogen, batteries, raw materials, solar and marine energy.
- Smart grids will play a crucial role especially in promoting the integration of different sectors such as electricity, gas and water as well as in enhancing grid security and resilience.
- Research on Hydrogen is increasingly important in the context of the growth of renewables, offering a further chance to store the green energy produced, through the application of power-to-gas technological solutions.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	65.56	58.50	60.01	31.59	63.38
CCS	-	-	-	-	-
Renewables	79.60	65.23	79.72	83.99	86.23
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	13.20	10.04	16.69	19.04	19.04
Other Power & Storage Technologies	50.12	41.10	48.71	51.51	52.63
Other Cross-cutting Technologies/ Research	40.85	47.50	44.23	47.03	48.15
Unallocated	-	15.34	12.51	14.56	14.56
TOTAL	249.3	237.7	261.9	277.7	284.4

2016 data has been changed with reference to the 2019 survey since the Italian Statistical Institute - ISTAT has recently communicated the official and definitive data for 2016 and 2017.

It is worth to note that the amount of spending indicated in the table for the years 2018 and 2019 represents around 80% of the actual overall amount spent in R&D in the energy sector since it does not include other R&D Institutions whose expenses accounting is still in progress by the Italian Statistical Institute - ISTAT.

For the activities of Mission Innovation the Budget Law 2019 has approved an additional budget for clean energy R&D of €35.8 million, for the period 2019-2020, and with the Budget law 2020 another additional budget up to €40 million has been approved for the same period 2019-2021. A further financing of €111.8 million is foreseen up to the year 2022 to be confirmed by the next Budget Law 2021.



JAPAN

High impact innovation activity triggered by MI

Japan plans to continuously conduct the “Mitou” challenge 2050 program with an aim to promote industry-academia collaboration among researchers aged 40 or younger in academia to generate new ideas for reducing GHG emission by 2050.

Impact of your national clean energy innovation activity

While carrying out the formulated “Environment Innovation Strategy”, Japan will steadily reduce the GHG emission toward carbon neutrality and further strive to Beyond Zero.

Update on clean energy innovation policies and strategies

In June 2019, Japan formulated the “Long-Term Strategy under the Paris Agreement”^{35 36} as Growth Strategy, and submitted it to the United Nations.

In September 2019, in the field of hydrogen and fuel cells technologies Japan formulated a “Strategy for Developing Hydrogen and Fuel-Cell Technologies”³⁷, which is a policy that stipulates specific approaches to developing technologies toward the achievement of field-based goals set in the “Strategic Roadmap for Hydrogen and Fuel Cells”³⁸. The roadmap was renewed in March 2019 in line with the hydrogen-related policy materials, namely the Basic Hydrogen Strategy, the Fifth Strategic Energy Plan, and the Tokyo Statement.

In January 2020, Japan formulated the “Environment Innovation Strategy”^{39 40} based on the growth strategy for establishing innovative technologies that enable the reduction of global GHG emissions toward carbon neutrality and further reduction of the accumulated atmospheric CO₂ level “Beyond Zero” by 2050. The strategy consists of the “Innovation Actions Plans”, “Acceleration Plans” and “Zero-Emission Initiatives”.

Major innovation initiatives and programmes in 2019/20

On 15-16 June 2019, Japan held the **G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth**⁴¹ to discuss issues on climate change and securing affordable, reliable, accessible energy [systems] for supporting global economic growth.

On 25 September 2019, the **International Conference on Carbon Recycling**^{42 43} was held in order to exchange the latest international knowledge of Carbon Recycling and find the potential in international collaboration on Carbon Recycling, with 10 MI member countries participating. At the conference, Japan established “Carbon Recycling 3C Initiative”⁴⁴, which is composed of:

- (i) promotion of mutual exchange (Caravan),
- (ii) establishment of R&D and demonstration base (Center of Research) and
- (iii) promotion of international joint research (Collaboration).

³⁵ <http://www.env.go.jp/press/111914.pdf>

³⁶ <https://unfccc.int/sites/default/files/resource/The%20Long-term%20Strategy%20under%20the%20Paris%20Agreement.pdf>

³⁷ https://www.meti.go.jp/english/press/2019/0918_001.html

³⁸ https://www.meti.go.jp/english/press/2019/0312_002.html

³⁹ <https://unfccc.int/sites/default/files/resource/The%20Long-term%20Strategy%20under%20the%20Paris%20Agreement.pdf>

⁴⁰ Described as “Progressive Environment Innovation Strategy” in the Long-Term Strategy.

⁴¹ https://www.meti.go.jp/english/press/2019/0617_001.html

⁴² https://www.meti.go.jp/english/press/2019/0927_002.html

⁴³ <https://carbon-recycling2019.go.jp/en/>

⁴⁴ https://www.meti.go.jp/english/press/2019/0925_001.html

On the same day, the **Second Hydrogen Energy Ministerial Meeting**^{45 46} enriched discussions on future directions of policies for utilization of hydrogen at a global level, and released “Global Action Agenda” as action guidelines that member countries, including 15 MI members, should take involving hydrogen and fuel cells.

On 9 October, the **Green Innovation Summit**⁴⁷ brought together representatives of a series of international conferences, i.e. the Task Force on Climate-related Financial Disclosures (TCFD) Summit, Innovation for Cool Earth Forum (ICEF) on Research and Development 20 for Clean Energy Technologies (RD20) to exchange views on measures for accelerating disruptive innovations in order to realize a decarbonized society. In the Summit, Japan’s inauguration of an international joint research base for zero emission technologies, as a hub of aggregated knowledge from all over the world was announced.

Japan launched the new ambitious “Moonshot Research and Development Program”⁴⁸: aiming to solve various difficult issues in today’s society and to promote disruptive innovations by aggressively encouraging challenging R&D from domestic and foreign researchers and others. In February 2020, a call for research proposals designated as one of goals, “The Realization of sustainable resource circulation to recover the global environment by 2050” has announced. The total program budget is 100 billion JPY over the five-year period.

Japan launched a global collaboration program, “Research and Development Program for Promoting Innovative Clean Energy Technologies Through International Collaboration” (FY2020–FY2024)⁴⁹, which is led by research institutes or universities between Japan and other countries mainly from G20 members in order to create new and innovative clean energy technologies that will have practical use after 2030. The total program budget is 900 million JPY per project/per year.

Private sector engagement in 2019/20

“The Carbon Recycling Fund Institute”⁵⁰ was established in August 2019 as a private sector organization with the aim of both addressing the global warming issue and improving energy access throughout the world. The institute will foster innovation in carbon recycling and development in the field by public relations and sponsoring the research while strengthening international collaboration and coordination with national projects, contributing to new job creation and other forms of regional revitalization in partnership with local government.

Major activities in support of the Innovation Challenges in 2019/20

The IC5 roadmap workshop was held in Hiroshima in November 2019. Many experts from Japan also participated in the workshop to discuss how “the current SUNRISE technological roadmap”⁵¹ in the solar fuels fields can be improved to the global roadmap. The R&D activity of Japan Technological Research Association of Artificial Photosynthetic Chemical Process (ARPCChem) was also introduced.

IC8 members participated in the second Hydrogen Ministerial Meeting in Japan in September 2019 to present MI IC8 activity. Japan designated the three regional locations, Fukushima, Yamanashi and Fukuoka in the Hydrogen Valleys initiatives oriented to the platform for sharing best practices about hydrogen demonstrations among the members.

⁴⁵ https://www.meti.go.jp/english/press/2019/0927_002.html

⁴⁶ <https://h2em2019.go.jp/en/>

⁴⁷ https://www.meti.go.jp/english/press/2019/1010_002.html

⁴⁸ https://www8.cao.go.jp/cstp/english/moonshot/outline_en.pdf

⁴⁹ <https://www.nedo.go.jp/content/100903472.pdf>

⁵⁰ <https://carbon-recycling-fund.jp/aboutus/en.php>

⁵¹ <https://sunriseaction.com/sunrise-releases-its-technological-roadmap-to-a-clean-energy-eu/>

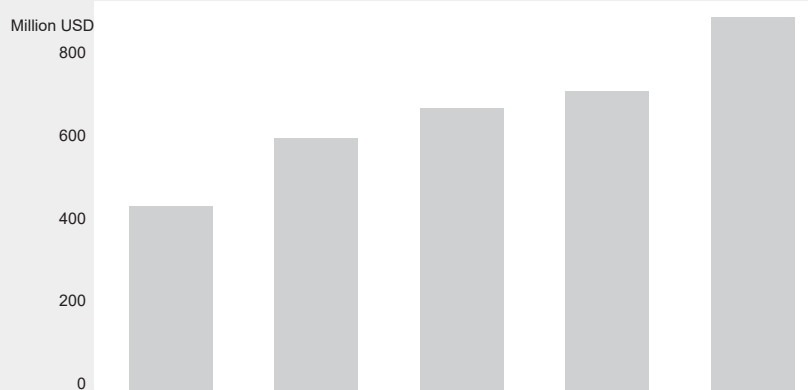
National plans and priorities for clean energy innovation

The “Innovation Action Plans” is one of the elements in the Environment Innovation Strategy. The plan identifies and prioritises 39 themes and 16 important and technical challenges in the five fields -

- (i) energy transformation,
- (ii) transportation,
- (iii) industry,
- (iv) business, household, cross-sectoral and
- (v) agriculture, forestry and fisheries/carbon sinks

- to establish innovative technologies that enable the reduction of global GHG emissions towards carbon neutral and further reduction of the accumulated atmosphere CO₂ level “Beyond Zero” by 2050. This also specifies i) cost targets, estimation of GHG reduction potential, ii) contents & formation of R&D, and iii) the process from basic research to demonstration.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
TOTAL	412.7	582.3	669.4	693.3	865.7

The figures in the table below include overlapping areas therefore the sum is not equal to the total amount of public R&D investment.

*In Billion Japanese Yen	Baseline	First Year	Second Year	Third Year	Fourth Year
Production process	9.1	16.1	16.3	18.1	21.0
Structural material	21.2	31.6	32.7	29.6	25.8
Storage Battery	9.8	14.4	19.0	21.6	24.6
Hydrogen	12.2	16.4	20.7	20.4	28.2
Photovoltaic	6.9	11.5	14.3	15.6	18.8
Geo-thermal	1.6	3.5	4.1	4.6	7.1
CCUS	11.1	18.1	22.0	24.1	49.4
Core technologies for Systems	16.3	29.3	33.6	40.5	45.3

Japan has reached the doubling commitment by the positive effect of engaging the “Moonshot Research and Development Program” aims to solve various difficult issues in today’s society including global warming.

The “Environmental Innovation Strategy” launched in January 2020 gives priority to the continued R&D investment.

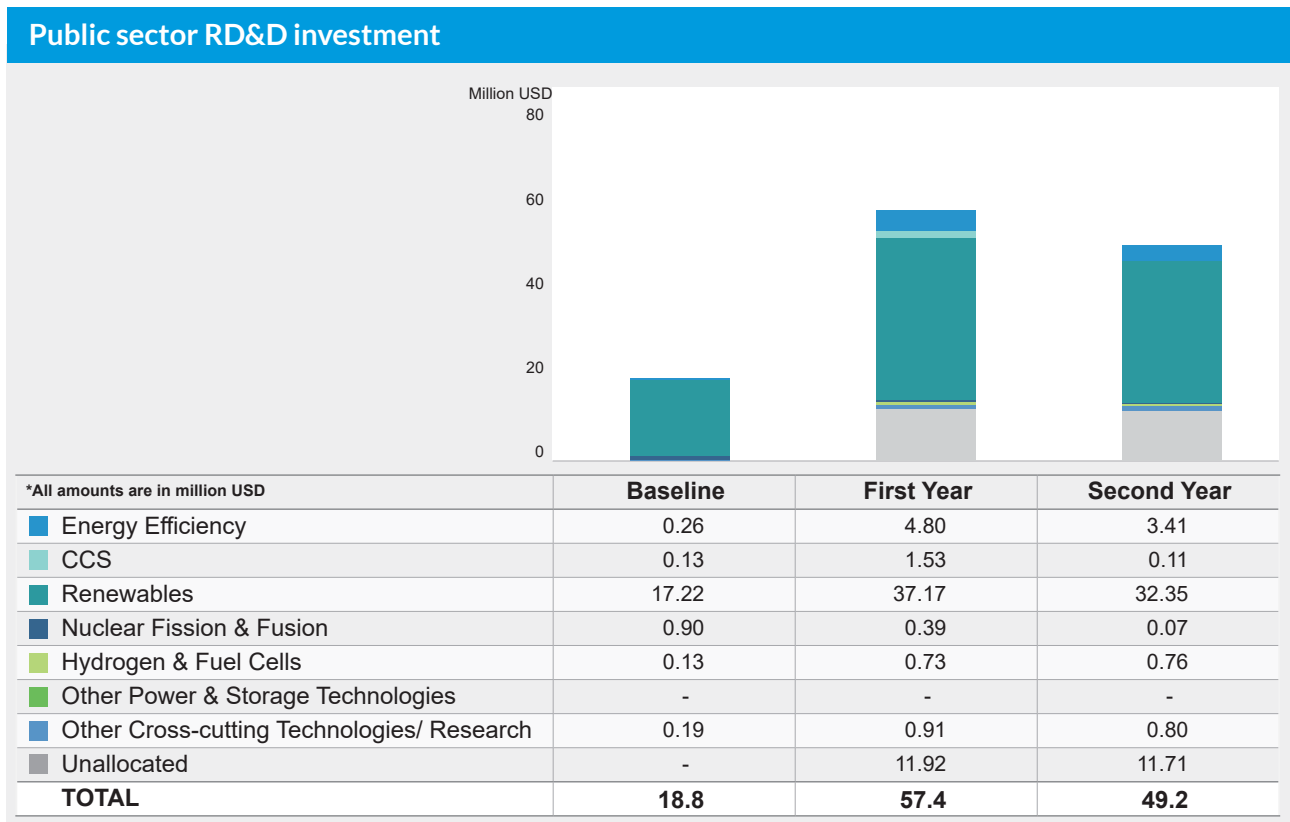
New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Additional information
Australia, Canada, Norway, Saudi Arabia, the Netherlands, the ROK, the UAE, the USA, Morocco	International Conference on Carbon Recycling	The leading experts from industry, academia, and government shared global innovative efforts and the latest knowledge, discussed and identified potential for international collaboration, and consolidated networks.	Public-public	Research and development	2019	https://www.meti.go.jp/english/press/2019/0927_002.html https://www.nedo.go.jp/english/news/AA5en_100405.html
Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Mexico, Saudi Arabia, the ROK, the UK, the USA, the EU	Research and Development 20 for Clean Energy Technologies (RD20)	International conference gathering leaders of research institutes engaged in R&D for clean energy technologies from G20 member countries in order to create disruptive innovation toward large reduction of CO ₂ .	Public - private	Research and development	2019	https://rd20.jp/overview/



MEXICO

Please view Mexico's full narrative on the [Mission Innovation website](#).





MOROCCO

High impact innovation activity triggered by MI

Launching the joint call MI2020.

Impact of your national clean energy innovation activity

- **801** professors, doctoral students and engineers supported
- **510** international communications
- **350** international publications
- **17** Laboratories created
- **8** in start-up creations in progress
- **29** Patents registered
- **27** Doctoral theses defended
- **6** Scientific events in 2019
- **318** Internships provided

Update on clean energy innovation policies and strategies

In 2009, Morocco has adopted a national energy policy in favour of the development of renewable energies to secure its energy supply in a context of strong growth in energy demand, to control the future costs of energy services in relation to the upward trend of petroleum products prices and, finally, to preserve the environment by mitigating greenhouse gas emissions.

