MUSE -
Managing Urban Shallow geothermal Energy

Steiner, C. & Goetzl, G.

Geological survey of Austria

Online presentation EGU, 01.04.2020 – 30.05.2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

Managing Urban Shallow Geothermal Energy

16 Geological Survey Organisations (GSOs)

17 letter of interests of local stakeholders: **Authorities, municipalities, universities, installers, drilling companies**

Project lead: Geological Survey of Austria

MUSE project partners

Geologische Bundesanstalt
Instituto Geológico y Minero de España
ICGC Institut Cartogràfic i Geològic de Catalunya
GEUS
HGI 1909 HRVATSKI GEOLOŠKI INSTITUT CROATIAN GEOLOGICAL SURVEY
TNO
brgm Geoscience for a sustainable Earth
Geological Survey of Belgium
museum NATURALSCIENCES.BE
PAŃSTWOWY INSTYTUT GEOLOGICZNY
BGS British Geological Survey Expert | Impartial | Innovative
GeoZS
CZECH GEOLOGICAL SURVEY 1919
ŠTÁTNY GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA
SGU Geological Survey of Sweden
Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

MUSE is one of 15 GeoERA (ERA-NET Co-Fund Action of 45 European GSOs) projects

€ Budget total: € 1,313,260

In-kind total: € 923,238

Project life time:
01.07.2017 – 30.06.2021

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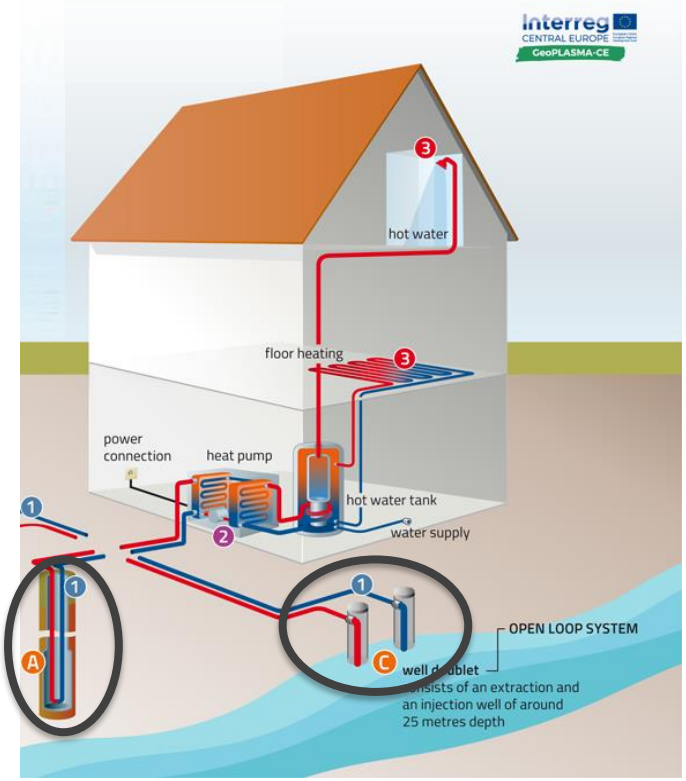
GeoERA GEO-ENERGY

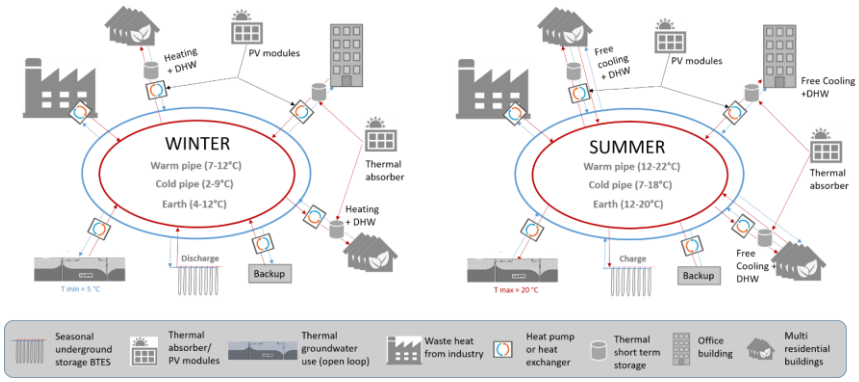
Introduction

"Shallow geothermal energy (SGE) is a key-technology for heating, cooling and seasonal heat storage"

From single family home use…



… to low temperature heating and cooling grids



Main SGE systems included in MUSE are borehole heat exchangers and thermal use of groundwater (secondarily other systems like underground storage)

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GeoERA GEO-ENERGY

Introduction

Why talk about shallow geothermal energy?

- It supplies heating, cooling and seasonal heat storage by the same technology
- It is available everywhere
- It represents a non-fluctuating, stable energy source
- It is low emissive and consumes little surface space
- It supports sector coupling

Why is it important to address urban areas?

