



MISSION INNOVATION COUNTRY HIGHLIGHTS

3RD MI MINISTERIAL 2018

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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 describing the nature of their clean energy research, development, and demonstration (RD&D) investments; current strategies, priorities, and needs; Mission Innovation funding and progress; and plans for future growth.

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—and then prior to the Second MI Ministerial in June 2017. Once again, MI members have submitted information prior to the Third MI Ministerial in Malmö, Sweden in May 2018. 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.

This document provides a compilation of the most recent information that has been submitted by each of the 23 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 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 books. 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 May 2018, include 22 countries and the European Commission on behalf of the European Union.

A complete list is provided at: <http://mission-innovation.net/countries/>.

² Please see Annex A for full data set

³ The exchange rates used were taken from “HMRC foreign exchange rates: yearly averages and spot rates (Average for the year to 31 March 2018)”³ <https://www.gov.uk/government/publications/exchange-rates-for-customs-and-vat-yearly> Unless not specified otherwise, all currency units are in nominal values.

AUSTRALIA

Overview 2017

New clean energy innovation policies and/or strategies

The Australian Government established the \$200 million Clean Energy Innovation Fund in July 2016. The fund provides financial support for innovative and emerging clean energy technologies to become commercially viable. It has committed approximately AUD\$50 million to date. The fund has supported technologies such as hybrid solar generation and storage energy management systems, electric vehicles in medium-duty trucks, and scaling up of the Internet of Things network focused on cutting energy use. This funding also includes an AUD\$10 million cornerstone investment in a Clean Energy Seed Fund administered by Artesian Venture Partners. The Seed Fund targets scalable, high growth potential start-ups fuelling innovation and creating opportunities in the development of clean technology.

The Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Low Emissions Technology Roadmap published in June 2017 made recommendations on where to focus Australia's future domestic clean energy research and development and international collaboration opportunities, to deliver clean energy solutions for Australia. The Roadmap identified opportunities for both domestic hydrogen and a hydrogen export industry. Hydrogen as an energy storage medium would not only enhance domestic energy system security, but could also be exported to countries in need to diversify their energy mix and reduce carbon intensity of their energy sector.

Top clean energy innovation successes in 2017

1. The Australian Government through the CSIRO launched a Hydrogen Future Science Platform in November 2017. This involves investing AUD\$13.5 million into hydrogen fuel research to enable the development of technologies that allow Australia to export its solar energy, as well as providing low emissions energy solutions for Australians.
2. The Australian Government is further encouraging increased research and development work in the hydrogen supply chain through an AUD\$20 million R&D funding round, announced in late 2017. Hydrogen

production, conversion to a carrier for transport, storage or export, and transformation into energy at point-of-use are all stages of the hydrogen supply chain that have significant potential for cost reductions.

3. In December 2017, the Australian Government, through the Australian Renewable Energy Agency (ARENA), provided AUD\$29 million to twenty R&D projects that will further accelerate the development of solar PV technology, improving its efficiency and reducing its costs.

Top activities delivered in support of the Innovation Challenges in 2017

The Australian Government, through the Australian Renewable Energy Agency (ARENA) announced an AUD\$5 million International Engagement Program in late 2017. The Program supports leading researchers and industry experts to participate in eligible International Energy Agency Technology Collaboration Programs and six of the seven Mission Innovation Challenges which focus on accelerating renewable energy development. The Program will support CSIRO's international participation in the Smart Grids and

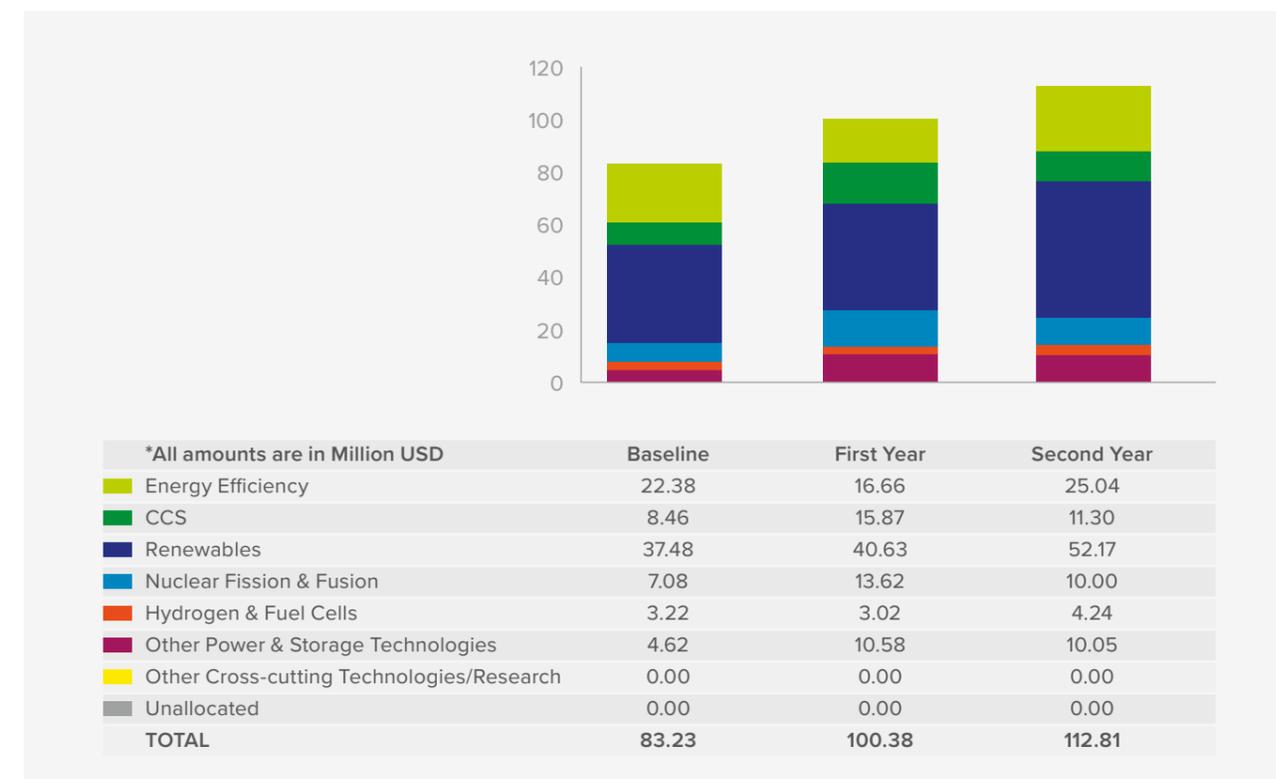
Affordable Heating and Cooling of Buildings Innovation Challenges, the University of Adelaide's participation in the Converting Sunlight Innovation Challenge, and the Australian Photovoltaic Institute's participation in the Off-grid Access to Electricity Innovation Challenge. The top three activities Australia delivered in supporting specific Innovation Challenges in 2017 are as follows:

1. The Australian Government, through CSIRO, is leading work on the Storage Integration work stream under the Smart Grids Innovation Challenge (MI IC#1) alongside our UK counterpart. Australia also hosted an MI-IC#1 workshop as a side-event of the ISGAN ExCo15 meeting in Newcastle, Australia in March 2018.
2. The Australian Government, through CSIRO, is leading the Predictive Maintenance and Optimization work stream under the Affordable Heating and Cooling of Buildings Innovation Challenge (MI IC#7). Australia prepared and presented a technical discussion paper on Predictive Maintenance and Optimization at the MI IC#7 workshop in November 2017. Australia is working with other countries such as Canada, the US and the

Netherlands on developing an Open Data Platform for energy efficiency and smart buildings research. The Platform will provide innovators with both access to low-cost high-quality data from buildings, and infrastructure to enable HVAC software-as-a-solution-services.

3. Australia spearheaded the creation of a new Innovation Challenge on hydrogen. This Challenge will create a platform for interested Mission Innovation countries to collaborate with each other and with existing international co-operation forums such as the IPHE and the Hydrogen Council, to identify key technical barriers to widespread production, transport, storage, and use of hydrogen. Australia will co-lead this Challenge.

Public Sector RD&D investment



Note: Australia's MI baseline includes research and development, but not demonstration.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	Funding Amount
Canada, Netherlands, USA, Mexico, New Zealand, Israel ⁴	Affordable Heating and Cooling Open Data Platform	The Platform aims to provide innovators with access to low-cost high-quality data from buildings and infrastructure to enable HVAC software-as-a-solution services.	Public - Public - Public	2018	Up to \$20 million

⁴Additional information on Australia's collaboration: [Switch Automation Solution Overview](#), explaining how the Platform drives scalable, repeatable building improvements. [Switch Automation Case Studies](#), highlighting building optimisation results for a variety of global enterprise organisations.

BRAZIL

Narrative

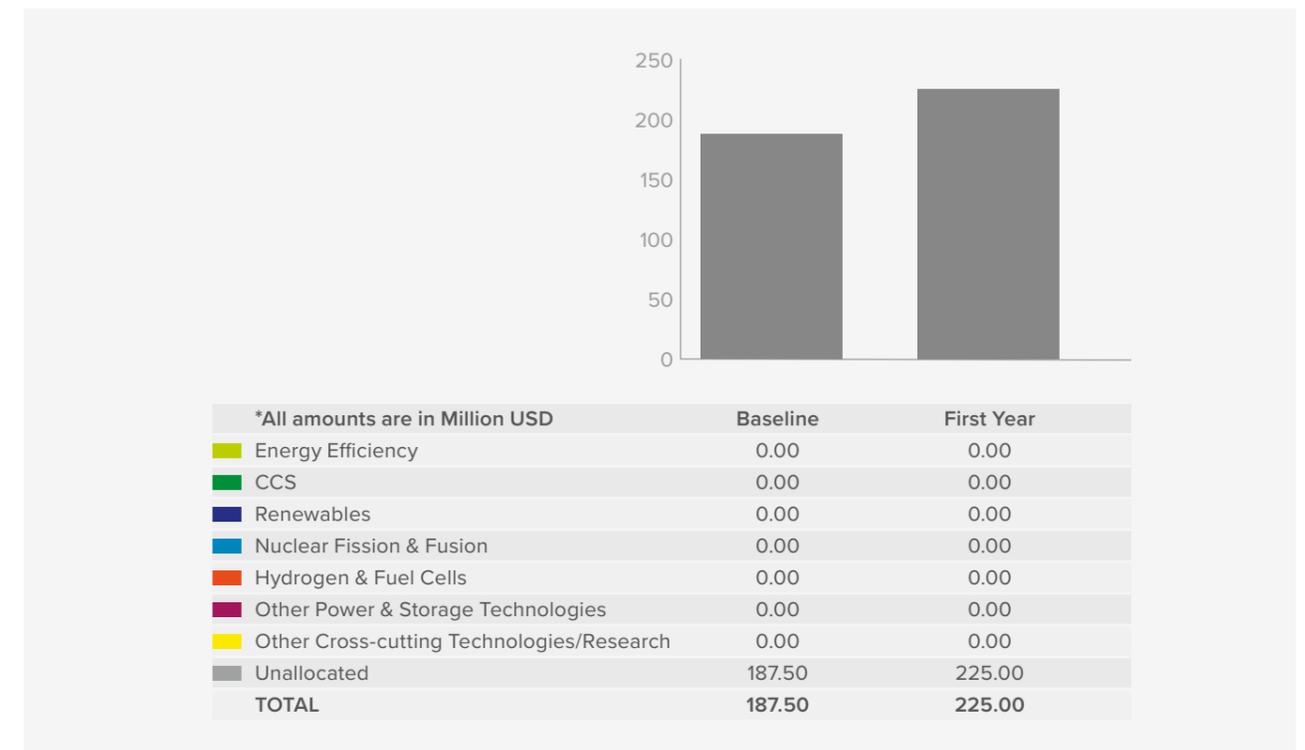
Brazil will seek to double its government and/or state directed investment in clean energy technology innovation over the next five years, focusing on renewable and clean energy technologies with the potential to reduce the cost, accelerate public and private partnerships for research, development, demonstration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

The participation of renewables in the Brazilian energy matrix is around 45%, where the flagships are the sugar-cane ethanol and hydropower. The share of renewable energy sources in its electricity mix varies between 70% and 90%, which 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\$ 600 million (US\$ 150 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



CANADA

Overview 2017

New clean energy innovation policies and/or strategies

In December 2016, the Government of Canada signed a [Pan-Canadian Framework on Clean Growth and Climate Change](#) (PCF) with provinces and territories, which will serve as the basis for action to meet or exceed Canada's 2030 emissions targets and transition Canada to a stronger, more resilient low-carbon economy. Accelerating innovation to support clean technologies and create jobs was a key pillar of the Framework, alongside pricing carbon pollution, complementary measures to further reduce emissions, and measures to adapt to the impacts of climate change and build resilience.

In Canada's federal [Budget 2017](#), the Government of Canada announced important new funding for clean energy RD&D in order to deliver on the PCF. This included, for example, the following funding to Natural Resources Canada:

- **Clean Growth Program:** \$155M over four years to advance clean technology RD&D, up to first commercial demonstration, in Canada's natural resources sectors (energy, mining and forestry).
- **Impact Canada Initiative – Clean Technology Stream:** \$75M over four years, starting in 2017-18, to support high-impact clean technology challenges (e.g. helping Canada's northern communities reduce their reliance on diesel; biojet fuel).
- **Green Infrastructure** (Phase 2): Starting 2018-19, this includes:

- o Smart Grids: \$35M over four years to demonstrate key emerging smart grid technologies.
- o Net-Zero Buildings: \$64M over eight years for RD&D to drive down costs and create market confidence in net zero construction.
- o Remote Communities: \$59.4M over six years to demonstrate innovative clean energy solutions for northern communities and reduce reliance on diesel power.
- o Electric Vehicle Infrastructure: \$30M over four years to demonstrate next generation electric vehicle charging technologies.
- **Energy Innovation Program (EIP):** \$52.9M per year as of 2018-19 to fund clean energy RD&D. The EIP spurs broader investment by providing direct funding to external recipients, as well as providing core funding for federal energy laboratories for public good R&D and science to inform codes and standards.

In addition, Budget 2017 announced \$400 million over five years to recapitalize [Sustainable Development Technology Canada's SD Tech Fund](#) to support projects across Canada to develop and demonstrate new clean technologies that promote sustainable development, including those that address environmental issues such as climate change, air quality, clean water and clean soil.

powered and heated industrial park, which aims to prove the viability of a geothermal reservoir through drilling and well testing and to conduct a grid connection and power plant certification.

- **Oil and Gas Clean Tech Program** (OGCT): A total of nine projects have been selected, for total federal funding of \$49.4M and an additional \$119.2M in leveraged funding from project partners. As an example, NRCan has provided \$10M to develop the [Alberta Carbon Conversion Technology Centre](#), a facility with five outdoor test bays that will be used to progress innovative approaches to convert CO₂ emissions into marketable products such as building materials, fuels, chemicals and plastics. In June 2018, the first tenants of the Centre will include the five finalists of the natural gas track of the US\$20M Carbon XPRIZE competition, sponsored by US-based NRG and Canada's Oil Sands Innovation Alliance.

Top clean energy innovation successes in 2017

Funding allocated in Budget 2016 began to be disbursed through various federal programs over the course of the year. Highlights from Natural Resources Canada (NRCan) include:

- **Electric Vehicle Infrastructure Demonstrations** (EVID): To date, 10 projects have been selected for \$23.8M in federal funding and an additional \$38.1M in leveraged funding from project partners. [A project led by Fastcharge TCH](#) and supported by \$8M from the EVID program, for example, will bring 34 electric vehicle charging stations, each with three charging heads, to the TransCanada Highway, connecting Ontario to the Manitoba-Saskatchewan border.
- **Clean Energy Innovation:** For the funding allocated to the program in Budget 2016, a total of 38 projects have been selected, for total federal funding of \$42.2M and an additional \$179M in leveraged funding from project partners. For example, NRCan is providing \$1.54M to the [Sustainville Geopark](#), a demonstration of a geothermal

Top activities delivered in support of the Innovation Challenges in 2017

- **Bioenergy for the Future workshop:** In November 2017, MI's Sustainable Biofuels Innovation Challenge (IC4) joined the International Energy Agency's (IEA's) Renewable Energy Division to hold a one-day "Bioenergy for the Future" workshop in Ottawa, Canada. The workshop featured the rollout of the [IEA Technology Roadmap for Bioenergy: Delivering Sustainable Bioenergy](#), included a report on the Biofuture Platform, and also served as a review of "Lessons Learned" from previous attempts at scale-up of biofuels supply and conversion technologies. The workshop was attended by over 100 participants from Canada, the US, the EU, Brazil, India and New Zealand. The joint MI/IEA workshop was linked to other biofuels events taking place in Ottawa during the same week: the international conference [Scaling Up 2017: Making the Global Bioeconomy Mainstream](#) and technical meetings under the IEA Technology Collaboration Program on Direct Biomass

Liquefaction. The proceedings of these events are being integrated into a report on scaling up, currently being prepared by IC4 participants.

- **Clean Energy Materials Innovation Challenge:** Prior to stepping up as co-lead of this Challenge in early 2018, Canada was an active participant in the workshop hosted in Mexico in September 2017.
- **Carbon Capture Innovation Challenge:** Over 20 Canadian experts participated in the carbon capture, use and storage (CCUS) workshop held in Houston in September 2017. Over 250 academic and industry representatives from 22 countries participated in active discussions across 13 panels to establish the current state of CCUS technology. The recently released workshop report will serve as an important signpost for future R&D activities in carbon capture technologies.

Public Sector RD&D investment



*All amounts are in Million USD

	Baseline	First Year	Second Year
Energy Efficiency	66.32	74.94	67.79
CCS & Fossil Fuels	76.61	71.35	70.01
Renewables	49.81	78.34	72.69
Nuclear Fission & Fusion	73.80	114.89	93.03
Hydrogen & Fuel Cells	9.43	8.73	10.05
Other Power & Storage Technologies	22.58	21.95	25.01
Other Cross-cutting Technologies/Research	3.04	3.42	2.97
Unallocated	0.00	0.00	0.00
TOTAL	301.59	373.63	341.55

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
Mexico	Flare Emissions Factors Measurement & Modelling	The project will support demonstration of technologies in Mexico's oil and gas sector for methane and black carbon emissions measurement, reporting, verification, and reduction.		2018	2022	\$9 Million
China	Canada-China Collaboration on VOC and methane emissions reduction	This project will demonstrate and measure the effectiveness of Canadian emissions reduction technologies at oil and gas production facilities in China.		2017	2022	\$2 Million
United Kingdom	Collaboration on Smart Energy Systems	As part of this initiative, Canada and the UK will jointly develop and launch a grand challenge focused on breakthrough smart grid / energy storage technologies. This initiative is a key part of the Partnership between Canada and the UK on Clean Growth and Climate Change.	Public - public, public - private	2018	2021	\$10M CDN from Canada and up to £6M from UK

CHILE

Overview 2017

New clean energy innovation policies and/or strategies

In 2015, the Ministry of Energy launched a long-term Energy Policy⁵, establishing goals for 2035 and 2050. After a wide participatory process, the agreement was that Chile does not want just any kind of development, but one that is inclusive, equitable, and respects the environment and social harmony. A transformation was needed. This is where innovation emerges as a great opportunity for the energy sector, which is a key sector for the competitiveness of the country.

As actions of the National Energy Policy, three main initiatives were developed regarding innovation: a science, technology and innovation strategy⁶, a strategic solar energy program⁷ and an electro mobility strategy⁸. The Ministry of Energy has carried out a new participatory process in order to address the short and medium problems of the energy sector, where the science, technology and innovation will have a privileged status. This will be a main focus of the Chilean energy roadmap 2018-2022.

Top clean energy innovation successes in 2017

- One of the Strategic Solar Energy Program's initiatives is the desert module and system technology program so-called AtaMoS-TeC (Atacama Module and System Technology Center). The AtaMoS-TeC brings together the government, and national and international companies and technology centres in a partnership to implement a portfolio of research, development and innovation projects to develop photovoltaic systems created specifically for desert conditions, covering a gap in the knowledge of its own features for solar power generation. The goal of AtaMoS-Tec is to adapt and develop new materials, components and operation and maintenance services for photovoltaic systems, ensuring their durability and performance under desert climate conditions.
- A Technology Program was launched last year to take advantage of the opportunity of using hydrogen as

an energy vector. The call was specifically focused on the development of new low emission mining extraction trucks powered by hydrogen, both by mixing hydrogen and diesel, and by powering by fuel cells. Two consortiums have been created, including national and international universities and companies experienced on hydrogen applications.

- Chile has recently joined the International Energy Agency's groups on Photovoltaics Power System (PVPS) and Solar Power and Chemical Energy Systems (SolarPaces). Their objective is to share first-hand information on photovoltaic and concentrated solar power technologies. SolarPACES 2017 was held successfully in Santiago de Chile, connecting to top researches and related companies with the national R&D ecosystem related to concentrated solar power and energy storage.

