

Annual report on the RD&I activities and their impacts

2 YEAR – Report on 2020 RD&I activities

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Deep GEOTHERMAL IWG
SUPPORT UNIT



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Introduction

The first Annual report presented the review of the annual 2019 RD&I activities and their impacts. This second report on activities performed in 2020 outlines the new and ongoing RD&I projects to better understand the trends and the ongoing RD&I activities in the geothermal energy sector. It includes the activities of the IWG-DG on SET Plan reporting & the contribution to input papers.

This analysis is part of the Task 6.1 that requires a Comprehensive Analysis of the RD&I Geothermal Panorama. The analysis of the RD&I activities is crucial in order to assess how the SET Plan related RD&I activities (detailed in the 8+2 IP fiches) and the targets of the Deep Geothermal Implementation Plan are executed.

Methodology

This report compiles the final results from Deliverables in **WP2-3-4** and data collection activities that were already started by the ETIP Deep Geothermal and the ERANET-Geothermal. The basis of this report comprises the information from:

- **Member States level (D2.3)**
- **Researchers (D3.4)**
- **Industry (D4.4)**

It reports data collected for the SET Plan during the annual reporting for the Steering Group in 2020.

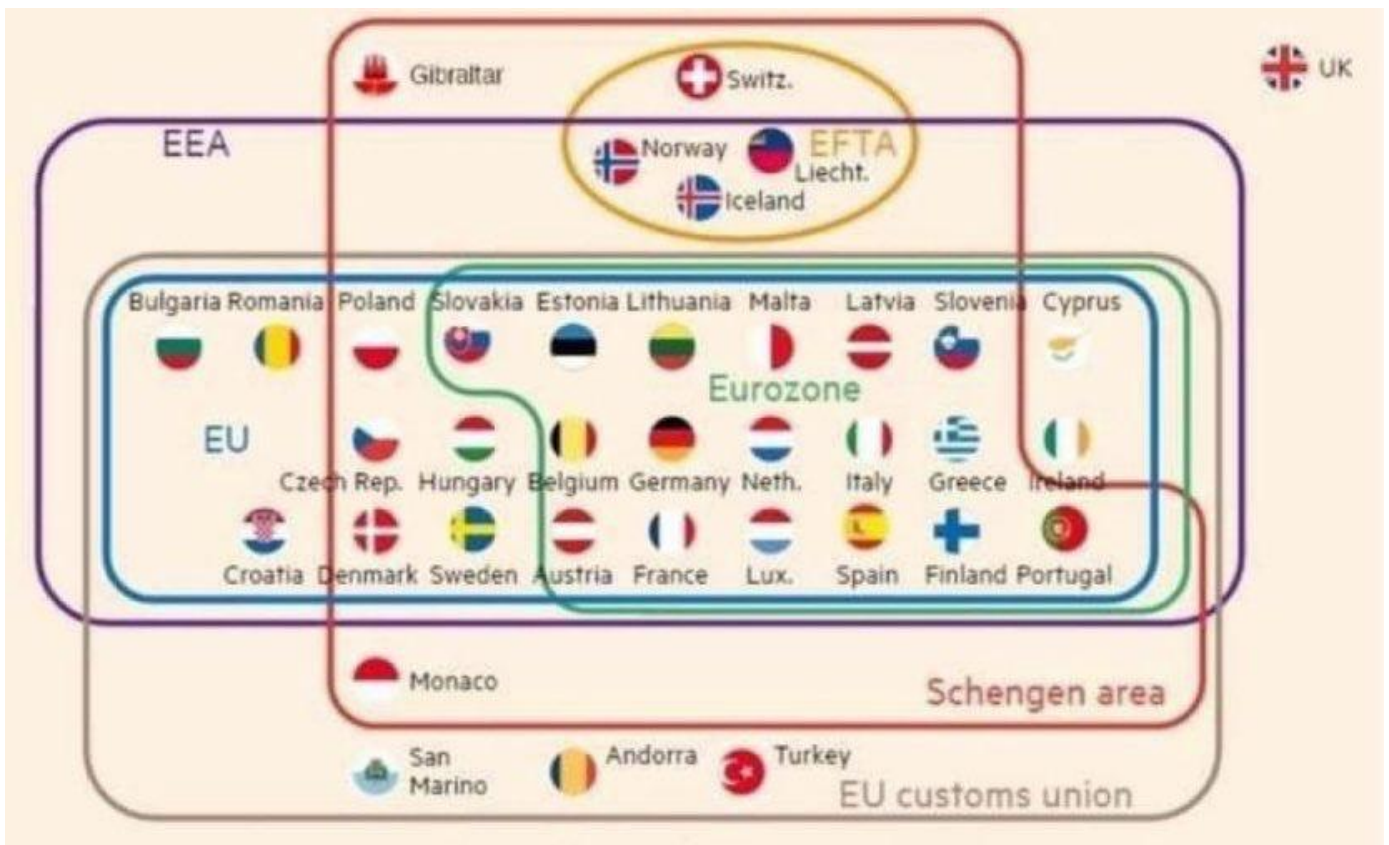
RD&I activities 2020

ACTIVITIES AT NATIONAL LEVEL

The following information is based on the inputs from the report **D2.3**.

An important change at national level is the phenomenon of Brexit and the United Kingdom's exit from the European Union on 31 January 2020. As a consequence of Brexit, the UK lost all its rights and benefits it had as an EU Member State. It is no longer part of the EU's Single Market and Customs Union and lost a big share of EU's funding programmes.

Graph 1: Presentation of the European areas: EU, EEA, EFTA, Schengen area, EU customs area



OnGoing H2020 OnGoing R&I Projects per Country

In turn, the analysis of table 3 "H2020 OnGoing R&I Projects per Country", results in 8 countries in several Horizon 2020 projects, namely: **France, Germany, Iceland, Netherlands, Spain, Sweden, Switzerland, and Turkey**. However, specifically in the case of the Netherlands, none of the projects is financed with Dutch public funds - H2020, and the German participation in Coseismiq does not include additional project financing. On the other hand, the absence of a response from some countries may be related to the geothermal potential of the country to engage in R&I projects, according to the objectives of the projects. This identification allowed to provide the degree of development and to present the main involvement of the Member States involved in the different projects for the development of geothermal energy as one of the main sources of renewable energy for their energy market.