- More than 75% of the European population lives in urban areas!
- The number of installations are continuously increasing leading to conflicts of interest
- Efficient and sustainable use of the urban subsurface requires interdisciplinary and integrative management
- Knowing the subsurface conditions is key for management

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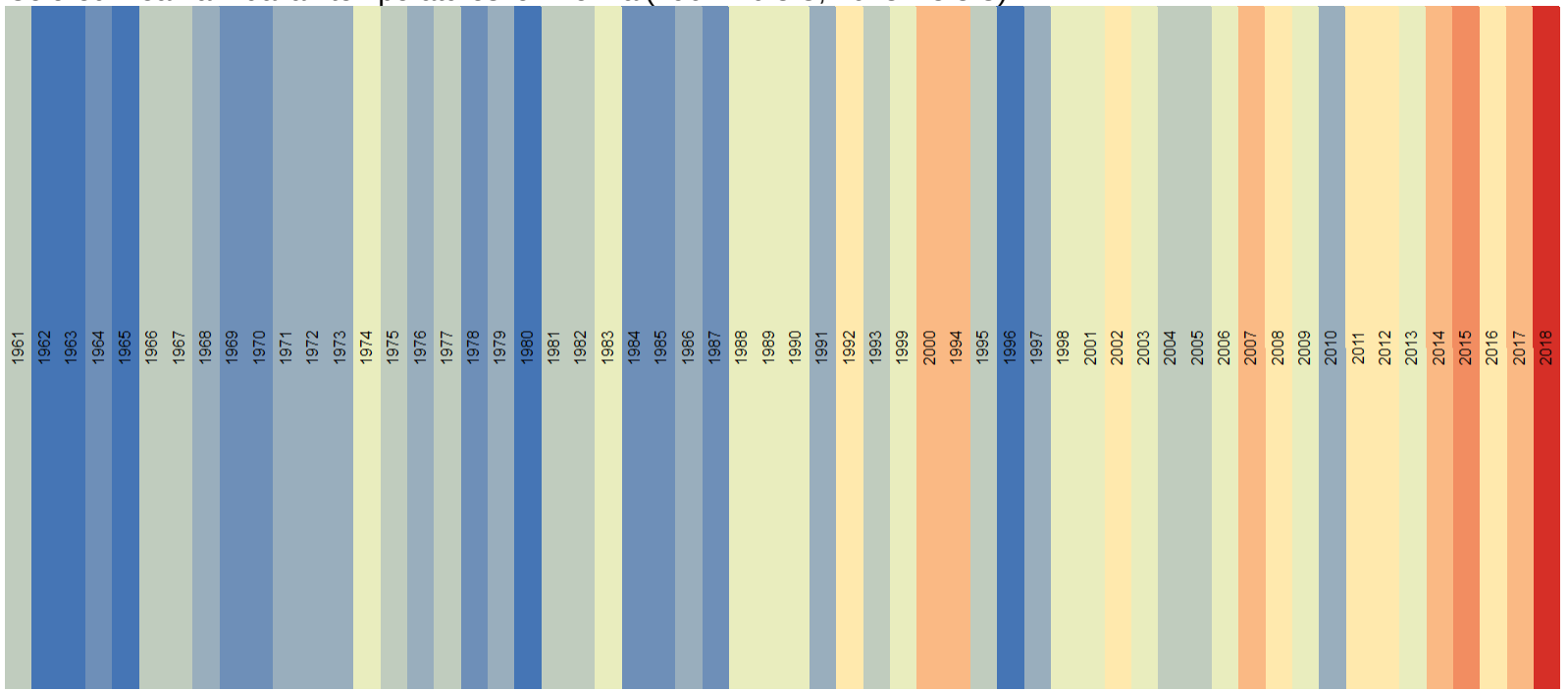
Introduction

Why is shallow geothermal energy especially in urban areas important?

Colored mean annual air temperatures for Vienna (1961: 10.8 C, 2018: 13.8 C)



It's getting hot in the cities!

→ Not only air temperatures, but also underground temperatures are increasing (Underground – urban heat island effect):

Sewage systems, district heating pipes, tunnels, subway, underground parking, shallow geothermal energy systems

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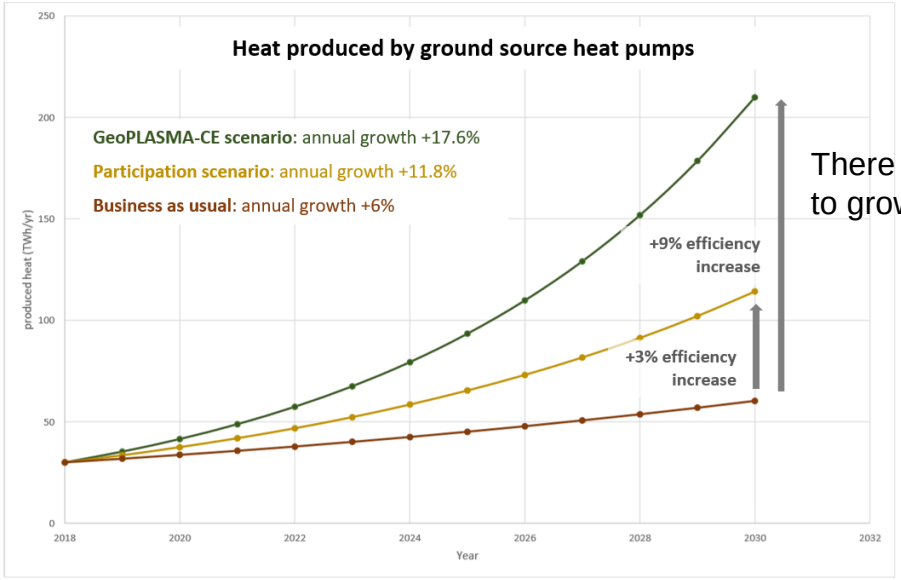
Introduction

Shallow geothermal energy in Europe – a technology ready to leave its current niche!

