JOINT REPORT ON THE USER DEMANDS AND BARRIERS FOR THE IMPLEMENTATION OF SHALLOW GEOTHERMAL METHODS IN ENERGY PLANNING STRATEGIES

Deliverable: D.T4.1.2	**Final**
Project partner: LP-GBA	**07 2018**

G.Goetzl[1], M. Heiermann[2], M. Kłonowski[3] & the GeoPLASMA-CE team

[1]Geological Survey of Austria, [2]Saxon State Office for Environment, Agriculture and Geology, [3]Polish Geological Institute - National Research Institute

Contact details of author: gregor.goetzl@geologie.ac.at

The involved GeoPLASMA-CE team

Geological Survey of Austria (LP)	G. Goetzl (coordination), D. Rupprecht (interviews Austria)
Saxon State Office for Environment, Agriculture and Geology (PP04)	M. Heiermann (interviews and summary pilot area Vogtland, editorial team)
Czech Geological Survey (PP05)	J. Holecek (interviews and summary pilot area Bratislava)
State Geological Institute of Dionýz Štúr (PP06)	R. Cernak, Natália Bahnová (interviews and summary pilot area Bratislava)
Geological Survey of Slovenia (PP07)	M. Janza (interviews and summary pilot area Ljubljana)
Polish Geological Institute - National Research Institute (PP08)	M. Kłonowski (editorial team), W. Kozdrój (interviews and summary pilot area Wałbrzych)
AGH University of Science and Technology	M. Hajto (interviews and summary pilot area Krakow)
City of Ljubljana (PP11)	Š. Gregorin (interviews and summary pilot area Ljubljana)

Content

1. Executive summary

The inclusion of shallow geothermal energy use in heating and cooling concepts is strongly depending on the expectations and reservations of regional stakeholder towards this technology in the addressed pilot areas. For preparing policies and strategies for the GeoPLASMA-CE regions, the project team performed a stakeholder survey to identify demands and barriers towards an enhanced application of shallow geothermal. In the period between November 2017 and April 2018, the team performed 47 stakeholder interviews, which also covered simplified SWOT analyses to assess opportunities and threats in the opinion of stakeholders. Local authorities, agencies, SMEs as well as research and NGOs represent the interviewees. All of them might play a role in applying the strategies on the use of shallow geothermal energy for the pilot areas. This report summarizes the outcome of a stakeholder survey on the inclusion of shallow geothermal energy (SGE) use in heating and cooling supply in six pilot areas of GeoPLASMA-CE. The feedback received in the different pilot areas represent the basis for developing individual regional strategies for fostering shallow geothermal in heating (and cooling) supply. The comparative analyses of the outcomes of this survey at the different regions will also feed into the joint "Strategy report for future energy planning and management concepts to foster the use of shallow geothermal methods".

The stakeholders in most of the regions involved see SGE as stable, non-volatile renewable energy source for heating and cooling, affected by a very low level of emission, which also includes waste heat (for cooling) and noise (compared to air based heat pump systems). The **main opportunities** for a future market diffusion are seen in substituting fossil fuels and other energy sources affected by emissions or reduced efficiency (e.g. air based heat pumps and chillers and biomass based heaters). Heating and cooling provided by the same system is also seen as an asset for future investments as well as a supporting European and national legal framework in line with climate change mitigation and environmental protection policies.

In contrast, stakeholders of all involved regions see **predominate barriers** in high investment costs, a general low awareness of decision makers at all levels and unfavourable energy-economical boundary conditions in the moment (ration of energy prices for electricity and fossil fuels). As SGE is seen as a "luxury" energy source, there are barriers to reaching low cost energy consumers, which very often rely on fossil based, emissive energy sources, especially in the Eastern European countries. Low level of awareness in turn leads to lack of political will to support SGE and leads to prejudged opinions on the efficiency and environmental impact or risks associated with the use of this technology. Missing access to knowledge and complex legal procedures also represent significant barriers towards further market diffusion of SGE. Another surprising barrier observed in all regions addresses a general low level of awareness of policy and decision makers, which seems to be independent of the level of market diffusion of SGE. Although SGE is well established on the Austrian heating market, the involved stakeholders show or complain about a rather low level of awareness. This can be explained by the market being dominated by private investments at a rather low level of political intervention on the one hand. On the other hand, the absence of interest groups in all involved regions may also explain the general low level of awareness.

However, most stakeholders are convinced that the importance of shallow geothermal energy in providing heat supply will enhance in the future.

2. Introduction

2.1. Nomenclature

SGE	Shallow geothermal energy
SWOT analysis	Strengths – Weaknesses – Opportunities – Threats analysis

2.2. Aim and scope of the deliverable

This deliverable summarizes the outcome of a stakeholder survey on the inclusion of shallow geothermal energy (SGE) use in heating and cooling supply in six pilot areas of GeoPLASMA-CE. It represents the basis of the later strategies on SGE use in the pilot areas of GeoPLASMA-CE and aims at giving an overview on demands, opportunities as well as current and/or future barriers towards a further diffusion of this technology at heating (and cooling) markets. The comparative analyses of the outcomes of this survey will also feed into the joint "Strategy report for future energy planning and management concepts to foster the use of shallow geothermal methods" (D.T4.4.1).

2.3. Applied approach

The user survey performed in the beginning of the preparation activities for this deliverable relies on the outcome of the previous deliverable D.T4.1.1 ("Harmonized questionnaire template for assessing the user demand and energy management strategies in the pilot areas"). While preparing the harmonized questionnaire, the involved project partners agreed to implement a SWOT analysis in order to identify the view of stakeholders on SGE use from different perspectives (goals, strengths, weaknesses, opportunities, threats and follow up measures). In that context, the SWOT analyses give a general atmospheric picture on shallow geothermal methods in the GeoPLASMA-CE regions. In advance of the stakeholder interview, the partners performed preliminary SWOT analyses, which were later used to compare the expert answers inside the team with the stakeholder answers.

The partners furthermore agreed to focus on direct interviews (personal interview or phone interview) to get into close contact with users and stakeholders of the strategies planned in GeoPLASMA-CE in order to seek and specify opportunities of future cooperation inside the project. Before distributing among the project stakeholders, the questionnaire was partly translated into the national languages. In addition, the project partners provided the interviewees with technical support and explanations if needed. After the interviews had been accomplished and delivered, the partners summarized the outcomes in a harmonized matrix and prepared a short summary of the main outcomes. During the technical session on WPT4 in Bratislava, the involved partners briefly presented the outcomes of the WPT4 survey to the project team.

The milestones of the applied activities are listed in the table below:

3. Overview of the user survey

The survey was performed between **November 2017 and April 2018** and **involved 47 stakeholders** from different public and private sectors. For simplification reasons, interviews performed in countries with shares of two pilot areas (Austria and Czech Republic) were summarized to national regions.

We afterwards grouped the different target groups referring to the nomenclature of the Interreg Central Europe program to the following three main groups:

i. NGOs and research organizations

ii. Public administration bodies and near governmental organizations

iii. Private and public investors

The clustering of detailed target groups is shown in the subsequent table:

Table 1: Clustering of detailed target groups

	Central Europe target groups	
NGOs and research	Interest groups including NGOs	1
	Higher education and research	2
	International organisation, EEIG under national law	
Public administration and near governmental institutions	Local public authority	1
	Regional public authority	2
	National public authority	3
	Sectoral agency	4
Public and private investors	Infrastructure and (public) service provider	1
	SME	2
	General public	

As shown in the subsequent figure, public administration bodies (57.4%) represent the target group with the highest involvement into the survey, followed by NGOs and research and Public and private investors (each 21.3%). Local public authorities represent the largest single target group (29.8%), followed by Interest groups including NGOs and Infrastructure and service providers (each 17.0%). SMEs and research groups show the lowest involvement (1 interview each). To sum up, we achieved a certain cross-section through different stakeholder groups, although the view of public bodies, which are a significant stakeholder of GeoPLASMA-CE, represent the major share inside our survey.

Total sum: 47		
NGOs and research	**9**	
	Detailed TG	
	Interest groups including NGOs	8
	Higher education and research	1
Public administration and near governmental institutions	**29**	
	Detailed TG	
	Local public authority	14
	Regional public authority	6
	National public authority	5
	Sectoral agency	4
Public and private investors	**9**	
	Detailed TG	
	Infrastructure and (public) service provider	8
	SME	1

Figure 1: Statistical overview of the involved target groups.

In most regions, the partners achieved 4 interviews. A significantly higher number of interviews were achieved in Austria, the pilot areas Bratislava and Krakow. Except for interviews in the Czech Republic, stakeholders from all or most of the above listed different main groups were involved. In the Czech Republic, only local and regional authorities were interviewed.

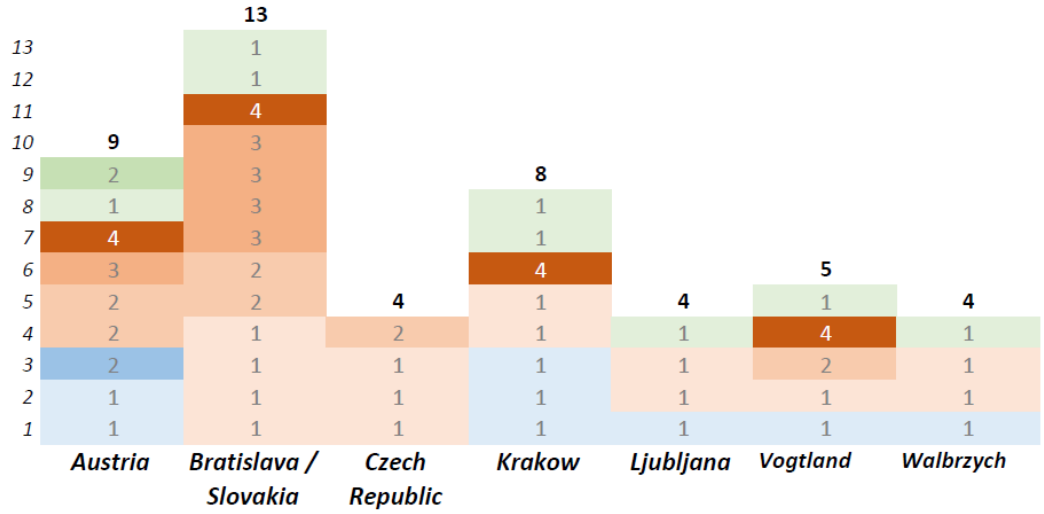

Figure 2: Composition of the target groups involved into the surveys in the investigated region. The color legend is shown in table 1.

The interview partners were asked to estimate their level of knowledge concerning shallow geothermal technologies referring to their professional life. In general, most interviewees declared to have at least a basic knowledge on the technology. Only two interviewees in the regions Bratislava and Czech Republic admitted to have no knowledge at all. A high level of knowledge was estimated in Austria and the pilot area Vogtland. In both regions shallow geothermal energy use is well established in the heating market. Big differences were observed between the Polish regions Krakow city (same level like in Austria and Vogtland) and Walbrzych (non-urban). This also marks the awareness gap between urban and non-urban regions in

country with a rapidly growing market on ground source heat pumps. A rather moderate level of knowledge was observed in the remaining regions too, which also include urban areas. This may be a consequence of the low visibility of shallow geothermal energy technologies on the heating market in these countries.