Table 2 - Ongoing Horizon 2020 R&I Projects per country.



H2020 Ongoing R&I Projects Per Country	Member-State										
											
CARBFIX2		✓		✓				✓		✓	
CHPM2030				✓				✓	✓		
CoolHeating			✓								
CrowdThermal			✓					✓			
Deepgs		✓	✓	✓							
Descramble			✓								
Destress		✓	✓				✓			✓	
EoCoE-II			✓					✓			
Geco		✓	✓	✓				✓			
Gemex		✓	✓	✓			✓				
Geo-Cat				✓							
GeoEnvi		✓		✓							




H2020 Ongoing R&I Projects Per Country	Member-State											
												
Georisk		✓	✓								✓	✓
Geofit												
GeoHex												
GeoPro												
GeoPro												
GeoSmart		✓	✓									
GeoUs												
GeoWell			✓	✓			✓					
MEET		✓	✓									
Reflect												
S4CE			✓	✓							✓	
SURE			✓	✓			✓					
Thermo Drill			✓					✓		✓		



Summary of Ongoing R&I Projects for the Development of Geothermal Energy per Country

The table below 4 summarizes the Ongoing R&I projects for geothermal development in the Member-States that collaborate within the IWG and the importance for the implementation plan of IWG, namely: **Germany, Ireland, and Turkey**. New responses to the SU-DG-IWG Survey were obtained, namely, by Member States **Netherlands, Spain, Sweden, and Switzerland**.

Table 3 - Resume of OnGoing R&I in Member-States for development of Geothermal Energy

Member State	Project Name	Start year	End year	Budget (€ Mln)	Funding (€ Mln)	R&I	Results open to Set Plan community (Y/N)
	Sense	2020	2023	1.1	0.95	5,9	Y
	Zokrates	2021	2021	10.9	10.0	1,3,6	Y
	Mesotherm	2020	2023	3.9	3.6	1,5	Y
	Sensor ASIC	2020	2023	4.8	2.3	2,4	Y
	ATES-IQ	2020	2022	0.7	0.7	1	Y
	Hotlime	2018	2021	1.66	0.072	5	https://geoera.eu/projects/hotlime6 and http://www.gsi.ie
	Muse	2018	2021	1.30	0.012	1	https://geoera.eu/projects/hotlime6 and www.gsi.ie
	Geconnect3d	2018	2021	1.83	0.022	5	https://geoera.eu/projects/hotlime6 and www.gsi.ie
	Geo-Urban	2018	2021	0.74	0.29	1	www.gsi.ie
	Coseismiq	2018	2021	2.48	0.2	NTBE B	www.gsi.ie
	Thermowell	2020	2023	0.27	0.22	6	Data will be made available at different stages.
	ShallowTherm	2020	2020	0.6	0.5	5	Data will be made available at different stages.
	Dig	2020	2023	0.78	0.78	5	Data will be made available at different stages.

Member State	Project Name	Start year	End year	Budget (€ Mln)	Funding (€ Mln)	R&I	Results open to Set Plan community (Y/N)
	Warming-up	2020	2022	18.9	9.4	1,9	Y
	Knowledge Programme effects of Mining	2018	X				Y
	Disenõ y desarrollo experimental de una metodologia multiparamétrica para la exploración de recursos geotérmicos ocultos de alta entalpia en Canarias	2018	2021	1,855827	0,894574	5	
	TERMOVOCALN	2018	2021	1,465920	0,620232	7	
	GeoBATT	2018	2021	2,868971	0,563896	1	
	TOGETHER	2018	2021	0,996105	0,282444	7	
	MAGYSTER	2018	2021	0,687295	0,108663	8	
	Demonstration of test holes for development of Engineered Geothermal Systems	2020	2021	5,1	1,2	1,2,4,5,6,7,8,9	Y
	VALTRE	2018	2020		2,2	3	Y

	ThePoTun	2018	2021	0,26	1	Y
	SPALL-APP	2018	2020	0,27	6	Y
	Zodrex	2018	2021	0,39	3,6	Y
	Coseismiq	2018	2021	0,57		Y
	Heatstore	2018	2021	4,61	1	Y
	REX	2019	2022	0,62	5,10	Y
	PSIGE	2019	2022	0,46	5	Y
	SUCCEED	2019	2022	2	http://www.act-ccs.eu/succeed	Y

ACTIVITIES OF THE RESEARCH COMMUNITY

These focus mostly on the set of the research and innovation (R&I) priorities for deep geothermal energy actions described in the Geothermal Implementation Plan and on the mobilisation of the research community by its realisation (Task 3.2 of the project).

The EERA Joint Programme still remains a network with high ambitions. It needs further incentives to intensify the cooperation and to better structure the joint efforts. In the last year, the network gained on visibility and acknowledgement. In January 2021, **EERA Geothermal** implemented a **Mobility Scheme for its members** and submitted proposals for the Green Deal Calls, which were developed within the network.

These activities will lead to an increased visibility and attraction of new members. However, the growing group will have to change its focus on more cross-cutting activities and more cooperation with the industry and other EERA joint programmes. The Support Unit will further assist in:

- Establishing direct contacts to non-EERA members via EU projects
- Liaison with the industry
- Organising SU webinars/workshops for non-EERA members (if needed)
- Initiating a forum on cross-cutting activities
- Providing space for discussions on challenges and the future of geothermal energy during the 3rd SU Workshop in autumn 2021

As the pandemic situation is expected to continue in 2021 and perhaps 2022, mobilising non-EERA institutions will continue to require new ways and ideas. 2020 enabled the identification of geothermal institutions across Europe, including EU-13 countries and associated states. Reaching out to institutions, getting the necessary information and enabling collaboration will require new effective actions that meet the individual needs of the institutions. Large ROs such as Fraunhofer and CSIC need to be contacted with the support of scientists who already collaborate strongly on projects. In this case, the role of IWG DG should be put in focus and the possible influence on the topics of the EU calls. Universities could be attracted by mobility scheme that would allow PhD students and young scientists to stay in ROs that possess large and modern research infrastructures. This offer would also animate the EU-13 and associated countries, especially if extended to include senior scientists. In addition, a mobility programme would give the IWG DG more recognition and promote its work.

