Energy Technology RD&D Budgets

October 2021 Edition

Database documentation

International Energy Agency

INTERNATIONAL ENERGY AGENCY

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.

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Singapore
South Africa
Thailand

This document provides information regarding the 2021 edition of the IEA *Energy Technology RD&D Budgets* database.

For more information about trends and data please visit:

https://www.iea.org/reports/energy-technology-rdd-budgets-overview.

Please address your inquiries to RDD@iea.org.

Please note that all IEA data are subject to the following terms and conditions found on the IEA website: www.iea.org/t&c/.

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Changes from the last edition

Geographical coverage

The IEA is happy to announce that the 2021 edition has been expanded to include data for Lithuania, a country seeking accession to full membership to the IEA, and for Brazil, an IEA association country.

Time coverage

In an effort to expand the coverage of this database, the 2021 edition includes 2020 data and 2021 data for a selection of countries. It should be noted that the 2021 data are based on forecasts submitted by each country and, as such, are likely to be revised in coming releases.

Private RD&D data

The 2021 edition has also been expanded to include private RD&D spending for a selection of countries that have carried out surveys and submitted the results to the IEA. Details on the coverage of those surveys can be found in the relevant notes for each country. The private data can be found in the Excel file *IEA_Energy_RDD_selected_data.xlsm* available *here*.

Information on data collection

Finally, the 2021 edition has been expanded to include information on the national data systems including information on what type of programmes are included and what is the data collection approach, which can be found in the Excel file *IEA_Energy_RDD_selected_data.xlsm* available *here*.

Database structure

The database *Energy Technology RD&D Budgets* includes annual data for:

Countries: 30 IEA countries; 4 IEA regions; the European Union; Brazil and Lithuania. For availability of data by country, see section 4: *Geographical coverage and country notes*.

Years: 1974-2021 unless otherwise specified.

The database includes the following ten files:

RDD_Country Budgets.IVT
RDD_Country Budgets.txt

Detailed country RD&D budgets: 33 countries (32 individual countries + European Union), 8 products and 184 flows

RDD_Country Budgets_ Summary.IVT
RDD_Country Budgets_ Summary.txt

Summary country RD&D budgets: 33 countries (32 individual countries + European Union), 8 products and 11 flows (8 summary groups of energy technologies + Total + Memos: Low-carbon and Non-low-carbon).

RDD_Region_Budget.IVT
RDD_Region_Budget.txt

Estimated RD&D budgets by region: 4 regions, 3 products and 11 flows.

RDD_Indicators.IVT
RDD_Indicators.txt

RD&D indicators: 34 countries (32 individual countries + EU27 + EU28) and 4 indicators.

RDD_Per_GDP.IVT
RDD_Per_GDP.txt

RD&D budgets per GDP: 32 countries and 1 indicator.

IEA_Energy_RDD_selected_data.xlsm

Selected data from the database

Flow definitions

The *IEA Guide to Reporting Energy RD&D Budget/Expenditure Statistics*, which includes the detailed definitions, can be found in the same folder as this document and is also available for download here.

The following tables shows the complete set of technologies covered in the questionnaire. The different countries submit at various levels of disaggregation depending on availability at national level.

Flow

Long name	Short name
GROUP 1: ENERGY EFFICIENCY	EFFICIENCY
11 Industry	11EFFIND
111 Industrial techniques and processes	111INDTE
112 Industrial equipment and systems	112INDEQ
113 Other industry	113INDOT
119 Unallocated industry	119INDUN
12 Residential and commercial buildings, appliances and equipment	12EFFRCO
121 Building design and envelope	121BUDEE
1211 Building envelope technologies	1211ENVE
1212 Building design	1212DESI
1219 Unallocated building design and envelope	1219BUUN
122 Building operation and efficient building equipment	122OPERA
1221 Building management systems (including smart meters) and efficient internet and communication technologies	1221EMAN
1222 Lighting technologies and control systems	1222LTEC
1223 Heating, cooling and ventilation technologies	1223HEAT
1224 Other building operations and efficient building equipment	1224OTHE
1229 Unallocated building operations and equipment	1229OPUN
123 Appliances and other residential/commercial	123APPLI
1231 Appliances	1231APPL
1232 Batteries for portable devices	1232BATT

Long name	Short name
1233 Other residential/commercial	1233ORCO
1239 Unallocated appliances and other residential/commercial	1239APUN
129 Unallocated residential/commercial buildings, appliances and equipment	129EFFRUN
13 Transport	13TRANSP
131 On-road vehicles	131ORVEH
1311 Vehicle batteries/storage technologies	1311VBAT
1312 Advanced power electronics, motors, EV/HEV/FCV systems	1312ADVA
1313 Advanced combustion engines	1313ENGI
1314 Electric vehicle infrastructure (including smart chargers and grid communications)	1314INFR
1315 Fuel for on-road vehicles (excluding hydrogen)	1315UFUE
1316 Materials for on-road vehicles	1316MATE
1317 Other on-road transport	1317OTHE
1319 Unallocated on-road vehicles	1319ORUN
132 Off-road transport and transport systems	132OFFRO
133 Other transport	133OTRAN
139 Unallocated transport	139TRANUN
14 Other energy efficiency	14OEFFIC
141 Waste heat recovery and utilisation	141WASTE
142 Communities	142COMMU
143 Agriculture and forestry	143AGRIF
144 Heat pumps and chillers	144HEATP
145 Other energy efficiency	145OENEF
149 Unallocated other energy efficiency	149OEFUN
19 Unallocated energy efficiency	19EFFUN
GROUP 2: FOSSIL FUELS: OIL, GAS and COAL	FOSSILFUEL
21 Oil and gas	21OILGAS
211 Enhanced oil and gas production	211ENHAN
212 Refining, transport, storage of oil and gas	212REFIN
213 Non-conventional oil and gas production	213NONCO
214 Oil and gas combustion	214COMBU

Long name	Short name
215 Oil and gas conversion	215CONVE
216 Other oil and gas	216OTOIL
219 Unallocated oil and gas	219OGUN
22 Coal	22COAL
221 Coal production, preparation and transport	221CPROD
222 Coal combustion (including IGCC)	222CCOMB
223 Coal conversion (excluding IGCC)	223CCONV
224 Other coal	224OCOAL
229 Unallocated coal	229COALUN
23 CO2 capture and storage	23CO2CS
231 CO2 capture/separation	231CAPSE
232 CO2 transport	232CTRAN
233 CO2 storage	233CSTOR
239 Unallocated CO2 capture and storage	239CO2CSUN
29 Unallocated fossil fuels	29FOSFUN
GROUP 3: RENEWABLE ENERGY SOURCES	RENEWABLE
31 Solar energy	31SOLAR
311 Solar heating and cooling	311SHEAT
312 Photovoltaics	312PHOTOV
313 Solar thermal power and high-temp. applications	313THERMA
319 Unallocated solar energy	319SOLUN
32 Wind energy	32WIND
321 Onshore wind technologies	321WONSH
322 Offshore wind technologies (excluding low wind speed)	322WOFFS
323 Wind energy systems and other technologies	323WSYST
329 Unallocated wind energy	329WINDUN
33 Ocean energy	33OCEAN
331 Tidal energy	331TIDAL
332 Wave energy	332WAVE
333 Salinity gradient power	333SALIN
334 Other ocean energy	334OOTHE

