ALCUE NET
Latin America, Caribbean and European Union Network on Research and Innovation

European Overview on Geothermal Energy

Dr. Isabella Nardini

EERA
European Energy Research Alliance
Joint Programme Geothermal Energy

Geothermal Energy Workshop
Salta – 9-11 December 2014

EC Activities related to Energy R&D

- 7th Framework Program
- Strategic Energy Technology Plan (SET-Plan):

  - to reach the climate goals
  - to support the Framework Program
  - to combine all efforts by MS, Institutions and Industry
  - to speed up the R&D process

Elements of the SET-Plan

- SET-Plan steeting group
- SETIS (european energy technology information system)
- EII´s
- **EERA**
- EIT-KIC-Energy
- Energy Systems of the Future
- International Cooperations

European Energy Research Alliance: STORYLINE

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Part I

Introduction

- EERA founded in 2008
- Putting into coherence national & EU programs
- 15 EERA JPs
- 250 Organisations

Mission

- Support to EU SET-Plan
- Implements strategic research
- TRL 2-7 with focus on 2-5

Vision

- Key actor of the EU research area in low-carbon energy
- Output-oriented programs
- Reference point for industry

State of the Art

- Clear added value for researchers
- Community building across borders
- Common strategy development JP/MS/indus.

3 pillars of EERA contributions to the SET-Plan objectives

PILLAR I	PILLAR II	PILLAR III
Research activities carried at TRL level 2-7, **in order to better serve industry needs.** Such contribution will complement existing H2020 activities.	**Coordination activities** including dedicated mobility schemes, **putting into coherence national and EU research programs and increased access to infrastructure across borders.**	**A better structured collaboration with industry to ensure market uptake of research products.**

- Key areas yet identified (and to be explored)
  - CCS
    - Pre-combustion and oxyfuel
    - Storage
    - Other aspects…
  - CSP
  - Wind
  - Solar PV and solar thermal
  - Second generation bio fuels (and beyond)
  - Materials for nuclear
  - Fuel cells
  - Smart grids
  - **Geothermal Energy**
  - Marine applications
  - More to follow….

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EERA
European Energy Research Alliance
Joint Programme Geothermal Energy

European Energy Research Alliance

Joint Programme on Geothermal Energy

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Helmholtz Centre Potsdam, GFZ

Isabella Nardini JP Secretary

CNR Pisa - Institute of Geosciences and Earth Resources

David Bruhn

Helmholtz Centre Potsdam, GFZ

EERA – JPGE List of Participants

EERA European Energy Research Alliance
JointProgrammeGeothermalEnergy

2010

Short Name	Country
BRGM	France
ENERGEA	Italy
CNR	Italy
CNRS	France
CRES	Greece
ETH Zürich	Switzerland
GFZ Potsdam	Germany
ISES	Netherlands
ISOR	Iceland
KIT	Germany
LIAG	Germany
TNO	Netherlands

12 participants
7 countries
~250 persons

2012

Short Name	Country
Uni Neuchâtel	Switzerland
ENEA	Italy
INGV	Italy
LNEG	Portugal
PT Milano	Italy
BGS	UK
RWTH Aachen	Germany
U Torino	Italy
VITO	Belgium
IFE	Norway
U Bari	Italy
U Trieste	Italy
TU Darmstadt	Germany

25 participants
11 countries
~350 persons

2013

Short Name	Country
TÜBITAK	Turkey
OGS U Trieste	Italy
PT Torino	Italy
IRIS	Norway
GZ Bochum	Germany

NEW

2014

U Bergen, Christian Michelsen Research, Uni Research - Norway

Uni Roma Tre – Italy

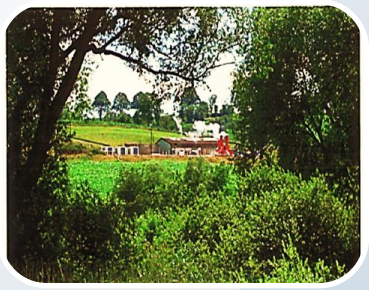
ORC-AXIS - Germany

Current status:
37 participants
12 countries
~420 persons

EERA Joint Programme on Geothermal Energy (EERA JPGE): OVERALL GOAL

Development of new cost-effective technologies suitable for a sustainable growth of geothermal energy in Europe and worldwide