ACTIVITIES OF PRIVATE ACTORS

The Implementation Working Group (IWG) on Deep Geothermal of the SET plan proposed in 2020 an **update of the Implementation Plan** which is currently up for endorsement of the SET Plan Steering Group. The updated Implementation Plan includes the following **priorities for RD&I actions in the deep geothermal sector:**

1. Geothermal heat in urban areas
2. Integration of geothermal electricity and heating & cooling in the energy system responding to grid and network demands
3. Improvement of overall geothermal energy conversion performance for electricity and heating&cooling generation
4. Closed loop electric and heating & cooling plants integrated in the circular economy
5. Sustainable and efficient production technologies
6. Development and exploitation of geothermal resources in a wider range of geological settings
7. Advanced drilling/well completion techniques
8. Innovative exploration techniques for resource assessment and drilling target definition
9. Increasing awareness of local communities and involvement of stakeholders in sustainable geothermal solutions
10. Risk mitigation (financial/project)

These updated priorities cover a broad range of topics for the deep geothermal sectors and involve all segments of the deep geothermal value chain. Across the different parts of the geothermal value chain, different types of actors are contributing with their own expertise and resources to advancing the priorities for research, development and innovation in the deep geothermal sectors, along the lines identified in the SET Plan Deep Geothermal Implementation Plan. For each priority, the scope is briefly described and the typology of actors implementing the SET Plan Deep Geothermal RD&I priorities is described.

The listing presents co-funded projects, with a public and private financial contribution, supported by the European programmes such as Horizon2020, Interreg, COSME; and supported by national public contributions co-funded by the European funds such as ERANET Geothermica and GeoERA.

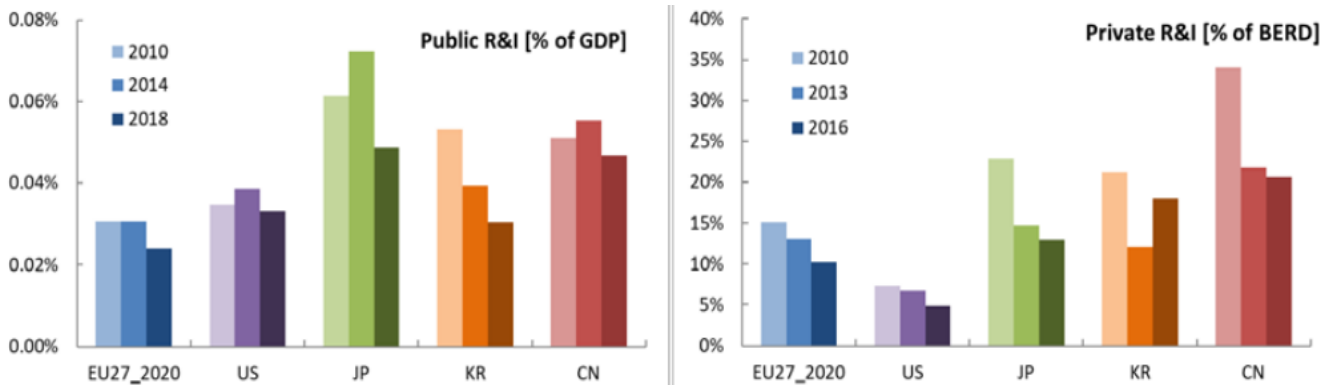
Furthermore, as highlighted in D4.4, **private financing is leading the investments race in R&I on the European level**. According to the European Commission's *Report on the*

progress of clean energy competitiveness, the EU has invested in recent years an average of **nearly EUR 20 billion a year on clean energy R&I** prioritised by the Energy Union¹:

- EU funds contribution - 6%
- Public funding from national governments accounts - 17%
- **business contribution estimated - 77%**

Despite this fact, according to the 2020 report on the State of the Energy Union, **the overall estimated private investment in Energy Union R&I priorities has been decreasing in recent years. R&I investment in the activities set out in the European Strategic Energy Technology Plan**, agreed between Member States, industry, the research community and the Commission, **represents only 15% of the estimated needs up to 2030.**

Graph 2: Estimated public and private R&I financing in the Energy Union priorities



(source: [2020 report on the State of the Energy Union pursuant to Regulation \(EU\) 2018/1999 on Governance of the Energy Union and Climate Action](#))

To tackle this issue and to better understand the private R&I investment trends within the geothermal industry, the SU DG IWG drafted a **questionnaire that aims to collect data on R&I investments within the geothermal private sector** (see D4.4, Annex 1). It started to be disseminated at the end of 2020. However, due to the lack of active engagement of private stakeholders in the data collection process, the Secretariat will need to extend the deadline and treatment of data in **the final report**. This data collection process will allow the SU DG IWG to explore the granularity of the private sector investments and analyse the main trends, especially within the context of economic recovery. The final estimation and main trends/results of private R&I spending in geothermal will be outlined in the annual reporting 3 year (in 2022).

¹ Report from the Commission to the European Parliament and the Council on progress of clean energy competitiveness, https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

OVERVIEW OF ONGOING GEOTHERMICA PROJECTS

Project: Cage - Composite casing and the Acceleration of Geothermal Energy

Objective: CAGE is a development and demonstration project of several cost-saving and output-improving installation technologies. The objective is to demonstrate a new GE concept, suitable for limestone areas and target depths of 1 to 2.5 km.

Website: <http://www.geothermica.eu/projects/cage/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 13.5/5.8

Relevant activities addressed/targets achieved: R&I 6

Results open to SET Plan community: Y

Project Coseismiq - Control seismicity and manage induced earthquakes

Objective: aims to improve and validate the advanced technologies for monitoring and controlling induced seismicity that have been developed and coded in the past three years. These technologies are now ready to be used as a data-driven, adaptive decision support tool during industrial applications, the core objective of COSEISMIQ.