Long name	Short name
339 Unallocated ocean energy	339OCEUN
34 Biofuels (including liquid biofuels, solid biofuels and biogases)	34BIOFUE
341 Production of liquid biofuels	341LPROD
3411 Gasoline substitutes (including ethanol)	3411GAS
3412 Diesel, kerosene and jet fuel substitutes	3412DIES
3413 Algal biofuels	3413ALG
3414 Other liquid fuel substitutes	3414LOTH
3419 Unallocated production of liquid biofuels	3419LPUN
342 Production of solid biofuels	342SPROD
343 Production of biogases	343GPROD
3431 Thermochemical	3431GTHE
3432 Biochemical (including anaerobic digestion)	3432GBIO
3433 Other biogases	3433GOTH
3439 Unallocated production of biogases	3439GPUN
344 Applications for heat and electricity	344BAPPL
345 Other biofuels	345BOTHE
349 Unallocated biofuels	349BIOUN
35 Geothermal energy	35GEOTHE
351 Geothermal energy from hydrothermal resources	351GEOHY
352 Geothermal energy from hot dry rock (HDR) resources	352GEHDR
353 Advanced drilling and exploration	353DRILL
354 Other geothermal energy (including low-temp. resources)	354GOTHE
359 Unallocated geothermal energy	359GEOUN
36 Hydroelectricity	36HYDROE
361 Large hydroelectricity (capacity of 10 MW and above)	361HLARG
362 Small hydroelectricity (capacity less than 10 MW)	362HSMAL
369 Unallocated hydroelectricity	369HYDRUN
37 Other renewable energy sources	37OTHREN
39 Unallocated renewable energy sources	39RENUN
GROUP 4: NUCLEAR	NUCLEAR
41 Nuclear fission	41FISSON

Long name	Short name
411 Light water reactors (LWRs)	411LWRS
412 Other converter reactors	412OTHNU
4121 Heavy water reactors (HWRs)	4121HWRS
4122 Other converter reactors	4122OTHE
4129 Unallocated other converter reactors	4129OTNUN
413 Fuel cycle	413FUCYC
4131 Fissile material recycling/reprocessing	4131RECY
4132 Nuclear waste management	4132WAST
4133 Other fuel cycle	4133OTCY
4139 Unallocated fuel cycle	4139FUCUN
414 Nuclear supporting technologies	414SUPTE
4141 Plant safety and integrity	4141SAFE
4142 Environmental protection	4142PROT
4143 Decommissioning	4143DECO
4144 Other nuclear supporting technologies	4144ONUC
4149 Unallocated nuclear supporting technologies	4149ONUN
415 Nuclear breeder	415BREED
416 Other nuclear fission	416OFISS
419 Unallocated nuclear fission	419FISUN
42 Nuclear fusion	42FUSION
421 Magnetic confinement	421MACON
422 Inertial confinement	422INCON
423 Other nuclear fusion	423OFUSI
429 Unallocated nuclear fusion	429FUSUN
49 Unallocated nuclear	49NUCUN
GROUP 5: HYDROGEN AND FUEL CELLS	HGENCELL
51 Hydrogen	51HYDROG
511 Hydrogen production	511HYPRO
512 Hydrogen storage	512HYSTO
513 Hydrogen transport and distribution	513HYTRA
514 Other infrastructure and systems	514HYINF

Long name	Short name
515 Hydrogen end-uses (including combustion; excluding fuel cells and vehicles)	515HYEND
519 Unallocated hydrogen	519HYDUN
52 Fuel cells	52FUELCE
521 Stationary applications	521FUSTA
522 Mobile applications	522FUMOB
523 Other applications	523FUOTH
529 Unallocated fuel cells	529FUELUN
59 Unallocated hydrogen and fuel cells	59HYFUUN
GROUP 6: OTHER POWER AND STORAGE TECHNOLOGIES	OTHERPANDS
61 Electric power conversion	61POWCON
611 Power generation technologies	611GETEC
612 Power generation supporting technologies	612GESUP
613 Other electricity power generation	613GEOTH
619 Unallocated electric power generation	619POWUN
62 Electricity transmission and distribution	62TRADIS
621 Transmission and distribution technologies	621TDTEC
6211 Cables and conductors (superconducting, conventional, composite core)	6211CABL
6212 AC/DC conversion	6212ACDC
6213 Other transmission and distribution techs.	6213OTHE
6219 Unallocated transmission and distribution	6219TDTUN
622 Grid communication, control systems and integration	622GRIDC
6221 Load management (including renewable integration)	6221LOAD
6222 Control systems and monitoring	6222CONT
6223 Standards, interoperability and grid cyber security	6223STAN
6229 Unallocated grid communication, control systems and integration	6229GRIDUN
629 Unallocated electricity transmission and distribution	629TRANUN
63 Energy storage (non-transport applications)	63ENSTOR
631 Electrical storage	631ELSTO
6311 Batteries and other electrochemical storage (excluding vehicles and general public portable devices)	6311BATT
6312 Electromagnetic storage	6312ELMA

Long name	Short name
6313 Mechanical storage	6313MECH
6314 Other storage (excluding fuel cells)	6314OSTO
6319 Unallocated electrical storage	6319ELSUN
632 Thermal energy storage	632THEST
639 Unallocated energy storage	639ENSTUN
69 Unallocated other power and storage technologies	69OPOWUN
GROUP 7: OTHER CROSS-CUTTING TECHNOLOGIES AND RESEARCH	OTHERTECH
71 Energy system analysis	71SYSANA
72 Basic energy research that cannot be allocated to a specific category	72BASICUN
73 Other	73OTHER
GROUP 8: UNALLOCATED	UNALLOC
TOTAL BUDGET	TOTAL

Long name	Short name	Definition
Memo: Low-carbon	MEMOLC	Includes: energy efficiency, carbon capture and storage (CCS), renewable energy sources, nuclear, hydrogen and fuel cells, other power and storage, and other cross-cutting technologies and research. =EFFICIENCY+23CO2CS+RENEWABLE+ NUCLEAR+HGENCELL+OTHERPANDS+OTHERTECH+UNA LLOC
Memo: Non-low-carbon	MEMONLC	Includes: coal, gas, oil and other fossil fuel RD&D with the exception of CCS. =21OILGAS+22COAL+29FOSFUN

Product definitions

Products

Long name	Short name	Definition
Total RD&D in million USD (2020 prices and exchange rates)	RDDUSD	Total RD&D expenditure data, converted from current prices in national currencies to US dollars in constant 2020 prices using GDP deflators and 2020 exchange rates.
Total RD&D in million USD (2020 prices and PPPs)	RDDUSDPPP	Total RD&D expenditure data, converted from current prices in national currencies to US dollar PPPs in constant 2020 prices using GDP deflators and 2020 PPPs. Purchasing power parities (PPPs) are the rates of currency conversion that eliminate the differences in price levels between countries. For more information on PPP methodology, see www.oecd.org/std/prices-ppp.
Total RD&D in million EUR (2020 prices and exchange rates)	RDDEURO	Total RD&D expenditure data, converted from current prices in national currencies to euros in constant 2020 prices using GDP deflators and the euro 2020 exchange rates.
Total RD&D in million national currencies (2020 prices)	RDDNCREAL	Total RD&D expenditure data in national currencies, deflated using country-specific GDP deflators.
Total RD&D in million national currencies (nominal)	RDDNC	Total RD&D expenditure data, expressed in national currencies at current prices.
Government R&D in million national currencies (nominal)	GOVTRD	Government R&D expenditure data, expressed in national currencies at current prices.
Government Demonstration in million national currencies (nominal)	GOVTDEMO	Government Demonstration expenditure data, expressed in national currencies at current prices.
State-owned R&D in million national currencies (nominal)	STATERD	Total R&D expenditure data, expressed in national currencies at current prices.

Energy RD&D Budgets per thousand units of GDP

Long name	Short name	Definition
RD&D per thousand units of GDP	RDD1000GDP	Total RD&D in nominal national currencies divided by GDP in nominal national currencies at market prices and volumes, expressed in thousand units of GDP.

RD&D Economic Indicators

Long name	Short name	Definition
U.S. dollar exchange rate	USEXRMEI	Source: National Accounts (OECD) for OECD Countries and European Union and IMF for Brazil.
Purchasing power parity (PPP)	PPP	Source: National Accounts (OECD) for OECD Countries and European Union and World Bank for Brazil.
Nominal GDP in national currency (Millions)	GDPNCN	Source: National Accounts (OECD) for OECD Countries and European Union and World Bank for Brazil.
GDP deflator	GDPDEF	Source: National Accounts (OECD) for OECD Countries and European Union and IMF for Brazil.