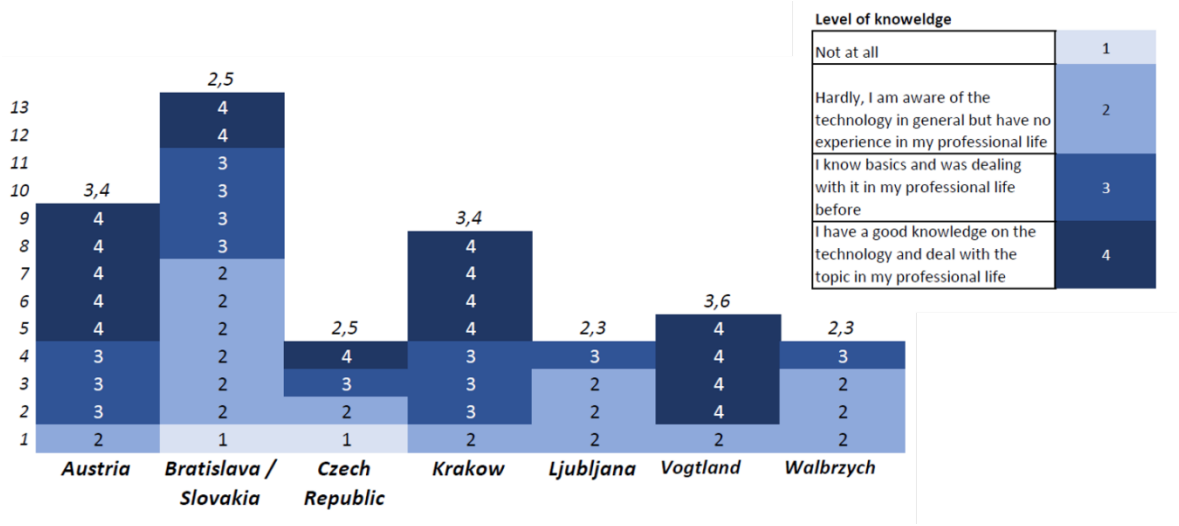

Figure 3: Level of knowledge specified by the interview partners referred to the different regions involved into the survey.

In a final step, we investigated the cumulated level of knowledge per target group. Despite of the single participants from the sectors SME and research groups, which may not be representative, a generally high level of knowledge was observed for sectoral agencies and regional public authorities. It appears that these groups with the strongest involvement in shallow geothermal energy use within the addressed target groups. In contrast, national as well as local public authorities revealed a significantly lower level of knowledge. **At this point, our survey already shows that regional and national authorities, which are very often involved in climate mitigation and energy strategies, need to be addressed more specifically at information- and awareness raising campaigns**. In general, the involved interviewees from public bodies estimated a significantly lower level of knowledge than participants form NGOs and research as well as from public and private investors.

Restrictively speaking, we have to admit that the selection of interviewees also influenced the general level of knowledge, as representatives at a high level of knowledge or awareness may have rather been willing to participate at the interviews than representatives with a low level of knowledge and interest, respectively.

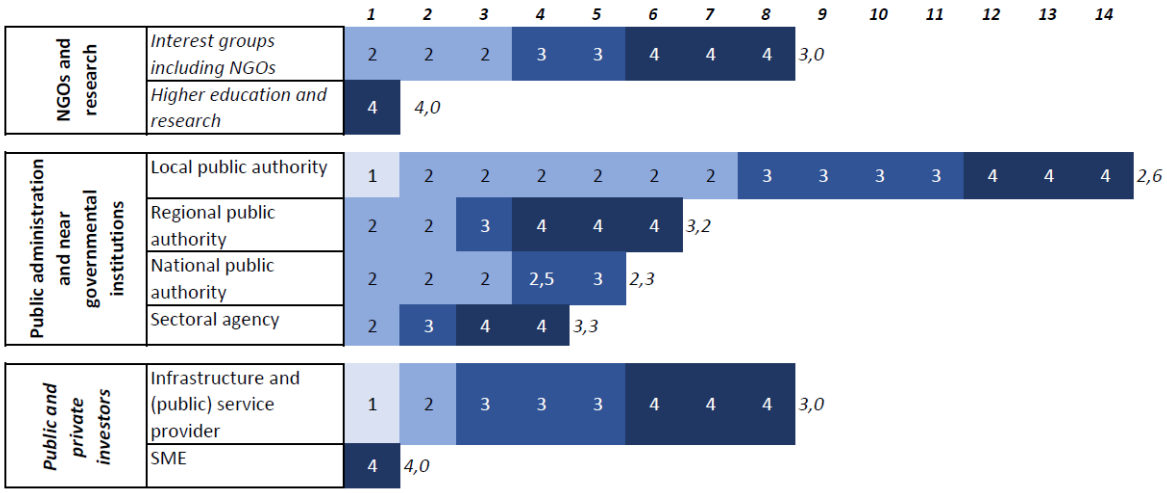

Figure 4: Level of knowledge on shallow geothermal based on a self-assessment of the interviewees.

4. Pilot area Vogtland (Germany)

4.1. Introduction

Five interviews were performed in Dec 2017 and Jan 2018. Interview partners included the regional planning office responsible for the pilot area, local authorities, a local energy provider, the regional energy agency and a nationwide association for geothermal energy.

The interviews were aimed at collecting the unfiltered opinions of the interview partners, i.e. it was avoided to ask leading questions or to influence the interviewee's opinion.

4.2. Estimated present and future role of shallow geothermal energy use

Currently, SGE is mainly installed in single-family homes. Only around 3% of SGE installations in the Vogtland district have an output >30 kW, accounting for 14.5% of installed geothermal power. **Mining waters pose a large potential for medium and large projects which is currently not utilized**.

The majority of the participants stressed that the future user demand hinges on economic feasibility, i.e. on market developments primarily of fossil fuel prices, but also regarding SGE technology and services as well as electricity prices. Since disproportionate taxation of heat pump electricity consumption presents a sizeable barrier, incentives play a major role under current (i.e. skewed) market conditions. Other aspects influencing user demand, such as decreasing demand for housing, requirements to replace aged heating installations etc., were deemed to have comparatively little impact. **User demand is limited almost exclusively to newly erected buildings**. As in the past, future user demand is expected to focus on small-scale projects supplying individual buildings (both commercial and residential) and to include larger multi-family buildings or commercial estates to a much lesser degree. **Future demand for local heating/cooling grids was generally viewed with doubt**.

4.3. Strengths and opportunities for future inclusion of shallow geothermal energy

Of the collected list of strengths and opportunities, the following were deemed the most consequential for the Vogtland pilot area:

Strengths

- Sustainable and continuously available (base load)
- Low emissions (aerosol, gas, noise)

Opportunities

- Political drive for electrification of heat demand and integrated heat/energy systems (SGE improves grid efficiency by utilizing peak electricity supply)
- Favourable framework of laws and policies (e.g. market incentive programme, energy saving ordinance, renewable energies heat act)

4.4. Weaknesses and threats for future inclusion of shallow geothermal energy

The following were deemed the most consequential for the Vogtland pilot area:

Weaknesses

- High initial investment
- The CO_2 balance is unfavourable compared to other RES – this is only the case if the current average electricity source (containing electricity generated from brown coal and other fossils) is utilized for the calculation of the CO_2 balance rather than electricity generated from renewables

Threats

- Direct competition with air source HP
- Adverse priorities in energy planning: Focus is on electricity generation via wind or biomass
- Lack of long-term experience reports
- Longer lead time required for licensing and installation (compared to exchange of oil/gas boiler)

4.5. Proposed future strategies for the inclusion of shallow geothermal energy

S/O strategies (matching)

- Targeted approach of heating contractors and energy consultants, including promotion of „Best Practice“ examples
- Information for building owners and construction companies, e.g. industry fairs, articles, leaflets distributed with building permission
- Inclusion of low-level decision makers, e.g. recommendations to municipal planning offices

S/T strategies (neutralization)

- Awareness-raising measures:
  - Emphasize long-term benefits - both financial and environmental (legacy)
  - Promote suitability for district heating/cooling grids
- Influence energy planning: Regional plan, local energy strategy
- Instigate additional funding schemes on district level

W/O strategies (conversion)

- Provision of information on land-use conflicts
- Broker access to advice on financial grants and subsidies
- Emphasize growing share of renewables in electricity generation and resulting improvement of CO2 balance in PR measures
- Promote additional uses of SGE (e.g. cooling; de-icing of public spaces, railway switches or industrial sites)

W/T strategies (defense)

- Adjust technical specifications for grants and subsidies to lift mismatch between geothermal and air source heat pumps

4.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

In the Vogtland pilot area, the interviews brought several important aspects to light:

- SGE appears to be unattractive to business investors since the amortization period is quite long and grants/subsidies are perceived as inaccessible. However, there are also internal obstacles, e.g. the company structure may not provide dedicated personnel dealing with SGE.
- Quite unexpectedly, the **advantage of cooling does not come into play in Vogtland** - there is little demand now and a significant increase is not foreseen due to costs and local climate conditions. A cheap air chiller unit for a single room per home usually satisfies any demand.
- In the political arena, there is little opportunity for the GeoPLASMA-CE project to exert further influence since the relevant documents (e.g. Regional Development Plan, Regional Plan Chemnitz, and local energy strategy) are not due for review until the end of GeoPLASMA-CE.

All partners were interested in some form of cooperation with GeoPLASMA-CE. The local authorities (district level) proposed joint public awareness activities with the Energy Commissioner and will establish contact between GeoPLASMA-CE and the individual municipalities.

Both the local energy strategy "Klimaschutzteilkonzept Erneuerbare Energien im Vogtlandkreis" and the Regional Plan Chemnitz accepted non-binding recommendations from GeoPLASMA-CE into their latest revision (2018).

As expected, the **background of the interview partners coloured their approach to SGE**. Regarding the SWOT analysis, any particular entry of the SWOT analysis might be evaluated with focus on its economic impact, its environmental aspects or its significance within the web of energy politics, depending on the interviewee. The SWOT analysis illustrated the different points of view and priorities of the stakeholders quite clearly, allowing quite a differentiated and complex view of SGE in the Vogtland pilot area, which was difficult to integrate and summarize. The SWOT analysis also helped to highlight factors, which are specific to the Vogtland pilot area (e.g. below-average modernization rates, energy demand decreasing due to depopulation rather than increased energy efficiency, competition by wood stoves, hardly any demand for cooling predicted).

5. Czech pilot areas (Western Bohemia, Broumov)

5.1. Introduction

The stakeholder survey was performed in **3 steps during March 2018**. In the first phase, stakeholders were contacted by official email communication from CGS. After 7 to 14 days, they were contacted by phone to explain possible ambiguities and to discuss the survey topics. In some cases, additional third phone contact was made in case of difficulties.

Western Bohemia as well as Broumov are non-urban areas with small towns and villages. We selected and contacted town municipalities of the urban units covering the major part of inhabitants living in the pilot areas. We also contacted regional (county) authorities. Totally, we contacted 8 persons in Western Bohemia area (Regional authority of Karlovy Vary region, 3 municipalities with extended competence and 4 municipalities) and 10 subjects in Broumov area (Regional authority of Hradec Králové region, 4 municipalities with extended competence and 5 municipalities). The villages without departments of nature protection or energy planning have been omitted.

Despite all the effort, we received only four survey responses from 18 contacted entities. The response ratio is about 22 %.

5.2. Estimated present and future role of shallow geothermal energy use

The Czech Republic has emerging market of the shallow geothermal energy utilisation. It is supposed to be continuously growing in future, however the strength of the growth depends on the general public knowledge of the shallow geothermal technology and the presence of national "green" incentive programmes.

- The stakeholders feel the role of shallow geothermal energy (SGE) in the future heating of **small private households** or **individual public buildings**, however SGE installations can occur also in commercial projects like shopping centres, business parks etc.
- Some stakeholders have worries about the collision of SGE with groundwater protection issues.
- Stakeholders have opinion that **groundwater protection is the priority and utilisation of SGE has only secondary importance**.
- The stakeholders in the Czech Republic think the **cooling demand will not increase in future** and will be similar as todays.
- Current stakeholders often show the lack of knowledge or just basic awareness about SGE. Only minority is familiar with SGE.

