Joint Programme Geothermal - European Energy Research Alliance

Inga Berre

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Scientific Advisor, NORCE

EERA
The most influential energy research community in the EU & globally

50,000+ experts

250+ organisations

30 countries

Joint Research Programmes	17
SET-Plan key actions	all 10
ETIPs and other platforms	all 10
cross-cutting & societal challenges	35%
Mission Innovation challenges	6/8

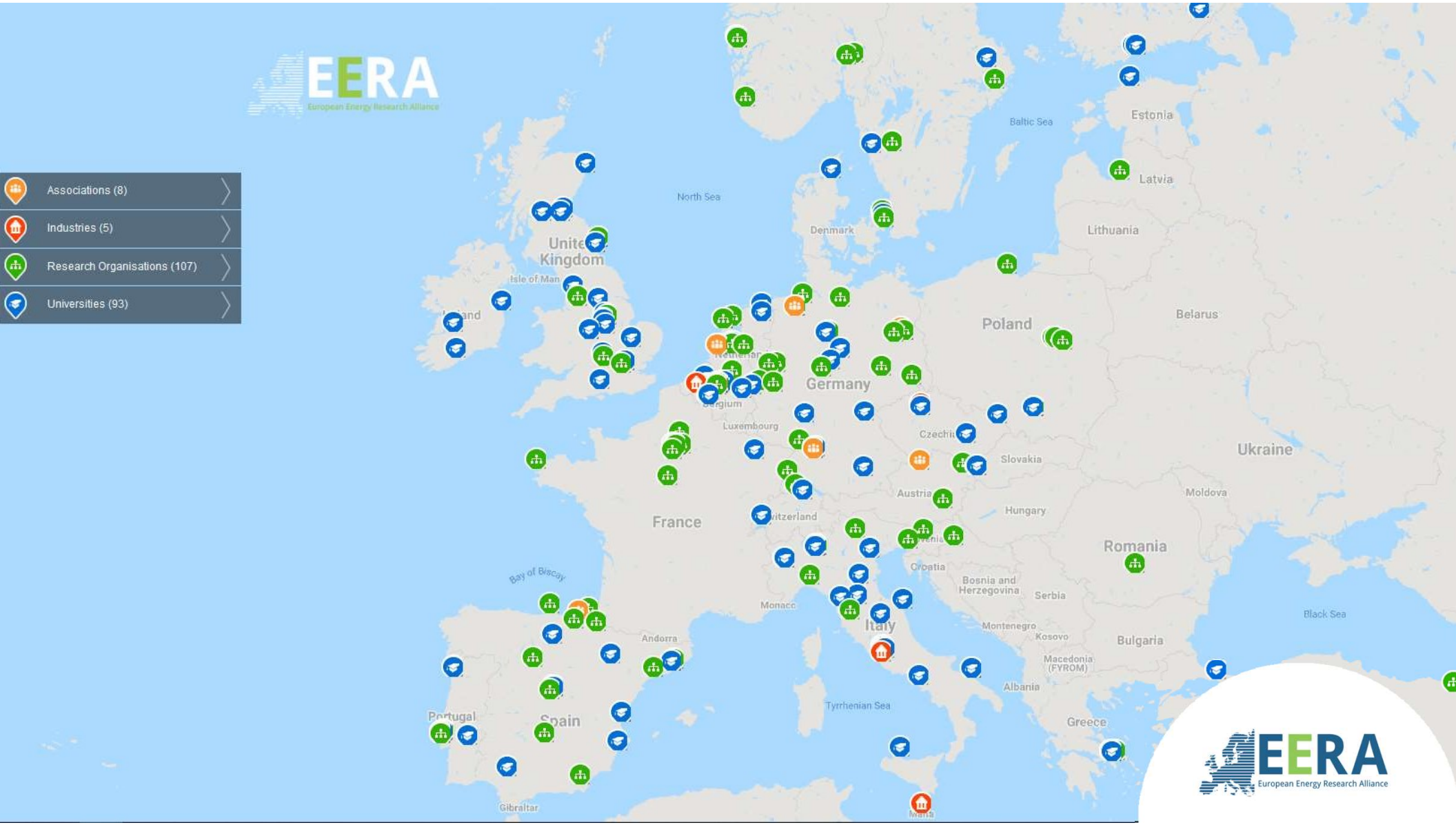
EERA‘s mission

Catalysing European energy research to achieve a climate-neutral society by 2050

