Documentation of the Knowledge Exchange Workshop at the German Geothermal Congress on September 12, 2017 in Munich

D.T4.1.5: Knowledge exchange workshop on integration of shallow geothermal energy use in local energy planning

09 2017

G. GOETZL[1], & THE GEOPLASMA-CE TEAM.

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The involved GeoPLASMA-CE team

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GeoENERGIE Konzept GmbH (PP03)	R. Grimm
Geological Survey of Slovenia (PP07)	M. Janza
Polish Geological Institute (PP08)	M. Klonowski
City of Ljubljana (P11)	A. Loose

Content

Interreg CENTRAL EUROPE GeoPLASMA-CE

1. Introduction

1.1. Scope and aim of the deliverable

Activity A.T4.1 deals with the assessment of user needs in the six pilot areas and the screening for existing energy planning and implementation strategies in the regions involved in GeoPLASMA-CE as well as on an international, especially EU level.

Concerning the assessment of existing strategies and relevant aspects of integrating shallow geothermal methods into them, knowledge exchange workshops provide a powerful instrument to get connected to experts and capitalize from existing knowledge gained at other studies and initiatives. The Knowledge Exchange Workshop on integration geothermal energy use in local energy planning represents an importing starting point of Work Package WPT4.

This report summarizes the outcomes of this workshop and lists the following documents as annexes:

- Minutes of the workshop
- Participant list
- Presentations given at the workshop.

1.2. Organization and concept of the workshop

The workshop was organized by LP-GBA and co-hosted by the Interreg Alpine Space projects GRETA (http://www.alpine-space.eu/projects/greta) and PEACE_Alps (http://www.alpine-space.eu/projects/peace_alps). It was scheduled at the German Geothermal Congress (DGK) 2017 in Munich, which took place between September 12 and 13 2017. To attract a high number of participants, the visit of the workshop was free of costs.

The workshop was split into two parts:

After a short introduction to the scope of the project and the hosting EU projects, 6 short presentations (each 10 min) were given to the following topics:

- The existing and possible future role of shallow geothermal use in urban energy concepts.
- The existing and possible future role of shallow geothermal use in non-urban regions.
- International initiatives on the inclusion of shallow geothermal methods in energy supply

For the second part, a panel discussion was planned focusing on the contents of the presentation given and the following questions:

- Can shallow geothermal energy play a future role for heating and cooling supply in Europe and to what extent?
- Which barriers have to be overcome for enhancing geothermal use in energy planning strategies?
- Which concepts and strategies seem to be the most suitable and prospective for urban / non-urban / Alpine regions?

1.3. Date and location of the workshop

The workshop took place on September 12th, 10:20 – 12:00 at BMW Welt, Room 2b, Am Olympiapark 1, 80809 Munich.

2. Outcomes of the workshop

The workshop was attended by 25 participants from 17 different institutions. Thirteen of the 25 participants were not members of the hosting Interreg projects. Apart of the GeoPLASMA-CE project team, sectoral agencies (Austria, France, Honduras and Costa Rica), research institutes (Germany, Italy), non-profit organizations (Germany), infrastructure providers (Slovenia) and international organizations (Belgium) represented the involved target groups.

In the first part of the workshop, the following talks focused on concepts and roles of shallow geothermal energy in urban and non-urban areas, as well as on international strategies and initiatives. Speakers have scientific background as well as extensive experience in urban planning.

Table 1: Speakers list

SPEAKER	TITLE OF PRESENTATION
A. KINSPERGER	The possible role of shallow geothermal energy use in the NREAP of the city of Vienna
A. LOOSE	The role of shallow geothermal energy use in the NREAP of the city of Ljubljana
A. KRESS	PEACE_Alps – Supporting local energy action with an intermunicipal approach
R. VACCARO	GRETA: Promoting the integration of NSGE into Energy plans
K. ZOSSEDER	GRETA: Near-surface Geothermal Resources in the Territory of the Alpine Space. The case example Munich.
B. SANNER	What role can transnational cooperation and international organisations play to promote inclusion of shallow geothermal in energy planning?

Concerning the role of shallow geothermal energy use at urban regions, the following key messages were delivered by the presenters:

- Major cities like Vienna, Munich and Ljubljana are currently reviewing environmental protection plans, sustainable energy action plans (SEAPs) or elaborating general framework strategies. The role of heat pump energy supply concepts, which also include shallow geothermal energy use, have been identified as crucial elements of these strategies and plans.

The general goals are similar and consist of (1) a reduction of energy consumption, (2) a reduction of greenhouse gas emissions and (3) a raise of the share of renewables.

However, the role of shallow geothermal use slightly varies in the above-mentioned cities due to the legal framework and the special infrastructural needs. In Ljubljana, for example, there exists a groundwater body, which has the potential to both, provide geothermal energy and drinking water. For that reason, energy implementation plans also have to consider interests of drinking water supply to avoid conflicts of interests.

Munich faces the problem of lacking communication between the different decision makers at the city administration. The Technical University of Vienna has already collected general information on the groundwater conditions in Munich for shallow geothermal use. Now, the next step is to translate the geoscientific knowledge into strategies and maps for energy planners. In contrast to other renewables, like solar energy or wind power, the thermal potential of shallow groundwater bodies cannot be described by simple key values describing "static" resources in terms of capacities or energy in place. In addition, dynamic sum-up affect by interfering single uses have also be taken into account.

Individual, not harmonized use of groundwater bodies in cities for heating or cooling supply has been identified as a significant barrier towards an efficient and sustainable implementation of shallow geothermal energy in urban energy supply concepts.

- Considering smaller cities or rural regions, barriers for implementation shallow geothermal in local energy supply concepts are given by the lack of knowledge and awareness of the available technologies. As pointed out in several presentations, pooling of competences and consultation as well as training of stakeholders seem to be inevitable measures for the inclusion of shallow geothermal energy. In that context, the Covenant of Mayors and energy consultants seem to be most important stakeholders. In addition, SEAPs represent the most suitable instrument for implementing shallow geothermal use into local energy planning. By now, even in countries with a well-developed market (e.g. Germany), the share of SEAPs mentioning shallow geothermal energy is very low.
- International cooperation for the inclusion of shallow geothermal energy is still very important. International activities already started in the late 1980s and were focusing on R&D issues. At this time, the International Energy Agency (IEA) and research institutes form the so-called D-A-CH (Germany, Austria and Switzerlan) region represented the driving forces for international cooperation. Since the 2000s, the focus of cooperation shifted to planning and implementation and capacity building. Recently, successful cooperation projects like Regeocities or LEGEND (Adriatic region) showed the importance of pan-European action.

The subsequent discussion was focusing on existing barriers and actions needed to be taken to overcome them. Some of the current hurdles for a further inclusion of shallow geothermal energy, like the current energy costs (cheap fossil fuels and high costs for electric energy) are currently outside the scope of joint research, promotion or consultation activities. Other barriers, like lacking awareness decision makers or lacking competences of planning bodies can be reduced by consequent communication and capacity building initiatives.

During the discussion, the importance of addressing the right stakeholders and the right instruments for planning was also pointed out. As already mentioned, the Covenant of Mayors and Sustainable Energy Action Plans for municipalities play the key role for a successful implementation of shallow geothermal use in energy planning strategies.

The next crucial step is given by a successful communication with stakeholders: Land-use and energy planners as well as technicians have a different understanding of energy potentials than geoscientific experts. Basic maps, created by geoscientists need to be interpreted for planners and technicians. Furthermore, the available resources for a technical use of shallow geothermal energy represent the product of the (a) pure geoscientific potential (heat in place or heat storage capacity), (b) the energy demand or the load profiles and (c) sum-up effects of interferences by other existing uses. Factor (b) requires flexible, interactive planning tools (user input). For thermal use of shallow groundwater bodies, parameter (c) in turn demands for dynamic potential maps based on the calculation of sum-up effects. Until now, no standardized workflows exist for accounting the above-mentioned factors of influence in detailed planning maps. International activities, such like GRETA and GeoPLASMA-CE aim creating workflows for all main steps of the energy planning process. In addition, PEACE_Alps is aiming at instruments to capitalize and pool knowledge at the Covenant of Mayors to integrate new technologies in the preparation of SEAPs.

Finally, the implementation of demonstration projects was also identified as an important step to establish the use of shallow geothermal methods on a municipality level. This measure may support a shift of paradigm from a predominant individual use of shallow geothermal energy to a joint use based on low temperature heating and cooling grids. As shown in the presentation of Mr. Vaccaro, starting at a threshold heat demand of 150 MWh/ha/year, a municipality heating and cooling grid operated by a heat supplier is more efficient from a technical and economical point of view than individual use.

3. Outlook

The outcomes of this workshop will be used for planning the assessment of the user demand and the screening of existing implementation strategies (A.T4.1). We will put emphasize on integrating the CoM in the user demand survey and decided to implement existing SEAPs in the involved countries in the assessment of existing energy planning strategies.

The next and last knowledge exchange workshop will take place in Salzburg on November 8th 2017 and will focus on legal requirements, procedures and policies related to shallow geothermal use.

4. Annexes

- Minutes of the workshop
- Participant list
- Presentations given

GeoPLASMA-CE
Minutes

Compiled by G. Goetzl, D. Rupprecht & C. Steiner on 18.09.2017

Date, Time 12.09.2017, 10:20 – 12:00

Location BMW Welt, Room 2b, Am Olympiapark 1, 80809 Munich

Concern

D.T4.1.5: Knowledge exchange workshop on the integration of shallow geothermal energy in local energy planning

Participants (Project team)

PP-Acronym	Name		*PP-Acronym*	Name
LP-GBA	G. Goetzl, D. Rupprecht, C. Steiner			
PP03 – geoENERGIE	R. Grimm			
PP07-GeoZS	M. Janza			
PP08 PGI NRI	M. Klonowski,			
PP11-COL	A. Loose			

Stakeholder Meetings/Events (if applicable)

Please, identify the target groups involved (*from participant list*) and fill out the information below:

X	*Types of participants/target groups*	*Number of participants*
	Local public authority	
	Regional public authority	
X	*Infrastructure and (public) service provider*	*1*
X	*Interest groups including NGOs*	*2*
	SME	
X	*International organisation, EEIG under national law*	*1*
X	*General public*	*3*
	National public authority	
X	*Sectoral agency*	*4*
X	*Higher education and research*	*4*
Topics tackled and links to deliverables and outputs		*Integration of geothermal potential maps in local energy planning strategies; Renewable Energy Action Plans (REAP); international cooperation for integrating shallow geothermal energy;*

Geologische Bundesanstalt · Landesamt für Umwelt, Landwirtschaft und Geologie – Freistaat Sachsen · Czech Geological Survey · GeoZS Geološki zavod Slovenije · Interreg CENTRAL EUROPE – European Union European Regional Development Fund · AGH · geoENERGIE Konzept · GiGa infosystems · Bundesverband Geothermie · City of Ljubljana · GeoPLASMA-CE

Expected effects and follow up	The workshop intended to raise awareness on the possibility to integrate shallow geothermal utilizations in local energy planning strategies in both urban as well as non-urban areas. In the second part of the workshop a discussion took place on possibilities and challenges on to consider shallow geothermal use in REAPs or other energy planning strategies; The workshop was co-hosted by the Interreg projects GRETA and PEACE_Alps (both Interreg Alpine Space). The next Knowledge Exchange workshop will take place in Salzburg on November 8th. It will address the current policies and legal framework to use shallow geothermal energy in different European countries.

Annexes (If relevant): E.g. pictures, media coverage web-links, etc.

- Photo documentation
- Presentations given

Agenda

1. Short presentations by invited experts and members of the projects GeoPLASMA-CE, GRETA and PEACE_Alps on different aspects of implementation of shallow geothermal energy in energy supply strategies.

2. Panel discussion on the topics of the workshop

Outcomes

1. Short presentations

Short presentations by experts

Summary

The following talks focused on concepts and roles of shallow geothermal energy in urban and non-urban areas, as well as on international strategies and initiatives. Speakers have scientific background as well as extensive experience in urban planning.

SPEAKER	Title of presentation
A. KINSPERGER	The possible role of shallow geothermal energy use in the NREAP of the city of Vienna
A. LOOSE	The role of shallow geothermal energy use in the NREAP of the city of Ljubljana
A. KRESS	PEACE_Alps – Supporting local energy action with an intermunicipal approach
R. VACCARO	GRETA: Promoting the integration of NSGE into Energy plans

K. ZOSSEDER	GRETA: Near-surface Geothermal Resources in the Territory of the Alpine Space
B. SANNER	What role can transnational cooperation and international organisations play to promote inclusion of shallow geothermal in energy planning?

The given presentations are listed in the annex of this minutes. In the following, the key messages of each presentations are listed:

The first three presentations were focusing on aspects of energy planning in urban conglomerates based on the cities of Vienna, Ljubljana and Munich.

A. Kinsperger: The city of Vienna is rated as one of the most liveable cities in the world. It is also rapidly growing at an average expansion rate of +9,4% during the past 10 years. By 2030 Vienna will reach the mark of 2 Million inhabitants. The goals of the Smart City Vienna Framework Strategy for 2050 are represented by (1) the preservation of resources and (2) an optimum quality of life. Amongst others, the following objectives have been set:

- Reduce 80% of GHG and 1 to CO_2 per capita
- Reduce 40% of energy consumption (reach 2000 W) per capita
- Enhance the share of Renewable Energy Sources to 50%

To reach these objectives, an Energy Framework Strategy and some sectoral plans are prepared. One of them is a renewable Energy Action Plan. Another one is the Energy Efficency Program, which exists since 2006. Therefore, the total annual energy consumption is still more or less on the level of 1995 although the city was distinctively growing.

In 2017, the city of Vienna was awarded as "Heat pump city of the year", as the following actions were achieved:

- Implementation of an online GIS based map for shallow geothermal potential https://www.wien.gv.at/stadtentwicklung/energie/themenstadtplan/erdwaerme/index.html
- Implementation of heat pump guidelines https://www.wien.gv.at/stadtentwicklung/energie/pdf/waermepumpenleitfaden.pdf
- Incentives for renewable heat and seasonal storage in terms of investment support
- Demonstration projects: new business centres (e.g. Aspern IQ), refurbished buildings (TU Vienna, Eberlgasse), low temperature local grids (Kallco – Q11). Currently 3 school campi are planned to be supplied by shallow geothermal energy.

A. Loose: In Ljubljana, shallow geothermal energy plays a role in (1) the Environmental Protection Programme (EPP, 2014, 2020), (2) Sustainable Energy Action Plan (SEAP, 2020) and (3) the Spatial Plan (2030).

The strategic goals of the EPP, affected by shallow geothermal energy, consists of (a) improved energy efficiency and increased use of renewable energy sources and (b) the long term supply with natural drinking water.

The goals of the SEAP of the city of Ljubljana, , decided in November 2011, consists in:

- Plus 20% in energy efficiency
- Plus 25% share of RES
- Minus 30% of greenhouse gas emissions.

To reach these goals a total investment of around 1,7 billion EUR is needed. Based on PPP solutions, the city of Ljubljana planned to make investments in the order of 0,5 billion EUR. By the end of 2015 61% of the targets in energy efficiency, 48% of RES and 42% of GHG reduction have been achieved. The cooperation in international projects like GeoPLASMA-CE, ELENA EOL, INCOME and CC Waters provide an important measure to capitalize existing knowledge and make investment decisions. Due to fast developments in in sustainable developments, the city of Ljubljana was awarded as the Green Capital City of Europe in 2016.

Concerning the use of shallow geothermal energy, Ljubljana provides excellent conditions for groundwater based heat pump systems (open loop systems). In contrast, parts of the same groundwater body are used for drinking water supply. Therefore, GeoPLASMA-CE intends to perform a spatial potential and conflict of use study by combining potential maps for pen loop systems with water protection zones, the existing infrastructure and other aspects like natural heritages. The outcome will be provided by zoning maps of suitable types of heat pump based heating supply. Based on those zoning maps, the city will make investment decisions. Currently, the city administration is focusing on increasing the energy efficiency of public buildings, which may later be supplied by heat pump systems. Currently, 2 primary schools, 1 health centre and 1 kindergarten are refurbished and will be supplied by heat pump systems.

K. Zosseder (this presentation was planned on slot number 3, but was held later due to a conflict of time of the presenter): In 2012, the Technical University of Munich (TUM) started he scientific project GEPO ("Geothermal Potential of the Munich Gravel Plain"), which examined the potential for open loop systems in the groundwater body below Munich. Due to legal constraints, closed loop systems are limited to maximum depths of a few decades of meters in most parts of Munich. For that reason, using shallow geothermal energy is very much focused on the shallow groundwater body in quaternary gravels. In GEPO, a 3D model was set up based on 30.000 borehole data. Maps of the groundwater table and groundwater temperature were created based on 8000 measurements and archive data. Furthermore, a hydraulic conductivity map was set up based in 500 pumping tests assessed in archives and the existing use was estimated based on operational monitoring data (annual extraction reports).

During GEPO, TUM also established a working group with representatives of public authorities and planners. As 2017 the city of Munich decided to establish new energy plans, TUM promotes the implementation of shallow geothermal use. By now, an agreement was achieved, that potential maps established in GEPO will be further valorised and presented on public websites of the city of Ljubljana. In the moment, map series of suitability (closed- and open loop systems) and qualitative potential maps are planned. Those maps will address the general public. In addition, expert maps will be created and provided to city planners and public authorities. From the presenter's point of view, the full implementation of the expert knowledge in the future energy plans of Munich is not achieved yet. Barriers are given by spread competence between various, partly not communicating, institutions in the city administration and by an appropriate definition of a "technical potential". In contrast to pure static potentials like solar energy, shallow geothermal potential in shallow groundwater bodies is strongly determined by dynamic (transient) sum effects, related to the interference of different uses.

The next two presentations left the field of urban energy planning and covered aspects of energy planning in rural dominated small cities also taking account the special boundary conditions in the Alps.

A. Kress: The Interreg Alpine Space project PEACE_Alps supports local communities at creating Sustainable Energy Action Plans (SEAPs) by an inter-municipal approach. It aims at a joint development of SEAPs by pooling competences in governance, planning, information, training and incentives. The main target group of this project are local coordinators of the Covenant of Mayors.

To implement shallow geothermal energy in SEAPs it is important to understand, that those action plans represent a policy – action circle having the political commitment at both its beginning and end. In the presentation, Mr. Kress gave the good practice example of the city of Celle in Germany, which decided to apply shallow geothermal use as a focus area of the long term vision of the city's related climate plan. In that context, shallow geothermal methods may support the seasonal storage for heat gained by geocooling of for IT systems, which in turn will be used for the heating of public buildings.

R. Vaccaro: Promoting the integration of shallow geothermal energy into energy plans is a major objective of the Interreg Alpine Space project GRETA. EURAC, which is in charge of this task, developed a general concept how to approach this integration. This concepts consists of 3 major phases:

- Preliminary analysis and assessment of the existing energy supply situation and the conditions of shallow geothermal energy use:
  This comprises the evaluation of the current social-economic, legal, environmental and technical – economical boundary conditions. Based on this data- and knowledge gaps (content and spatial distribution) have to be identified as well as the relevant stakeholders for integrating shallow geothermal methods in energy plans. It is also important to identify trends and driving forces of energy supply (heating and cooling) and the current situation and expertise available on applying RES technologies in the investigated community. The before mentioned aspects will finally considered in a SWOT analysis.

- Spatial evaluation of the potential and demand.
  Based on spatial analyses using GRASS open GIS and Python software packages, the matching of potential and demand will be performed on a building sharp resolution for selected pilot areas in GRETA. Further constraints will be set by economic analyses based on a generalized cost models and the NPV method. In the analyses load curves (6 hour, monthly and annual base) as well as investment-, maintenance- and operational costs will be considered. The calculated The outcomes will then be compared to reference heat supply systems.

- Support the planning of decision makers
  The consultation of decision makers completes the integration activities. In a first step the scope of integration (objectives alternative scenarios and specific targets) have to be fixed. Based on the outcomes of the spatial evaluation, detailed recommendations will be gicen to stakeholders covering aspects of (a) governance (modification of procedures and the legal framework, incentives and subsidies as well as raising awareness), (b) competence building measures (guidelines and trainings) and (c) managing implementation aspects (identification and monitoring of energy indicators).

In the presentation, Mr. Vaccaro also mentioned the Bavarian guideline on energy planning ("Leitfaden Energienutzungsplan") as an already existing good practice example. It represents a comprehensive guideline on technical, legal and economic aspects also including zoning of suitable RES technologies on a regional level. It has to be mentioned, that this guideline also provides a threshold value for applying municipal heat supply concepts. This threshold is set to 150 MWh/ha/year. Below this, individual heat and cooling solutions are more effective.

In the last presentation given, the topic switched from local to regional aspects of energy planning to international cooperation for integrating the use of shallow geothermal energy.

B. Sanner: In the first part of the presentation, the current market situation concerning shallow geothermal use was presented based on the EGEC market report 2016 (including the reported market numbers for 2015). By the end of 2015, 23 GW were installed in more than 1,7 million uses across Europe. Taking a look at the installed capacities per capita, the highest ground source based heat pump systems (GSHP) densities can be observed in the Scandinavian countries as well as in Switzerland and Austria. In contrast to the absolute numbers, the relative density of installed capacities is rather low in Germany and France (both countries are topped by Slovenia for example).