5.3. Strengths and opportunities for future inclusion of shallow geothermal energy

The SWOT analyses revealed the following main arguments for the Czech pilot areas concerning the strengths and opportunities of SGE applications:

- Shallow geothermal energy represents kind of green renewable energy lowering CO_2 emissions.
- It is a stable non-disreputable energy source.
- It can be applicable in wide range of sectors (from single-family houses to large-scale applications) for heating and cooling in the future.
- With **national green incentives, the SGE can be interesting for investors**.

5.4. Weaknesses and threats for future inclusion of shallow geothermal energy

The main weaknesses and threats are represented by the following arguments:

- The **awareness about SGE and its' utilisation is still low** in the Czech Republic.
- The **costs of SGE installation are high compared to other conventional energy sources** and the payback time is long.
- Difficult and **unclear licencing and planning procedures**. The legislation and procedures are not unified across the country.
- SGE is still considered as a minor and 'exotic' energy source.
- The **collision of SGE with groundwater sources** can occur at many places.
- Difficulties of SGE installation are higher in comparison to conventional energy technologies (eg. gas, coal boilers).
- SGE will compete with other renewable sources (photovoltaics, wind energy, photothermic energy).

5.5. Proposed future strategies for the inclusion of shallow geothermal energy

Strengths vs. opportunities

- Some good examples of SGE utilisation exist in area of the Czech Republic.
- The **government supports the raise of renewable energy sources in national energy action plan**.
- National financial incentive programs for fostering the ecological energy sources exist and they are available for public.

Weaknesses vs. opportunities

- The shallow geothermal energy has to be actively promoted in all levels of public activities to raise the general awareness about SGE.
- The shallow geothermal energy has to be implemented in national as well as local energy plans.
- The **legislation procedures have to be harmonised and simplified**.

Strengths vs. threats

- All different risks concerning the utilisation of SGE and its' life-cycle have to be presented to investors and processes of risk mitigation have to be established.
- The overproduction of the cheap conventional energy sources (gas, oil, coal) may slow down the adoption of new clean technologies.

Weaknesses vs. threats

- It is necessary to **define quality standards** for an effective use of SGE. It can be directed by the conditions of the incentives.
- Inappropriate usage of SGE can cause harms on natural resources (e.g. contamination of drink groundwater resources).

5.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

The lack of knowledge of SGE in public is the main limitation of the spreading this renewable energy source. The SGE is still perceived as an energy source of minor or insignificant importance and SGE is missing in many documents concerning energy plans. Some interviewees expressed concerns about the risk and influence of SGE on natural environment and its' resources. On the other hand, SGE is believed as green and stable source of thermal energy. **Under current politico-economic conditions, SGE can hardly compete with traditional "dirty" energy technologies without the national financial incentives**.

6. Pilot area Walbrzych (Poland)

6.1. Introduction

The stakeholder survey in the Wałbrzych area, Poland, took place between **November 2017 and February 2018**. This was preceded the GeoPLASMA-CE stakeholder meeting organized on 28.11.2017 by PGI-NRI in cooperation with the municipality of Wałbrzych, the major local project stakeholder. The meeting was attended by **16 participants** representing the main actors within the Wałbrzych, mainly local municipalities, regional authorities, infrastructure and public service providers as well as the NGOs and interests groups. Except for the detailed explanations on the mission, scope and activities of the project, the stakeholder questionnaire was presented too. The participants were provided with the blank forms of the questionnaire and instructed how to technically fill it in. The participants declared providing the filled in questionnaire in an electronic way after the meeting. In total **four replies** were received – 3 in December 2017 and 1 in February 2018.

6.2. Estimated present and future role of shallow geothermal energy use

The interviews performed revealed the following messages crucial for the present role of shallow geothermal supply in present and future for heating and cooling purposes:

- All interviewed stakeholders underlined that the **general level of knowledge** on SGE and possibilities of its application is **rather low**. In such context information provided by the project personnel during the meeting was of great importance;
- In general, all the interviewees agree with a significant and still increasing role of shallow geothermal energy for heating and cooling;
- The interviewed stakeholders also agree that in the Wałbrzych area heating and cooling with SGE is especially important in case of **private family houses and public buildings**. According to the results of the questionnaires this tendency is expected to grow and be of a greater importance in future. Thus SGE can be utilized in commercial buildings, multi-family houses and local heating and cooling grids.

The **highest confidence** in application of SGE among the interviewees was demonstrated by the **public administration bodies and the local energy supplier**. The interviewed investor is aware of an increasing relevance of SGE technologies in heating and cooling grids in the future.

6.3. Strengths and opportunities for future inclusion of shallow geothermal energy

The SWOT analyses revealed the following main arguments for the Wałbrzych pilot area in SW Poland concerning the strengths and opportunities of SGE applications:

- SGE represent RES which is stable and widely available in the region;
- SGE technologies are modern and ecological solutions which positively influence emissions of GHG, noise, heat and smog thus show high ecological effect;
- SGE technologies and GSHP installations mitigate low emission – a major smog reason in the urban areas;
- **SGE may gradually substitute other thermal energy sources**, also considered as the ecological ones, due to their growing prices;

- Growing public awareness and well-organized education may enforce development and wider use of SGE.

6.4. Weaknesses and threats for future inclusion of shallow geothermal energy

The main weaknesses and threats are represented by the following arguments:

- In the general opinion **SGE technologies are still expensive** in terms of investment;
- The GSHP require the electricity supply thus these installations are risky and dependant on the external energy sources;
- Geological risks are the key issue for proper installation of the ground source heat pumps;
- Geology and hydrogeology of the investment site must be thoroughly checked in order to avoid any natural risks;
- General lack of awareness on ground source heat pumps and shallow geothermal energy use is a source of uncertainty for investors;
- There is a **high competition from other cheaper energy sources** also regarded as the ecological ones;
- The degree of intervention into the natural environment is high due to drilling;
- The **licencing procedure is too long**;
- The propaganda promoting the use of hard coal is too pushy and evident;
- **National policy to support so called clean technologies is not efficient enough**;

Lack of advertising campaign popularising the use of shallow geothermal energy among the users.

6.5. Proposed future strategies for the inclusion of shallow geothermal energy

Strengths vs. opportunities

- Education activities and popularisation of SGE technologies in order to increase their application for mitigation of low emissions in urban areas;
- **Pilot installations in order to prove efficiency and effectiveness of SGE technologies**.

Weaknesses vs. opportunities

- Education and training on economic aspects of application of SGE and GSHP;
- Comparative analysis of SGE and other RES with special emphasis on combined systems, i.e. SGE and photovoltaics, in the context of independent electricity supply;
- Inclusion of stricter geological research in licensing procedure in order to avoid any potential georisks.

Strengths vs. threats

- Education and training on ecological effects of SGE application and georisks;
- Advertising campaign addressing positive aspects of SGE including ecological and economic benefits;
- Promoting SGE and GSHP towards other energy sources including RES.

Weaknesses vs. threats

- Implementation of thorough information systems on national / regional and local levels in Poland;
- **Definition of quality standards** and **introduction of quality certificates for designers as well as installers** and installations. Information campaigns on possible risks and hazards (good and bad practices);
- **Implement an interest- and lobbying platform for shallow geothermal use** on regional and local levels in Poland;

Developing recommendations for quality standards for sustainable and ecological heating and cooling linked to incentives and funds (catalogue of measures).

6.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

The performed SWOT analyses allowed for gaining a better overview on the general knowledge on SGE and GSHP as well as the stakeholders needs. Nonetheless, the presented opinions cannot be regarded as exhaustive as the interviewees represent only limited extension of the project stakeholders in the Wałbrzych area. As a matter of the fact, no stakeholder questioned ecological effect of SGE although there were some negative remarks on economic aspects of its application.

It was surprising to the project team that all the interviewees agree on rather **low degree of awareness** and knowledge on SGE and GSHP and possibilities of its practical implementation as well as **inclusion** of those technologies **in regional and local energy policies and action plans**. Thus the stakeholder meeting and the performed interviews, especially the SWOT analysis, helped to increase public awareness on that issue. In addition, most of the stakeholders offer their help and assistance in the process of data collecting especially if it comes to heating and cooling demand as well as local thermal energy grids.

It must be emphasised that due to many reasons such as legal regulations and groundwater quality the GSHP installation in **closed loop are of special interest in whole Poland including the Wałbrzych area**. The open systems, for example doublets using groundwater as a medium, are of lesser use and importance in Poland.

The results of SWOT analysis are very valuable both to the project and the interviewees and allowed for increasing knowledge

7. Pilot area Krakow (Poland)

7.1. Introduction

Within the survey on assessment the user demand and energy management strategies in the Krakow pilot area, consultations **with eight stakeholders were executed**. The survey **started on January 25th** and was carried out in two stages, including the period before and after the Bratislava meetings (held on 09-13/04/2018). The **last interview took place on 30th of April 2018**, when information from the Department of Environmental Development of the Krakow Municipality Office have been collected. Due to incomplete data only the results of 3 surveys were presented at the WPT4 workshop in Bratislava.

In order to conduct the survey, and to obtain as much representative results as possible, for the whole Kraków pilot area, a target entities group of stakeholder has been selected. The selected 8 stakeholders are represented by the institutions/agencies both the local and national scale. The contact list included:

1) **Local Public Authority**: **a)** ***Department of Municipality Services of the Kraków Municipality Office*** - responsible for developing a strategy of heat supply for the residents of Krakow; ***b) The Kraków Metropolis Association*** - associations of local government units, acts as the Integrated Territorial Investments (ITI), constituting a joint representation of local government units, implementing such investments as defined in the principles for the implementation of ITI in Poland. KMA combines joint efforts of Krakow surrounding municipalities to raise funds for investments, including environmental protection; **c)** ***Department of Environmental Development of the Kraków Municipality Office*** – responsible for the environmental protection issues, including protection of waters, air, green areas (surface) as well as tasks in the field of agriculture, forestry, animals, geology in Kraków;

2) **Sectoral Agency (regional)***: National Funding Team of the Regional Fund for Environmental Protection and Water Management*, financing issues related to environmental protection, including low-carbon policy;

3) **Non-governmental Organizations (nationwide geothermal energy lobbying organizations)** – **a)** ***Polish Geothermal Society*** - aim at determination of overall ambient conditions surrounding geothermal projects, participates in legal consultations on newly-created law, including: environmental protection law, state raw materials policy, geological and mining law, renewable energy sources law, etc., **b)** ***Polish Organization of Heat Pump Technology Developmen***t - aim at increasing the quality of HPs installations, dissemination of knowledge and good practices about heat pumps and influence on improvements the conditions for fast and sustainable development of the heat pump market in Poland. Participating in legal consultations on heat pump use in Poland;

4) **Infrastructural and (public) service provider: a)** ***Municipal Heating Enterprise (Miejskie Przedsiębiorstwo Energetyki Cieplnej S.A)*** **–** a local district heating provider, with the main responsibilities and aim is production and supply of steam, hot water and air for air conditioning systems for Krakow and suburban Skawina. MPEC provides heat and domestic hot water, heating services, taking care of quality and security of heat supply and environmental protection; **b)** ***Kraków Nowa Huta Future SA*** **–** a public company established by the Municipality of Krakow and the Małopolska Voivodeship, to ensure comprehensive revitalization of the post-industrial areas (ca. 40 ha for investments) of the eastern part of Kraków (Nowa Huta) on a infrastructural, functional and social levels.

A regional aims of the survey was primarily to identify the level of awareness on present and future role of shallow geothermal energy among a group of the main involved stakeholder in the Kraków pilot area. Secondly, the aim was also to identify needs of users of the project results in the field of energy planning, management and to define overall environmental conflicts to establish an interface for involving decision makers in the energy supply concepts developed in GeoPLASMA-CE.