Geographical coverage and country notes

Countries and regions

IEA	**Short name:** IEAEST
Definition	Includes Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico (starting with 2013 data), the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.
IEA Americas	**Short name:** IEAAMEST
Definition	Includes Canada, Mexico (starting with 2013 data) and the United States.
IEA Europe	**Short name:** IEAEUREST
Definition	Includes Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom.
IEA Asia Oceania	**Short name:** IEAAOEST
Definition	Includes Australia, Japan, Korea and New Zealand.

Australia	Short name: **AUSTRALI**
Definition	**Source**: Department of the Environment and Energy **Latest submission:** 2018/2019 **Latest available data:** 2019 **Funding institutions included in the submission**: • AusIndustry • Australian Nuclear Science and Technology Organisation (ANSTO) • Australian Renewable Energy Agency (ARENA) • Australian Research Council (ARC) • Commonwealth Science and Industrial Research Organisation (CSIRO) • Cooperative Research Centres (CRCs) • Department of Education and Training (DoET) • Department of Industry, Innovation and Science (DIIS) • National Energy Resources Australia (NERA). **Country note:** Excludes overseas territories. All data refer to the financial year; for example, 2018 refers to 1 July 2018 to 30 June 2019. No data are reported under state-owned companies because there is no relevant expenditure in that section in Australia. The decrease in spending that occurred in Government R&D between 2013 and 2014 was mainly due to completion of major programs supporting CCS, solar energy and energy efficiency. Expenditure by individual institution can vary greatly from year to year, and an agency's proportion of total spending will also vary (e.g. completion or termination of projects, etc.). The budgetary stages would change over the years, considering the completion of various long-term funded projects. Thus, depending on the funding institution, the budgetary stage may be final budget appropriation or obligations. From 1999 to 2003, only aggregate figures are available for nuclear fission/fusion. Data for 2009, 2010 and 2011 have been estimated by the Australian administration, causing breaks in series between 2008 and 2009. In 1993, figures for nuclear fuel cycle include nuclear supporting technology data. Prior to 1997, biofuels includes geothermal and other renewable energy not elsewhere classified.

Austria	**Short name:** AUSTRIA

Definition	**Source:** Austrian Energy Agency on behalf of the Austrian Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)
	Latest submission: 2020/2021
	Latest available data: 2020
	Major funding institutions and programmes included in the submission:
	• Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)
	  • City of Tomorrow
	  • IEA Research Cooperation
	  • Smart Energy Systems
	  • JPI Urban Europe
	  • Mobility of Tomorrow
	• Climate and Energy Fund
	  • Energy Research Programme
	  • Flagship Region Energy
	  • Zero Emission Mobility
	  • Smart Cities
	  • Energy Transition 2050
	• Austrian Research Promotion Agency
	  • General programme

Austria Definition (continued)	**Country note:** Government RD&D data cover central or federal government units as well as provincial and state government units. In Austria, state owned companies are covered in the R&D-surveys for the private sector. They are intentionally not covered in the detailed survey for IEA. For every second year (2015, 2017...) Austria provides a total annual sum for energy R&D for the whole private sector (including state owned) in the IEA questionnaire. Due to confidentiality and data protection, no individual technology figure is disclosed by the federal statistics authority. Financial flows from European programmes (Horizon 2020, Research Fund for Coal and Steel…) are excluded, national contributions on project level are included. Austrian contributions to the European Union budget are excluded. IEA TCPs (including common funds) are included. Data are collected from a performer perspective as expenditures by using voluntary surveys for equity capital used by research organizations and universities, and identifying contracted funding with data provided by funding agencies. Estimated share of the sample of the total expenditure covered: • Government >95% • Higher education >80% Details on methodology and sample coverage are available at: https://nachhaltigwirtschaften.at/resources/iea_pdf/events/20200708_webinar-energiewende/webinar-energiewende-energieforschung-indinger-katzenschlager-2020-07-08_en.pdf.
Belgium	Short name: **BELGIUM**

Definition	**Source**: Belgium Federal Government
	Latest submission: 2020/2021
	Latest available data: 2020
	Major funding institutions and programmes included in the submission:
	Flemish region:
	• Research Foundation Flanders (FWO) (https://www.fwo.be/en/).
	• Flanders Innovation & Entrepreneurship (VLAIO) (https://www.vlaio.be/nl/andere-doelgroepen/flanders-innovation-entrepreneurship)
	• Interuniveristy Micro-electronics Centre (Imec) (https://www.imec-int.com/en/home)
	• Flanders Make (https://www.flandersmake.be/en)
	• Flemish Institute for Technological Research (VITO) (https://vito.be/en).
	
	"VLAIO" and "Research Foundation – Flanders" are funding agencies for research. IMEC, VITO, Flanders Make are strategic research centres who yearly receive a public funding amount (dotation) from the Flemish government.
	
	Walloon region:
	• Walloon Public Service (https://spw.wallonie.be/)
	  • Energie - ERA-NET SES (Smart Energy System) – H2020
	  • Recherche
	
	Brussels–capital region:
	• Bruxelles–Environnement (https://environnement.brussels/)
	• Innoviris (https://innoviris.brussels/) – until 2019
	
	Federal (nuclear):
	• Federal Public Service Economy (https://economie.fgov.be/en)
	  • NIRAS/ONDRAF
	  • IRE
	  • SCK CEN
	  • Waste treatment and dismantling techniques for decommissioning of legacy facilities
	  • BELSPO

Belgium Definition (continued)	• Royal Military School • Energy Transition Fund grants. Contributions to CERN are not included. **Country note**: <u>Public RD&D data coverage</u> Government RD&D covers: • central or federal government units • provincial and state government units Covered in public energy RD&D: • national projects • international projects: national contributions to the European Commission energy R&D programs • international projects: national contributions to international RD&D programmes, including ITER but excluding CERN, which is not considered an energy-related activity by the country • international projects: national contributions to international RD&D efforts under the IEA TCPs. <u>Data collection methodology</u> **Federal (nuclear)**: Data are collected with a **hybrid** methodology by using **voluntary surveys** at the federal level. Estimated share of the sample of the total expenditure covered: • Government 100% • Information obtained from SCK CEN, IRE, NIRAS/ONDRAF, BELSPO and the Royal Military School • Higher education 0% • Business sector 0% **Flemish region:** Data are collected from a **funder perspective as budgets**. The data are derived from the budget. The figures are composed from the survey of the funding agencies (VLAIO and FWO) and some public institutions which are financed by the government for the research activities. For the Flemish region, data are based on final budget appropriations. Flemish data rely on the individual analysis of budgets of approved project proposals in the energy technology field, and only includes Flemish public RD&D expenditures (no European / international / private co-funding budget is included). **Walloon region:** Data are collected from a **funder perspective as budgets**. The data are derived from the budget. For the Walloon region, data provided are based on obligations, and on the individual analysis of the projects themselves. Only the national/regional public funding has been taken into account for projects which are co-financed by Europe. **Brussels–capital region:** For the Brussels region, data provided are based on obligations (budgetary stage vi), and on the individual analysis of the projects themselves. The data include all the projects in which there is a regional co-funding involved. There are no state-owned companies. For 2021 estimates, only data for nuclear budgets are available.

Brazil	**Short name: BRAZIL**
Definition	**Latest submission:** 2019/2020 **Latest available data:** 2018 **Funding institutions included in the submission**: • Financiadora de Estudos e Projetos (FINEP) • Fundo Nacional de Desenvolvimento Científico e Tecnológico (FNDCT) • Agência Nacional do Petróleo, Gás Natural e Biocombustíveis (ANP) • Agência Nacional de Energia Elétrica (ANEEL) • Banco Nacional do Desenvolvimento (BNDES) • Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) • Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) • Comissão Nacional de Energia Nuclear (CNEN). **Country note:** The dataset is the result of a project called Energy Big Push (EBP), which gathered all the relevant actors active in the energy innovation scenario of Brazil, including: the Brazilian Ministry of Mines and Energy and the Ministry of Science, Technology, Innovations and Communications, the main actors in energy innovation in Brazil. EBP project analysed the RD&D spending data of the relevant federal institutions listed above and the state of São Paulo. It is important to note that a significant amount of resources is associated with contractual investment obligations, considered public-oriented in this project. 100% of the contractual obligation for minimum investment in R&D is allocated as public-oriented investment. This is the case for all investments under regulated programs of the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), and Brazilian Electricity Regulatory Agency (ANEEL). The database of the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP) was not available at project level. Thus, it was necessary to adopt the premise that all investment is made in the oil and gas industry. This was a necessary simplification to report the data, but it is recognised that a part of these resources may be invested in renewable energy. For values associated with the Brazilian National Development Bank (BNDES), the database contains the financing granted by the institution in energy RD&D area, considering BNDES loans and non-reimbursable funding.