GENERAL STRUCTURE OF JPGE



SP5

SUSTAINABILITY, ENVIROMENT AND REGULATORY FRAMEWORK

SP1

RESOURCE ASSESSMENT

OVERALL GOAL

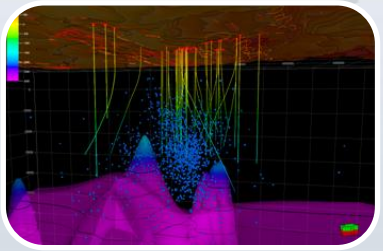
Development of new cost– effective technologies suitable for a sustainable growth of geothermal energy in Europe and worldwide

SP4

PROCESS ENGINEERING AND MANAGEMENT OF GEOTHERMAL SYSTEMS

SP2

EXPLORATION



SP 3

ACCESSING AND ENGINEERING A RESEARVOIR

JP Geothermal Energy

EERA
European Energy Research Alliance
JointProgrammeGeothermalEnergy

Examples for joint activities

IMAGE: Integrated Methods for Advanced Geothermal Exploration

☆ Magmatic sites

☆ Non-magmatic sites

IMAGE

November 2013 + 4 years

Budget: 13 Mio €, (incl. EC 10 Mio€)

19 partners (6 from industry)

→ **SP 2**

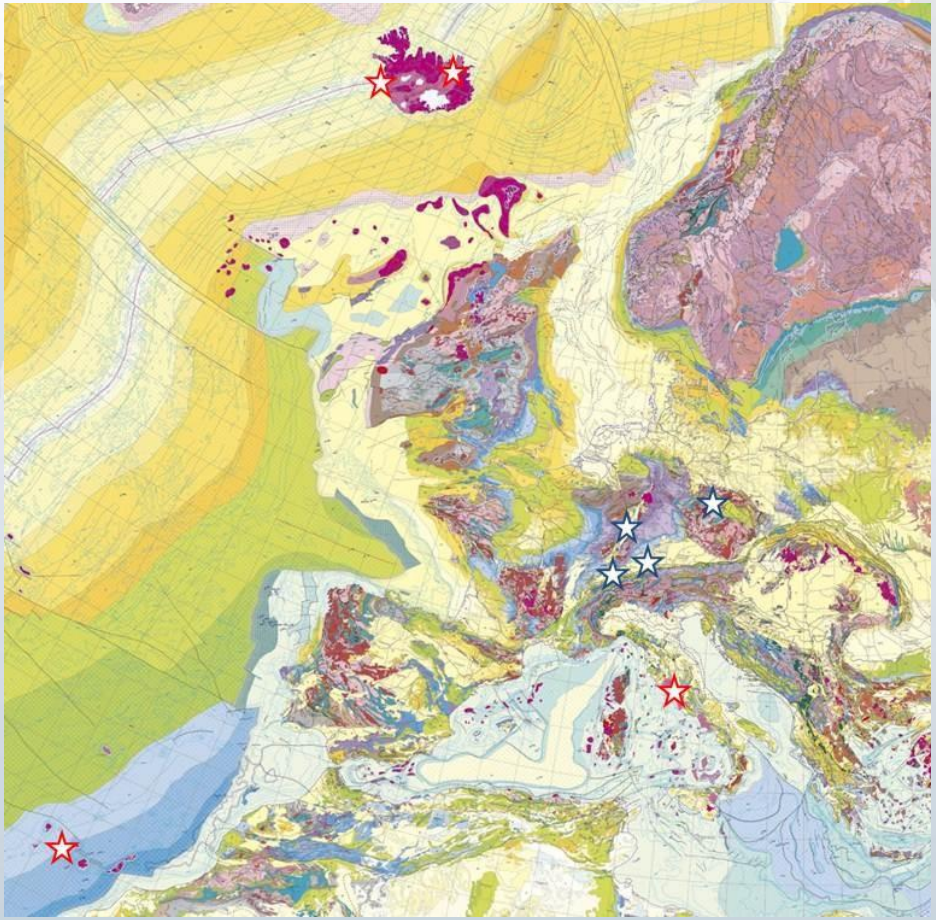


IMAGE: Integrated Methods for Advanced Geothermal Exploration

Objectives

Develop reliable exploration methods for site characterization and well-siting

- **Understand processes and parameters** for prediction of the critical exploration parameters from continental to local scales
- **Develop exploration techniques** to improve assessment of critical exploration parameters by data-acquisition and processing in