7.2. Estimated present and future role of shallow geothermal energy use

The following information regarding the present and future role of shallow geothermal methods for heating and cooling supply were delivered during the survey performed in the Kraków pilot area:

- Heat pump market in Krakow, as well as in Poland, it is relatively young and dynamically developing, however still **a lack of information including market monitoring tools** and system of HPs registration is being reported;
- According to the interviewed stakeholders the most developed sectors, in terms of HPs usage are a **private homes** (single family homes) and public buildings including infrastructure;
- The main purpose of SGE use is heating, whilst **no evidence of HPs usage for cooling purposes were indicated so far**;
- The remaining sectors including: commercial buildings and business parks, multi-family buildings, combined buildings for housing and commercial use at a large volume indicate significant potential for the use of HPs in Kraków, especially noticeable when compare to a high increase in demand and investment in this type of objects are observed;
- The possibilities of SGE using for cooling purposes are widely known, but at actual stage of knowledge it should be treated more as a curiosity and advantage than the actual element of stakeholder's interest, which results mainly from low awareness and lack of good examples of such use.

Due to the specificity of the heating market in Kraków, characterized by an extensive heating network (over 846 km) and high annual heat demand, equal to ca. 10,000 TJ/a, **we do not expect a significant share of SGE**. It's worth mentioning that currently, MPEC (local district heating provider) in Kraków has a 65% share in the heating market in Krakow, the remaining **35% of facilities use individual heating** (mainly **coal or gas**) and local boiler rooms. These **individual heating units should be the main interests for HPs market** development in Kraków. Considering that according to the municipal heating network development plan, the **heating network will not reach some peripheral settlements**, such a Kostrze or Tyniec, as well as some areas located in the eastern part of Krakow (Nowa Huta), where construction of large housing estates is planned. This was widely recognized as the main opportunity and challenge for all sizes HPs installations in Krakow, where SGE would partially or even completely replace relatively small units based on gas or other sources. Unfortunately use of SGE in densely built-up and populated city centre is also questionable where drilling, due to lack of necessary space, may encounter with considerable technical difficulties.

7.3. Strengths and opportunities for future inclusion of shallow geothermal energy

The following main arguments for the Kraków pilot area concerning the strengths and opportunities of SGE applications were recognized based on the SWOT analysis:

- All interviewees confirmed the strengths supporting the use of SGE in Krakow, emphasizing the **high ecological effect** of such installations. The representative of the local authorities emphasized that the **EU climate policy** will probably be continued, aiming at growing the share of RES in the EU energy balance, what may also influence on share of SGE use;
- According to municipal heating network development plan, the heating network will not reach some peripheral settlements, such a Kostrze or Tyniec, as well as some areas located in the eastern part of Krakow (Nowa Huta), where construction of large housing estates is planned. This was recognized as a main opportunity and challenge for all sizes HPs installations in Krakow;
- Finally opportunities for increasing the use of HPs in Krakow result from adopted solutions and formal documents, namely "**Low emission economy plan for the Krakow Municipality**", dated on

2015 and its update on 2017, introduces a **total ban on the use of solid fuels (coal, wood, etc.) in Krakow since September 2019**. It causes that a low emission issue ceases, on the one hand, to be an argument, but on the other - it may be an opportunity for SGE, especially when retrofitting of already existing and designing of heating sources for new single-family houses in Krakow will take place.

Some differences were found when an issues related to reliability, sustainability of HPs installations, especially WHPs (open loop systems), were taken into consideration. One emphasized that durability of wells and efficiency of WHPs installations over time, due to a short time of their operation is still a questionable matter.

It was also emphasized that due to high heat demand in Krakow (heat sales at the level of approx. 10,000 TJ/a), future use of HPs per capita, will be rather low, additionally related ecological effects will be more noticeable on a local scale.

7.4. Weaknesses and threats for future inclusion of shallow geothermal energy

The main weaknesses and threats are represented by the following arguments:

- The representative of the Krakow authorities, as well as *Kraków Nowa Huta Future SA* (public company responsible for infrastructure planning at certain area of Kraków) pointed out the issues related to a **land-use conflicts**, growing in a densely populated and developed **city centre** - a greater land demand than in traditional solutions;
- The weaknesses influencing insufficient HPs development result also from the **high initial investment costs**, lack of information and ignorance of GHPs system construction and operation, as well as **possible adverse effects on groundwater**, including drinking waters in Krakow;
- No objections were raised regarding formal procedures for obtaining a permit to perform a GHP installation, however one suggested that approval and/or authorization should be closely related to **more effective collection of information on completed GHPs installations**;

Price competition with other technological solutions, including air source HPs, as well as comparable prices of fossil fuels - primarily natural gas, were raised. In the end it was pointed out that the main disadvantages of HPs use in Poland may rise from the fact that still 95% of electricity in Poland comes from coal.

7.5. Proposed future strategies for the inclusion of shallow geothermal energy

The stakeholder interviews revealed the following strategies and future measures:

Strengths vs. opportunities

- **Promotion of best practice examples** (heating and cooling, business models);
- Positioning of SGE in already existing district heating system (mainly heating purposes, heating clusters taking into account the use of SGE);
- **Involving relevant actors in strategic cooperation** for the implementation of **demonstration sites and information campaigns** (rising awareness and convince decision makers);

Weaknesses vs. opportunities

- **Training of actors** to minimize risk of failure or to avoid bad practice in HPs installations;
- **Increase the efficiency of the legal framework** (simplification procedures, integrative management and adaption of building regulations to support SGE use).

Strengths vs. threats

- Promote the advantages of SGE towards other energy sources and perform **full life-cycle cost analyses**;
- Develop funding scheme which support system efficiencies;

Weaknesses vs. threats

- Establish an **interest group / lobby for SGE use** (first step is already done under GeoPLASMA-CE, D.T2.4.2 – National stakeholder event ("*Ground coupled heat exchangers - present status, barriers and directions of technology development*", held on 22/05/2018);

Information campaigns on possible risks and hazards (bad practice examples).

7.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

The survey carried out under A.T4.1 activities confirmed the **diverse level of knowledge and reception** of SGE technologies among the main stakeholder in Kraków, which results from a different area of their activity. It is worth emphasizing that everyone had a positive opinion on SGE, however some interviewees argued that HPs are not quite an ecological source of energy, given the fact that **over 95% of electricity in Poland comes from coal**, it was also raised as the main disadvantages of the technology itself. Some interviewees, familiar with the rules of district heating system operation, pointed out that HPs cannot directly cooperate with the system, which results from a completely different temperature work levels, namely heat distribution network supply water/steam with temperature about 130^{o}C, whilst HPs can provide a temperature of water in the range of 40-50^{o}C.

Finally, two possible joint actions together with the Kraków Municipality Office were identified. Both aim at delivering relevant information on the geothermal potential and conflict maps, related to the use of HPs for the purpose of supplementing Krakow's strategic documents concerning:

- Supplying heat for the municipality "**Assumptions for the heat supply plan for the Krakow Municipality**" and
- A low-carbon economy plan "**A low-carbon economy plan for the Krakow Municipality**", expected to be released in the second half of 2018y.

In addition, relatively large possibilities to use SGE were recognized within the emerging project, comprising a large areas of residues after the "Lenin" steel factory (actually Arcelor Mittal Poland), aiming at revitalization of degraded, post-industrial areas (ca. 40 ha for investments), located in the eastern part of Kraków (**Nowa Huta district**). Interview stakeholder, the public company - *Nowa Huta Future SA* is a responsible entity for preparing strategies related to general infrastructure issues, including an indication of possible heat and cold sources and the concepts of its supply for this specific area.

The survey and associated SWOT analyses helped to raise awareness on HPs technology and was a good opportunity to pre-define areas towards possible, further cooperation, also after the GeoPLASMA-CE project closure.

8. Pilot area Bratislava (Slovakia)

8.1. Introduction

The stakeholder survey in Slovakia was performed from **January to March 2018** involving **15 stakeholders** from different target groups:

- Local public authority including municipalities: Municipal office Malacky - Municipal office Malacky - dept. of Construction and Environment and dept. of Strategic Development (3 persons), Municipal office Pezinok- dept. of Construction and Environment (2 persons), Building office Pezinok (1 person), Municipal office Bratislava - dept. of Energy Management (1 person), Office of the Chief architect of the City of Bratislava (1person)
- Regional public authorities: energy planning or environmental authorities: District Office Malacky - dept. of environment (1 person), District Office Pezinok - state Water Administration Dept. of Environmental Care (1 person)
- National public authorities: Ministry of Environment - dept. of Air Protection (2person), dept. of Climate Change Policy (1 person), dept. of Emission Allowances Trading (1 person), state Water Administration department (1 person)
- Infrastructure and public service provider: ENGIE TERMING (1 person) - provider of energy service in Pezinok, Malacky, Stupava and in some parts of Bratislava city.

One interview was performed by e-mail and phone, 14 were done in personal interview.

We aimed on assessing opinions and future trends on the role of shallow geothermal energy use in Bratislava pilot area and the municipalities in vicinity of the Bratislava city located in Self Governing Region Bratislava. For that reason, emphasis was put on the SWOT analyses performed with the interviewed stakeholders. As in case of other project partners, we did not deliver the preliminary SWOT analysis to the interview partners in advance.

8.2. Estimated present and future role of shallow geothermal energy use

Regarding present and future role of shallow geothermal energy use the following observation can be formulated based on interviews:

- **Existing strategies** in municipalities and **do not directly count on shallow geothermal energy use**. Strategies and investments are focused on building efficiencies (mainly reconstruction of grids, insulation, building efficiency)
- Higher governing units (like Bratislava Self Governing Region) have limited knowledge on utilization of the SGE. More information is spread in private sector and potential users (Associated partner Bratislava Self Governing Region - Mr. Pavol Stano).
- For the future, the interviewed persons (mainly authorities) expect higher increase of the SGE sector, though in general view. **No municipality has specified the expected or aimed development of the SGE sector**.

8.3. Strengths and opportunities for future inclusion of shallow geothermal energy

In this chapter the input from interviewed persons is given without the evaluation by project partner.

The SWOT analyses revealed the following main arguments for the Bratislava pilot area concerning the strengths and opportunities of SGE applications.

STRENGTHS:

- Ecological effect of the GHPs installations-RES
- Good image as a green technology
- Low emission level (including noise)
- High system control by new technologies (remote control…)

The interviewed persons stipulated mostly following arguments: independent of energy distribution, modern, ecology, the cleanest energy source, low operating costs, in a developer's project, stable temperature of groundwater, heating and cooling provided by one technology, advanced technology-maintenance-free, technology is good when at sound installation.

OPPORTUNITY:

- Requirement for energy-efficient building permit
- The City of Bratislava is the signatory of initiatives EC - Covenant of Mayors (2012) and Mayor's Adapt (2014)
- Bratislava Self-Governing Region is Covenant coordinator
- **EU funds and national programs supporting** RES (thermo-modernization, replacement of heating systems)
- Suitable geological conditions for a GHP in the pilot area

Interviewed persons stipulated mostly following arguments: economically powerful = high GDP in Bratislava, modern region, be modern-keep up with the world, new building - development areas without gas network, local ecology, improving of air quality in local areas in Bratislava, good climate, weak winter, high general awareness, multiple households heating/cooling, plan for future development areas of settlements (Malacky-Malina development project).

8.4. Weaknesses and threats for future inclusion of shallow geothermal energy

In this chapter the input from interviewed persons is given without the evaluation by project partner.