Canada	Short name: **CANADA**

Definition	**Source**: Natural Resources Canada (NRCan), Government of Canada
	Latest submission: 2020/2021
	Latest available data: 2021
	Funding institutions included in the submission: Figures are based on data from approximately 30 federal departments and agencies as well as all provincial and territorial governments. The Canadian process surveys all federal, provincial and territorial organizations funding energy RD&D related activities with the exception of municipalities. Government figures include combined data from federal departments and agencies and all of provinces and territories.
	• Natural Resources Canada (NRCan)
	  • Program of Energy Research & Development (PERD)
	  • Energy Innovation Program (EIP)
	  • Impact Canada Initiative – Clean Technology Challenges
	  • Clean Growth Program (CGP)
	  • Green Infrastructure (GI) – Smart Grid, Buildings, Electric Vehicles Infrastructure, Clean Energy for Rural & Remote Communities,
	  • Canadian Emissions Reduction Innovation Network (CERIN)
	  • Breakthrough Energy Solutions Canada (BESC)
	• Natural Resources Canada (NRCan) – Atomic Energy of Canada Limited (AECL)
	  • Revitalization of the Chalk River Laboratories

Canada Definition (continued)	• Federal Nuclear Science and Technology Work Plan • Innovation, Science and Economic Development Canada (ISED) – Sustainable Development Technology Canada (SDTC) • SD Tech Fund • Innovation, Science and Economic Development Canada (ISED) – National Research Council Canada (NRC) • R&D programs • Industrial Research Assistance Program (IRAP) • Innovation, Science and Economic Development Canada (ISED) – Natural Sciences and Engineering Research Council of Canada (NSERC) • Discovery Research • Research Training and Talent Development • Research Partnerships Of approx. 30 federal departments/agencies, five federal organizations are identified as major spenders. Federal organizations are not listed in any particular order (i.e. ranked by spending). Provincial and territorial governments were also surveyed but the details of their major programs are not provided here. **Country note**: For Canada, State-Owned Enterprises (SOEs) are reported only from provincial and territorial governments. SOEs are considered Provincial or Territorial Crown Corporations, such as electric or gas utilities. Not all provincial and territorial governments reported relevant spending from SOEs. 2012-2013 fiscal year was the first year Canada started reporting SOEs separately. Public energy RD&D data cover: • National Projects • International Projects: national contributions to international RD&D programmes or organizations such as the International Atomic Energy Agency (IAEA) and OECD Nuclear Energy Agency (NEA). • International Projects: national contributions to international RD&D efforts under the IEA Technology Collaboration Programmes The data are collected with a hybrid methodology by using voluntary surveys Canada uses both funder and performer perspectives to collect energy RD&D data, as the investment flows externally outside the government (i.e. to private sector) and also internally within the government (i.e. national laboratories). NRCan, as a coordinator of the data, works with both performers and funders within the Government of Canada (GOC) to check and verify the data submitted. This particular process puts enhanced measures to ensure the accuracy of the data received including budgeted and estimated expenditures. GOC's internal performers do not often provide budgeted/estimated expenditures. In those cases, budgeted/estimated figures are provided by the program administrators. For provinces and territories, each provincial/territorial government has its own coordinating ministry that is responsible for collecting the data, on behalf of its provincial/territorial government. All data refer to the fiscal year, for example, 2019 refers to April 1st 2019 to March 31st 2020. Data up to and including 2019 refer to actual outlays. Data beyond 2019 are considered estimates based on the available data at the time of reporting. Each year, the data collection period starts in October and ends in March/April.

Czech Republic	Short name: CZECH
Definition	**Source**: Ministry of Industry and Trade of the Czech Republic **Latest submission:** 2019/2020 **Latest available data:** 2020 **Funding institutions included in the submission**: No details available. **Country note**: Publicly funded R&D projects can be searched through public databases and portals. These are mainly the ISVAV (https://www.rvvi.cz/) and the STARFOS portal (https://starfos.tacr.cz/cs). Based on individual code and project name, basic informations can be found. These are mainly: the amount of eligible costs and the amount of public support (not for every year but only total amount), basic information about an institution carrying the research, project solution time, program of a concrete project, public tender number, R&D categories field, etc. Each specific project has an individual code that serves as a unique identifier. R&D projects data are collected by the Technology Agency of the Czech Republic (TA CR). The above-mentioned public databases are managed by the Technology Agency of the Czech Republic (STARFOS), respectively by the Research, Development and Innovation Council (ISVAV). The Ministry of Industry and Trade with the help of the Technology Agency of the Czech Republic (TA CR), which has direct access to background data, such as eligible costs and public support for each individual year, searched specific energy projects in the Czech Republic within the STARFOS database from 1996 to 2020. These projects were supplemented by already searched projects, as the search was carried out in 2015 while preparing one of the previous questionnaires. These projects were subsequently exported, including the key information necessary to complete the questionnaire.

Denmark	Short name: **DENMARK**
Definition	**Source**: Danish Energy Agency, Ministry of Energy, Utilities and Climate **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Energiteknologisk Udviklings- og Demonstra-tionsprogram (EUDP) - primarily an RD&D program but including some support to research activities • ELFORSK – RD&D for efficient use of electricity, emphasis om R&D • The Danish Innovation Fund – primarily supports research activities. **Country note:** Excludes Greenland and the Danish Faroes. Figures included in the Danish submission consist exclusively of funding of project proposals directed towards Danish RD&D programs. Contributions to international organisations and programmes are not included. Danish data are based on obligations for 2018 and 2019 (budgetary stage vi).

Estonia	**Short name: ESTONIA**

Definition	**Source**: Ministry of Economic Affairs and Communications
	Latest submission: 2020/2021
	Latest available data: 2020
	
	Funding institutions included in the submission:
	• Estonian Research Council (https://www.etag.ee/en/funding/programmes/)
	  • RITA, grant, personal funding
	• Ministry of Economic Affairs and Communications
	  • R&D programme for the National Development Plan of the Energy Sector until 2030
	Research programmes are described here: https://www.hm.ee/en/activities/research-and-development/research-programmes
	
	Country note:
	Data include state-owned energy companies belonging to the Republic of Estonia:
	• Eesti Energia (https://www.energia.ee/en/ettevottest)
	• Elering (https://elering.ee/en/about-company)
	
	All projects and other RD&D related activities by the evaluated institutions listed at: https://www.etis.ee/Portal/Institutions/Index?lang=ENG are registered at the Estonian Research Information System.
	
	Data are collected from a performer perspective as expenditures.
	Data prior to 2011 are not available.
	Data reported under the name of Coal actually correspond to oil shale.

Finland	Short name: **FINLAND**
Definition	**Source**: Statistics Finland **Submitted by:** Energy Department, Ministry of Economic Affairs and Employment **Latest submission:** 2020/2021 **Latest available data:** 2019 **Funding institutions included in the submission**: • Ministry of Economic Affairs and Employment • The Finnish State Nuclear Management Fund • Tekes - Finnish Funding Agency for Innovation / Business Finland • VTT Technical Research Centre of Finland • Geological Survey of Finland • The Finnish Academy • Ministry of the Environment • Finnvera • Nordic Investment Bank • Ministry of Agriculture and Forestry. **Country note:** “Other coal” contains budgets allocated to peat research. “Coal combustion” includes "Coal conversion". R&D also includes demonstration budgets.