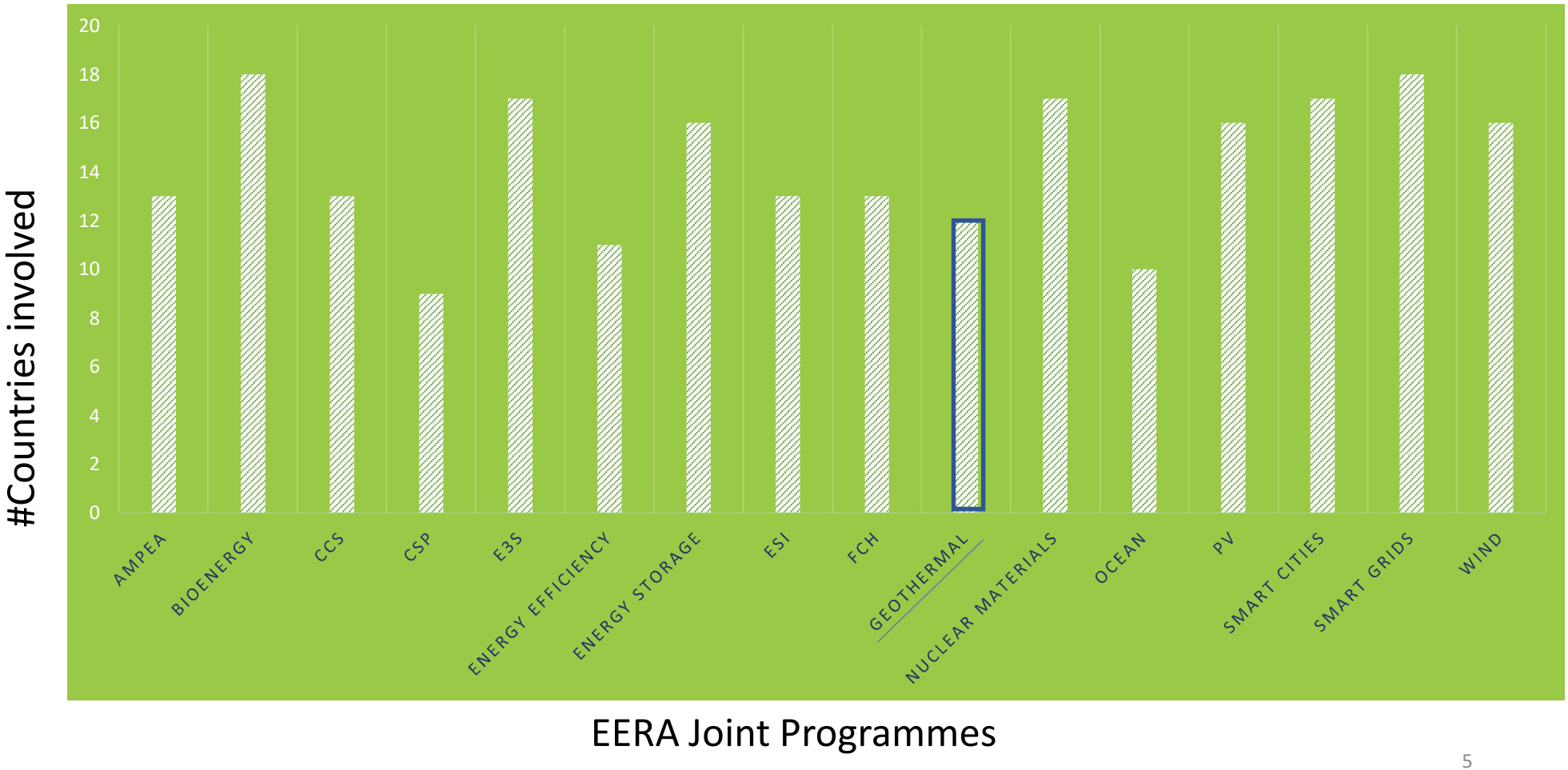
- EERA undertakes integration and knowledge transfer among European energy research stakeholders to increase efficiency in R&I and create a momentum larger than the sum of the individual stakeholders
- EERA deliver research results from basic research to the demonstration phase (TRLs 2 to 5) and ensure efficient transfer to industry and market
- EERA is an integrated part of the European energy R&I ecosystem
- EERA advise EU and MS/AC on long-term decarbonisation scenarios and R&I investment priorities