Top activities delivered in support of the Innovation Challenges in 2017

- The electro mobility strategy is the result of a collaborative effort that included the Ministry of Energy and also the Ministries of Transportation and Environment. This strategy has the long-term goal of reaching 100% of public transportation and at least 40% of private vehicles being electric by 2050. For

the success, it is necessary focusing the efforts in the establishment of new regulations and standards; lower the entry barriers to foster a fast deployment of electric vehicles, but also give an impulse to the promotion of collaborative research and development initiatives.

⁵ <http://www.energia2050.cl/wp-content/uploads/2016/08/Energy-2050-Chile-s-Energy-Policy.pdf>

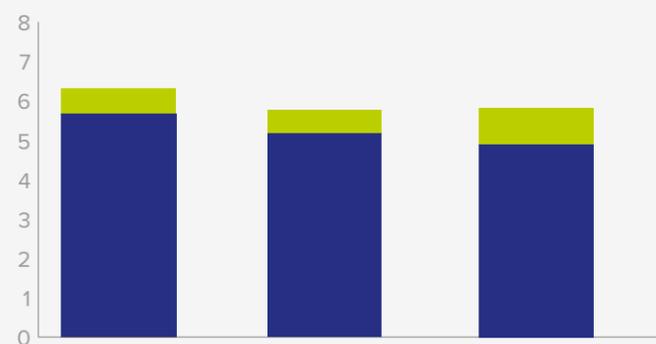
⁶ <http://www.energia2050.cl/wp-content/uploads/2017/11/Estrategia-CTI.pdf>

⁷ <http://www.programaenergiasolar.cl/english/>

⁸ http://www.minenergia.cl/archivos_bajar/2018/electromovilidad/estrategia_electromovilidad-27dic.pdf

- For solar industrial development, an Open Innovation Platform has been established⁹. This project aims to develop a virtual supply-and-demand interaction platform, in addition to a specialized team in charge of studying the main energy-related problems, needs and opportunities in the national industry so they can translate into business innovation opportunities. It also contemplates a specialized team in charge of incentivizing participation by local suppliers and advising them on the construction of innovative and valuable proposals to take advantage of those opportunities. The objective is to contribute to closing the existing information and knowledge gaps between supply and demand of energy solutions and to facilitate access to financing to materialize the proposed innovations.
- From late 2015, the Ministry of Energy and the Chilean Economic Development Agency have a joint program looking for the promotion of innovation in energy efficiency, co-funding the development of prototypes for the mining industry, by initiatives for the spreading of new technologies that improve the efficient use of energy and by the development of platforms that support the deployment of innovative solutions in the national market.

Public Sector RD&D investment



*All amounts are in Million USD

	Baseline	First Year	Second Year
Energy Efficiency	0.65	0.60	0.93
CCS	0.00	0.00	0.00
Renewables	5.66	5.17	4.89
Nuclear Fission & Fusion	0.00	0.00	0.00
Hydrogen & Fuel Cells	0.00	0.00	0.00
Other Power & Storage Technologies	0.00	0.00	0.00
Other Cross-cutting Technologies/Research	0.00	0.00	0.00
Unallocated	0.00	0.00	0.00
TOTAL	6.31	5.78	5.81

⁹ <http://www.brillasolar.cl>

CHINA

Overview 2017

New clean energy innovation policies and/or strategies

From 2016 to 2017, China's Ministry of Science and Technology successively launched a number of state research and development programs in areas of clean and high efficiency utilization of coal and new types of energy saving technology, new energy vehicle and smart grid, and provided active support to such R&D and demonstration projects in the field of clean energy. In the area of clean and high efficiency utilization of coal, the objective is to fully carry out the energy saving strategy, comprehensively improve clean and high efficiency utilization of coal and independent R&D capability in areas of processing, system, equipment, materials and platforms, and realize industrial-scale demonstrations. In the area of new energy vehicle, the program aimed at continued in-depth implementation of the strategy of technological transformation towards "pure electric drive" new energy vehicle, and to upgrade the technological platform of new energy vehicle power system, taking full advantage of the opportunity of the new round of technological change brought about by technologies in areas of new energy, new materials and informatization, deploying R&D for the next generation of technology to support large scale industrialization by 2020. And in the area of smart grid, the objective is to realize full range deployment from basic research to major generic key technological research to typical application demonstration, and to realize China's overall leading position in smart grid technology internationally.

In April 2017, a number of government agencies including the state Ministry of Science and Technology, National Development and Reform Commission and the Ministry of

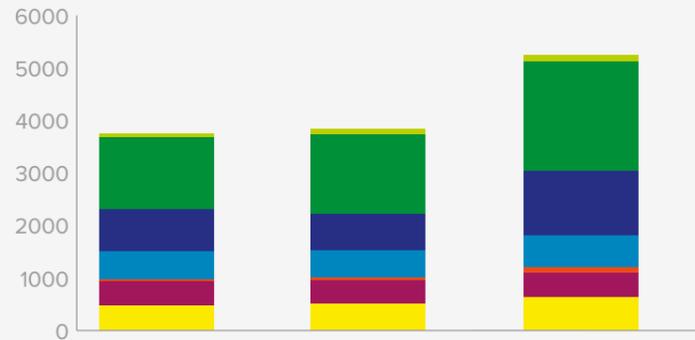
Education jointly published the "Plan for State Technological Innovation Project during the 'Thirteenth Five-year Plan' Period". The Plan defined that the key areas of clean energy deployed by the State Technological Innovation Centre will include nuclear energy, smart grid and clean and high efficiency utilization of coal. The Plan put forward the general objective of the perfection of an enterprise-centered, market-oriented technological innovation system with combined resources from industry, academy and R&D, improvement of enterprises' independent innovation capability and core industrial competitiveness, and strengthening of the transformation of technological achievements and the perfection of an innovation and start-up business service system. One of the key tasks of the Plan is to "strengthen the support to technological innovation, and encouragement of innovation resources to concentrate in enterprises". The Plan also stressed importance to guide the establishment of diversified financing channels, on one hand the state will strengthen guidance and support to technological innovation through state science and technology programs, while on the other hand takes advantage of the state medium and small enterprise development fund, state emerging industry start-up and investment guidance fund and state technological achievement transformation guidance fund, to encourage development of angel investment, venture capital investment, industrial investment, and strengthen direct financing support to enterprises in seed and initial stages.

Top activities delivered in support of the Innovation Challenges in 2017

1st MI Smart Grids Innovation Workshop: On June 6th 2017, the 1st MI Smart Grids Innovation Workshop, which was an important side event of CEM8 and MI-2, was held at the Beijing National Convention centre. More than 150 representatives of international organizations, universities, research institutions and enterprises from 20 countries attended the workshop. Li Meng, Deputy Minister of Ministry of Science and Technology gave the welcome speech. Harsh Vardhan - Union Minister for Science Technology and Earth Sciences and Zhang Jie -Deputy

Minister of Chinese Academy of Sciences gave greeting speeches. Patrick Child- Deputy Director General of European Commission, Research & Innovation and Chair of MI Steering Committee was invited to give a keynote speech about Innovation activities of Smart Grids in EU and Ivan Scalfarotto - Deputy Minister of Italian Ministry of Economic Development (MiSE) made the closing remarks.

Public Sector RD&D investment



*All amounts are in Million USD	Baseline	First Year	Second Year
Energy Efficiency	78.02	91.53	121.54
Cleaner Fossil Fuels	1,371.43	1,515.48	2,100.66
Renewables	792.25	690.22	1,215.38
Nuclear Fission & Fusion	546.17	525.16	600.19
Hydrogen & Fuel Cells	18.01	45.01	105.03
Other Power & Storage Technologies	477.15	450.14	480.15
Other Cross-cutting Technologies/Research	468.15	508.66	628.70
Unallocated	0.00	0.00	0.00
TOTAL	3,751.18	3,826.20	5,251.65

DENMARK

Overview 2017

New clean energy innovation policies and/or strategies

A new energy agreement for the period of 2020-30 is being prepared and is expected to be finalized in 2018.

Top clean energy innovation successes in 2017

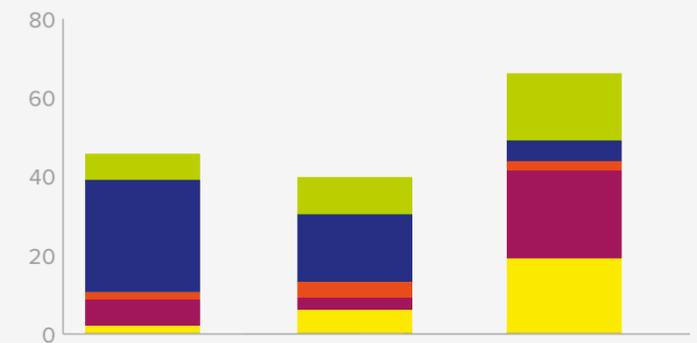
- The Danish research program on energy technology has an emphasis on demonstration of new energy technologies, which is a step towards bridging the gap between research and commercialization.
- In 2017 the Danish government launched a green energy technology export strategy, which helps attract private sector finance to the area.
- In 2017 the Government increased its funding for energy research.

Top activities delivered in support of the Innovation Challenges in 2017

Denmark is actively involved in IC# 1, 5, and 7, contributing to the discussions and development of activities. As co-hosts of MI-3 in Malmö, we are promoting the cooperation when possible. Under the umbrella of the Nordic Clean Energy Week in connection with the MI and CEM meetings in Malmö and Copenhagen, Denmark is trying to engage stakeholders and create new networking opportunities and showcasing the plethora of MI-related activities in

the Nordic region. Denmark and Danish stakeholders are actively using the information on other countries' priorities when reaching out and creating new working relationships. One example is the local energy materials research community, which took the initiative to create a materials workshop in connection with MI-3 and secured the participation of IC#6 through the MI network.

Public Sector RD&D investment



*All amounts are in Million USD	Baseline	First Year	Second Year
Energy Efficiency	6.75	9.45	16.96
CCS	0.00	0.00	0.00
Renewables	28.39	17.30	5.35
Nuclear Fission & Fusion	0.00	0.00	0.00
Hydrogen & Fuel Cells	2.06	3.92	2.39
Other Power & Storage Technologies	6.49	3.03	22.29
Other Cross-cutting Technologies/Research	1.84	5.90	18.84
Unallocated	0.00	0.00	0.00
TOTAL	45.53	39.59	65.83

EUROPEAN COMMISSION

Overview 2017

New clean energy innovation policies and/or strategies

The implementation of the [Accelerating Clean Energy Innovation \(ACEI\) strategy](#) is ongoing, and a report¹⁰ was produced taking stock of progress in each of the 20 actions. Significant progress was achieved in a number of actions, in particular:

- the EU funding for clean energy research and innovation and its top-up with private investment has continued to increase;
- the European Investment Bank will from now on reserve at least 40% of financing under the infrastructure and innovation window of the European Fund for Strategic Investment for projects that contribute to the EU's climate and energy commitments;
- a more systematic process for dissemination and exploitation of EU funded projects in clean energy research and innovation has been developed, aiming to bring the most promising results to the attention of investors;
- an Africa-EU Research and Innovation Partnership on Climate Change and Sustainable Energy has been endorsed at the Africa-EU Summit in November 2017.

The European Commission has adopted a set of measures to drive innovation in Europe in the sectors of mobility and transport. In particular, new targets for the EU fleet-wide average CO2 emissions of new passenger cars and vans have been set to help accelerate the transition to low-and zero emissions vehicles. In this context, an EU Battery Alliance has been created in order to mobilise the European industry towards electro-mobility, providing an increased investment in the EU research and innovation for energy storage and batteries in particular. In addition, the European Strategic Transport Research and Innovation Agenda¹¹ (STRIA) was adopted, presenting an integrated approach to the decarbonisation and digitalisation of transport. With STRIA and the European [Strategic Energy Technology Plan \(SET Plan\)](#), the two dimensions of the Energy Union research and innovation priorities, transport and energy, are now fully covered.

Top clean energy innovation successes in 2017

1. The [2018-2020 work programme](#) for Horizon 2020 was published with more than EUR 2 billion dedicated to four priority areas to accelerate clean energy innovation:
 - Decarbonizing the EU building stock by 2050: from nearly-zero energy buildings to energy-plus districts – EUR 479,5 million
 - Strengthening EU leadership on renewables (RES) – EUR 784 million
 - Developing affordable and integrated energy storage solutions – EUR 389,5 million
 - Electro-mobility and a more integrated urban transport system – EUR 355 million
2. Three new inducement prizes related to clean-energy innovation were launched:
 - [Fuel from the Sun: Artificial Photosynthesis](#) (Prize: EUR 5 million)
 - [Innovative Batteries for eVehicles](#) (Prize: EUR 10 million)
 - [Big data technologies](#) (Prize: EUR 2 million)
3. The European [Strategic Energy Technology Plan \(SET Plan\)](#) has also seen important developments since the launch of Mission Innovation. Eight [implementation plans](#) to coordinate research among European countries were endorsed with the goal of boosting European competitiveness in the Energy Union priority areas of concentrated solar power, deep geothermal, energy efficiency in industry, photovoltaics, storage, ocean energy, resilience and security of energy systems, and carbon capture storage and use. The associated investment forecast for the execution of these plans amounts to around EUR 18 billion.

¹⁰ 2017 progress in Accelerating Clean Energy Innovation
¹¹ <https://trimis.ec.europa.eu/>

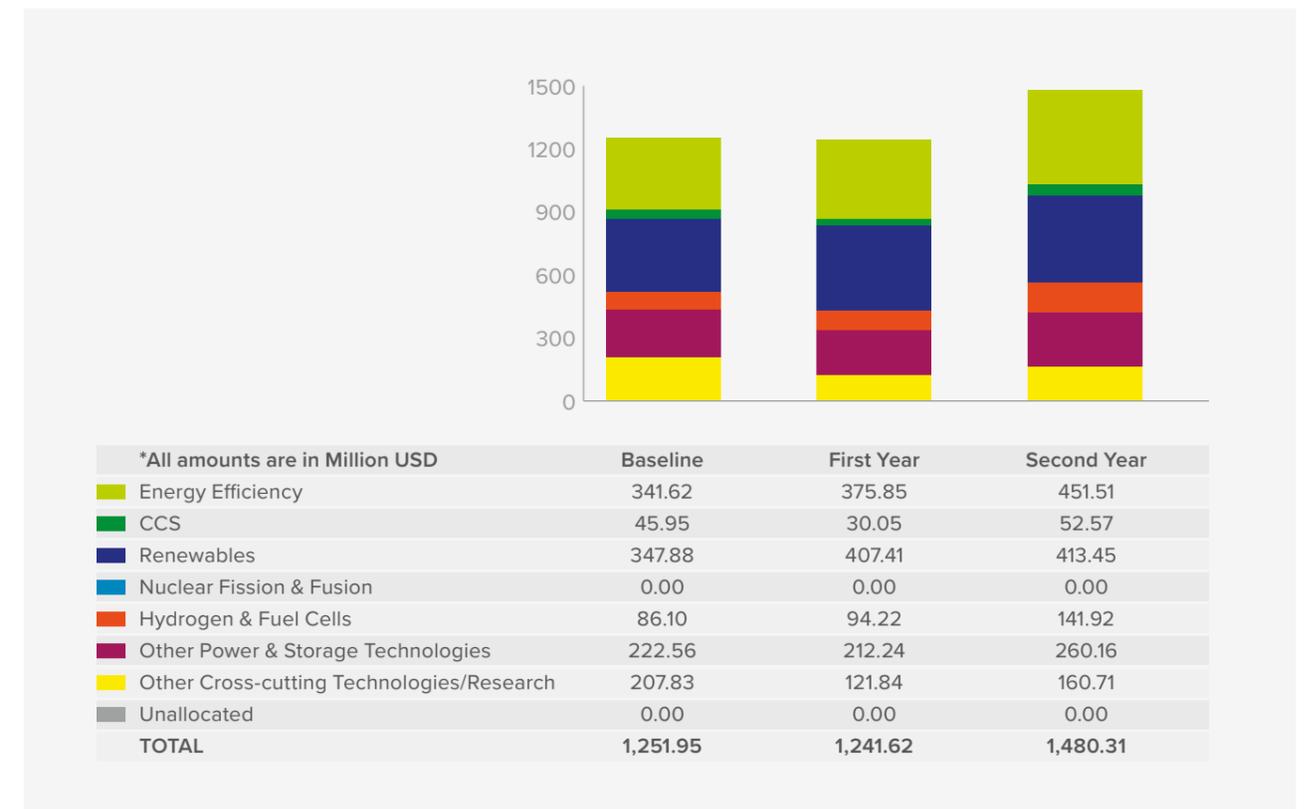
Top activities delivered in support of the Innovation Challenges in 2017

The EC has stepped up its support to Innovation Challenges through the following actions:

1. The [2018-2020 work-programme](#) for Horizon 2020 was published with around EUR 300 million allocated to calls related to all Mission Innovation Challenges.
2. Two new calls were introduced in the EC's Framework Research Programme (Horizon 2020) with the specific objective of supporting the implementation of Innovation Challenges #5 and #2 of Mission Innovation. These two calls, both open to international cooperation, are:
 - Converting Sunlight to storable chemical energy (LC-SC3-RES-29-2019 – budget: EUR 5 Million)

- Demonstration of plug and play solutions for renewable off-grid electricity (LC-SC3-RES-30-2019 – budget: EUR 10 Million)
- In addition, an inducement prize was launched to specifically support the implementation of Innovation Challenge “Converting Sunlight into Storable solar Fuels” [Fuel from the Sun: Artificial Photosynthesis](#) (Prize: EUR 5 million).
3. A workshop was co-organised by the EC and the MI Secretariat on tracking progress for MI, where key performance indicators for innovation challenges were also discussed.

Public Sector RD&D investment



Note: The MI baseline for the European Commission is the average funding over the period 2013-2015 (EUR 989 Million = USD 1,204 Million). The figures presented in the baseline column refer only to the average of the years 2014 and 2015, for which a detailed breakdown is available.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
Brazil ¹²	BECOOOL (project): Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels	The BECOOL project is a complementary effort of a European consortium with a corresponding consortium from Brazil (BioVALUE). The main objective of these projects is to strengthen EU-Brazil cooperation on advanced lignocellulosic biofuels. Information alignment, knowledge synchronization, and synergistic activities on lignocellulosic biomass production logistics and conversion technologies are key targets of both projects. Both projects are structured in 3 main pillars covering in a balanced way the whole range of activities of the biofuels value chain (biomass production, logistics, conversion and exploitation).	Open to both Public and Private sector	2017	2021	EUR 10 Million (each party contributing EUR 5 million)
Mexico ¹³	GEMex (project): Cooperation in Geothermal energy research Europe-Mexico for development of Enhanced Geothermal Systems and Superhot Geothermal Systems	The GEMex project is a complementary effort of a European consortium with a corresponding consortium from Mexico. The joint effort is based on three pillars: 1) Resource assessment at two unconventional geothermal sites; 2) Reservoir characterization using techniques and approaches developed at conventional geothermal sites; 3) Concepts for Site Development.	Open to both public and private sector	2016	2019	EUR 20 million (each party contributing EUR 10 million)

¹² Additional information on EC-Brazil collaboration: https://cordis.europa.eu/project/rcn/210282_en.html

¹³ Additional information on EC-Mexico collaboration: https://cordis.europa.eu/project/rcn/205825_en.html

FINLAND

Overview 2017

New clean energy innovation policies and/or strategies

The Government of Finland published a new national energy and climate strategy in November 2016¹⁴. The National Energy and Climate Strategy outlines the actions that will enable Finland to attain the targets specified in the Government Programme and adopted in the EU for 2030, and to systematically set the course for achieving an 80–95 per cent reduction in greenhouse gas emissions by 2050. The strategy includes two main lines for clean energy RD&D:

- Energy technology and innovations may serve as a significant driver of economic growth. Finland will continue to make major investments in developing new technologies and commercialising innovations,

in particular to speed up the introduction of clean and smart energy systems and the associated products and services, and more extensively resource-wise solutions that are based on user needs and required by communities.

- Full use will be made of the international Mission Innovation cooperation to promote the networking of Finnish cleantech companies and research institutes of the field and creating partnerships. For this purpose, a clean energy ecosystem will be organised as part of the growth programme (a cooperation network for actors) based on a strong public-private partnership.