This National Energy Strategy provided a road map for the transition to a clean energy future with greater energy security and lower carbon emissions in an effort to reduce dependence on imported energy. Its objectives included enhancing energy supply security, diversifying and optimising the electricity fuel mix, accelerating the deployment of renewables, making energy efficiency a national priority, supporting foreign investments in the sector, improving regional integration of the energy sector and allowing energy access for different social segments.

The Moroccan Government has made impressive progress in electrification. In 2018, the share of the population having access to electricity reached 99.43%, compared to just 48.1% in 1990. The challenge now is to upgrade the system to drive economic activities (especially in remote rural areas) and improve quality of life and affordability.

Morocco is pursuing an ambitious climate change policy based on the National Sustainable Development Strategy (November 2017), and the Nationally Determined Contribution (NDC) submitted to UNFCCC when Morocco ratified the Paris Agreement on 21 September 2016. By 2030, Morocco has committed to reducing greenhouse gas (GHG) emissions across the entire economy by 17% below BAU levels, and to reducing them by an additional 25%, conditional on international support.

The energy sector is in a transition phase in Morocco over the last two decades. This reform is characterized by high penetration of renewables (42% of renewable electricity generation capacity in 2020), rational legal and institutional reforms, and liberalization of the electricity market. In fact, this orientation is the response to the rising demand for electricity following the accelerated development of industrial activities, the population growth, and the increase in per capita energy consumption.

Morocco aims to develop a national renewable energy industry, as it is diversifying its energy supply and increasing significantly the share of renewable energy in the electricity mix. Morocco seeks to become a major player in regional markets and has supported the development of cutting edge technologies, notably in solar photovoltaic and solar thermal energy systems.

The renewable energy objectives have become more ambitious: the 2030-target is now 52% of installed power capacity from renewable sources, of which 20% will consist of solar energy, 20% wind energy and 12% hydro energy. An increased ambition, regarding the new energy efficiency strategy with 20% by 2030.

In November 2016, Morocco became an IEA Association country. In June 2017, Morocco and the IEA signed a three-year Joint Programme of Work to deepen bilateral cooperation in the areas of energy security, energy efficiency, renewable energy, capacity building, data and statistics. The work programme is tailored to Morocco's specific needs as it transitions to a low-carbon economy.

In November 2018 the Steering Committee in charge of the implementation of the National Strategy for Sustainable Development (NSSD) has prepared the State's exemplary plan for sustainable development.

Major innovation initiatives and programmes in 2019/20

The investment included in the baseline and the doubling target represents 100% of Morocco's clean energy innovation spending. The clean energy R&D Budget comes from the Energy Development Fund. It covers the specific budgets related to annual calls for R&D&I projects and the development of Research infrastructures, mainly:

- Annual R&D call "Green INNO-PROJECT", specifically dedicated to supporting collaborative R&D projects with a strong potential for developing new market-oriented products, services or processes. The maximum duration of projects is three years. The funds provided are given in the form of a subvention in accordance with the project specifications. The maximum financial contribution for each funded collaborative R&D project is €300,000 per project.
- Annual R&D JOINT call "INNO-ESPAMAROC ENERGY" with the Spanish Government, between IRESEN and CDTI (SPAIN), specifically dedicated to supporting collaborative R&D projects with a strong potential for developing new market-oriented products, services or processes. The maximum duration of projects is three years. The funds provided are given in the form of a subvention in accordance with the project specifications. The maximum financial contribution for each funded collaborative R&D project is about €1 million per project.
- Annual Innovation call for projects: "Green INNO-BOOST" dedicated to support developers in the incubation or acceleration phases, mainly entrepreneurs (young companies and SMEs) who want to innovate, in partnership with a university or a research centre, having already developed an innovative product, service or process with high commercialization potential and added value. This involves paying attention to technology, but also to market issues, intellectual property, and financial challenges that could impact the success of the project. The funding is provided in the form of a grant and credit at 0%, according to the project specifications. The maximum duration of the project is two years. The maximum financial contribution for each collaborative R&D project is €300,000 per project, in the form of maximum 30% subsidy and maximum of 70% loan at 0% rate.
- Grants for Ph-D students, mobility of researchers and purchase of equipment and consumables.
- Setup of Laboratories inside the universities (more than 17 laboratories) and development of highly specialised research units as well as creation of knowledge and know-how through innovative and collaborative projects.

Private sector engagement in 2019/20

The General Confederation of Moroccan Companies - CGEM: The CGEM has contributed to the creation and preservation of a dynamic entrepreneurial environment that is essential to a healthy economy and sustainable growth, notably through the following two commissions:

The Logistics and Energy Competitiveness Commission and the Green Economy Commission: the role of these commissions is to reflect, encourage consultation and propose solutions on common issues related to the company's activity, whether in economic, social, legal or tax matters. These commissions are forums for communication and debate that invite the members of the CGEM to enrich it with their proposals, ideas and actions.

Major activities in support of the Innovation Challenges in 2019/20

Development and setup of research infrastructures that provide universities and enterprises with testing, researching and training services:

IC3: Carbon Capture:

The Green H2A platform

IC5: Converting Sunlight:

The Green Energy Park, operational since 2017, is a renewable energy platform for testing, researching and training located in the town of Benguerir, next to Mohamed VI Polytechnic University. The facility was built in collaboration between IRESEN and the OCP Group and is considered as the first R&D platform of its kind in Africa. It is designed to create synergies and partnerships between different Moroccan research institutions, and to support the various partner universities as well as Moroccan industries in acquiring knowledge and know-how.

The Morocco-Ivory Coast Energy Park (MICEP) for south-south collaboration, in joint collaboration with INPHB institute in Yamoussoukro (Ivory Coast), dedicated to renewable energy and energy efficiency. It aims to bring together various institutions from Morocco and Ivory Coast (research centres, universities, development agencies, SMEs, etc.), and to encourage training, knowledge transfer and innovation in green technologies.

Other Mission Innovation related activity in 2019/20

Development and setup of research infrastructures that provide universities and enterprises with testing, researching and training services:

IC7: Affordable Heating & Cooling of Buildings

The Green and Smart Building Park (GSBP) is due to be opened in 2020 as a research and education platform dedicated to green buildings, energy efficiency and the integration of renewable energy sources in the building sector. It aims to bring together various institutions and local actors in the building sector (research centres, universities, development agencies, SMEs, etc.), and to encourage research in energy efficiency and savings in the building environment.

IC8: Renewable and Clean Hydrogen

The World PtX SUMMIT 2020 , 1-3 December.

National plans and priorities for clean energy innovation

- The Ministry of Industry's new strategy for the green economy
- Creation of a national PtX commission
- Development of the national PtX strategy

NETHERLANDS

High impact innovation activity triggered by MI

In 2019 The Netherlands provided the project-leadership for the international development of a comfort climate box. This stimulates an active cooperation between international initiatives (IEA TCP's and MI IC7), integral approach of innovation (not just technical but also social and legal aspects) where different countries bring different types of expertise to the table.

MI stimulated this activity by creating a platform for countries through which they can more easily collaborate. Also, by connecting the development to an MI Innovation Challenge, participants gained more leverage to initiate developments.

Impact of your national clean energy innovation activity

Since 2015 The Netherlands has increased public funding of energy innovation from €153 million per year to €320 million per year. This has stimulated private matching of funds from €71 million per to €209 million per year. The Netherlands was in fourth position in the Global Competitiveness Index 2017-2018 of the World Economic Forum, amongst others due to the strong innovation ecosystem (as mentioned in the report). The Netherlands successfully developed (or is developing) for example:

- ECOVAT Seasonal Thermal Energy Storage & Provider for Grid flexibility⁵²
- Lightyear
- Ampyx Power Airborne Wind Energy System (AWES)
- Demonstrator GE Haliade X - 12 MW offshore windturbine⁵³
- Motion Compensated Pile Gripper (MCPG)
- Gentle driving of piles⁵⁴
- Supersludge⁵⁵
- High Performance Geothermal Well⁵⁶
- Zero Emission, Energy Efficient Protein Production⁵⁷
- ALIGN⁵⁸
- ELEGANCY⁵⁹
- Heatstore⁶⁰

Update on clean energy innovation policies and strategies

The Netherlands has set an ambitious CO₂ reduction target of 49% in 2030, with a view on increasing the EU target for CO₂ emission reduction to 55% in 2030 compared to 1990. The Netherlands is targeting CO₂ reduction on a sectoral level with the Dutch Climate Agreement of 2019⁶¹ for the Electricity sector, Industry, Mobility, The built environment and Agriculture & land-use.

⁵² <https://www.ecovat.eu/?lang=en>

⁵³ <https://projecten.topsectorenergie.nl/projecten/demonstrator-ge-haliade-x-12-mw-offshore-windturbine-00031437>

⁵⁴ <https://www.grow-offshorewind.nl/project/gentle-driving-of-piles>

⁵⁵ <https://www.stowa.nl/publicaties/supersludge-demonstratie-van-zuiveringsslib-superkritisch-water>

⁵⁶ <https://projecten.topsectorenergie.nl/projecten/high-performance-geothermal-well-00029150>

⁵⁷ <https://projecten.topsectorenergie.nl/projecten/zero-emission-energy-efficient-protein-production-00028933>

⁵⁸ <https://www.alignccus.eu/>

⁵⁹ <https://www.sintef.no/elegancy/>

⁶⁰ <https://www.heatstore.eu/>

⁶¹ <https://www.government.nl/documents/reports/2019/06/28/climate-agreement>

The knowledge and innovation challenges for these sectoral missions have been translated in 2019 into the mission-oriented knowledge and innovation agenda (IKIA), which contains 13 mission oriented innovation programs (MMIP's) (see National plans and priorities section for an overview). Through sectoral Mission-oriented Innovation teams (MI-teams) - composed of end-users, private actors, knowledge institutes and government agencies - all Dutch innovation efforts concerning Climate and Energy across all TRL-levels are guided towards the MMIP's and the missions of the Climate Agreement, creating focus and mass. The Netherlands is also currently drafting a mission oriented international innovation agenda, in line with the IKIA, so that our international efforts in various initiatives contributes to the missions of our Climate Agreement.

In total the Netherlands is committing roughly €320 million public funds and €590 million private funds per year on climate and energy innovation, through the Knowledge and Innovation Covenant for 2020⁶².

Major innovation initiatives and programmes in 2019/20

With the Dutch Climate Agreement in place as well as the mission oriented knowledge & Innovation agenda derived from that, the 13 multi annual mission Oriented Innovation Programmes have been worked out in more detail.

This is achieved in a very intense collaboration between knowledge institutes, the private sector, the government and NGO's, and were published in the fall of 2019. The involvement of NGO's and the civil society is regarded as crucial, as transition may stall if societal engagement is not achieved.

A declaration of intent (KIC) has been drawn up and signed in mid-November by all involved parties in which the foreseen financial means have been made clear. For climate and energy there is almost €1 billion in 2020: about €320 million public funding for RDD and €590 million private funding.

2020 is the year in which execution commences. Subsidy schemes have been reshaped, for example:

- the subsidy schemes of the Topsector Energy (MOOI, €22.5 million per year)⁶³ have been modified to facilitate consortia that can help deliver concrete integrated concepts that will help deliver on the set missions for 2030 in the built environment, for our renewable energy targets on land but also at sea (multi-use, eco-friendly, at a lower cost) and for the CO₂ reduction targets in the industry.
- the Energy Innovation Demonstration grant scheme (DEI+, €86 million per year)⁶⁴ has been modified to also facilitate a natural gas free built environment, a flexible energy system (storage and conversion) and CO₂-reduction in industry.
- the Dutch Research Council (NWO) has published research calls on storage and conversion⁶⁵ (€3.8 million), and Ecology and North Sea⁶⁶ (€2.8 million). In 2020 the NWO will facilitate thematic calls for the mission oriented Topsector policy (for Energy transition and Sustainability €11 million per year).

Private sector engagement in 2019/20

The Netherlands supports public-private collaboration through various policies:

- General policies such as the public-private allowance, which facilitates private contributions for public-private partnerships for research and innovation within the Top Sectors⁶⁷.

⁶² <https://www.topsectoren.nl/publicaties/kamerstukken/2019/november/12-11-19/kic-2020-2023>

⁶³ <https://www.rvo.nl/subsidie-en-financieringswijzer/mooi>

⁶⁴ <https://www.rvo.nl/subsidie-en-financieringswijzer/demonstratie-energie-en-klimaatinnovatie-dei-2020>

⁶⁵ <https://www.nwo.nl/en/funding/our-funding-instruments/nwa/dutch-national-research-agenda-theme-storage-and-conversion/dutch-national-research-agenda-theme-storage-and-conversion.html>

⁶⁶ <https://www.nwo.nl/en/funding/our-funding-instruments/nwa/dutch-research-agenda---thematic-programme---theme-ecology--north-sea/dutch-research-agenda---thematic-programme---theme-ecology--north-sea.html>

⁶⁷ <https://www.rvo.nl/subsidie-en-financieringswijzer/pps-toeslag-onderzoek-en-innovatie/mogelijkheden/pps-programmatoeslag-tki>

- Energy-innovation policies, requiring a private contribution (in-cash or in-kind), for example the Renewable Energy Scheme (HER) (on average 50%), the DEI+ (on average 75%), the MOOI (on average 40%). In 2018 private matching of funds was €209 million.
- Private actors are part of the Mission Innovation Teams, prioritizing innovation efforts within the Mission Oriented Innovation Programs. By involving the private sector and the demand-side of innovation in aligning our energy innovation investments (from fundamental research to demonstration/implementation), policies, regulations, market conditions and international efforts we aim to create focus and mass in clean energy investments. This provides a more predictable and focussed framework for investors to invest in low-carbon innovations.
- The Netherlands has created a new investment agency – Invest-NL – which aims to invest in innovative, low-carbon technologies with a higher risk profile. This venture capital should trigger new investments from the private sector to bring innovative technologies onto the market.
- The Netherlands is currently creating an investment fund to enhance the structural growth of Dutch welfare. This fund will focus on education, labour, research, innovation and large transitions in for example energy, industry and agriculture.
- In the Dutch Knowledge and Innovation Covenant (KIC)⁶⁸ both public and private actors specify their intended contribution to the Dutch mission oriented Topsector policy. This amounts to roughly €320 million public funds and €590 million private funds on climate and energy innovation.

Major activities in support of the Innovation Challenges in 2019/20

ACT ERA-NET cofund call (IC3)

Second call of €30 million to internationally accelerate CCUS technologies, with a reference to the MI-IC3 report on Priority Research Directions (PRDs). Projects have started from autumn 2019. Some of them address MI-IC3 PRDs. MI members: NO, DE, FR, NL (€4 million), UK, USA. Other: CH, ES, GR, RO, TR. Third call in preparation, where DK and the Canadian province of Alberta intend to participate as well. Relevant to MI-4 Objective: Demonstrating impact.

Biofuels (IC4)

The Netherlands actively participated in MI IC4, made the Dutch research community aware of the funding through the H2020 program and encouraged them to formulate proposals (which are currently being evaluated).

The Netherlands participated in the preparation of the BBEST/Biofuture Platform/IEA Bioenergy joint meeting about development of biofuel research and implementation, scheduled for the end of March 2020. Unfortunately this meeting is cancelled due to the Corona virus.

Comfort climate box (IC7)

The Netherlands has provided project-leadership to develop a prototype for a comfort climate box. So far 13 countries are involved, cooperation with MI members of IEA HPT/ECES network (UK, Austria, Sweden, Canada, Italy) and IEA member countries (USA, China, Germany, France, Turkey etc). The focus is heating in combination with cooling for the residential sector. Cooling only and larger systems are expected in follow up annexes/projects. Relevant to MI-4 Objective: Challenging Members and the Private Sector.