The main weaknesses and threats are represented by the following arguments:

WEAKNESS:

- Assumption as expensive investment costs
- **Unknown impact on long-term use** (on the environment, buildings…), measurable indicators
- The necessity of drilling boreholes that need field/space
- **Enhanced costs for refurbishment of heating installations** in existing facilities

The interviewed persons stipulated mostly following arguments:

- not suitable for renovated facilities due to change of heating system and full reconstruction of heating installation;
- high entry costs and financial irreversibility;
- complicated technology and specific conditions of use;
- the heat pump is inefficient at a certain temperature;

- environmental impacts such as soil freezing and change groundwater temperature and pressure;
- it is not appropriate to disconnect from central heating;
- the technology is bad when is bad installation.

THREAT:

- Existing heating installation in buildings (central heating), existing gas infrastructure
- Using public financial support for insulation of building, photovoltaics or HP air-water
- Legislation favours central heating, missing GHP as RES in strategies and Action Plans
- **Too long formal procedure** for obtaining a permit to perform a GHP installation

Interviewed persons stipulated mostly following arguments: geology - clay layers, high level of groundwater, central heating, weak winter, connection to central heating (legislation + economics), low general awareness, low PR, low funds from EU, interference neighbouring households, protected landscape areas (Žitný ostrov – main groundwater source in Central Europe).

8.5. Proposed future strategies for the inclusion of shallow geothermal energy

The stakeholder interviews revealed the following strategies and future measures:

Strengths vs. opportunities - Matching strategy

- Bratislava is part of the Covenant of Majors and GHP is environmentally friendly, it might get support from the EU funds, good argument for heat pump producers and installers
- **Integration of shallow geothermal in urban heat island strategies** (cooling and utilization of excess heat in groundwater bodies)
- New projects that are started in the area (supported by research and development funds from Government) are focused on Urban heat island – promotion of the topic in sustainable way

Weaknesses vs. opportunities - Transformation strategies

- **Legal framework** is well established but **rather complicated for water utilization** - simplification procedures
- Although "impact on long-term use" is not known, GHP is the widely used in Bratislava (even though official information is lacking),
- The boreholes and wells are high entry costs – Bratislava higher GDP for area - **better access to the private funds**, better knowledge of the new technologies – higher efficiency houses (private)

Strengths vs. threats - Neutralizing strategies

- Ground Source heat Pumps are often compared to the Central Heating Systems (CHS). CHS have usually good network and new developments have to primarily be connected to them. GSHP are used in developed area for cooling - resulting to THREAT as a rise of the groundwater temperature in towns (Urban Heat Island)
- Promote the advantages of SGE towards other energy sources and **perform full life-cycle cost analyses**.
- Promote sustainable utilization of heating and cooling cycle.
- **Develop funding scheme which support system efficiencies**.

Weaknesses vs. threats - Defense strategies

- Better and **transparent reporting needed**, as the **water is owned by state** – Ministry (or body authorized by Ministry – e.g. Hydrometeorological institute) should monitor and report the quality state of the groundwater and ground itself
- Manage the utilization monitoring of Urban Heat Island
- **Information campaigns on possible risks and hazards** (mainly for authorities)

8.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

From the stakeholder point of view, the request was placed (Associated partner (AP) Bratislava Self Governing Region - Mr. Pavol Stano) for development of the pilot strategy or an action plan that would be serving as good practice and example for future strategies (or other municipalities).

Based on the experience of the AP, the main questions in municipalities address **financial analyses of investment**, **payback times** and **financial efficiency**. Other valued information is how to apply for financial support due to lack of support for such activities (all the municipality have low budget for other things like road net etc.).

The complex strategies are not recommended in first step as they may lead to "too complicated solutions" like change of the heating grid network. By information from Mr. Pavol Stano (Bratislava Self Governing Region) **municipalities did not reflect to the ideas (projects) if only environmental effect was emphasised** e.g. "green energy solution" like adaptation to the climate change.

Good attitude would be simple analysis of savings for small community, part of the municipality if they implement SGE systems (or other renewable sources). After implementation of small steps and after some time municipalities there were more active in implementation of simple ideas into their plans.

We can conclude that **municipalities show lack of specific information about the Shallow Geothermal Energy**, their day to day problems with environmental issues are narrowed to air, soil and water pollution (temperature as change of quality is not reflected). Authorities are bound to compliance with the law that is focused on water utilization (pumping and injection). **There are no standards / rules on SGE utilization**.

9. Austrian Pilot areas (Vienna, Hainburg – Kittsee)

9.1. Introduction

The stakeholder survey in Austria was executed from **January to March 2018** involving **9 stakeholders** from different target groups. Eight out of the nine interviews were performed personally. One interview was realized via telephone. We aimed on assessing opinions and future trends on the role of shallow geothermal energy use in both Austrian pilot areas. For that reason, emphasis was put on the SWOT analyses performed with the interviewed stakeholders. To avoid biased answers, we did not deliver the preliminary SWOT analysis performed to the interviewees in advance. Furthermore, the survey as well as the related analyses were not separated for the two Austrian pilot areas in Vienna and Hainburg – Kittsee.

The majority of the interviewed stakeholders have a good knowledge on shallow geothermal energy use and are frequently dealing with this topic in their professional life.

The survey did not involve stakeholders dealing with licensing and managing shallow geothermal energy use as the survey was focused on energy supply. Unfortunately, no local community could be involved into the stakeholder survey in the Austrian part of the pilot area Bratislava – Hainburg due to lacking interest.

9.2. Estimated present and future role of shallow geothermal energy use

The interviews performed revealed the following key messages for the present and future role of shallow geothermal methods for heating and cooling supply:

- In general, the interviewed stakeholders **estimate a significantly increasing role of shallow geothermal energy (SGE) in the future heating and cooling market**.
- All interviewed stakeholders believe that **cooling will have a more important role in the future**. However, some interviewees limit the importance of SGE for cooling to urban areas in Austria.
- In the **present**, small-scale applications of SGE (e.g. **single-family homes**) received the highest number of ratings of relevance. Furthermore, the number of ratings given by the interview partners decrease with increasing size of application (large volume buildings). For the **future** situation, the role of given ratings of relevance significantly **increase for large-scale applications** (e.g. business parks or multi-family homes) while the ratings for single family homes even slightly decrease.
- **Local heating- and cooling grids** as well as **district heating systems** supplied by SGE applications (especially open loop systems) may play an important role in the future market in Austria.
- For the present market in Austria, public administration bodies and near governmental institutions showed the highest confidence in the importance of SGE applications while interviewed **investors still have a rather low confidence**. For the future role of SGE, the confidence of the interviewed stakeholders from NGOs and the research sector significantly increases. Investors see an increasing relevance in heating and cooling grids in the future.

9.3. Strengths and opportunities for the future inclusion of shallow geothermal energy

The SWOT analyses revealed the following main arguments for the Austrian pilot areas concerning the strengths and opportunities of SGE applications:

- Shallow geothermal represents a **stable and non-volatile energy source** leading to increased heat-pump efficiencies.

- Shallow geothermal allows **heating and cooling as well as seasonal storage**.
- It is widely available and **does not consume much surface space** which supports the chance of public acceptance (technology suitable for urban areas).
- Shallow geothermal applications rely on simple- and well approved technical concepts at a **low level of waste emissions including noise and heat** (geothermal cooling).
- Combination of shallow geothermal with volatile renewables to either provide base loads and/or provide a seasonal storage.
- The need for substituting fossil fuels and biomass as well as limitations on air based heat pump systems (noise level and waste heat in case of cooling).
- **Higher efficiency demands on cooling** (reduction of waste heat and electricity consumption) and consumption of surface space (shift of energy systems to the underground) in urban areas.
- A **supporting legal framework** (e.g. Directive 2009/28/EC) and efficient incentive measures, which support the decarbonisation and regionalization of the heating and cooling market as well as appropriate business models (e.g. long term investment in local heating and cooling grids and all in one services).

9.4. Weaknesses and threats for future inclusion of shallow geothermal energy

The main weaknesses and threats are represented by the following arguments:

- **High specific investment costs** compared to competing systems. In addition, the demand for low temperature heating systems leads to additional investment costs in older buildings.
- **Complex licensing and planning procedures**, which require the **involvement of several professionals**.
- **Low awareness of stakeholders** and lack of access to information and trainings of relevant actors (energy consultants, planners and installers). Still, the technology is affected by a general low visibility at decision makers.
- Ongoing **negative economical boundary conditions** (price for gas and electricity), which lowers the economic competitiveness of shallow geothermal use.
- The **uncertainty and risk level at installations is higher than for other renewables**. In addition, negative ecological rebound effects due to covering the increased electricity demand by heat pumps with non-green energy may occur.

9.5. Proposed future strategies for the inclusion of shallow geothermal energy

The stakeholder interviews revealed the following strategies and future measures:

Strengths vs. opportunities

- Promotion of **best practice examples** (heating and cooling, large scale units and business models) inside and outside of Austria.
- Integration of shallow geothermal in **urban heat island strategies** (cooling and utilization of excess heat in groundwater bodies).
- **Involving relevant actors in strategic cooperation** for the implementation of demonstration sites and information campaigns (**convince decision makers**).

> Support the implementation of demos in regions with low activity and awareness on the technology.

Weaknesses vs. opportunities

> Training of actors and establishing of competence and educational centres in Austria.

> **Implement easy accessible information systems**.

> Increase the efficiency of the legal framework (simplification procedures, integrative management and adaption of building regulations to support SGE use).

Strengths vs. threats

> Promote the advantages of SGE towards other energy sources and perform **full life-cycle cost analyses**.

> Develop **funding scheme which support system efficiencies**.

> Development of **contracting and business models for large scale SGE applications** (local heating and cooling grids)

Weaknesses vs. threats

> Establish an **interest group / lobby for SGE use in Austria**.

> Define **quality standards for an efficient and sustainable SGE use** and link them to incentives.

> Information campaigns on possible risks and hazards (bad practice examples).

9.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

To include SWOT analyses into the performed interviews was valuable to receive a deeper insight into views, also partly affected by prejudgement. We wanted to include environmental NGOs to see if objections towards SGE use is existing. To our surprise, it turned out that nobody of the 9 interviewees had a negative opinion on shallow geothermal. In contrast, we rather had to deal with a surprising low level of awareness on the role of shallow geothermal in strategic energy supply concepts. **Some interviewees just considered SGE for filling up balance gaps in energy strategies without deeper analyses of resources and limitations of this technology**. To our surprise, some interviewees saw an important role of SGE to substitute biomass in urban areas. In addition, the interviewees also see a big benefit of SGE use in the stability and durability of the technology as well as in the possibility to combine SGE with volatile heat sources.

We believe that the SWOT analyses helped to raise awareness on the technology at interviewees and was a good starting point for future cooperation, although **most of the mentioned strategies and measures are clearly beyond the scope of GeoPLASMA-CE** (e.g. foundation of a geothermal interest group). One outcome of the survey towards future cooperation with stakeholders inside GeoPLASMA-CE covers the execution of a regional feasibility study on the inclusion of open loop systems in the district heating system in Vienna. However, most interviewees expressed their interest in staying in touch with GeoPLASMA-CE without a clear plan for cooperation inside the project, as there is currently no window of opportunity for a direct feed into local strategies or action plans. The strategies, which were already chosen to be developed in advance of the stakeholder survey (e.g. integrative management strategy, feed into the Renewable Action Plan for Vienna), were confirmed during the interviews.

10. Pilot area Ljubljana (Slovenia)

10.1. Introduction

The stakeholder survey in Slovenia was executed in **January 2018** involving **4 stakeholders** from different target groups. Interviews were carried out with the representatives of:

- Department for Environmental Protection, City of Ljubljana;
- Department of Urban Planning, City of Ljubljana;
- Public company Energetika Ljubljana;
- Greenpeace Slovenia.