Website: <http://www.geothermica.eu/projects/coseismiq/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 2.5/1.1

Relevant activities addressed/targets achieved: R&I, NTBE A

Results open to SET Plan community: Y

Project GeConnect - Tight Geothermal Casing Connections for Axial Stress Mitigation

Objective: The GeConnect project proposal aims at increasing the reliability of the downhole construction of geothermal wells beyond the state of the art, using new innovative technology of flexible couplings.

Website: <https://www.geothermalresearch.eu/geconnect/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 1.2/0.9

Relevant activities addressed/targets achieved: R&I 3,6

Results open to SET Plan community: Y

Project: GEOFOOD

Objective: The aim of the project is to provide innovative concepts illustrating how to increase the economic viability of geothermal heat infrastructure using circular food production systems. The production systems are based on optimised use of energy, water, nutrients, manpower and other resources to support viable agri-businesses which can help to cover the costs of running geothermal heat installations.

Website: <https://geofoodproject.eu/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 1.7/1.2

Relevant activities addressed/targets achieved: R&I 7, NTBE A

Results open to SET Plan community: Y

Project: Geo-Urban- Geothermal resources to generate heat in urban areas

Objective: The project aims to explore the potential for low enthalpy geothermal in urban environments. It will focus on two target locations – Dublin, Ireland and Vallès, Spain. The final objective is to identify the geothermal resources available in two challenging urban locations and to demonstrate a commercialization strategy that has the potential to be adapted in other similar locations.

Website: <http://www.geothermica.eu/projects/geo-urban/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 0.7/0.5

Relevant activities addressed/targets achieved: R&I 1

Results open to SET Plan community: Y

Project: HEATSTORE – Underground Thermal Energy Storage Facilitates the low-Carbon transition of the heating and cooling sector

Objective: The main objectives of the HeatStore project are to lower the cost, reduce risks, and improve the performance of high temperature (~ 25°C to ~ 90°C) underground thermal energy storage (HT-UTES) technologies and to optimize heat network demand side management (DSM).

Website: <https://www.heatstore.eu/project.html>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 16.3/8.3

Relevant activities addressed/targets achieved: R&I 1, 7

Results open to SET Plan community: Y

Project: PERFORM - Improving Geothermal System Performance through Collective Knowledge Building and Technology Development

Objective: The objective is to improve geothermal plant performance in order to increase energy output and provide economic feasibility to current and future geothermal projects. Existing geothermal plants still face a large variety of operational problems caused by flow obstructions and inefficient injection strategies.

Website: <http://www.geothermica.eu/projects/perform/>

Start year: 2018

End year: 2021

Budget/Funding (€ million):3.0/2.2

Relevant activities addressed/targets achieved: R&I 2,4

Results open to SET Plan community: Y

Project: Zodrex

Objective: Aims at demonstrating drilling, completion and production technologies increasing technical and economic successes of geothermal projects.

Website: <http://www.geothermica.eu/projects/zodrex/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 4.9/2.9

Relevant activities addressed/targets achieved: R&I 6, 3

Results open to SET Plan community: Y

OVERVIEW OF ONGOING HORIZON 2020 R&I PROJECTS

Project: CARBIFIX 2

Objective: Aims to turn CO₂ into stone underground in less than two years through proprietary technology that imitates and accelerates natural process. The company's mission is to be a key instrument to tackle climate change and substantially reduce CO₂ levels in the atmosphere.

Website: <https://www.carbifix.com/>

Start year: 2017

End year: 2021

Budget/Funding (€ million): 2.2/2.2

Relevant activities addressed/targets achieved: R&I 8

Results open to SET Plan community: Y

Project: CHPM2030 – Combined Heat, Power and Metal extraction

Objective: aims to develop a novel and potentially disruptive technology solution that can help satisfy the European needs for energy and strategic metals in a single interlinked process.

Website: <https://www.chpm2030.eu/>

Start year: 2016

End year: 2019

Budget/Funding (€ million): 4.2/4.2

Relevant activities addressed/targets achieved: R&I 3

Results open to SET Plan community: Y

Project: CoolHeating - Market uptake of small modular renewable district heating and cooling grids for communities

Objective: is to support the implementation of "small modular renewable heating and cooling grids" for communities in South-Eastern Europe. CoolHeating transfers knowledge from partners in countries where renewable district heating and cooling examples exist (Austria, Denmark, Germany) to countries where there are less examples in the sector (Croatia, Slovenia, Macedonia, Serbia, Bosnia-Herzegovina). Core activities, besides techno-economical assessments, include measures to stimulate the interest of communities and citizens to set-up renewable district heating systems as well as the capacity building about financing and business models. The outcome is the initiation of new small renewable district heating and cooling grids in 5 target communities up to the investment stage.

Website: <https://www.coolheating.eu/en/>

Start year: 2016

End year: 2018

Budget/Funding (€ million): 1.6/1.6

Relevant activities addressed/targets achieved: R&I 1,7

Results open to SET Plan community: Y

Project: CROWD THERMAL

Objective: aims to empower the European public to directly participate in the development of geothermal projects with the help of alternative financing schemes (crowdfunding) and social engagement tools.

Website: <https://cordis.europa.eu/project/rcn/224316/factsheet/en>

Start year: 2019

End year: 2022

Budget/Funding (€ million): 2.3

Relevant activities addressed/targets achieved: NTBE A&B

Results open to SET Plan community: Y

Project: DEEPEGS - Deployment of deep enhanced geothermal systems for sustainable energy business

Objective: The objective of DEEPEGS is to increase the use of enhanced geothermal systems (EGS) in Europe by demonstrating and testing proven technologies that make deep geothermal resources a competitive energy alternative for commercial use. For DEEPEGS three different resource systems have been selected representing different locations and geological formations in Europe, enabling this demonstration to be transferable to other geothermal sites with deep geothermal potential.

Website: <https://deepegs.eu/>

Start year: 2015

End year: 2019

Budget/Funding (€ million): 42/19

Relevant activities addressed/targets achieved: R&I 3,6

Results open to SET Plan community: Y

Project: Destress - Demonstration of soft stimulation treatments of geothermal reservoirs

Objective: The overall goal of DESTRESS is to optimise stimulation treatments while minimising environmental impacts such as seismic events or pollution of groundwater reservoirs. As well as controlled enhancement of the reservoir, sustainable operation also presents a challenge: newly opened fractures may close again due to reduced reservoir pressure or chemical interaction with fluid.