Top clean energy innovation successes in 2017

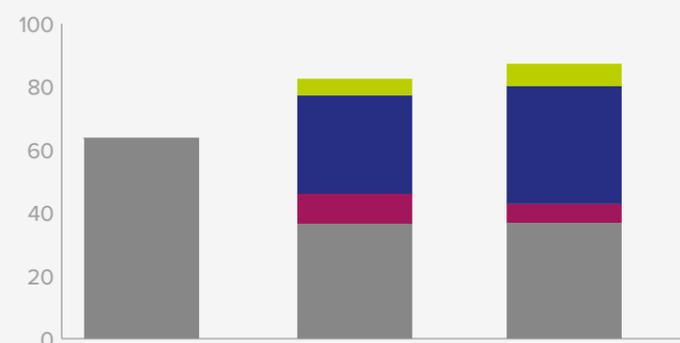
- **NeoCarbon research project:** NEO-CARBON ENERGY –project funded by Innovation Funding Agency, Business Finland (former Tekes). The project was carried out in cooperation with Technical Research Centre of Finland VTT Ltd, Lappeenranta University of Technology LUT and Finland Futures Research Centre FFRC at University of Turku. Neo-Carbon Energy's solution is an entirely new energy system based on solar and wind alongside other renewables such as hydro power, geothermal and sustainable biomass. The system will produce energy that is emission-free, cost-effective and independent. The primary solution for neocarbonisation is to use atmospheric CO₂ as a source of carbon for synthesising hydrocarbons. Researchers at Lappeenranta University of Technology (LUT) have received the national Energy Globe Award for their work in renewable energy. The award was given to the research project Neo-Carbon Energy.
- **The Finnish company Solar Foods Oy** produces an entirely new kind of nutrient-rich protein using only air and electricity. The goal of the company is to start commercial production of the environmentally revolutionary protein in 2020. Solar Foods' concept redefines the basics of food production, as it isn't dependent on agriculture, the weather, or the climate. The price of the protein product is also competitive compared to sources such as soy protein. The company's

production method is based on the research project NeoCarbon of the VTT Technical Research Centre of Finland and the Lappeenranta University of Technology (LUT) that proved the viability of the production concept for extremely protein-rich food. The results of these research projects have attracted a lot of international attention.

- **Norsepower Oy** The Norsepower Rotor Sail Solution is a modernized version of the Flettner rotor – a spinning cylinder that uses the Magnus effect to harness wind power to propel a ship. When the wind conditions are favorable, Norsepower Rotor Sails allow the main engines to be throttled back, saving fuel and reducing emissions while providing the power needed to maintain speed and voyage time. Rotor sails can be used with new vessels or they can be retrofitted to existing ships. In 2017 the company made a large scale up to full size demonstration. Norsepower has won a number of awards for the innovative Rotor Sail technology. In September 2015 the Norsepower Rotor Sail Solution won the Energy Efficiency Solution Award in annual Ship Efficiency Awards, organized by Fathom Maritime Intelligence. In June 2016 the product was awarded with the Innovation of the Year Award at the Electric & Hybrid Marine Awards. In May 2017 Norsepower's CEO Tuomas Riski was awarded the Young Entrepreneur Award at Norshipping.

¹⁴ In English: http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/79247/TEMjul_12_2017_verkkojulkaisu.pdf?sequence=1&isAllowed=y

Public Sector RD&D investment



*All amounts are in Million USD	Baseline	First Year	Second Year
Energy Efficiency	0.00	5.22	7.31
CCS	0.00	0.00	0.00
Renewables	0.00	31.33	37.13
Nuclear Fission & Fusion	0.00	0.00	0.00
Hydrogen & Fuel Cells	0.00	0.00	0.00
Other Power & Storage Technologies	0.00	9.52	6.15
Other Cross-cutting Technologies/Research	0.00	0.00	0.00
Unallocated	63.71	36.20	36.67
TOTAL	63.71	82.27	87.26

Note: the majority of unallocated spend is funding on demonstration projects. The baseline is based on average spend between 2013-2015.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date
China	Joint call	Cleantech including energy	Public – Private	2017	2018
Germany	Joint call	Smart energy	Public – Private	2017	2018

FRANCE

Overview 2017

New clean energy innovation policies and/or 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. According to the Green Growth Act, France published its national low carbon strategy in November 2015 which is currently under revision and is expected to be endorsed by the end of 2018. Meanwhile, a regular tracking process was implemented based on a scoreboard built from 184 indicators.

Regarding research and innovation, France published its National Energy Research Strategy in December 2016, focusing on key transformational themes for energy transition (energy efficiency and integration of renewable sources, increased flexibility, digitization and decentralization of systems). It also emphasizes the need to support cross disciplinary research, to foster innovation in relation to territories and the industrial network, in particular small businesses, and to develop skills and knowledge for and through R&D.

On July 6th 2017, the Minister for the Ecological and Inclusive Transition presented the Government’s Climate Plan. Drawn up at the request of the President and Prime Minister, it calls on all government departments across the board to step up the pace of the energy and climate transition and of the Paris Agreement’s implementation, throughout a five-year term. This Climate Plan sets forth the Government’s vision and ambition for laying the foundations of a new model of prosperity that makes more sparing use of energy and natural resources and for seizing the opportunities before us in terms of innovation, investment and job creation. It stakes out a sea change as regards the main greenhouse gas-emitting sectors: construction, transport, energy, agriculture and forestry, industry and waste. Showing solidarity with the most vulnerable and poorest segments of our society, in the North and South alike, is the golden thread running through all of the actions outlined in this plan, to ensure that no one is left by the wayside and that solutions are found for everyone. It is an action plan for the entire five-year term, calling on all of the government departments concerned at the impetus of the President of the Republic and the Prime Minister: with that in mind, it not only sets out specific measures but also defines the main guidelines for action which will be implemented over the coming months and discussed with

the stakeholders. Efforts will be made across the spectrum to ensure cooperation and drawing up of contracts with the local authorities, economic sectors concerned and civil society.

Regarding the actual financing of clean energy innovation projects, a new round of the French programme of investments for the future was launched at the end of 2016, with a total amount of funding of 10 billion euros over 2017-2025. Around two thirds of this sum will be dedicated to the ecology and energy transition in general, including clean energy innovation in particular. In this framework, eight calls for projects were launched at the beginning of 2018 to support research, development and demonstration projects in the field of ecological and energetic transition. These eight calls will enable a financial support amounting to 300 M€ in 2018 and 2019. The targets are for projects with TRL between 4 and 6. Besides, the French public bank of investment accompanies projects of higher TRL towards the development of demonstrators. In parallel, the programme of investments for the future enabled the setting-up of the so-called Energetic transition institutes (ITE). These structures are 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. The ITE’s aim at carrying out industrial and services developments starting from the technological innovation down to the demonstrator and the industrial prototype. Round ten ITE’s were recognized, covering various sectors, namely: green chemistry and bio-sourced materials, renewable marine energy, solar energy, geothermal energy, smart electric grids, energy efficiency, sustainable buildings, decarbonised vehicles and innovative mobility. In 2017, took place the triennial evaluation for several ITE’s, which could highlight a high quality R&D activity for a majority of these institutes, with a strong emphasis given to economic valorisation of the results achieved. The whole programme is provided with a budget envelope amounting circa 1 billion euros, financing up to 50% of the activities of the institutes.

Finally, France has launched in November 2018 a wide consultation process with stakeholders in order to adopt a new Buildings renovation plan. The plan will be adopted in April 2018 and will include a focus on innovation development and diffusion in the Building sector, in order to improve the renovation processes and works, to increase the skills and means of the SME’s of the sector. An additional program of 30 M€ will be implemented.

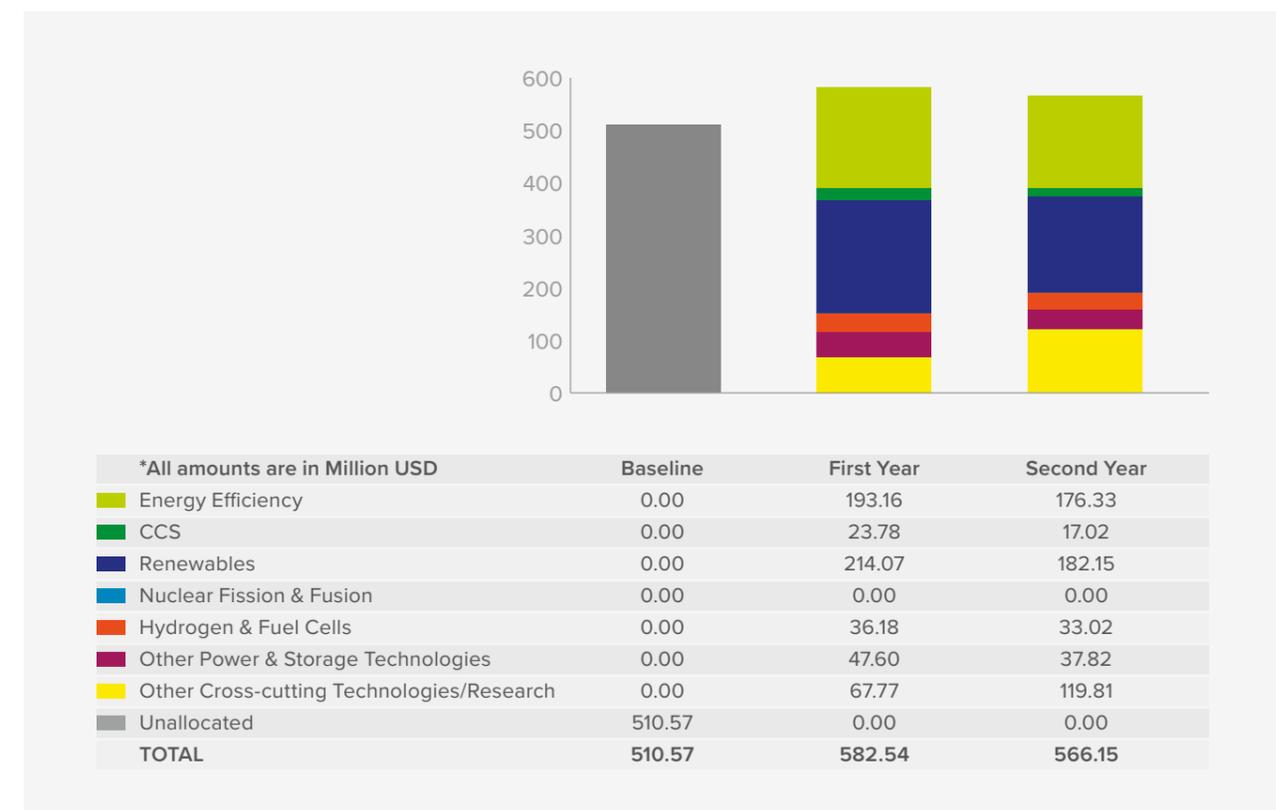
Top clean energy innovation successes in 2017

- In 2017, 216 innovation projects related to the thematic of the energetic transition were launched in the framework of the French programme of investments for a total public support of 396 M€.
- In the framework of IC#2, co-lead by France and India, France launched a call for proposals (CFP) on innovative solutions for off-grid access to energy. The CFP was closed last November and more than 90 project proposals were received. Beginning of January 2018, a selection was made by a Jury including French Ministries (energy, research and economy), AFD, IEA and ADEME. 9 projects were selected for funding. The global budget of these 9 projects amounted to 5.8 million Euros and public support amounted to 1.8 million Euros. These 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...). Innovation was also present in the projects governance.
- Floatgen, a floating wind turbine demonstration project was inaugurated at Saint-Nazaire harbour last October. The equipment is planned to be installed off the coast of Brittany (France) and goal is to deliver 2MW to the electric grid. This project is supported by the European Union as part of the FP7 programme.

Top activities delivered in support of the Innovation Challenges in 2017

- IC#2: Among the 7 Challenges identified by Mission Innovation, the Challenge on “innovation for off-grid electricity access from renewable” is co-led by France and India. In July 2017, France organized an international workshop on “off grid access to electricity” Challenge IC#2 in Paris with the International Energy Agency. This workshop gathered more than 100 stakeholders involved in Off grid access to electricity (large and small enterprises, NGOs, Governments, Funding Institutions) in order to exchange on innovations needed for the Challenge of electricity access for Off grid populations.
The main conclusions of the workshop underlined the expectation of innovation in term of technologies improvement in electricity production systems (including storage and system management) and in electricity utilization efficient equipment but also in term of business models, maintenance and empowerment of local professional. The French Ministry of Ecological and Solidary Transition asked ADEME, the French Agency for Environment and Energy Management to launch a call for proposals (CFP) on innovative solutions for off-grid access to energy as described above.
- IC#1: Smart grids: France sets the thematic smart grid as high priority in the context of the energetic transition. Therefore, France is actively participating to the regular exchanges happening under the challenge.
- IC#3: Carbon capture and usage innovation challenge: France participated to the experts' workshop which took place in September 2017 in Houston, focussing on early stage breakthrough CCUS technologies. This event hosted 250 experts of the domain and succeeded in identifying research priorities. Among the different topics addressed, France was particularly interested in the challenge of the re-use of the CO2. The report following this workshop is expected shortly.

Public Sector RD&D investment



Note: The latest available figures are those of 2016. The government spending on clean energy RD&D remained stable in 2015 and 2016 at around 500 M€. The emphasized focus areas are: energy efficiency, carbon capture and use, renewable energy sources, Hydrogen and fuel cells, energy storage, smart grids and cross-cutting activities. Despite the fact that public support is brought by France to nuclear R&D (as reported to IEA), those figures are not included in the information here, because not belonging to the perimeter taken into account in the framework of the financial doubling plan commitment under Mission Innovation. Regarding the future, it is expected that the new round of the investment for the future programme, launched in 2017, will boost the amounts allocated to clean energy innovation in the coming years.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	Funding Amount
Germany ¹⁵	Joint call ANR-BMBF for collaborative research projects on smart grids and renewable energy storage	Collaborative projects 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	2018	20 Million €
India	Joint launch of 2 calls for projects in France and India related to off-grid access to electricity	Call for projects on innovative off-grid energy access in France by the Ademe and the Ministry of Ecological and Inclusive Transition and in India by Ministry of Science and technology	Public – Private	2018	2 Million € (French call) over 6 Million € overall
EU ¹⁶	ERANet Geothermica	Combination of 17 geothermal energy research and innovation programme owners and managers from 14 countries and their regions	Public – Private	Last call took place in 2017	
EU ¹⁶	ERANet Smart Energy Systems	The initiative deals with the key challenges and topics of the future energy system: Smart Power Grids Integrated Regional Energy Systems Flexible Heating and Cooling Systems Smart Services	Public – Private	Last call took place in 2017, results expected in summer 2018	

¹⁵ Additional information on France-Germany collaboration: <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/>

¹⁶ Additional information on France-EU collaborations: <http://www.geothermica.eu> ; <http://www.eranet-smartenergysystems.eu/>

GERMANY

Overview 2017

New clean energy innovation policies and/or strategies

No new policies or strategies have been implemented in Germany since the launch of Mission Innovation, but a new

Energy Research Program is currently under preparation (see below).

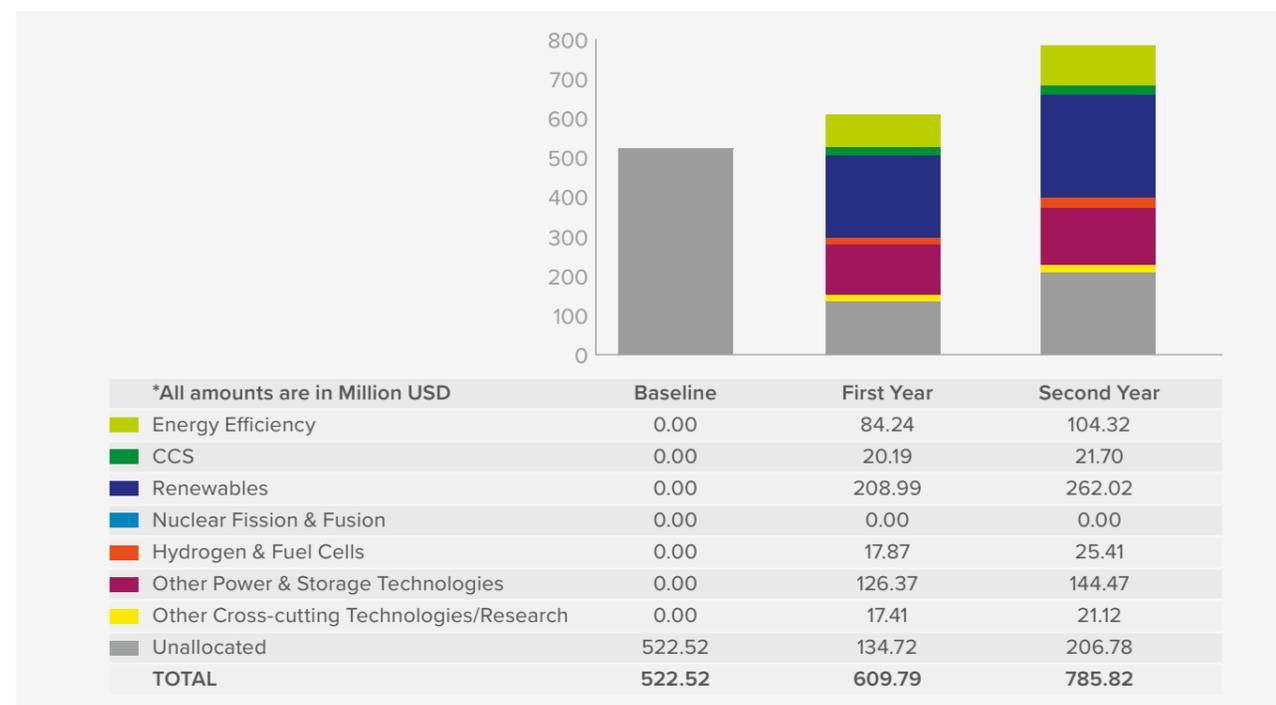
Top clean energy innovation successes in 2017

- Comprehensive consultation regarding research priorities of all major scientific, industrial and societal stakeholders in preparation of a new energy research program to be launched in 2018.
- Funding initiative “Energy Efficient Cities” launched: Living labs in six large demonstration projects in seven city quarters around Germany. The goal is to demonstrate innovative technologies for the efficient use of renewable energies in an urban context, complemented by monitoring and socio-economic analysis. The Federal Government provides more than 100 million Euros for these projects, over a period of around five years.
- Launch of funding initiative “Energy Transition in the Transport Sector: Sector Coupling through the use of Electricity-Based Fuels”. The focus of the funding initiative is on research projects which seek to produce and use alternative electricity-based fuels and to integrate the latest technologies into the energy sector. The Federal Ministry for Economic Affairs and Energy is providing around 100 million Euros worth of funding for this initiative.

Top activities delivered in support of the Innovation Challenges in 2017

- Co-leading IC#5. Organizing the work of an international expert group, resulting in the work plan presented at MI-2. Representatives from Germany have participated in numerous discussions regarding the development of Innovation Challenges as well as the different activities within Innovation Challenges. One particular focus was strengthening ties with existing initiatives and frameworks, in particular the IEA Technology Collaboration Programmes.
- Encouraging the involvement of external stakeholders and experts from Germany in Innovation Challenges (in particular IC#1, IC#5, IC#6 and IC#7). This includes presentations to selected scientists and industry representatives about MI or specific Innovation Challenges (in particular IC#5 and IC#6).
- Supporting the work of Innovation Challenges by answering surveys and providing information for country reports (e.g. IC#1, IC#5, IC#6, IC#7).

Public Sector RD&D investment



Note: The Mission Innovation baseline for Germany (450 million Euros) was defined by averaging the budget for project funding within the 6th Federal Energy Research Programme on renewable energy and energy efficiency technologies for fiscal years 2012 to 2015. Funding for Nuclear Safety Research is not included, since nuclear energy is not included in the definition of Clean Energy used by Germany in the context of Mission Innovation. In addition to project funding within the 6th Federal Energy Research Programme the numbers reported below for 2016 and 2017 also include new programmes for Clean Energy demonstration projects that started after the launch of Mission Innovation.

Collaborations

Country	Name of collaboration	Brief description	Start Date	End Date	Funding Amount
Finland	Second Finnish German Joint Call	The initiative is supporting the European Strategic Energy Technology Plan (SET-Plan)	2018		~ 9 million Euros (German side only)
France ¹⁷	MOPGA-GRI	Contribution to the Fellowship Programme "Make our planet great again" initiated by France in the fields of climate, earth system and energy research	2017	2022	5 million Euros for energy-research

¹⁷ Additional information on Germany-France collaboration: www.fona.de/de/deutsch-franzoesisches-foerderprogramm-fuer-klima-energie-und-erdsystemforschung-findet-grosse-internationale-resonanz-22858.html

INDIA

Overview 2017

New clean energy innovation policies and/or strategies

The Indian Government plans to provide 24x7 power to the entire country by the year 2019. It would like to create infrastructure that is cost effective, sustainable as well as solutions that use clean energy. The Government is also looking at providing sustainable and energy efficient infrastructure in 100 smart cities that would include provision for adequate power generation and using renewable as well as energy efficiency technologies.