All interviews were performed personally. The SWOT analysis was not delivered to the interview partners in advance to avoid biased answers. The majority of the interviewed stakeholders have already been informed about shallow geothermal energy potential and technology in general, but have no professional experiences.

All interviewed stakeholders agreed that geothermal heat pump systems represent technologies that may significantly help to achieve environmental goals of the City of Ljubljana.

10.2. Estimated present and future role of shallow geothermal energy use

The performed interviews revealed the key messages listed below for the present and future role of the shallow geothermal potential use for heating and cooling. Factors that are hindering a more intensive use of SGE systems are:

> Competing heating/cooling systems and defined priority use of energy sources (abundant availability of waste/residual heat); The use of shallow geothermal potential for heating/cooling **is feasible in areas where no district heating or natural gas network is planned to be constructed** within the five-year period. The order of energy source for heating priority use in City of Ljubljana is defined in Decree on priority use of energy source for heating;

> **Low awareness** on SGE potential;

> Lack of comparative economic analysis with competing heating and cooling systems (**lack of quantification of SGE potential**);

> **Restrictions due to the presence of groundwater** (used as drinking water) protection zones. The aquifers of Ljubljana Polje and Ljubljana Barje are the source of drinking water for the city. Due to the early implementation of the water protection areas in Ljubljana, the high quality of the groundwater and consequently drinking water is preserved.

> **High investment costs** of the heat pump prospection and implementation as well as **complicated and time-consuming licensing procedure**;

Inputs from the established capacities and natural potential values will be included within the SEAP (part of the Local Energy Concept of the City of Ljubljana).

10.3. Strengths and opportunities for future inclusion of shallow geothermal energy

The SWOT analyses revealed the following main arguments for the Ljubljana pilot areas concerning the strengths and opportunities of SGE application:

- Heat pumps can **reduce emissions that are hazardous to climate and air quality**. Due to the realisation of SEAP the air pollution is significantly decreased, but still we have to prepare Climate adaptation strategy with more restricted GHG emission targets;
- In general, the interviewed stakeholders estimate a **significantly increasing role of shallow geothermal energy (SGE) in cooling market**;
- In future SGE will be especially **relevant for private houses and multi-family buildings**;
- **Availability of EU funds and national funding schemes** supporting programmes of sustainable energy production/use;
- Increase of RES share in all sectors. **Implementation of Compact and Covenant of Mayors commitments**;
- The guidelines for SGE implementation have already been prepared and will be used as the bases for the further work;

Better recognition of SGE. Knowledge dissemination will contribute as well.

10.4. Weaknesses and threats for future inclusion of shallow geothermal energy

The SWOT analysis revealed the following main facts for the Ljubljana pilot areas concerning the weaknesses and threats of SGE application:

- **High investment costs** of the heat pumps and complex licensing procedure;
- Timing (5 year period) of gas and/or district heating network expansion (priority use of energy sources);
- **Time-consuming and complex licencing procedure** for the **increase of the connection power for electricity**;
- **Low public awareness** about SGE. There is not enough emphasis on shallow geothermal energy in communication with general public;
- Threat of **contamination of aquifer** that is the only and high quality source of drinking water for the city;

Economic problems with the implementation of larger open/close loop systems connected with the economic viability of performance.

10.5. Proposed future strategies for the inclusion of shallow geothermal energy

The stakeholder interviews resulted in the proposals of the following steps and strategies to be prepared and implemented:

Strengths vs. opportunities

- **Promotion** of implementation/development of new technologies of heat pumps that include **possibility of cooling** (also applicable for large-scale units);
- **Realisation of SEAP** (increase of RES share) for the Ljubljana pilot area;
- Use of **EU funding** as well as national programs financially supporting sustainable energy projects – Eco found financing;
- Better recognition of SGE. Knowledge dissemination will contribute as well;

- Promote good geological conditions for a geothermal heat pump implementation for the open loop system in the Ljubljana pilot area;
- Larger open/close loop systems are suitable for smaller/local district heating systems and multi-family buildings.

Weaknesses vs. opportunities

- **Promotion of good practice examples** to increase awareness of the general public about SGE,
- Time schedules of gas/district heating network expansion should be yearly upgraded;
- Preparation of **comparative economic analysis with other competing heating/cooling sources**;
- Quantification of SGE potential.

Strengths vs. threats

- Increase of CO2 emissions, due to the increasing population in the City of Ljubljana and traffic, as Ljubljana lies at the intersection of all domestic and international road corridors;
- Larger open/close loop systems that are not yet economically feasible for central district heating system. Efforts to increase the share of RES in all areas/sectors.

Weaknesses vs. threats

- **Promotion of funding schemes and supporting programmes for SGE investments**;
- Elaboration of **guidelines on licencing procedure for implementation of SGE systems**;
- Clear **definition of restriction arising from groundwater/drinking water protection areas**;
- **Training of stakeholders** to understand technical mechanism of geothermal heat pumps operation;
- **Shorter licensing procedure** (e.g. establishment of one stop shop procedure).

10.6. Conclusions and possible impact on the strategies performed within GeoPLASMA-CE

Inclusion of the SWOT analyses into the interviews was of a great value because we have obtained a deeper insight into the facts that most of the people are not acquainted with the most recent technologies and their possible use within the wider Ljubljana area. The results of the interviews showed **low level of awareness about technology of shallow geothermal use and low level of awareness on the role of shallow geothermal energy in energy supply concepts**, but on the other side interviewees had **positive attitude to the possibilities of the implementation of SGE**.

All interviewed stakeholders agreed that geothermal heat pump system represent technologies that can significantly help to achieve environmental goals in the Ljubljana pilot area. Opportunities are related with the **areas not reached by district heating system** and **implementation of SGE systems for cooling purposes** that are expected to be more often implemented in the future.

We believe that the SWOT analysis helped us to raise awareness on the SGE technologies among the interviewees and that it represents a good starting point for the future cooperation. Most interviewees expressed their interest in staying in touch with GeoPLASMA-CE. Two of the interviewees are also stakeholders of GeoPLASMA-CE project.

Energy concept (and SEAP) will be upgraded in 2019 due to the new target values of RES to be reached. **With GeoPLASMA-CE project results (map of geothermal potential), we will increase the share of SGE in SEAP that will consequently help us to reach our RES goals**.

11. Joint conclusion on user demands, expectations and barriers for the implementation of shallow geothermal energy

11.1. Summarized stakeholder expectations on the role of shallow geothermal energy use

This chapter describes the summarized rating of the present and future role of SGE in the different sectors of target groups involved as well as for the different geographically regions. The rating was assessed during the interviews and aimed at assessing the different views on the present situation and possible future assets.

For estimating the **present role of SGE**, we defined the following sectors for heating and cooling application:

- Single family homes
- Commercial buildings and business parks
- Multifamily buildings and combined buildings for housing and commercial use (large volume buildings)
- Public buildings and public infrastructure (e.g. train stations, tunnels etc.)
- Local heating and / or cooling grids (at a low temperature level).

For estimating the **future role** of SGE, we added the following category:

- Public (conventional) district heating systems (at a higher temperature level)

The overall feedback received on the expected present and future role of SGE for heating and cooling revealed the following picture:

- The single-family home sector (small scale units) is seen as the most important field of application for SGE use by the interviewed stakeholders.
- The interviewees have a generally optimistic view on the future role of SGE: The total number of rated relevance increases from 101 (present) to 167 (future) and the interviewed stakeholders estimate a greater diversification of use with regard to the different heating and cooling sectors.
- There is a certain confidence of stakeholders in future use of SGE in public- or communal heating and cooling supply. In that context, 18% of the received relevance ratings addressed a future role of SGE in supplying both, low temperature heating and cooling grids (11%) as well as conventional district heating networks (7%). The same relevance rating was given for public buildings and public infrastructure supplied by SGE.

In a next step, we analysed the given **ratings of relevance with regard to the regions involved in GeoPLASMA-CE**:

The feedback received for the present role of SGE is summarized in Figure 5. The feedback on the future role is shown in Figure 6.

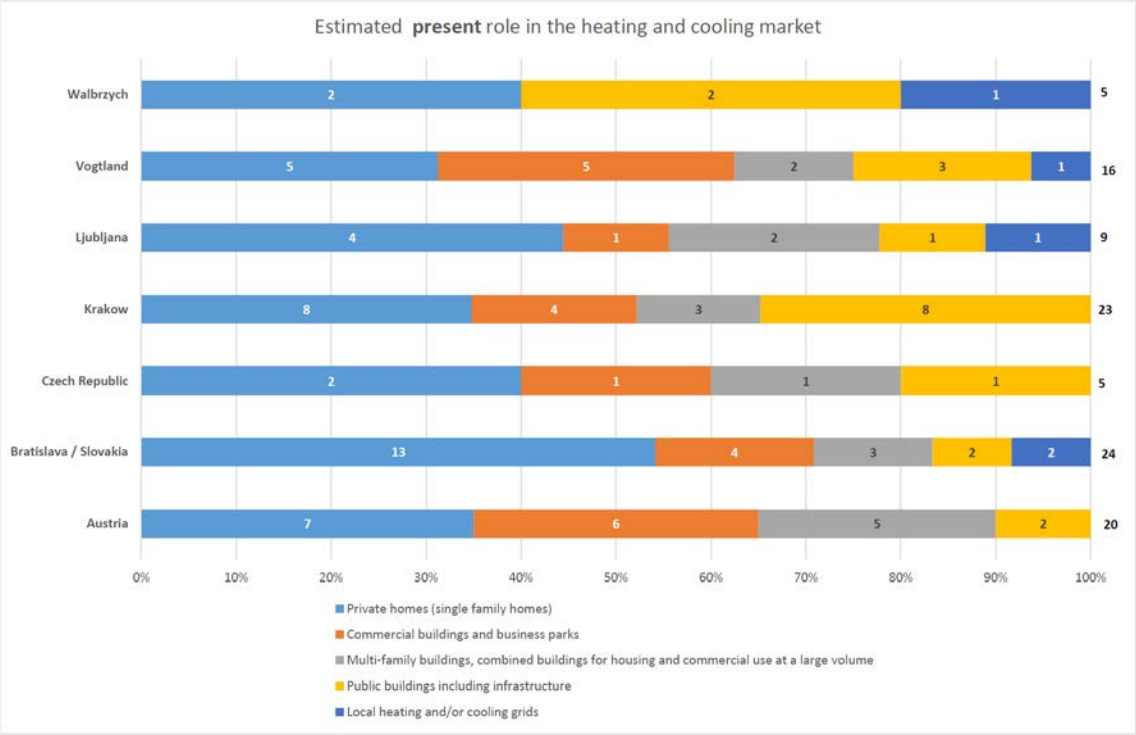

Figure 5: Estimated role of SGE in the present heating and cooling market with regard to the regions involved.