Hydrogen (IC8)

The Northern Netherlands has been selected by the Fuel Cell and Hydrogen Joint Undertaking (FCH JU) as the first European Hydrogen Valley. The region of the Northern Netherlands is also actively involved (on behalf of the whole of the Netherlands) in the efforts of FCH JU, Roland Berger and MI to establish a worldwide hydrogen valley platform and network. Also, The Netherlands has participated in workshop in the UK on blending of hydrogen.

⁶⁸ <https://www.topsectoren.nl/publicaties/kamerstukken/2019/november/12-11-19/kic-2020-2023>

Other Mission Innovation related activity in 2019/20

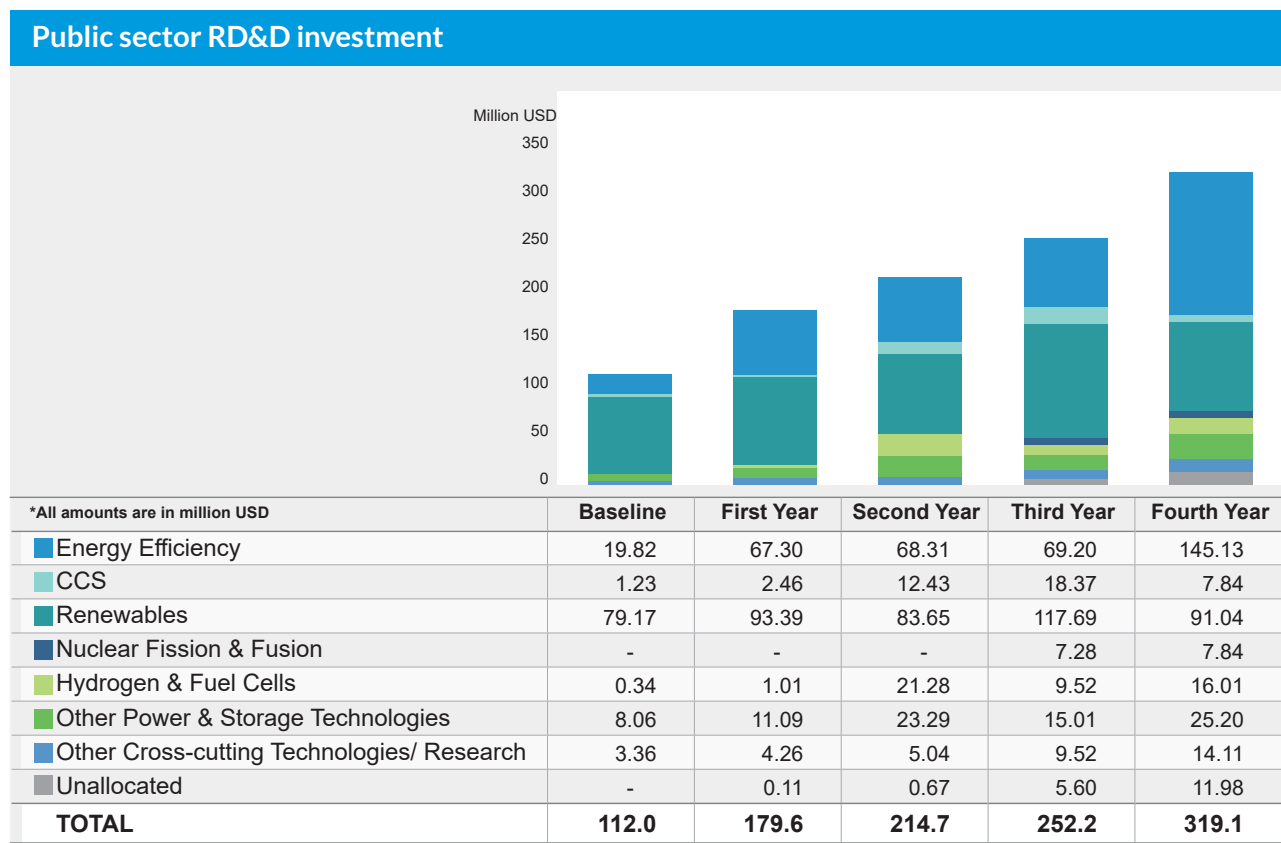
- The Netherlands has provided a voluntary contribution to Mission Innovation in order to facilitate the Beyond 2020 workstream.
- The Netherlands actively participates in the Beyond 2020 workstream.
- The Netherlands participated in the 2019 MI Champions program and continues its participation in 2020.
- We are investigating with the Communication Department of the Dutch Ministry of Economic Affairs and Climate Policy, how we can improve the promotion of Mission Innovation.

National plans and priorities for clean energy innovation

The Dutch energy innovation policy in the coming years will focus on the missions of the national Climate Agreement Through the Mission Oriented Knowledge and Innovation Agenda (IKIA). In doing so the innovation policy contributes to reducing national CO₂-emissions by 49% by 2030. The sectoral priorities are listed below:

Missions	With the following interim target(s)	MMIPs	
A. An entirely carbon-free electricity system by 2050	By 2030: <ul style="list-style-type: none"> • a minimum amount of 35 TWh of electricity will be produced on land each year using wind energy and solar energy >15kW; • at least 49 TWh of electricity will be generated by offshore wind energy. 	<ol style="list-style-type: none"> 1. Offshore renewable electricity 2. Renewable electricity generation on land and in the built environment 	13. A robust energy system supported by society
B. A carbon-free built environment by 2050	By 2030: <ul style="list-style-type: none"> • natural gas will be phased out of 200,000 existing homes per year; • 1.5 million homes and 15% of commercial buildings and public property will be natural gas free; • at least 20% of local energy consumption (incl. EV) within the built environment will be generated from renewable sources. 	<ol style="list-style-type: none"> 3. Acceleration of energy renovations in the built environment 4. Sustainable heating and cooling in the built environment (incl. glasshouse horticulture) 5. The new energy system in the balanced built environment 	
C. By 2050, raw materials, products and processes in industry will be net climate neutral and at least 80% circular	By 2030: <ul style="list-style-type: none"> • 50% fewer primary feedstocks will be used; • greenhouse gas emissions from production processes and the waste sector will have been reduced to approx. 36 Mt of CO₂ equivalent; • sustainability improvement of the industrial heat system up to 300°C will have been achieved; • electrification and reuse of CO/CO₂ will have been implemented; • CCS will be implemented in a cost-effective manner; • sustainable hydrogen production will be on the road to implementation; • bio-based raw materials will be seen as the norm. 	<ol style="list-style-type: none"> 6. Creating circular industrial chains 7. Carbon-free industrial heat system 8. Electrification and radically redesigned processes 	
D. Zero-emission mobility of people and goods by 2050	By 2030: <ul style="list-style-type: none"> • there will be 1.9 million electric vehicles; • 1/3 of all energy consumption in mobility will be renewable; • we will have reduced business mileage by 8 billion kilometres; • the 32 largest municipalities, at minimum, will have zero-emission zones for city logistics. 	<ol style="list-style-type: none"> 9. Innovative propulsion and use of sustainable energy carriers for mobility 10. Efficient transport movements for people and goods 	
E. By 2050, the agricultural and nature system will be net carbon-neutral	By 2030: <ul style="list-style-type: none"> • an additional reduction of at least 1 Mt CO₂ eq for methane, 1 Mt CO₂ eq for energy consumption in glasshouse horticulture and 1.5 Mt CO₂ eq through smarter land use will have been achieved. 	<ol style="list-style-type: none"> 11. Climate-neutral production of food and non-food 12. Optimal carbon capture and utilisation on land and water 	

Also, The Netherlands has developed an innovation program on hydrogen (as a cross-cutting theme), in line with the developing government vision on hydrogen and the developing government vision on the organization of the energy market. This program focusses on the development, demonstration and (especially) scale-up of hydrogen applications in different sectors.



This year's submission includes revised data for the years 2016-2018 (MI first until third-year) and new data for 2019 (MI fourth-year). This is different from previous submission, as previously only the spending of the new year has been added in the submission and data of previous years stayed untouched. This year further analysis has been done on the allocation of the spend against the categories provided which resulted in the revised dataset.

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
Canada, Morocco, Netherlands, Germany, Australia, (Pacific Islands, North Sea Islands).	IEA-PVPS Task 18 Microgrids & Edge of grid.	Task 18 will deal with off-grid electrical systems and edge-of-grid electrical systems which include photovoltaics. The task is led by Australia and Morocco and the task is still open for countries that can contribute cases and data. The short term deliverables this year 2020 are a comparison of levelized cost (LCOE) of Lithium battery storage in microgrids and an inventory plus evaluation of the existing tools for its design and economic feasibility.	Public-public	Research, best practice, accelerate roll out of microgrids.	2019 to 2023	Average 120,000 hours per year	https://iea-pvps.org/research-tasks/off-grid-and-edge-of-grid-photovoltaic-systems/
Austria, Canada, Denmark, France, Germany, Italy, Netherlands, Norway, Sweden	IEA-industry annex 19 - Electrification of industry	<ul style="list-style-type: none"> • to enhance international collaboration in the field of industrial electrification, and to set up and sustain a platform within IEA for sharing experiences and findings in R&D projects in the long term. • to improve the awareness of the topic of industrial electrification in participating and other IETS countries in course of identifying partners in participating and other IETS countries. • to identify and clarify areas of joint interest for further cooperation, in order to focus the subtasks and contents of a subsequent Task 2 and help to define annex and task leadership within that Task 2. • to elaborate a basic overview on ongoing activities, roadmaps, and areas of common interest. 	Public-public	Research	2019 to 2020	Participants finance their own activities	https://iea-industry.org/annexes/electrification-in-industry/

Canada, EC, India, Japan, Korea, Netherlands, Norway, Saudi Arabia, United States	CEM hydrogen initiative	<ul style="list-style-type: none"> The new Hydrogen Initiative will drive international collaboration on policies, programs and projects to accelerate the commercial deployment of hydrogen and fuel cell technologies across all sectors of the economy. It will aim to address barriers and identify opportunities for hydrogen in the global transformation to a clean, affordable and reliable energy sector looking at the global supply chains of this new energy vector. The new Hydrogen Initiative will focus on how hydrogen can contribute to cleaner energy systems, while promoting sustainability, resiliency and energy security. Initial work carried out through the initiative will focus on three different areas: <ol style="list-style-type: none"> Helping to ensure successful deployment of hydrogen within current industrial applications. Enabling deployment of hydrogen technologies in transport (e.g. freight, mass transit, light-rail, marine). Exploring the role of hydrogen in meeting the energy needs of communities. 	Public-public	Research, Development, Demonstration and Deployment	2019	NL has provided €100.000. Total budget not yet known	http://www.cleanenergyministerial.org/initiative-clean-energy-ministerial/hydrogen-initiative
Germany	Enhanced collaboration between Fraunhofer-Gesellschaft and TNO (applied research institutes)	Enhanced collaboration between Fraunhofer-Gesellschaft and TNO on AI and Intelligent Energy Networks. Still work in progress, will possibly result in a separate MoU (The Netherlands and Germany signed an MoU in 2019)	Public-public	Research	2019	Participants finance their own activities	
Germany	Electrochemical Conversion and Materials (ECCM)	An exploratory joint workshop will be held in the first half of 2020 with business, academia and government. The aim is to define joint calls or projects. This collaboration is linked to the trilateral collaboration between Flanders (in Belgium), Northrhine-Westfalia (in Germany) and the Netherlands.	Public-private	Research	2019	Participants finance their own activities	



NORWAY

Update on clean energy innovation policies and strategies

On June 4th 2020 the Norwegian Minister of Petroleum and Energy, Tina Bru, launched a **new national hydrogen strategy**. The strategy has been developed in cooperation between the Norwegian Ministry of Petroleum and Energy (MPE) and the Norwegian Ministry of Climate and Environment (MCE), and includes several initiatives which aim to help Norway achieve its goal of reducing 90 to 95% of its climate gas emissions compared to 1990 levels within 2050.

The strategy document addresses both production and use of hydrogen, in Norway and to some extent internationally. The maritime sector is, together with heavy transportation and industrial processes, touted as the most relevant sectors for use of hydrogen.

One of the relevant initiatives was the earmarking of **120 million NOK** for the ENERGIX-research program, with a priority for hydrogen-related research and development.

Major innovation initiatives and programmes in 2019/20

The biggest offshore wind farm in the World: In August 2019, the Norwegian government decided to support the development of **Hywind Tampen**, a floating offshore wind farm, with in total \$255 million (Nkr 2.3bn) through state enterprise ENOVA. When completed, this will be the world's first floating offshore wind farm supplying renewable power to offshore oil and gas installations. The Hywind Tampen project will contribute to further developing floating offshore wind technology and reducing the costs of future floating offshore wind farms. The project itself may also reduce CO₂ emissions by more than 200,000 tonnes per year, equivalent to emissions from 100,000 private cars.

New centres for energy research: In June 2019, Norway granted financing for two new research centres that look particularly at social sciences and the green energy transition. They complement eight national technological centres and are given funding for a period of up to eight years. In total, they will be granted about 200 million NOK during this period.

NTRANS is established to deliver world leading research on the energy system in the transition to the zero-emission society⁶⁹.

INCLUDE is a research centre that will produce knowledge about how to realise a socially just low-carbon society through socially inclusive processes and in close collaboration between researchers and partners in the public, private and voluntary sectors⁷⁰.

Private sector engagement in 2019/20

PILOT-E: Emission-free maritime transport and climate-neutral industry:

PILOT-E is a financing offer for the Norwegian business community, established by the Research Council, Innovation Norway and Enova. It is designed for the private sector and works like a "fast-track" through the stages of research; from idea to market.

The aim of the scheme is for completely new products and services in environmentally friendly energy technology to be more rapidly developed and used to contribute to reducing emissions both in Norway and internationally. In 2020, the fourth round of PILOT-E was launched; projects that can contribute towards emission-free maritime industry or climate-neutral industry were invited to apply.

⁶⁹ <https://www.ntnu.edu/ntrans>

⁷⁰ <https://www.sum.uio.no/english/include/>

Previously, PILOT-E has resulted in some impressive innovations. The all-electric sightseeing vessel "**Future of the fjords**" started operations in 2018. The 40m-long vessel carries up to 400 tourists in the fjord between Flam and Gudvangen, which is a UNESCO world heritage site. Another example is the development of **electric excavators**, as a part of the ambition to have **zero-emission construction sites**. This is a project that started in 2017 and such excavators are already being used in Oslo.

Other Mission Innovation related activity in 2019/20

Norway supports the second edition of **MI Champions** and our representative for the second cohort will be Annemie Wyckmans of NTNU University in Trondheim. Her field of expertise is research on smart and sustainable cities.

National plans and priorities for clean energy innovation

The Norwegian full-scale CCS project:

A very important priority for Norway in 2020 is to move forward with the our **full-scale CCS project**.

The Norwegian government has an ambition to realize a cost-effective solution for full-scale CO₂ management in Norway, given that this provides technology development in an international perspective. There are two alternative projects: Norcem Brevik may become the world's first cement factory equipped with a CO₂ capture plant. The other is Fortum that plans to capture CO₂ from their waste-to-energy plant in Oslo. This could become one of the first plants in the world to remove significant amounts of CO₂ from the carbon cycle as much of the waste is biogenic. Either way, this is one of the first industrial CCS projects to develop an open access infrastructure with the intent and the capacity to store significant volumes of CO₂ from across the European continent. An investment decision is expected soon⁷¹.