Website: <http://www.destress-h2020.eu/en/home/>

Start year: 2016

End year: 2020

Budget/Funding (€ million): 24.7/10.7

Relevant activities addressed/targets achieved: R&I 3, 6

Results open to SET Plan community: Y

Project: Descramble - Drilling in supercritical geothermal condition

Objective: The primary objective of DESTRESS is to develop a comprehensive compilation of good practices for successful geothermal projects through demonstration and research.

Website: <http://www.descramble-h2020.eu/>

Start year: 2015

End year: 2018

Budget/Funding (€ million): 15.7/6.8

Relevant activities addressed/targets achieved: R&I 6, 3

Results open to SET Plan community: Y

Project: EoCoE-II - Energy Oriented Center of Excellence

Objective: Develops and applies cutting-edge computational methods in its mission to accelerate the transition to the production, storage and management of clean, decarbonized energy.

Website: www.eocoe.eu

Start year: 2019

End year: 2021

Budget/Funding (€ million): 8.6/8.3

Relevant activities addressed/targets achieved: R&I 5

Results open to SET Plan community: Y

Project: GECO - Geothermal Emission Control

Objective: Is an innovative EU funded research project which aims to provide a clean, safe, and cost-efficient non carbon and sulfur-emitting geothermal energy across Europe and the World.

Website: <https://geco-h2020.eu/>

Start year: 2018

End year: 2022

Budget/Funding (€ million): 18.2/15.6

Relevant activities addressed/targets achieved: R&I 8

Results open to SET Plan community: Y

Project: Gemex - Cooperation in Geothermal energy research Europe-Mexico for development of Enhanced Geothermal Systems and Superhot Geothermal Systems**Objective:**

- To speed up the geothermal development in Mexico and beyond
- To reduce pre-drill mining risk by in depth understating of the geological context of the resource
- To improve geophysical imaging and detection of deep reservoir structures by novel approaches
- To improve predictive models for reservoir characterisation and simulation
- To provide conceptual models for sustainable site development.

Website: <http://www.gemex-h2020.eu/index.php?lang=en>**Start year:** 2016**End year:** 2020**Budget/Funding (€ million):** 10/10**Relevant activities addressed/targets achieved:** R&I 3, 5**Results open to SET Plan community:** Y**Project: Geo-coat - Development of novel and cost-effective corrosion resistant coatings for high temperature geothermal applications**

Objective: It aims to design the new high-performance coatings to resist each of the specified threats or combinations of threat, as experimentally derived at key failure points within geothermal runs, and to apply them only to the affected components.

Website: <http://www.geo-coat.eu/>**Start year:** 2018**End year:** 2021**Budget/Funding (€ million):** 4.7/4.7**Relevant activities addressed/targets achieved:** R&I 2**Results open to SET Plan community:** Y**Project: GeoEnvi - Tackling the environmental concerns for deploying geothermal energy in Europe**

Objective: The objective of the GEOENVI project is to answer environmental concerns in terms of both impacts and risks, by first setting an adapted methodology for assessing environment impacts to the project developers, and by assessing the environmental impacts and risks of geothermal projects operational or in development in Europe.

Website: <https://www.geoenvi.eu/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 2.5/2.5

Relevant activities addressed/targets achieved: R&I 8, NTBE A

Results open to SET Plan community: Y

Project: GeoRisk - Developing geothermal and renewable energy projects by mitigating their risks

Objective: The GEORISK project aims to develop financial schemes mitigate the impact of the resource risk by spreading it in such a manner that project developers can accept their fair share of it. This mitigation of the risk through financial instruments allows to lower the financial exposure of developers in case of failure to develop a geothermal reservoir.

Website: <https://www.egec.org/georisk-project/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 2.2/2.2

Relevant activities addressed/targets achieved: NTBE B

Results open to SET Plan community: Y

Project: GeoSmart - Technologies for geothermal to enhance competitiveness in smart and flexible operation

Objective: Aims to optimise and demonstrate innovations to improve the flexibility and efficiency of geothermal heat and power systems.

Website: <https://www.geosmartproject.eu/>

Start year: 2019

End year: 2023

Budget/Funding (€ million): 19.7/17.4

Relevant activities addressed/targets achieved: R&I 7, 4, 2

Results open to SET Plan community: Y

Project: GeoWell - Innovative materials and designs for long-life high-temperature geothermal wells

Objective: It aims at developing reliable, cost effective and environmentally safe technologies for design, completion and monitoring of high-temperature geothermal wells.

Website: <http://geowell-h2020.eu/>

Start year: 2016

End year: 2019

Budget/Funding (€ million): 4.7/4.7

Relevant activities addressed/targets achieved: R&I 2, 6

Results open to SET Plan community: Y

Project: MEET - Multidisciplinary and multi-context demonstration of EGS exploration and Exploitation Techniques and potentials

Objective: aims at boosting the development of Enhanced Geothermal Systems (EGS) across Europe in various geological contexts (sedimentary, volcanic, metamorphic and crystalline) by different means.

Website: <https://www.meet-h2020.com/>

Start year: 2018

End year: 2021

Budget/Funding (€ million): 11.7/10.0

Relevant activities addressed/targets achieved: R&I 3, 4

Results open to SET Plan community: Y

Project: S4CE - Science for Clean Energy

Objective: aims to develop, test and implement technologies needed for successfully detecting, quantifying and mitigating the risks connected with geo-energy operations in the sub-surface.

Website: <http://science4cleanenergy.eu/>

Start year: 2017

End year: 2020

Budget/Funding (€ million): 9.8/9.8

Relevant activities addressed/targets achieved: R&I 8

Results open to SET Plan community: Y

Project: SURE - Novel Productivity Enhancement Concept for a Sustainable Utilisation of a Geothermal Resource

Objective: aims to investigate the radial water jet drilling (RJD) technology for deep geothermal reservoir rocks at different geological settings such as deep sedimentary basins and magmatic regions at the micro-, meso- and macro-scale.