Key facts in Europe (2018)

- More than 1.9 million installations
- Installed capacities ~ 23 GW_{th} (deep geothermal: 5 GW_{th})
- Annual heat production ~ 27 TWh
- Renewable market share ~ 2%
- Strong competition with aerothermal heat pumps



There is still room to grow in Europe!

Figure 2: EU Shallow Geothermal Energy League 2018
Source: EGEC 2018 Market Report for 22 EU Member States

Rank	Installed units (per 1000 inhabitants)	Growth rate (sales 2018/stocks 2017)
#1	Sweden (55.0)	Bulgaria (+100%)
#2	Finland (21.5)	Belgium (+21.2%)
#3	Estonia (12.7)	Luxembourg (+17.3%)
#4	Austria (12.4)	The Czech Republic (+15.0%)
#5	Denmark (11.3)	Poland (+12.5%)
#6	Slovenia (5.7)	Estonia (+12.4%)
#7	Germany (4.7)	The Netherlands (+10.4%)
#8	The Netherlands (3.5)	Lithuania (+10.2%)
#9	France (2.4)	United Kingdom (+9.2%)
#10	Lithuania (2.0)	Spain (+8.4%)
#11	Poland (1.4)	Portugal (+8.3%)
#12	Luxembourg (1.3)	Finland (+6.8%)
#13	Bulgaria (1.2)	Germany (+6.6%)
#14	Belgium (1.2)	Italy (+6.1%)
#15	The Czech Republic (1.1)	Ireland (+5.5%)
#16	Ireland (0.9)	Austria (+5.1%)
#17	Slovakia (0.7)	Slovenia (+4.8%)
#18	United Kingdom (0.5)	Sweden (+4.3%)
#19	Hungary (0.2)	Hungary (+4.0%)
#20	Italy (0.2)	Slovakia (+3.4%)
#21	Portugal (0.1)	Denmark (+3.3%)
#22	Spain (<0.1)	France (+2.1%)
Average: 7.9		Average: +6.3%

MUSE partner country

MUSE brings together experts from countries with different market situations of shallow geothermal energy