- A new policy for "testing, standardisation and certification" of products in the renewable energy sector has been developed. The policy aims to adopt, update and develop standards for all renewable energy equipment, systems, components and devices in line with international practices and make performance certification mandatory to ensure quality and reliability in renewable energy supply in the country.
- **Wind Solar Hybrid Policy** to Strengthen Energy Security of India: The Government has formulated draft National Wind-Solar Hybrid Policy with the objective to provide a framework for promotion of large grid connected wind-solar PV system for optimal and efficient utilization of transmission infrastructure and land, reducing the variability in renewable power generation and thus achieving better grid stability. Further, the policy aims to encourage new technologies, methods and way-outs involving combined operation of wind and solar PV plants.
- The new **National Policy on Bio-fuels** has been formulated and submitted for cabinet approval. The goal of the policy is to enable availability of biofuels in the market thereby increasing the blending percentage. There may be incentives for setting up biorefineries through Variability Gap Funding schemes for differential pricing and off take insurance.
- **Solar energy:** The Government of India has been able to revise projects based on National Solar Mission target of Grid Connected Solar Power from 20,000 MW to 100,000 MW by the year 2022. Further, the Ministry of New and Renewable Energy has sanctioned a master plan for developing 50 solar cities of the proposed 60 cities which is inclusive of cities in the National Capital Region.
- **Wind energy:** The Union Cabinet – headed by Prime Minister Narendra Modi – has approved the National Offshore Wind Energy Policy. This approval now gives a path for offshore wind energy development which also includes setting up of offshore wind power projects, along with activities such as research and development.
- **Hydrocarbons:** the Ministry of Power invited global firms for participating in the unconventional hydrocarbons sector in India, especially focusing on exploring as well as exploiting alternate energy sources including shale gas, shale oil as well as gas hydrates.
- The new government implemented institutional change affecting the research policy through creation of National Institution for Transforming India (**NITI Aayog**), which replaced the earlier Planning Commission. Under the above mentioned institution, the Atal Innovation Mission (currently endowed with a budget of around € 20m) aims to provide an innovation promotion platform and related R&D funds. Its mandate states that it should promote a network of world-class innovation hubs (e.g. as part of IITs, IIMs, AIIMs, etc). The new government also launched a FDI Policy 2015 and a new National IPR Policy.

Top clean energy innovation successes in 2017

- State-run Indian Oil Corporation Ltd (IOCL) and LanzaTech, carbon recycling company, have signed a deal to build the world's first refinery of gas-to-bioethanol production facility in India at an investment of Rs 350 crore.
- DBT-Indian Oil Corporation Centre has successfully developed indigenous enzyme technology which has successfully been evaluated in the pilot plant at M/s PrajIndustries, Pune and have shown comparable efficiency to the commercially used current enzyme. The indigenously developed cellulase enzyme can be integrated with the commercial 2G Bioethanol production using onsite enzyme production model to reduce the opex and dependability on few proprietary suppliers.
- India is taking a leading role in the International Renewable Community and was a leading country along

with France in the formation of the International Solar Alliance (ISA), an international body of 121 countries lying between the Tropic of Cancer and Tropic of Capricorn. 47 countries have signed the Framework Agreement and 18 countries have ratified it within 1 year of opening of Framework for signature. Accordingly, ISA became a legal entity on 6/12/2017, with its headquarters in India.

to drive the cost of LED lights down by 85 % in less than three years. The energy savings from replacing 770 million household and street lights will cut India's peak electricity demand by 20,000 megawatts (MW) and slash emissions of climate-heating CO2 by nearly 80 million tonnes annually.

- A government supported company, Energy Efficiency Services Limited, has worked with LED manufacturers

- India's solar and wind boom has pushed costs off a cliff, falling from 12 cents a kW/hr to just 4 cents a kW/hr for solar.

Top activities delivered in support of the Innovation Challenges in 2017

- **Mission Innovation Smart Grids Workshop** - An International workshop was organised during 16-19th November, 2017 in New Delhi to define research priorities and an develop action plan for time-bound realisation of these objectives.¹⁸
- The Department of Science and Technology announced **Funding opportunity Announcement** to financially support activities towards the design of research, development and demonstration projects that can address the issue of integration and inter-operability of existing centralized power networks (without disturbing the existing power network) with renewable energy-based power plants in the short-run and also develop R&D pathways for 100% renewable powered grid.¹⁹
- **Mission Innovation Off-Grid Access to electricity Workshop:** A national workshop was organized in May 2017 in New Delhi with the objective of supporting a significant reduction in price and increase performance of renewable power systems by 2020 for individual homes in off grid region and, for remote communities. Pursuant to this, the **Department of Science and Technology** announced the **Funding Opportunity Announcement for Off-Grid Access** to electricity. The purpose of the call is to develop the systems that integrate innovative technologies (components, subsystems etc.) at high readiness level, demonstrate their technical feasibility and cost effectiveness in diverse social contexts of countries requiring off-grid access to electricity including India. It is expected to evolve technology and develop methodology and business models tunable to local conditions.²⁰
- **Mission Innovation Carbon Capture & Utilization Workshop:** A national workshop on carbon Capture and Utilization was organized on 13th September 2017 at New

Delhi, India.²¹ As a follow up, a National RD&D Funding Opportunity Announcement is proposed to support the **IC#3 challenge**. This funding will support researchers and private sector actors to work collaboratively on 3-year projects. The focus will be to accelerate innovation around the focus of innovation challenge IC#3 and collaborative work is encouraged.

- The Mission Innovation India Unit with support from Department of Biotechnology organized the **International Conference on Sustainable Biofuels** in February 2018 in New Delhi. The aim of the conference was to bring together experts and delegates from 19 countries together to take stock of current knowledge, share information and best practices, and build consensus on the actions most needed to move forward. Also, the conference aimed at seeking a clear understanding of the development of the bio-economy made by participating countries and to increase awareness of policy makers about the challenges faced by the industry-investor for commercial scale up of advanced biofuels. The need for collaboration-cooperation to speed up commercialization and focus on latest R&D in advanced biofuels will be the expected outcomes of this International event.²²
- Pursuant to the ICSB 2018, a **Funding opportunity Announcement (FoA)** for Sustainable Biofuels has been proposed. The details for this FoA have been shared with all the Sustainable Biofuel Innovation Challenge (SBIC) member countries.
- The Mission Innovation India unit with support from DBT organized the National Workshop on **Sunlight Conversion Innovation Challenge** in September 2017. At New Delhi India.²³ India is in process of announcing a Funding Opportunity call to support the IC#5 Innovation Challenge.

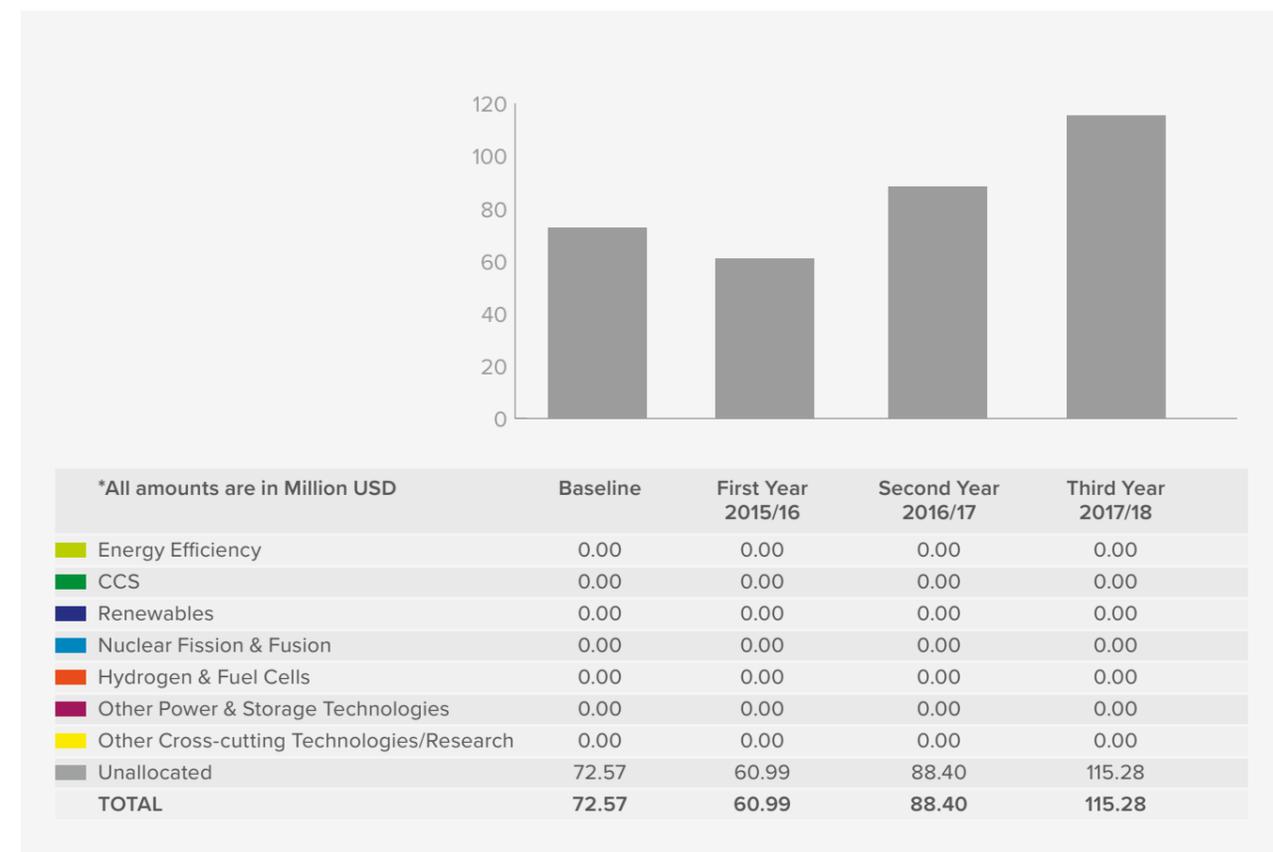
¹⁸ <http://dst.gov.in/news/mission-innovation-smart-grids-workshop>
¹⁹ <http://dst.gov.in/sites/default/files/MI%20Call%20Smart%20Grids.pdf>
²⁰ <http://www.dst.gov.in/sites/default/files/4-MI%20Off%20Grid%20Call%20VF.pdf>
²¹ <http://mission-innovation-india.net/wp-content/uploads/2017/12/IC3.pdf>
²² <http://pib.nic.in/newsite/PrintRelease.aspx?relid=176768>
²³ <http://mission-innovation-india.net/wp-content/uploads/2017/12/IC5.pdf>

This funding will support researchers and private sector to work collaboratively on a 3year projects. The focus will be to accelerate innovation around the focus of innovation challenge IC#5 and collaborative work is encouraged.

- **Mission Innovation India workshop on Clean Energy Materials** was organized on August 17, 2017 New Delhi.²⁴ Under the National Funding Programme, a Call for proposal on Clean Energy Materials (Materials for Energy Storage (MES) and Material for Energy Conservation and Storage Platform (MECSP) has been proposed.

Mission Innovation–India Workshop on **Affordable Heating and Cooling of Buildings** was organized on August 17th, 2017 at New Delhi.²⁵ A RD&D funding call on IC#7, Affordable heating and Cooling of Buildings has been proposed for this year to accelerate innovation around the focus of innovation challenge IC#7 and collaborative work is encouraged.

Public Sector RD&D investment



²⁴ <http://mission-innovation-india.net/wp-content/uploads/2017/12/IC6.pdf>
²⁵ <http://mission-innovation-india.net/wp-content/uploads/2017/12/IC7.pdf>

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Funding Amount
USA ²⁶	INDO-US JCERDC	The overall aim of the JCERDC is to facilitate joint research and development on clean energy to improve energy access and promote low-carbon growth. To achieve this objective, the Indo-US JCERDC supports multi-institutional network projects using a public-private partnership model of funding.	Public-Public	\$50 Million USD
USA ²⁶	UIASSIST: U.S.-India collaborative for smart distribution System with Storage	Multi-disciplinary team to address essential issues related to the adoption & deployment of smart grid concepts along with Distributed Energy Resources (DERs), including storage and the distribution network for its efficient & reliable operation.	Public-Public	\$30 Million USD
USA ²⁶	U.S.-India Clean Energy Finance Initiative (USICEF)	The initiative will raise and deploy up to \$20 million in project preparation support, to be sourced equally from U.S. foundations and the Government of India, to solar power projects under consideration for financial support from the Overseas Private Investment Corporation (OPIC).	Public-Private	\$20-400 Million USD
USA ²⁶	U.S.-India Catalytic Solar Finance Program (CSFP)	The CSFP will raise and deploy up to \$40 million in high-impact catalytic capital, to be sourced equally from U.S. foundations and the Government of India, in support of investments into India's solar market, with a particular focus on the off-grid and solar rooftop markets that will benefit poor communities.	Public-Private	\$40 Million - \$1 Billion USD
UK ²⁷	UK-India Joint Virtual Clean Energy Centre	The Centre, which will be delivered through the RCUK Energy Programme involving the Engineering and Physical Sciences Research Council and other research councils, brings together leading experts from the UK and India with complementary expertise and experience to address technical challenges associated with rapidly growing solar generation in both countries.	Public-Public	\$10 Million USD

²⁶ Additional information on India-USA collaborations: <http://www.dbtindia.nic.in/indo-us-jcerdc/>; <https://www.iitk.ac.in/new/data/press/Press-Release-IIT-Kanpur-to-Lead-a-Joint-Indo-US-Program.pdf>; <https://www.usicef.org/us-india-clean-energy-finance-usicef-opens-call-applications/>; <http://pib.nic.in/newsite/PrintRelease.aspx?relid=155588>

²⁷ Additional information on India-UK collaborations: <https://epsrc.ukri.org/newsevents/news/virtualcleanenergycentre/>; <http://www.dst.gov.in/callforproposals/energy-demand-reduction-built-environment-joint-india-uk-call-proposals>

Country	Name of collaboration	Brief description	Type of collaboration	Funding Amount
UK ²⁷	Indo-UK Cooperation Programme on "Energy demand reduction in the built environment"	UK's EPSRC to evolve a joint India & UK research programme to help reduce energy demand in UK & India's built stock, both new major urban developments' currently being planned and existing built stock.	Public-Public	\$3.8 Million USD
Brazil ²⁸		International Cooperation projects Ongoing: Wastewater to Bioenergy Integrated Biorefinery Approach towards production of sustainable fuel and chemical from Algal biobased systems Biorefining of sugarcane bagasse for production of bioethanol and value-added products	Public-Public	
Germany ²⁹	UNDP/GEF assisted Project on "Scale Up of Access to Clean Energy for Rural Productive Uses" DFID assisted Project on Energy Access Policy Fund (EAPF) GIZ assisted Project on "Green Energy Corridor (GEC), Integration of Renewable Energies (I-RE) and Access to Energy in Rural Areas (ACCESS) US assisted project on "Promoting Energy Access through Clean Energy" ("PEACE")	Clean Energy Initiatives	Public-Public	

²⁸ Additional information on India-Brazil collaboration: www.dbt.nic.in

²⁹ Additional information on India-Germany collaboration: <https://mnre.gov.in/file-manager/annual-report/2017-2018/EN/pdf/chapter-11.pdf>

INDONESIA

Narrative

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

Public Sector RD&D investment



*All amounts are in Million USD

	Baseline	First Year
Energy Efficiency	0.00	0.00
CCS	0.00	0.00
Renewables	0.00	0.00
Nuclear Fission & Fusion	0.00	0.00
Hydrogen & Fuel Cells	0.00	0.00
Other Power & Storage Technologies	0.00	0.00
Other Cross-cutting Technologies/Research	0.00	0.00
Unallocated	16.70	30.40
TOTAL	16.70	30.40

ITALY

Overview 2017

New clean energy innovation policies and/or strategies

The Italian Government launched in November 2017 a new National Energy Strategy (NES). NES 2017 is based on evidence, input and contributions that emerged in national and international meetings and a broad public consultation. The reference scenario has been elaborated considering the trend of the EU and national energy context by 2030 and 2050. NES 2017 also promotes technology innovation to support energy transition by means of doubling of public funds for cleantech research according to the Mission Innovation initiative. Italy committed to double public funds

for R&D for clean energy from 222 Million Euro in 2013 to 444 Million Euro in 2021.

The Italian Government also launched at the end of 2017 the National Strategy for Sustainable Development which promotes energy for development with appropriate and sustainable technologies optimized for local contexts, especially in rural areas, support for the development of enabling policies and regulatory mechanisms leading to a modernization of energy governance.

Top clean energy innovation successes in 2017

- The Ministry of Economic Development has approved the 2017 year-plan of the National Electric System Research Fund. The resources allocated amount to approximately EUR 95.5 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. 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, electric transmission and end-use. It is financed through a specific component of the end-user electricity price.
- The Ministry of Education, Universities and Research (MIUR) has approved in 2017 the National Energy Technology Cluster which supports RD&D as well as technology transfer in the Energy Area. The Cluster aims at combining the demand for innovation from the industrial sector with the offer of innovation coming from

the research structures of the country, supporting the achievement of the expected targets in terms of research planning from the European SET-Plan, the NES and the participation in Mission Innovation. Two project lines are foreseen: The development of innovative technologies for energy transformations and storage, in particular for Concentrated Solar Plants (CSP), and Smart grids. The leading Agency is ENEA with more than 80 stakeholders involved from industries, R&D organisations, universities.

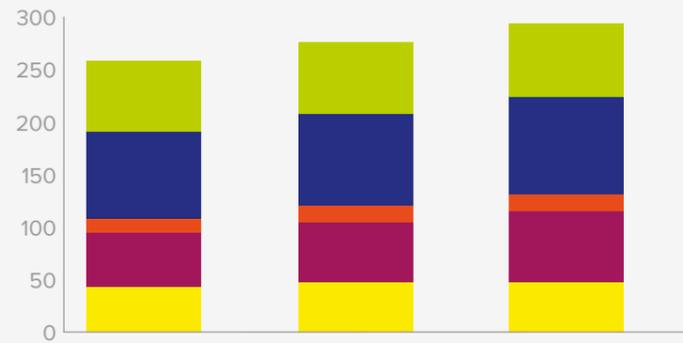
- The Ministry of Economic Development has launched in 2017 a Call for proposals on the electrical infrastructures for the development of smart grids for energy distribution in the territories of the least developed regions of Italy. The resources allocated amount to EUR 80 million. The Call foresees a series of interventions aimed at creating smart grids for energy distribution and directly increasing the distribution of energy produced from renewable sources, as well as storage systems for energy produced by renewables.

Top activities delivered in support of the Innovation Challenges in 2017

- Bilateral programs/collaboration agreements with India and China launched on Nov. 2017 in the field of Smart Grids Innovation Challenge.
- A 3.7 M€ funding programme for tests and experimental activities for the assessment of the environmental impact of the biofuel emissions, as well as the expected benefits from its use in place of traditional fuels in the aviation sector.

- Italy has contributed to the IC7 Workplan with its experience in studies on the energy rehabilitation of the existing park of public buildings aimed at achieving the "nearly zero energy buildings - nZEB". In particular a few R&D topics have been launched in support of the workplan, such as: advanced heat pumping and heat storage solutions, IoT and cloud computing for predictive maintenance, building-level integration of heating and cooling systems.

Public Sector RD&D investment



*All amounts are in Million USD	Baseline	First Year	Second Year
Energy Efficiency	67.94	68.75	69.91
CCS	0.00	0.00	0.00
Renewables	82.48	87.24	92.93
Nuclear Fission & Fusion	0.00	0.00	0.00
Hydrogen & Fuel Cells	13.68	15.30	16.46
Other Power & Storage Technologies	51.94	56.93	67.03
Other Cross-cutting Technologies/Research	42.33	47.56	47.32
Unallocated	0.00	0.00	0.00
TOTAL	258.37	275.78	293.65

Note: All data is provisional. The Italian MI baseline has been set at 222 million Euro with reference to the 2013 spending, doubling to Euro 444 million by 2021. The 2018 budget law foresees the establishment of a Fund for the development of immaterial capital, competitiveness and productivity managed by the Ministry of Economy, in agreement with the Ministry of Economic Development and the Ministry of Education, Universities and Research, which will be used partially to cover the doubling commitment, together with other funding sources. The amount for the year 2018 is 5 million euros each of the years 2019 to 2020 is 125 million euros, for each of the years from 2021 to 2024 is 250 million euros, for each of the years 2025 to 2030 is 210 million euros and from the year 2031 is 200 million euros.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
India	Executive Program for scientific and technological cooperation on:	Inter-Ministerial program of co-funding scientific cooperation projects between Italy and India	Public – Public	2017	2019	€100,000 per program
		<ul style="list-style-type: none"> Development of catalysts for converting biomass derived synthesis gas to fuels via Fischer-Tropsch synthesis Sustainable development of Electro-membrane bio-reactors for waste water reuse with production of alternative green energy 				
China	Cooperation Agreement between Ricerca sul Sistema Energetico (RSE) and the Institute of Electrical Engineering, Chinese Academy of Science (IEECAS)	Cooperation Agreement on Joint Application for Strategic Key Programme for International Scientific and Technological Innovation Cooperation Project of China “Mission Innovation Smart Grids International Environmental Project”	Public – Public	2017	2020	
India	Cooperation Agreement between Ricerca sul Sistema Energetico (RSE) and the Indian Institute of Technology Roorkee (IIT Roorkee)	Cooperation Agreement on Joint Application for Strategic Key Program for International Scientific and Technological Innovation Cooperation Project of Italy “Mission Innovation Smart Grids International Environmental Project”	Public – Public, Public - Private	2017	2022	\$2M

JAPAN

Narrative

Japan has been positively working on R&Ds on energy and environmental fields.