  - Passive and Active seismic
  - Electro-Magnetic methods
  - Temperature measurement, geothermometers and tracers
  - Fieldwork and stress measurement
  - To test the developed exploration techniques on selected sites of the industry partners
- **Develop and demonstrate integrated sound methods for site characterisation and well-siting in field integration**.

Geothermal **E**ngineering Integrating Mitigation of **I**nduced **SE**ismicity in **R**eservoirs

The European GEISER project

GEISER

GEOTHERMAL ENGINEERING INTEGRATING MITIGATION OF INDUCED SEISMICITY IN RESERVOIRS

www.geiser-fp7.eu

SEVENTH FRAMEWORK PROGRAMME

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Understand processes and mechanics of induced seismicity in geothermal systems

- Develop mitigation strategies
- Provide legal and administrative guidelines for licensing of geothermal power generation

Funding period: 42 months, starting January 2010
Co-funded by the European Commission within FP7
13 partners from 7 countries, 2 industry

→ **SP 3, 4, 5**

Perspectives for Hazard Assessment of Induced Seismicity in a Regulatory Framework

Earthquake Catalogue

⇩

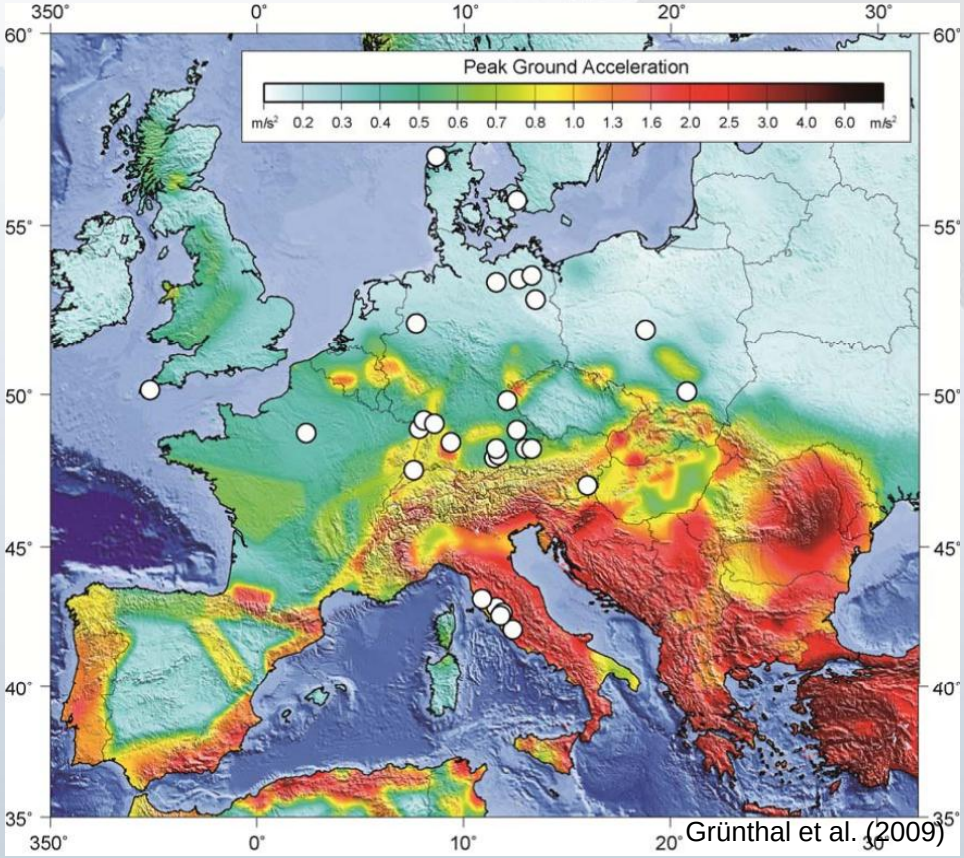
Zonation & Attenuation Relations (GMPE)