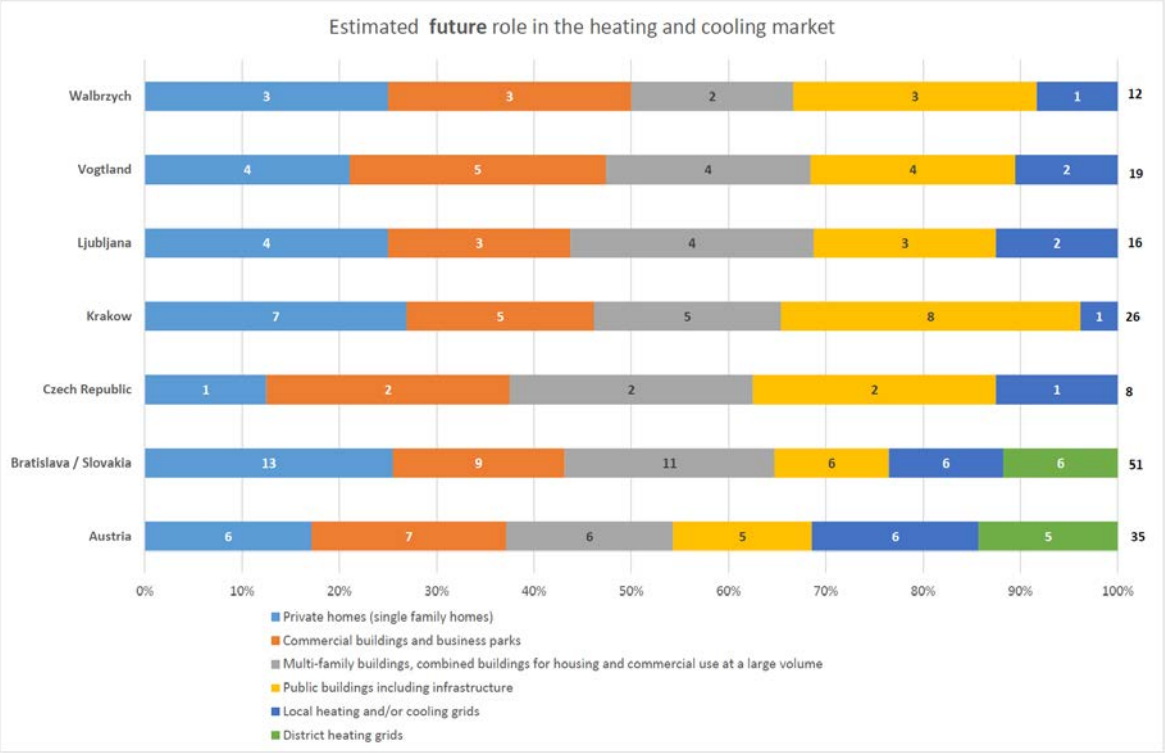

Figure 6: Estimated role of SGE in the future heating and cooling market with regard to the regions involved.

Looking at the estimated role of SGE in the present heating and cooling market, we see a quite homogeneous distribution of relevance ratings, which is still dominated by the application of small scale heat pump units for the use in single family homes (share of given ratings exceeds 30% in all investigated regions). However, there are some regional differences worth mentioning:

- The application of SGE in supplying public buildings or public infrastructure has a higher share in the investigated Polish regions irrespective if they represent urban or non-urban regions.
- The application of SGE in commercial buildings and business parks is estimated as relevant by a higher share of stakeholders in the Vogtland region and in Austria. In Germany and Austria, the use of SGE for commercial buildings is already well established.
- In four of the 7 pilot areas, stakeholders rated the use of SGE for local heating and cooling grids as relevant in the present situation although this technical concept is currently still in the demonstration phase in some countries like Switzerland, Germany or Sweden. This underlines a clear optimistic, almost enthusiastic, view of stakeholders on the application of SGE in communal heating / cooling supply.

Comparing the feedback given on the future role of SGE to the present market situation we see that the dominance of small-scale units in single-family homes is decreasing (share of given relevance ratings below 30% in all investigated regions). The estimated fields of SGE use is more diversified and in some regions, like Austria, almost split up in even shares for all sectors. The estimated future role includes large-scale ground source heat pump units in commercial buildings, multifamily homes and local heating and cooling grids in all regions. Concerning communal heating and cooling supply supported by SGE, only stakeholders from the pilot area Krakow have a rather pessimistic view of relevance. Stakeholders from Austria and the Bratislava pilot area even see a significant role of SGE in (conventional) district heating grids. In the Krakow pilot area, stakeholders gave most relevance ratings to the supply of public buildings and pubic infrastructure by shallow geothermal methods.

Finally, we analysed the change of ratings by stakeholders for the present and future market situation:

The highest increase of given ratings per individual stakeholder can be observed for the pilot areas Walbrzych (+140%), Bratislava (+112%) and Ljubljana (+78%). In all mentioned regions, SGE use is still at the beginning and does not yet play a significant role in the heating market. Nevertheless, the stakeholders involved in the survey have a positive view of the future role.

In contrast, a lower increase of relevance ratings per individual stakeholder is observed in the pilot areas Krakow (+13%), Vogtland (+19%) and the Czech Republic (+60%). It has to be mentioned in this context that the average rating of relevance is already rather high in the pilot areas Krakow and Vogtland. This may be explained by the fact that stakeholders already have a clear, maybe a little bit narrowed picture of the field of applications related to SGE use. In contrast, the received average rating of relevance per individual stakeholder in the Czech Republic is the lowest within all investigated regions. We conclude that SGE faces a generally low level of awareness and confidence in this country.

In a final step, we analysed the feedbacks received **with regard to the different target groups addressed** in the survey, irrespective of the involved regions. The feedback received from stakeholders on the current role of SGE in the heating and cooling market is shown in Figure 7 while Figure 8 summarizes the estimated future role. The involved target groups are listed in Table 1. It has to be pointed out in advance that the interviewed stakeholder groups are dominated by public and near governmental organizations, especially by local public authorities, and that only 1 representative each of SME and R&D was involved in the survey. For that reason, the analysis of answers given by different target groups is limited.

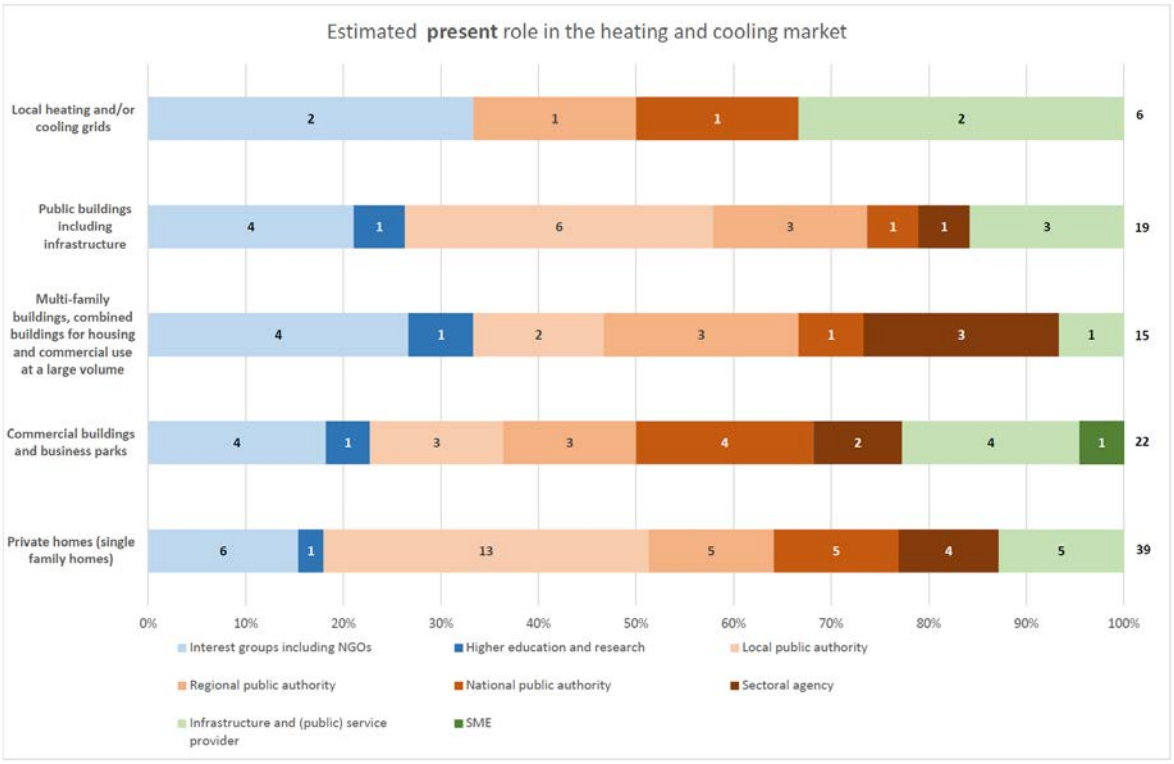

Figure 7: Estimated role of SGE in the present heating and cooling market with regard to the stakeholder target groups involved.

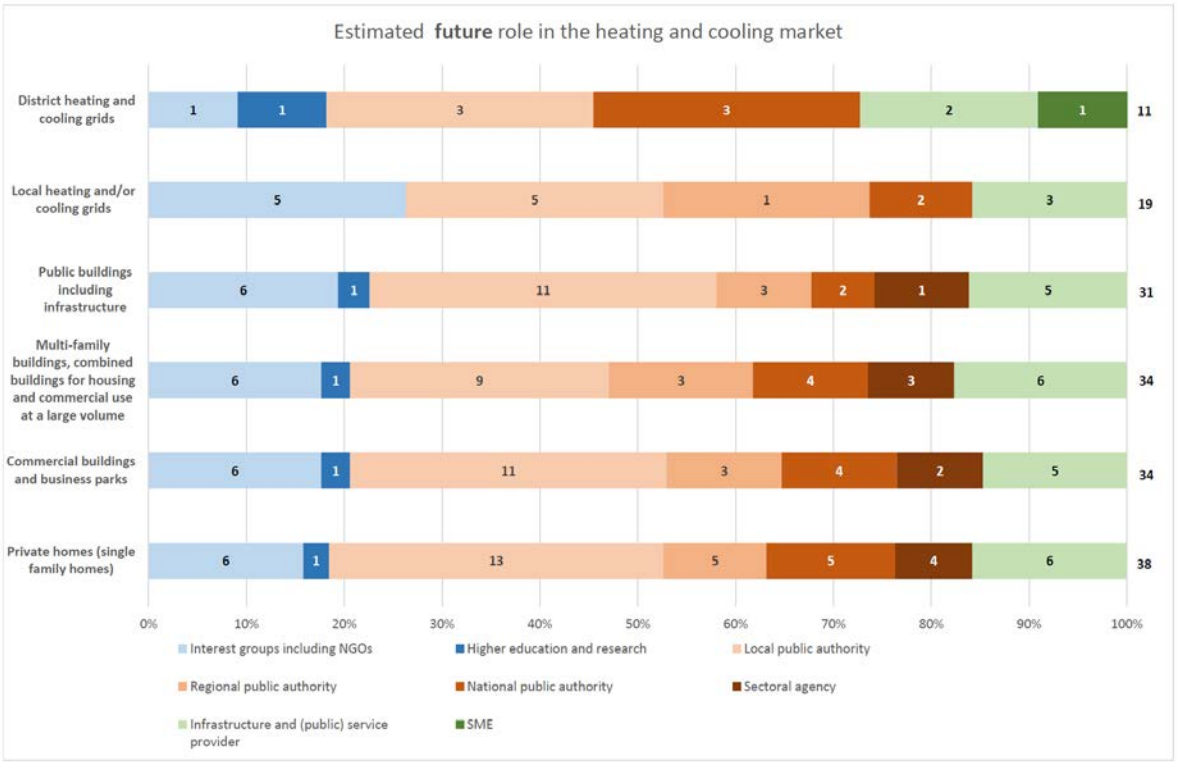

Figure 8: Estimated role of SGE in the present heating and cooling market with regard to the stakeholder target groups involved.

With regard to the present role of SGE in the heating and cooling market, public bodies gave a higher absolute number of relevance ratings for single-family homes and public buildings. The share of public bodies decreases with the size of the SGE use, while the lowest confidence in relevance was estimated for local heating and cooling grids. The other two main target groups, consisting of NGOs & research and investors revealed a higher share of relevance ratings in large-scale applications.

Taking a detailed look at the average rating of relevance per individual stakeholder, we see that local public authorities estimated the lowest relevance of SGE in the present market (average: 1.71 ratings per participant from this target group), while NGOs, sectoral agencies and regional pubic authorities are significantly more confident (average: 2.50).