For instance, since the mid-1970s, Japan has been promoting R&Ds of technologies in the field of energy and environment including photovoltaic cells, heat pumps and fuel cells, under the national strategies such as the “Sunshine Project” and the “Moonlight Project”. Based on such long-term strategies, Japan has realized breakthrough innovations including wide diffusion of solar energy generation and the commercialization of fuel-cell vehicles, ahead of the rest of the world.

In order to accelerate R&Ds of innovative technologies for drastically reducing GHG emissions in the long-term, Japan has established a new national strategy, the “National Energy and Environment Innovation Strategy towards 2050 (NESTI2050)”, in 2016. Under this strategy, Japan identified such promising technologies as next-generation batteries and technologies related to hydrogen and will focus to conducting R&Ds on these technologies. This effort is in line with that of MI.

Japan registered the FY 2016 as its base year and 45 billion yen for its baseline amount. Further, Japan will try

to allocate as much budget as possible to the fields of innovative technologies looking ahead to the year of 2050 in NESTI2050. Even if there are financial constraints, Japan will aim at doubling the budget in five years.

In addition, Japan compiled a report called the Long-term Energy Supply and Demand Outlook for FY2030 (the “Energy Mix”). Tackling climate change issues requires finding a balance between mitigation measures and economic growth. To achieve this, Japan is committed to:

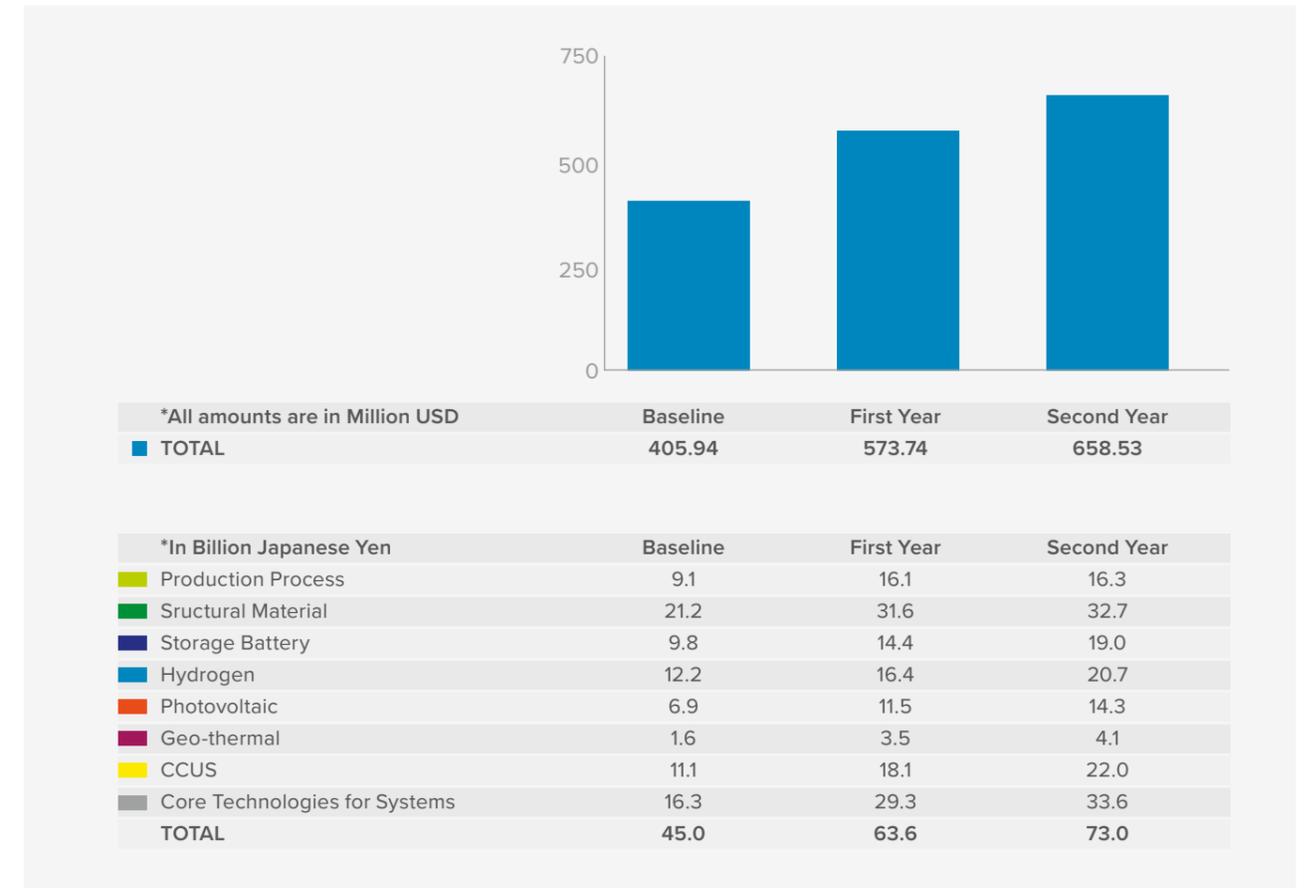
1. Promoting energy-saving measures,
2. Expanding the use of renewable energy sources, and
3. Increasing investments aimed at establishing a new energy system to improve the efficiency of energy use.

In particular, the total share of renewable energy is set to double from 12% in 2013 to 22-24% (Solar 7.0%, Wind 1.7%, Biomass 3.7-4.6%, Geothermal 1.0-1.1%, Hydropower 8.8-9.2%) in 2030.

Public Sector RD&D investment

- Country-Determined Baseline Year(s): 2016
- Baseline Funding Amount: JPY 45 billion
- Doubling Target-Year: 2021
- Doubling Target Amount: JPY 90 billion

Updated Public Sector RD&D investment



MEXICO

Overview 2017

New clean energy innovation policies and/or strategies

Mexico has organized three National Research Priorities Workshops: Materials Acceleration, Clean Cities and Energy Storage. The former resulted in the Materials Acceleration Platform Report, which was published in January 2018. The results of these workshops indicate the guiding lines for research and development for the energy sector.

Mexico has developed National Roadmaps for Clean Energies, associated with each of the five ongoing CEMIEs

(Mexican Energy Innovation Centres). As of April 2018, we have published the following: Geothermal, Wind, Solar PV, Ocean, Solid Biofuels, Bioethanol and Biodiesel; and during the following weeks will also publish reports on Biojet, Biogas, Solar Thermal and Direct Use Geothermal. All of these documents are treated as Public Policies to drive each renewable energy's research and development.

Top clean energy innovation successes in 2017

- Mexico launched a call for proposals in cooperation with the University of California System, to support energy efficiency projects. After the evaluation process, five projects were selected and will receive 122 million pesos [MXP]. These projects are set to begin during 2018.
- Mexico launched a call for proposals in Cooperation with the UK Newton Fund to build research teams that focus on energy policy development, on themes such

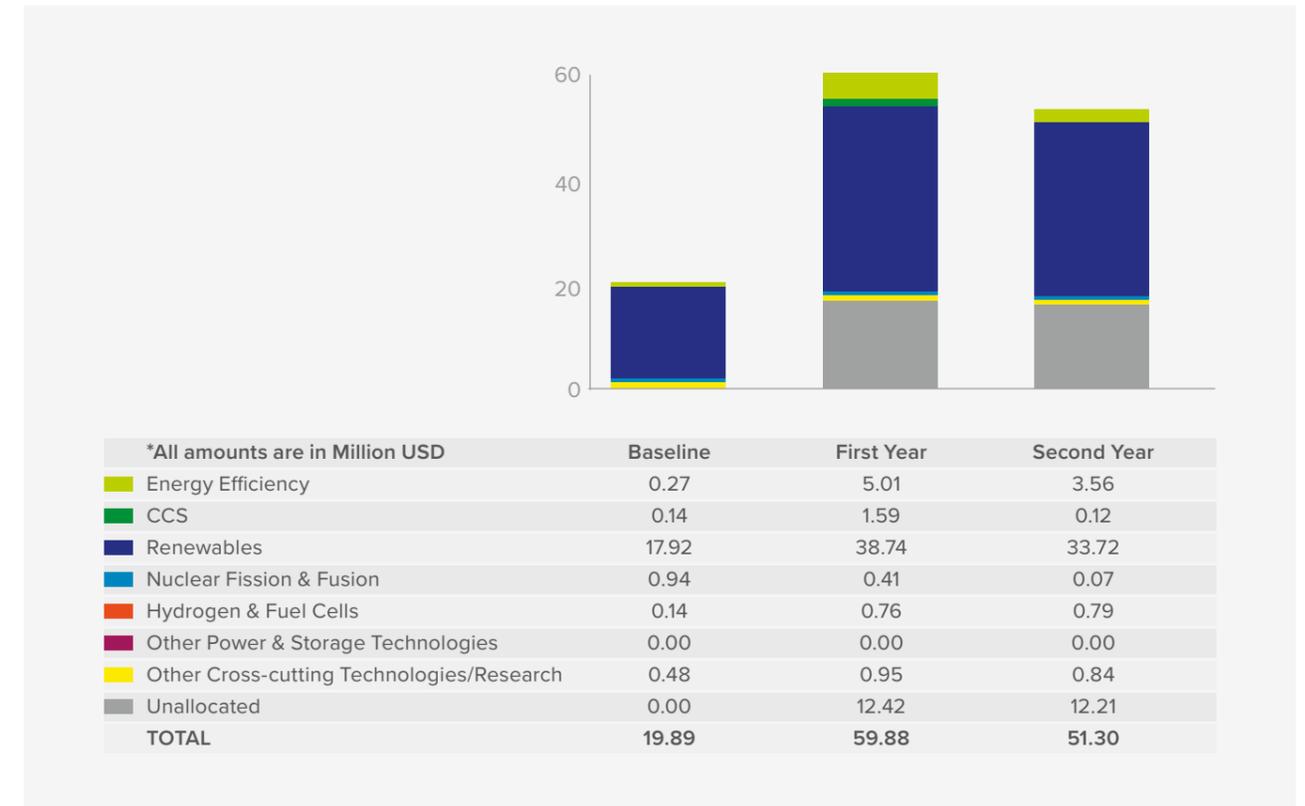
as Energy Storage, Energy Efficiency and Epidemiology, Materials for Clean Energies and Offshore clean energy technologies. Six projects were selected and will be receiving 6.3 million MXP during 2018.

- Mexico also published two calls for proposals that relate directly to two Mission Innovation Challenges: Smartgrids and CCUS. With 450 and 988 million MXP, respectively, México expects to have two projects running in 2019.

Top activities delivered in support of the Innovation Challenges in 2017

- Co-organized and hosted the first international BRN Workshop, working closely with our co-lead the US DOE and other MI partners, especially from Canada, Italy, and EC.³⁰ Together with our co-leads from US DOE, MI partners, and experts who participated in the Mexico Workshop, we published the first international BRN Workshop Report.³¹ Engaged with our MI partners and brought on board Canada / NRCAN as the third co-lead of this initiative.³²
- Together with our co-leads from US DOE, MI partners, and experts who participated in the Mexico Workshop, we submitted a paper for publication in the renowned Journal Nature Materials. Title: Accelerating Discovery of New Materials for Clean Energy in the Era of Smart Automation.³³
- Mexico has supported the Mission Innovation Secretariat with two former Masters' Students, who were supported with scholarships from the Energy Sustainability Fund. Even though the Scholarships Program is not reported as a Mission Innovation Investment Commitment, we are developing talent that will be able to drive the national effort in the Clean Energy Transition.
- Mexico is actively participating in the Biofuels Innovation Challenge, having frequent meetings and calls with Canada and the US. Also, a Mexican technical delegation attended a Biofuels Workshop in India last February.

Public Sector RD&D investment



Note: Baseline spend is based on average between 2013-15.

Collaborations

Country	Name of collaboration	Brief description	Sectors	Start Date
USA–Canada	Materials Acceleration Platform	Report describing priorities and opportunities for MI countries engaged in R&D in IC6.	Public-Public	2017
USA - Canada	North American Biojet Research Priorities Workshop	Workshop to identify priorities for research and deployment of biojet within North America.	Public-Public	2018

³⁰ Press article: <http://mission-innovation.net/2017/09/19/ic6-deep-dive-workshop/>

³¹ <http://mission-innovation.net/wp-content/uploads/2018/01/Mission-Innovation-IC6-Report-Materials-Acceleration-Platform-Jan-2018.pdf>

³² <http://mission-innovation.net/2018/01/26/press-release-materials-workshop-report/>

³³ Authors: Daniel Tabor, Loïc Roch, Semion Saikin, Christoph Kreisbeck, Dennis Sheberla, Joseph Montoya, Shyam Dwaraknath, Muratahan Aykol, Carlos Ortiz, Hermann Tribukait, Carlos Amador-Bedolla, Christoph Brabec, Benji Maruyama, Kristin Persson, and Alán Aspuru-Guzik

NETHERLANDS

Overview 2017

New clean energy innovation policies and/or 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. The Netherlands aims to set ambitious CO2-reduction targets on a sectoral level within a Climate Agreement with all relevant stakeholders, including industrial stakeholders. For each sector, the Netherlands wants to agree on a balanced and future-oriented package of instruments and measures.

The Netherlands aims to create a set of mission-oriented innovation programmes that are designed to stimulate the development and market-introduction of effective CO2-reduction technologies. The Netherlands aims to finalize the general framework of the Climate Agreement by mid-2018 and develop implementation programs by the end of 2018 that will consist of a package of measures and a confined number of mission oriented programs.

Top clean energy innovation successes in 2017

The Netherlands supports energy-innovation projects through a variety of programs and collaborations. Among the most successful national programmes are the Netherlands Topsector Energy programme, the demonstration programme for energy-innovation that supports the demonstration of projects with a big potential for export and the renewable energy programme that supports early technologies to achieve cost reductions.

Among the research, development and demonstration activities that the Netherlands has delivered, we would like to highlight the following projects:

1. Airborne wind energy under offshore conditions: a tethered aircraft that converts wind at higher altitudes into electricity.
2. Electric high-temperature heat pump; generation of tapwater at a temperature of 65 oC in combination with high and/or low temperature heating and cooled water leading to energy savings of 40%-60%.
3. Geothermal Directional Drilling: making it possible to efficiently develop a new spectrum of geothermal energy at a depth between 500 – 1.250 meters.

Top activities delivered in support of the Innovation Challenges in 2017

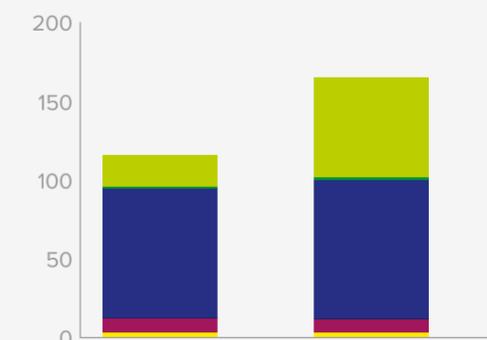
The Netherlands has initiated the development of the Comfort and Climate Box as a collaboration in a Super Annex under two IEA Technology Collaboration Platforms (TCPs) and MI Innovation Challenge #7. Integrated systems consisting of heat pumps and storage are an important technological option to accelerate the use of renewable energy for heating and cooling. By combining heat pumps and storage, several issues may be tackled, such as

- Balancing & controlling electricity grid loads;
- Capturing a large(r) share of renewable (local/regional) input (i.e. solar thermal, solar PV);
- Optimizing economics, CO2-emissions, fuel use throughout time;
- Providing optimal supply security to buildings.

Commercial development of this type of solution is progressing very slowly. This Combined Annex will accelerate market development of combined heat pump / storage packages (working title “Comfort and Climate Box”, or CCB).

This is an example for cooperation and leveraged output quality for both this Annex and IC#7. This Annex may serve to bring together several ongoing and projected research efforts, serving as a kick-starter for researching, testing and deployment of systems, giving IC#7 a head start. At the same time, external funding of the partners of this Annex is essential to achieve the highest ambitions.

Public Sector RD&D investment



*All amounts are in Million USD

	Baseline	First Year
Energy Efficiency	20.54	63.82
CCS	1.28	1.39
Renewables	82.04	88.31
Nuclear Fission & Fusion	0.00	0.00
Hydrogen & Fuel Cells	0.35	0.23
Other Power & Storage Technologies	8.35	8.12
Other Cross-cutting Technologies/Research	3.48	3.25
Unallocated	0.00	0.00
TOTAL	116.04	165.12

The Netherlands can only provide the final data on Energy Research expenditures after the corresponding budgets have been committed within funding rounds and after the funding rounds have formally been closed. This takes place in July each year. Therefore, we are not able to report yet on the MI RD&D spending in 2017 at this point in time.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
IT, DE, FR, DK, EC ³⁴	ERANET Cofund GEOTHERMICA	Transnational collaboration, forwarding geothermal energy utilization	Public – Public	2017	2022	1st call: €30 million
EC, Norway, etc.	ACT Era-net call	Transnational collaboration on CCUS research and innovation	Public – Public	2018		

³⁴ www.geothermica.eu

NORWAY

Overview 2017

New clean energy innovation policies and/or strategies

The Energi21 Strategy– A common point of reference for Norwegian clean energy RD&D: This spring Norway will launch a revised strategy for research, development and demonstration in the energy sector. Energi21, an advisory board appointed by the Norwegian Ministry of Petroleum and Energy, is developing the new strategy with broad input from the Norwegian energy technology community. The board of Energi21 is dominated by industry, but research institutes, universities and authorities are also well represented. They provide the Ministry with recommendations on future strategic priority areas. Energi21 was launched for the first time in 2008 and they revise the strategy about every

third year. In an international context, this cooperation and coordinated efforts to find a national common ground is quite unique.

The new revised strategy will analyze current trends in the energy sector and give advice on how Norway should adapt its energy RD&D policies. Specifically, the new edition will look at how energy for transport should be integrated into the strategy. It will also look at the energy system as a whole, where digitalization is a key trend. Furthermore, hydropower, solar energy, CCS and offshore wind will remain key priorities for Norway.

Top clean energy innovation successes in 2017

- **PILOT-E: Fast-track from idea to market:** At the second Mission Innovation Ministerial in Beijing, Norwegian Minister Terje Søviknes highlighted a new financing programme, called PILOT-E. This is a collaboration between different Norwegian energy RD&D support schemes and it works as a “fast-track” through the stages of research; from idea to market. PILOT-E is inspired by the American programs ARPA and DARPA, and is designed to address specific challenges.

operation. The FME centres span the areas of hydropower, smart grids, energy efficiency in trade and industry, environment-friendly transport, CO2 management (CCS), solar cells, biofuels and zero-emission urban zones.

FME is a Norwegian acronym for “Centre for Environmentally-friendly Energy Research” and consists of a host institution and partners from both other research communities as well as industry and the private sector. The FME scheme is a long-term initiative designed to generate world-class research and solutions to climate- and energy-related challenges. Industrial development is also a key goal. Because of that, at least 25 per cent of the funding of these centres has to come from business and other user partners. This ensures private sector relevance.

Through their long-term cooperation in the centres, research groups and partners in the private and public sectors have created dynamic networks and developed a mutual understanding of what it takes for a centre to succeed. The centres also serve as key partners and hubs for international research cooperation. In other words, the centres are our “national teams” within the abovementioned technologies.

The first call was launched in 2016 and the challenge was “emission-free maritime transport”. The industry was mobilized and several consortiums that also included collaboration with research communities were established. Following up on that success, a new call was launched in 2017 that addressed two specific challenges:

- Emission-free land-based transport (excl. private transport)
- The digital energy system of the future

Again, the call mobilized both industry and research communities and several exciting projects received funding. Furthermore, and as an illustration of the fast-track characteristic of PILOT-E, the first vessel from the first call has already been tested on water and is ready for delivery this summer. “Future of the fjords” is an all-electric, fully battery-driven, sightseeing vessel that can operate in 16 knot, with 400 passengers, for 2.5 hours.