⇩

Seismic Hazard Map Intensity or Peak Ground Acceleration (PGA)

→ **SP 2, 5**

10% Exceedence Probability in 50 a (T = 475 a)



Grünthal et al. (2009)

In situ Geothermal Lab Groß Schönebeck

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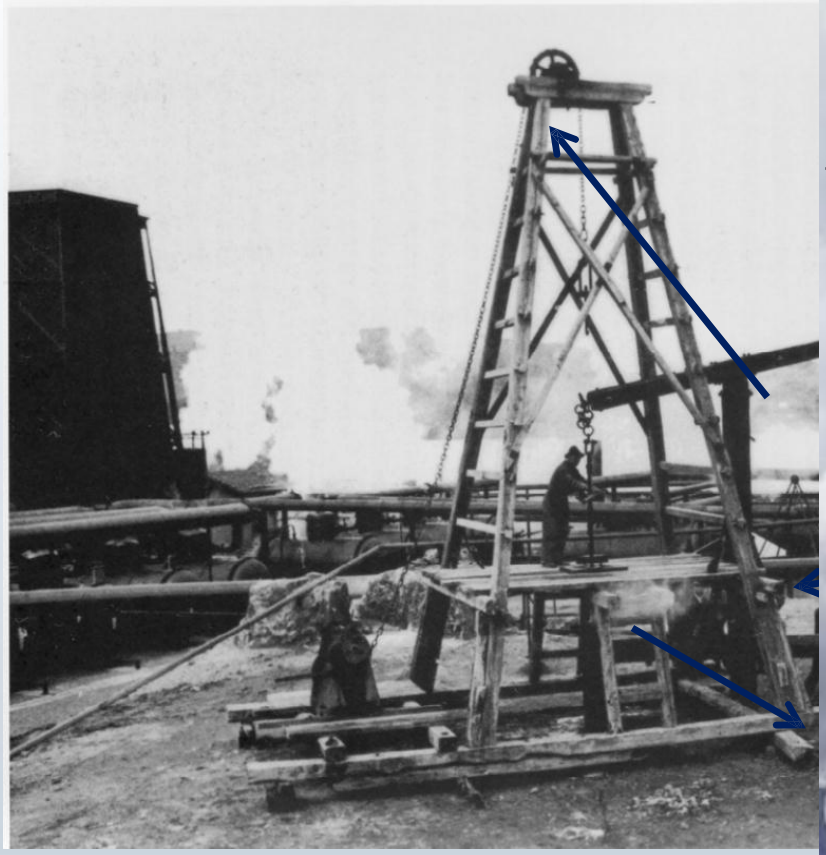
→ SP 2, 3, 4

EU: temperature at 2000 m depth



Since 1904, Tuscany/Italy, today conventional geothermal power plants

Icelandic deep drilling; magmatic conditions, testing 2011-2012, new well starting soon

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- Enhanced Geothermal Systems (EGS): Demonstration of reliability
- Zero-emission power plants: Total re-injection
- Development of reservoirs with supercritical fluids (fluids in the thermodynamic area above the critical temperature and pressure)

Other research topics

- Geothermal energy in urban areas
- Energy and Earth's underground - Multiple sources and storage options (geothermal, CCS, shale gas, new materials)

1) *EGS: Demonstration of reliability*

The EGS concept includes artificial improvement of the hydraulic performance of a reservoir with the goal to use it for an economical provision of heat or electric energy

issues to be addressed

- Upscaling from small units to 10+ MWe
  => increase flow rate!
- Mitigation of induced seismicity