France	Short name: FRANCE

Definition

Source: Service de la Donnée et des Etudes Statistiques, Ministère de la Transition Ecologique et Solidaire

Latest submission: 2019/2020

Latest available data: 2019

Funding institutions included in the submission: 14 public scientific and technical institutions, industrial and commercial institutions, public interest groups or public funding programmes:

- Agence de l'environnement et de la maitrise de l'énergie (ADEME)
- Agence nationale pour la gestion des déchets radioactifs (ANDRA)
- Agence nationale de la recherche (ANR)
- Banque publique d'investissement (BPI)
- Bureau de Recherches Géologiques et Minières (BRGM)
- Centre national de la recherche scientifique (CNRS)
- Centre Scientifique et Technique du Bâtiment (CSTB)
- Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
    - ITER, Jules Horowitz reactor project
- Institut français pétrole énergies nouvelles (IFPEN)
- Institut de radioprotection et de sûreté nucléaire (IRSN)
- Institut français de recherche pour l'exploitation de la mer (IFREMER)
- Institut national de la recherche pour agronomique (INRA)
- Institut français des sciences et technologies des transports, de l'aménagement et des réseaux (IFSTTAR)
- Fonds unique interministériel (FUI).

Country note:

SOEs are not included in the submission due to the business secrecy rules applicable in France.

Government RD&D covers central or federal government units.

The following type of projects are covered in public energy RD&D:

- National projects
- International projects: national contributions to international RD&D programmes or organizations including IAEA (International Atomic Energy Agency), ITER (International Thermonuclear Experimental Reactor) and CERN (European Organization for Nuclear Research)

For example, indirect funding related to the ITER project, via Euratom, is excluded from the submission.

Data are collected from a funder perspective as budget.

Includes Monaco, and excludes the following overseas departments and territories (Guadeloupe, Guyana, Martinique, New Caledonia, French Polynesia, Reunion, and Saint-Pierre and Miquelon).

In 2010 the French Administration revised the RD&D budgets back to 2002. This results in a break in series between 2001 and 2002.

The French data submission is mostly based on actual budget outlays (budgetary stage vii), with a few French institutions reporting on obligations.

It covers a combination of basic research/ applied research/ experimental development programmes as well as both energy related and fundamental research programmes.

In 2018, International Thermonuclear Experimental Reactor (ITER) funding (via the Commissariat à l'énergie atomique et aux énergies alternatives -CEA-, GOVT R&D budgets) was added ("Other nuclear fusion" item) with also data from 2002 to 2017.

In 2017, a new structure (specialized in nuclear waste management) was added with data since 2002. No incidence on GOVT demonstration budgets: only GOVT R&D budgets was updated.

France Definition (continued)	In 2021, the data transmitted by the CNRS (Centre national de la recherche scientifique) have been revised from 2002 to improve the coverage. French data include ITER contributions and exclude other EU or other international RD&D programmes, nor contributions to these programmes.
Germany	Short name: **GERMANY**
Definition	**Source**: Federal Ministry for Economic Affairs and Energy **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: The funding reported is the funding within the 7th Energy Research Programme of the Federal Government. Funding institutions are the Federal Ministry for Economic Affairs and Energy, the Federal Ministry of Education and Research and the Federal Ministry of Food and Agriculture. With the transition to the 7th Energy Research Programme, the data for 2019 onwards are based on a new categorization of energy research funding. **Country note**: Public RD&D data coverage Government RD&D covers: Central or federal government units Provincial and state government units State-owned enterprises data are not included. Covered in public energy RD&D: • national projects • international projects: national contributions to international RD&D efforts under the IEA TCPs. All government energy RD&D expenditures for project funding are managed with the electronic accounting system profile. The Federal Ministry for Economic Affairs and Energy uses a fine-grained categorisation system in order to match project expenditures to the categories of national and IEA energy RD&D reporting. The other ministries use similar systems. The sample coverage is 100%. Data do not include the new Laender of Germany prior to 1992. Data do not include expenditures by regional governments. Data include basic research and applied research projects. From 2003 onwards, the institutionally financed R&D activities of the Helmholtz centers are included. From 2018 onwards, the institutional funding for non-nuclear energy research is mainly allocated to category 8, “Unallocated”. The figures submitted to IEA are based on the 7th Energy Research Programme. The “total budget” data are identical to figures reported in the yearly updated “Federal Government Report on Energy Research” available online. Figures on international or European programmes are not included. 2020 estimated data are based on actual outlays (budgetary stage vii).

Greece	**Short name: GREECE**
Definition	**Source**: General Secretariat for Research and Technology **Latest submission:** 2010/2011 **Latest available data:** 2011 **Funding institutions included in the submission**: No detail available. **Country note**: From 2000 onwards, Greece has provided only aggregated data until 2007.
Hungary	Short name: **HUNGARY**
Definition	**Source**: National Research, Development and Innovation Office (NRDI) **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: National Research, Development and Innovation Office and Ministry of Finance. **Country note**: Data for 1995, 1996, 1998 and 1999 are not complete. New data were received for the period 2013-2016 in cycle 2016/17, explaining the break in time series between 2012 and 2013. Data refer to obligations for projects supported by Hungarian budgetary funds (National research, development and Innovation Fund) and the projects co-financed by European Structural and Investment Funds (ESIF represented 75% of the total RD&D budget in 2017 and 80% in 2017). In most of the cases in Hungary, RD&D funds are not allocated to a specific field of science but are assigned to different projects through tenders; thus energy obligations may vary from year to year. Further details about Hungarian RD&D budget are available on the NRDI website.
Ireland	**Short name:** IRELAND
Definition	**Source**: Sustainable Energy Authority of Ireland **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Sustainable Energy Authority of Ireland (SEAI) • National Research Funding Programme • Ocean Energy Prototype Development Fund • Department of Agriculture, Food and the Marine (DAFM) • Competitive Research Funding Programme • Department of Transport • National funding through departmental vote • Green Public Transport Fund • Environmental Protection Agency (EPA) • EPA Climate Call • Enterprise Ireland • Commercialisation Fund • Geological Survey Ireland (GSI) • Geothermica/GSI Research Programme • Marine Institute • Marine Institute's Marine Research Programme • Marine Research Programme – Industry-led Awards • Science Foundation Ireland (SFI) • SFI Future Innovator Prize • SFI Industry Fellowship

Ireland Definition (continued)	• SFI Frontiers for the Future Programme • SFI Centres Programme • Irish Research Council (IRC) • Employment Based Postgraduate Programme • EPS Postgraduate Application • EPS Postdoctoral Application • Ulysses • Advanced Laureate Awards • Government of Ireland Postgraduate Award • Government of Ireland Postdoctoral Award **Country note**: The data have been collected from a funder perspective as budgets. Data prior to 2015 consist of funding of project proposals directed towards Irish energy RD&D programs and are based on reported "actual expenditures". Data include deployment prior to 2010. Data from 2016 onwards refer to a new data methodology based on a data collection run by SEAI with the main organisations, listed above, which disburse public funding. Data for this period are based on awarded budgets (budgetary stage vi). For transnational projects (e.g. ERANET), only the financial contribution from the Irish agencies was included (when this information was made available to SEAI). For such projects, in-kind contribution from Irish agencies was not accounted for in the reporting (when this information was made available to SEAI); Irish funder's contribution had to be estimated in some cases. The value of funding provided by International/European organisations (e.g. European Commission etc.) is not included in the data. Transnational projects in which Irish public funding agencies are participating as a partner or a lead were not included (e.g. Interreg projects). Further information relating to energy RD&D projects funded in Ireland is available at the SEAI National Energy Database. Ireland does not have any state-owned enterprises.
Italy	Short name: **ITALY**
Definition	**Source**: Department of Energy, Ministry of Economic Development **Latest submission:** 2018/2019 **Latest available data:** 2018 **Funding institutions included in the submission**: Not detail available. **Country note**: The Italian BES R&D survey is census-based, considering that the target population comprises all the active enterprises that potentially perform R&D, according to the information we received from other statistical or administrative sources. In 2018 the target population comprised over 37 000 enterprises. The Italian BES R&D survey is a web survey. The data collection made use of the Istat Business Statistical Portal, a single entry point for Istat web-based data collection from enterprises. ISTAT Business Statistical Portal implements a new approach for the organisation and management of data collection processes. Since 2016, ISTAT has implemented an imputation method to take into account the non-response units. This action solves the previous problem of "under-estimations" of Italian business R&D expenditures and personnel, and it improves the quality of the final results. It is a partial imputation of the non-response units because only the units in the previous two surveys that gave preliminary R&D data were considered in the imputation process. Specifically, in this process – based on a predictive regression imputation, applied to the two key variables (R&D expenditure and R&D personnel in fte) – about 3 000 non-response enterprises were involved in the 2018 edition of the Italian BES R&D survey. Private RD&D data coverage Business Sector: 70% of the performers (response rate for the A reference year 2018)