- **FME – Eight new Centres for Environment-friendly Energy Research:** In 2017, eight new centres for environmentally-friendly energy research went into

- **Ocean technology – Synergies between different industries:** In 2017, the Norwegian government launched an “Ocean Strategy”. That was the first comprehensive strategy that looks at the different ocean industries in a coherent way. An important background for this strategy was a report by the OECD about the future of the “Ocean Economy”. They estimate that ocean-based industries

could double their contribution to the global economy by 2030. Key elements are how the industries can cooperate in a profitable and sustainable way, as well as taking advantage of knowledge transfers and synergies. In this context, the Research Council of Norway launched a call spanning over different thematic programs, like renewable ocean-energy, petroleum, maritime technology and fisheries, under the umbrella of “ocean technology”.

In total, more than 100 million NOK was awarded to 11 different projects. An important example of a successful knowledge transfer is Statoil’s Hywind demo-park for floating offshore-wind. The facility, located off the coast of Scotland, started operations in 2017 and clearly demonstrates how knowledge and competence from the petroleum sector also can be used for renewable energy technologies.

Public Sector RD&D investment



* Includes programs run by the Research Council of Norway: ENERGIX, FME and Statagic Energy Research.

** Includes programs run by the state-owned enterprise ENOVA and specifically the amounts dedicated to technology.

*** Includes the research program CLIMIT.

**** Includes operations at the test facility Technology Centre Mongstad (TCM) as well as studies for a full-scale CCS-plant in Norway.

Note: Due to difficulties in applying the same categorization, these numbers are reported using a different breakdown to other members. The Norwegian baseline is composed of relevant budgetary allocations for the fiscal years of 2013-2015, as defined by the Norwegian definition of clean energy RD&D, of the Ministry of Petroleum and Energy.

Collaborations

Country	Name of collaboration	Brief description	Start Date	Funding Amount
Germany, Netherlands, UK ³⁵	ACT -Accelerating CCS Technologies	ACT is an initiative to facilitate RD&D and innovation within CO2 capture and storage (CCS).	ACT published the first call for project proposals in June 2016 with due date for proposals in September 2016. There are plans for a second call in 2018.	The budget for the first call was € 41.2 million.
India ³⁶	Indo-Norwegian industrial cooperation on energy research	Environmentally friendly energy research within mutually agreed fields.	Call completed in 2017.	A budget of up to 8 million NOK from the Norwegian side and matching funding from India.

³⁵ Additional information on ACT: <http://www.act-ccs.eu/about-us/>

³⁶ Additional information on Norway-India collaboration: <http://www.dst.gov.in/sites/default/files/India-Norway-Joint-Call-on-Renewable-Energy-2017.pdf>

REPUBLIC OF KOREA

Overview 2017

New clean energy innovation policies and/or strategies

Since the launch of the Mission Innovation, to refocus Korea's energy R&D on clean energy, seven relevant government ministries and approximately 200 experts from industry, academia and research institutes collaborated to establish the clean energy technology development strategy through the Clean Energy Technology Roadmap. The Republic of Korea's Clean Energy Technology Roadmap marks the milestones for clean energy technology development in order to achieve a low-carbon society, and it helps to realize the energy policy directions of the Korean government. The vision of the roadmap is to "convert the new climate regime crisis into an opportunity for economic growth through clean energy technology innovation." The goals of the roadmap are 1) responding to climate change by contributing to the reduction of greenhouse gas emissions 2) creating new energy business, and 3) leading global technological innovation.

The government also released a revised plan for renewable energy recently. The "Renewable Energy 3020" implementation plan includes the goal of increasing the share of renewable energy in power generation to 20% by 2030. Under this plan, the generation capacity from renewable sources will reach 63.8GW by 2030. 95% of the renewable generation capacity is planned to be delivered by wind power and photovoltaics. For the R&D development, the short-term goal is to support the commercialization of market-ready technologies, whereas the long-term goal is to obtain cutting-edge technologies. The major R&D area will be photovoltaics and wind power. For photovoltaics, the next generation solar cells including OPV, perovskite, metallic compound will be developed. For wind power, floating-type off-shore wind power with 5MW capacity and multi-type turbine beyond 10MW (2.5MWx4) will be focused.

Top clean energy innovation successes in 2017

- Clean Energy Technology Joint-Call Program for MI Innovation Challenges:** In 2017, the Republic of Korea has designed a new joint research program for MI Innovation Challenges, and it has been approved to be launched in 2018. The funding size for this program is 3 billion Korean Won (approximately 2.7 million US Dollars) for 3 years. For this program, all research areas related to the Innovation Challenges are eligible. Researchers from any MI member countries can apply for the fund as long as their research consortium is formed with the Korean participants.
- Budget increase on clean energy technology demonstration projects:** In 2017, the Ministry of Trade, Industry, and Energy has confirmed to invest 98 billion Korean Won (approximately 91 million US Dollars) for clean energy demonstration projects. It was an increase of 2.2 million Korean Won (approximately 20 million US Dollars) compared to 2016. The priority areas would be smart grid, renewable energy and ESS. The investment plan for clean energy demonstration projects has been included in a newly launched roadmap called "Energy Technology Demonstration Roadmap". Also,

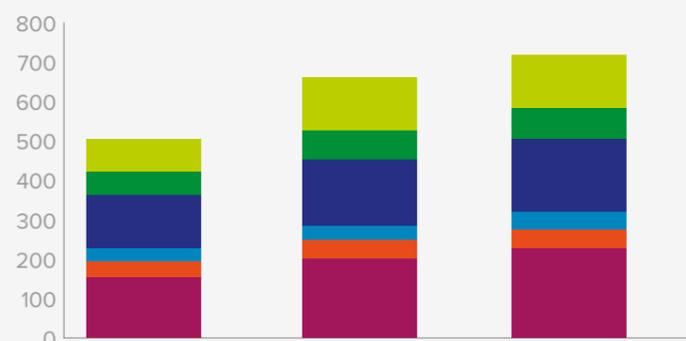
the operational guidelines for demonstration projects have been established to alleviate cumbersome regulation procedures. In order to accelerate the deployment of clean energy technology in the market through demonstration projects, KETEP, energy R&D agency of Korea, consults and supports the researchers to breakthrough bottlenecks such as licensing, civil complaints, and other troublesome issues related to commercialization.

- Engagement of energy public enterprises:** To fulfill the doubling plan for the R&D investment, more active engagement of the energy public enterprises was needed. In 2017, the council for the energy public enterprise was newly launched. In this council, 17 energy public enterprises were convened to announce their R&D investment plans, which sum up to 1.2 trillion Korean Won (approximately 1.1 billion US Dollars) for 2018. Their investment priorities are research areas related to energy transition and energy issues in the 4th industrial revolution.

Top activities delivered in support of the Innovation Challenges in 2017

- Since the launch of the Innovation Challenges in 2016, the Republic of Korea has been engaging in Smart Grid, Off-grid, CCUS, and Clean Energy Materials Innovation Challenge. The Republic of Korea has been participating in networking, various workshops, conference calls and documentation of reports.
- Through the Smart Grid Innovation Challenge, the Republic of Korea has communicated with the United Kingdom, and as an outcome, a joint project call was launched in Feb 2018. Researchers from both countries will form an R&D joint consortium to resolve Smart Grid related technical issues.
- For the documentation, the Republic of Korea has participated in writing “country report” for the Smart Grid Innovation Challenge, which introduces smart grid policies and R&D programs of the Republic of Korea. Also, the Republic of Korea has participated in writing “workshop report” in the Clean Energy Materials Innovation Challenge. In addition, the Republic of Korea has shown an interest in participating in the Affordable Heating & Cooling of Buildings Innovation Challenge.

Public Sector RD&D investment



*All amounts are in Million USD

	Baseline	First Year	Second Year
Energy Efficiency	80.98	134.94	135.98
CCS	59.29	75.20	76.51
Renewables	136.81	167.20	186.42
Nuclear Fission & Fusion	33.29	37.51	43.93
Hydrogen & Fuel Cells	39.85	45.97	48.82
Other Power & Storage Technologies	153.59	201.27	226.44
Other Cross-cutting Technologies/Research	0.00	0.00	0.00
Unallocated	0.00	0.00	0.00
TOTAL	503.80	662.08	718.09

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	Funding Amount
UK ³⁷	ROK-UK Joint Call on IC#1	ROK and UK plan to announce a joint call at MI-3 that will support researchers and private sector from both countries to work collaboratively on 3 year projects. The focus will be to accelerate innovation around the focus of IC#1.	Public – Private	Launched in Feb. 9th, 2018	\$8.8 Million USD
None	MI Joint Call on Clean Energy Technologies	Korea plans to launch 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 participation on ICs and enhance their outcomes.		The call for the project will begin in June 2018.	\$1 Million USD annual funding

³⁷ Additional information on ROK-UK collaboration: www.ketep.re.kr; <https://www.gov.uk/guidance/funding-for-innovative-smart-energy-systems>

SAUDI ARABIA

Overview 2017

New clean energy innovation policies and/or strategies

In order to transfer the Kingdom to a Knowledge-based economy, KACST (King Abdulaziz City for Science and Technology) has developed a strategic plan for the development of science, technology and innovation, that serves the objectives of Saudi Vision 2030. For the STC

(Science, Technology and Innovation) Policy, The Council of Ministers Resolution (No. 411), was issued on 12/09/1436H stipulating that King Abdulaziz City for Science and Technology (KACST) to have a Board of Directors to replace its High Committee.

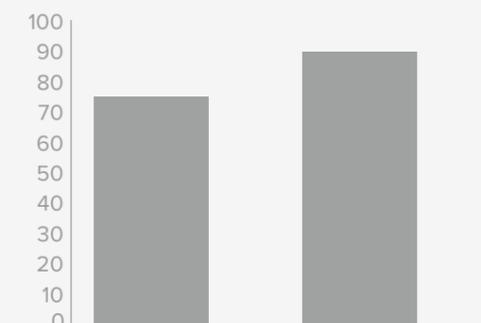
Top clean energy innovation successes in 2017

- Saudi Arabia and United States signed a MoU (December 2017) on clean fossil fuels and carbon management, to increase collaboration between the two countries in the areas of supercritical carbon dioxide (sCO2) power cycles; carbon capture, utilization, and storage (CCUS); chemical looping and oxy-combustion; the energy-water nexus, as well as other areas of mutual interest related to clean fossil fuels and carbon management. The two countries will exchange experts, engineers, and scientists and facilitate the transfer of technology.
- Saudi Arabia and United Kingdom signed a MoU (March 2018) on Clean Energy to work closer on developing technologies that will reduce carbon emissions while growing their respective economies. As part of the agreement, the two countries will share innovation, technical knowledge and expertise on clean energy, including smart grids, electric vehicles and Carbon Capture Utilization and Storage.
- Saudi Aramco established a CO2 Utilization Chair at King Fahd University of Petroleum and Minerals in 2017. The main objective is to build technical and research capacities in the area of CO2 Utilization, and to advance CO2 conversion chemistry. Saudi Aramco will fund this chair with \$0.5MM/Year.
- Launching of the Home of Innovation. The Home of Innovation™ is a SABIC growth initiative that combines marketing, innovation and technology to create demand and grow business on a local, regional and global level. The Home of Innovation has over 200 advanced systems, materials and products including many that reduce the energy and water use. The facility includes a modern home designed with locally available technology to achieve a net-zero energy balance (LEED platinum certified). If all homes in Saudi Arabia were as efficient as the demonstration house it would reduce CO2 emissions by the equivalent of six coal-fired power plant.

Top activities delivered in support of the Innovation Challenges in 2017

Saudi Arabia and the United States conducted an expert workshop on September 25-29, 2017 in Houston, under the theme of Accelerating Breakthrough Innovation in Carbon Capture, Utilization, and Storage. The outcomes of this workshop are planned to be announced during MI-3 Ministerial Meeting in May.

Public Sector RD&D investment



*All amounts are in Million USD	Baseline	First Year
Energy Efficiency	0.00	0.00
CCS	0.00	0.00
Renewables	0.00	0.00
Nuclear Fission & Fusion	0.00	0.00
Hydrogen & Fuel Cells	0.00	0.00
Other Power & Storage Technologies	0.00	0.00
Other Cross-cutting Technologies/Research	0.00	0.00
Unallocated	75.02	90.01
TOTAL	75.02	90.01

The Netherlands can only provide the final data on Energy Research expenditures after the corresponding budgets have been committed within funding rounds and after the funding rounds have formally been closed. This takes place in July each year. Therefore, we are not able to report yet on the MI RD&D spending in 2017 at this point in time.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
USA	MoU on clean fossil fuels and carbon management	MoU aims to increase collaboration between the two countries in the areas of supercritical carbon dioxide (sCO2) power cycles; carbon capture, utilization, and storage (CCUS); chemical looping and oxy-combustion; the energy-water nexus, as well as other areas of mutual interest related to clean fossil fuels and carbon management. The two countries will exchange experts, engineers, and scientists and facilitate the transfer of technology.	Public – Public	2017		1st call: €30 million

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
UK	MoU on Clean Energy	MoU commits both countries to work closer on developing technologies that will reduce carbon emissions while growing their respective economies. As part of the agreement, the two countries will share innovation, technical knowledge and expertise on clean energy, including smart grids, electric vehicles and Carbon Capture Utilization and Storage.	Public – Public	2018		
Saudi Arabia (KACST, SABIC), the UK (Oxford), Germany ³⁸	Clean Fuel Initiative	In line with Saudi Vision 2030, this initiative aims to develop a model for the production of catalysts to obtain a clean fuel free of sulfur and nitrogen compounds, as well as to develop fuel.	Public – Private	2016	2021	\$10 MM
Saudi Arabia (KACST), USA(UC Berkeley) ³⁹	KACST-UC Berkeley Center of Excellence for Clean Energy Applications (CENCEA)	CENCEA aims to innovate nanomaterials to develop solutions to challenges in renewable and cleaner energy. The centre aims to develop strong research collaborations between KACST and UC Berkeley on the subject of innovative nanomaterials for CO2 capture and conversion, storage and production of clean energy to develop solutions for challenges in renewable and cleaner energy sources.	Public – Private	2016	2021	\$5 MM
None	KFUPM/CO2 Utilization	This is a Saudi Aramco funded project in collaboration with King Fahd University of Petroleum and Minerals. The project aim to advance CO2 conversion chemistry	Public – Private	2017		\$0.5 MM/ Year

³⁸ Additional information on Clean Fuel Initiative: Production of Hydrogen from heavy crude oil using unconventional technology (Microwave technology). Fuel additives as an alternative to MTBE for the production of high efficiency clean fuel.

³⁹ Additional information on CENCEA collaboration:

- CENCEA collaboration led to the discovery of a new class of woven materials - materials that have the potential to have unusual mechanical strength, encompass dynamic characteristic (multifunctional capability to sense, trigger mechanical motion, and/or react or shut down pores), computing frameworks, or electron donor-acceptors in one crystal.

- CENCEA collaboration led to the development of ZIF CO2 capture adsorbents as well as ZIFs for volatile organic compound removal from humid air.

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
USA	Centre Of excellence for Solid state lighting	The centre will capitalize on leverage and combine research expertise and capabilities at KACST, KAUST and UCSB to develop the next generation Solid State Lighting (SSL) technology that will bring immediate benefits to KSA in terms of energy efficiency and development of a high technology economy. The center will diversify the economic trajectory of the Kingdom and render KSA a leader in SSL technology. By developing advanced SSL technology, Saudi Arabia aims to promote energy savings in society, decrease energy requirements for next-generation lighting systems, and improve quality of life through technology development and education.		2018	2023	\$1 MM/ Year

SWEDEN

Overview 2017

New clean energy innovation policies and/or strategies

The Swedish Government has recently submitted a Bill to Parliament on Energy Policy (prop. 2017/18:228) which is based on the recent agreement between five of the eight political parties in the Swedish Parliament on long term energy policy. The proposals in the Bill include the targets that

- The Swedish electricity supply should be 100 % renewable by 2040, and that
- The energy use should be 50 % more efficient by 2030 in relation to 2005, in terms relative to the GDP

In another Parliamentary decision, the goal that Sweden should have net zero emissions of Green-house gases to the atmosphere in 2045.

The Parliament decision based on the Government Bill Energy Research and Innovation for Ecological Sustainability, Competitiveness and Security of Supply (prop. 2016/17:66, bet. 2016/17:NU9, rskr. 2016/17:164) has established new guidelines and increased budget for energy R&I for the period 2017 – 2020.

Top clean energy innovation successes in 2017

A number of projects financed through the Swedish National Energy Research and Innovation Programme (SNERIP) have resulted in more widely recognized results. Among these are

- A project financed by the Swedish Energy Agency (SEA) together with Volvo Construction Equipment has been launched to develop and demonstrate electrification of all machinery in an open-pit mine for the extraction of gravel. The aim is to decrease the emissions of CO2 by 95 %.
- A project together with SSAB and Vattenfall have been launched to explore the possibilities of switching from coal to hydrogen for the iron- and steel making processes, which could have a huge impact on GHG emissions and on the demand and infrastructure for renewable hydrogen.
- A study on The Life Cycle Energy Consumption and Greenhouse Gas emissions from Lithium-Ion Batteries has received a lot of media attention. A network for Life Cycle Analyses of vehicles has been initiated.
- The SEA has supported the R&D on fuel cells of the Swedish Company PowerCell Sweden AB since 2009. The company has now received its first big international order from a Chinese company.

- A demonstration platform for trucks and buses has led to highly visible results, e.g. a bus service in Gothenburg served by ten EV or EHV buses.

The entire Swedish Energy R&I programme is focused on clean and efficient, sustainable energy solutions, products and services. Some examples:

- In support of Mission Innovation, continued and increased efforts on strategic basic energy research have been carried out, including = a programme on innovative long-term energy research, and on researcher defined Strategic Innovation Programmes.
- The programme A Challenge from Sweden has been further developed to include both Swedish and international (mostly from MI countries) buyers' groups for global Prize competition/Innovation procurement projects.
- The support to product development and commercialisation continues to expand and so far, more than 80 SME's have received support in some form. Of these, thirteen have entered a stock exchange and are now valued at about 10 times as much as the total SEA support to all the 80 + companies.

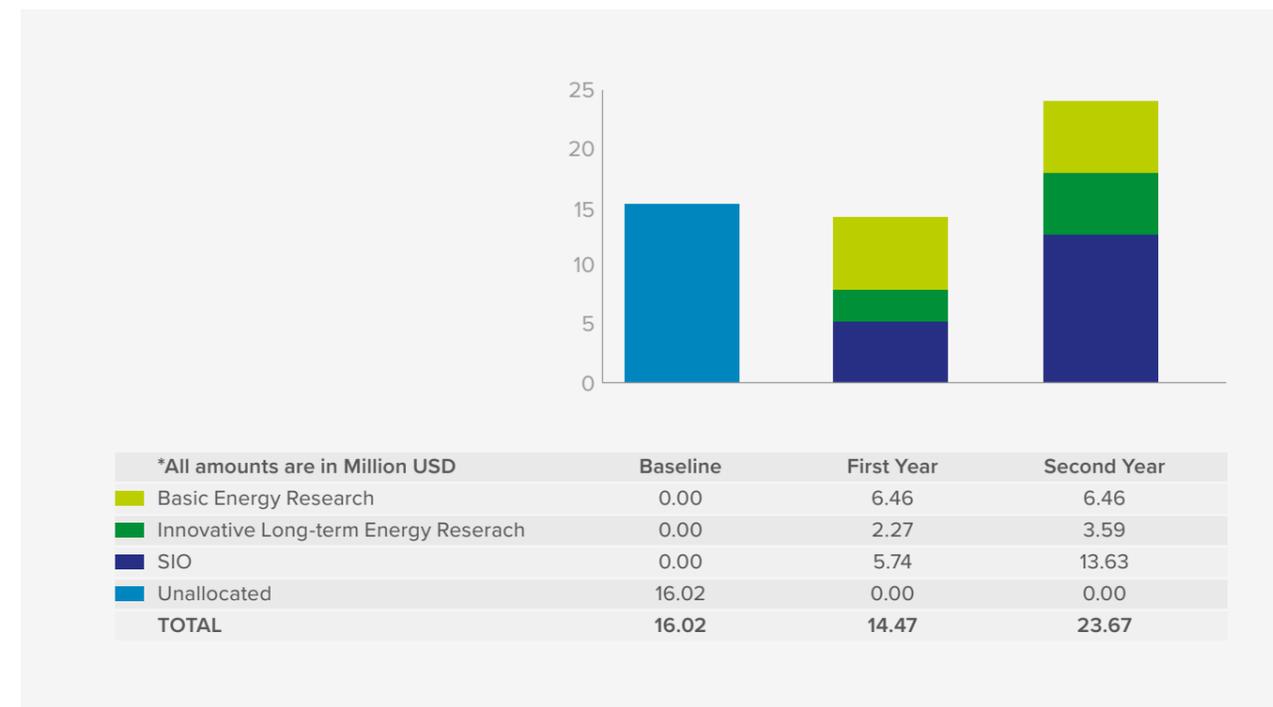
Top activities delivered in support of the Innovation Challenges in 2017

Regarding engagement in the MI workstreams, Swedish actors have engaged primarily in the IC#1 on Smart Grids, the IC#5 on Solar Fuels and the IC#7 on Affordable Heating and Cooling.