Considering the National Renewable Energy Action Plans (NREAP) of the EU countries to achieve the 2020 goals, GSHPs were only mentioned in 7 countries. Based on the market numbers reported for 2015, the roadmap for reaching the NREAP goals in those countries is quite diverse:

- Only Sweden already exceeded the goals (147%)
- Germany (86%), France (62%) and the Netherlands (54%) are on a good way or at least on track.
- Denmark (47%), Italy (30%) and the UK (23%) are lacking behind the action plan.

The EGEC market report also mentions the following crucial activities to “continue the success story of shallow geothermal energy in Europe”:

- Opening the market for applying shallow geothermal in existing buildings (refitting)
- Promoting small scale thermal grids for heating and cooling
- A further reduction of installation costs for GSHP and capacity building measures for stakeholders
- Raising awareness in small (developing) markets

In the second part of the presentation, the role of international cooperation was examined. In the field of shallow geothermal use, international activities can be traced back to the 1980s. At this time, cooperation was focusing on R&D and was dominated by the International Energy Agency (IEA) as well as by institutions from the so called D-A-CH region (Germany, Austria and Switzerland).

In the beginning harmonization activities were focusing on joint quality standards for heat pumps. Certificates established in the D-A-CH region were later also established in the European Heat Pump Association (EHPA). Later on, quality standards for borehole heat exchangers have been set up in Switzerland. Nowadays, also France established such quality certificates.

Since the year 2000, international cooperation shifted the focus on planning and implementation. The main aspects were covered by 1) removing barriers and 2) transfer of knowledge. In that context, amongst others the projects K4RES-H, GROUNDREACH, GTR-H, Regeocities and LEGEND represent good practice examples of international cooperation.

The recently accomplished project Regeocities was focusing on the actual barriers a) economic shortcomings (fossils are too cheap, electricity is too expensive), b) insufficient awareness and c) exaggerated licensing requirements. To tackle this barriers, factsheets and capacity building workshops were organized. This finally led to the spin-off initiative “The heat under your feet”, which is till maintained by the European Geothermal Energy Council (EGEC).

Considering international cooperation to promote the inclusion of shallow geothermal in energy planning, Mr. Sanner identifies the Covenant as Mayor (CoM) as he most important stakeholder of activities. As already mentioned in the presentation of Mr. Kress, the CoM network may have a significant influence in preparing SEAPs for municipalities. Mr. Sanner also mentions the currently still low awareness in Germany for shallow geothermal in existing SEAPs. Only 4 cities mention shallow geothermal energy in SEAPs. In contrast, good practice examples how to integrate shallow geothermal energy in SEAPs are given by the cities of Stockholm and Rotterdam.

2. Panel discussion

Summary

Summary

The second workshop part hosted a panel discussion about the role of shallow geothermal energy in Europe. The following key questions were put to discussion:

- Which barriers are existing for shallow geothermal use in Europe and how can they be tackled?
- Which concepts and strategies seem to be the most suitable for urban / non-urban areas and who are the important stakeholders to be addressed?
- How can geoscientific findings can be translated to decision makers?
- Can shallow geothermal energy play a future role for heating and cooling supply in Europe and to what extent?
- Is there a need for transnational cooperation?

Based on the presentations and the discussion, the main barriers are:

- Economic shortcomings for heating mode in certain countries (cheap fossil fuels and expensive electricity)
- Insufficient awareness at relevant decision makers the public (potential consumers), the planners/installers and the regulatory administration.
- Especially in urban areas, split up competences between different departments and public entities (e.g. city administration and energy suppliers), which goes in hand with a poor internal communication.
- Exaggerated licensing requirements, and uncertainty of subsidies
- Existing high temperature district heating systems

Subsidies and grants can only partly offset the barriers, additional strategies and actvities are necessary to achieve the goal of a larger role of shallow geothermal energy in Europe.

- *Transnational cooperation (to raise awareness and build capacities)*
  Such as GeoPLASMA-CE and GRETA to promote SGE. Early transnational cooperation focused on research and development. This is still important, but activities now should shift to harmonization of quality standards, transfer of knowledge and capacity building.

Another important aspect of transnational cooperation is given by harmonization of language (understanding of resource and conflict terms) and methods to assess options for geothermal use.

- *Seek the right stakeholders*
  As indicated by the projects PEACE_Alps and Regeocities, the Covenant of Mayors is a powerful stakeholder to promote the inclusion of shallow geothermal use in energy plans. In that context Sustainable Energy Action Plans (SEAPs) are a very promising instrument for defining strategic targets.

- *Scientist and other knowledge carrier should enhance communication with decision maker and need to find the right arguments to promote shallow geothermal use.*
  The current economic boundary conditions on the energy market cannot be influenced that easily. Therefore, new arguments aside economic efficiency have to be communicated to stakeholders. SEAPs, aspects of cooling and reducing energy dependency may also change the thinking of decision makers. As shown in the examples for Munich, stakeholder communication is a long term process. Especially, when decision makers are split up at different entities. As underground based energy sources are always affected by greater uncertainties than solar- or wind energy, it is also crucial to find a common understanding between geoscientific experts and (predominately non-geoscientific) decision makers on potentials, resources and conflicts of use in order to prepare proper planning instruments.
  As indicated in the presentation of R. Vaccaro concerning the GRETA project, also shifts of paradigms concerning the way how to use shallow geothermal energy may be part of a sustainable energy supply concept. This may lead to a change of the legal framework or a prioritization of use. Considering highly dynamic effects by competitive individual uses of open loop systems, a solution could be provided to give priority to centralized groundwater uses for public heating and cooling grids.

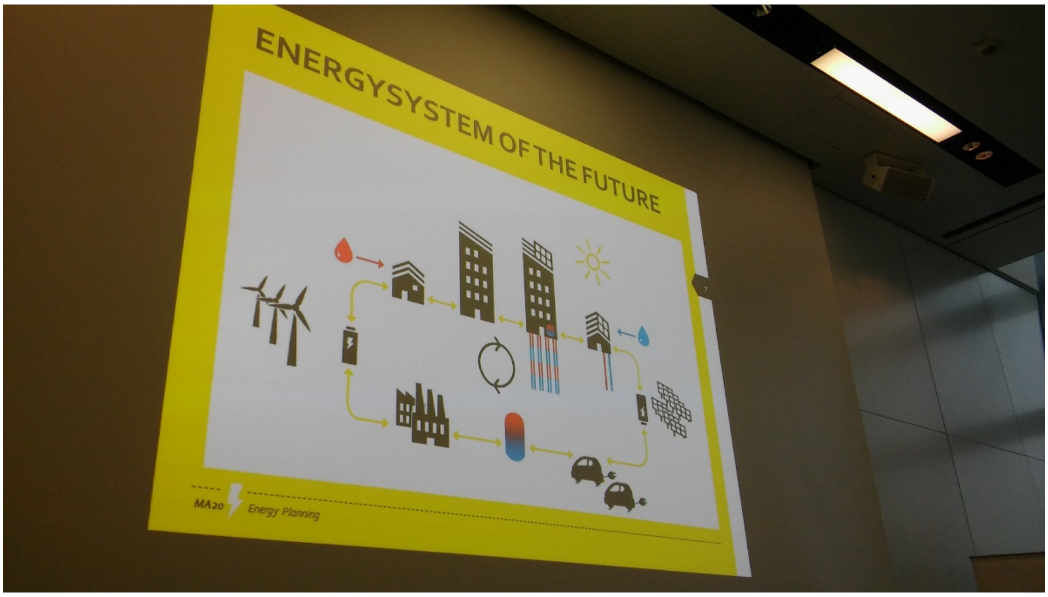
- *Promote demonstration projects to raise awareness*
  Concepts of innovative heating and cooling solutions for municipal use have already been developed and tested in some cities, especially Zürich, Vienna. Further pilots are needed to establish the proof of concept and to raise awareness. Low temperature heating and cooling grids have the big advantage towards conventional high temperature grids by providing cooling at a low- or no cost tariff. As presented, the threshold for such grids is given by a heat demand of only 150 MWh/ha/year. Based on the proof of concept, the next step could be in elaborating roadmaps to stepwise reduce the grid temperature of conventional heating grids to allow a transformation in bidirectional heating and cooling grids. This may lead to a diversification of heat sources and sinks, where shallow geothermal methods could also play an important role of providing subsurface seasonal heat storages.

3. Photo documentation and annexes

Photo documentation

Meeting room at the German Geothermal Congress (DGK) 2017, which hosted the joint GeoPLASMA-CE, GRETA and PEACE_Alps workshop (photo: G. Goetzl).

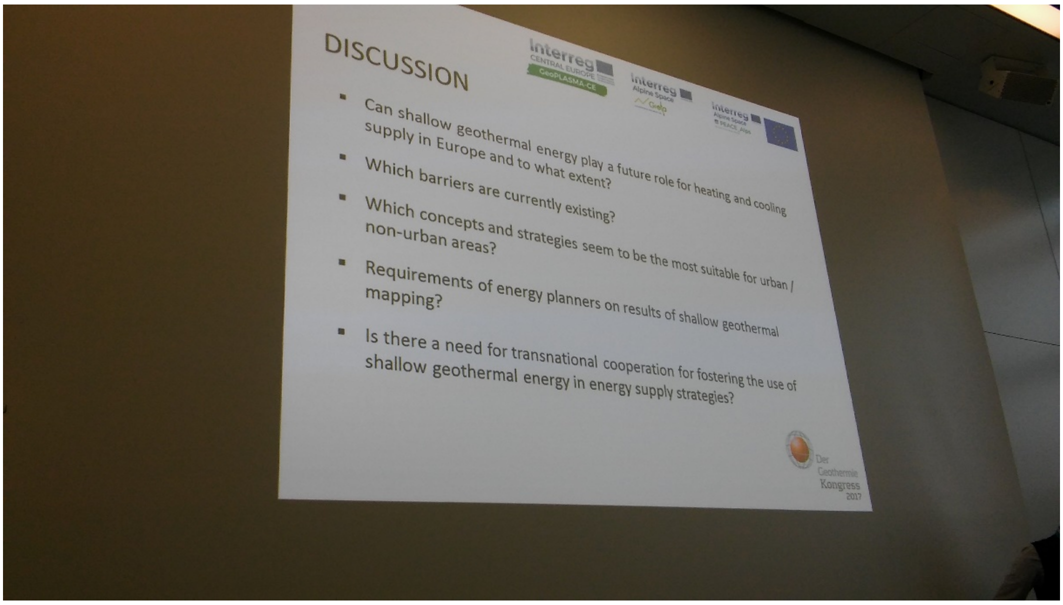
The joint Knowledge exchange workshop on the integration of shallow geothermal energy in local energy planning was hosted by the Interreg Europe project GeoPLASMA-CE and the Interreh Alpine Space projects GRETA & PEACE_Alps (photo: C. Steiner).



Future energy systems in urban areas feature smart, de-centralized energy production, consuming, distributing and storage networks. As indicated in this slide, taken from the presentation of A. Kinsperger (city of Vienna), shallow geothermal energy may play an important role in the seasonal storage of heat (photo: C. Steiner).

Presentation of A. Loose (city of Ljubljana) on the role of shallow geothermal energy use in the environmental protection plan and Sustainable Energy Action Plan for the city of Ljubljana (photo: C. Steiner).

Presentation of A. Kress about the Interreg Alpine Space project PEACE_Alps on pooling expertise for the generation of Sustainable Energy Action Plan (photo: C. Steiner)



Introduction to the panel discussion based on relevant questions raised by the projects GeoPLASMA-CE, GRETA and PEACE_Alps.

Group phot of the presenters (from left to right): A. Kress, B. Sanner, A. Loose, K. Zosseder, R. Vaccaro, A. KInsperger, G. Goetzl and F. Boettcher (photo: C. Steiner).

Annexes

- Participant list
- Presentations given

Knowledge exchange workshop on the integration of shallow geothermal energy in local energy planning

Date	**September 12th 2017, 10:20 – 12:00**
Location	**German Geothermal Congress (DGK 2017)** BMW Welt, Room 2b Am Olympiapark 1, 80809 Munich

Program of the workshop

- 10:20 – 11:20: **Block 1**: Short presentations by experts on the following topics:
  Concepts and roles of shallow geothermal energy in urban and non-urban areas: Existing strategies, challenges & solutions
  International strategies and initiatives
- 11:20 – 12:00: **Block 2**: Panel discussion focusing on the following questions:
  Can shallow geothermal energy play a future role for heating and cooling supply in Europe and to what extent?
  Which barriers are existing?
  Which concepts and strategies seem to be the most suitable?

Andrea Kinsperger	MA20, City of Vienna	*The possible role of shallow geothermal energy use in the NREAP of the city of Vienna*
Fabian Böttcher	TU-Munich	*GRETA - Thermal groundwater use in spatial energy planning*
Alenka Loose	City of Ljubljana	*The role of shallow geothermal energy use in the NREAP of the city of Ljubljana*
Andreas Kress	Climate Alliance	*Peace_alps - Supporting local energy action with an intermunicipal approach*
Roberto Vaccaro	EURAC	*Greta: Promoting the integration of NSGE into Energy Plans*
Burkhard Sanner	EGEC	*What role can transnational cooperation and international organisations play to promote inclusion of shallow geothermal in energy planning?*

Interreg CENTRAL EUROPE
European Union European Regional Development Fund
GeoPLASMA-CE

www.geoplasma-ce.eu

Interreg Alpine Space
EUROPEAN UNION
Greta
EUROPEAN REGIONAL DEVELOPMENT FUND

www.alpine-space.eu/projects/greta

Interreg Alpine Space
EUROPEAN UNION
PEACE_Alps
EUROPEAN REGIONAL DEVELOPMENT FUND

www.alpine-space.eu/projects/peace_alps

Der Geothermie Kongress 2017

DISCUSSION

- Can shallow geothermal energy play a future role for heating and cooling supply in Europe and to what extent?
- Which barriers are currently existing?
- Which concepts and strategies seem to be the most suitable for urban / non-urban areas?
- Requirements of energy planners on results of shallow geothermal mapping?
- Is there a need for transnational cooperation for fostering the use of shallow geothermal energy in energy supply strategies?

Der Geothermie Kongress 2017

MA 20 – Energy Planning *Munich, 12.09.2017*

Shallow geothermal energy use in Vienna –

a protomotion strategy

DI Andrea Kinsperger

Geothermie-Kongress 2017

SMART CITY WIEN

Vienna! ahead

Energy Planning

City of Vienna

VIENNA

- Vienna is changing & growing
- Most livable city
- Population: 1.8 million inhabitants (2014)
- Area: 415 km²; almost 50% green areas
- Growth: + 9.4% over the last 10 years

VIENNESE POPULATION DEVELOPMENT

SMART CITY WIEN

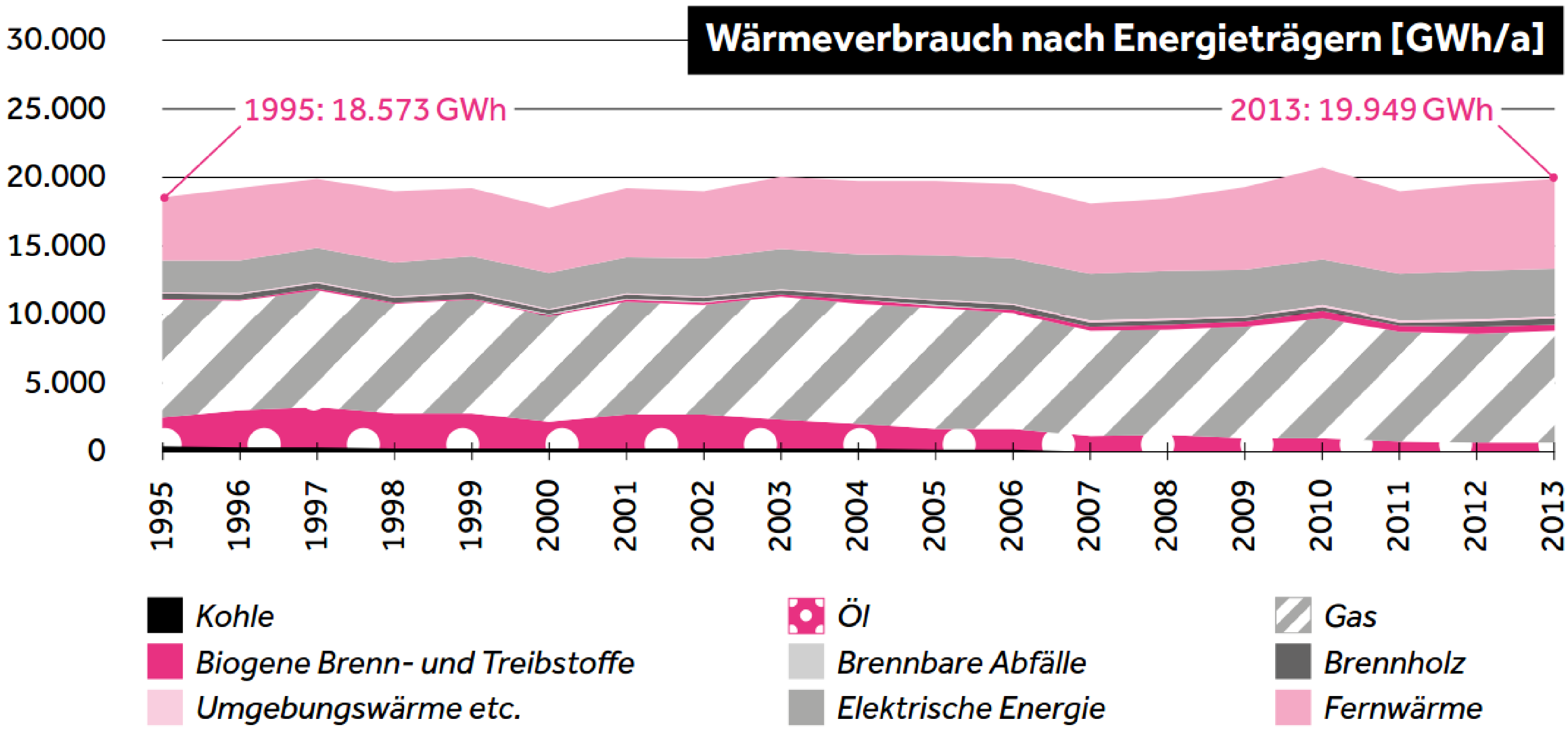
Framework Strategy

Key goal for 2050 of Smart City Wien: Highest possible resource preservation together with optimum quality of life for all citizens. This can be achieved through comprehensive innovations.