mission

EERA
European Energy Research Alliance


EERA
European Energy Research Alliance
Associations (8)
Industries (5)
Research Organisations (107)
Universities (93)
North Sea
Baltic Sea
Estonia
Latvia
Lithuania
Denmark
Poland
Belarus
Germany
France
Ukraine
Moldova
Romania
Hungary
Slovakia
Austria
Czechia
Luxembourg
Belgium
Netherlands
Switzerland
Croatia
Bosnia and Herzegovina
Serbia
Montenegro
Kosovo
Bulgaria
Macedonia (FYROM)
Albania
Greece
Italy
Monaco
Andorra
Spain
Portugal
Gibraltar
Bay of Biscay
Tyrrhenian Sea
Black Sea
Malta
EERA
European Energy Research Alliance

MS/AC subscription in EERA Joint Programmes



European Energy Research Alliance

Joint Programme Geothermal

- established in 2010
- 29 Participants, 7 Associate Participants
- common endavour to coordinate geothermal energy research across Europe
- approximately 40% of European research capacity

1	Austrian Institute of Technology
2	Centre for Renewable Energy Sources and Saving
3	Ecole Polytechnique Fédérale de Lausanne
4	French geological survey
5	Helmholtz Association (HGF)
6	Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences
7	Iceland GeoSurvey
8	Institute for Energy Technology
9	Instituto Nazionale di Oceanografia e di Geofisica Sperimentale
10	International Geothermal Centre
11	Italian Institute for Geophysics and Volcanology
12	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
13	Italian National Research Council
14	Karlsruher Institut für Technologie
15	National Laboratory for Energy and Geology
16	Natural Environment Research Council/ British Geological Survey
17	Netherlands Energy Research Alliance
18	NORCE -Norwegian Research Centre
19	Politechnic di Torino
20	Politecnico di Milano
21	RWTH Aachen University
22	Sant'Anna School of Advanced Studies
23	Sapienza University of Rome
24	SINTEF
25	Swiss Federal Institute of Technology in Zurich
26	Technische Universität Darmstadt, Department of Geothermal Science and Technology
27	The Belgian Research Alliance
28	The Netherlands Organisation for applied scientific research
29	University of Bari Aldo Moro
30	University of Bayreuth
31	University of Bergen
32	University of Florence
33	University of Lorraine
34	University of Strasbourg
35	University of Turin
36	University of Utrecht

EERA European Energy Research Alliance GEOTHERMAL

EERA Geothermal provides research to

- expand the type, number and size of geothermal resources suitable for increasing power and heat generation,
- improve efficiency, sustainability and flexibility in production of geothermal resources and
- improve integration of geothermal heat and power in the energy system.

EERA Geothermal Annual Meeting in Bochum, 27-28 May 2019

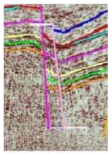
Steering Committee
All Participants

Secretariat

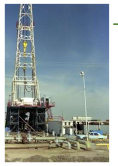
Managemenet Board
Joint Programme Coordinator
Scientific Secretary
Sub-Programme Coordinators