Sweden has been active in connecting the Mission Innovation Challenge #7 on Affordable Heating and Cooling

to the Technology Collaboration Programmes (TCP) from the IEA network. The TCP network has the global expert network to support the goals of Mission Innovation and accelerate the international collaboration. The first joint collaboration project is already under preparation and further projects are under discussion.

Public Sector RD&D investment



Note: These numbers are reported using a different breakdown to other members. The prognosis for 2020 shows that Sweden will currently reach + 100 % increase in RD&D investments.

Collaborations

Sweden's collaborations entered into since the launch of MI has so far included projects and programmes within the Nordic Energy Research, the EU Horizon 2020 programme, the EU SET-Plan collaboration and the 22 IEA Technology Collaboration Programmes.

UNITED ARAB EMIRATES

Narrative

The UAE leadership has launched the UAE Vision 2021 strategy which aims to make the UAE among the best countries in the world by the Golden Jubilee of the Union. In order to translate the Vision into reality, its pillars have been mapped into six national priorities which represent the key focus sectors of government action in the coming years and this includes Competitive Knowledge Economy and Sustainable Environment and Infrastructure. Reflecting the UAE Vision 2021, clean energy is core to the UAE's INDC, which sets a national target to increase clean energy to 24% of the total electricity generation mix by 2021, from under less than 1% today. Advancing innovation and technological breakthroughs is critical to addressing climate change and also aligns with the UAE's long-term commitment to diversify our economy and energy mix. On November 30th 2015 the UAE joined the world leaders in Paris to launch Mission Innovation which aims to accelerate the public and private global clean energy innovation with the objective to make clean energy widely affordable.

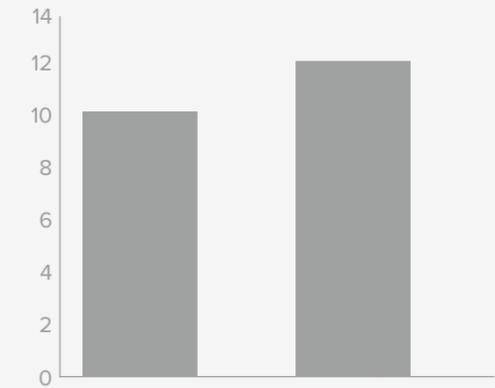
In 2014, the UAE launched a National Innovation Strategy and the Science and Technology with the aim of making the UAE one of the most innovative nations in the world within seven years. The strategy aims at: insuring an innovation

friendly ecosystem (including enhanced regulatory framework, technology infrastructure, supporting services, investments and incentives); creating a culture of innovation among individuals, firms, and the public sector; focusing on seven main sectors to lead innovation on the national level. Renewable and Clean Energy is one among the seven main sectors identified by the government.

Following the launch of the National Innovation Strategy the Science Technology and Innovation policy was prepared and which identified 24 focus areas including Solar and Alternative Energy Technology Systems and Smart City Applications and Solutions. Under the guidance of the national strategies the UAE is moving towards innovation in clean energy and energy efficiency to address economic growth and energy security.

In line with the vision of the mission innovation the UAE pledges the doubling clean energy R&D by 2021 based on the baseline set in 2015. These support highlight UAE's strong believe in research and development for resolving the challenge which hinder the implementation of clean energy and energy efficiency programs in UAE.

Public Sector RD&D investment



*All amounts are in Million USD	Baseline	First Year
Energy Efficiency	0.00	0.00
CCS	0.00	0.00
Renewables	0.00	0.00
Nuclear Fission & Fusion	0.00	0.00
Hydrogen & Fuel Cells	0.00	0.00
Other Power & Storage Technologies	0.00	0.00
Other Cross-cutting Technologies/Research	0.00	0.00
Unallocated	10.00	12.20
TOTAL	10.00	12.20

UNITED KINGDOM

Overview 2017

New clean energy innovation policies and/or strategies

In 2017, the UK launched two ambitious strategies to lead the world in cutting carbon emissions to combat climate change, while driving economic growth. **The Industrial Strategy: building a Britain fit for the future**⁴⁰ and the **Clean Growth Strategy: Leading the way to a low carbon future**⁴¹ set out how actions to meet the UK's ambitious targets to tackle climate change can be a win-win: cutting consumer bills, driving economic growth, creating high value jobs and helping to improve quality of life.

Both Strategies emphasise and confirm at the highest level the UK's commitment to the principles underpinning the purpose and aims of Mission Innovation. Innovation is at the heart of both strategies, recognising its importance for reducing the costs of clean technologies and creating new high value jobs and industries. The Industrial Strategy commit's the UK to raising public and private investment

in R&D to 2.4 per cent of GDP by 2027, the UK's largest increase in public spending on science, research and innovation in over three decades. As part of the UK's commitment to Clean Growth, the Clean Growth Strategy includes over £2.5 billion to deliver programmes between 2015-2021 in low carbon energy, transport, agriculture and waste across all stages of the innovation cycle, from basic research to pre-commercial trials.

We will continue to build our international partnerships in clean growth research and innovation: the UK is a proud member of Mission Innovation – a global initiative that aims to reinvigorate and accelerate the global clean energy revolution.

Statement in Industrial Strategy

Top clean energy innovation successes in 2017

- **BEIS Energy Innovation Programme:** The £505 million BEIS Energy Innovation Programme is accelerating the commercialisation of innovative clean energy technologies and processes. As part of this programme, the UK announced several new funding commitments in 2017:
 - o up to £10 million for innovations that provide low carbon heat in domestic and commercial buildings
 - o up to £10 million for innovations that improve the energy efficiency of existing buildings
 - o an extra £14 million for the Energy Entrepreneurs Fund, including a new sixth fund
 - o up to £20 million in a Carbon Capture and Utilisation demonstration programme
 - o up to £20 million to demonstrate the viability of switching to low carbon fuels for industry
 - o up to £20 million to support clean technology early stage funding
- The **Industrial Strategy Challenge Fund**⁴² provides funding and support to UK businesses and researchers to ensure that research and innovation takes centre stage in

the government's **Industrial Strategy** in order to meet the major industrial and societal challenges of our time. Three programmes focused on clean energy challenges were announced in 2017, 1) to develop cutting edge capabilities in smart energy systems, 2) on construction methods to build efficient buildings that are safer, healthier and use less energy and 3) the **Faraday Challenge** - a £246m commitment over the next four years to support the design, development and manufacture of batteries for the electrification of vehicles.

- **Future Fuels for Flight and Freight Competition (F4C).** The F4C is a £22m industry competition launched in August 2017 intended to support construction of novel low carbon fuel plants in the UK. It targets low carbon aviation and HGV fuels, sectors with relatively few decarbonisation options. The intention is to help demonstrate the technical and commercial viability of high-potential technologies, by removing fundamental barriers to scale up, and enable them to reach commercial scale. Government funding will be at least matched by the private sector, and is expected to support construction of up to five plants by 2021.

⁴⁰ <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>

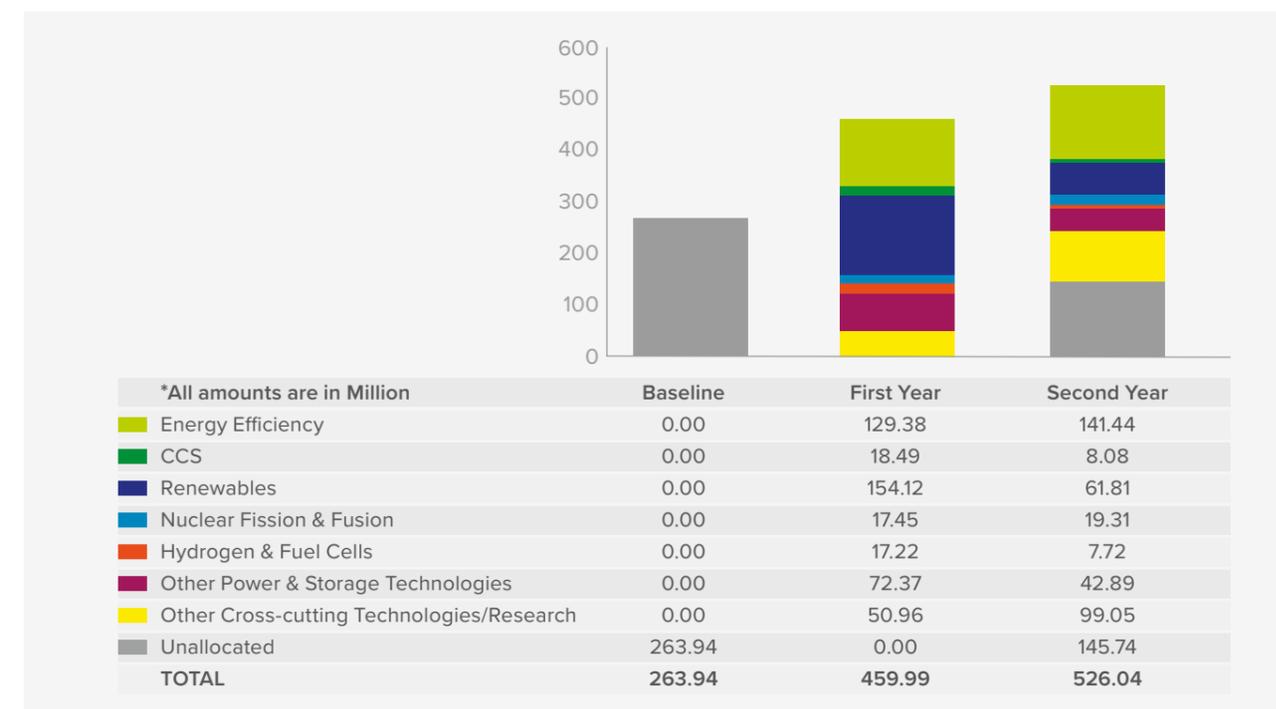
⁴¹ <https://www.gov.uk/government/publications/clean-growth-strategy>

⁴² <https://www.gov.uk/government/collections/industrial-strategy-challenge-fund-joint-research-and-innovation>

Top activities delivered in support of the Innovation Challenges in 2017

- As co-lead of the **Heating & Cooling of Buildings Innovation Challenge (IC#7)**, the UK has been instrumental in driving forward activities within this challenge. Last year, IC#7 identified 6 priority areas where additional research collaboration could add value, with the UK leading on Heat Pumps. The UK supported the planning and facilitation of the IC#7 technical workshop in Abu Dhabi in November 2017, which was well attended by UK researchers. As a result of this workshop, the UK is exploring an international collaboration on sorption heat pumps with other MI member countries.
- The UK has undertaken two bilateral collaborations:
 - o The UK and the Republic of Korean Governments are committing up to £6m, from 2018 to 2021, to deliver a bilateral competition on **smart energy innovation**. This innovation collaboration competition will provide grant funding to companies and other organisations for the development and demonstration of smart energy technologies and services. Projects supported by this competition could include: Energy storage, Demand-side response, Vehicle-to-grid technologies, System integration and Flexibility trading models.
 - o **UK-Canada Collaboration on Smart Energy Systems:** Announced at the 3rd MI Ministerial meeting in Malmo, Sweden in May 2018, the UK and Canada are collaborating to develop and launch a challenge focused on breakthrough smart grid / energy storage technologies. This initiative is a key part of the Partnership between the UK and Canada on Clean Growth and Climate Change.
- The UK has played an active role in the development of the CCUS Innovation Challenge, with over 20 UK participants attending the workshop in Houston. As part of our support for **Carbon, Capture, Utilisation and Storage** activities, the UK, jointly with the International Energy Agency, will be holding a high-level international CCUS Summit in November 2018, bringing together Governments, senior leaders from industry and investors to consider practical steps to accelerate progress on CCUS.

Public Sector RD&D investment



Note: the MI Second year RD&D numbers are provisional only. Further analysis is ongoing on the allocation of the spend against the categories provided. The UK Mission Innovation baseline does not include all UK energy innovation spend, it only includes those programmes specifically targeted at energy RD&D challenges that are consistent with the MI scope and objectives and does not include basic research.

Collaborations

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
India ⁴³	UK-India Joint Virtual Clean Energy Centre	To address the challenge of integrating intermittent, renewable energy sources with energy storage for both grids and isolated communities in India and UK.	Public – Public	2016		£10 Million Total
USA	US Nuclear Energy University Programs (NEUP)					
India	Joint UK/ India Energy Demand Reduction in the Built Environment Call	Open to UK/India collaborative proposals - call topic of reducing energy demand in the built environment.	Public – Public	2017	2021	Up to £7.6 total
USA, Sweden, Germany ⁴⁴	Efficiency for Access (UK contribution is Low Energy Inclusive Appliances – LEIA)	The Efficiency for Access (EforA) Coalition is a global initiative that is scaling up and bringing together a range of programmes and support mechanisms to accelerate energy efficiency in clean energy access efforts. The LEIA contribution involves research to accelerate the availability, affordability, efficiency and performance of Appliances suited to developing country contexts.	Public – Private	2017	2022	£18m from UK
None ⁴⁵	Transforming Energy Access (TEA)	TEA supports early stage testing and scale up of innovative technologies and business models that will accelerate access to affordable, clean energy based services to poor households and enterprises. It incorporates a range of partnerships, competitions, funds, platforms and skills initiatives.	Public – Private	2016	2021	£65 Million

⁴³ Additional information on UK-India Joint Virtual Clean Energy Centre: The Centre brings together experts from the UK and India with complementary expertise and experience to address technical challenges associated with rapidly growing solar generation in both countries.

⁴⁴ Additional information on Efficiency for Access collaboration: Official Development Assistance funding focussed on Sub-Saharan Africa and South Asian countries.

⁴⁵ Additional information on TEA: Official Development Assistance funding focussed on Sub-Saharan Africa and South Asian countries.

Country	Name of collaboration	Brief description	Type of collaboration	Start Date	End Date	Funding Amount
Republic of Korea ⁴⁶	Bilateral collaboration on smart energy innovation	The competition will provide grant funding to companies and other organisations for the development and demonstration of smart energy technologies and services focused on: <ul style="list-style-type: none"> • energy storage • demand-side response • vehicle-to-grid technologies • system integration flexibility trading models	Public-public, funding private-private projects	2018	2021	£6M in total (up to £3M UK contribution)
France	Smart energy system technologies	Knowledge sharing and identifying priority innovation areas on Smart Energy System Technologies to deliver a secure, robust, affordable, low carbon energy system and facilitate the transition to low carbon transport, which will provide clean growth and contribute to the achievement of our international clean energy goals.	In development			
Canada	Collaboration on Smart Energy Systems	The UK and Canada will jointly develop and launch a challenge focused on breakthrough smart grid / energy storage technologies. This initiative is a key part of the Partnership between the UK and Canada on Clean Growth and Climate Change.	Public-public, funding private-private projects	2018	2021	Match funding between the UK and Canada to total C\$20M (up to £6M UK contribution)

⁴⁶ Additional information on UK-ROK collaboration: <https://www.gov.uk/guidance/funding-for-innovative-smart-energy-systems>

UNITED STATES

Overview 2017

New clean energy innovation policies and/or strategies

The United States is moving forward swiftly with a true “all of the above” energy strategy founded on a new energy realism to drive clean energy progress through innovation. This includes a definition of clean energy that recognizes the role of nuclear energy and high-efficiency fossil fuels in the energy mix for the foreseeable future, as well as the strong progress of cost competitive renewable energy

technologies in the marketplace. Cutting edge research and development (R&D) in highly efficient fossil fuels, next generation nuclear reactors and fuels, renewable energy technologies, storage, and energy efficiency remains a critical element of the overall energy and economic strategy of the United States.

Top clean energy innovation successes in 2017

The U.S. Department of Energy (DOE) engages in a wide range of R&D activities in energy and basic science. Research at DOE’s National Laboratories is widely recognized in the scientific community as cutting edge. In 2017, DOE researchers won 33 of the 100 awards given out by R&D Magazine and received a special recognition award for the most outstanding technology developments with promising commercial potential. The annual R&D 100 Awards are given in recognition of exceptional new products or processes that were developed and introduced into the marketplace during the previous year. The following three illustrative examples of clean energy innovation successes in 2017 are among a wide range of innovation breakthroughs across DOE programs:

Petra Nova, the world’s largest post-combustion carbon capture project, was completed on-schedule and on-budget with the commencement of operations in April 2017. The large-scale demonstration project, located at the W.A. Parish power plant in Thompsons, Texas, is a joint venture between NRG Energy (NRG) and JX Nippon Oil & Gas Exploration Corporation (JX). Funded in part by DOE and originally conceived as a 60-megawatt electric (MWe) capture project, the project sponsors expanded the design to capture emissions from 240 MWe of generation at the Houston-area power plant, quadrupling the size of the capture project without additional federal investment. During performance testing, the system demonstrated a carbon capture rate of more than 90 percent. The successful commencement of Petra Nova operations also represents an important step in advancing the commercialization of technologies that capture CO₂ from the flue gas of existing power plants. Its success could become the model for future coal-fired power generation facilities. The addition of CO₂ capture capability to the existing fleet of power plants could support CO₂ pipeline infrastructure development and drive domestic enhance oil recovery (EOR) opportunities.

DOE announced nearly \$67 million in new nuclear energy research, facility access, crosscutting technology development, and infrastructure awards in 28 U.S. states in April 2017. In total, 85 projects were selected to receive funding that are helping to advance innovative nuclear technologies. These awards provide funding for nuclear energy-related research through the Nuclear Energy University Program, Nuclear Science User Facilities, and Nuclear Energy Enabling Technologies programs. In addition, a number of nuclear technology developers will receive access to unique research capabilities and other assistance consistent with the goals and objectives of the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative. This was in addition to the successful completion of DOE’s Advanced Small Modular Reactor (SMR) Licensing Technical Support Program.

Building on the momentum of the installation of the first U.S. offshore wind farm off the coast of Block Island, Rhode Island in 2016, DOE supported a broad portfolio of offshore wind and wave research, development, and demonstration projects in 2017. DOE has allocated over \$200 million to offshore wind research and development projects for technology development and market barrier removal, as well as advanced technology demonstration. In addition, DOE’s Water Power Technologies Office (WPTO) and Oregon State University concluded detailed negotiations in 2017 around the development and operation of the Pacific Marine Energy Center South Energy Test Site (PMEC-SETS), a world-class wave energy test facility to be constructed off the coast of Newport, Oregon. Initial operation is expected beginning summer 2021. The site will accommodate up to 20 wave energy converters in four test berths at one time, while supplying up to 20 MW of electricity to the grid.

Top activities delivered in support of the Innovation Challenges in 2017

Some key examples of U.S. international engagement under MI in 2017 include:

Carbon Capture Innovation Challenge: The United States co-led the Carbon Capture Innovation Challenge with Saudi Arabia in 2017. The goal of the Carbon Capture Innovation Challenge is twofold: first, to identify and prioritize breakthrough technologies; and second, to recommend research, development, and demonstration (RD&D) pathways and collaboration mechanisms. The challenge is intended to focus on early stage research and development, as opposed to deployment activities or policy initiatives. In September of 2017, the United States and Saudi Arabia hosted an Expert’s Workshop to determine high impact research areas to focus CCUS R&D. The workshop, attended by over 200 researchers from 17 different countries, developed a set of priority research directions which can serve as a guiding document for future R&D activities. The report is expected to be published concurrently with the workshop, and serve as a basis for further conversations. The Carbon Capture Challenge continues to build upon the outcomes of the workshop, including developing communication and collaboration mechanisms, coordination of research and development, and identifying funding opportunities that can accelerate technology performance and result in further cost reductions.

Clean Energy Materials Innovation Challenge: The United States co-led the Clean Energy Materials Innovation Challenge with Mexico in 2017. As part of cooperative activities, the U.S. Department of Energy supported a 3-day Energy Materials Innovation Workshop hosted in Mexico City on September 11-14, 2017. This invitation-only workshop convened more than 50 preeminent scientists and experts in advanced theoretical and applied physical chemistry/materials sciences, advanced computing, machine learning, and robotics. The workshop’s agenda was designed to identify critical R&D priorities and gaps in clean energy materials innovation processes and propose opportunities for deeper collaboration. These efforts culminated in the release On 25th January in Mexico City, the Clean Energy Materials Innovation Challenge released a “Materials Acceleration Platform: Accelerating Advanced Energy Materials Discovery by Integrating High-Throughput Methods with Artificial Intelligence” report on January 25, 2018. The Expert Workshop Report calls for integrating material sciences with next-generation, high performance computing, artificial intelligence (machine learning) and robotics to accelerate the pace of materials discovery. Among the recommendations are the development of “self-driving/autonomous laboratories”, “smart and super-fast materials factories” that automatically design, perform and interpret experiments in the quest of new high-performance, low cost energy materials.