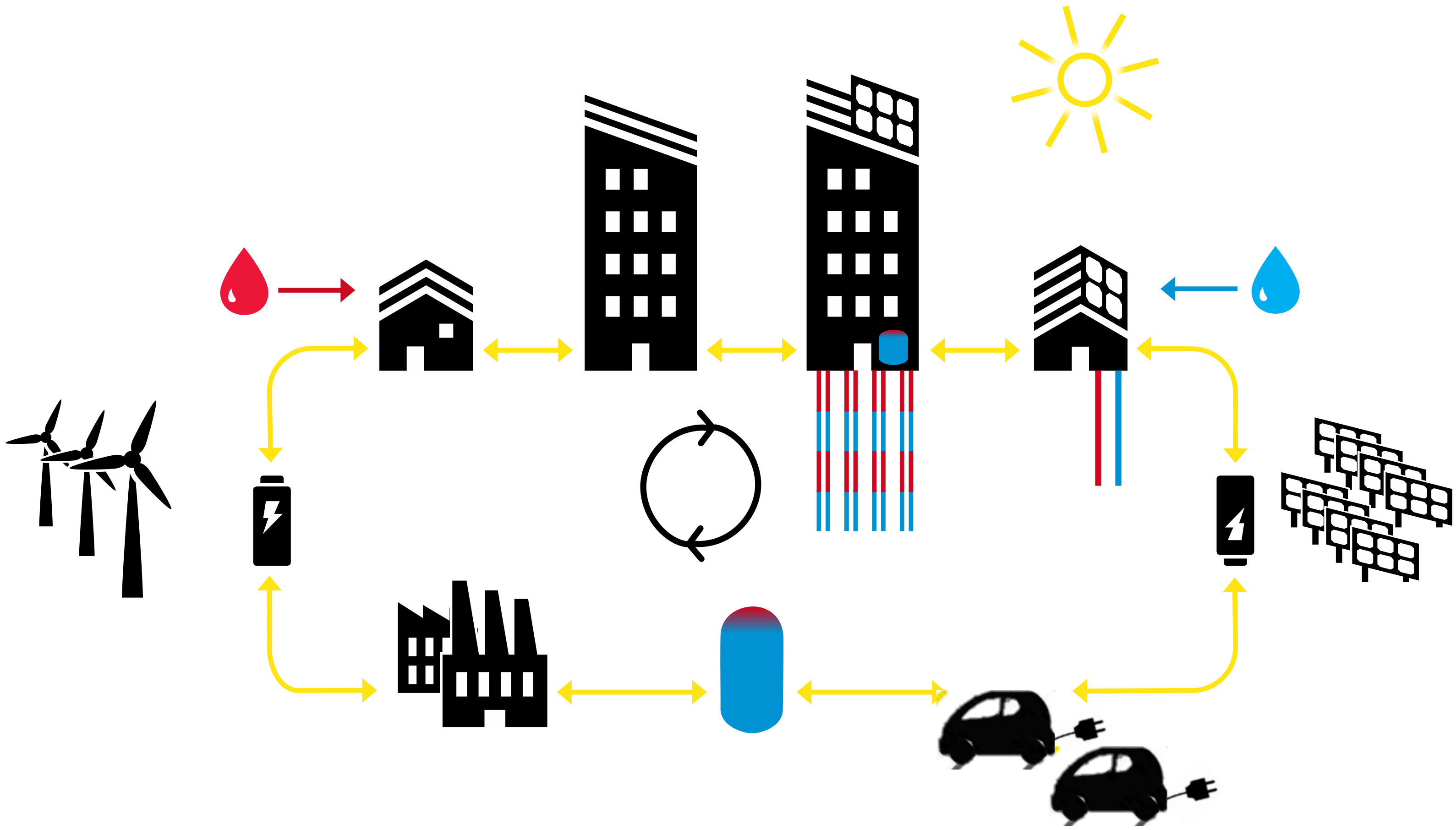
Climate- & Energy Targets 2050

- Minus 80% GHG
- Minus 40% energy consumption (p.c.)
- 50% RES
- 2000 Watt per capita (cf. 2000 Watt society)
- 1 to CO_2 per capita

HEAT CONSUMPTION



ENERGYSYSTEM OF THE FUTURE

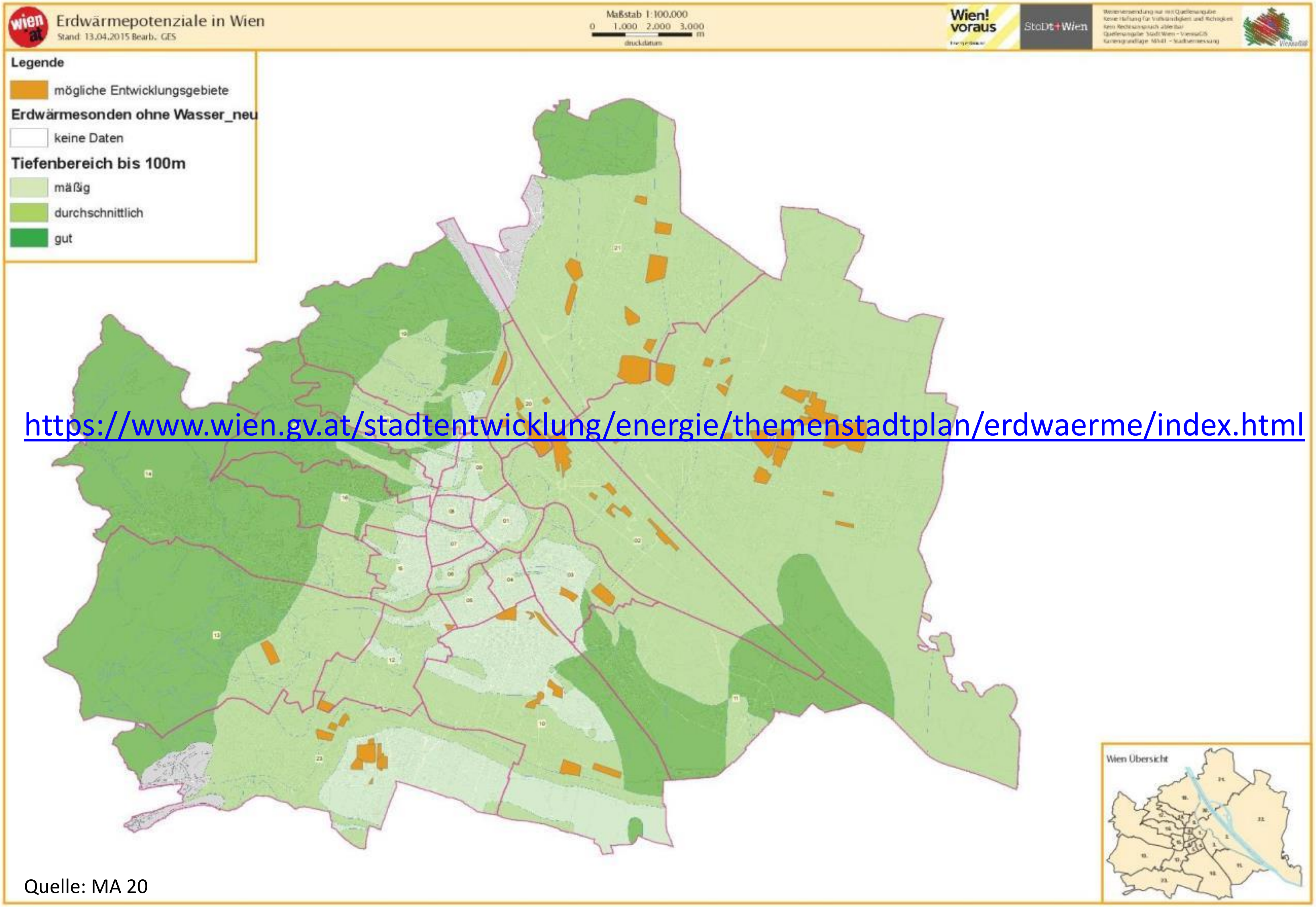


HEAT PUMP PROMOTION STRATEGY OF THE CITY OF VIENNA

- Online map of the geothermal potential
- Funding priority „Renewable heat & seasonal storage"
- Heat pump guidelines
- Demonstration projects

2017: Vienna was awarded „ Heat pump city of the year"

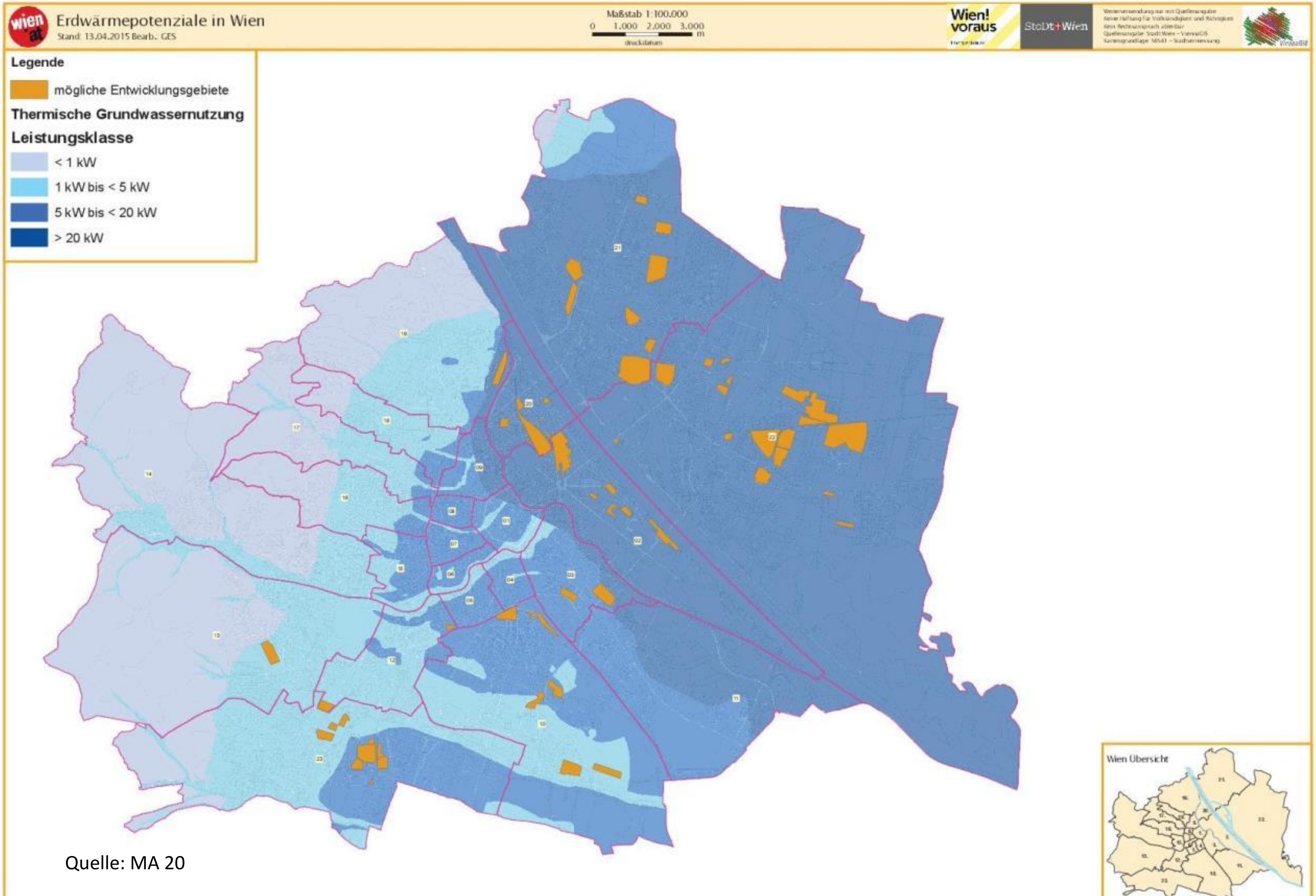
SHALLOW GEOTHERMAL POTENTIAL



https://www.wien.gv.at/stadtentwicklung/energie/themenstadtplan/erdwaerme/index.html

Quelle: MA 20

GROUNDWATER POTENTIAL



Quelle: MA 20

FUNDING SCHEME

Since March 2016:

- subsidies for heat pumps in residential buildings using
  - ambient heat,
  - systems for the thermal use of groundwater and ground heat,
  - seasonal heat storage systems (for waste heat and renewable energy) to help balance the load between the different times of production and use of heat
- financial support for investment costs for heat pumps and storage technologies

HEAT PUMP GUIDELINES

- showing the functional principles of different heat pumps and possible heat sources.
- decision support for planners and property owners

  – https://www.wien.gv.at/stadtentwicklung/energie/pdf/waermepumpenleitfaden.pdf
  – https://www.wien.gv.at/stadtentwicklung/energie/pdf/waermepumpe-kundenbroschuere-bf.pdf
  – https://www.wien.gv.at/stadtentwicklung/energie/pdf/leitfaden-erdwaerme.pdf

SHALLOW GEOTHERMAL ENERGY FOR VIENNIESE SCHOOL CAMPI

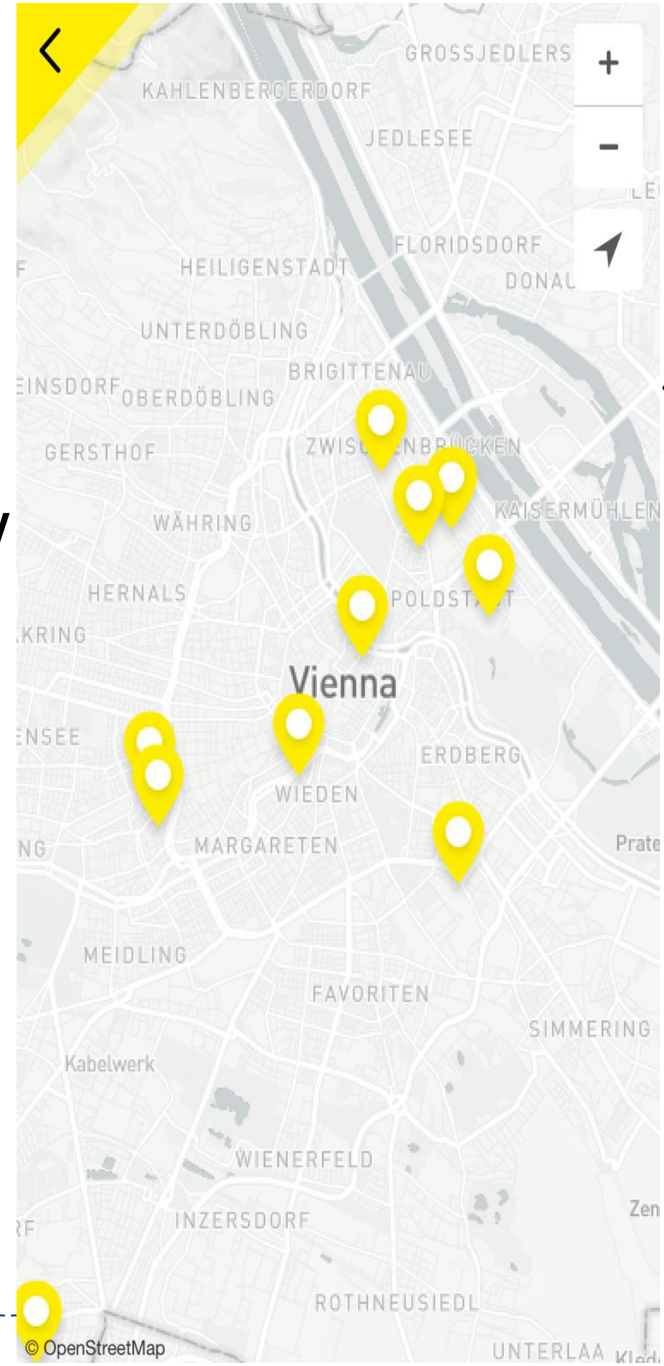
3 projects to be realised soon:

- Aspern Nord
- Wien West
- Atzgersdorf

some more to come!

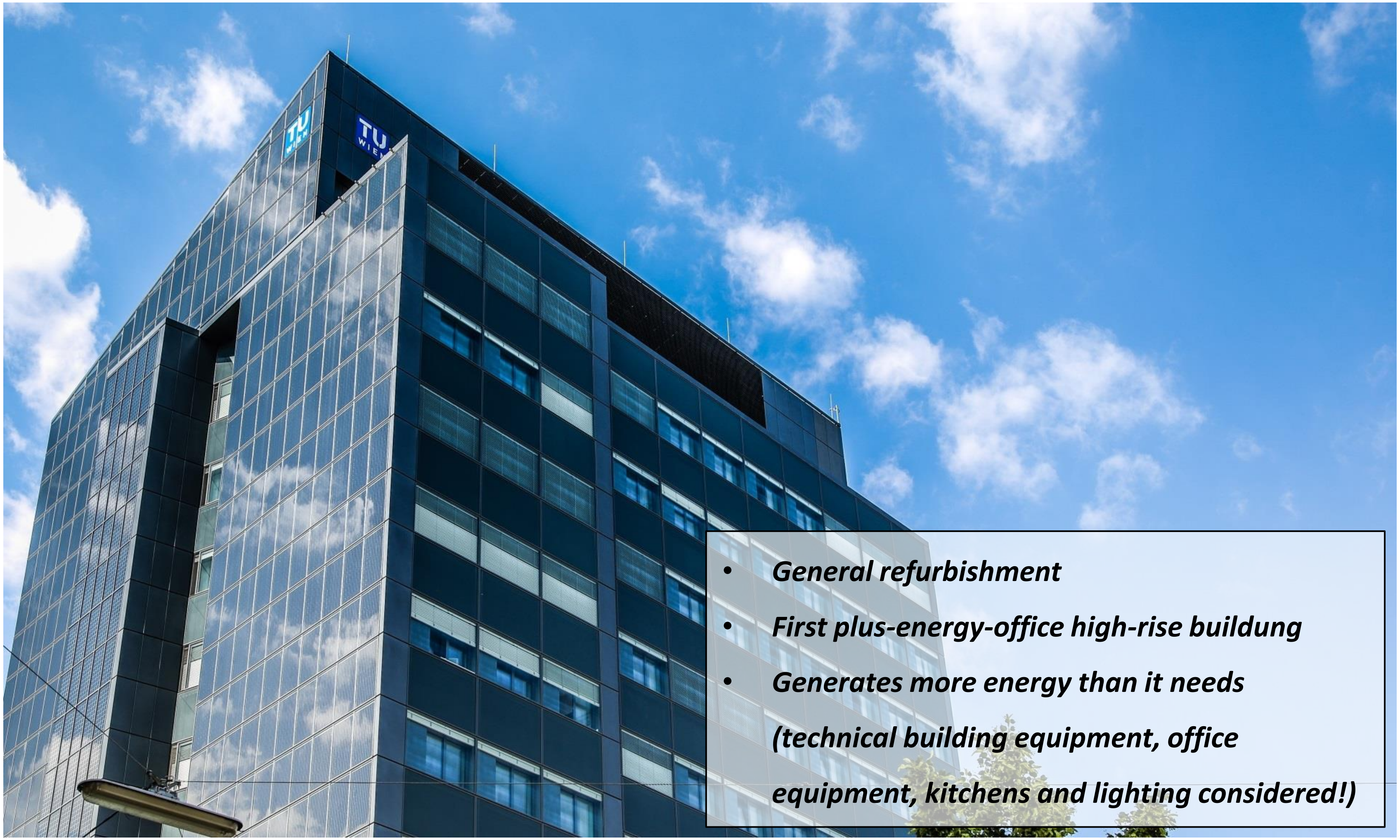
ENERGY!AHEAD VIENNA-APP

- Energy showcase projects
- First selection of projects
- Other showcases will follow



usable for iOS and android-systems

TU VIENNA
PLUS-ENERGY-OFFICE HIGH-RISE BUILDUNG



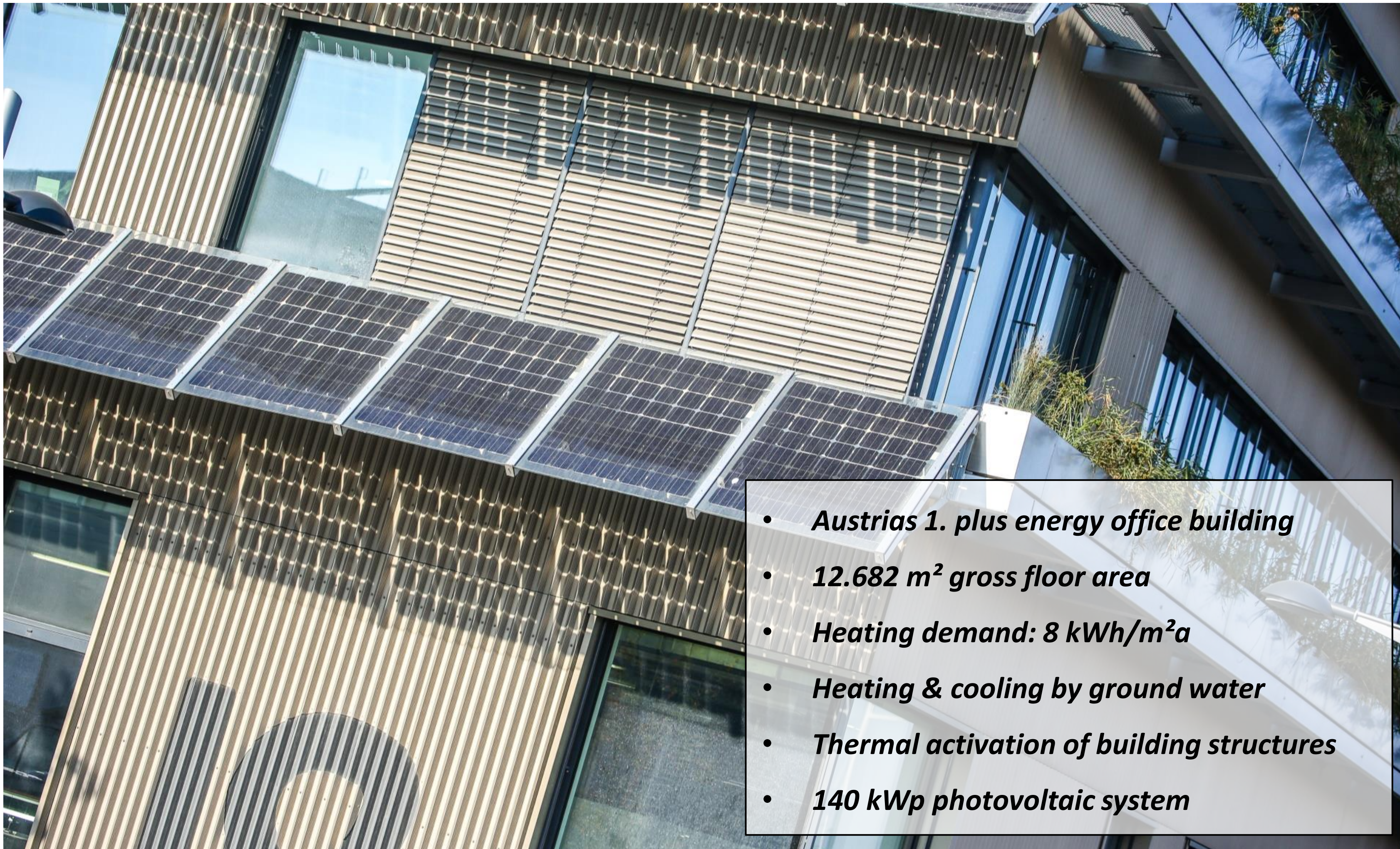
- *General refurbishment*
- *First plus-energy-office high-rise buildung*
- *Generates more energy than it needs (technical building equipment, office equipment, kitchens and lighting considered!)*

ASPERN - D12

SUBSIDISED HOUSING – ANALYSING DIFFERENT ENERGY SUPPLY SYSTEMS

- *213 flats (low energy building)*
- *7 different heat pump systems (800 kW)*
- *Solar heat (90 kW) + Hybrid (60 kWp.th + 20 kWp.el) + PV (15 kWp)*
- *Soil storage (40 MWh)*
- *Battery-storage (20 kWh)*
- *Smart home automation*

ASPERN IQ



- ***Austrias 1. plus energy office building***
- ***12.682 m² gross floor area***
- ***Heating demand: 8 kWh/m²a***
- ***Heating & cooling by ground water***
- ***Thermal activation of building structures***
- ***140 kWp photovoltaic system***

PASSIVE HOUSE EBERLGASSE

FIRST REFURBISHMENT OF AN EARLY DAYS BUILDING TO PH-STANDARD

- *General refurbishment*
- *Change of heating system from gas to RES*
- *Subsequent installation of a ground water heat pump*
- *Ventilation with heat recovery, in- & outdoor LED lighting, energy recovery from elevator*

KALLCO – Q11

AFFORDABLE HOUSING IN 11. DISTRICT

- *325 flats (low energy building)*
- *Monthly rent including heating ~ 12 €/m²*
- *Surface heating systems*
- *Geothermal energy for heating and cooling*
- *Partly regeneration of soil by cooling the flats*
- *District heating for peak loads and remaining regeneration of soil*

Source: http://www.kallco.at/wohnen-quartier11


THANK YOU!
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E-Mail: andrea.kinsperger@wien.gv.at
www.energieplanung.wien.at

GRETA

Near-surface Geothermal Resources in the Territory of the Alpine Space

12th September 2017 – F. Böttcher/K. Zosseder – TUM

DGK, Munich

The GRETA project is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme.