Website: <http://www.sure-h2020.eu/>

Start year: 2016

End year: 2019

Budget/Funding (€ million): 6.1/5.9

Relevant activities addressed/targets achieved: R&I 6, 3

Results open to SET Plan community: Y

Project: Thermodrill - Fast track innovative drilling system for a deep geothermal challenges in Europe

Objective: aims to developing a fast and cost-efficient drilling system based on an innovative combination of conventional rotary drilling and water jetting.

Website: <http://www.thermodrill-h2020.org/>

Start year: 2015

End year: 2019

Budget/Funding (€ million): 5.8/5.4

Relevant activities addressed/targets achieved: R&I 6

Results open to SET Plan community: Y

NEW EUROPEAN PROJECTS STARTED IN 2020

Project name (min. > € 1 mln)	Website or short description	Start year	End year	Budget / Funding (EUR million)	Relevant activities addressed/ targets achieved	Results open to SET Plan community (Y/N)
GEOTHERMICA						
RESULT	https://www.result-geothermica.eu/	2020	2023	x / 6.1	R&I 1, 6, 7	Y
GRE-GEO	https://www.gecco.de/images/Publikationen/PM_E0241_200903_Start_of_Research_Project_GRE_GEO.pdf	2020	2023	x / 4.0	R&I 7	Y
DEEP	Innovation for De-risking Enhanced Geothermal Energy projects https://www.unige.ch/res/en/projects/	2020	2023	x / 5.7	R&I 6	Y
SPINE	https://www.lih.rwth-aachen.de/cms/LIH/Forschung/Ingenieurgeologie/Aktuelle-Projekte/~lovpu/Spannungsprofilierung-in-verbesserten-ge/?lidx=1	2020	2023	x / 4,1	R&I 7	Y
	<i>*Contract negotiations for a few other projects still ongoing</i>					
Horizon 2020						
REFLECT	https://www.reflect-h2020.eu/	2020	2022	4.9	R&I 6	Y
GEOPRO	https://cordis.europa.eu/project/id/851816	2019 (nov)	2022	4.9	R&I 3	Y
GeoHex	https://cordis.europa.eu/project/id/851917	2019 (nov)	2022	5.0	R&I 3&6	Y
REGEN-BY-2	https://www.regen-by-2.eu/	2020	2024	5.4/ 4.9 EU contr.	R&I 6, 8	Y
OptiDrill	https://cordis.europa.eu/project/id/101006964	2020	2023	3.9	R&I 7	Y
ORCHYD	https://cordis.europa.eu/project/id/101006752	2020	2023	3.9	R&I 7, 8	Y
IANOS	https://www.ianos.eu/	2020	2024	8.7 / 6.9 EU contr.	R&I 5	Y
GeoUS	http://geous.vsb.cz/	2020	2022	0.8	R&I 1	Y
EASYGO	https://cordis.europa.eu/project/id/956965	2020	2024	3.4	R&I 3&6	Y

ALIGHT	https://cordis.europa.eu/project/id/957824	2020	2024	15.6/ 11.2 EU contr.	R&I 1&2	Y
Multilateral funding opportunities						
SUCCEED	https://www.imperial.ac.uk/energy-futures-lab/succeed/about/	2019	2022	2.5	R&I 5,6	Y

NEW NATIONAL PROJECTS

List of relevant national projects that address the targets of the Implementation Plan

Project name (min. > € 1 mln)	Website or short description	Start year	End year	Budget / Funding (EUR million)	Relevant activities addressed/ targets achieved	Results open to SET Plan community (Y/N)
Large national/regional projects						
Warming-up	https://www.warmingup.info/	2019	2022	9,3	R&I 1	Y
UnLimited	https://www.geothermal-lithium.org/	2020		0.7/ 2.7	R&I 5,6	Y
Sense		2020	2023	1.1/ 0.95	R&I 5, NTBE-A	Y
Mesotherm	https://www.sandsteinfazies.de/f-e-verbundvorhaben/mesotherm/	2020	2024	3.9/ 3.6	R&I 1,5	Y
Sensor ASIC		2020	2023	4.8/ 2.3	R&I 2,4	Y
ATES-IQ	https://www.gfz-potsdam.de/sektion/geoenergie/projekte/ts-ates-iq/	2020	2022	0.7/ 0.7	R&I 1	Y

Thermowell	https://renews.biz/59138/ireland-shares-1m-for-geothermal-research/	2020	2023	0.27/ 0.22	R&I 6	Data will be made available at different stages
ShallowTherm	https://renews.biz/59138/ireland-shares-1m-for-geothermal-research/	2020	2020	0.6/ 0.5	R&I 5	Data will be made available at different stages
Dig	https://www.seai.ie/data-and-insights/seai-research/research-projects/details/dig:-derisking-irelands-geothermal-energy-potential	2020	2023	0.78	R&I 5	Data will be made available at different stages
Demonstration of test holes for development of Engineered Geothermal Systems		2020	2021	5,1/ 1,2	R&I 1,2,4,5,6,7,8, NTBE-A	Y

APPROXIMATION OF FINANCIAL CONTRIBUTION

Breakdown and comparison of approximate total funding (that includes EU, national and private) in 2019 and 2020 for geothermal energy projects according to the R&I activities set by the IWG DG

List of Research and Innovation Activities	DG IWG	Funding 2019 (EUR million)	Funding 2020 (EUR million)
Geothermal heat in urban areas	R&I Activity 1	14.6	25.8
Materials, methods and equipment to improve operational availability (high temperatures, corrosion, scaling)	R&I Activity 2	6.5	12.1
Enhancement of reservoir (conventional and unconventional);	R&I Activity 3	/	9.1
Improvement of performance (conversion to electricity and direct use of heat)	R&I Activity 4	6.5	4.3
Exploration techniques (including resource prediction and exploratory drilling)	R&I Activity 5	26.8	18.5
Advanced drilling/well completion techniques	R&I Activity 6	1.3	23.5
Integration of geothermal heat and power in the energy system and grid flexibility	R&I Activity 7	6.5	16.7
Zero emissions power plants	R&I Activity 8	/	5.4
Increasing awareness of local communities and involvement of stakeholders in sustainable geothermal solutions	9: NTBE-A	4.4	1.8
Risk mitigation (financial/project)	10: NTBE.B	1.1	/
TOTAL		67.7	117.2

Table above represents the comparison of the approximate total amount of diverse funding sources (EU, national programmes, and private finance) for geothermal energy projects in 2019 and 2020. The amounts were categorised according to each Research and Innovation Activity that was set in the updated Implementation Plan of the DG IWG.