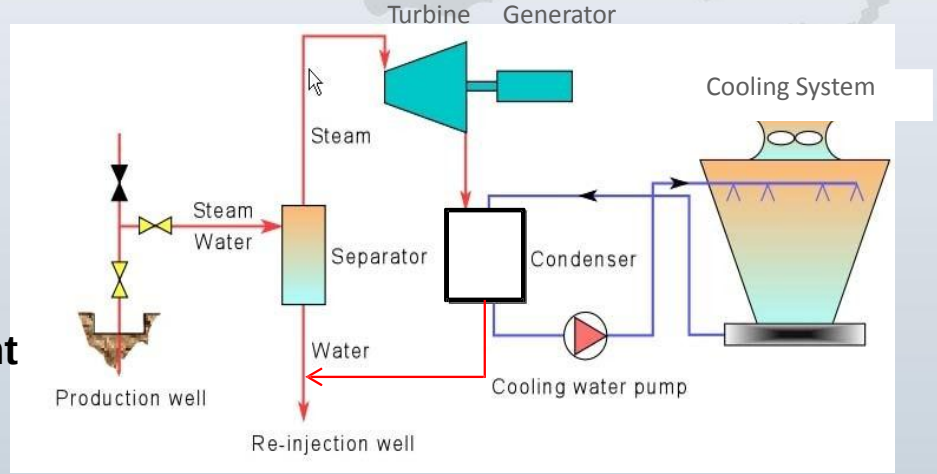
Topic goal
provision of heat and power from geothermal reservoirs in Europe and worldwide independent of site

Main research topics: **GEOTHERMAL ENERGY**

2) Conventional geothermal power plants – environmental requirements




At the beginning: power production with release of brine and steam
→re-injection (up to 30-40%)
→H_2S and Hg abatement system (AMIS)
→next:
zero-emission geothermal power plant



Main research topics: **GEOTHERMAL ENERGY**

2) Zero-emission power plants / total re-injection

will increase

- Public acceptance
- Sustainability: environmental, reservoir performance => economics

requires

- Research across several disciplines
- Cooperation with key industry partners

Topic goal
short term increase of conventional geothermal power provision (from 2- >10 GW) fulfilling all environmental constraints

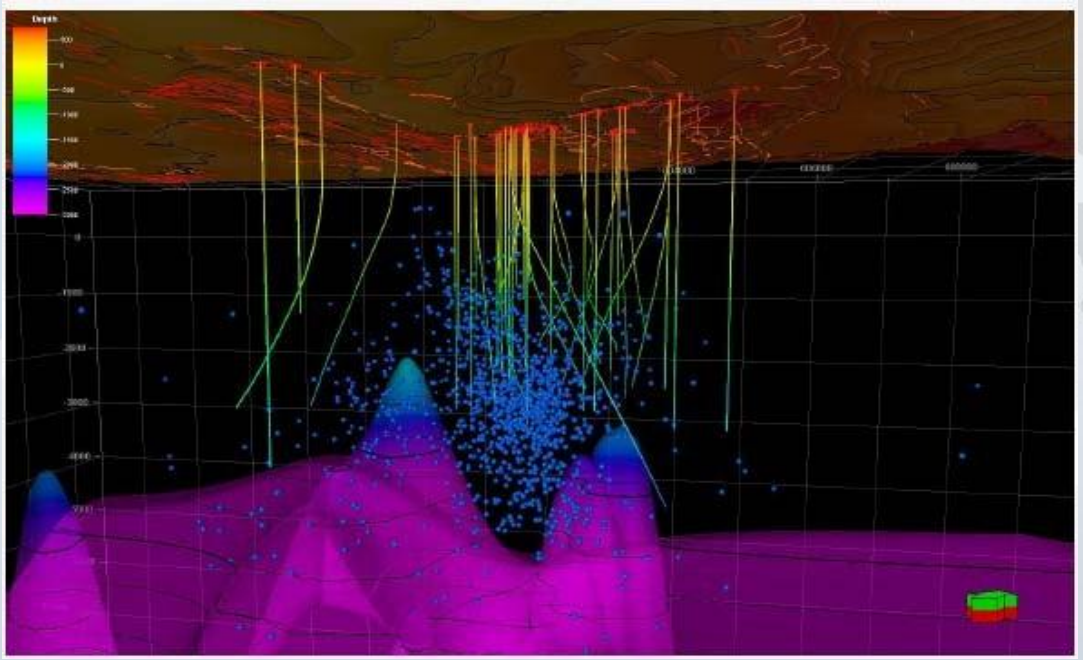
Main research topics: **GEOTHERMAL ENERGY**