The use case **Munich**

Project “GEPO” started 2012

- 3 years project with five researchers
- About 800.000 € funding
- Collecting data, quality control, data analysis and interpretation

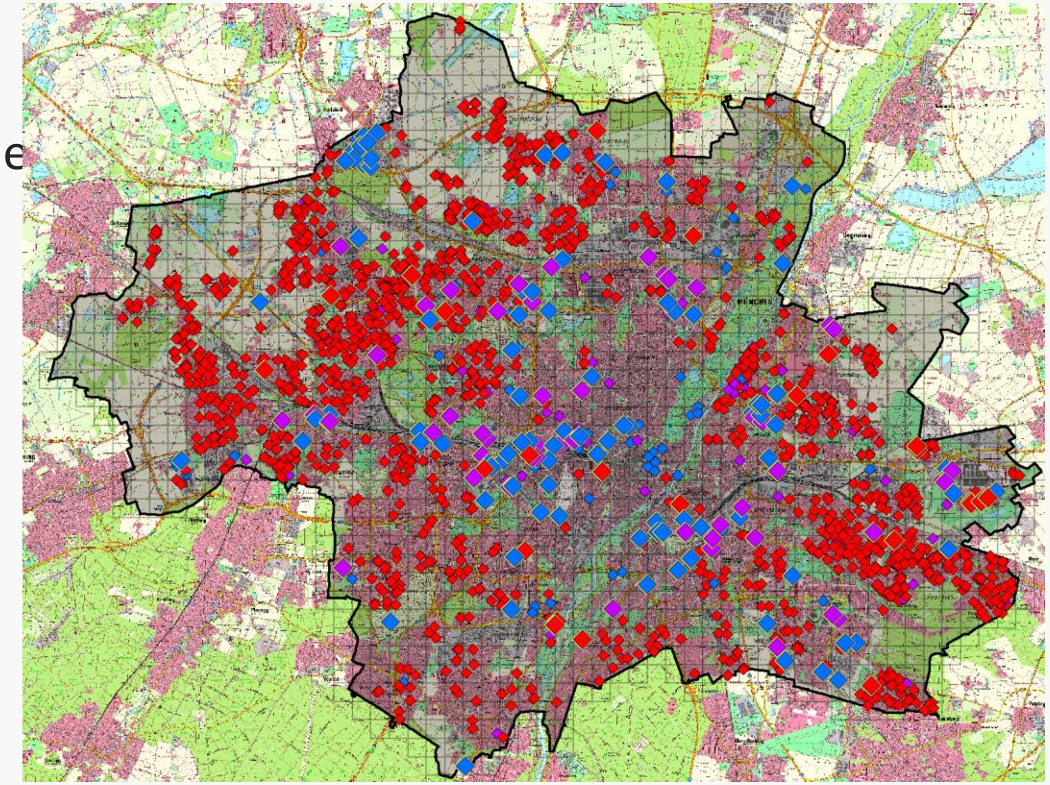
Key point: Establish a “working group” with all relevant institutions dealing with groundwater data in Munich

- Information and Knowledge Exchange
- Data exchange
- Dissemination of the Results

The use case **Munich**

History

- 2012-2015: Project GEPO at the TUM
  (**Ge**othermal **Po**tential of the Munich Gravel Plain)
- 2016-2018: EU-Project GRETA
- 2017: Information that the City of Munich will establish a ne
- Announcement Planning for this plan
- → GWHP-Potential not integrated



- Integration the Shallow Geothermal Potential
  in **Energy Plans**

The requirements

Meeting with the City of Munich - results

+ Map for the general public (Potential Map) with the content:

    A coloured display of areas where:

    + a thermal groundwater usage for heating (with heatpumps) is possible
    + a use of BHE is possible

+ two maps would be better than one with both informations
+ if possible integrate a differentiation between “good case”; “only limited usage”; “no usage possible”
+ Regulation Limitations should be considered and integrated in the maps
+ These maps should be published on the official Website of the city
+ Warning should be integrated “This map replace not a detailed system planning from an expert”
+ link to the water permission Webpage with the application forms should be done

The requirements

Meeting with the City of Munich - results

+ An “expert map” for the internal municipality Webpage:
  + this map should show more parameters (e.g. hydraulic conductivity; distance to groundwater table)
  + and the possible thermal extraction (average expected thermal power per borehole length)
  + It should be a more detailed explanation of the potential map.
  + This map should be published after a test phase.

+ Open questions: data security; Implementation the information into the Energy planning

Assess the Geothermal Potential

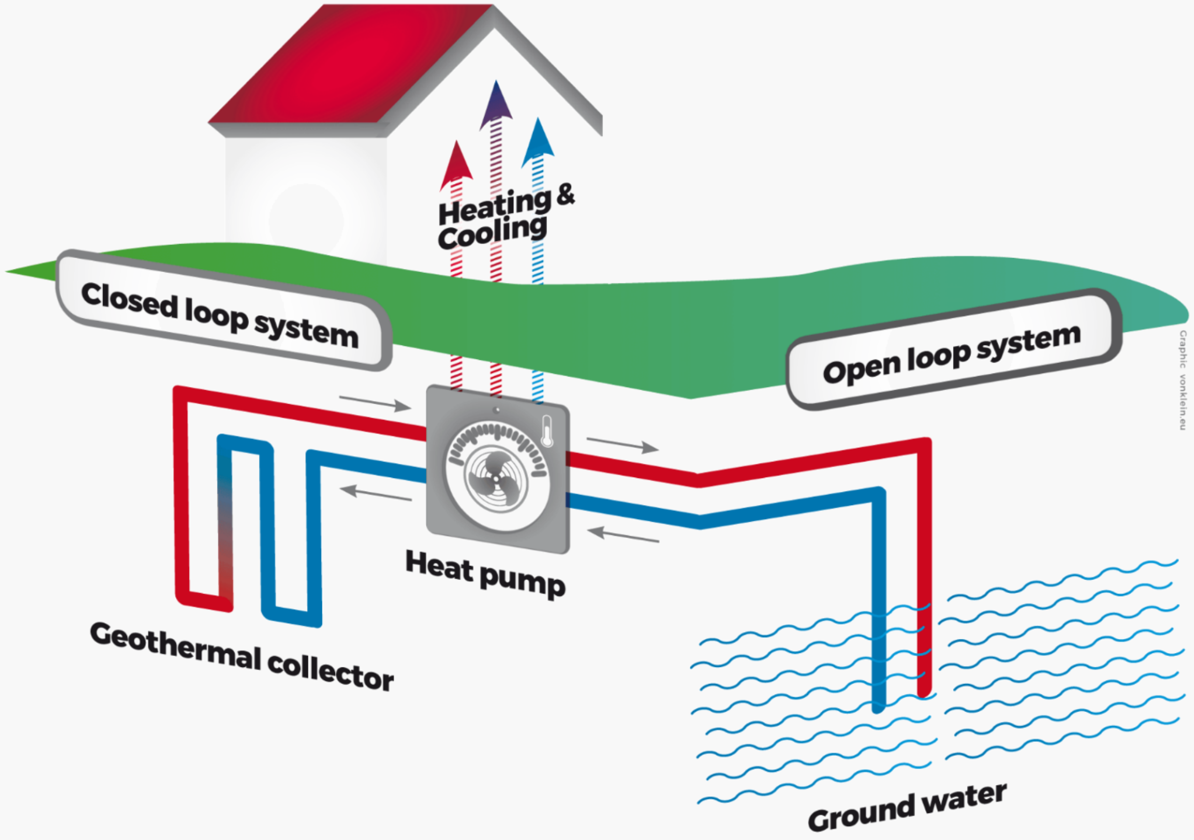
Parameters to derive the Volume Flux

- depth to water table
- aquifer thickness
- hydraulic conductivity
- groundwater flow direction
- flow velocity
- groundwater recharge

required Geothermal Parameters
Volume Flux
Groundwater Temperature
Geothermal Potential

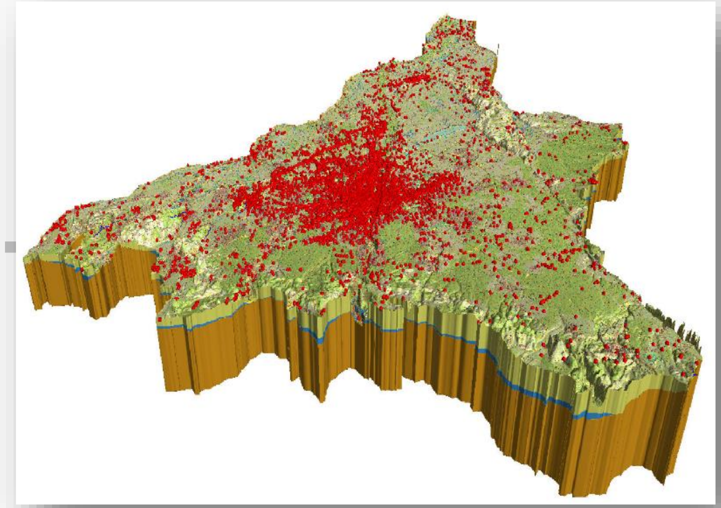
Thermal Parameters

- groundwater-, soil- and air temperature
- temporal and local temperature variance (natural and anthropogenic influence
- thermal conductivity + heat capacity
- existing geothermal usage



Interreg Alpine Space
Greta

GEPO Project

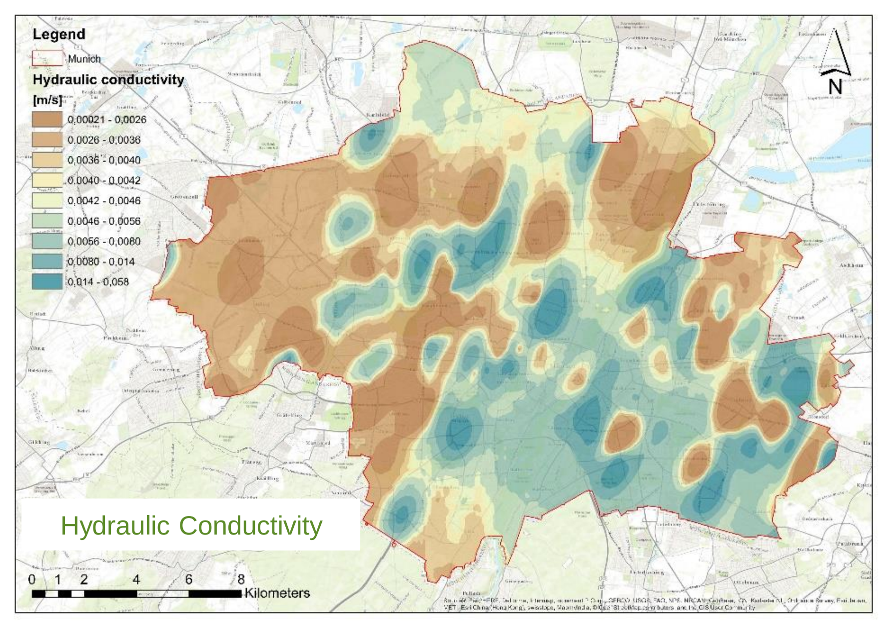


Data acquisition and analysis
Data quality control of 30.000 borehole data
Creating a 3D-modell

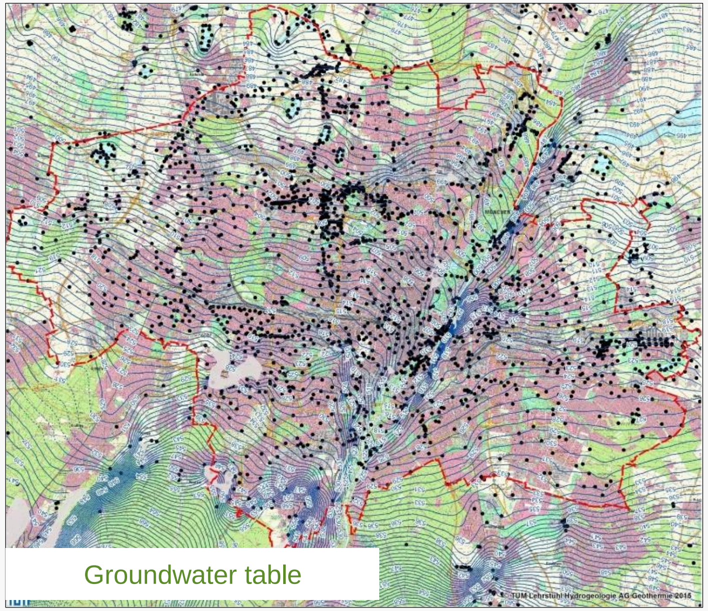
Groundwater Measurements
Groundwater table (over 8000 GW-measurements in 1 week)
Groundwater temperature measurements

Analysis of the Hydraulic Conductivity
Ca. 500 Analysis of pump test from archives

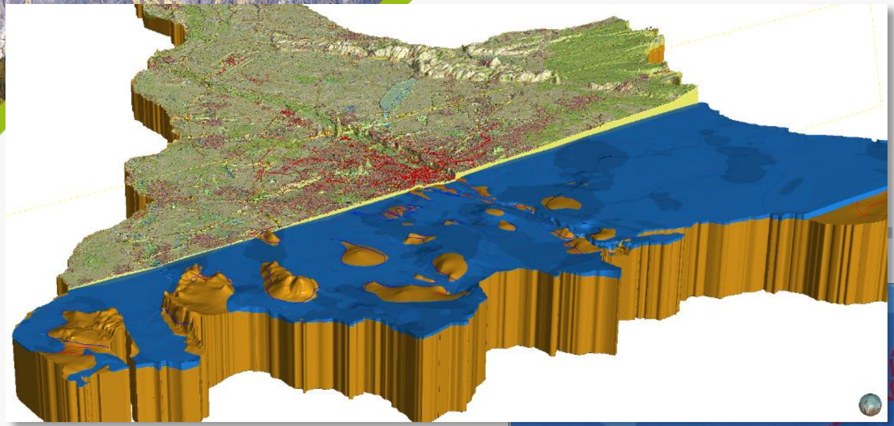
Estimation of the existing thermal groundwater use
Analysis of yearly reports

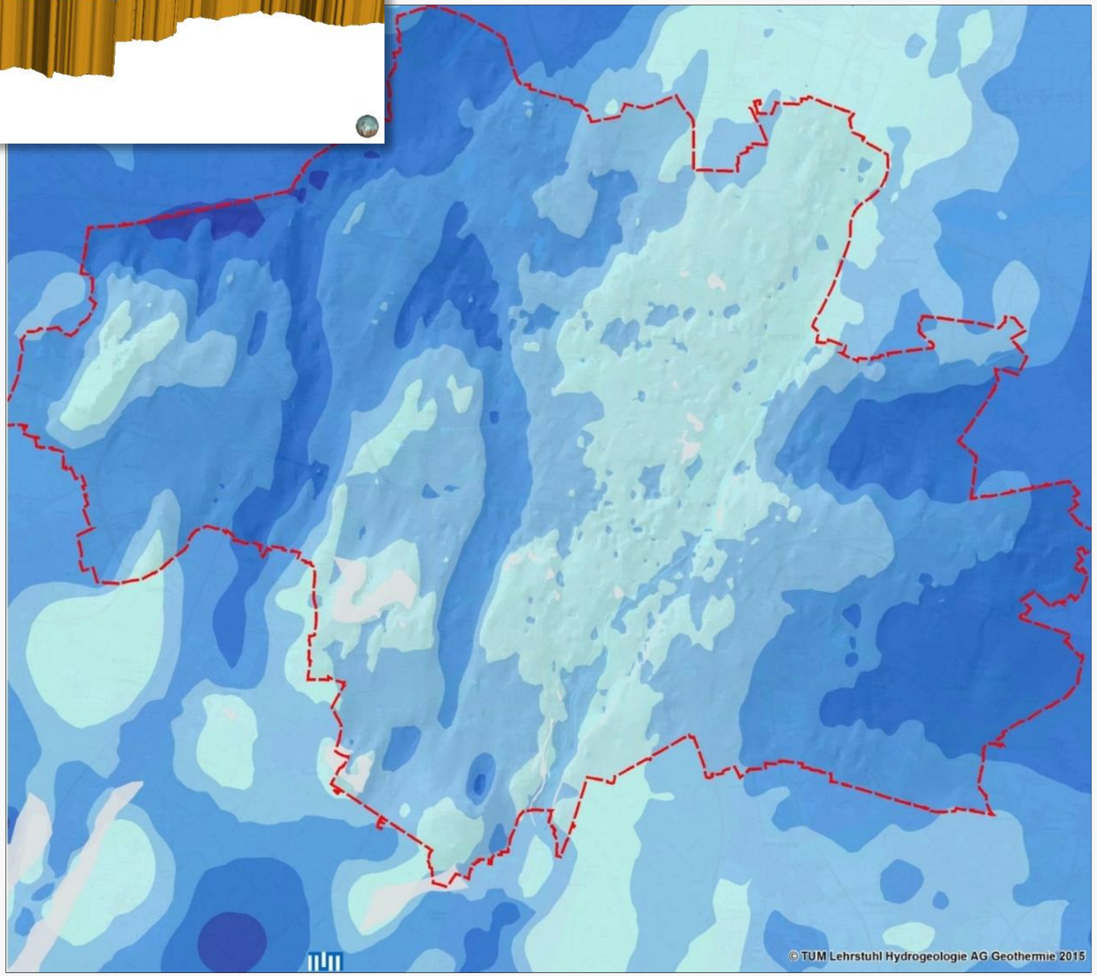


Hydraulic Conductivity


Groundwater table

Groundwater thickness





Groundwater filled channel structures

Less groundwater available in some tertiary plateaus

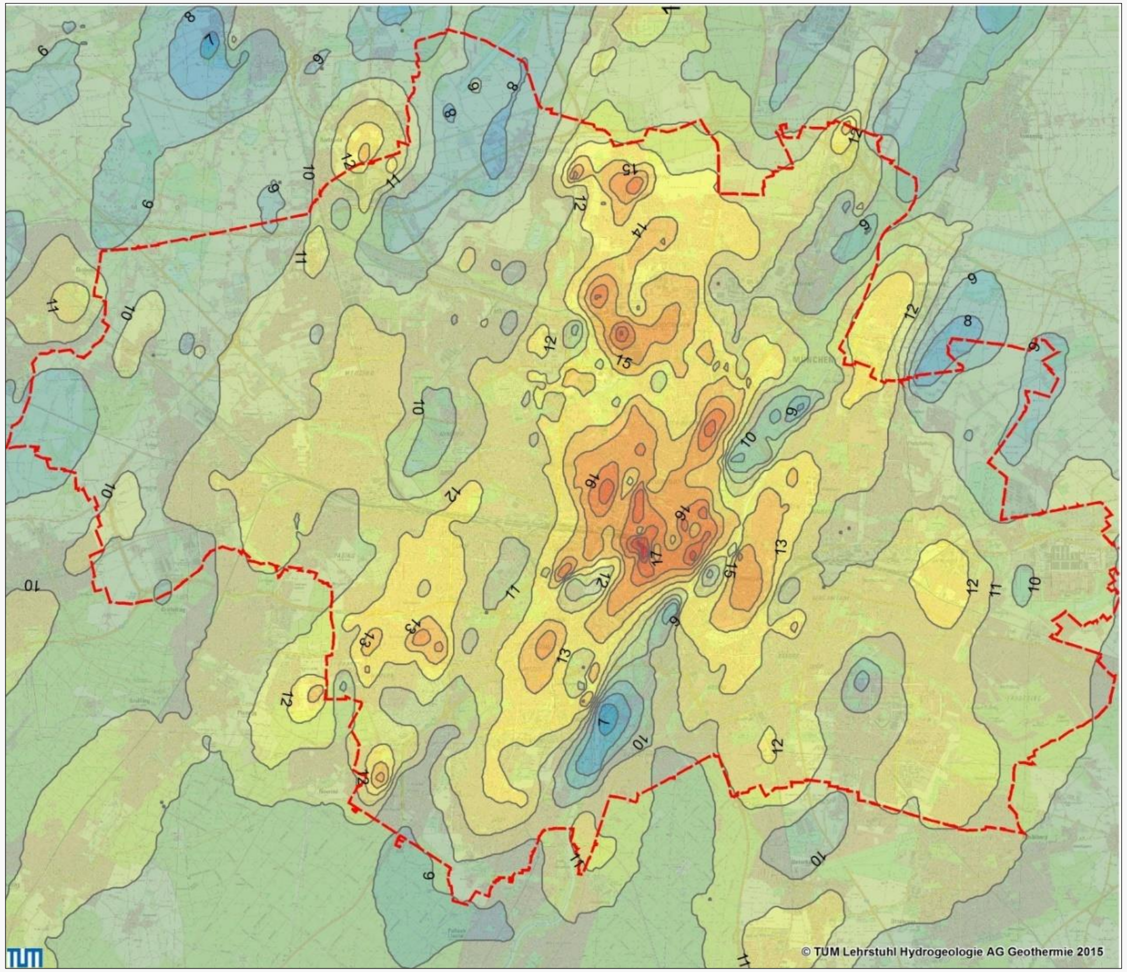
„groundwater free" areas

GW-thickness about 0-20 m

Legend:

0 m 20 m

Groundwater temperatures



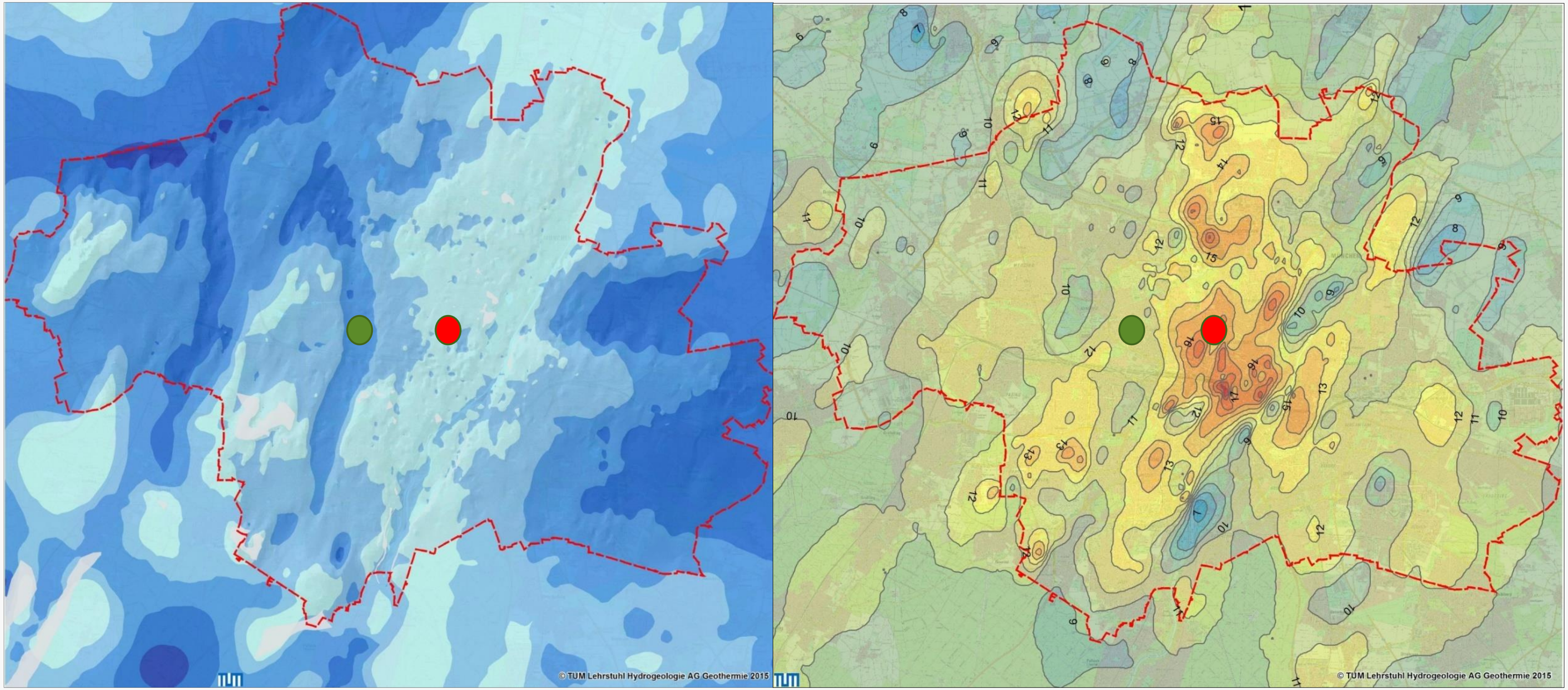
[°C]
7
8
9
10
11
12
13
14
15
16
17
18
19

Temporally and locally heterogeneous distribution of the groundwater temperature

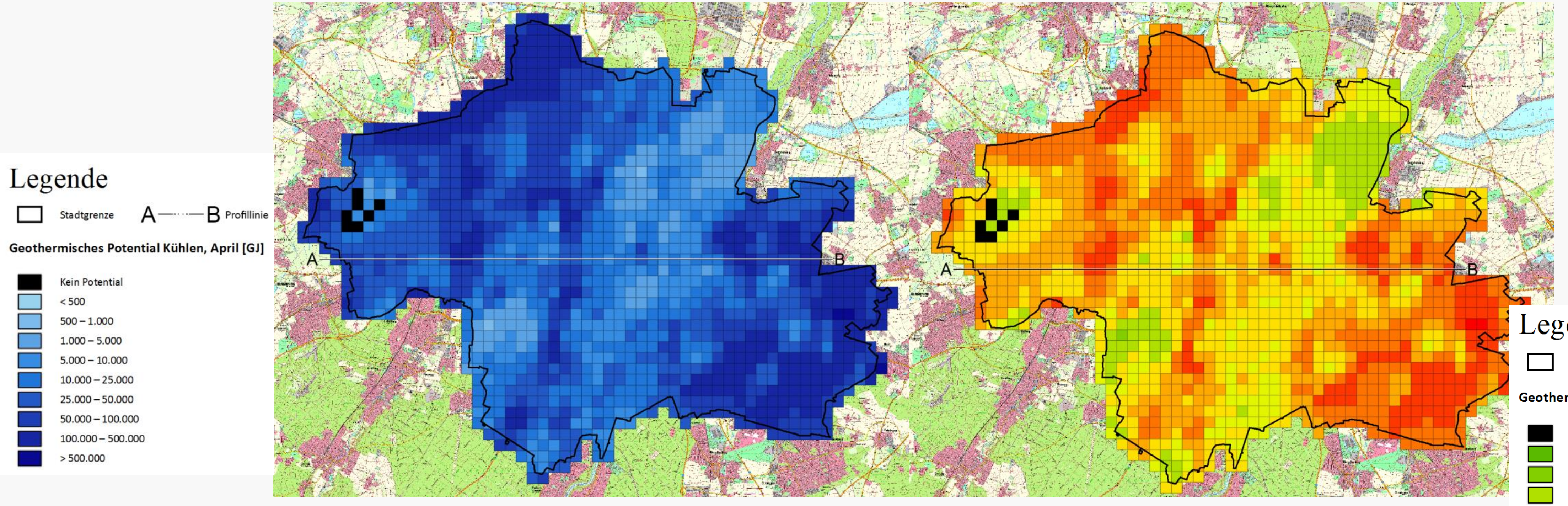
significant changes of the temperature in the urban area.

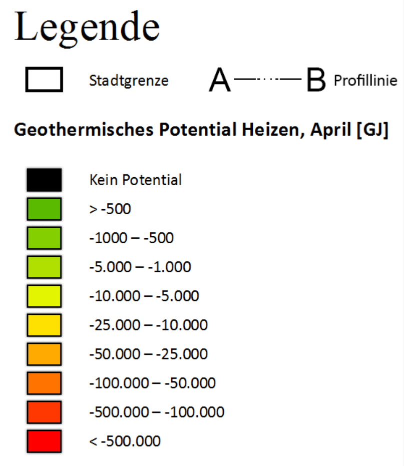
1.479 temperature data points
Min-Max: 5,9 – 20,5°C
Median: 10,6°C

Data for the initial planning phase



Static Geothermal Potential





Calculated a volume flux with Darcy with the assessed data and use the requirements for heating: temperature spreading is max. 5°C and for cooling: max. injection temperature of 20°C as example

Question

Is this useful and correct?

How can you compare that with the Potential of solar panels?

How should we use that for planning?

→Always the same question: Which potential do you mean and for which purpose is it?

Please specify!

The objective

Can we heat this district with GWHPs?

How many systems can be realized without negative interaction?

Extractable geothermal energy?

+ At a specific temperature spread
+ At a specific flowrate of the well

Spatial footprint of an open loop system?

+ Distance between the well doublet
+ Extent of the temperature anomaly (major part)
+ Integrating technical and regulation issues

Development of a method that can evaluate **the spatial potential** for the thermal use of groundwater

Save the date: 7th Nov. 2017 Mid-term conference

See more at www.alpine-space.eu/projects/greta
Find us on facebook
Follow us on LinkedIn
Send us an email at contact@greta-alpinespace.eu

Interreg Alpine Space
EUROPEAN UNION
Greta

Technische Universität München · ARPA Valle d'Aosta · Geological Survey of Austria · GeoZS Geološki zavod Slovenije · brgm Geoscience for a sustainable Earth · Politecnico di Torino · EURAC research · triple.s · INDURA · Regione Lombardia · Climate Alliance · Angewandte & Umwelt Geologie

Mestna občina Ljubljana

The Role of Shallow Geothermal Energy Use in Ljubljana SEAP

Alenka Loose, Mitja Janža, Špela Gregorin

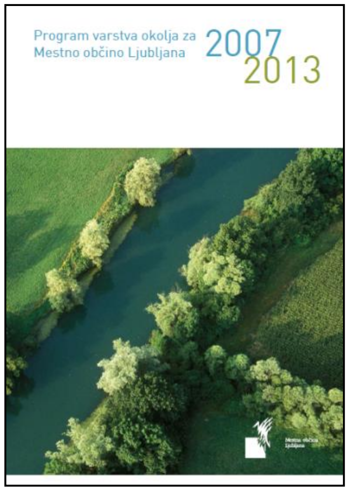
German Geothermal Congress,
Munich, September 12, 2017

alenka.loose@ljubljana.si

STRATEGIES

- Environmental Protection Programme (2014, 2020)
- Sustainable Energy Action Plan (2020)
- Sustainable Mobility Plan (2020)
- Electromobility Strategy (2020)
- Spatial Plan (2030) – open for suggestions
- Zero Waste Plan (2035)

Environmental Protection Program for COL 2007 – 2013 (EP COL)



Environmental goals and indicators set

Action plan prepared

4 STRATEGIC GOALS:

1. Established system of sustainable mobility
2. **<u>Improved EE and increased use of RES</u>**
3. **<u>Assured long-term supply with natural dinking water</u>**
4. Assured nature protection and green area management

Environmental Protection Program

Up to date realization of Strategic goal 2:

Improved energy efficiency and use of renewables

- ✓ Sustainable Energy Action Plan will be prepared and adopted by City Council – November 2011
- ✓ Energy efficiency of municipal public buildings will be increased, new in E-efficient and passive standard
- ➢ Bigger objects will be connected to Central cooling system
- ✓ Share of renewables will be increased up to 12 %
- ✓ Purchase of comfortable CNG and hybrid buses
- ✓ Adaptation of the bus-lines according to demand (city growth)
- ✓ Change of habits – education – awareness raising

SEAP – goals and figures

+20(EE) +25(RES) -30(GHG):

total costs: 1.729.185.000 EUR,

COL share: 533.165.000 EUR

End 2015 – realization of goals in %

EE(61%) 48%(RES)42%($CO2_{eq}$)

Economising the Sustainable Energy Issues in COL

1. COL became GCE due to the fastest sustainable development

2. To reach our strategic goals (incl. SEAP) huge investments should be prepared and realised

3. International projects help us to provide the expert solutions and bases for investments in further sustainable development of the city

ELENA Technical assistance

September 19, 2012: official submission of the Energy retrofit programme for the public buildings in Ljubljana (Energetska Obnova Ljubljane – EOL) to EIB, started on January 1, 2013, ended on December 31, 2016

Fundinag approved: ca. 1.500.000 EUR
used: ca. 1.000.000

Investments: ca. 50.000.000 EUR realised or
being realised (contracts signed)

Co-funded by the Intelligent Energy Europe Programme of the European Union

European Investment Bank

Until now numerous international projects helped us to prepare basis for investments

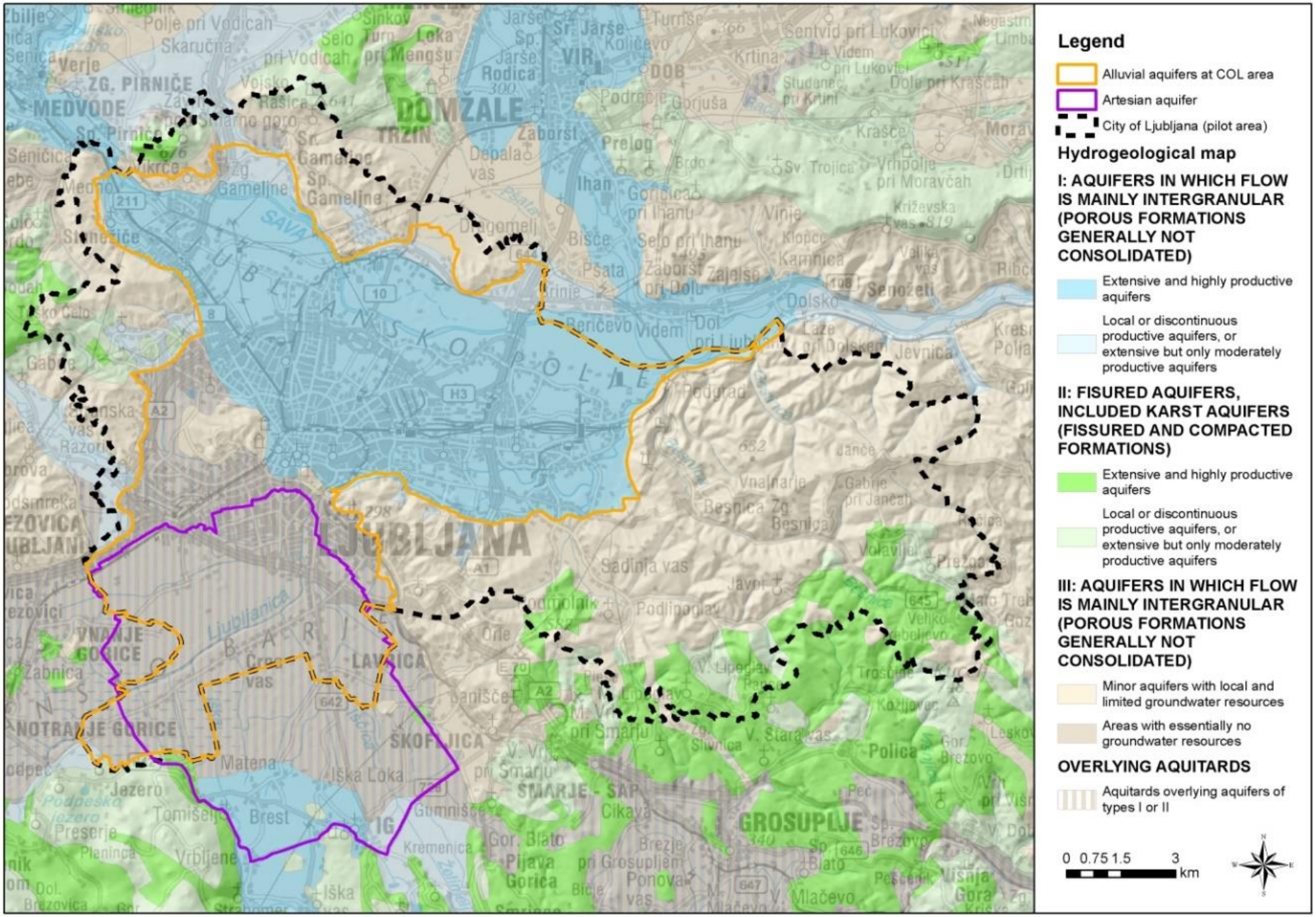
CIVITAS ELAN (CIVITAS Plus) sustainable mobility, introduction of sustainable public transport and electromobility;

URBAN HEAT ISLAND (CENTRAL EUROPE COOPERATING FOR SUCCESS. UHI **)**

and currently we are doing our best to determine the

Possibilities of shallow geothermal potential use within **GeoPLASMA-CE project** Interreg CENTRAL EUROPE GeoPLASMA-CE European Union European Regional Development Fund

Ljubljana pilot area



Environmental Protection Program SG 3

Strategic goal 3: **Assured long-term supply with natural drinking water**

Conflicts that may occure regarding SEAP **goal - increase of RES:**

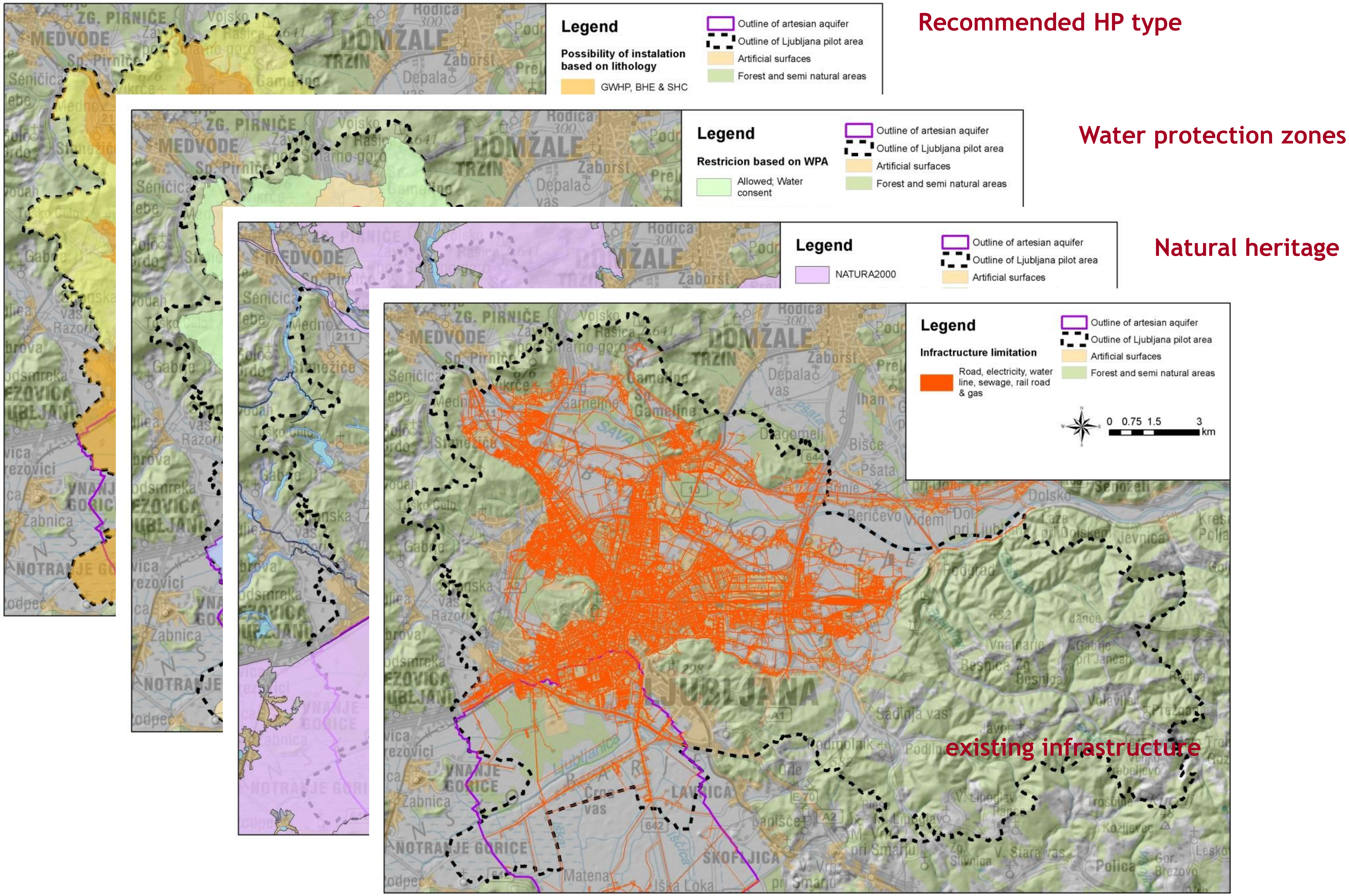
- Water Protection Zones (WPZ - should be respected)

The potential and risks are being examined through

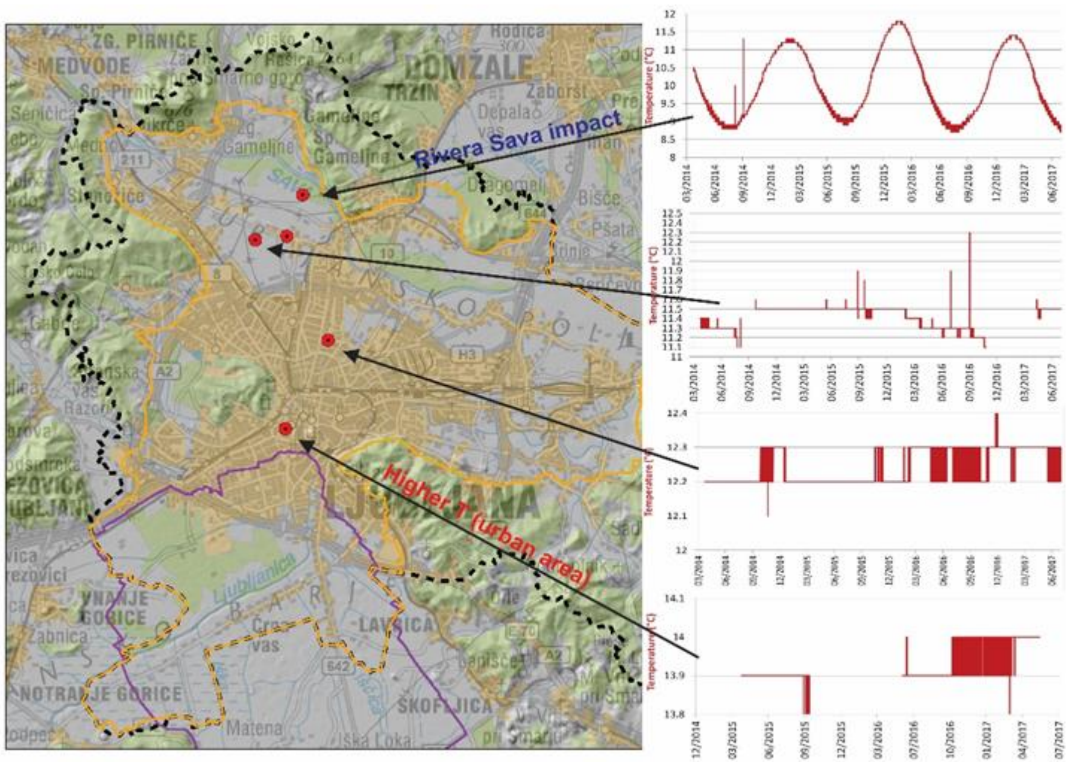
Interreg CENTRAL EUROPE GeoPLASMA-CE European Union European Regional Development Fund

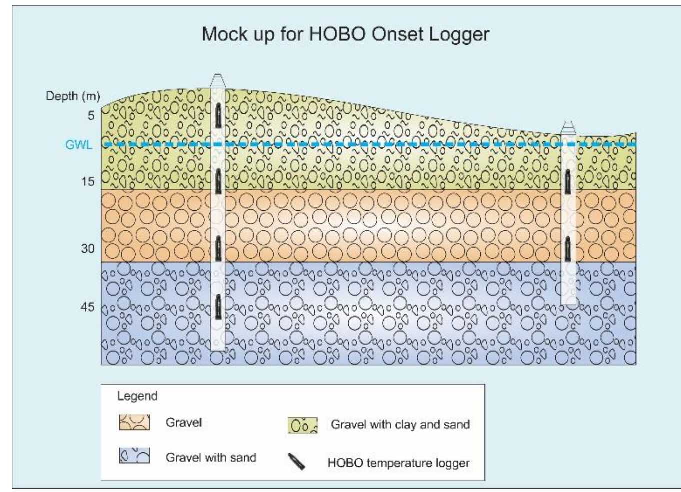
where shallow geothermal potential is being examined for Ljubljana pilot area.