Italy Definition (continued)	The target population comprises all the Italian active enterprises that could potentially perform R&D. The main statistical source used for defining the target population of R&D performers is the most updated release of the official Italian business Register, Asia 2018. Other sources of information were: • the inventory of the enterprises claiming tax relief for R&D activities and projects (Dichiarazione Unico from the Italian Agency for fiscal revenues of the Ministry of Economy) • the list of the enterprises reporting R&D activities in the two previous R&D surveys • the list of the enterprises reporting intramural R&D activities in the previous CIS • the register of the innovative start-ups included in the Business Register of the Italian Ministry of Economic Development • the register of the contributors to international research programs (EU 7th Framework Program for Research and Technical Development for projects) • the list of the enterprises operating in one of the Italian Scientific and Technological Parks • the lists of R&D performing firms provided by some industrial associations, such as Federchimica and Assobiotech.
Japan	**Short name:** JAPAN
Definition	**Source**: Ministry of Economy, Trade and Industry **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Ministry of Economy, Trade and Industry (METI) • Ministry of Environment (MOE), from 2018 onwards • Ministry of Education, Culture, Sports, Science and Technology (MEXT). **Country note:** The items included in Conservation were expanded in 1994. Earlier budgetary data are not comparable. "State-owned R&D" budgets are not covered in the "Government R&D" totals. Data provided are based on final budget appropriations (budgetary stage v), and does not include budgets related to international RD&D programmes. Data for Japan cover budgets allocated by METI for all years and include the spending of MOE for the first time in 2018. In 2018 MOE represented 13% of the total national budget, which explains the break in time series between 2017 and 2018. This also affects the aggregates "IEA Total" and "IEA Asia Oceania".
Korea	Short name: **KOREA**
Definition	**Sources**: Ministry of Trade, Industry, and Energy (MOTIE), Korea Institute Energy Technology Evaluation and Planning (KETEP) **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: No detail available. **Country note**: Data include RD&D budgets based on the technology development and international cooperation reflected in the Energy R&D Program of the MOTIE. Data are based on actual outlays.

Lithuania	**Short name: LITHUANIA**
Definition	**Source**: Ministry of Energy of the Republic of Lithuania **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Ministry of Energy of the Republic of Lithuania • Ministry of Economy and Innovation of the Republic of Lithuania • Ministry of Education, Science and Sport of the Republic of Lithuania • Agency for Science, Innovation and Technology • Lithuanian Business Support Agency • information from universities regarding their own financing of energy RD&D projects. **Country note:** Data prior to 2019 are not available. Data from one more important RD&D funder in Lithuania – Research Council of Lithuania – are not available for the current submission, but they are planned to be included in following submissions. Figures for the year 2019 are actual outlays and figures for the year 2020 are obligations. In many cases, RD&D funds are not allocated specifically to energy-related technologies but are assigned to different projects through tenders.
Luxembourg	Short name: **LUXEMBOU**
Definition	**Source**: Ministère de l'Economie, Direction générale Recherche, propriété intellectuelle et nouvelles technologies **Latest submission:** 2013/2014 **Latest available data:** 2012 **Funding institutions included in the submission**: Luxembourg Government, conventions are double signed by both the Minister of Economy and Minister of Finance. **Country note**: Luxembourg has provided just partial information for 1991 to 2000. The figures provided do not show the split between R&D and Demonstration since the split is not available within current reporting scheme. Data provided are based on obligations (budgetary stage vi).
Mexico	**Short name:** MEXICO

Definition	**Source**: Secretaría de Energía – Dirección General de Investigación, Desarrollo Tecnológico y Formación de Recursos Humanos
	Latest submission: 2020/2021
	Latest available data: 2020
	
	Major funding institutions and programmes included in the submission:
	• SENER – CONACYT
	  • Fondo Sectorial de Hidrocarbos
	  • Fonda Sectorial de Sustentabilidad Energética
	
	Country note:
	There are two SOEs in Mexico:
	• Petróleos Mexicanos (PEMEX)
	• Comisión Federal de Electricidad (CFE)
	They are **not included** in the submission.
	
	The data cover government RD&D from central or federal government units.

Mexico Definition (continued)	Covered in public energy RD&D: • national projects • international projects: national contributions to international RD&D efforts under the IEA Technology Collaboration Programmes Includes contribution committed by the Energy Sustainability Fund for a project in collaboration with the European Commission Data are collected **from a funder perspective as budget.** Data for Mexico are available starting in 2013.
Netherlands	Short name: **NETHLAND**
Defintion	**Source**: Netherlands Enterprise Agency (RVO.nl), Ministry of Economic Affairs and Climate Policy **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • The Ministry of Economic Affairs and Climate Policy (EZK) • The Ministry of Education, Culture and Science • The Ministry of the Interior and Kingdom Relations (IKR). R&D budgets and expenditures of universities, as well as funding from local governments programs, are not included in the submitted data. **Country note**: Excludes the former Netherlands Antilles. The Netherlands submission does not include EU or international RD&D programmes, nor the Dutch contributions to IAEA, ITER or CERN. Data submitted are based on obligations (budgetary stage vi).
New Zealand	**Short name:** NZ

Definition	**Source**: Ministry of Business, Innovation and Employment
	Latest submission: 2020/2021
	Latest available data: 2019
	
	Major funding institutions and programmes included in the submission:
	• Ministry of Business, Innovation and Employment
	  • Endeavour
	  • Strategic Science Investment Fun Programmes
	  • National Science Challenges and Partnerships
	  • Provincial Development Unit
	
	Country note:
	State-owned companies are not included in the submission. There is one SOE, Transpower New Zealand Limited.
	
	Government RD&D covers central or federal government units and provincial and state government units.
	Only national projects are covered in public energy RD&D:
	Data are collected from a **funder** perspective as **budgets**.
	
	The data provided are based on actual expenditures.

Norway	Short name: **NORWAY**

Definition	**Source**: Climate, Industry and Technology Department, Ministry of Petroleum and Energy
	Latest submission: 2020/21
	Latest available data: 2021
	Funding institutions included in the submission:
	• Government R&D/Demo:
	  ◦ The Research Council of Norway
	  ◦ Enova SF
	  ◦ Transnova SF
	  ◦ Innovation Norway;
	  ◦ The Norwegian Water and Energy Directorate
	  ◦ Gassnova SF.
	• State-owned enterprises R&D/Demo:
	  ◦ Statnett
	  ◦ Statkraft.
	Not included: Statoil (only partially state-owned).
	
	Country note:
	Includes the Svalbard archipelago (Spitsbergen).
	The Norwegian schemes for governmental RDD support are, for the most part, technology-neutral. The actual allocations each year to various energy fields and technologies are based on the quality of the projects responding to the calls, i.e. competition among researchers and projects proposals, where the best projects are funded within available budgets. Reporting on final budget appropriations is only possible for very broad fields such as petroleum, CCS and energy efficiency/ renewable energy/ energy system/ storage.
	Allocations for International R&D programmes (e.g. Horizon 2020) are, in general, not included. However, support of Norwegian participation in ERA-NET Cofunds is included. In addition, some national programmes provide financial support to Norwegian actors that participate in international programmes. Such schemes are included in the Norwegian submission of the RD&D questionnaire.