Public sector RD&D investment



*All amounts are in million USD	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	-	-	-	-	-
CCS	-	-	-	-	-
Renewables	-	-	-	-	-
Nuclear Fission & Fusion	-	-	-	-	-
Hydrogen & Fuel Cells	-	-	-	-	-
Other Power & Storage Technologies	-	-	-	-	-
Other Cross-cutting Technologies/ Research	-	-	-	-	-
Unallocated	128.65	195.36	153.09	211.6	387.66
TOTAL	128.7	195.4	153.1	211.2	387.7

⁷¹ <https://ccsnorway.com/>

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
Canada, France, India, Italy, the Netherlands, UK, USA, Germany, Denmark	ACT – Accelerating CCS technologies	ACT is an international initiative to facilitate RD&D and innovation within CO ₂ capture, transport, utilisation and storage (CCUS).	Public-private		2016 – ongoing Third call was announced in June 2020.	Approx. €30 million	http://www.act-ccs.eu/
China	Joint call with China	In 2019 Norway and China published a joint call within renewable energy research.	Public-private	Research and development	2019 to 2020	75 million NOK from Norway and a similar amount from China	



REPUBLIC OF KOREA

Impact of your national clean energy innovation activity

Establishing an Energy Transition Roadmap to expand the power generation ratio of renewable energy (October 2017).

The government plans to implement 3020 renewable energy schemes including the expansion of public participation and improvement of supply conditions to achieve 20% of the renewable energy generation ratio in 2030.

Announcement to promote a Hydrogen Economy Energy Roadmap to build a hydrogen industry ecosystem based on hydrogen cars and fuel cells.

Update on clean energy innovation policies and strategies

The main point of the 3rd Basic Energy Plan is to transform the energy consumption system of the supply-oriented into a high-efficiency and low-consumption structure through the innovation of the consumption structure.

The government target is to foster new industry/service and create jobs in the energy sector, by solving procurement matters and fulfilling the obligation to reduce greenhouse gas emissions under the Paris Agreement while maintaining stable energy supply and demand.

Five Major Challenges:

- 1 Strengthen demand management - 38% improvement in consumption efficiency and an 18.6% reduction in demand over 2017.
- 2 Transition to clean and safe energy mix - Increase the proportion of renewable energy generation by 30 to 35% by 2040.
- 3 Expansion of distributed and participatory energy systems - Distributed power expansion and power prosumer expansion, etc.
- 4 Strengthening the global competitiveness of the energy industry - Promoting future energy industries such as renewable energy
- 5 Expansion of the Foundation for Energy Conversion - Building an energy big data platform and improving the power market system, etc.

Major innovation initiatives and programmes in 2019/20

The Ministry of Trade, Industry and Energy (MOTIE) plans to continue to increase investment related to energy technology development.

In 2019, the government invested \$651 million to develop energy technologies to strengthen the competitiveness of renewable energy technologies, industries, and market.

Through the development of energy technology, Korea achieved the world's highest efficiency in next-generation solar cells, succeeded in localization of 270MW large gas turbines, and developed 10 times the efficiency of particulate matter gathering in thermal power plants.

The government plans to invest \$774 million in energy technology development in 2020.

Private sector engagement in 2019/20

2019 Investment Road Show

The Korea Institute of Energy Technology Evaluation and Planning (as below 'KETEP') and the Venture Capital Association promotes the Investment Road Show program for SME in 2019.

Through evaluation, small and medium-sized enterprises were selected. KETEP supports investment attraction strategies, consulting, and investment counselling.

The Investment Road Show has successfully attracted a total of \$10 million over the past two years and is also promoting a program to link domestic and foreign investment institutions belonging to the Council of Foreign Investment Institutions.

Energy Convergence Complex Plan

The MOTIE plans to designate the Energy Convergence Complexes in Saemangeum district and Gwangju/ South Jeolla area. It could simultaneously promote regional decentralization and fostering new industries, one of the key Energy Transition policies, in November 2019.

Energy convergence complex: A cluster consisting of energy-specialized companies, research institutes, universities, support agencies, energy public enterprises, energy supply facilities (such as power plants), demonstration, and testing facilities to promote the aggregation and convergence of the energy industry and related industries.

Major activities in support of the Innovation Challenges in 2019/20

The Republic of Korea has been participating in the Innovation Challenge, a group of experts in clean energy technology, since November 2016 to clarify the implementation of mission innovation.

At the 4th MI Ministerial meeting in Canada, Korea declared its participation in the Hydrogen IC and participated in 6 of the total 8 ICs.

The KETEP funds MI-oriented international joint research projects from Dec 2018 to Jan 2021. The budget is around \$1 million per project every year. This is delivered in cooperation with the USA, Canada, Germany, and India. KETEP funds a total of eight projects in the field of innovation challenges and conducting various activities such as joint workshops, manpower dispatch, joint thesis discussion, research sample exchange, and demonstration plant visits.

16 major energy-focused technologies, including solar energy, wind power, hydrogen, etc, are presented to promote the main point of the basic energy plan. Also, 50 tasks are drawn up according to the technology Roadmap of each field.

National plans and priorities for clean energy innovation

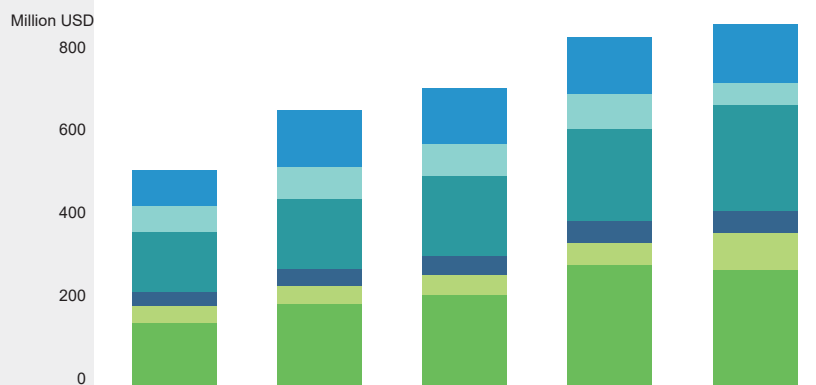
The 4th Energy Technology Development Plan.

The MOTIE announced the 4th Energy Technology Development Plan in 2019 which includes the vision, goals, and R&D investment strategies for the next 10 years.

The Korean government has effectively supported Energy Transition and presented a key strategy for the mid/ long-term energy policy goals under the vision of becoming an energy technology powerhouse for leading new industries over the world.

16 major energy-focused technologies, including solar energy, wind power, hydrogen, etc, are presented to promote the main point of the basic energy plan. Also, 50 tasks are drawn up according to the technology Roadmap of each field.

Public sector RD&D investment



*All amounts are in million USD

	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	77.32	128.84	129.83	125.92	143.15
CCS	56.61	71.80	73.05	77.63	55.57
Renewables	130.63	159.64	177.99	202.94	231.26
Nuclear Fission & Fusion	31.78	35.81	41.95	45.43	61.24
Hydrogen & Fuel Cells	38.04	43.89	46.61	50.10	77.57
Other Power & Storage Technologies	146.64	192.17	216.21	272.79	252.16
Other Cross-cutting Technologies/ Research	-	-	-	-	-
Unallocated	-	-	-	-	-
TOTAL	481.0	632.2	685.6	774.8	820.9

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors (public-public; public-private)	Type of Collaboration	Duration	Funding amount (Ten thousand won)
Canada	MI Joint Call on Clean Energy Technologies	Korea launches a program to support all MI Innovation Challenges with annual funding. To participate in the program, researchers of member countries with partnered Korean researchers can apply with any subject related to any IC. The focus of this program is to support activate	Pu/Pr - Pu	Research	2018 to 2021	27.6
US			Pu/Pr - Pu	Demonstration		19.4
US			Pu/Pr - Pu/Pr	Research		27.5
India			Pu/Pr - Pu	Demonstration		25.3
Germany			Pu/Pr - Pr	Research		27.3
Germany			Pu/Pr - Pu	Research		29.1
Canada			Pu/Pr - Pu	Research		19.2
US			Pu/Pr - Pu	Research		27.6

SAUDI ARABIA

Update on clean energy innovation policies and strategies

The National Industrial Development and Logistics Program (NIDLP) was launched in January 2019 as a part of the 2030 Vision. The program is mandated to transform the Kingdom of Saudi Arabia into a leading industrial powerhouse and a global logistics hub in promising growth. The program has a research, development, and innovation (R&DI) section that includes oil and gas R&DI including carbon capture, utilization, and storage.

Major innovation initiatives and programmes in 2019/20

- Saudi Arabia Basic Industries Corporation (SABIC) is developing a process to utilize CO₂ to produce acrylic acid by catalytic coupling of CO₂ and ethylene. The main advantages of this process are
 - (i) the CO₂ represents ~60% of the final product mass and
 - (ii) it will lead to the avoidance of the feedstock loss, by over-oxidation, in the current commercial technology to produce acrylic acid via propylene oxidation.
- SABIC is developing a technology to produce hydrogen from water splitting. Solar H₂ production from water could be the key to a sustainable energy economy with wide environmental, economic and social impacts. H₂ is commercially made mainly from natural gas or coal reforming, where 8kg of CO₂ is produced for every 1 kg of hydrogen made.

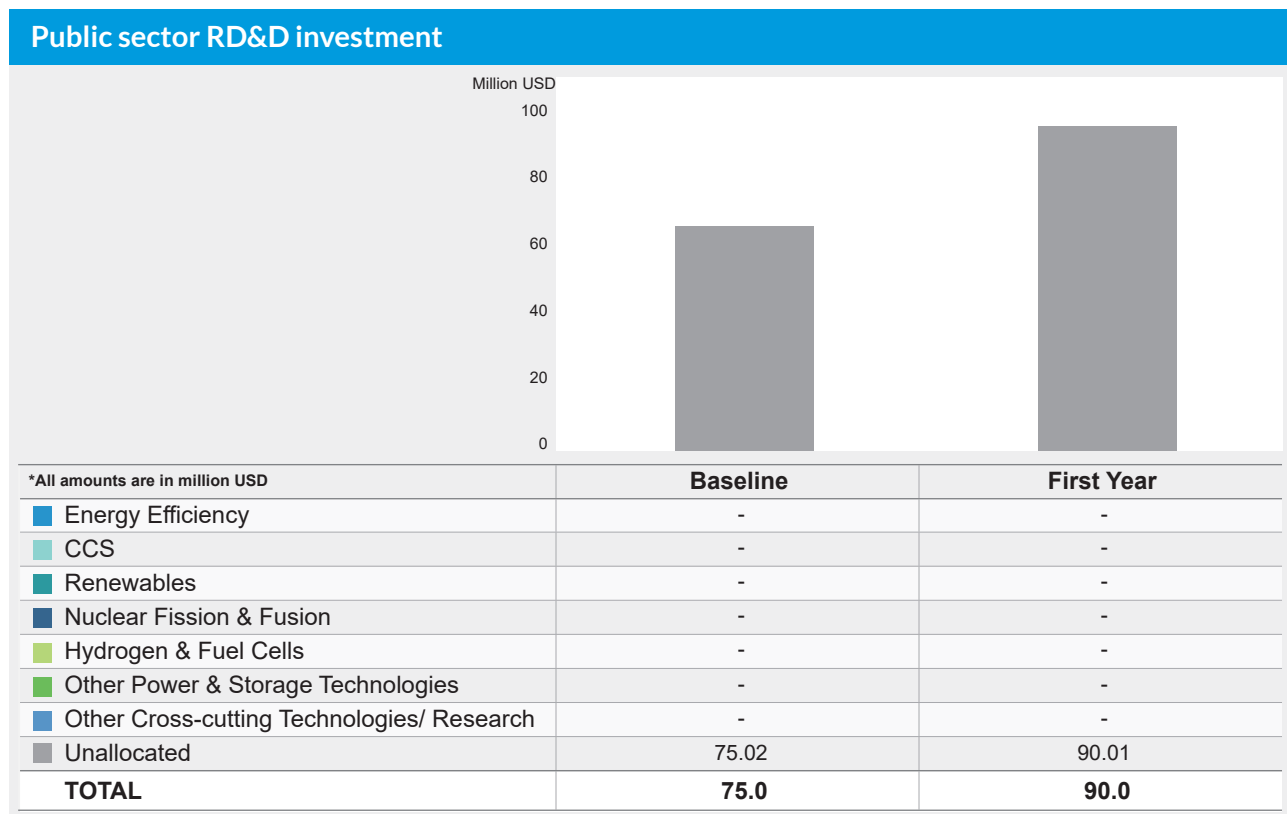
Major activities in support of the Innovation Challenges in 2019/20

Saudi Arabia is working with the United Kingdom, Mexico, and Norway to identify innovation opportunities in higher technology readiness levels that are of particular interest to industry partners. A workshop took place in June 2019 bringing together CO₂ capture, utilisation and storage (CCUS) experts from academia and industry partners in the oil and gas, power, and energy intensives industries to build and complement the IC3 CCUS report with technological challenges that have the potential to accelerated CCUS deployment. A summary report was released in October 2019, looking at six CCUS technology areas including decarbonising industry and the role of CCS in enabling low carbon hydrogen.

Other Mission Innovation related activity in 2019/20

The Kingdom of Saudi Arabia hosted MI member representatives met in Riyadh in February 2020. As the initiative enters its fifth year, this was a pivotal moment to look back on impact and progress to date, to discuss future trends and challenges in the global innovation landscape and to explore options for the future of MI.

Saudi Arabia will host the Fifth Mission Innovation Ministerial meeting in September 2020.





SWEDEN

High impact innovation activity triggered by MI

- Increased efforts for connecting start-ups with investors.
- Increased efforts on long-term, researcher-initiated clean energy research.
- The Avoided Emissions Framework.
- The participation in the MICalls.
- Increased Swedish activities on heating and cooling for IC7 and relevant IEA TCP's.

Impact of your national clean energy innovation activity

The Swedish efforts on clean energy research and innovation consist of several different programmes. One of the largest is the Energy R&I Programme of the Swedish Energy Agency; with a budget of about 1,500 million SEK in 2019. The programme is regularly reported and followed up in the governments annual budget bill; e.g. as to quality and quantity, resulting scientific papers, doctoral dissertations, pilot and demonstration results etc.

Individual programmes within the SEA activities are regularly evaluated.

The activities with Strategic Innovation Programmes have been evaluated with good results.

The efforts on innovation and product development support for SME's were evaluated during 2019 with good results.

The general development of the Swedish energy systems is reported annually in the publication on energy indicators (Energiindikatorer).

Update on clean energy innovation policies and strategies

The Swedish Parliament has set the following goals:

- The Swedish electricity supply should be 100 % renewable by 2040.
- The energy use should be 50% more efficient by 2030 relative to 2005, in terms relative to the GDP.
- Net zero Swedish emissions of Greenhouse gases to the atmosphere in 2045; negative net emissions thereafter.

An agreement between four political parties form the basis of the government, and includes action like the following:

- Easier and more profitable to invest in renewable energy for your own use, e.g. in solar PV and solar heating, or in sea-based wind power.
- Taxes on work and commercial activities to be lowered in exchange for increased environmental taxes.
- Infrastructure for charging and for filling vehicles with fossil free fuels are to be expanded.
- Investment support for pilot plants achieving negative climate emissions to be implemented.
- Sale of petrol or diesel-powered cars should not be allowed after 2030.

The stated ambition of the Government is that Sweden should be the first fossil-free developed nation.

During 2020, the government plans to submit a bill on research and innovation policy, and a separate one on energy research and innovation policy.

Major innovation initiatives and programmes in 2019/20

Support for technology to reduce the GHG emissions of the process industry was established in 2017 with an annual budget of 300 million SEK. For 2019, the budget was increased to 600 million SEK per annum, including 100 million SEK for pilot projects to achieve negative CO₂ emissions.