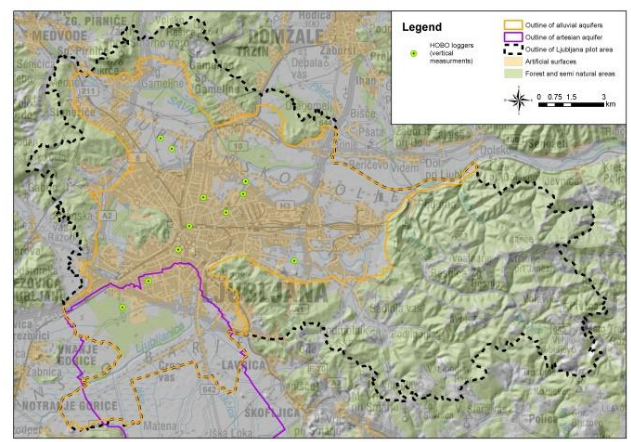
Potential and Constrains



Study of natural conditions







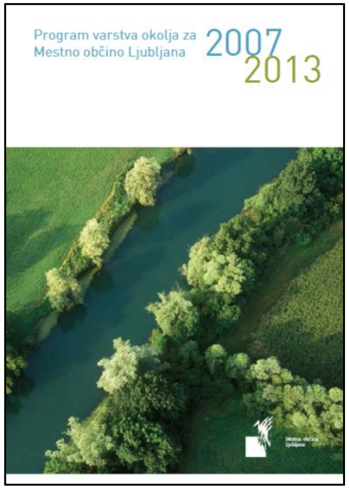
PROJECT EOL 4 HP

All four on WPZ III

2 Primary schools
1 Health Centre
1 Kindergarten

presented by red dots

Environmental Protection Program for COL 2007 – 2013 (EP COL) and SEAP



Environmental and SEAP goals and indicators are being realized also with help of different international projects, as followes:

1. Established system of sustainable mobility (CIVITAS ELAN, UHI – Central Europe)
2. **Improved EE and increased use of RES** (ELENA EOL, GEOPLASMA - Interreg)
3. Assured long-term supply with natural dinking water (INCOME and CC Waters)
4. Assured nature protection and green area management

Ljubljana is geting more sustainable with your help as well!

THANK YOU

Supporting local energy action with an intermunicipal approach

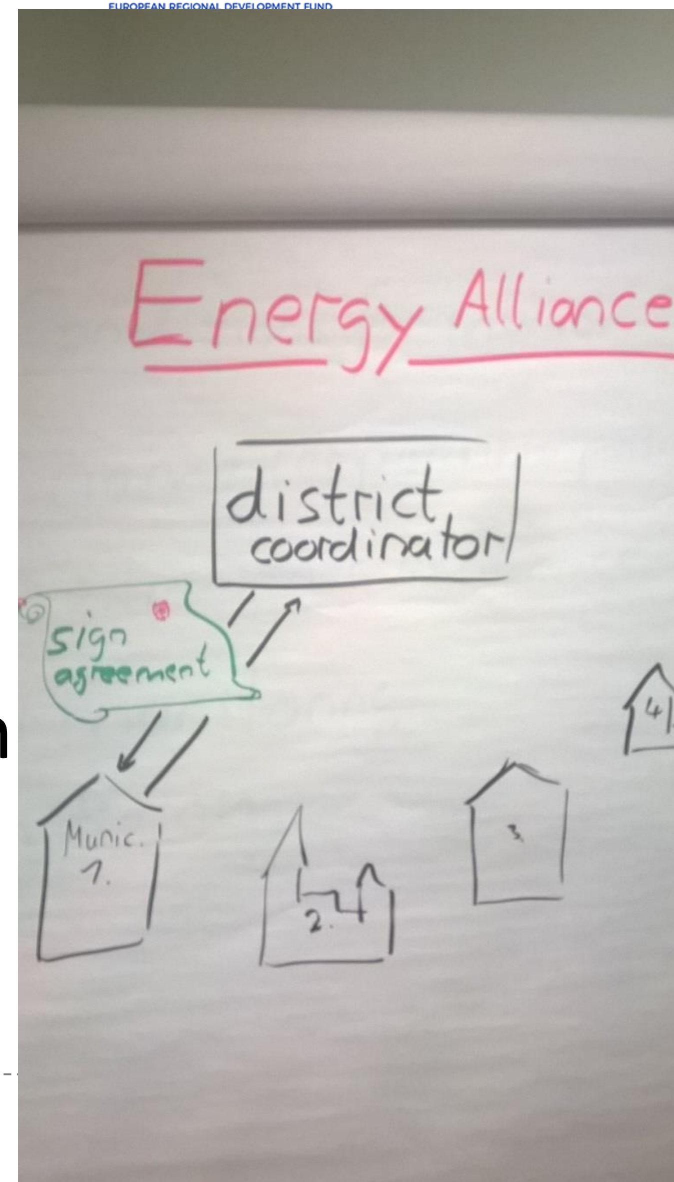
Dr. Andreas Kress

Munich 12.09.2017

Objective of Peace_alps

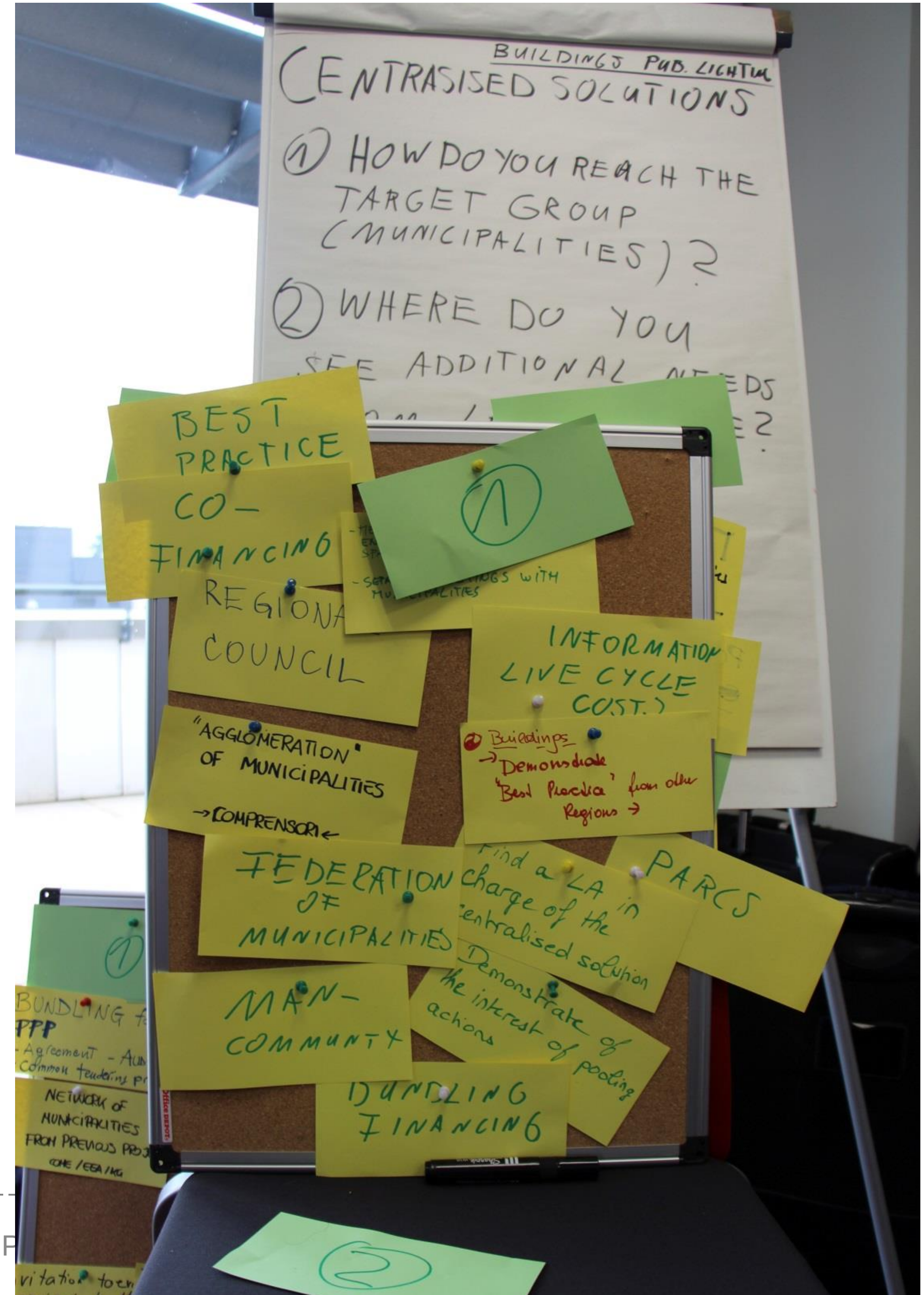
Interreg
Alpine Space
PEACE_Alps

Implementation of Sustainable Energy Action Plans (SEAPs) or any other Energy concepts already endorsed by Local Authorities (LAs) in Alpine Space Area by supporting LAs in developing concrete actions with an inter-municipal approach.



Pooling of action

- Governance
- Planning
- Information
- Training
- Monitoring
- Incentives



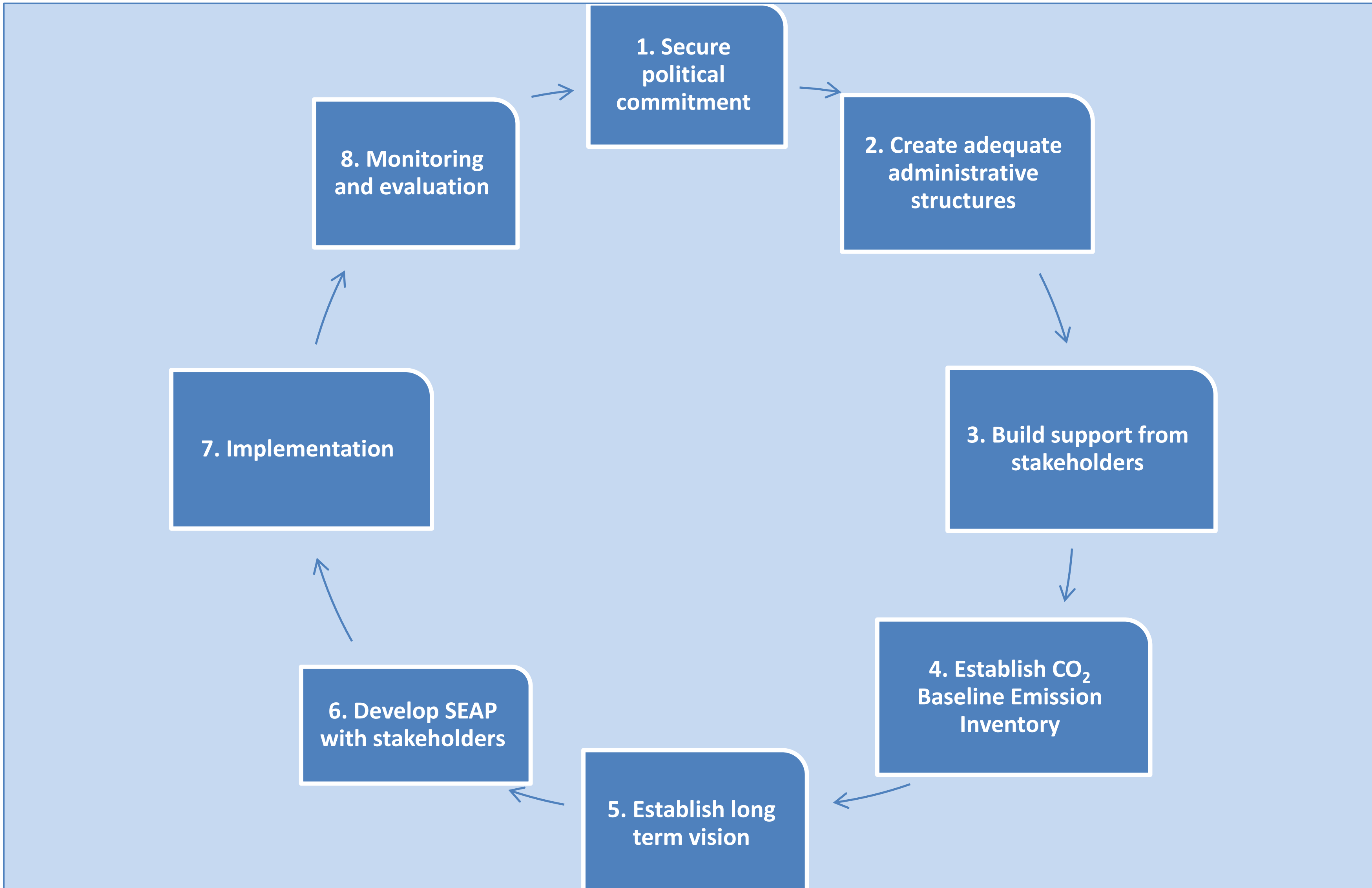
Integration of shallow geothermal energy use in local energy planning

Sustainable Energy action Plans (SEAPs) offer Municipalities the possibility to get political support to , organise structures, set targets, implement and monitor success.

The target - staff supporting, preparing and developing SEAPs

- Political decisions-makers supporting SEAP development.
- Municipality staff involved in the organisation of SEAP development, including staff supporting SGE
- Covenant Coordinators; public administrations providing strategic guidance, financial and technical support to municipalities
- Covenant Supporters; expert knowledge of the regulatory, legislative and financial framework
- Consultants facilitating SEAP development.

Sustainale Energy Action plan- SEAP cycle



Interreg
Alpine Space
PEACE_Alps
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Initiation Phase

- Political commitment
- Development of a SEAP can help to win political support for SGE.
- Council of the City of

Celle: Geothermal use as focus area of Climate Plan (Long-term vison).

Planning phase

Interreg
Alpine Space
PEACE_Alps
EUROPEAN REGIONAL DEVELOPMENT FUND
EUROPEAN UNION

Elaborating the plan

- Establishing a working group on SGE to develop a SEAP.

Developing measures

- identify which best practices have delivered effective results in similar contexts.
- review the targets and objectives similar to those set by the municipality
- Climate Plan of Celle: Cooling system for IT system, heat system for public buildings.

Thank you for your attention!

GeoPLASMA-CE & GRETA Workshop

Greta: Promoting the integration of NSGE into Energy Plans

Roberto Vaccaro (eurac research), München 12.09.’17

The GRETA project is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme.

Integrate the NSGE potential into energy plans

Eurac is in charge of coordinating the activities of WP5 of Greta aiming at supporting the process of integrating NSGE into energy plans.

This process by simplifying can be split in three phases:

- Preliminary analysis and assessment of local situation
- Spatial evaluation of feasibility and potential
- Planning support phase with involvement of decision makers

Preliminary analysis and assessment of local situation

Preliminary analysis and assessment of local situation

Assessing general framework conditions regarding the following areas:

- Socio-economical
- Legislative and procedural
- Geographical-environmental
- Technical-economical

Preliminary analysis and assessment of local situation

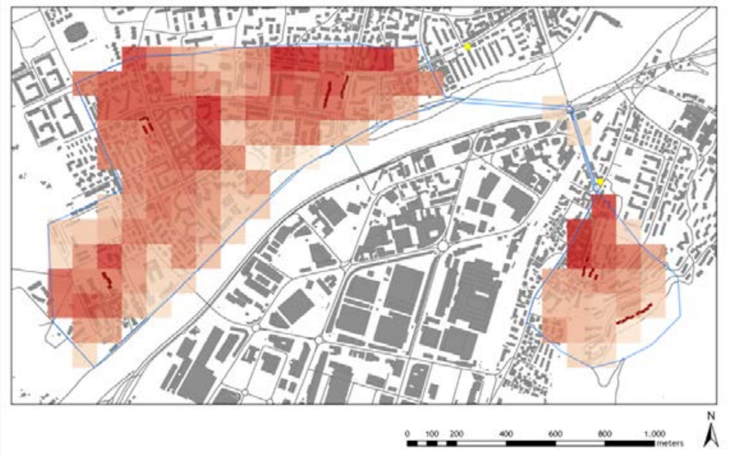
- Identification and consultation of stakeholders (including decision makers)
- Comparison of legislative and procedural analysis
- Analysis of existing plans and strategies
- Assessment of data availability and of knowledge gaps for feasibility study
- Evaluation of trends and driving forces
- Assessment of local employment of RES technologies and related expertise
- Structuring barriers and drivers into a SWOT matrix

Spatial evaluation of feasibility and potential

Development of code for spatial evaluation of feasibility and potential

Within GRETA eurac will develop a tool using Python and Grass for the evaluation of the spatial feasibility and potential of NSGE on a territory.

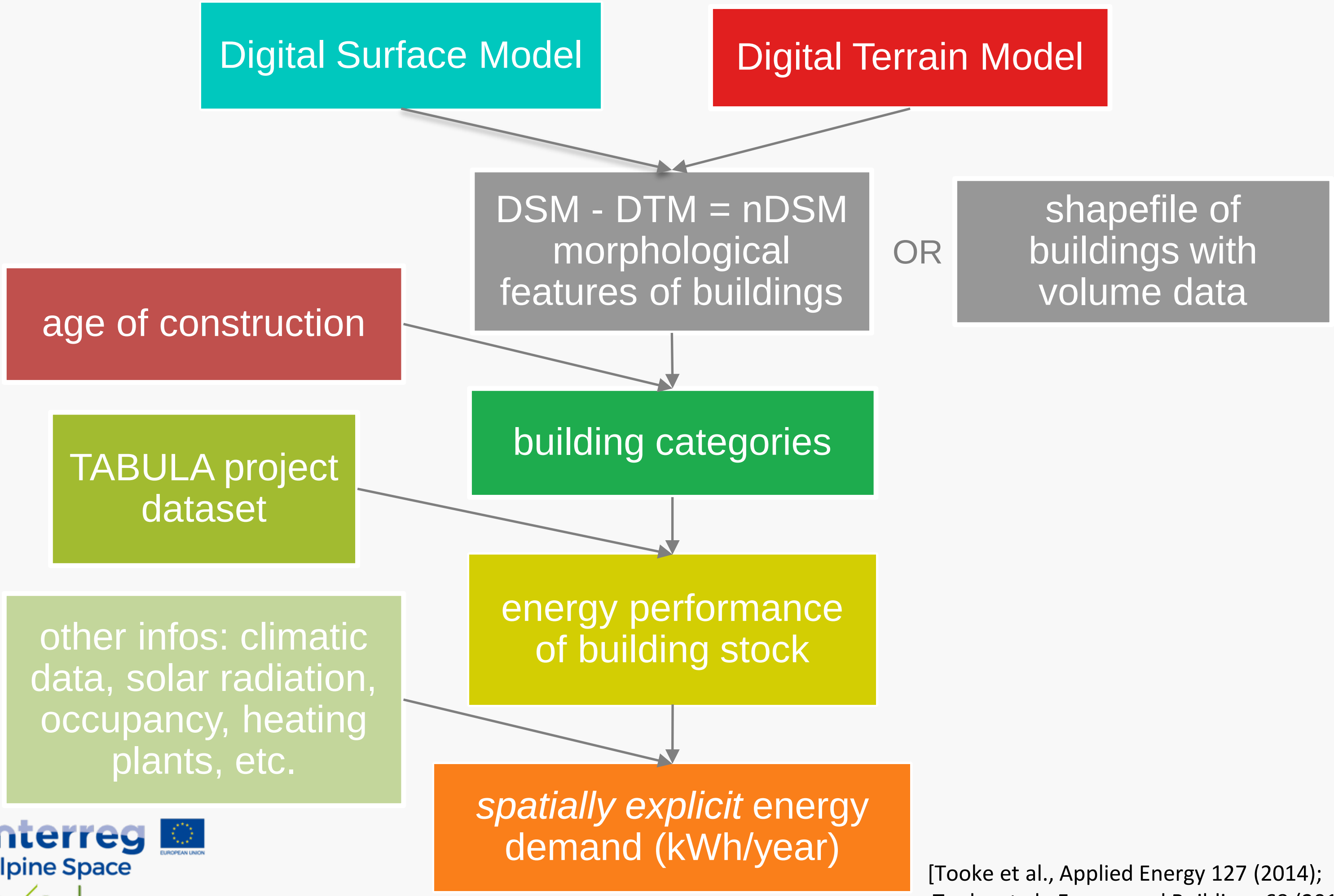
The tool will be made available under the GPLv3 licence through the Greta project homepage.