Regarding the future role of SGE, the feedback of all target groups shows an increase of confidence of SGE in all heating and cooling sectors. The survey did not reveal major differences in the rating according to the different sectors of applications, which means that public authorities also see a relevant role of SGE in large scale use including communal heating and cooling supply. It is worth mentioning that local public authorities, which have a rather sceptical view on the role of SGE in the present situation, revealed the highest increase in confidence (+117%) in the future role of SGE. A significant increase of confidence was also observed at the interviewed public authorities and energy suppliers. Both are relevant drivers for a future market diffusion of SGE in central Europe.

11.2. Identified commonalities and possible impacts on a joint strategy for fostering the use of shallow geothermal energy in central Euorpe

As shown in the previous chapter 10.1, the interviewed stakeholders at the 7 different regions have a quite optimistic view of the future role of SGE in various fields of applications. The also performed SWOT analyses now allow us to look at opportunities and barriers towards a future market diffusion of SGE technologies. Moreover, the interviewees were also asked to propose future strategies and measures for the inclusion of SGE in the heating and cooling market. We will refer to the proposed measures in the context of GeoPLASMA-CE since we also asked the stakeholders on their demands and expectations on us and possible synergies to the activity planned in our project.

In this chapter, we want to exhibit communalities of the investigated regions, which feed into an aimed strategy for fostering the share of SGE for heating and cooling in central Europe. The subsequent chapter will give insight into regional differences, which might be needed to be considered at the regional strategies in the pilot areas.

The stakeholders in most of the regions involved see SGE as stable, non-volatile renewable energy source for heating and cooling, affected by a very low level of emission, which also includes waste heat (for cooling) and noise (compared to air based heat pump systems). The **main opportunities** for a future market diffusion are seen in substituting fossil fuels and other energy sources affected by emissions or reduced efficiency (e.g. air based heat pumps and chillers and biomass based heaters). Heating and cooling provided by the same system is also seen as an asset for future investments as well as a supporting European and national legal framework in line with climate change mitigation and environmental protection policies.

In contrast, stakeholders of all involved regions see **predominate barriers** in high investment costs, a general low awareness of decision makers at all levels and unfavourable energy-economical boundary conditions in the moment (ration of energy prices for electricity and fossil fuels). As SGE is seen as a “luxury” energy source, there are barriers to reaching low cost energy consumers, which very often rely on fossil based, emissive energy sources, especially in the Eastern European countries. Low level of awareness in turn leads to lack of political will to support SGE and leads to prejudged opinions on the efficiency and environmental impact or risks associated with the use of this technology. Missing access to knowledge and complex legal procedures also represent significant barriers towards further market diffusion of SGE. Another surprising barrier observed in all regions addresses a general low level of awareness of policy and decision makers, which seems to be independent of the level of market diffusion of SGE. Although SGE is

well established on the Austrian heating market, the involved stakeholders show or complain about a rather low level of awareness. This can be explained by the market being dominated by private investments at a rather low level of political intervention on the one hand. On the other hand, the absence of interest groups in all involved regions may also explain the general low level of awareness.

Some of the measures proposed by stakeholders in all or most pilot areas to overcome the before mentioned barriers fit well with the objectives of GeoPLASMA-CE:

- **Promote best practice examples**: In GeoPLASMA-CE, we will collect best practice examples with regard to technical solutions and management concepts and distribute it to external users via our web portal.
- **Implement easily accessible web information systems**: The GeoPLASMA-CE web portal will offer state of the art web based information services, which might act as a role model for other regions in central Europe.
- **Promote the advantages of SGE over other energy sources**: We will certainly include this as a basic level in our project outputs. However, quite a lot of stakeholders proposed to perform economic life cycle cost analyses, which are beyond the scope of GeoPLASMA-CE.
- **Provide education and training for managing and using SGE in an efficient way**: As GeoPLASMA-CE is focusing on a sustainable and efficient use of SGE we will provide training to local users as part of our strategies in the pilot areas. At an international level, we aim at **knowledge transfer** and **awareness raising** via the knowledge platform of our web portal. For that purpose, we are planning to interlink the GeoPLASMA-CE web portal with other international web portals relevant for SGE use.
- **Seek strategic cooperation with relevant actors:** At our local to regional scale pilot areas, we already started to cooperate with relevant actors. At an international level, we are aiming for a European stakeholder event on the use of SGE in Europe in late spring 2019 in cooperation with other organizations and groups (interest groups and project teams) dealing with SGE use.

For other strategies and measures, proposed by stakeholders in most or all of the regions in central Europe, **GeoPLASMA-CE just can offer starting points for follow-up initiatives without realization in full**:

- Implement interest- and lobbying platforms for the use of SGE: The interviewed stakeholders from many pilot areas proposed the implementation of lobbies as an important measure on both national as well as international level. Although international organizations and interest groups for the use of geothermal energy (dominated by deep geothermal energy use) and heat pump systems already exist, a clear focus on SGE is still missing. The implementation of such an interest group is clearly outside the scope of GeoPLASMA-CE, but we aim at setting important starting points for international cooperation and interlinking by means of the GeoPLASMA-CE web portal.
- Develop initiatives to foster and promote the installation of demonstration sites (across central Europe)
- Introduction of quality certificates for installing and managing shallow geothermal use: GeoPLASMA-CE will collect and evaluate existing quality standards in the involved regions. Based on this evaluation, we will give general recommendations on joint minimum standard on the whole management cycle of SGE use, which will be one of the major outputs of the project. However, the project team does not have the competence to introduce certificates at a European level.
- Simplification and efficiency increase in licensing procedures: In GeoPLASMA-CE we have to limit our activities to a comparison and evaluation of the current legal framework and management procedures in the regions involved. We will include some general considerations on follow-up measures in our joint strategies.

- Information campaigns on possible risks and hazards associated to the installation and use of SGE represent an important measure to face prejudged opinions on this technology. Most cases of hazards during the installation process or inefficient or unsustainable use of SGE is related to technical or operational errors due to lack of expertise. Regions, which are not suited at all for geoscientific reasons, are exhibited at the conflict maps of our regional web services for the pilot areas. Unfortunately, issuing a general guideline to avoid technical risks or operational failures is outside the scope of GeoPLASMA-CE, but is planned to be addressed in one of the local strategies in the pilot area Vienna.
- Training of relevant actors for providing all-in-one services on installing and managing SGE: As the market on SGE use was dominated in the past by small-scale private investments, service providers for installing and managing SGE use at larger scale are not developed yet at a critical mass. Involving several different companies (planners, installers and service providers) for implementing SGE at a larger scale (e.g. large-scale buildings or local heating and cooling grids) leads to several interfaces, which can be affected by various errors in communication and logistic planning. All-in-one services, also covering the servicing of large-scale uses, are currently developing in Switzerland with regard to local heating and cooling grids. All-in-one services may represent promising future business models, which also mitigate restraints of investors. Such services do not just address private entities. They might also complement the expertise of pubic energy suppliers. GeoPLASMA-CE may include this topic in the joint strategies without having the competence of offering such trainings.
- Funding schemes focusing on system efficiency: Although monetary incentives are outside the scope of GeoPLASMA-CE, we will communicate the proposed strategy in our joint strategies. Together with recommendations on simplifying the legal framework, incentives will be part of the policy part of our joint strategies.

In addition to the proposals made by interviewed stakeholders, the given answers at the SWOT analyses reveal the need for an additional policy for supporting the use of SGE in central Europe:

As indicated by several stakeholders, high investment costs are a significant barrier towards investment decisions. The current energy costs do not allow the lower operational costs to compensate investment costs (unless cooling is seen as a monetary good). As SGE appears to represent a “luxury” energy source, as mentioned before, the willingness for investment or political support significantly decreases with decreasing level of income / budget or GDP. In turn, the level of emission (use cheap, dirty energy sources) increases with a decreasing level of income / budget or GDP. This is especially valid for eastern European regions, still dominated by fossil fuels, which in turn face the highest level of air pollution. A shift of paradigm towards clean and non pollutive heating sources may only be realized by **de-coupling the selection of energy sources from the GDP**.

At the end of this chapter, we briefly want to delineate **which strategies and measures will be applied in all or at least most pilot areas of GeoPLASMA-CE**:

- GeoPLASMA-CE will feed into existing and currently developing policies and strategies and action plans in the pilot areas Ljubljana, Vienna and Krakow: As revealed during the stakeholder interviews, there have been no windows of opportunities in the other pilot areas as strategies have recently been developed or updated (e.g. Vogtland) or are not planned at all. The strongest cooperation between GeoPLASMA-CE and local strategies will be realized in the pilot area Ljubljana, where a direct support of the updated Sustainable Energy Action Plan (SEAP) is planned.
- Active Knowledge transfer will take place in the framework of the planned stakeholder trainings, which will focus on the GeoPLASMA-CE web portal and on the developed management concepts. This will also represent the most rudimentary measure to include SGE use in local energy planning concepts in the involved regions by raising awareness. In some regions, like the Austrian part of the

Bratislava – Hainburg pilot area (Slovakia – Austria) there are no further measures planned in the moment due to lack of interest of local stakeholders. Furthermore, in Austria and the Czech Republic, joint information and promotion campaigns with national actors are planned as well.

11.3. Identified distinctions between the investigated pilot areas

After presenting the communalities of identified opportunities, barriers and measures for including in SGE in future heating and cooling supply, we will now focus on regional and infrastructural distinctions observed.

- **Urban areas**: Urban heat island strategies have been identified as a future opportunity for prevention of waste heat by geothermal cooling and seasonal heat storage. In general, SGE use is seen as more relevant in new buildings and peripheral districts, which are not supplied by conventional district heating.
- **Cooling**: Surprisingly, cooling is not seen as an opportunity in all pilot areas. No relevance was reported in the pilot area Vogtland as well as from stakeholders in the Czech Republic. Lower relevance was also reported from the urban pilot area Krakow. We also observed that cooling based on SGE is, in general, not so relevant in non-urban areas, where conflicts due to noise and waste heat emissions caused by air-based chillers are not as obvious as in cities. In addition, local climatic conditions in these regions may not put so much pressure on seeking solutions for environmentally friendly cooling.
- **Predominating negative opinion on impacts on groundwater by SGE use**: Objections against SGE use for groundwater protection reasons have been assessed in all countries, in which groundwater is owned by the state and the legal framework does not imply a reinjection of groundwater used for energetic purposes. We assume a direct link between the legal framework and a negative view about possible impacts on the groundwater. Of course, drinking water supply should always be higher prioritized than SGE use. Open loop systems based on the reinjection of used water do not have a significant negative impact on the quality of groundwater as long as groundwater bodies are not excessively heated up by cooling applications. Joint quality standards on the operation of SGE use, like for instance hydraulically separated circuits between heat carriers and the groundwater, can minimize the risk of hazards.

12. Contact details

Pilot area Vogtland	Martina Heiermann, Peter Riedel (both LfULG) Martina.heiermann@smul.sachsen.de, peter.riedel@smul.sachsen.de
Czech pilot areas	Jan Holecek (CGS) jan.holecek@geology.cz
Pilot area Walbrzych	Wieslaw Kozdroj (PGI NRI) wkoz@pgi.gov.pl
Pilot area Krakow	Marek Hajto (AGH-UST) mhajto@agh.edu.pl
Pilot area Bratislava	Radovan Černák, (both SGIDS) radovan.cernak@geology.sk
Austrian pilot areas	Gregor Goetzl (LP-GBA) gregor.goetzl@geologie.ac.at
Pilot area Ljubljana	Mitja Janza (GeoZS) Mitja.Janza@GEO-ZS.SI