The Swedish National Energy Research and Innovation Programme is administered by the Swedish Energy Agency (SEA) and is focused on clean and efficient, sustainable energy solutions, products and services. The budget for 2018 was about 1.55 billion SEK; a slight increase.

The support to small and medium sized companies for product development and innovation was evaluated during 2019 with excellent results.

Contributions to the capital of the GreenTech Venture Capital Fund continues to be added.

The government Innovation Partnership Programmes will be continued and expanded.

Three R&I funding agencies collaborate on a programme of Strategic Innovation Programmes. Among the programmes are Re:Source (on solutions for circular materials flow, reducing waste and energy use) and Viable Cities (aiming to have nine Swedish climate neutral cities or communities by 2030).

Several conferences and workshops to connect innovative companies with venture capital have been arranged; among them the Swedish SustainTech Venture Day, and the Cleantech Forum 2019.

Private sector engagement in 2019/20

The programme on energy research and innovation has, in itself, substantial collaboration and co-financing from industry and other stakeholders. The total project budgets are provided by the Swedish Energy Agency to 43% and by other stakeholders by 57%. I.e. the total amount paid out from the Programme in 2019 was 1,247 million SEK; corresponding to a total project budget of 2,900 million SEK.

The part of the programme focusing on innovation and product development for SME's are entirely targeted on the private sector.

The investments from the Green Innovation Fund goes to the private sector.

The so-called Strategic Innovation Programmes, some of which addresses energy issues, rests on the active engagement and participation of the private sector.

Major activities in support of the Innovation Challenges in 2019/20

Sweden participates actively in IC1, IC5 and IC7; and follows the work in IC2, IC4 and IC6.

In IC5, Sweden has worked with EC to develop a global roadmap for solar fuels (in progress). An Action Plan of fundable R&D activities has been published

Sweden participates in the implementation of the MICalls and leads the work together with Austria.

Sweden contributes with the Avoided Emissions Framework project.

Sweden contributes actively to the UN global leadership group on climate transition in heavy industry.

Sweden has carried out two innovation competition in the A Challenge from Sweden programme. The second led to three winners being announced in the summer of 2019. The programme and its approach to the promotion of innovation is now under evaluation.

Robert Andrén, the Director General of the Swedish Energy Agency, is currently a vice chair of the MI Steering Committee.

Other Mission Innovation related activity in 2019/20

The Government has given the Swedish Energy Agency the special task of promoting private investments in new products, services and innovations. This has a direct relation to the MI. Partly as a result, Breakthrough Energy Ventures has invested in the Swedish company Climeon.

In February 2019, the SEA arranged the Sweden Sustaintech Venture Day with the aim of connecting innovative SME's with investors. The event was planned for 70 investors, but more than 200 turned up.

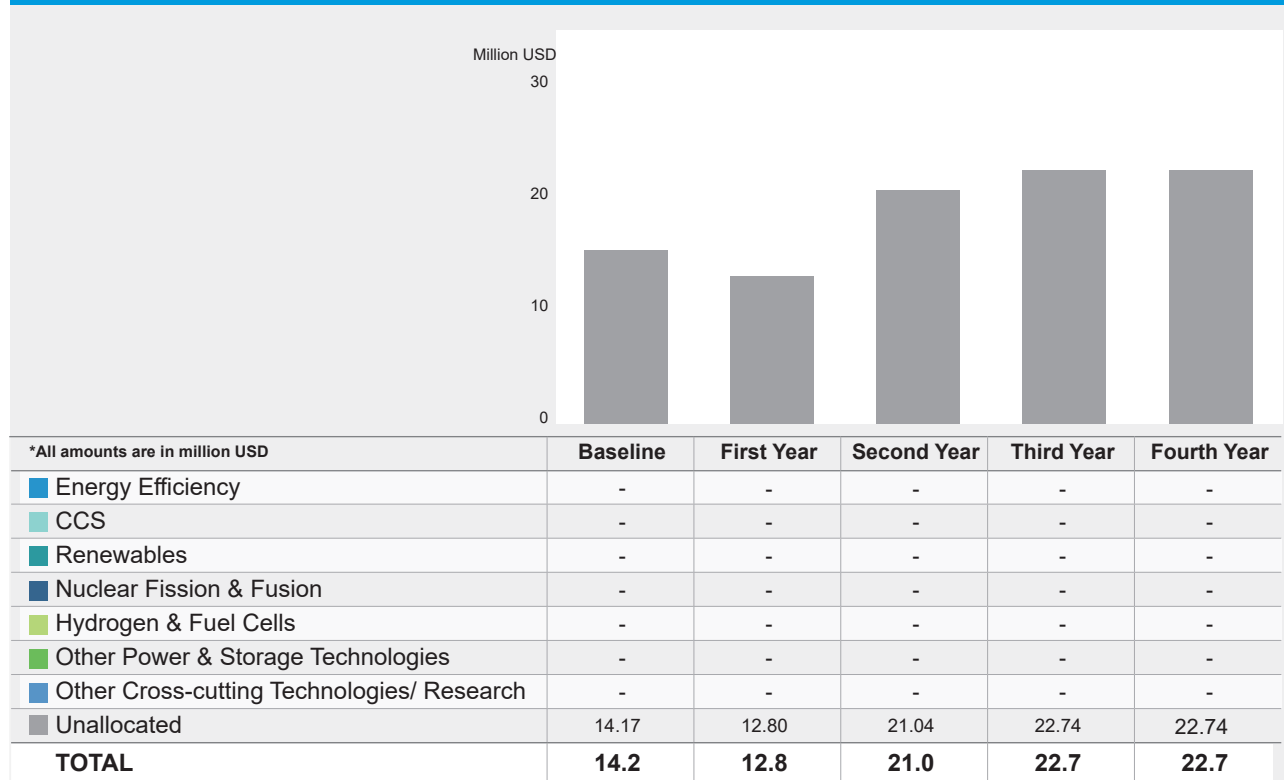
In May 2019, the Swedish Energy Agency was the host of the Cleantech Forum. The meeting was held in Stockholm and gave the opportunity for more than 400 non-Swedish investors to meet Swedish industry as well as more than 40 Swedish start-ups.

Sweden has participated in the first year of the MI Champions programme.

National plans and priorities for clean energy innovation

In 2020, the Government will present a bill on Research and Innovation Policy for the period 2021 – 2024. A parallel bill on Energy Research and Innovation for 2021 – 2024 is also planned. Resources, focus areas, etc. will be discussed and proposed in these bills.

Public sector RD&D investment



Please note that the figures are for spending, i.e. actual payments. The budget has increased more than this, but it takes time to start pilot- and demonstration projects on large-scale solutions; e.g. on emissions from industry or on technology for negative emissions. For example, the budget for these two efforts in “The Industry Step” was 600 million SEK in 2019, but only about 100 million SEK was actually used during the year.

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
SE, EC, IT, UK, NL, FR, US, NO, KR, CH, JP, FI, AT, DE, DK, CA, BE IEA HPT & ECES collaboration with IC7	Comfort & Climate Box	Integrated systems consisting of heat pumps and storage are an important technological option to accelerate the use of renewable energy for heating and cooling.	Public-private	Research and innovation	Q4 2018 to Q2 2021	€530 000 SE budget	https://heatpumpingtechnologies.org/annexes/ideas-and-proposals/
SE, AT, DE, DK, FI, IN, UK, IT	MICall	Joint R&D call for projects on energy storage solutions	Public-private	Research, development, demonstration and innovation	Q2 2019 to Q4 2023	€22.5M total, €2M SE budget	https://www.ernet-smartenergysystems.eu/Calls/SG_Plus_Calls/SG_Joint_Call_2019
EU countries	Battery 2030+	SE coordinates EU Large-scale Research Initiative on battery research https://battery2030.eu/	Public-public; public-private	Large-Scale, Long-Term Research	2019 - ongoing	€22.5M total, €2M SE budget	https://ec.europa.eu/digital-single-market/en/news/battery-2030-inventing-batteries-future
IC5, EC: 8 MI countries	SUNRISE merging efforts with CSA ENERGY-X to the joint initiative on SUN-ERGY	SE participates in EU Large-scale Research Initiative on the production of fuel and chemicals from sunlight. https://sunriseaction.com/	Public-public	Large-Scale, Long-Term Research	2019 to 2020 (first step)	2019 to 2020 (first step) €1M from the EC	https://docs.wixstatic.com/ugd/8993fb_d548a65940774debaf4645423c6f83a.pdf



UNITED ARAB EMIRATES

Update on clean energy innovation policies and strategies

Energy Strategy 2050: In 2017, the UAE launched 'Energy Strategy 2050', which is considered the first unified energy strategy in the country that is based on supply and demand. The strategy aims to increase the contribution of clean energy in the total energy mix 50% by 2050 and reduce carbon footprint of power generation by 70%. It also seeks to increase consumption efficiency of individuals and corporates by 40%.

National Climate Change Plan 2050: National Climate Change Plan of the UAE 2017–2050⁷² is the UAE's comprehensive framework to address the causes and impacts of climate change, plan the transition into a climate resilient green economy and achieve a better quality of life. The primary objectives of the Climate Plan are to: manage greenhouse gas (GHG) emissions while sustaining economic growth, minimise risks and improve capacity of adaptation to climate change, and enhance the UAE's economic diversification agenda through innovative solutions.

National Strategy for Advanced Innovation: In February 2018, the UAE government approved the National Strategy for Advanced Innovation. The new strategy is the updated version of the National Innovation Strategy⁷³ and marks a new phase that is based on enabling people to shift from focusing on vital sectors to the goals and outcomes in seven areas: exploration, future skills, quality of health, living and life, green power, transport, harnessing technology to serve humankind.

The innovation strategy aims to position the UAE among the world's top leaders of innovation and to develop a type of thinking that encourages experimentation and taking well-thought-out risks to achieve the goals of UAE Centennial 2071⁷⁴.

National Advanced Sciences Agenda 2031: In April 2018, the UAE government launched the National Advanced Sciences Agenda 2031 and the 2021 Advanced Science Strategy, which falls under the Agenda 2031. The 2031 Agenda aims to utilize advanced sciences in the development and creation of solutions to future challenges and support the government's efforts to achieve the objectives of Vision 2021 and Centennial Plan 2071 through three consecutive strategies starting with 2021 Advanced Science Strategy. The 2031 Agenda sets out eight scientific priorities up to 2031 and 30 scientific targets up to 2021. The eight scientific priorities aim to make the most of all strategic natural resources in the country through: national capacity-building, promoting the sustainable energy sector, enhancing water security using advanced and clean technology, developing advanced scientific food security system, addressing health challenges in the UAE through a national scientific system, developing advanced industries sector, building a system of logistical support based on scientific studies and data, creating a strategic industries complex.

Major innovation initiatives and programmes in 2019/20

The UAE government and XPRIZE will invest \$81 million towards research and development of new technologies as part of the Ghadan 21 programme. The programme will direct \$13.6 billion to accelerate the Abu Dhabi economy through digital technologies, new business models and partnerships with local, regional and international players in various industries. The \$81 million Ghadan investment will be directed towards research and development of solutions to address water scarcity, energy efficiency, food security, artificial intelligence, human ageing, and environmental conservation.

In 2017, Abu Dhabi fund Mubadala announced plans for its Aerospace, Renewables & ICT platform to invest a further AED82.5 million (\$22.4 million) in research and development (R&D) over the next five years.

⁷² [https://government.ae/en/information-and-services/environment-and-energy/climate-change/-/media/Information-and-services/Environment-and-Energy/Updated_NCCP-2017-2050_English-\(1\).ashx?la=en](https://government.ae/en/information-and-services/environment-and-energy/climate-change/-/media/Information-and-services/Environment-and-Energy/Updated_NCCP-2017-2050_English-(1).ashx?la=en)

⁷³ <https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/national-innovation-strategy>

⁷⁴ <https://government.ae/en/more/uae-future/2030-2117#centennial-plan-2071>

Solar Decathlon Middle East is a collegiate competition of 10 contests that challenge students to design and build solar-powered houses. On June 17, 2015, the Dubai Supreme Council of Energy, Dubai Electricity and Water Authority, and the U.S. Department of Energy signed an agreement to collaborate on the development of Solar Decathlon Middle East (SDME 2018-2020), a competition that will integrate unique local and regional characteristics. In 2018, 18 university teams from 16 countries competing at Solar Decathlon.

In 2014, DEWA launched the R&D Centre in Mohammed bin Rashid Al Maktoum Solar Park, which focuses on four key operations: producing electricity using solar energy, integration of smart grids, energy efficiency, and water. 500 AED million is being dedicated towards the R&D and the Centre will be ready in 2020.

From its inception in 1971 up to December 2018, Abu Dhabi Fund for Development (ADFD), the leading national entity for international development aid, has financed hundreds of development projects in the renewable energy sector around the world worth AED4.4 billion (US\$1.187 billion). Driving the objectives of the United Nations' Sustainable Development Goals (SDGs), these projects have contributed to the production of about 2,584 MW of renewable energy in different countries. Since 1974, ADFD has contributed to financing about AED2.7 billion (US\$737 million) in renewable energy projects through joint financing agreements with the governments of many developing countries. The remaining funds were allocated through innovative and strategic partnerships including the seven-cycle AED1.285 billion (US\$350 million) IRENA/ADFD Project Facility, the AED183.4 million (US\$50 million) UAE-Caribbean Renewable Energy Fund (UAE-CREF), as well as the UAE-Pacific Partnership Fund (UAE-PPF) valued at AED183.4 million (US\$50 million). In addition to supporting sustainable development in key socio-economic sectors, ADFD has funded important renewable energy projects. Notable projects include:

Sheikh Zayed Solar Power Complex in Jordan

In line with the Jordanian government's objective of generating 20 per cent of energy from renewables by early-2020, ADFD contributed AED550 million (US\$150 million) to funding the Sheikh Zayed Solar Power Complex. The project involved the installation of 328,320 photovoltaic panels that will produce 227 GWh of solar power annually over a period of 20 years, enough to illuminate about 50,000 homes.

Project works included the provision of electrical switches, a medium voltage and signal cable system, transformers and all required equipment to connect the plant to the national power grid. The support also covered civil construction works, roads and safety systems as well as overall project operation and management.

The plant contributed to the creation of about 1,000 jobs during the construction phase and is set to provide 30 permanent jobs for its sustained operation and maintenance.

Upper Atbara and Setit Dam Complex in Sudan

ADFD allocated a US\$90 million concessionary loan and contributed to the construction of the Upper Atbara and Setit Dam Complex in Eastern Sudan. With a storage capacity of 2.7 billion cubic metres of water, the twin dams provide the hydroelectric power plant with enough power to generate 320 megawatts of electricity.

Merowe Dam in Sudan

ADFD provided AED735 million for the construction of the Merowe Dam in north Sudan. One of the largest hydropower projects in Africa and the second major hydropower project in Sudan, this strategic project helps the country fill its power deficit by producing electricity totalling 1,250 megawatts – benefitting more than 30 million people.

Located nearly 350 km north of the capital Khartoum, the dam is about 1.1 km across the river and is 9 km long and 60 metres tall. The project included all the necessary civil works including the power plant to accommodate 10 generators, each with a capacity of 125 megawatts, and the electromechanical works. The works also comprised the transmission lines and connectivity to the national grid.

Waste-to-energy facility in the emirate of Sharjah

ADFD allocated an AED121 million (US\$33 million) concessionary loan for the development of a waste-to-energy facility in the emirate of Sharjah.