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Introduction

Management cycle of shallow geothermal energy

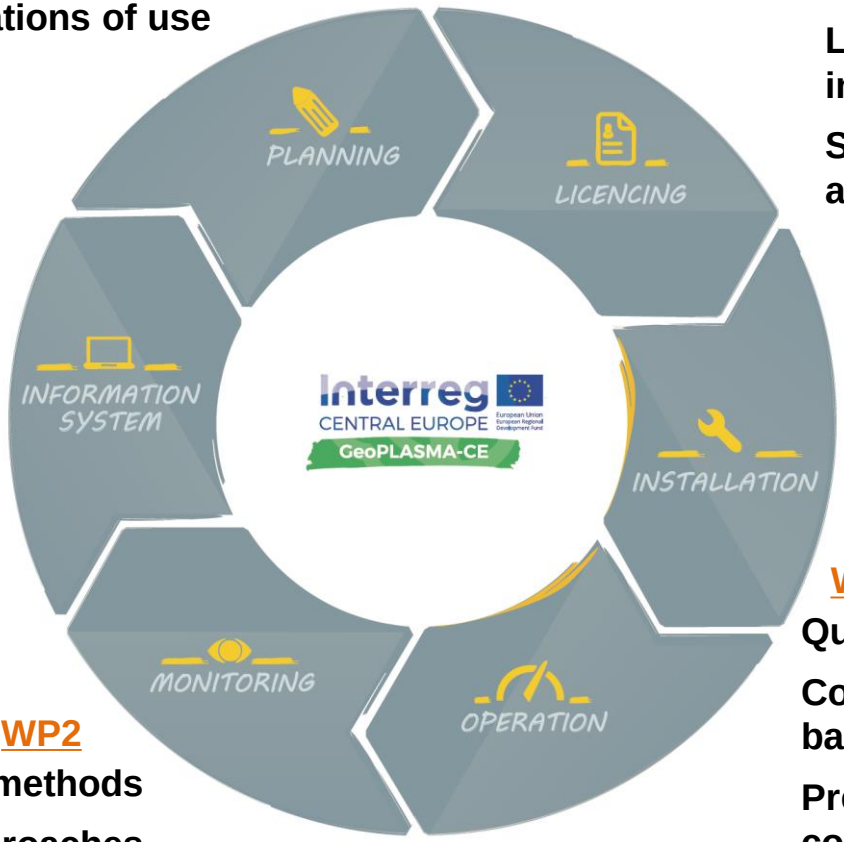
WP4

Assessment of resources and possible limitations of use

WP3

Legal framework and incentives

Strategies for energy supply and energy action plans



WP5

Web portal

Web services

MUSE addresses all parts of management cycle

WP2

Quality standards

Collection of best practice / bad practice cases

Presentation of innovative concepts

WP2

Modern methods

Integrative approaches

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GeoERA GEO-ENERGY

Introduction

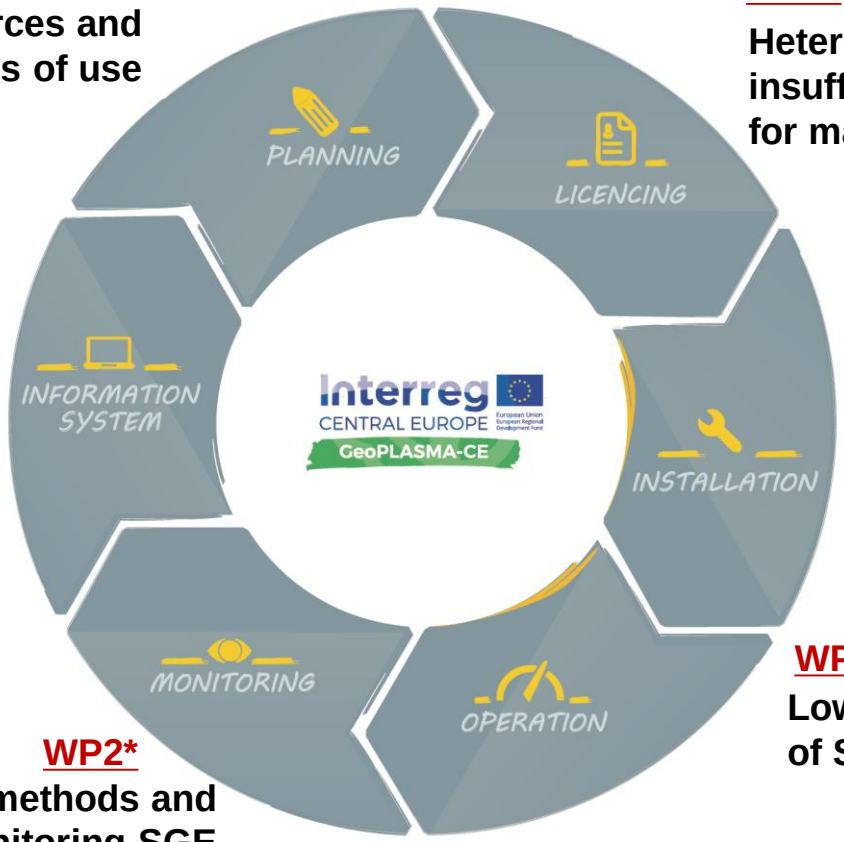
Challenges of shallow geothermal energy

WP2/WP4*

Lack of uniform methods to assess ressources and limitations of use

WP3*

Heterogenous and insufficient legal framework for managing uses



WP5*

Lack of modern efficient information systems

Different parts of management cycle face different challenges

WP2/WP1/WP5*

Low visibility and awareness of SGE systems

WP2*

Lack of uniform methods and templates for monitoring SGE installations

*** MUSE workpackage dealing with the respective challenges**

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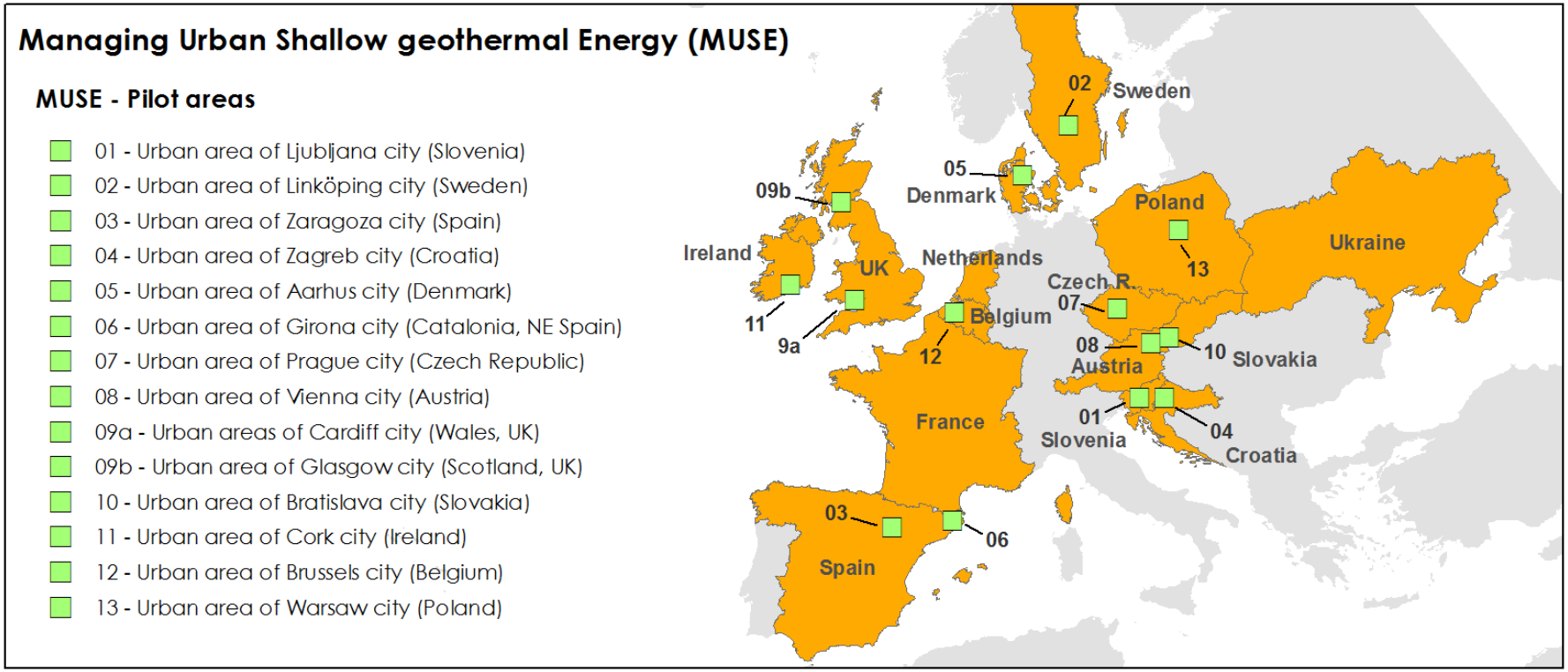
Pilot area activities