Sub-Programmes

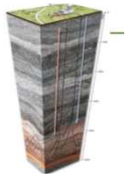
SP1
Assessment of Geothermal Resources



SP2
Exploration of Geothermal Reservoirs

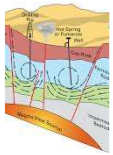


SP3
Constructing Geothermal Wells



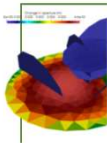
SP4
Resource Development

SP5
Energy Conversion Systems



SP6
Operation of Geothermal Systems

SP7
Sustainability, Environment and Regulatory Framework



SP 8
Computing and Data Management

Joint Programme Management Board

Coordinator/Chair

Inga Berre

University of Bergen

Scientific Secretary

David Bruhn

GFZ/TU Delft

Programme Officer

Charlotte Krafft

NORCE

Programme Officer

Justyna Ellis

GFZ

SP1 Assessment of Geothermal Resources

Philippe Calcagno

BRGM

SP2 Exploration of Geothermal Reservoirs

Jan Diedrik van Wees

TNO

SP3 Constructing Geothermal Wells

Erlend Randeberg

NORCE

SP4 Resource Development

Martin Saar

ETH Zürich

SP5 Energy Conversion Systems

Paola Bombarda

Politecnico di Milano

SP6 Operation of Geothermal Systems

Thomas Kohl

Karlsruhe Institute of Technology

SP7 Sustainability, Environment and Regulatory Framework

Franscesco Rizzi

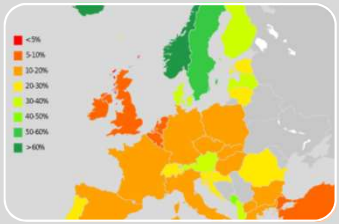
Scuola Superiore Sant'Anna

SP 8 Computing and Data Management

Florian Wellmann

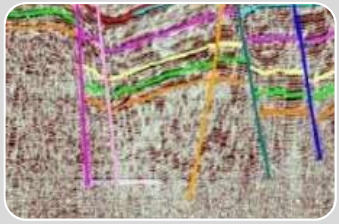
RWTH Aachen University

EERA Geothermal - Actions



SP1 Assessment of Geothermal Resources

- A 1.1 Interdisciplinary 3D geothermal knowledge
- A 1.2 Performance estimates
- A 1.3 Implementation of European Geothermal Information System/Platform



SP2 Exploration of Geothermal Reservoirs

- A 2.1 Conceptual models
- A 2.2 Imaging
- A 2.3 Natural laboratories

SP3 Construction of Geothermal Wells

- A 3.1 Improvement of conventional drilling and horizontal drilling for geothermal scenarios
- A 3.2 Development of novel drilling methods
- A 3.3 Development of novel well completion/logging concept

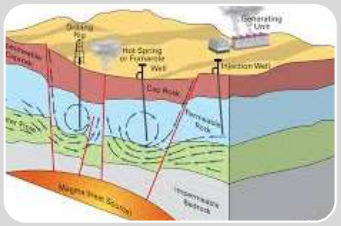
SP4 Reservoir Development

- A 4.1 Hydraulic, Thermal and/or Chemical Stimulation
- A 4.2 Effect of engineering operations in superheated and supercritical water systems
- A 4.3 Induced microseismicity
- A 4.4 Alternative engineered geothermal systems
- A 4.5 Numerical Simulators

EERA Geothermal - Actions

SP 5 Energy Conversion Systems

- A 5.1 Component improvement
- A 5.2 Underground thermal energy storage
- A 5.3 System and network integration, modelling and optimization

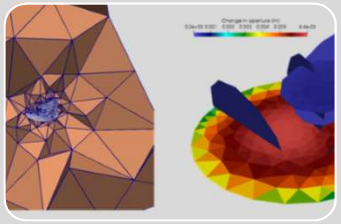


SP6 Operation of Geothermal Systems

- A 6.1 Sustainability of reservoir and environmental risk
- A 6.2 Longevity of materials
- A 6.3 Socio-economics

SP7 Sustainability, Environment and Regulatory Framework

- A 7.1 Business models.
- A 7.2 Socio-economic and environmental evaluations
- A 7.3 Social acceptance