The 2020 data was calculated from the list of projects that are listed in this report. The 2019 calculations were based on the list of projects that was outlined in D6.1 and that were initiated in 2019.

According to the funding data, majority of funds were directed to technologies and projects that are supporting R&I Activities 1 (Geothermal heat in urban areas) and 5 (Exploration techniques including resource prediction and exploratory drilling). This fact underlines the need of geothermal heating supply in urban areas as well as the necessity for further improvement in exploration techniques that will lead to more geothermal energy supply.

SET Plan reporting & contribution to input papers in 2020

The IWG on DG provided its annual report to the SET Plan in September 2020. Compiling and analysing the reporting from all IWGs, the SETIS produced a summary report presented during the 2020 SET Plan Conference.

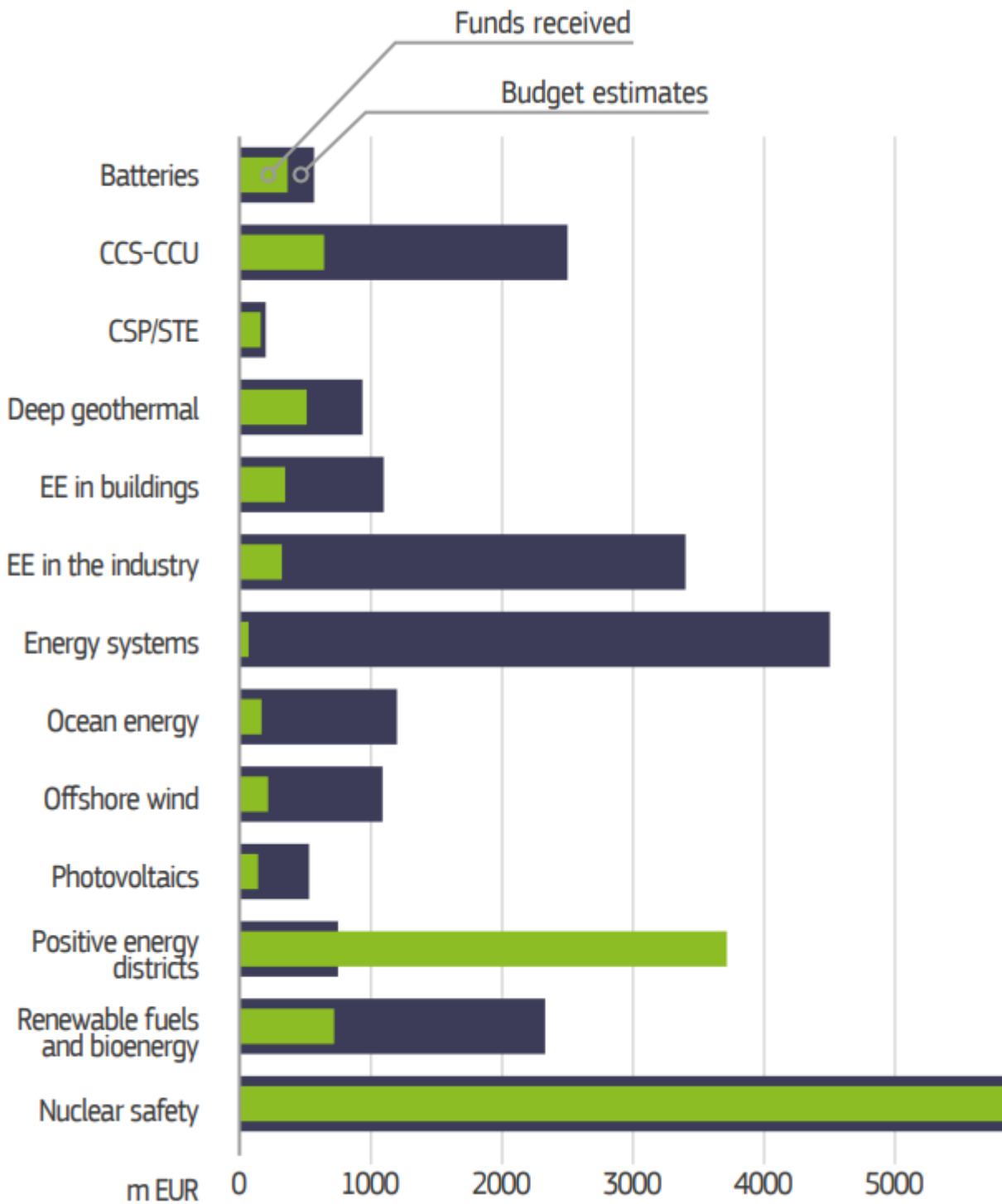
The figure below (Graph 3) depicts the amount (in € million) of the fund received and the budget estimates for each IWG. It shows that the IWG DG has executed about 50% of the budget estimate. The funds already received for executing the Implementation Plan on Deep Geothermal are amounted to approximately €500 million.

It must be noted that geothermal systems contribute also to the execution of other IWGs, such as:

- *Batteries* (highlighting geothermal lithium extraction)
- *CCS* (by R&I on the underground)
- *CSP/STE* (for hybrid plants)
- *EE buildings* (with low temperature geothermal heating and cooling systems)
- *EE in industry* (with a base load heat supply to low-medium temperature industrial processes)
- *Energy systems* (with base load and flexible power generation, supply of heating, cooling and hot water, underground thermal energy storage (UTES), and providing materials extracted from geothermal brines such as lithium for batteries)
- *Positive energy district* (with geothermal heating and cooling systems in district heating grids, also assisted by large heat pumps and UTES)

Based on preliminary analysis, the IWG DG highlights the importance to further enhance the link between the IWG-DG and the other IWGs in the next years to allow an efficient execution and implementation of all IPs.