14 geological/climatological divers urban pilot areas in Europe



- Test and demonstration of elaborated methods to assess resources / possible limitations of use and targeted communication with stakeholders
- Providing proven concepts, strategies and tools for managing environmentally friendly heating and cooling in Europe

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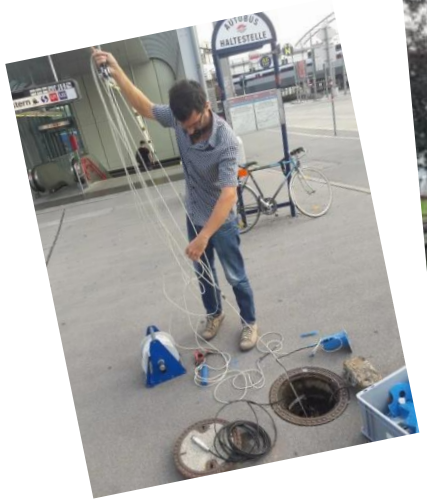
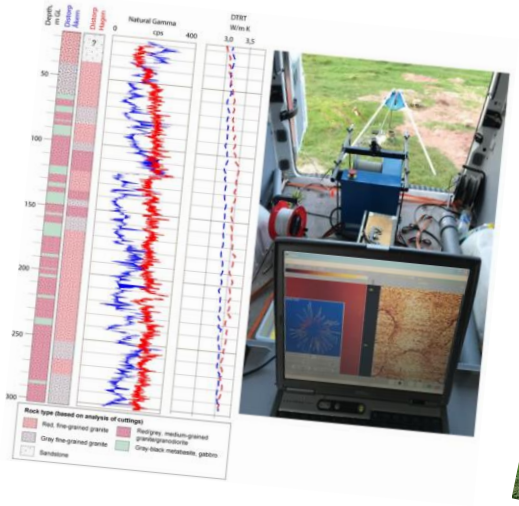
Pilot area activities

Impressions of the field works





Find out more about our pilot area activities on our blog:

http://geoera.eu/projects/muse3/

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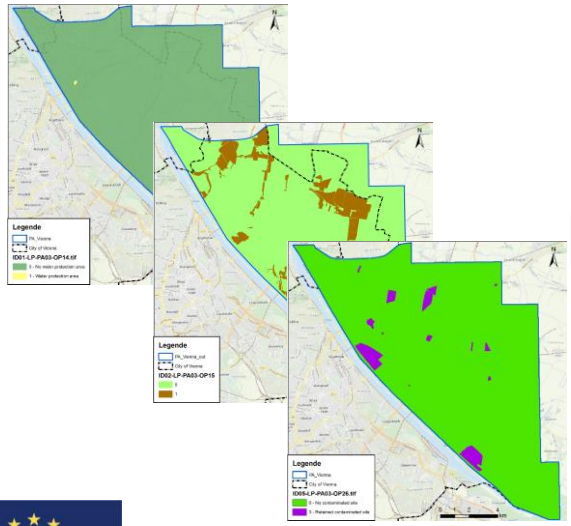
Compilation of methods to assess ressources and limitations of use

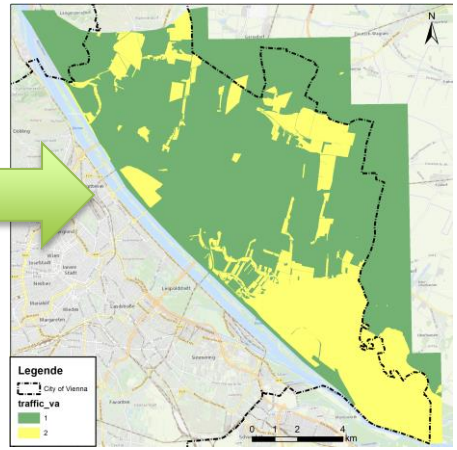
Objective

Provide a catalogue of evaluated methods and guidelines on exloration, assessment and technical monitoring of SGE in urban areas