ANNEX A

Annex A: Full data set

The full datasets submitted by members according to IEA RD&D categorisations are provided below. Please note that this data only refers to Mission Innovation baselines and Mission Innovation relevant spend for the first and second years of MI. Each country — according to its own priorities, policies, processes, and laws — has independently determined its baseline and the best use of its R&D funding and defines its own [R&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 (Million AUD)			Canada (Million CAD)		
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2
1. Energy Efficiency						
1.1 Industry	2.43	1.18	1.71	11.92	30.46	30.68
1.2 Residential and commercial buildings, appliances and equipment	2.55	4.55	4.78	17.09	20.64	19.41
1.3 Transport	1.95	1.46	1.56	45.74	30.56	21.78
1.4 Other energy efficiency	6.95	5.17	5.24	10.26	13.20	13.83
1.5 Unallocated energy efficiency	14.96	9.12	18.99	0.02	1.23	1.22
2. Cleaner Fossil Fuels						
2.1 Oil and gas	0	0	0	64.17	69.80	65.57
2.2 Coal	0	0	0	6.91	5.18	4.93
2.3 CO2 capture and storage	10.9	20.45	14.56	26.70	15.15	17.17
2.4 Unallocated fossil fuels	0	0	0	0.44	1.36	2.08
3. Renewable Energy Sources						
3.1 Solar energy	32.5	43.1	48.69	19.34	13.95	12.47
3.2 Wind energy	0.42	0.5	0.29	3.89	2.80	2.93
3.3 Ocean energy	0.8	1.24	1.53	10.97	4.22	1.59
3.4 Biofuels (including liquid & solid biofuels and biogases)	3.9	5.23	3.77	25.34	73.66	70.58
3.5 Geothermal energy	0.24	0.57	0.7	1.81	0.77	0.89
3.6 Hydroelectricity	0	0	0.19	1.87	3.73	3.47
3.7 Other renewable energy sources	0	0	0.24	0.31	0.94	0.51
3.8 Unallocated renewable energy sources	10.45	1.73	11.83	0.34	0.38	0.76
4. Nuclear Fission and Fusion						
4.1 Nuclear fission	7.4	15.3	11.45	88.11	138.90	106.79
4.2 Nuclear fusion	1.72	2.14	1.26	6.51	8.41	12.49
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	3.18	3.03	2.25
5.2 Fuel cells	1.74	1.57	1.72	8.91	8.17	10.65
5.3 Unallocated hydrogen and fuel cells	0	0	0	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	1.56	2.31	1.89
6.2 Electricity transmission and distribution	4.59	5.36	6.55	17.97	15.04	15.41
6.3 Energy storage (non-transport applications)	0	0	0	9.37	10.18	14.71
6.4 Unallocated other power and storage technologies	0	0	0	0.06	0.62	0.06
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	0	0	0	2.58	1.59	1.20
7.2 Basic energy research that cannot be allocated to a specific category				0.56	1.48	1.14
7.3 Other	0	0	0	0.76	1.31	1.47
8. Unallocated	0	0	0	0.00	0.00	0.00
TOTAL BUDGET	107.28	129.38	145.4	386.69	479.06	437.92

Category	Chile (Million CLP)			China (RMB Billion Yuan)		
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2
1. Energy Efficiency						
1.1 Industry	412.00	384.30	590.03	0.00	0.00	0.00
1.2 Residential and commercial buildings, appliances and equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.3 Transport	0.00	0.00	0.00	0.00	0.00	0.00
1.4 Other energy efficiency	0.00	0.00	0.00	0.00	0.00	0.00
1.5 Unallocated energy efficiency	0.00	0.00	0.00	0.52	0.61	0.81
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	9.14*	10.10*	14.00*
2.3 CO2 capture and storage	0.00	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	0.00
3. Renewable Energy Sources						
3.1 Solar energy	2,103.02	2,593.51	2,591.67	0.00	0.00	0.00
3.2 Wind energy	0.00	0.00	0.00	0.00	0.00	0.00
3.3 Ocean energy	0.00	449.90	469.00	0.00	0.00	0.00
3.4 Biofuels (including liquid & solid biofuels and biogases)	1,228.80	0.00	0.00	0.00	0.00	0.00
3.5 Geothermal energy	0.00	0.00	0.00	0.00	0.00	0.00
3.6 Hydroelectricity	0.00	0.00	0.00	0.00	0.00	0.00
3.7 Other renewable energy sources	269.84	250.00	500.00	0.00	0.00	0.00
3.8 Unallocated renewable energy sources	0.00	0.00	0.00	5.28	4.60	8.10
4. Nuclear Fission and Fusion						
4.1 Nuclear fission	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Nuclear fusion	0.00	0.00	0.00	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	0.00	0.00	0.00	3.64	3.50	4.00
5. Hydrogen and Fuel Cells						
5.1 Hydrogen	0.00	0.00	0.00	0.00	0.00	0.00
5.2 Fuel cells	0.00	0.00	0.00	0.00	0.00	0.00
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	0.12	0.30	0.70
6. Other Power and Storage Technologies						
6.1 Grid communication, control systems and integration	0.00	0.00	0.00	0.00	0.00	0.00
6.2 Electricity transmission and distribution	0.00	0.00	0.00	0.00	0.00	0.00
6.3 Energy storage (non-transport applications)	0.00	0.00	0.00	0.00	0.00	0.00
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00	3.18	3.00	3.20
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	0.00	0.00	0.00	0.00	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	0.00
7.3 Other	0.00	0.00	0.00	3.12	3.39	4.19
8. Unallocated	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL BUDGET	4,013.65	3,677.71	4,150.70	25.00	25.50	35.00

*Clean and efficient utilization of coal resources

Category	Denmark (Million DKK)			EC (Million Euros)		
	Baseline	Year 1	Year 2	Average 2014-15*	Year 1	Year 2
1. Energy Efficiency						
1.1 Industry	2.20	9.30	33.30	82.50	126.10	171.40
1.2 Residential and commercial buildings, appliances and equipment	26.40	5.60	34.70	88.10	81.00	86.80
1.3 Transport	0.00	6.30	7.50	45.20	26.60	45.50
1.4 Other energy efficiency	14.70	39.40	33.20	78.60	90.20	85.40
1.5 Unallocated energy efficiency	0.00	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	0.00
2.2 Coal	0.00	0.00	0.00	0.00	0.00	0.00
2.3 CO2 capture and storage	0.00	0.00	0.00	39.60	25.90	45.30
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	28.50	13.70	9.50	68.30	88.50	94.50
3.2 Wind energy	66.70	56.30	17.30	50.50	26.90	46.50
3.3 Ocean energy	11.00	0.10	1.70	42.50	61.30	48.60
3.4 Biofuels (including liquid & solid biofuels and biogases)	68.60	35.80	5.80	81.80	94.60	85.10
3.5 Geothermal energy	7.20	0.00	0.00	35.50	23.10	31.60
3.6 Hydroelectricity	0.00	0.00	0.00	0.60	7.90	7.60
3.7 Other renewable energy sources	0.00	5.00	0.00	20.60	48.80	42.40
3.8 Unallocated renewable energy sources	0.00	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	0.00
4.2 Nuclear fusion	0.00	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	0.00
5. Hydrogen and Fuel Cells						
5.1 Hydrogen	0.60	16.50	15.30	18.70	45.40	32.20
5.2 Fuel cells	12.60	8.60	0.00	37.30	34.20	74.30
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	18.20	1.60	15.80
6. Other Power and Storage Technologies						
6.1 Grid communication, control systems and integration	4.20	0.00	0.00	0.50	1.60	0.00
6.2 Electricity transmission and distribution	28.80	0.00	0.00	92.40	122.70	164.00
6.3 Energy storage (non-transport applications)	8.60	19.40	0.00	98.60	47.00	57.20
6.4 Unallocated other power and storage technologies	0.00	0.00	142.90	0.30	11.60	3.00
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	0.00	0.00	0.90	0.00	0.00	0.00
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00	30.90	23.00	31.20
7.3 Other	11.80	37.80	119.90	148.20	82.00	107.30
8. Unallocated	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL BUDGET	291.9	253.8	422.00	1078.90	1070.00	1275.70

*Baseline covers 2013-2015. As data is not available for 2013, this column refers only to an average for years 2014-15

Category	Finland (Million Euros)			France (Million Euros)		
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2
1. Energy Efficiency						
1.1 Industry	0.00	0.00	0.00	0.00	14.61	13.88
1.2 Residential and commercial buildings, appliances and equipment	0.00	0.00	0.00	0.00	31.67	32.95
1.3 Transport	0.00	0.00	0.00	0.00	97.03	87.75
1.4 Other energy efficiency	0.00	0.00	0.00	0.00	23.16	17.39
1.5 Unallocated energy efficiency	0.00	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	0.00
2.2 Coal	0.00	0.00	0.00	0.00	0.00	0.00
2.3 CO2 capture and storage	0.00	0.00	0.00	0.00	20.49	14.67
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	0.00	0.00	0.00	0.00	71.17	62.77
3.2 Wind energy	0.00	0.00	0.00	0.00	9.62	6.94
3.3 Ocean energy	0.00	0.00	0.00	0.00	7.58	4.37
3.4 Biofuels (including liquid & solid biofuels and biogases)	0.00	0.00	0.00	0.00	84.81	73.45
3.5 Geothermal energy	0.00	0.00	0.00	0.00	6.59	4.67
3.6 Hydroelectricity	0.00	0.00	0.00	0.00	2.71	1.93
3.7 Other renewable energy sources	0.00	0.00	0.00	0.00	1.59	2.23
3.8 Unallocated renewable energy sources	0.00	27.00	32.00	0.00	0.42	0.61
4. Nuclear Fission and Fusion						
4.1 Nuclear fission	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Nuclear fusion	0.00	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	0.00
5. Hydrogen and Fuel Cells						
5.1 Hydrogen	0.00	0.00	0.00	0.00	19.51	14.67
5.2 Fuel cells	0.00	0.00	0.00	0.00	10.43	12.64
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	0.00	1.24	1.15
6. Other Power and Storage Technologies						
6.1 Grid communication, control systems and integration	0.00	0.00	0.00	0.00	1.92	1.25
6.2 Electricity transmission and distribution	0.00	3.90	3.50	0.00	16.53	10.37
6.3 Energy storage (non-transport applications)	0.00	4.30	1.80	0.00	22.55	20.97
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00	0.00	0.02	0.00
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	0.00	4.50	6.30	0.00	15.46	15.38
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00	0.00	12.91	55.45
7.3 Other	0.00	0.00	0.00	0.00	30.03	32.41
8. Unallocated	54.90	31.20	31.60	0.00	0.00	0.00
TOTAL BUDGET	54.90	70.90	75.20	440.00	502.02	487.90

Category	Germany (Million Euros)			Italy (Million Euros)		
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2
1. Energy Efficiency						
1.1 Industry	0.00	33.40	47.10	0.00	0.00	0.00
1.2 Residential and commercial buildings, appliances and equipment	0.00	26.30	28.40	0.00	0.00	0.00
1.3 Transport	0.00	12.90	14.40	0.00	0.00	0.00
1.4 Other energy efficiency	0.00	0.00	0.00	0.00	0.00	0.00
1.5 Unallocated energy efficiency	0.00	0.00	0.00	58.55	59.25	60.25
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	0.00	17.40	18.70	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	0.00	78.60	99.30	0.00	0.00	0.00
3.2 Wind energy	0.00	49.70	75.10	0.00	0.00	0.00
3.3 Ocean energy	0.00	0.00	0.00	0.00	0.00	0.00
3.4 Biofuels (including liquid & solid biofuels and biogases)	0.00	37.30	32.70	0.00	0.00	0.00
3.5 Geothermal energy	0.00	12.50	16.50	0.00	0.00	0.00
3.6 Hydroelectricity	0.00	2.00	2.20	0.00	0.00	0.00
3.7 Other renewable energy sources	0.00	0.00	0.00	0.00	0.00	0.00
3.8 Unallocated renewable energy sources	0.00	0.00	0.00	71.08	75.18	80.08
4. Nuclear Fission and Fusion						
4.1 Nuclear fission	0.00	0.00	0.00	0.00	0.00	0.00
4.2 Nuclear fusion	0.00	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	0.00
5. Hydrogen and Fuel Cells						
5.1 Hydrogen	0.00	0.00	0.00	0.00	0.00	0.00
5.2 Fuel cells	0.00	0.00	0.00	0.00	0.00	0.00
5.3 Unallocated hydrogen and fuel cells	0.00	15.40	21.90	11.79	13.19	14.19
6. Other Power and Storage Technologies						
6.1 Grid communication, control systems and integration	0.00	0.00	0.00	0.00	0.00	0.00
6.2 Electricity transmission and distribution	0.00	66.90	89.20	0.00	0.00	0.00
6.3 Energy storage (non-transport applications)	0.00	42.00	35.30	0.00	0.00	0.00
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00	44.76	49.06	57.76
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	0.00	15.00	18.20	0.00	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	0.00
7.3 Other	0.00	0.00	0.00	36.48	40.98	40.78
8. Unallocated	450.30	116.10	178.20	0.00	0.00	0.00
TOTAL BUDGET	450.30	525.50	677.20	222.66	237.66	253.06

Category	Mexico (Million Pesos)			Netherlands (Million Euros)	
	Baseline (avg 2013-15)	Year 1	Year 2	Baseline	Year 1
1. Energy Efficiency					
1.1 Industry				7.40	34.00
1.2 Residential and commercial buildings, appliances and equipment	1.33	41.10	40.20	5.70	6.00
1.3 Transport		23.00	8.00	0.00	2.20
1.4 Other energy efficiency	3.73	28.20	17.40	4.60	12.80
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	2.53	29.40	2.20	1.10	1.20
2.4 Unallocated fossil fuels	0.00	0.00	0.00	0.00	0.00
3. Renewable Energy Sources					
3.1 Solar energy	89.43	181.40	105.30	33.90	19.30
3.2 Wind energy	37.47	48.20	37.80	12.90	17.70
3.3 Ocean energy	0.43	0.80	132.60	2.20	0.00
3.4 Biofuels (including liquid & solid biofuels and biogases)	19.13	272.20	141.00	20.30	26.70
3.5 Geothermal energy	183.83	211.60	150.40	1.40	8.70
3.6 Hydroelectricity	0.00	0.00	0.00	0.00	3.70
3.7 Other renewable energy sources	0.00	0.00	54.60	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	17.30	7.50	1.30	0.00	0.00
5. Hydrogen and Fuel Cells					
5.1 Hydrogen	0.00	0.00	0.00	0.30	0.10
5.2 Fuel cells	0.00	0.00	0.00	0.00	0.10
5.3 Unallocated hydrogen and fuel cells	2.50	14.10	14.60	0.00	0.00
6. Other Power and Storage Technologies					
6.1 Grid communication, control systems and integration	0.00	0.00	0.00	0.00	0.00
6.2 Electricity transmission and distribution	0.00	0.00	0.00	3.10	0.70
6.3 Energy storage (non-transport applications)	0.00	0.00	0.00	4.10	6.30
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00	0.00	0.00
7. Other Cross-cutting Technologies or Research					
7.1 Energy system analysis	3.57	5.70	11.00	0.00	0.00
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0.00	0.00	3.00	2.80
7.3 Other	0.00	11.80	4.40	0.00	0.00
8. Unallocated	0.00	229.00	225.10	0.00	0.00
TOTAL BUDGET	361.27	1104.00	946.00	100.00	142.30

Category	Norway* (Million NOK)			Republic of Korea (Million Won)		
	2015	2016	2017	Baseline	Year 1	Year 2
1. Energy Efficiency						
1.1 Industry	90.00	90.00	98.00	35,910	52,771	60,131
1.2 Residential and commercial buildings, appliances and equipment	61.00	73.00	78.00	21,420	34,338	34,300
1.3 Transport	46.00	63.00	120.00	32,767	63,027	56,858
1.4 Other energy efficiency	0.00	0.00	0.00	0	0	0
1.5 Unallocated energy efficiency	0.00	0.00	0.00	0	0	0
2. Cleaner Fossil Fuels						
2.1 Oil and gas	0.00	0.00	0.00	0	0	0
2.2 Coal	0.00	0.00	0.00	0	0	0
2.3 CO2 capture and storage	202.20	249.50	215.80	65,966	83,669	85,122
2.4 Unallocated fossil fuels	0.00	0.00	0.00	0	0	0
3. Renewable Energy Sources						
3.1 Solar energy	92.00	108.00	111.00	60,842	72,198	78,601
3.2 Wind energy	93.00	95.00	60.00	40,844	40,679	50,636
3.3 Ocean energy	4.00	6.00	6.00	0	0	0
3.4 Biofuels (including liquid & solid biofuels and biogases)	88.00	90.00	102.00	34,267	40,510	45,442
3.5 Geothermal energy	0.00	8.00	13.00	0	0	0
3.6 Hydroelectricity	31.00	35.00	55.00	0	0	0
3.7 Other renewable energy sources	21.00	4.00	0.00	16,266	32,638	32,731
3.8 Unallocated renewable energy sources	0.00	0.00	0.00	0	0	0
4. Nuclear Fission and Fusion						
4.1 Nuclear fission	0.00	0.00	0.00	0	0	0
4.2 Nuclear fusion	0.00	0.00	0.00	0	0	0
4.3 Unallocated nuclear fission and fusion	103.15	103.15	103.15	37,038	41,733	48,882
5. Hydrogen and Fuel Cells						
5.1 Hydrogen	14.00	31.00	35.00	4,892	12,370	12,750
5.2 Fuel cells	39.00	30.00	15.00	39,441	38,773	41,569
5.3 Unallocated hydrogen and fuel cells	0.00	0.00	0.00	0	0	0
6. Other Power and Storage Technologies						
6.1 Grid communication, control systems and integration	0.00	0.00	0.00	46,769	60,693	60,843
6.2 Electricity transmission and distribution	100.00	112.00	142.00	85,156	109,016	135,006
6.3 Energy storage (non-transport applications)	0.00	0.00	0.00	38,957	54,231	56,095
6.4 Unallocated other power and storage technologies	0.00	0.00	0.00	0	0	0
7. Other Cross-cutting Technologies or Research						
7.1 Energy system analysis	47.00	41.00	48.00	0	0	0
7.2 Basic energy research that cannot be allocated to a specific category	16.00	15.00	15.00	0	0	0
7.3 Other	0.00	0.00	0.00	0	0	0
8. Unallocated	0.00	0.00	0.00	0	0	0
TOTAL BUDGET	1047.35	1153.65	1216.95	560,535	736,646	798,966

*The numbers provided here show public financing for R&D projects as reported to the IEA for 2015, 2016 and 2017. This is not the same as the MI baseline, due to difficulties applying the same categorization.

Category	UK (Million GBP)		
	Baseline	Year 1	Year 2
1. Energy Efficiency			
1.1 Industry	0.00	2.32	2.42
1.2 Residential and commercial buildings, appliances and equipment	0.00	11.55	20.06
1.3 Transport	0.00	79.46	83.12
1.4 Other energy efficiency	0.00	2.86	1.58
1.5 Unallocated energy efficiency	0.00	1.84	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	0.00	14.01	6.12
2.4 Unallocated fossil fuels	0.00	0.00	0.00
3. Renewable Energy Sources			
3.1 Solar energy	0.00	24.52	7.16
3.2 Wind energy	0.00	36.10	27.10
3.3 Ocean energy	0.00	5.47	1.38
3.4 Biofuels (including liquid & solid biofuels and biogases)	0.00	15.82	4.72
3.5 Geothermal energy	0.00	4.95	0.02
3.6 Hydroelectricity	0.00	8.84	0.16
3.7 Other renewable energy sources	0.00	14.78	2.05
3.8 Unallocated renewable energy sources	0.00	6.31	4.25
4. Nuclear Fission and Fusion			
4.1 Nuclear fission	0.00	8.84	13.69
4.2 Nuclear fusion	0.00	0.00	0.00
4.3 Unallocated nuclear fission and fusion	0.00	4.38	0.94
5. Hydrogen and Fuel Cells			
5.1 Hydrogen	0.00	7.17	3.93
5.2 Fuel cells	0.00	5.22	1.57
5.3 Unallocated hydrogen and fuel cells	0.00	0.65	0.34
6. Other Power and Storage Technologies			
6.1 Grid communication, control systems and integration	0.00	0.31	0.08
6.2 Electricity transmission and distribution	0.00	18.62	7.18
6.3 Energy storage (non-transport applications)	0.00	12.67	2.33
6.4 Unallocated other power and storage technologies	0.00	23.25	22.92
7. Other Cross-cutting Technologies or Research			
7.1 Energy system analysis	0.00	7.87	0.02
7.2 Basic energy research that cannot be allocated to a specific category	0.00	0	0.00
7.3 Other	0.00	30.74	75.03
8. Unallocated	200.00	0.00	110.44
TOTAL BUDGET	200.00	348.56	398.61



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