3) Drilling to magma in Iceland

Surface Geophysics shows magma body at 4-5 km depth

All micro-earthquakes occur above magma body

Drilling hit magma at 2.1 km depth



Need for more accurate exploration methods → IMAGE

Main research topics: **GEOTHERMAL ENERGY**

3) *Development of reservoirs with supercritical fluids*
(fluids in the thermodynamic area above the critical temperature and pressure)

will increase

- Energy output per well
- Contribution of geothermal energy to total electricity production => economics

requires

- Major research (+funding) across several disciplines
- Cooperation with key industry partners

→ IMAGE

Topic goal

development of > 1 magnitude higher productive geothermal systems per well

Strategic activities

Geothermal Energy under-represented in SET Plan

Contribution to SET-Plan documents

JPGE input in the

- Roadmapping exercise ***Materials for the SET Plan – Materials for Geothermal Energy*** (2011)
- ***Exercise on Education and Training for the SET Plan*** (2012/13). Rapporteur: Prof. Eva Schill (formerly Univ. Neuchâtel/CH)
- **Integreated Road Map**
- Side event at the SET Plan Conference (10th of December 2014)

Energy and Earth's underground - Multiple sources and storage options (geothermal, CCS, shale gas, new materials)

Workshop with EU Commissioner Oettinger

Brussels 15th of November 2012

"Geothermal Energy for Urban Areas"

European geothermal PhD day

1. 12th of February 2010, Potsdam / Germany
2. 1st/2nd of March 2011, Reykjavík / Iceland
3. 29th/30th of March 2012, Pisa / Italy
4. 6th/7th of May 2013, Szeged / Hungary
5. 1st/2nd of April 2014, TU Darmstadt / Germany
6. 25th/26th of February 2015, TU Delft / NL

60 to 100 PhD students at each PhD Day

With industry support

GEOTHERMAL ERA NET CONSORTIUM

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IS	Orkustofnun (National Energy Authority),
NL	Rijksdienst voor Ondernemend Nederland
CH	Swiss Federal Office of Energy (SFOE)
I	National Research Council of Italy (CNR)
D	Jülich (PTJ)
F	ADEME (BRGM as third party)
IS	Icelandic Centre for Research (RANNÍS)
TR	TÜBITAK (Scientific and Technological Research Council of Turkey)
~~SVK~~	~~Slovak Ministry of Education, Science, Research and Sport~~

New partners

MFIG	Hungarian Geological and Geophysical Institute
SED	Slovenian Energy Directorate
EAD	Electicidade dos Acores

Lead partner is Orkustofnun
operating the
Geothermal ERA NET Coordination Office

Good geographical balance (North-West to South-East Europe) Partner countries chosen a.o. on basis of their 2020/2050 geothermal ambitions

Geothermal ERA NET Objective

Exchange information on the status of geothermal energy

Lay groundwork to create a **European Geothermal Information Platform**

Highlight **barriers** and **recommend practical solutions**

Recommend measures
to
Strengthen European Geothermal Development,
for
Economic Opportunities, Energy Security and Mitigate Climate Change

EGEC, the European Geothermal Energy Council, was founded in 1998 as an international non-profit association in Brussels.

The aim s to promote the use of geothermal energy, as follows:

• In priority, By exercising appropriate actions among European institutions to implement a legal and institutional framework and financial instruments allowing geothermal sources to compete with conventional energy systems, and to secure economic support in consideration of the environmental benefits.
• By encouraging R&D in the field of geothermal utilisation
• By conducting any activity which is intended to promote the market deployment of geothermal energy in Europe and the export of European geothermal technology, services and equipment to other parts of the world.
• By representing the interests of the European geothermal energy industry and users to governments and international organizations, with a view to improving business conditions for the industry.
• By co-operating with national and international geothermal associations.

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Develop Geothermal Electricity in Europe to have a renewable energy mix

GEOELEC

GEODH

Promote Geothermal District Heating Systems in Europe (01/04/2012 – 30/11/2014)
Supported by Intelligent Energy Europe

repowermap

European map for promoting renewable energies and energy efficiency (01/04/2012-30/09/2014)

REGEOCITIES

Regulations of Geothermal HP systems at local and regional level in Europe (01/05/2012 to 30/04/2015)
Supported by Intelligent Energy Europe

For more information

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