Approach

1. Partner questionnaire about outputparameters ✓
2. Assessment of existing methods and approaches ✓
3. Preparation of methods and workflows ✗
4. Application and test in pilot areas ✗
5. Collect feedback from pilot areas – „lessons learned“ ✗
6. Preparation of final version ✗





✓ Task already achieved
✗ Task open

Compilation of traffic light map, Based on maps for limitations of use (example)

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GeoERA GEO-ENERGY

Management strategies and action plans for a sustainable and efficient use of SGE

Main objectives

A) Evaluating currently-existing regulation measures for SGE in Europe with focus on the addressed pilot areas

B) Proposing scientific-based guidelines for managing SGE use in specific geo-environments of urban areas

C) Providing a sound basis for tailored management strategies including the whole management circle

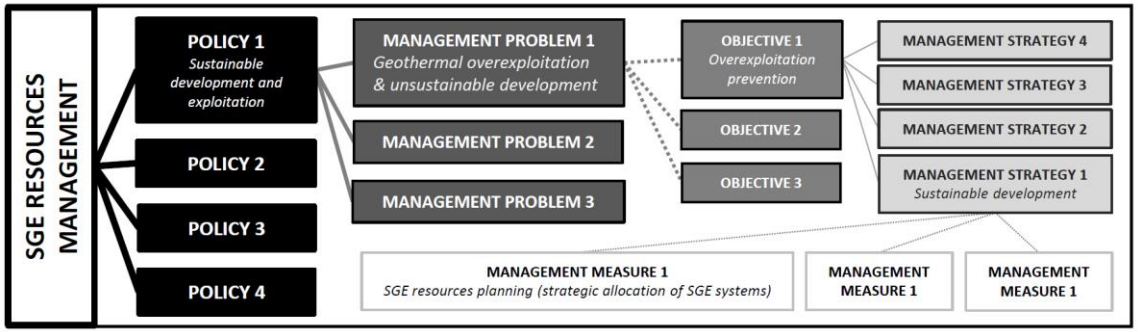
D) Proposing specific measures and actions for integrating SGE use into urban energy supply and climate as well as environmental protection action plans (e.g. SEAPs).

Approaches

Compilation of SGE legal framework
- **EU reports + Sc. Reviews**
- **Internal questionnaire (legal framework)**

Compilation of SGE Management policies
- **compendium of renewable resource management concepts for SGE**
- **Internal questionnaire (Management approaches)**

A. Legal regulations and licensing procedures
B. Flowcharts showing procedures and regulations for assessing applications and granting licenses (permits) on SGES
C. Special geological and geographical conditions which can limit the installation of SGES
D. Regulation elements for the installations, implementation and operation of SGES



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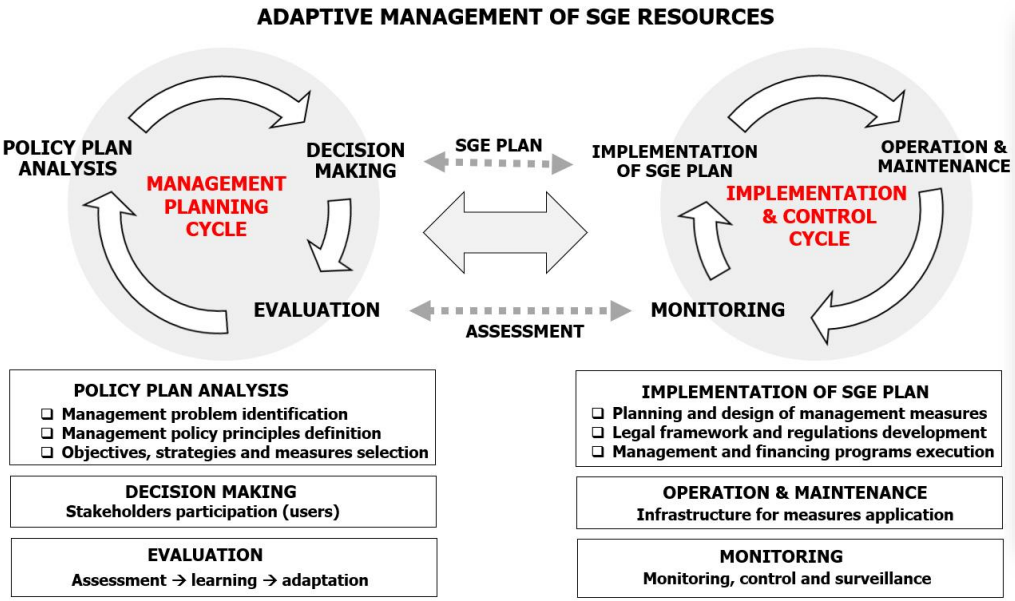
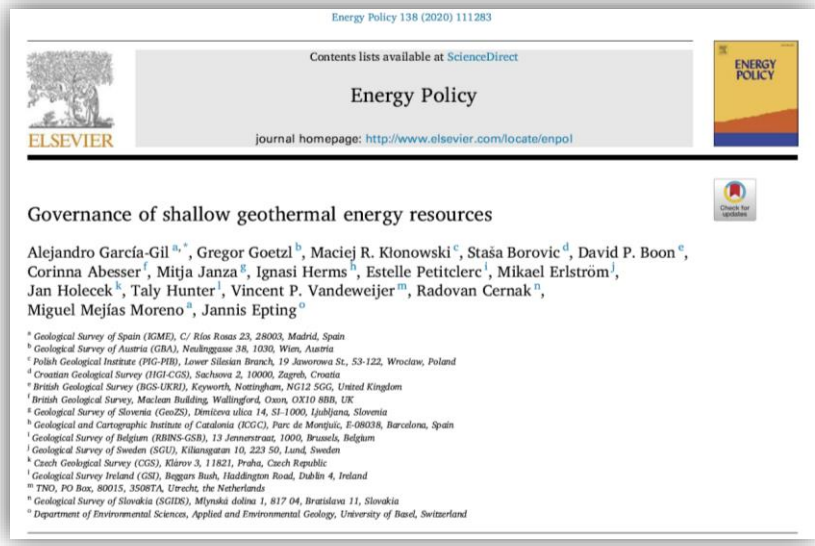
Management strategies and action plans for a sustainable and efficient use of SGE