Expected to treat more than 300,000 tonnes of municipal solid waste (MSW) each year, or 37.5 tonnes per hour, the plant will have the capacity to generate around 30 megawatts of energy. Due for completion by early 2021, the facility aims to help attain Sharjah's zero-waste-to-landfill target and the UAE's objective of diverting 75 per cent of its municipal solid waste from landfills by 2021.

Producing electricity using wind power in Seychelles

In the Republic of Seychelles, ADFD allocated AED103 million (US\$28 million) to produce clean electricity using wind turbine technology.

Known for being costly to operate and maintain as well as harmful to the environment, diesel-powered electrical power plants were replaced with wind power. This project included the supply, installation and activation of wind turbine farms for electric power generation in several different areas of the island of Mahé.

Eight farms were built to generate between 4 to 6 MW of electrical power. The project also included maintenance and the development of the transmission network, as well as technical services for the studies of wind power and project management.

IRENA/ADFD Project Facility

In 2013, ADFD committed US\$350 million over seven funding cycles for the IRENA/ADFD Project Facility. After the announcement of the sixth funding cycle in January 2019, the cumulative funding to date is US\$245 million. The Facility helps developing countries access low-cost capital for renewable energy projects to increase energy access, improve livelihoods and advance sustainable development.

Since the selection of projects for the first cycle in 2014, ADFD's funding has benefitted 24 renewable energy projects in 23 countries, covering up to 50 per cent of the total project costs. They will bring more than 157 megawatts of renewable energy capacity online and create electricity access for over seven million people, significantly improving their livelihoods. Spanning Asia, Africa, Latin America and Small Island Developing States, the projects encompass a broad spectrum of renewable energy sources – wind, solar, hydro, geothermal and biomass – and technologies.

In 2019, the sixth cycle of this Project Facility has approved projects worth \$31 Million USD with the following projects:

In **Guyana**, a project will receive a loan of US\$8 million to install 5.2 megawatt (MW) grid-connected solar PV systems in the hinterland regions to reduce fossil fuel consumption and increase the reliability of electricity supply. An estimated 34,700 people in the target areas will benefit and around 120 direct and indirect jobs are set to be created throughout the project lifecycle.

In **Liberia**, the loan of US\$8 million will contribute to the construction of a 2.1 MW run-of-river hydropower plant on the Gee River. The project will benefit over 30,000 people through providing a clean, reliable and affordable source of energy to households, schools, health facilities and small businesses, enhancing living conditions and helping to reduce poverty.

In **Togo**, a 30 MW grid-connected solar PV plant will be constructed with the investment of a US\$15 million loan. The project aims to bring clean, reliable power to around 700,000 households and small businesses and reduce greenhouse gas emissions by 9,242 tonnes/year. Local communities will benefit from greater access to drinking water, education and healthcare as well as job creation that prioritises women.

UAE-Caribbean Renewable Energy Fund (UAE-CREF)

Launched at Abu Dhabi Sustainability Week 2017, UAE-CREF aims to deploy renewable energy projects with a capacity of 11 MW in 16 Caribbean countries to help reduce reliance on fossil fuel imports, stimulate economic activity and enhance climate change resilience. The fund is also a testament to the UAE's efforts to advance the UN Sustainable Development Goals.

At Abu Dhabi Sustainability Week 2019, the third cycle of the US\$50 million UAE-Caribbean Renewable Energy Fund (CREF), was allocated to projects delivered in Jamaica, Cuba, Suriname, Trinidad & Tobago.

UAE-Pacific Partnership Fund (UAE-PPF)

ADFD earmarked US\$50 million in funding to the UAE-Pacific Partnership Fund (UAE-PPF), a pillar of the UAE's wider strategy to support sustainable development projects around the globe through the deployment of renewable energy, with the supervision of the UAE's Ministry of Foreign Affairs and International Cooperation. Abu Dhabi Future Energy Company, Masdar was appointed to develop and implement renewable energy projects in 11 countries under UAE-PPF.

The first cycle of UAE-PPF funding enabled the completion of small-scale solar and wind power projects in Kiribati, Fiji, Samoa, Tonga, Tuvalu and Vanuatu. The project deliverables included cyclone-proof wind turbines and space-optimising solar power solutions. In some cases, the installed projects met as much as 50% of local power requirements.

In May 2016, phase 2 of UAE-PPF supported the delivery of renewable energy projects in the Solomon Islands, Nauru, the Marshall Islands, Palau and the Federated States of Micronesia – with a combined power generating capacity of 3.25 megawatts, displacing more than 4,000 tonnes of carbon dioxide annually, and reducing diesel imports by as much as 1.5 million litres per year.

In 2019, the Abu Dhabi Sustainable Finance Declaration (the Declaration) was signed by 25 public and private sector entities at the inaugural Abu Dhabi Sustainable Finance Forum (ADSFF) on 16 January as an united front to foster positive economic, social and environmental impacts and advocate sustainable finance and investments for the long-term well-being and growth of the country's economy.

UAE is host to the world's largest battery bank in Abu Dhabi, with a capacity of 108 megawatts distributed over 10 sites across the emirate. We believe storage has tremendous potential in the long term.

In 2019, DEWA launched its first Smart Grid Station (SGS) which comprises a 200-kilowatt (kW) photovoltaic solar power production system; a 9-kilowatt (kW) wind turbine; and a 500-kilowatt hour (kWh) lithium-ion battery energy storage system, which stores energy for later use. The station also includes over 2,000 sensors based on the Internet of Things (IoT) technology, and smart meters distributed throughout the facility to monitor power and water demand data in real-time for the purpose of improved energy and water management, with the potential to reduce demand when required by eliminating non-critical loads through smart lighting, smart power outlets, and smart air conditioning system.

Masdar and Bee'ah launched the Bee'ah Waste Management Center in Sharjah, the new plant will process more than 37.5 tonnes of municipal solid waste (MSW) per hour to generate electricity sustainably. Once operational, it will contribute significantly to reaching the UAE's target of diverting 75 per cent of its solid waste from landfills by 2021, as well as Sharjah's zero-waste-to-landfill goal.

Major activities in support of the Innovation Challenges in 2019/20

As co-leads of the Affordable Heating and Cooling in buildings Challenge along with the United Kingdom and the European Commission, the UAE is proud of the progress of this challenge which comes as a result of the efforts of the co-leading countries as well as India, Sweden and Australia, who have provided substantial support along with the member countries that have actively participated.

The UAE is pleased to have hosted the first workshop for IC7 which was held in November 2017 in its capital, Abu Dhabi. This IC7 workshop brought together 70 international experts from 13 countries to discuss the priority areas in Heating and Cooling and develop ideas and actions moving forward. The workshop provided the necessary platform for experts to discuss ideas for technological advancements and resulted in innovative ideas and research actions that aim for the development of commercially viable solutions.

The UAE is championing one of the main priority areas under IC7; Alternative Heat Sinks and Sources.

A conference call was hosted by the UAE in April 2019 to discuss progress and actions moving forward with different member countries.

Public sector RD&D investment

Million USD

14
12
10
8
6
4
2
0



*All amounts are in million USD

	Baseline	First Year
Energy Efficiency	-	-
CCS	-	-
Renewables	-	-
Nuclear Fission & Fusion	-	-
Hydrogen & Fuel Cells	-	-
Other Power & Storage Technologies	-	-
Other Cross-cutting Technologies/ Research	-	-
Unallocated	10.00	12.20
TOTAL	10.0	12.2



UNITED KINGDOM

High impact innovation activity triggered by MI

Power Forward Challenge: UK-Canada joint challenge on smart energy systems innovation

Through the Power Forward Challenge, the UK and Canada are jointly offering over £11 million to develop the best smart energy systems for the 21st Century with the aim of having pilot-scale demonstrations by December 2020.

This funding competition is a result of the relationships and understanding of mutual priorities that have been developed between the UK and Canada through MI. As a result of this relationship, in September 2017, the Prime Ministers of the UK and Canada agreed a Clean Growth and Climate Change Partnership, and the joint Power Forward challenge was announced at the 3rd MI Ministerial.

The challenge has generated significant interest on both sides of the Atlantic with 21 UK and Canadian companies funded for the Phase 1 feasibility studies. New collaborations include; the Maple project which is exploring the feasibility of exporting smart demand balancing controls systems domestic hybrid heat pumps to Canada, or the OpenFlex project which is bringing proven smart grid and smart home technology from Canada to the UK, taking advantage of the new UK smart metering infrastructure. In phase 2, project teams can apply for up to £1.8 million (C\$3m) per project for demonstration projects in the UK or Canada.

Impact of your national clean energy innovation activity

Innovation has been critical in driving down the costs of clean energy technologies.

- Energy efficient light bulbs over **80%** cheaper than 2010.
- The price of Lithium-ion batteries has fallen by **85%** since 2010 and is expected to more than halve again by 2030 according to industry experts.
- Offshore wind costs fallen by **two thirds** between 2015 and 2019.

The BEIS Energy Innovation Programme Impact so far:

- £505 million portfolio fully committed.
- **Over 700 organisations** supported.
- On average each Programme achieves **match funding of ~40%** from the private sector.

Update on clean energy innovation policies and strategies

In June 2019, the UK became the first major economy to legally commit the UK to reaching **Net Zero by 2050**⁷⁵. The UK has already reduced emissions by 42% while growing the economy by 72% and has put clean growth at the heart of industrial strategy. Innovation is essential to this goal, as it nurtures better products, processes, and systems, driving down the cost of clean technologies. This increases their accessibility and attractiveness, enabling clean technologies to deliver economic gains whilst generating significantly lower emissions.

The UK supports energy innovation through the BEIS Energy Innovation Programme (EIP), the UK Research and Innovation Councils, the Faraday Challenge and a range of department specific funds in BEIS, DfT, DfID and more. The BEIS EIP now expects to invest more than £3bn in low carbon energy innovation, higher than the £2.5bn set out in the 2017 Clean Growth Strategy⁷⁶.

⁷⁵ <https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law>

⁷⁶ <https://www.gov.uk/guidance/energy-innovation#history>

Major innovation initiatives and programmes in 2019/20

BEIS Energy Innovation Programme (EIP)

- The UK now expect to invest more than £3 billion in energy R&D and innovation between 2016 and 2021.
- As part of the UK government's £3 billion investment, the current £505 million Department for Business, Energy & Industrial Strategy's (BEIS) Energy Innovation Programme is investing: £70 million in smart systems; £90 million in the built environment; £100 million for industrial decarbonisation & CCUS; £180 million in nuclear innovation (fission); £15 million in renewables; £50 million supporting entrepreneurs and green finance.
- The BEIS EIP aims to reduce the costs of delivering secure, low carbon energy and to maximise the opportunities for UK businesses to capture a larger share of the expanding low carbon goods & services sector in the UK and abroad.
- Regional investment already realised includes UK government funding for the UK's first Carbon Capture & Use plant at Tata Chemicals, Cheshire. Once operational, it will capture 40,000 tonnes of CO₂ each year, a reduction in carbon emissions of 11% - equivalent of taking 22,000 cars a year off the road. Further support provided from the EIP includes:

- £7 million funding for a CCUS testing facility in Rotherham
- Testing of new offshore wind blades in the North East of England

- 30 home trial of advanced smart meters in Liverpool
- £10 million funding for the world's largest Liquid Air Energy Storage facility and one of Europe's largest energy stores in Manchester

International Climate Finance (ICF)

• Energy storage:

- Joined the Energy Storage Partnership (ESP) in May 2019 to foster energy storage solutions in developing countries.

- Contributed £200m to the Climate Investment Fund's Global Energy Storage Programme in September 2019.

• Sustainable cooling:

- Joined the UNEP Cool Coalition in September 2019 to expand access to sustainable cooling in developing countries.
- Published a Sustainable Cooling Guide in July 2020 showcasing UK leadership and opportunities-for-action ahead of COP 26.

- Co-hosted and presented in a virtual workshop on sustainable cooling at the Asia Clean Energy Forum in June 2020.

• Industrial decarbonisation:

- Joined the Leadership Group for Industry Transitions in September 2019 to foster cooperation between countries and businesses to support the decarbonisation of heavy industry.

- Co-hosted and presented in a virtual workshop on CCUS at the Asia Clean Energy Forum in June 2020.

• Cross-Cutting:

- Our international spend through Official Development Assistance for clean energy innovation (research, development and demonstration) is being doubled as part of the £1b Ayrton Fund over the next five years, announced by the UK Prime Minister in September 2019.

Department for Transport

- £1.4m Clean Maritime Call, supporting projects aiming to develop technological solutions for zero emission shipping. 10 project proposals were selected for funding to develop mid TRL (TRL 3-7) technology, out of a total of 55 submissions from organisation across the UK.

Department for International Development

- £41m spent on RD&D programmes in support of SDG7 (energy for all) and SG13 (climate change), including new clean energy access technologies and the business models needed to deploy them. This includes the flagship Transforming Energy Access Programme, which has already prototyped and demonstrated hundreds of new clean energy access innovations, and supported over 5 million people to improve their access to clean energy, created 54,000 sustainable long-term jobs in the clean energy generation and supply market, and leveraged £490 million of additional funding from public and private sources for clean energy R&D.

Private sector engagement in 2019/20

Clean Growth Fund

- Launched in May 2020, the Clean Growth Fund aims to speed up the deployment of innovative clean technologies that reduce emissions, by making direct investments in companies seeking to commercialise promising technologies. The £40m fund combines a £20m investment from BEIS and £20m from CCLA, a private sector investor with an environmental social governance agenda. The fund has ambitions to reach £100m and is now seeking additional investment from other private sector investors.

Energy Entrepreneurs Fund

- In September 2019, BEIS announced the recipients of Phase 7 Energy Entrepreneurs Fund, a competitive funding scheme to support the development and demonstration of state-of-the-art technologies, products and processes in the areas of energy efficiency, power generation and heat and electricity storage. 22 firms were funded, and a full list of all EEF recipients is available here. Since 2012 the EEF has invested ~£75m in grant money in over 130 companies, leveraging over £100m in private investment⁷⁷.

Net-Zero Compatible Innovations

- Through the Carbon Trust, we have supported the Net-Zero Compatible Innovations Initiative from RISE. This initiative supports the private sector through:

- Developing an "Avoided Emissions Framework" to enable analysis of the potential emissions savings of a new investment

- Assessing solutions directly, as part of a global target of 60 GtCO₂ of Climate Innovations

- Development of an assessment tool for independent use by private firms

Major activities in support of the Innovation Challenges in 2019/20

IC3 – Carbon Capture

- 3rd Accelerating CCUS Technologies (ACT) Call: The UK supports ACT as a key mechanism for international funding of CCUS technologies. The 3rd Call launched in June 2020, with Italy and India joining as new members⁷⁸.
- Trondheim Workshop: Jointly facilitated by the UK (BEIS) and Norway (SINTEF) this workshop focused on research gaps, opportunities, and priorities in late stage CCUS technologies. A summary report was released in October 2019⁷⁹, looking at six CCUS technology areas including decarbonising industry and the role of CCS in enabling low carbon hydrogen.

⁷⁷ <https://www.gov.uk/government/collections/energy-entrepreneurs-fund>

⁷⁸ <http://www.act-ccs.eu/calls>

⁷⁹ <http://mission-innovation.net/our-work/innovation-challenges/carbon-capture/>

IC5 – Converting Sunlight

- UK experts are co-leading, with the IC5 leadership in Brussels, the drafting and development of the IC5 Science and Technology Roadmap, including the co-chairing of roadmapping workshops in Brussels (Oct 2019), Hiroshima (Nov 2019) and USA/Online (August 2020).

IC7 – Affordable Heating and Cooling of Buildings

- Through its co-leadership of IC7, the UK has supported the Global Cooling Prize⁸⁰, which announced 8 finalists in November 2019. The UK was represented by the British High Commissioner to India Sir Dominic Asquith, and University of Cambridge based firm Barocal Ltd was announced as one of the finalists, asked to develop a demonstration on its non-vapor compression cooling technology in 2020.