SP8 Computing and Data Management

- A 8.1 Sustainable data management
- A 8.2 Data Science in Geothermal Energy applications
- A 8.3 Numerical simulation, parameter estimation and inversion
- A 8.4 Geothermal HPC

Integration and coordination

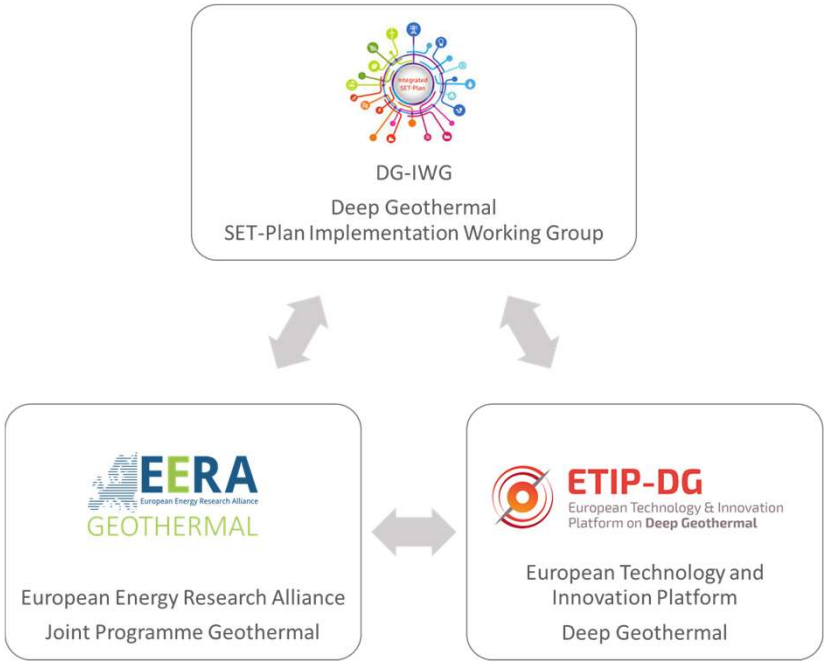
- Applications for joint research projects
- Pilar of SET-plan; contributes to SET Plan Implementation Plan Deep Geothermal
- Stakeholder in SET-Plan Implementation Working Group Deep Geothermal (IWG DG)
- Contributes to Support Unit of IWG DG
- Stakeholder in European Technology and Innovation Platform Deep Geothermal (ETIP-DG)
- Stakeholder in initiative for EU-Africa collaboration

Knowledge sharing

- Dissemination and communication (newsletters, web, etc.)
- Annual meeting (this year 27-28 May in Bochum)
- Co-organizer of the annual European Geothermal Workshop (this year **9-10 October in Karlsruhe**)
- EERA workshop (this year **8 October**)

Sharing of facilities

- Infrastructure map



SET-Plan **Deep Geothermal Implementation Plan**

Implementation Working Group (IWG)

SET-Plan Countries + EC

GEOTHERMICA

National research

EERA GEOTHERMAL

ETIP-DG European Technology & Innovation Platform on **Deep Geothermal**

National industry

EGEC GEOTHERMAL

HTTPS://SETIS.EC.EUROPA.EU/SYSTEM/FILES/SETPLAN_GEOTH_IP.PDF

Deep Geothermal Implementation Plan - Targets of the Declaration of Intents

EERA European Energy Research Alliance GEOTHERMAL

JPGE adapts the DGIP Targets of the Declaration of Intents (DOI):

- Increase reservoir performance* resulting in power demand of reservoir pumps to below 10% of gross energy generation and in sustainable yield predicted for at least 30 years by 2030;
- Improve the overall conversion efficiency, including bottoming cycle, of geothermal installations at different thermodynamic conditions by 10% in 2030 and 20% in 2050;
- Reduce production costs of geothermal energy (including from unconventional resources, EGS, and/or from hybrid solutions which couple geothermal with other renewable energy sources) below 10 €ct/kWhel for electricity and 5 €ct/kWhth for heat by 2025**;
- Reduce the exploration costs by 25% in 2025, and by 50% in 2050 compared to 2015;
- Reduce the unit cost of drilling (€/MWh) by 15% in 2020, 30% in 2030 and by 50% in 2050 compared to 2015;
- Demonstrate the technical and economic feasibility of responding to commands from a grid operator, at any time, to increase or decrease output ramp up and down from 60% -110% of nominal power.