Achievements of first half of the project

- 2 partner **questionnaires** (Legal framework & Resource Governance)
- Draft of guideline for integrating and managing the use of SGE in urban areas
- Harmonized **governance model** for SGE resources in urban environments





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Governance of shallow geothermal energy resources

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The MUSE Web portal…

… is constantly growing

Discover the web portal:
http://geoera.eu/projects/muse3/

Already available: Blogs about pilot areas and general information

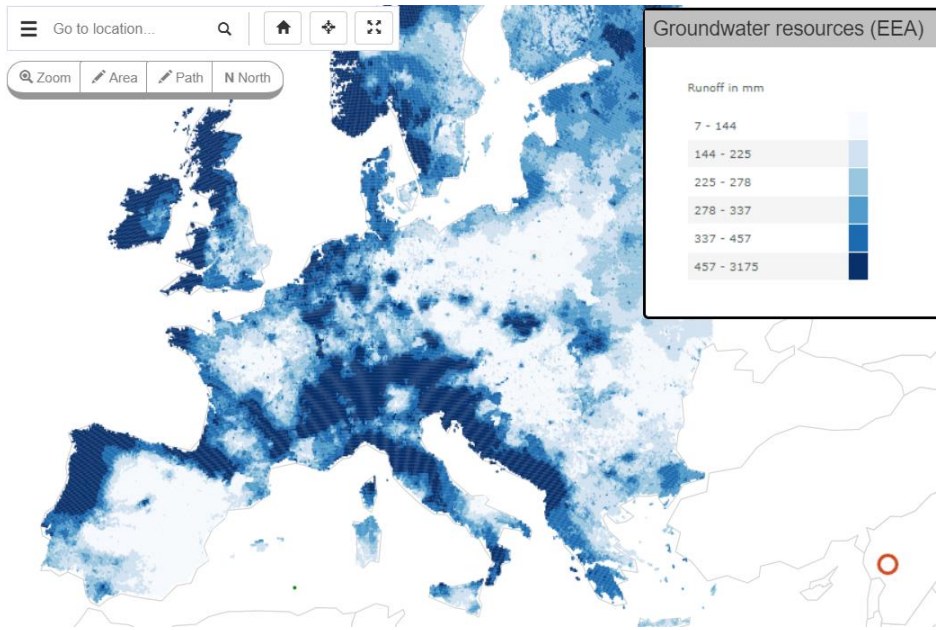
Work in progress: **Web map viewer**

Objective

- Show project results of pilot areas
- Provide an example of a web based information system about SGE