Other Mission Innovation related activity in 2019/20

The UK participated in the second call of MI Champions, which saw Dr. Michaela Kendall selected as the UK Champion. Dr. Kendall is CEO of Adelan, one of the world's first fuel cell businesses, which works towards commercialising a clean energy technology she co-invented. Adelan has managed industrial R&D programmes with the US, EU and China. Dr. Kendall started her career as an environmental scientist, building a 30 year career which addressed the emissions, security and cost of energy.

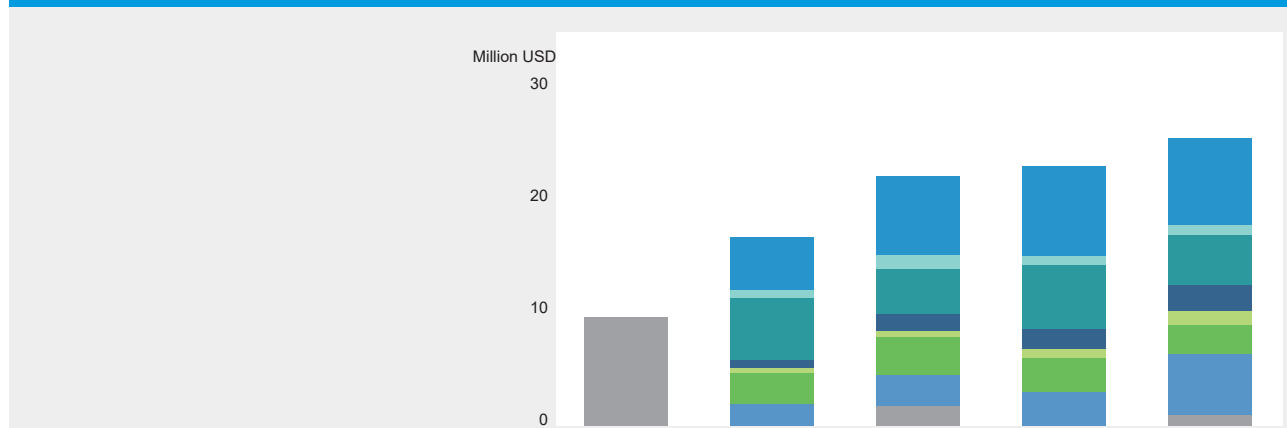
National plans and priorities for clean energy innovation

The UK is the first major economy to pass laws to end its contribution to global warming, reaching Net Zero by 2050. In his March Budget, the UK Chancellor announced that he would at least double the size of the BEIS Energy Innovation Programme to at least £1 billion, focusing on decarbonising our power, homes and industry to meet the challenge of net zero.

The UK is preparing for an ambitious COP26 conference in 2020. As a proud member of Mission Innovation we are pleased that its second phase is being supported as part of the UK's COP26 Presidency, and we look forward to its launch in 2021.

⁸⁰ <https://globalcoolingprize.org/>

Public sector RD&D investment



*All amounts are in million USD	Baseline	First Year	Second Year	Third Year	Fourth Year
Energy Efficiency	-	125.04	192.24	214.18	206.89
CCS	-	17.84	26.73	24.71	27.02
Renewables	-	148.97	114.01	149.78	120.40
Nuclear Fission & Fusion	-	16.86	32.22	45.36	55.33
Hydrogen & Fuel Cells	-	16.63	13.64	22.70	33.83
Other Power & Storage Technologies	-	69.96	91.11	78.25	67.21
Other Cross-cutting Technologies/ Research	-	49.25	71.06	76.86	144.78
Unallocated	255.10	-	47.55	3.04	24.86
TOTAL	255.1	444.6	588.6	614.9	680.3

New Collaborations

Collaborators	Name of Collaboration	Brief Description	Sectors	Type of Collaboration	Duration	Funding amount	Additional information
Canada, Denmark, France, Germany, India, Italy, The Netherlands, Norway, Finland, Sweden, US	3 rd ACT Call	ACT facilitates the emergence of CCUS via transnational funding aimed at accelerating and maturing CCUS technology.	Public-public	International Funding Call for RD&D CCUS Projects.	Start in Nov 2020 New projects to commence by September 2021	TBA Total – Current commitment from members is ~EUR29m	http://www.act-ccs.eu/all
17 countries (including AU, AT, BE, CA, CN, DK, DE, FI, IR, IT, JP, NL, NO, SG, SW, UK, US) and 48 entities involved.	Predictive Maintenance and Optimisation priority area	Goal: To accelerate the market development of next generation digital technology to drive innovation in advanced building management and energy efficiency. PMO addresses several issues:	Public – private	Collaboration: IEA Buildings and Communities Programme TCP 5 MI countries have secured national funding	April 2020 – April 2023		
11 countries including UK, SE, CA, TR, US, DE, IT, NL, AT, CH, FR plus the IEA	Comfort Climate box	Accelerating the market development for smart integrated heating, cooling and energy storage	Public – private	Collaboration: IEA TCP HPT & ECES 7 MI countries have secured national funding	Jan 2019 to June 2021		
UK, CH, CA, IT, NL	Advanced sorption heat pumps using salts	New project investigating low cost sorption systems	Public – public	Research collaboration through IC7	June 2020 to March 2023	£500k	
European Commission. IC5 global experts (particularly Japan and USA)	IC5 Science and Technology Roadmap	Development of IC5 Global roadmap, aligned with SUNRISE / SUNERGY initiatives. Includes series of 4 international workshops	Public – private	Research and Development	2019 to 2020	£20k direct funding for roadmap from EPSRC. €1.5M for aligned SUNRISE EU project. SUNERGY targeting €300M initiative	https://www.sunergy-initiative.eu/ ; https://sunriseaction.com/



UNITED STATES

Please view US's narrative on the [Mission Innovation website](#).

ANNEX A

Full data set

The full datasets submitted by members according to IEA research, development and demonstration (RD&D) categorisations are provided overleaf. Please note that this data only refers to Mission Innovation baselines and Mission Innovation relevant spend for the first, second and third years of Mission Innovation. Each country – according to its own priorities, policies, processes, and laws – has independently determined its baseline and the best use of its RD&D funding and defines its own RD&D priorities and path to reach the doubling goal. This data may not therefore be the same as other RD&D public sector data sets. Numbers denoted by “zero” in the following tables may indicate that no information has been provided for spend in that category.

Category	Australia			Austria		
	Million AUD			Million euros		
	Baseline	First Year	Second Year	Baseline	First Year (2018)	Second Year (2019)
1. Energy Efficiency						
1.1 Industry	2.43	1.18	1.71	0.00	11.88	0.64
1.2 Residential and commercial buildings, appliances and equipment	2.55	4.55	4.78	0.00	0.00	0.00
1.3 Transport	1.95	1.46	1.56	0.00	0.00	0.00
1.4 Other energy efficiency	6.95	5.17	5.24	0.00	0.00	0.00
1.5 Unallocated energy efficiency	14.96	9.12	18.99	0.00	0.00	0.00
2. Cleaner Fossil Fuels						
2.1 Oil and gas	0.00	0.00	0.00	0.00	0.00	0.00
2.2 Coal	0.00	0.00	0.00	0.00	0.00	0.00
2.3 CO2 capture and storage	10.9	20.45	14.56	0.00	0.00	0.00
2.4 Unallocated fossil fuels	0.00	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources						
3.1 Solar energy	32.5	43.1	48.69	0.00	0.00	0.00
3.2 Wind energy	0.42	0.5	0.29	0.00	0.00	0.00
3.3 Ocean energy	0.8	1.24	1.53	0.00	0.00	0.00
3.4 Biofuels (including liquid & solid biofuels and biogases)	3.9	5.23	3.77	0.00	0.00	0.00
3.5 Geothermal energy	0.24	0.57	0.7	0.00	0.00	0.00
3.6 Hydroelectricity	0.00	0.00	0.19	0.00	0.00	0.00
3.7 Other renewable energy sources	0.00	0.00	0.24	0.00	0.00	0.00
3.8 Unallocated renewable energy sources	10.45	1.73	11.83	0.00	0.00	0.00
4. Nuclear Fission and Fusion						
4.1 Nuclear fission	7.4	15.3	11.45	0.00	0.00	0.00
4.2 Nuclear fusion	1.72	2.14	1.26	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	0	0.11	0.18	0.00	0.00	0.00
5. Hydrogen and Fuel Cells						
5.1 Hydrogen	2.41	2.32	3.75	0.00	4.29	7.05
5.2 Fuel cells	1.74	1.57	1.72	0.00	4.52	0.00
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	0.00	0.00	0.00
6. Other Power and Storage Technologies						
6.1 Grid communication, control systems and integration	1.37	8.28	6.41	0.00	0.00	0.00
6.2 Electricity transmission and distribution	4.59	5.36	6.55	0.00	2.06	0.00
6.3 Energy storage (non-transport applications)	0.00	0.00	0.00	0.00	3.73	1.50
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00	0.00	0.00	0.00
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	0.00	0.00	0.00	0.00	1.45	0.00
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00	0.00	0.00	0.00
7.3 Other	0.00	0.00	0.00	0.00	2.48	5.02
8. Unallocated	0.00	0.00	0.00	16.00	0.00	15.00
TOTAL BUDGET	107.28	129.38	145.40	16.00	30.41	29.21

COUNTRY HIGHLIGHTS ANNEX A

	Canada				
	Million CAD				
Category	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency					
1.1 Industry	11.92	30.46	30.68	31.51	87.77
1.2 Residential and commercial buildings, appliances and equipment	17.09	20.64	19.41	31.98	39.18
1.3 Transport	45.74	30.56	21.78	53.99	98.47
1.4 Other energy efficiency	10.26	13.20	13.83	10.22	58.55
1.5 Unallocated energy efficiency	0.02	1.23	1.22	2.00	5.01
2. Cleaner Fossil Fuels					
2.1 Oil and gas	64.17	69.80	65.57	114.06	99.41
2.2 Coal	6.91	5.18	4.93	5.05	4.52
2.3 CO2 capture and storage	26.70	15.15	17.17	21.92	12.37
2.4 Unallocated fossil fuels	0.44	1.36	2.08	1.23	0.81
3. Renewable Energy Sources					
3.1 Solar energy	19.34	13.95	12.47	21.45	19.31
3.2 Wind energy	3.89	2.80	2.93	3.92	5.08
3.3 Ocean energy	10.97	4.22	1.59	2.65	3.08
3.4 Biofuels (including liquid & solid biofuels and biogases)	25.34	73.66	70.58	31.54	28.69
3.5 Geothermal energy	1.81	0.77	0.89	2.81	3.00
3.6 Hydroelectricity	1.87	3.73	3.47	3.52	5.38
3.7 Other renewable energy sources	0.31	0.94	0.51	0.52	2.54
3.8 Unallocated renewable energy sources	0.34	0.38	0.76	1.47	0.83
4. Nuclear Fission and Fusion					
4.1 Nuclear fission	88.11	138.90	106.79	116.22	88.85
4.2 Nuclear fusion	6.51	8.41	12.49	2.39	5.04
4.3 Unallocated nuclear fission and fusion	0.00	0.00	0.00	0.00	0.00
5. Hydrogen and Fuel Cells					
5.1 Hydrogen	3.18	3.03	2.25	6.46	7.16
5.2 Fuel cells	8.91	8.17	10.65	6.38	6.11
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	0.00	0.00
6. Other Power and Storage Technologies					
6.1 Grid communication, control systems and integration	1.56	2.31	1.89	2.10	2.31
6.2 Electricity transmission and distribution	17.97	15.04	15.41	17.41	30.29
6.3 Energy storage (non-transport applications)	9.37	10.18	14.71	15.41	18.54
6.4 Unallocated other power and storage technologies	0.06	0.62	0.06	2.35	1.34
7. Other Cross-cutting Technologies or Research					
7.1 Energy system analysis	2.58	1.59	1.20	5.86	8.53
7.2 Basic energy research that cannot be allocated to a specific category	0.56	1.48	1.14	0.13	6.35
7.3 Other	0.76	1.31	1.47	4.05	3.30
8. Unallocated	0.00	0.00	0.00	20.52	31.00
TOTAL BUDGET	386.69	479.06	437.92	539.11	682.78

Chile					China				
Million CLP					RMB Billion Yuan				
Baseline	First Year	Second Year	Third Year	Fourth Year	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency									
412.00	384.30	590.03	114.00	590.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	65.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.52	0.61	0.81	0.97	2.04
2. Cleaner Fossil Fuels									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	9.14	10.10	14.00	16.80	9.97
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources									
815.00	2,593.51	3,790.00	2,993.00	1,623.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	88.00	0.00	0.00	0.00	0.00	0.00
0.00	449.90	469.00	469.00	1,719.00	0.00	0.00	0.00	0.00	0.00
1,229.00	0.00	0.00	0.00	183.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	9.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	29.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	5.28	4.60	8.10	9.72	6.29
4. Nuclear Fission and Fusion									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	3.64	3.50	4.00	4.80	5.97
5. Hydrogen and Fuel Cells									
0.00	0.00	0.00	1,242.00	858.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	325.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.12	0.30	0.70	0.84	4.50
6. Other Power and Storage Technologies									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	3.18	3.00	3.20	3.84	3.93
7. Other Cross-cutting Technologies or Research									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
270.00	250.00	50.00	0.00	280.00	3.12	3.39	4.19	5.03	5.42
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2726.00	3677.71	4899.03	5143.00	5459.00	25.00	25.50	35.00	42.00	38.12

	Denmark				
	Million DKK				
Category	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency					
1.1 Industry	2.20	9.30	33.30	14.40	0.00
1.2 Residential and commercial buildings, appliances and equipment	26.40	5.60	34.70	43.50	0.00
1.3 Transport	0.00	6.30	7.50	6.60	0.00
1.4 Other energy efficiency	14.70	39.40	33.20	3.00	0.00
1.5 Unallocated energy efficiency	0.00	0.00	0.00	0.00	0.00
2. Cleaner Fossil Fuels					
2.1 Oil and gas	0.00	0.00	0.00	0.00	0.00
2.2 Coal	0.00	0.00	0.00	0.00	0.00
2.3 CO2 capture and storage	0.00	0.00	0.00	0.00	0.00
2.4 Unallocated fossil fuels	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources					
3.1 Solar energy	28.50	13.70	9.50	12.90	0.00
3.2 Wind energy	66.70	56.30	17.30	207.70	0.00
3.3 Ocean energy	11.00	0.10	1.70	1.10	0.00
3.4 Biofuels (including liquid & solid biofuels and biogases)	68.60	35.80	5.80	14.00	0.00
3.5 Geothermal energy	7.20	0.00	0.00	8.00	0.00
3.6 Hydroelectricity	0.00	0.00	0.00	0.00	0.00
3.7 Other renewable energy sources	0.00	5.00	0.00	0.00	0.00
3.8 Unallocated renewable energy sources	0.00	0.00	0.00	0.00	0.00
4. Nuclear Fission and Fusion					
4.1 Nuclear fission	0.00	0.00	0.00	0.00	0.00
4.2 Nuclear fusion	0.00	0.00	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	0.00	0.00	0.00	0.00	0.00
5. Hydrogen and Fuel Cells					
5.1 Hydrogen	0.60	16.50	15.30	14.10	0.00
5.2 Fuel cells	12.60	8.60	0.00	37.60	0.00
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	32.00	0.00
6. Other Power and Storage Technologies					
6.1 Grid communication, control systems and integration	4.20	0.00	0.00	0.00	0.00
6.2 Electricity transmission and distribution	28.80	0.00	0.00	0.00	0.00
6.3 Energy storage (non-transport applications)	8.60	19.40	0.00	38.30	0.00
6.4 Unallocated other power and storage technologies	0.00	0.00	142.90	5.90	0.00
7. Other Cross-cutting Technologies or Research					
7.1 Energy system analysis	0.00	0.00	0.90	32.50	0.00
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00	0.00	0.00
7.3 Other	11.80	37.80	119.90	14.40	0.00
8. Unallocated	0.00	0.00	0.00	0.00	509.50
TOTAL BUDGET	291.90	253.80	422.00	486.00	509.50