SET-Plan Deep Geothermal R&I Activities:

1. Geothermal heat in urban areas (TRL 7-9)
2. Materials, methods and equipment to improve operational availability (TRL Equipment 5-9, TRL Materials 4-6) - high temp., corrosion, scaling
3. Enhancement of conventional reservoirs and deployment of unconventional reservoirs (TRL 4-8)
4. Improvement of performance (TRL 5-8) - conversion to electricity and direct use of heat
5. Exploration techniques (TRL 5-8) - including resource prediction and exploratory drilling
6. Advanced drilling/well completion techniques (TRL 3-7)
7. Integration of geothermal heat and power in the energy system and grid flexibility (TRL 4-9)
8. Zero emissions power plants (TRL 5-7)

EERA Geothermal Sub-Programmes:

SP1 Assessment of Geothermal Resources -> R&I 1 / 3 / 5

SP2 Exploration of Geothermal Reservoirs -> R&I 3/5

SP3 Constructing Geothermal Wells -> R&I 6

SP4 Resource Development -> R&I 3

SP5 Energy Conversion Systems -> R&I 1 / 2 / 4 / 7 / 8

SP6 Operation of Geothermal Systems -> R&I 7

SP7 Sustainability, Environment and Regulatory Framework

-> Cross cutting

SP8 Computing and Data Management -> Cross cutting

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SP4 Resource Development -> R&I 3

SP5 Energy Conversion Systems -> R&I 1 / 2 / 4 / 7 / 8

SP6 Operation of Geothermal Systems -> R&I 7

SP7 Sustainability, Environment and Regulatory Framework

-> Cross cutting

SP8 Computing and Data Management -> Cross cutting

EERA Geothermal
Contributions to the SET Plan Implementation Plan Deep Geothermal

SET Plan - Implementation Plan Deep Geothermal R&I Activities	**# Annual EERA Geothermal person months**
Geothermal heat in urban areas	346
Materials, methods and equipment to improve operational availability (high temperatures, corrosion, scaling)	240
Enhancement of conventional reservoirs and deployment of unconventional reservoirs	410
Improvement of performance (conversion to electricity and direct use of heat)	203
Exploration techniques (including resource prediction and exploratory drilling)	469
Advanced drilling/well completion techniques	319
Integration of geothermal heat and power in the energy system and grid flexibility	216
Zero emissions power plants	32

Implementation Working Group
Deep Geothermal

Support Unit
for the Deep Geothermal Implementation Working Group (DG-IWG)

Project granted (EC Coordination and support action), start Q1 2019

Aims at

- Helping to promote geothermal RD&I priorities presented in the ten IP fiches, with strategies, RD&I investment decisions and programmes
- To establish the framework conditions for a long-term effective cooperation among industry, research and public authorities interested in the European energy and climate change policy, with focus on deep geothermal technologies for heating and cooling and for electricity

SU-DG-IWG WPs

WP1 Coordination and management (OS)

WP2 Member states input (DGEG)

WP3 Research Community Input (KIT[EERA Geothemal])

- Identify relevant ongoing national and European research actions supporting the implementation of the Deep Geothermal IPs RD&I actions by universities and research organisations.
- Investigate and promote cross-cutting RD&I actions between different IPWGs and other relevant research initiatives (Mission Innovation Challenge, FET-Flagships).
- Explore and implement supporting measures to enhance the knowledge transfer to industry.