Poland	**Short name:** POLAND
Definition	**Source**: Department of Innovation and Development, Ministry of Science and Higher Education **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Ministry of Science and Higher Education (MSHE) • National Centre for Research and Development (agency for applied research supervised by MSHE) • National Centre of Science (agency for basic research supervised by MSHE). • *Not included*: Other Polish ministries and institutes supervised by those ministries which may also fund some research projects (but marginally – the MSHE is the prime source of public funding for R&D via its above mentioned two supervised agencies). **Country note:** Only R&D projects are included in the submission. Demonstration projects are not included. In Poland, the Ministry of Science and Higher Education is responsible for financing research (basic and applied research projects, experimental development and research infrastructure), while “sectoral” ministries (e.g. ministry for energy, climate, agriculture, environment, defence etc.) are responsible for the implementation of demonstration projects and for the deployment of new technologies in their respective areas.. Data reported in questionnaire are not official statistical data, but only estimations based on analysis carried out by MSHE and its supervised funding agencies. Data provided are based on obligations (Minister’s and its agencies programmes and projects) and on the individual analysis of the projects themselves. Data reported come from R&D projects funded or co-funded from public money. Financial means from EU structural funds are also included (not

Poland Definition (continued)	included is contribution from international organisations and EC framework programmes like H2020). All projects, funded from science budget including “State-owned R&D” and “Government pilot projects” are included in the submission. Data reported in questionnaire do not include all funds on energy R&D from MSHE’s budget (may include even less than 50%). This is due to the structure of Polish science budget, which is divided into definite financing streams (on a base of legislative regulation). About half of science budget is appropriated on statutory tasks of scientific institutions and other tasks that means that not government (MSHE), but R&D institutions including academia decide about aims of spending received funds. In result, funds on statutory tasks - as far as division on definite economy sectors is concerned like e.g. different renewable energy – is practically impossible to measure. These could only be estimated by each of research unit and faculty at the university. They are not obliged to collect those data by the statistical Polish system. Official statistical data for R&D in Poland are delivered by the Polish Statistical Office. From 2013 the Polish Statistical Office presents government budget appropriations or outlays for R&D by socio-economic objectives (NABS), where energy is 1 of 13 these objectives (others are environment, agriculture, health, defence etc.). However those data are not detailed and divided into sub-areas as RES, fossil fuels, nuclear etc.). The decrease in energy R&D funding compared to the years 2010-2015 is related to the schedule of priorities implementation in the National Research Program. Energy was one from seven main country R&D priorities. The largest R&D projects were launched in 2010 and ended in 2015. In the following years, projects from other priorities were carrying out. However in September 2021 launches the new strategic R&D programme in the field of energy (the budget for 2021-2029 is 800 mln PLN). Data for 2021 are only initial estimation for on-going or planned projects. The final data for this period will vary and should be higher. In row “22.Coal” funds estimation for 2021 are 196 mln PLN (almost 10 times increase in funding compared to previous years). It is due to the launch of the new program ‘The Bloki 200+’ (Power Generation Units+) dedicated to mitigating the effects of shutting down coal-fired power plants and transforming the system towards renewable energy sources. The Bloki 200+ (Power Generation Units+) is an initiative designed to support research & development work in the area of energy. It aims to develop new technological, organisational and legal solutions to facilitate the adaptation of power generation units (which have to be operated for the next 15 years to ensure energy supply and security of the Polish energy system) to the changing operating conditions and new challenges associated with the national energy system, increasingly relying on wind and solar energy. The programme will contribute to limit GHG emission and enabling the implementation of new competing technologies based on renewable and other clean energy sources.

Portugal	Short name: **PORTUGAL**
Definition	**Source**: Direção Geral de Energia e Geologia **Latest submission**: 2020/2021 **Latest available data**: 2020 **Funding institutions included in the submission**: • National Foundation for Science and Technology • MIT Portugal. **Country note:** Includes the Azores and Madeira Islands. The financing budgets include expenditure on human resources related to the relevant energy projects. Energy-related projects undertaken with the European Union or other countries (bilaterally or multilaterally) are included in the Portuguese energy RD&D data. 2013 Total Budget triples, and this is because the figures include salaries and EU financing. From 2016 onwards, data include funding from the Nation Foundation for Science and Technology and other funding agencies.

Slovak Republic	**Short name:** SLOVAKIA
Definition	**Source**: Department of International Energy Relations, Ministry of Economy of The Slovak Republic **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Ministry of Education, Science, Research and Sport of the Slovak Republic - MESRS SR http://www.minedu.sk/about-the-ministry/ • Slovak Research and Development Agency – SRDA https://www.apvv.sk/?lang=en • Scientific Grant Agency – VEGA http://www.minedu.sk/vedecka-grantova-agentura-msvvas-sr-a-sav-vega/ • Research Agency – RA http://www.vyskumnaagentura.sk/en/; • Slovak Innovation and Energy Agency – SIEA http://www.siea.sk/. The Ministry of Education, Science, Research and Sport of the Slovak Republic (MESRS SR) is the central body of the state administration of the Slovak Republic for elementary, secondary and higher education, educational facilities, lifelong learning, and science, and for the state's support for sports. The R&D agenda belongs to competencies of MESRS SR and is supported from the state budget via grant agencies (Slovak Research and Development Agency – SRDA, Scientific Grant Agency – VEGA). The use of structural funds of European Union for research and development are administered by dedicated agency Research agency (RA) or directly via relevant section of MESRS SR - EU Structural Funds Section. Financial means from EU structural funds are included in the indicated amounts. Industries and private companies are co-operating with academic institutions, but the funding for these activities is small. Incentives for R&D – support from the state budget in SMEs and their co-operation with academic institutions – is implemented through Law no. 185/2009 Coll. and Commission Regulation (EU) No. 651/2014 (until now, no. 800/2008). **Country note**: Data concerning specific budgets for demonstration projects or any “seed-capital” budgets for R&D are not available.

Spain	Short name: **SPAIN**
Definition	**Source**: Secretaría de Estado de Investigación, Desarrollo e Innovación, MINECO. Subdirección General de Planificación Energética y Seguimiento, MINETUR **Latest submission:** 2020/2021 **Latest available data:** 2019 **Funding institutions included in the submission**: • National Research Agency (AEI) • Centre for Industrial Technological Development (CDTI). **Country note:** Includes the Canary Islands and the Islas Baleares.

Sweden	**Short name: SWEDEN**
Definition	**Source**: Energy Analysis Department, Swedish Energy Agency **Latest submission:** 2020/2021 **Latest available data:** 2020 **Funding institutions included in the submission**: • Swedish Energy Agency • VINNOVA – Sweden´s Innovation Agency • The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas) • The Swedish Research Council (VR). **Country note**: Definition of SOEs A form of company where the state is the main owner. Many Swedish state-owned enterprises have been transformed into state-owned limited companies. State-owned R&D exists but is not included. Data coverage Government RD&D data cover: Central or federal government units Covered in public energy RD&D: • National projects Swedish data are based on actual outlays annually presented to the IEA (budgetary stage vii). Data are collected **from a funder perspective as budget**. Swedish data are based on actual outlays annually presented to the IEA (budgetary stage vii). International programmes like ITER and expenditure to the IEA and the EU are included, but not contribution for IEA and EU memberships.

Switzerland	**Short name:** SWITZERLAND

Definition	**Source**: Swiss Federal Office of Energy, Energy Research & Cleantech
	Latest submission: 2020/2021
	Latest available data: 2021
	
	Major funding institutions and programmes included in the submission:
	• ETH domain
	  • basic financing and internal competitive programmes of the federal technical universities and research organisations (ETHZ, EPFL, PSI, EMPA, EAWAG, WSL)
	• Swiss National Science Foundation (SNSF)
	  • (Open) project funding (fundamental research)
	  • National Research Programmes
	• Swiss Innovation Agency (Innosuisse)
	  • (Open) project funding (applied research)
	  • Energy Programme (SCCER)
	  • EUREKA
	  • COST

Switzerland

Definition (continued)

- Swiss Federal Office of Energy (SFOE)
  - Energy Research Programmes
  - Pilot and Demonstration Programme
- Swiss Federal Nuclear Safety Inspectorate (ENSI)
  - Nuclear Safety and Radioactive Waste Research Programme
- State Secretariat for Education Research and Innovation (SERI)
  - Replacement measures Horizon 2020
- Cantons
  - basic financing of cantonal universities and universities of applied sciences

Country note:

Definition of SOE

The term "federal companies" refers to stock corporations that are based on a special law and whose shares are fully or partially owned by the federal government. Examples are the Swiss Federal Railways (SBB AG) or Swisscom AG. Federal research organisations (ETH-Domain, Agroscope, etc) are not companies and, thus, are part of the “government R&D”.