EC					Finland				
Million euros					Million euros				
Baseline	First Year	Second Year	Third Year	Fourth Year	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency									
0.00	151.30	130.80	113.50	68.30	0.00	0.00	0.00	0.00	0.00
0.00	96.90	96.10	90.60	103.30	0.00	0.00	0.00	0.00	0.00
0.00	41.60	101.50	28.60	68.20	0.00	0.00	0.00	0.00	0.00
0.00	74.90	131.70	167.80	144.90	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Cleaner Fossil Fuels									
0.00	4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	17.10	66.70	46.90	38.50	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources									
0.00	112.80	104.80	95.60	115.40	0.00	0.00	0.00	0.00	0.00
0.00	33.10	55.70	69.00	42.50	0.00	0.00	0.00	0.00	0.00
0.00	47.00	47.10	30.40	23.50	0.00	0.00	0.00	0.00	0.00
0.00	90.00	84.30	58.60	66.70	0.00	0.00	0.00	0.00	0.00
0.00	25.20	31.90	20.70	0.00	0.00	0.00	0.00	0.00	0.00
0.00	22.90	8.30	10.00	23.10	0.00	0.00	0.00	0.00	0.00
0.00	41.30	4.90	0.90	12.20	0.00	0.00	0.00	0.00	0.00
0.00	8.70	36.60	222.70	78.60	0.00	27.00	32.00	28.60	14.10
4. Nuclear Fission and Fusion									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Hydrogen and Fuel Cells									
0.00	67.70	40.60	47.10	71.80	0.00	0.00	0.00	0.00	0.00
0.00	38.90	74.40	52.10	26.20	0.00	0.00	0.00	0.00	0.00
0.00	7.20	8.20	4.50	0.00	0.00	0.00	0.00	0.00	0.00
6. Other Power and Storage Technologies									
0.00	3.60	7.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	134.00	175.00	148.80	141.60	0.00	3.90	3.50	2.30	4.90
0.00	34.90	39.50	64.30	157.30	0.00	4.30	1.80	3.60	11.80
0.00	0.10	3.80	0.00	20.30	0.00	0.00	0.00	0.00	0.00
7. Other Cross-cutting Technologies or Research									
0.00	0.00	24.00	33.70	9.30	0.00	4.50	6.30	15.80	21.80
0.00	17.40	27.50	6.30	59.20	0.00	0.00	0.00	0.00	0.00
0.00	47.00	101.40	164.50	122.40	0.00	0.00	0.00	0.00	0.00
989.00	0.00	0.00	0.00	0.00	54.90	31.20	31.60	42.60	36.90
989.00	1118.50	1402.00	1476.60	1393.30	54.90	70.90	75.20	92.90	89.50

	France				
	Million euros				
Category	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency					
1.1 Industry	0.00	14.60	13.88	12.04	12.02
1.2 Residential and commercial buildings, appliances and equipment	0.00	31.67	32.95	25.05	26.19
1.3 Transport	0.00	97.03	87.75	91.72	125.32
1.4 Other energy efficiency	0.00	23.16	17.39	22.42	20.57
1.5 Unallocated energy efficiency	0.00	0.00	0.00	0.00	0.00
2. Cleaner Fossil Fuels					
2.1 Oil and gas	0.00	0.00	0.00	0.00	0.00
2.2 Coal	0.00	0.00	0.00	0.00	0.00
2.3 CO2 capture and storage	0.00	20.49	14.67	12.28	15.20
2.4 Unallocated fossil fuels	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources					
3.1 Solar energy	0.00	71.17	62.77	56.22	54.66
3.2 Wind energy	0.00	9.62	6.94	6.23	6.56
3.3 Ocean energy	0.00	7.58	4.37	6.90	8.87
3.4 Biofuels (including liquid & solid biofuels and biogases)	0.00	84.81	73.45	52.80	48.92
3.5 Geothermal energy	0.00	6.59	4.67	3.22	7.19
3.6 Hydroelectricity	0.00	2.71	1.93	1.88	1.81
3.7 Other renewable energy sources	0.00	1.59	2.23	3.78	3.78
3.8 Unallocated renewable energy sources	0.00	0.00	0.61	0.00	0.00
4. Nuclear Fission and Fusion					
4.1 Nuclear fission	0.00	0.00	0.00	0.00	0.00
4.2 Nuclear fusion	0.00	0.00	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	0.00	0.00	0.00	0.00	0.00
5. Hydrogen and Fuel Cells					
5.1 Hydrogen	0.00	19.51	14.67	15.65	16.34
5.2 Fuel cells	0.00	10.42	12.64	11.36	10.72
5.3 Unallocated hydrogen and fuel cells	0.00	1.24	1.15	1.02	1.09
6. Other Power and Storage Technologies					
6.1 Grid communication, control systems and integration	0.00	1.92	1.25	0.79	2.18
6.2 Electricity transmission and distribution	0.00	16.53	10.37	15.54	23.52
6.3 Energy storage (non-transport applications)	0.00	22.55	20.97	24.80	25.61
6.4 Unallocated other power and storage technologies	0.00	0.02	0.00	0.00	0.00
7. Other Cross-cutting Technologies or Research					
7.1 Energy system analysis	0.00	15.46	15.83	18.80	5.43
7.2 Basic energy research that cannot be allocated to a specific category	0.00	12.91	55.45	58.76	66.46
7.3 Other	0.00	30.03	32.41	29.74	30.70
8. Unallocated	440.00	0.00	0.00	0.00	0.00
TOTAL BUDGET	440.00	501.61	488.35	470.99	513.14

Germany					Italy				
Million euros					Million euros				
Baseline	First Year	Second Year	Third Year	Fourth Year	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency									
0.00	33.40	47.10	52.41	66.20	0.00	0.00	0.00	0.00	0.00
0.00	26.30	28.44	29.17	72.90	0.00	0.00	0.00	0.00	0.00
0.00	12.90	14.35	14.11	34.21	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	10.65	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	58.55	52.24	53.59	55.00	57.00
2. Cleaner Fossil Fuels									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	17.40	18.70	42.41	42.41	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources									
0.00	78.60	99.35	92.68	110.16	0.00	0.00	0.00	0.00	0.00
0.00	49.70	75.11	59.70	72.95	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	37.30	32.74	28.54	40.59	0.00	0.00	0.00	0.00	0.00
0.00	12.50	16.50	15.38	13.85	0.00	0.00	0.00	0.00	0.00
0.00	2.00	2.15	1.40	1.71	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	71.08	58.25	71.19	75.00	77.00
4. Nuclear Fission and Fusion									
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Hydrogen and Fuel Cells									
0.00	0.00	0.00	0.00	21.49	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	16.68	0.00	0.00	0.00	0.00	0.00
0.00	15.40	21.92	27.58	0.00	11.79	8.96	14.90	17.00	17.00
6. Other Power and Storage Technologies									
0.00	0.00	0.00	0.00	21.43	0.00	0.00	0.00	0.00	0.00
0.00	66.90	89.24	71.45	67.63	0.00	0.00	0.00	0.00	0.00
0.00	42.00	35.35	27.33	26.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	2.77	44.76	36.70	43.50	46.00	47.00
7. Other Cross-cutting Technologies or Research									
0.00	15.00	18.17	27.67	28.17	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	19.45	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	36.48	42.42	39.50	42.00	43.00
450.30	116.10	178.17	171.31	103.23	0.00	13.70	11.17	13.00	13.00
450.30	525.50	677.29	661.15	735.57	222.66	212.27	233.85	248.00	254.00

	Mexico		
	Million pesos		
Category	Baseline (avg 2013-15)	First Year	Second Year
1. Energy Efficiency			
1.1 Industry			
1.2 Residential and commercial buildings, appliances and equipment	1.33	41.10	40.20
1.3 Transport		23.00	8.00
1.4 Other energy efficiency	3.73	28.20	17.40
1.5 Unallocated energy efficiency	0.00	0.00	0.00
2. Cleaner Fossil Fuels			
2.1 Oil and gas	0.00	0.00	0.00
2.2 Coal	0.00	0.00	0.00
2.3 CO2 capture and storage	2.53	29.40	2.20
2.4 Unallocated fossil fuels	0.00	0.00	0.00
3. Renewable Energy Sources			
3.1 Solar energy	89.43	181.40	105.30
3.2 Wind energy	37.47	48.20	37.80
3.3 Ocean energy	0.43	0.80	132.60
3.4 Biofuels (including liquid & solid biofuels and biogases)	19.13	272.20	141.00
3.5 Geothermal energy	183.83	211.60	150.40
3.6 Hydroelectricity	0.00	0.00	0.00
3.7 Other renewable energy sources	0.00	0.00	54.60
3.8 Unallocated renewable energy sources	0.00	0.00	0.00
4. Nuclear Fission and Fusion			
4.1 Nuclear fission	0.00	0.00	0.00
4.2 Nuclear fusion	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	17.30	7.50	1.30
5. Hydrogen and Fuel Cells			
5.1 Hydrogen	0.00	0.00	0.00
5.2 Fuel cells	0.00	0.00	0.00
5.3 Unallocated hydrogen and fuel cells	2.50	14.10	14.60
6. Other Power and Storage Technologies			
6.1 Grid communication, control systems and integration	0.00	0.00	0.00
6.2 Electricity transmission and distribution	0.00	0.00	0.00
6.3 Energy storage (non-transport applications)	0.00	0.00	0.00
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00
7. Other Cross-cutting Technologies or Research			
7.1 Energy system analysis	3.57	5.70	11.00
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00
7.3 Other	0.00	11.80	4.40
8. Unallocated	0.00	229.00	225.10
TOTAL BUDGET	361.27	1104.00	946.00

Netherlands					Republic of Korea				
Million euros					Million Won				
Baseline	First Year	Second year	Third Year	Fourth Year	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency									
7.40	34.20	20.50	25.90	35.00	35,910	52,771	60,131	51,348	51,613
5.70	10.20	13.30	14.30	28.40	21,420	34,338	34,300	39,078	75,909
0.00	2.50	12.90	2.70	41.40	32,767	63,027	56,858	56,307	39,289
4.60	13.20	14.30	18.90	24.80	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
2. Cleaner Fossil Fuels									
0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
1.10	2.20	11.10	16.40	7.00	65,966	83,669	85,122	90,458	64,754
0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
3. Renewable Energy Sources									
33.90	24.60	21.70	25.50	15.50	60,842	72,198	78,601	94,360	88,292
12.90	17.50	20.00	40.20	46.50	40,844	40,679	50,636	64,063	79,113
2.20	0.10	0.70	0.10	0.00	0	0	0	0	0
20.30	28.80	20.50	17.40	8.20	34,267	40,510	45,442	40,294	54,097
1.40	8.50	11.60	21.70	10.90	0	0	0	0	0
0.00	3.70	0.00	0.00	0.00	0	0	0	0	11,767
0.00	0.20	0.20	0.20	0.20	16,266	32,638	32,731	37,767	36,217
0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
4. Nuclear Fission and Fusion									
0.00	5.80	6.20	6.50	7.00	0	0	0	0	0
0.00	0.50	0.10	0.00	0.00	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	37,038	41,733	48,882	52,935	71,361
5. Hydrogen and Fuel Cells									
0.30	0.10	15.90	8.00	14.30	4,892	12,370	12,750	19,270	19,715
0.00	0.80	3.10	0.50	0.00	39,441	38,773	41,569	33,707	64,045
0.00	0.00	0.00	0.00	0.00	0	0	0	5,410	6,635
6. Other Power and Storage Technologies									
0.00	0.00	0.00	0.00	0.00	46,769	60,693	60,843	95,110	96,618
3.10	3.90	5.20	7.10	2.30	85,156	109,016	135,006	167,757	130,603
4.10	6.00	15.60	6.30	20.20	38,957	54,231	56,095	44,741	39,584
0.00	0.00	0.00	0.00	0.00	0	0	0	10,275	27,034
7. Other Cross-cutting Technologies or Research									
0.00	0.80	0.30	1.90	11.70	0	0	0	0	0
3.00	3.00	4.20	6.60	0.90	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
0.00	0.10	0.60	5.00	10.70	0	0	0	0	0
100.00	166.70	198.00	225.20	285.00	560,535	736,646	798,966	902,880	956,646

COUNTRY HIGHLIGHTS ANNEX A

	UK				
	Million GBP				
Category	Baseline	First Year	Second Year	Third Year	Fourth Year
1. Energy Efficiency					
1.1 Industry	0.00	2.32	3.31	0.00	0.00
1.2 Residential and commercial buildings, appliances and equipment	0.00	11.55	22.10	0.00	0.00
1.3 Transport	0.00	79.46	94.37	0.00	0.00
1.4 Other energy efficiency	0.00	2.86	2.50	0.00	0.00
1.5 Unallocated energy efficiency	0.00	1.84	28.44	167.92	162.20
2. Cleaner Fossil Fuels					
2.1 Oil and gas	0.00	0.00	0.00	0.00	0.00
2.2 Coal	0.00	0.00	0.00	0.00	0.00
2.3 CO2 capture and storage	0.00	14.01	20.96	19.37	21.18
2.4 Unallocated fossil fuels	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources					
3.1 Solar energy	0.00	24.52	20.90	0.00	0.00
3.2 Wind energy	0.00	36.10	26.54	0.00	0.00
3.3 Ocean energy	0.00	5.47	15.10	0.00	0.00
3.4 Biofuels (including liquid & solid biofuels and biogases)	0.00	15.82	19.45	0.00	0.00
3.5 Geothermal energy	0.00	4.95	0.63	0.00	0.00
3.6 Hydroelectricity	0.00	8.84	3.31	0.00	0.00
3.7 Other renewable energy sources	0.00	14.78	0.28	0.00	0.00
3.8 Unallocated renewable energy sources	0.00	6.31	3.17	117.43	94.39
4. Nuclear Fission and Fusion					
4.1 Nuclear fission	0.00	8.84	24.35	0.00	0.00
4.2 Nuclear fusion	0.00	0.00	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	0.00	4.38	0.91	35.56	43.38
5. Hydrogen and Fuel Cells					
5.1 Hydrogen	0.00	7.17	4.21	0.00	0.00
5.2 Fuel cells	0.00	5.22	6.46	0.00	0.00
5.3 Unallocated hydrogen and fuel cells	0.00	0.65	0.02	17.80	26.52
6. Other Power and Storage Technologies					
6.1 Grid communication, control systems and integration	0.00	0.31	0.08	0.00	0.00
6.2 Electricity transmission and distribution	0.00	18.62	37.50	0.00	0.00
6.3 Energy storage (non-transport applications)	0.00	12.67	17.03	0.00	0.00
6.4 Unallocated other power and storage technologies	0.00	23.25	16.82	61.35	52.69
7. Other Cross-cutting Technologies or Research					
7.1 Energy system analysis	0.00	7.87	0.95	0.00	0.00
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00	0.00	0.00
7.3 Other	0.00	30.74	54.76	60.26	113.51
8. Unallocated	200.00	0.00	37.28	2.38	19.49
TOTAL BUDGET	200.00	348.55	461.43	482.07	533.36



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