WP4 Industry Input (EGEC)

WP5 Communication and dissemination (EGEC)

WP6 Monitoring (EGEC)

WP7 Synergies, Strategy Support (GEORG/RVO)

SU-DG-IWG WP3 Research Community Input

Coordinator: KIT (EERA JPGE)
Contributors: EGEC (ETIP), FRCT

Tasks

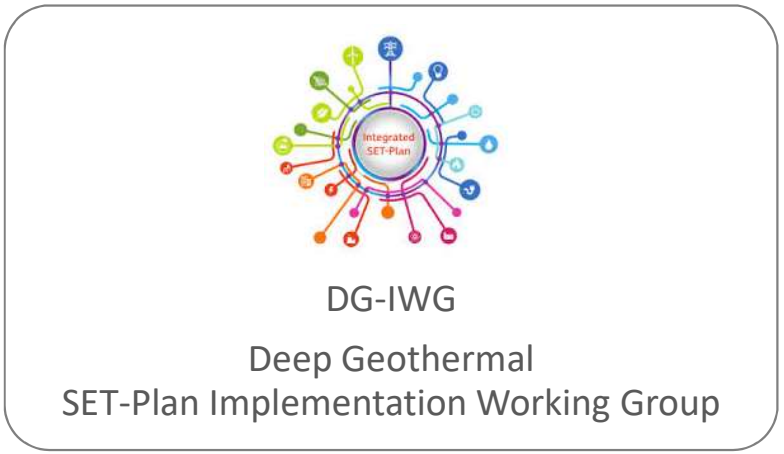
T3.1: Inventory of National and European Public Research in view of its effective mobilisation for researchers (Month 1 to 35)

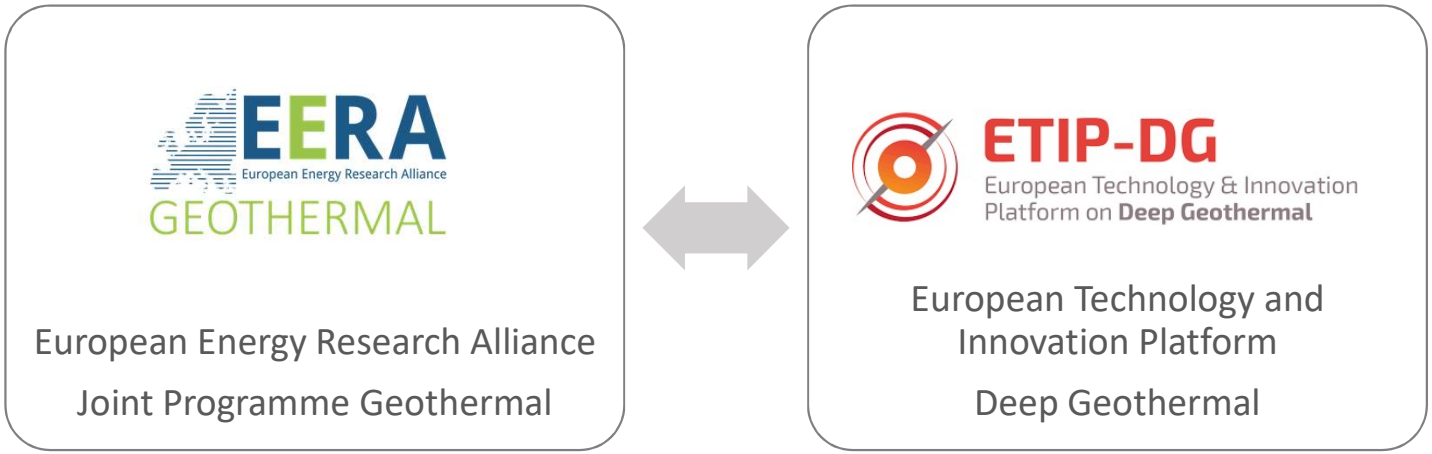
T3.2: Mobilisation of Public Resources towards the execution of the 8 RD&Is of the IP by researchers (Month 1 to 36)

T3.3: Promote cross-thematic and inter-disciplinary activities (Month 1 to 32)

T3.4: Research-Industry Knowledge Transfer (Month 1 to 34)

Workshop with EERA Geothermal 8 October at KIT.


Integrated SET-Plan
DG-IWG
Deep Geothermal
SET-Plan Implementation Working Group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European Technology and Innovation Platform
Deep Geothermal

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