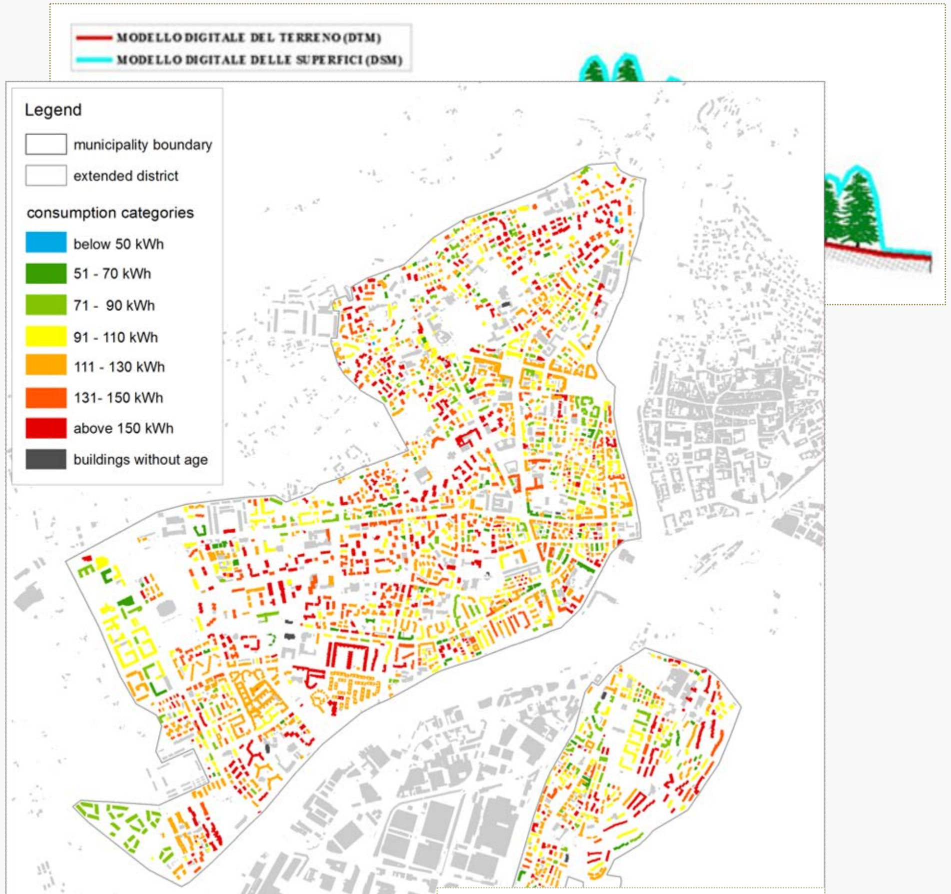


Spatial feasibility analysis: economical, environmental, technical and legislative

Spatial evaluation of	Type of data	Step 1	Step 2
Thermal energy DEMAND	**Estimated**: climate, land use, building and infrastructure data, etc. or **Measured**: based on energy consumptions	Evaluation of residual demand by considering the **share of renewable energy** in the local production and different typologies of buildings and local strategic options.	*Spatially explicit* analysis of the **economic and financial feasibility** for the use of NSGE which includes the legal, environmental and social context. Formulation of alternative scenarios.
Local energy PRODUCTION	**Estimated** or **Measured**		
Geothermal energy POTENTIAL	**Hydrogeological characteristics** and **Constraints**: environmental, legal and technical	**Mapping the potential** by combining characteristics and constraints	

Methodology to spatially evaluate the thermal energy demand of the existing building stock

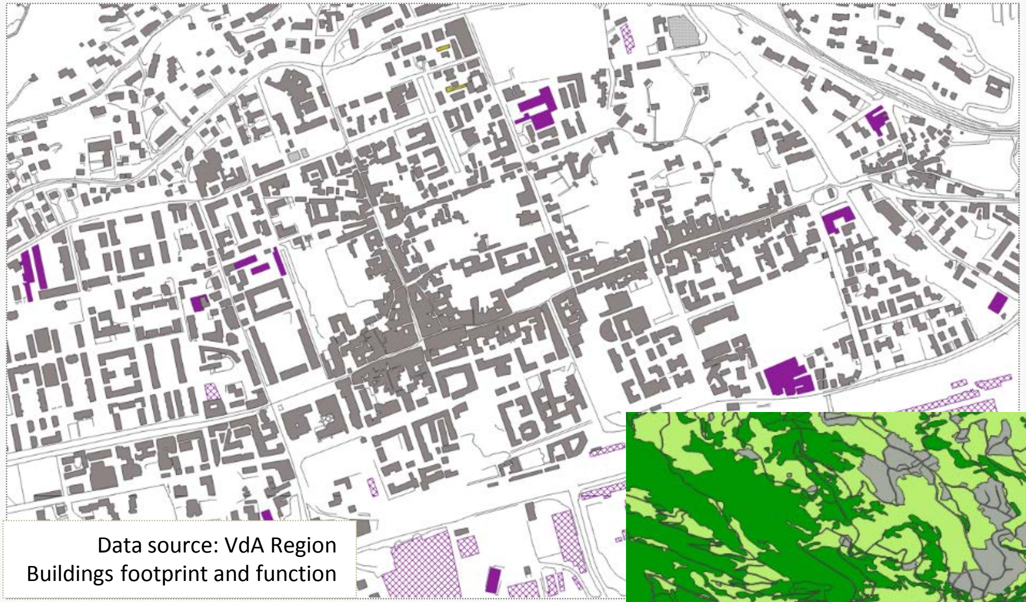




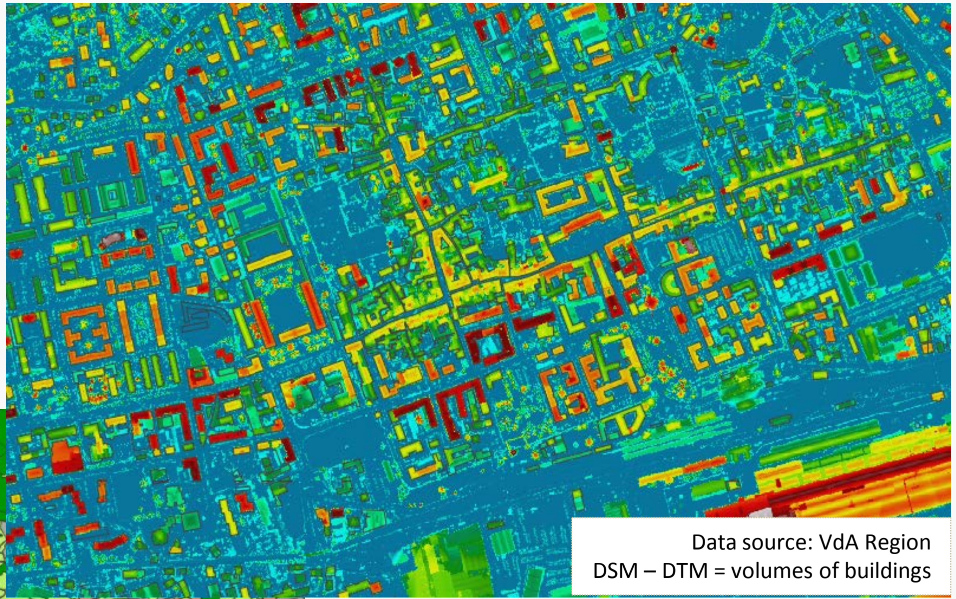
Source: Eurac Research
SINFONIA project (Bolzano district)

[Tooke et al., Applied Energy 127 (2014);
Tooke et al., Energy and Buildings 68 (2014)]

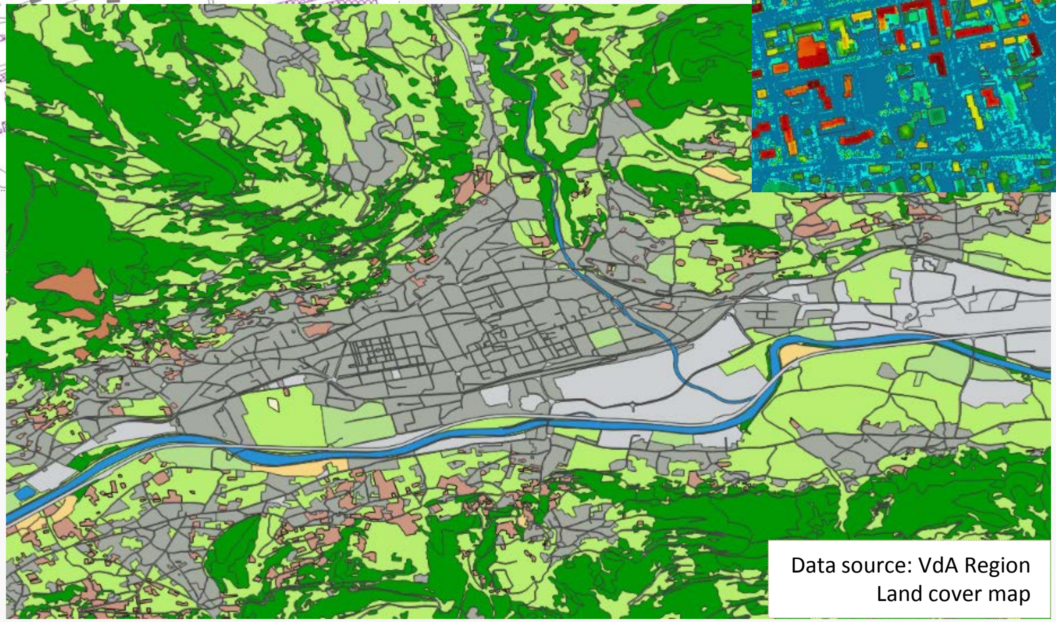
Example of data for Valle d'Aosta



Data source: VdA Region
Buildings footprint and function



Data source: VdA Region
DSM – DTM = volumes of buildings



Data source: VdA Region
Land cover map

Spatial feasibility analysis: economical, environmental, technical and legislative

Spatial evaluation of	Type of data	Step 1	Step 2
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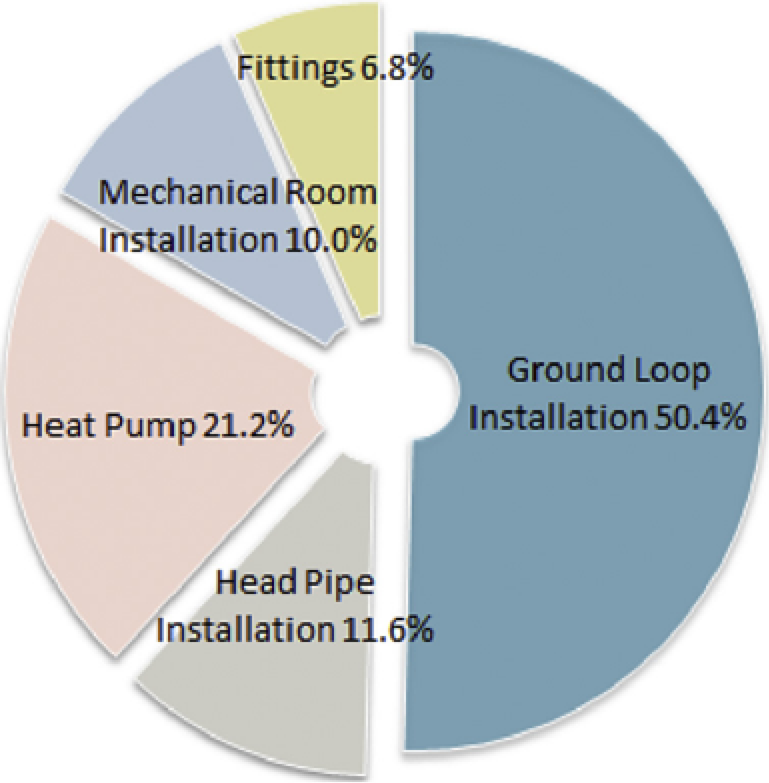
Local energy PRODUCTION	**Estimated** or **Measured**		
Geothermal energy POTENTIAL	**Hydrogeological characteristics** and **Constraints**: environmental, legal and technical	**Mapping the potential** by combining characteristics and constraints	

GSHP: Cost breakdown

Cost breakdown of a GSHP system.

	Cost ($)	Variation ($)
Ground loop installation	15,654	534
Head pipe installation	3,591	100
Heat pump	6,581	407
Mechanical room installation	3,104	294
Fittings	2,112	171
Total	31,041	1,506



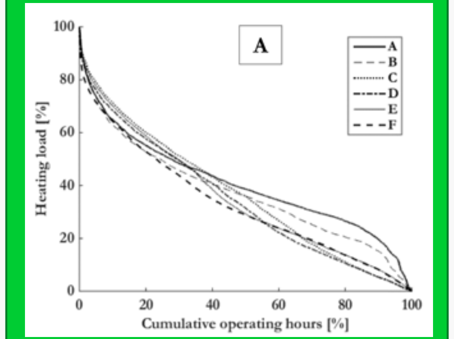
[Q. Lu et al. / Energy 125 (2017) 107-117]

Methodology to assess economic and financial feasibility of H/C systems

Demand side

Energy [kWh_t/y]

Load curves [kW]



Power [kW]

=> kW_t 6 hours
=> kW_t 1 month
=> kW_t 1 year

Supply side

Thermal generator systems
Like:

GSHP | ASHP | Boiler | Solar thermal | ...

Extra components
Like:

PV | fan-coils | radiant panels | windows | ...

Dimensioning system components

Characterize:
- Investment costs
- maintenance costs
- operative costs

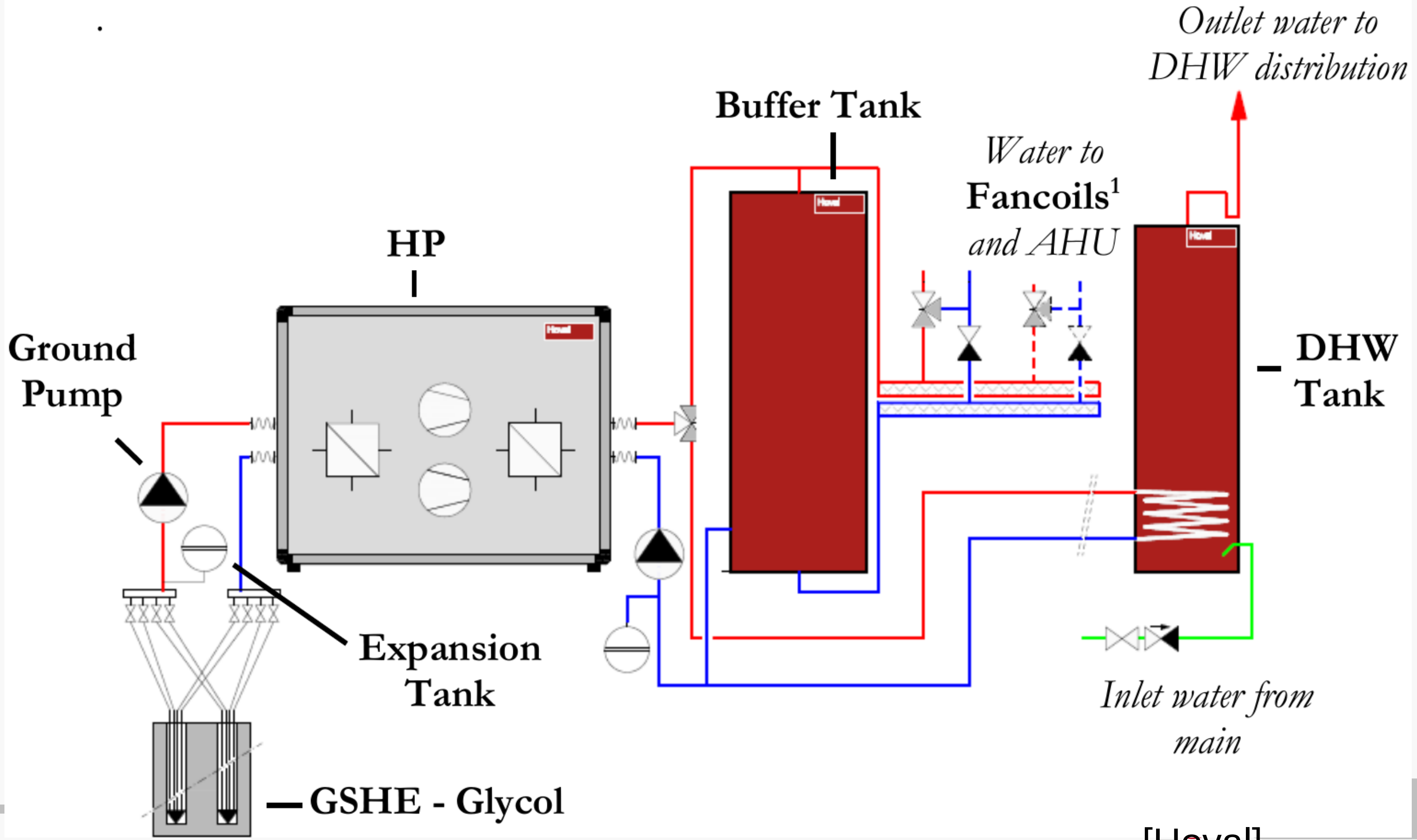
Economic indicators

- Present Value & Net Present Value
- Annual Worth,
- Internal Rate of Return
- External Rate of Return,
- Simple Payback Period,
- Discounted Payback Period,
- Levelized Cost of Energy
- ...

Supply systems: GSHP

Ground Source Heat Pump main components:

- Ground Source Heat Exchanger
- Ground Pump
- Expansion Tank
- Heat Pump
- Buffer Tank
- DHW Tank



[Hoval]

Economic indicators

Table 1
Economic methods used to evaluate engineering projects [28].

	Brief Description	Key equation	Disadvantage
PW (Present Worth)	Calculates the equivalent worth of all cash flows relative to starting point. When PW > 0 the project is feasible.	$PW(i\%) = F_0(1+i)^0 + F_1(1+i)^{-1} + \ldots + F_N(1+i)^{-N} = \sum_{k=0}^{N} F_k(1+i)^{-k}$	Future cash flow assumed to be reinvested at a rate of MARR.*
AW (Annual Worth)	Annual equivalent savings minus annual equivalent capital recovery amount. When AW > 0 the project is feasible.	$AW(i\%) = R - E - CR(i\%)CR(i\%) = I(A/P, i\%, N) - S(A/F, i\%, N)$	Future cash flow assumed to be reinvested at a rate of MARR.*
IRR (Internal Rate of Return)	Most widely used. It is the interest rate when the equivalent worth of cash inflows equates to the equivalent worth of cash outflow. When IRR > MARR,* the project is feasible.	$IRR = i'\% \sum_{k=0}^{N} R_k(P/F, i'\%, k) = \sum_{k=0}^{N} E_k(P/F, i'\%, k)$	Future cash flow assumed to be reinvested at a rate of IRR.
ERR (External Rate of Return)	Similar to IRR, but address the issue of reinvestment rate. When ERR > MARR* the project is feasible.	$ERR = i''\% \sum_{k=0}^{N} E_k(P/F, \varepsilon\%, k)(F/P, i''\%, N) = \sum_{k=0}^{N} R_k(F/P, \varepsilon\%, N-k)$	–
SPP (Simple Payback Period)	Calculate the number of years required for cash inflows to just equal cash outflows.	$Simple\ Payback\ Period = \theta$, such that $\sum_{k=1}^{\theta}(R_k - E_k) - I \geq 0$	Does not consider the time value of money; does not indicate project desirability; results may be misleading.
DPP (Discounted Payback Period)	Similar to Simple Payback Period, except it considers the time value of money.	$Discounted\ Payback\ Period = \theta'$, such that $\sum_{k=1}^{\theta'}(R_k - E_k)(P/F, i\%, k) - I \geq 0$	Does not indicate project desirability; results may be misleading.