Graph 3: Estimated amounts of the funds received and the budget needs for each IWG

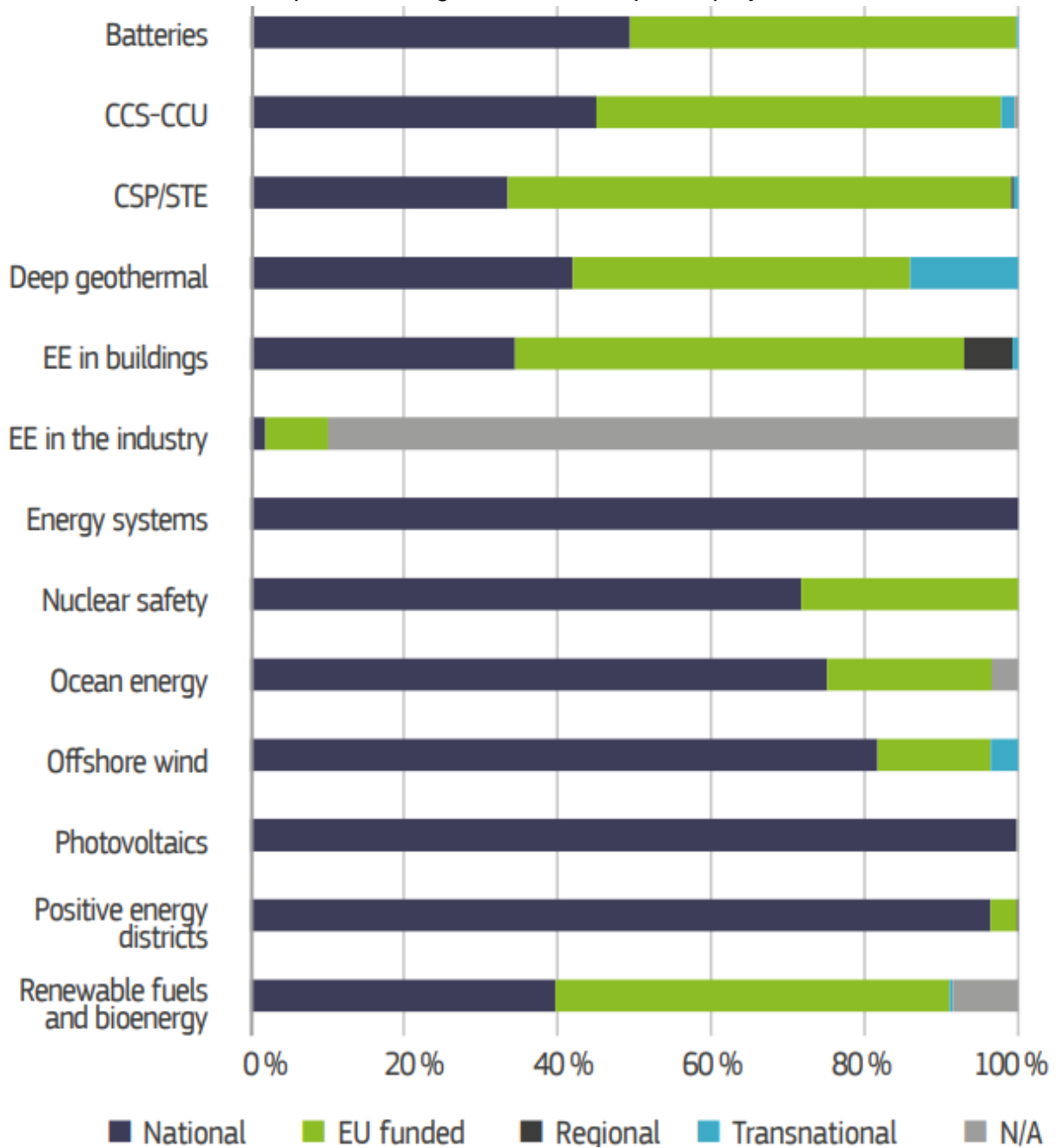


(source: SETIS, [Progress from the Implementation working groups 2020](#), pag 26)

Another chapter from the SETIS report 2020 represents the graph below that shows the share of public funding for executing the IWGs (such as national, regional, transnational, EU or other).

For Deep Geothermal, more than **40% of funding** of these activities reported for executing the IP on Deep geothermal, are **national**, **around 45% are EU funding** and **about 15% are transnational through Geothermica**. The share of regional funded projects is not assessed, but some activities such as the Smart Specialization Platform on geothermal will allow to further develop it.

Graph 4: Funding source of the reported projects



(source: SETIS, [Progress from the Implementation working groups 2020](#), pag 26)

Another activity of the IWG DG in 2020 was the contribution of the Group to the 14th SET Plan Conference 2020, where the SET Plan presented a series of Strategic Papers on "Making the SET Plan fit for the EU Green Recovery". On each strategic draft papers, **the IWG DG provided inputs to indicate the contribution deep geothermal on:**

The SET Plan contribution to the Energy System Integration strategy

"When it comes to the Deep Geothermal IWG, such energy technology provides ample supplies of renewable heating, cooling and electricity for buildings and industry. Beyond the heat extracted from geothermal brines for heat and electricity systems, lithium extracted from geothermal brines is key the decarbonisation of mobility. Key R&I activities include geothermal heat in urban areas, the integration of geothermal heat & power in the energy system and grid flexibility, as well as circular economy."

The SET Plan contribution to the Renovation Wave

"The Deep Geothermal IWG is part of the Renovation Wave Strategy as to contribute to the European building stock that is efficiently heated, cooled and powered by renewable energy sources, such as geothermal energy. To allow innovative heating and cooling grids to be deployed at a large scale in the future, the innovation focus should lie on advanced, low-temperature systems running on 100% renewables and unavoidable waste heat in combination with building renovation and energy system integration. In order to displace fossil fuels in buildings, geothermal heat pumps combined with geothermal heat grids are an affordable solution of renewable energy in constant supply. Regarding the IWG principal R&I activities, the focus is on geothermal heat in urban areas as well as increasing awareness and risk mitigation."