In agreement with the State Secretariat for Education Research and Innovation (SERI), state-owned enterprises are being treated like “private companies” and, thus, their R&D contributions are not included in the statistics. However, in the energy sector only the Swiss Federal Railways are active in RD&D and their expenditures are very low compared to the total governmental funding.

Public RD&D data coverage

Government RD&D covers central or federal government units, and provincial and state government units.

Cantons = state government units (they are included);

Communities and cities are not included.

Covered in public energy RD&D:

- national projects
- international projects: national contributions to international RD&D programmes or organisations including IAEA (International Atomic Energy Agency), ITER (International Thermonuclear Experimental Reactor) and CERN (European Organization for Nuclear Research)
- international projects: national contributions to international RD&D efforts under the IEA TCPs.

Data collection methodology

Data are collected with a **hybrid** methodology by using **voluntary surveys**.

Estimated share of the sample of the total expenditure covered

- Government 100%
  - All the Swiss federal research organizations receive the survey. All the institutions dealing in energy research do respond and declare their data in a remarkable degree of detail.
- Higher education 100%
  - All the Swiss universities and universities of applied sciences receive the survey. All the institutions dealing in energy research do respond and declare their data in a remarkable degree of detail.

The Swiss RD&D statistics are based on the real expenditures per project. Data about projects entirely or partially funded by the federal government are available from federal databases. However, federal research organisations, federal and cantonal universities, as well as cantonal universities of applied sciences, also run internal or third-party financed projects (cantonal/private, national/international). Data about these projects are declared by the performers annually on a detailed questionnaire (per project, including several classifications/categories). About 30% of the total expenditures are based on the survey.

Turkey	Short name: **TURKEY**
Definition	**Source**: The Scientific and Technological Research Council of Turkey (TÜBİTAK) and the Ministry of Energy and Natural Resources **Latest submission:** 2017/2018 **Latest available data:** 2018 **Country note**: Data for 2014-2018 include: • the funding programs of the Scientific and Technological Research Council of Turkey (TÜBİTAK) under the Academic R&D Funding Directorate (ARDEB) • the Public Research Grant Committee (KAMAG), as well as the Technology and Innovation Grant Programs Directorate (TEYDEB) • the research activities of the TÜBİTAK Marmara Research Center (MAM) Energy Institute, Chemistry Institute and Materials Institute that are funded from other public sources. The budget includes the public R&D funds that are provided to academic and private sector researchers, entrepreneurs, and/or research consortiums, including all related actors and public research institutes. Based on the responsibility area of TÜBİTAK, all national values represent R&D budgets and not demonstration. Turkish data are allocated and realised budgets (final budget appropriations, budgetary stage v) for the years 2016 and 2017. Only the budgets for 2018 represent estimated values. Data for 2014-2018 include European R&D project financial resources allocated in the corresponding years. The total values are EUR 3.97 million in 2016 and EUR 8.48 million in 2017 that have been converted to national currency based on the annual average conversion rates.

United Kingdom	**Short name:** UK

Defintion	**Source**: Department for Business, Energy and Industrial Strategy (BEIS)
	Latest submission: 2020/2021
	Latest available data: 2020
	
	Funding institutions included in the submission:
	• Department for Business, Energy and Industrial Strategy (BEIS)
	• Department for Transport (DfT)
	• Department for Environment Food And Rural Affairs (DEFRA)
	• Department for International Development (DfID)
	• UK Research and Innovation Councils (UKRI), primarily:
	  • Engineering and Physical Sciences Research Council (EPSRC)
	  • Innovate UK
	• Innovate UK
	• Scottish Government
	• Nuclear Decommissioning Authority (NDA)
	• Office for Low Emission Vehicles.
	
	Country note:
	Includes the Channel Islands.
	Due to data coming from multiple sources in the UK government that provide differing degrees of detail, only certain sub-totals can be shown.
	All data refer to the UK financial year; for example, the data year 2017 correspond starts April 1, 2017, and runs until March 31, 2018.
	Amounts reported for 2017 data under GROUP 8: “Unallocated” include budgets from EPSRC for which a more detailed breakdown was not available.

United Kingdom Definition (continued)	All programmes funded directly by the UK government, regardless of where they take place are included; whereas projects funded by EU institutions are not included. Data for year 2020 are estimates based on available information at the time of the submission to the IEA.

United States	**Short name:** USA
Definition	**Source**: U.S. Department of Energy, for the years 2012 to 2015. IEA estimates from public sources for earlier years and for 2016 onwards. **Latest submission:** 2016/2017 **Latest available data:** 2020 **Country note**: Includes Puerto Rico, Guam and the Virgin Islands and the Hawaiian Free Trade Zone. There is a large increase in RD&D spending observed in 2009 due to the increased expenditures associated with the American Recovery and Reinvestment Act of 2009 (stimulus) spending. This is a one-year appropriation (although actual expenditures may go into future years), and so 2010 saw a significant decrease. The item III.1.1 “Solar heating and cooling” is included under the item I.2 “Energy efficiency-residential and commercial” as it cannot be easily separated. 2012 data include both R&D and Demonstration budgets under the one heading of “R&D”. For the year 2016 and onwards, data refer to the estimates made by the IEA Secretariat based on publicly available information on final budget appropriations (figures as voted by the parliament for the coming year, including additional votes during the year). IEA estimates include data for the following agencies/departments: Department of Energy (DoE), Department of Defense (DoD), National Aeronautics and Space Administration (NASA), U.S. Department of Agriculture (USDA) and Department of Transportation (DoT).

European Union	**Short name:** EU
Definition	**Source:** European Union Directorate-General for Research and Innovation, Directorate for Energy **Latest submission:** 2020/2021 **Latest available data:** 2020 **Country note:** The figures include all relevant Horizon 2020 projects funded under calls for proposals in the years 2014 -2019 (cut-off date for data was 6 April 2020). The figures for 2019 refer to concrete projects signed under the 2019 calls; however, not all projects to be funded under the 2019 calls are already signed (figures will therefore be revised in the next data submission). The same goes for 2020 figures and calls. Only project grants are considered – financial instruments or contributions to other initiatives are not included. Figures refer to the committed – not yet paid – EU contribution to projects. Budgets have been allocated to the year of the calls for proposals and are not spread across the duration of the project. Only projects including an explicit reference to energy R&D objectives have been included. Projects have been classified according to their contribution to energy-related R&D objectives as either “fully”, “partially” or “not” contributing. The EU contribution to projects fully contributing was taken into account fully (100%), while for projects partially contributing, only 40% of the EU contribution has been taken into account in the figures. Besides the Horizon 2020 Societal Challenge “Clean, secure and efficiency energy”, the following programme parts contribute substantially to energy-related R&D objectives: “Nanotechnologies, Advanced Materials, Biotechnology, and Advanced Manufacturing and Processing (NMBP)”, “Smart, Green and Integrated Transport”, “European Research Council”, “Marie Skłodowska-Curie Actions”, “Information and Communication Technologies”, and “Innovation in SMEs”.

European Union Definition (continued)	The European Union revised data back to 2018 with the 2020 submission, in order to improve the attribution of funding to the specific years and technology categories. The EU provided substantial support to energy harvesting and the “Smart Cities and Communities” initiative. As there is no dedicated category in the current template for “Smart Cities and Communities” (SCC), which is a very substantial spending item for the EU Horizon 2020 programme, SCC is included under item 73 “Other cross-cutting technologies and research – Other” in the current figures. SCC is covering energy efficiency in buildings and transport as well as renewable energy and electricity transmission and distribution. Successful proposals under the “Green Deal” call have not been included in the current reporting. The total budget of this call is of almost EUR 1 billion and includes many energy-specific or relevant topics. With this in mind, the assumption can be made that the current budget figure will increase substantially, once these data become available.

IEA Publications

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