*MARR refers to Minimum Attractive Rate of Return. For non-business purpose, MARR is typically treated as equal to the interest rate of a saving account. For business purpose, MARR is normally set by the top management to reflect the minimum rate of return required for the company's operation.
Variables: i = effective interest rate or MARR per compounding period (e.g. monthly or yearly), k = index for each study period, F_k = future cash flow at the end of period k, N = number of study periods, R = annual equivalent saving of a project, E = annual equivalent expense, CR = annual equivalent capital recovery amount, I = initial investment, $I(A/P, i\%, N)$ = annual (A) initial investment given the present value (P) at interest rate $i\%$ per study period for N study periods, S = salvage (market) value at the end of study period, $S(A/F, i\%, N)$ = annual (A) salvage value given the future value (F) at interest rate $i\%$ per study period for N study periods, R_k = net revenue or savings for the k th year, E_k = net expenditure for the k th year, $i'\%$ = internal rate of return, $\varepsilon\%$ = external reinvestment rate (usually the MARR), $i''\%$ = external rate of return, I = capital investment made at the present time ($k = 0$).

[Q. Lu et al. / Energy 125 (2017) 107-117]

Planning support phase with involvement of decision makers

Planning support phases (decision makers involvement)

Context definition

+ Definition of objectives
+ Analysis and evaluation of alternative scenarios
+ Setting targets

Elaboration of recommendation

Governance aspects

+ Evaluation of the possibility to modify the legislative framework if needed/possible
+ Subsidies and financial schemes
+ Awareness raising and advertising

Technical aspects

+ Promotion of an “installation chain”
+ Training and competence building (designers, drillers, but also insurance and banks)

Managing implementation aspects

+ Identification of energy indicators
+ Monitoring

Short comparison with Energie-nutzungsplan from Bayern region

- reference to german norms
- organisation of analysis in “Distrikts” (vs single house level)
- property rights of data
- reference to german study on buildings (different from Tabula)
- considering industry demand
- privileging and suggesting the realisation of district heating system when the demand density is >150 MWh/ha y^-1 (vs individual solution)
- suggesting use of LCA analysis
- prioritisation of RES (in Greta not on spatial base but only aggregated)
- for the economic evaluation reference to a specific norm is made
- participative approach

Thank you for your attention

See more at www.alpine-space.eu/projects/**greta**

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Interreg Alpine Space Greta

Technische Universität München

Geological Survey of Austria

GeoZS Geološki zavod Slovenije

Geoscience for a sustainable Earth brgm

EURAC research

triple.s INDURA

Regione Lombardia

Climate Alliance

Angewandte & Umwelt Geologie

Knowledge Exchange Workshop
Munich, 12.9.2017

Interreg CENTRAL EUROPE
European Union European Regional Development Fund
GeoPLASMA-CE

What role can transnational cooperation and international organisations play to promote inclusion of shallow geothermal in energy planning?

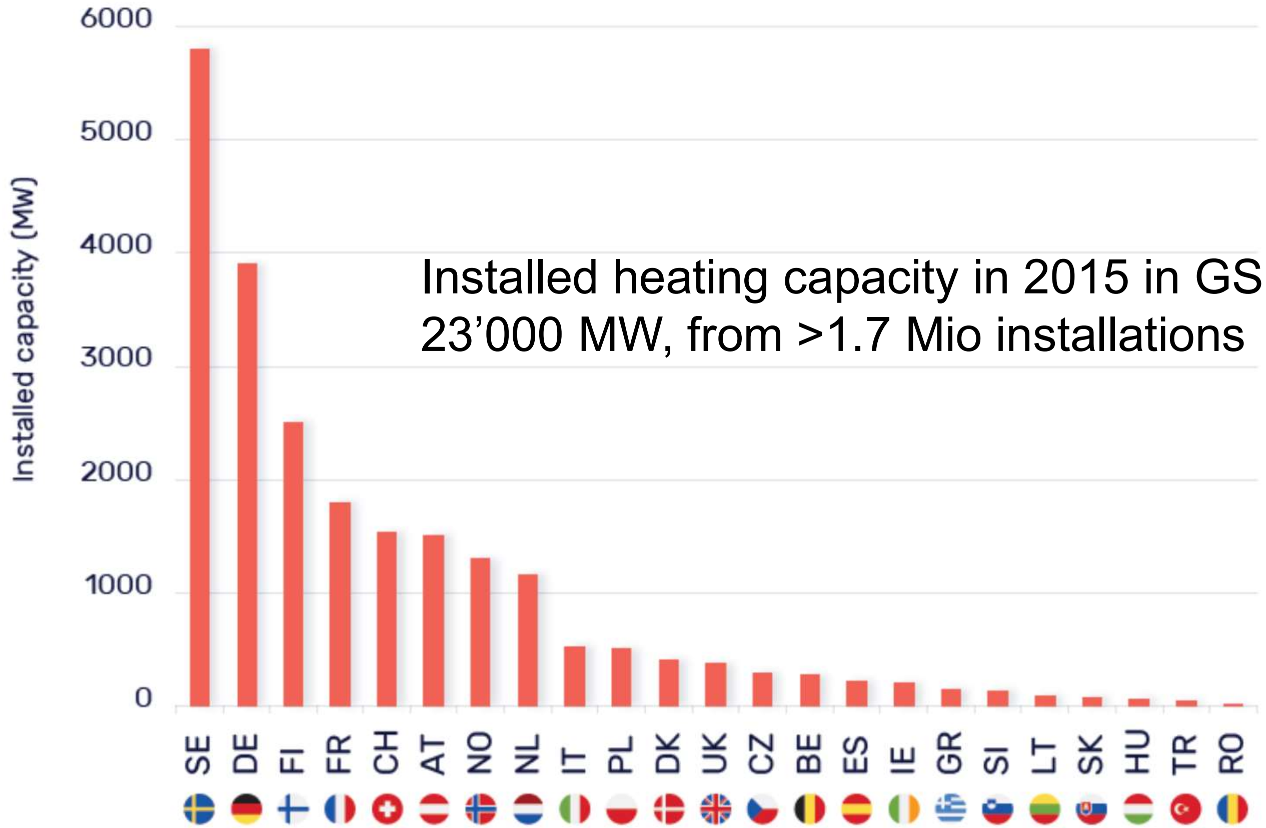
Burkhard Sanner and Philippe Dumas
EGEC, Brussels, Belgium

EGEC GEOTHERMAL

Where are we now in market development?

The shallow geothermal market has reached a considerable size and stability in Europe, however, with large differences among the countries

Total installed capacity of GSHP in 2015 (from EGEC Market Report 2016)



Installed heating capacity in 2015 in GSHP in Europe: 23'000 MW, from >1.7 Mio installations

Where are we now in market development?

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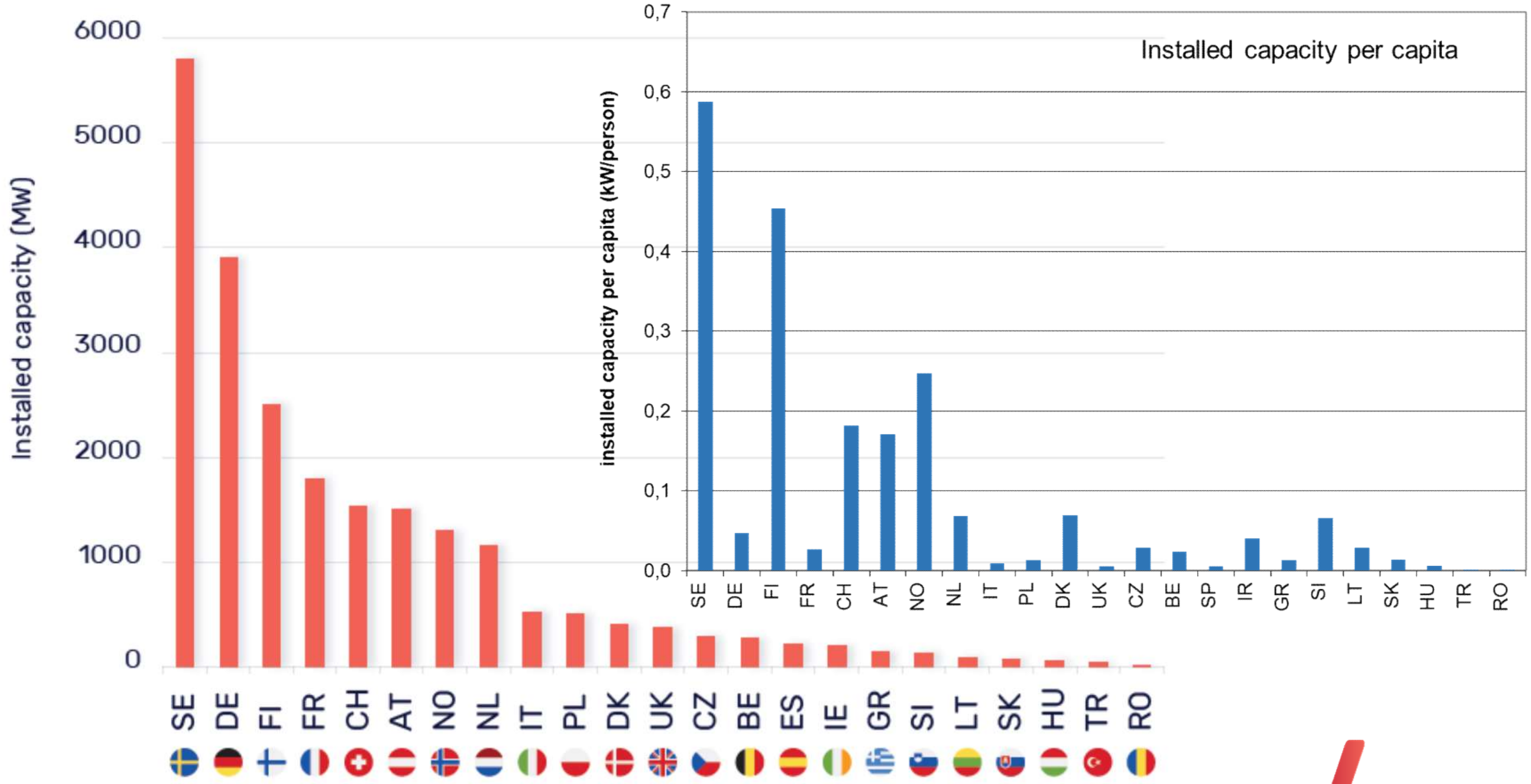


Where are we now in market development?

In 2010 the EU Member States had to deliver plans („NREAPs") how they intend to reach their targets towards the goal of 20 % Renewable Energy by 2020, and to give indicative development paths for the period 2010-2020.

The status halfway through the decade is shown in the table below, from the EGEC Market Report 2016; only countries mentioning GSHP in the NREAP explicitly are covered:

TABLE 2 - GSHP / TABLE SHOWING THE ACHIEVEMENT OF 2015 TARGETS FOR GSHP IN NREAPS

Sweden	147.7 %
Germany	85.9 %
France	61.8 %
Netherlands	53.7 %
Denmark	46.9 %
Italy	29.9 %
UK	22.8 %

Where are we now in market development?

The EGEC Market Report 2016 stated the following activities deemed crucial for continuing the success story of shallow geothermal in Europe:

- Opening the market for existing buildings (some success already e.g. in Switzerland)
- Providing solutions for industry, quarters (small grids), and making GSHP a standard option in smart thermal grids
- Continuing cost reduction for small installations in the residential sector (incl. NZEB)
- Increasing awareness with the general public and with the planners and contractors in countries with small market
- Helping engineers in new or smaller markets to understand GSHP and use it in their design

Early co-operation: mainly on R&D

In R&D, joint activities and knowledge exchange on shallow geothermal started in the 1980, mainly in the framework of IEA, and also among the German-speaking countries (D-A-CH)

Site visit to Schwalbach GSHP Research Station during German-Swiss workshop at Giessen University, 24.6.1986

Scientific Committee of 1st Symposium on GSHP, Schloss Rauischholzhausen, 9.10.1991 (AT, CH, DE, LI)

2nd Symposium on GSHP, Schloss Rauischholzhausen, 18.10.1994

Co-operation shifts to quality and training

Among the D-A-CH countries, joint quality certificates were discussed for heat pumps and for borehole heat exchangers (BHE):

Heat Pump Quality Label for Austria, Germany, Switzerland, from about 2000 on

today international label run by EHPA

From 2005 on, similar attempt for quality of BHE; Swiss label widely accepted, in other countries (e.g. Germany) meanwhile replaced

Today some more schemes like QualiForage in France

Co-operation shifts further to planning

Several international projects looked at legal and regulatory issues, with emphasis on transfer of best practises and on harmonisation:

Some OPET actions in the 1990s, several bi- or trinational activities in Interreg-projects etc. until today

K4RES-H - Key Issues for Renewable Heat in Europe, 2004-2007
(e.g. best practice in support schemes, incl. shallow geothermal)

GROUNDREACH - Reaching the Kyoto targets by means of a wide introduction of GSHP in the built environment, 2006-2008
(promotion of shallow geothermal with individuals and communities)

GTR-H - Geothermal Regulation, 2006-2009
(legal and regulatory framework)

REGEOCITIES - Regulations of Geothermal HP systems at local and regional level in Europe, 2012-2015

Role of Transnational Co-operation

Today, the barriers against further market growth of shallow geothermal can be divided into 3 groups:

- Economic shortcomings for heating mode in certain countries (fossil too cheap, electricity too expensive)
- Insufficient awareness with the public (potential consumers), the planners/installers, and the regulatory administration
- Exaggerated licensing requirements, driving cost and uncertainty

Subsidies and grants can only partly offset these barriers.

was tackled e.g. by projects Geotrainet and Regeocities

Role of Transnational Co-operation

Interreg CENTRAL EUROPE GeoPLASMA-CE

Regeocities

In several Euopean countries, shallow geothermal has already a firm place on the market.

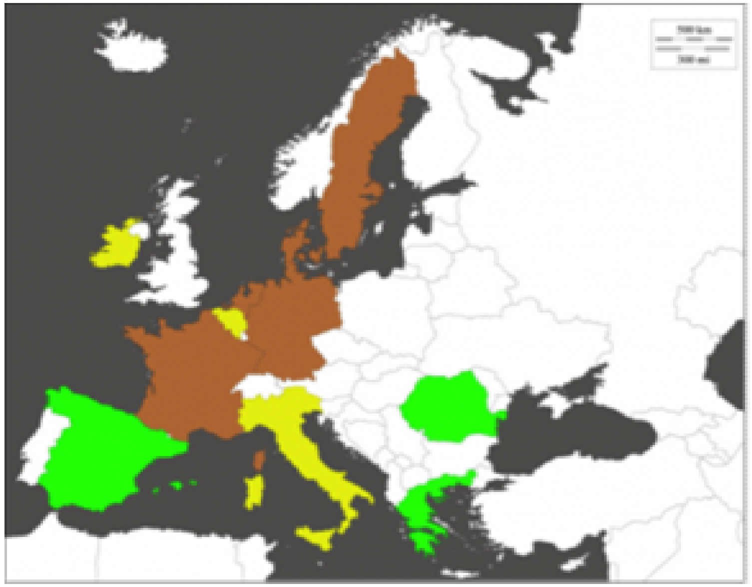
In other countries, the development is hindered by

- legal and regulatory barriers,
- lack of awareness,
- insufficient skills and knowledge with local workforce,
- distortions in the heating market (i.e. subsidised gas prices)
- and other obstacles.

Project Regeocities provided analysis of these barriers and proposed solutions

REGEOCITIES

http://regeocities.eu/



Regeocities partner countries

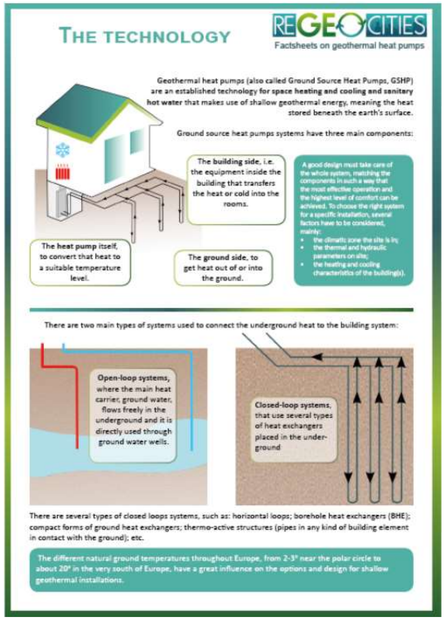
EGEC GEOTHERMAL

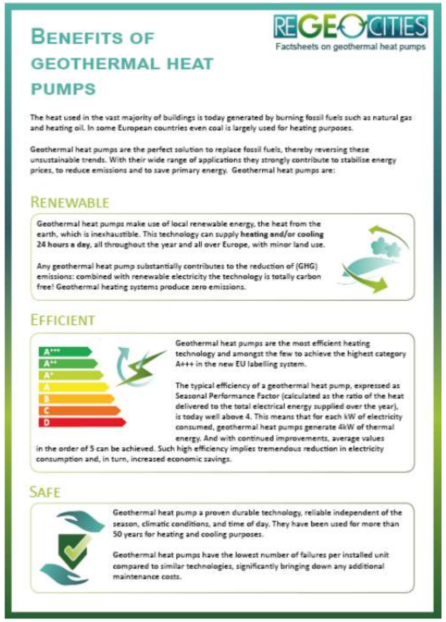
Role of Transnational Co-operation

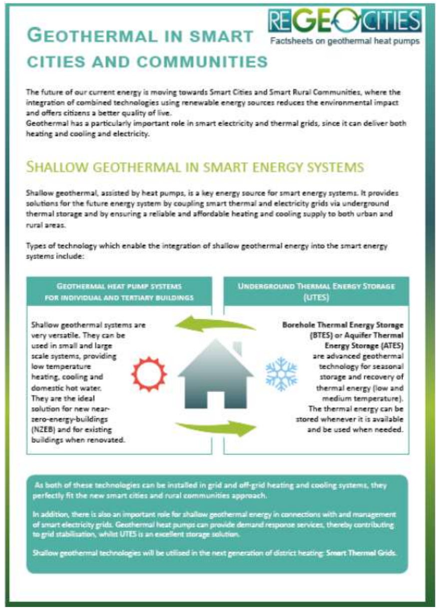
Heat Under Your Feet – Promotion for Shallow Geothermal Energy

The campaign „The Heat under your Feet“ is intended to create more awareness of shallow geothermal technologies, and the solutions and advantages they can deliver.

A spin-off from project Regeocities, now continued by EGEC, provides basic information in several languages.







Factsheets from
http://www.heatunderyourfeet.eu

Role of Transnational Co-operation

Heat Under Your Feet – Promotion for Shallow Geothermal Energy

Example for target on city planning:

Workshop in Brussels in June 2015
“Developing Sustainable Energy in your City?
The Heat Under Your Feet is a Solution”

http://www.heatunderyourfeet.eu

Role of Transnational Co-operation

Example of successful transfer of installation knowledge

LEGEND - Low Enthalpy Geothermal ENergy Demonstration cases for Energy Efficient building in Adriatic area

Partners from Albania, Bosnia-Herzegowina, Croatia, Italy, Montenegro, Serbia, Slovenia

The Project is co-funded by the European Union Instrument for Pre-Accession Assistance

Several projects in communities (schools etc.) built or refurbished using shallow geothermal, with monitoring campaign

Legend final conference in Castello d´Este, Ferrara, Dec. 2014

Role of Transnational Co-operation

The influence of the Covenant of Mayors

The CoM brings cities engaged in climate protection into a common framework.

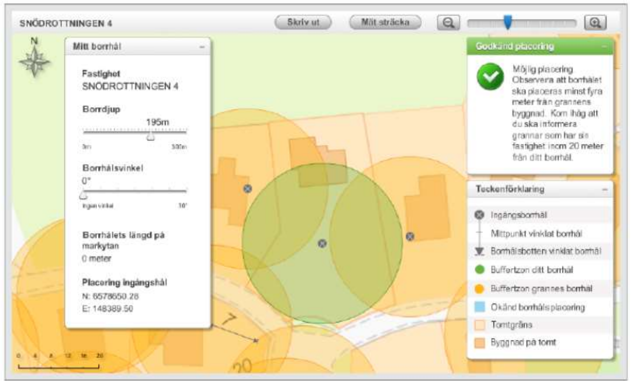
The cities have to pledge to some targets and prepare a Sustainable Energy Action Plan (SEAP).

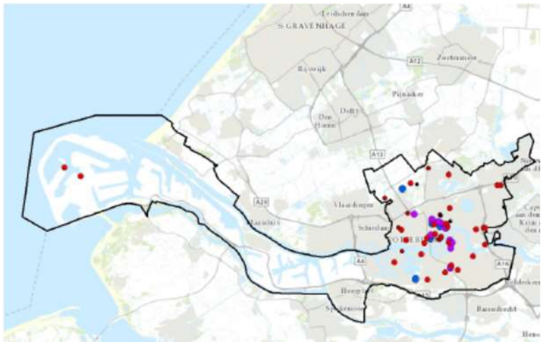
In Germany in 2012, of the 40+ CoM-cities only few did mention geothermal in their SEAP, and only 4 of them shallow geothermal.
This may have improved meanwhile, and needs to improve further!

Within Regeocities, joint seminars with CoM were held in 2013-2015, and cities like Stockholm or Rotterdam could inspire other with their regulatory achievements

Värmepump - ansök om tillstånd

Gemeente Rotterdam





Thank you for your attention!