Content

- Ressource maps
- Limitation of use maps
- Results of field measurements



Web map viewer of EGDI

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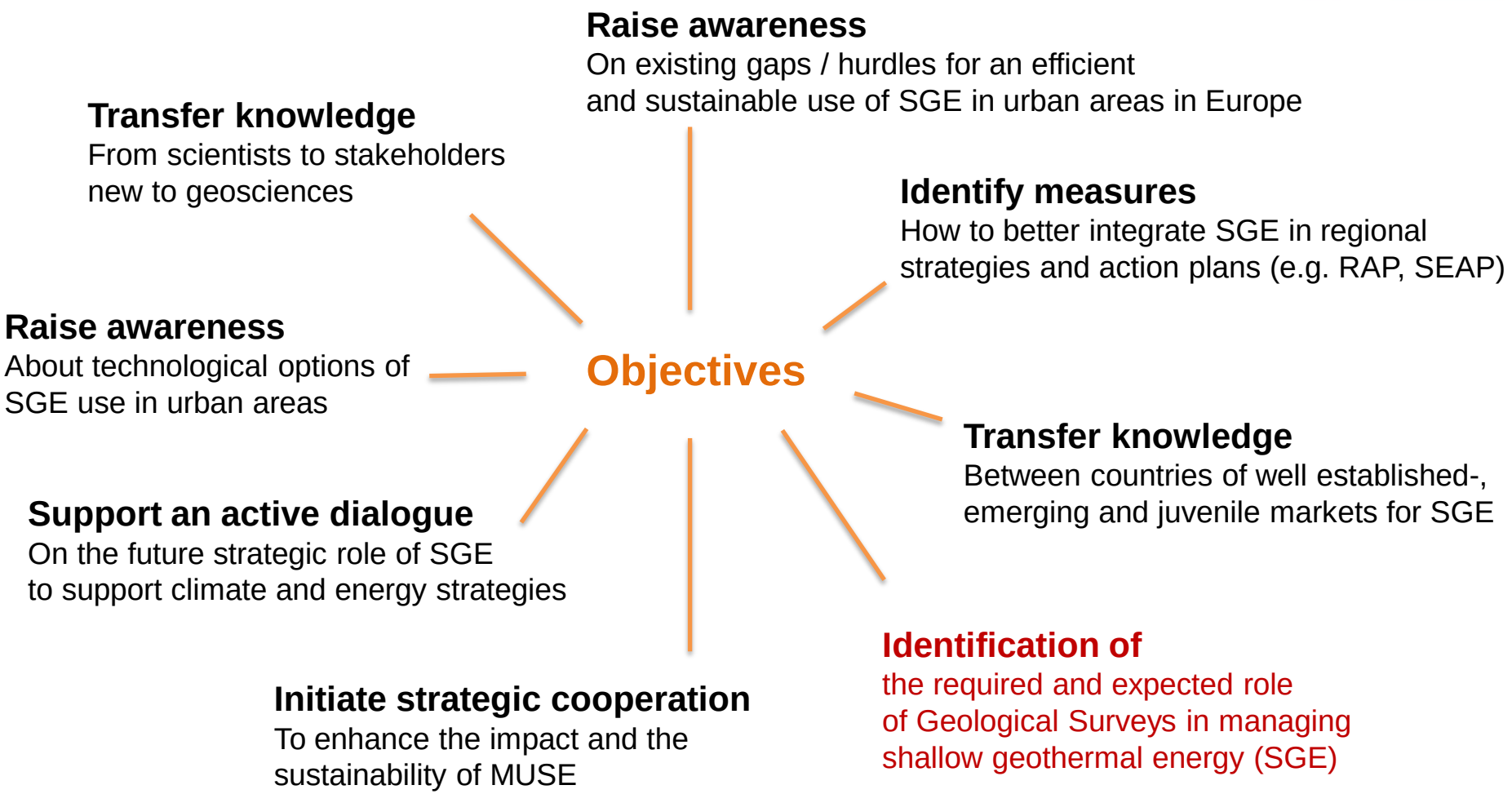
Targeted stakeholder communication



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Targeted stakeholder communication

Target groups

International

Target group	Abbreviation	Role
All target groups listed in Table 4 outside the MUSE pilot areas	--	Adapters
Geological survey organizations outside MUSE, EuroGeoSurveys	GSO	Adapters, multipliers
International interest groups, associations and federations	IIG	Multipliers
EU institutions and European organizations	EU	Adapters, decision makers, multipliers

Main stakeholder types

- Adapters, users
- Decision makers
- Multipliers

MUSE offers the project partners a **harmonized portfolio** of instruments and channels tailored to the target groups

Local (pilot areas)

Sector	Target Group	Abbreviation	Role
Public organizations and bodies	Local authorities, municipality departments and councils	LPA	Adapters, decision makers
	National public authorities, national governments, ministries	NPA	Adapters, decision makers
	Sectoral agencies: energy agencies, energy and land use planners, environmental agencies	SA	Adapters, decision makers, multipliers
	Policy makers and politicians	PM	Decision makers
Investors	Energy suppliers (public or private)	ESP	Adapters
	Real estate developers	RED	Adapters, decision makers, multipliers
Users	Planners, consultants and installers	PCI	Adapters, multipliers
	Architects, building constructors and facility managers	ABF	Adapters, multipliers
	Energy consultants	EC	Adapters, multipliers
Research and non-profit organizations	Academic bodies (universities, colleges, research centers)	RD	Adapters, multipliers
	NGOs	NGO	Multipliers

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Targeted stakeholder communication

Approach

Conception phase
Set up of the draft guidelines

Testing phase
Application of the draft guidelines in the pilot areas and internationally

Review phase
Adaption of draft guidelines, including lessons learned.

Indicators

- At least 14 communication activities (e.g. consultation meetings, trainings or workshops) addressing local stakeholders in the pilot areas
- At least 1 targeted international communication activities addressing international and EU stakeholders as well as multipliers for other regions

Final guidelines will become publicly available.

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Conclusion

Highlights achieved so far

- MUSE already set an important starting point to include shallow geothermal energy into the portfolio of EuroGeoSurveys → critical mass of 16 GSOs
- MUSE is well recognized among the European research scene on shallow geothermal energy
- Stronger awareness on urban subsurface management in the context of energy supply → environmental protection and subsurface spatial planning achieved on an international and local level (inside the partners, inside EuroGeoSurveys and at local stakeholders)
- MUSE stipulated follow-up research on international (e.g. COST Action Geothermal-DHC) and national level

Lessons learned so far

- Low funding share → challenge for a comprehensive topic like shallow geothermal energy
- The implementation of MUSE is highly dynamic → it took 18 months for 16 organizations spread across Europe to align the different ideas and understanding of shallow geothermal
- The project design depends on the outcomes of other GeoERA projects, however a close working connection has been difficult to establish

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Thank you for your interest in MUSE!

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