

GEOPLASMA-CE: CATALOGUE OF REQUIREMENTS

Stakeholder survey about requirements on shallow geothermal energy

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INES GÖRZ¹, Karina Hofmann¹, PETER RIEDEL¹, Ottomar Krentz¹, & THE GEOPLASMA-CE TEAM.

¹ Saxon State Survey for Environment, Agriculture and Geology (Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie)





The involved GeoPLASMA-CE team

<i>Geological Survey of Austria (LP)</i>	G. Goetzl, C. Steiner
<i>Czech Geological Survey</i>	Jan Holeček
<i>Polish Institute of Geology - National Research Institute</i>	M. Kłonowski, W. Kozdrój
<i>University of Science and Technology AGH Krakow</i>	M. Hajto
<i>State Geological Institute Dionýz Štúr</i>	Radovan Černák
<i>Geological Survey of Slovenia</i>	M. Janža, D. Šram, U. Šolc



Abstract

A stakeholder query was performed in order to investigate which information and products (maps, online-platforms) the stakeholders working in the field of shallow geothermal energy are interested in. The survey was accomplished in 6 states cooperating in the European GEOPLASMA-CE project, Austria, the Czech Republic, Germany, Poland, Slovakia and Slovenia. The most important stakeholder groups, licensing authorities, political stakeholders, designers/consultants of geothermal plants, drilling companies, equipment producers and others were asked to participate. A set of 65 parameters concerning different aspects of the use of geothermal energy was registered. A statistical analysis of the survey feedback shows, that all stakeholder groups are interested in:

- supporting information on the suitability of different forms of geothermal energy,
- geothermal potential maps,
- risk and land-use conflict maps,
- location queries on local scale in PDF format,
- detailed information on groundwater.

Some of the registered parameters are only interesting for specific stakeholder groups, like information on:

- temperature,
- specific thermal conductivity,
- specific heat extraction rate,
- geological units,
- various depth levels,
- factors of risk and landuse-conflicts like groundwater and curative water protection zones, existing geothermal usage, cavities, electric and pipe lines
- national legal frameworks and quality requirements for geothermal plants,
- suitable plant design,
- electronic administration systems,
- limitations of the admissible drilling depth.

The other registered parameters were not so interesting, like information on certificates of drilling companies or specific risk factors like karst.

As a result of the stakeholder survey, a catalogue of requirements is composed, showing, which information on shallow geothermal systems should be provided in each state of the GEOPLASMA-CE project.



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1. Introduction

The objective of this project is to compile joint methods, workflows, quality standards and regulations for the planning, assessment, management and monitoring of shallow geothermal energy plants (<http://www.interreg-central.eu/Content.Node/GeoPLASMA-CE.html>).

First, a stakeholder survey assessed relevant parameters concerning the requirements for planning, assessment, management and monitoring of shallow geothermal energy. The outputs of the stakeholder survey were interpreted and summarized to a catalogue of requirements which will form one of the bases of the GeoPLASMA-CE project. The country specific requirements for all partner states are listed as an overview in **Annex 3**.

2. Assessment of existing shallow geothermal systems

An investigation of existing shallow geothermal systems used in the participating countries and pilot areas gave an overview on the market situation of geothermal systems in each partner country (**Annex 1**). The results show various levels of development in the different partner countries and pilot areas of GeoPLASMA-CE. E.g. Slovakia and the Czech Republic cannot give any safe information about installed geothermal systems. Shallow geothermal installations are not registered by any legislative entity in the Czech Republic and Slovakia, so it is very difficult to say how many and where they are installed. Only a raw estimation exists for the heat pump market. In opposite to this, partner countries like Austria and Germany have a good knowledge about existing geothermal systems. In Slovenia there is no official register of installed shallow geothermal systems. The estimate provided here is the number of issued water permits for the use of groundwater for geothermal systems. The lack of information about existing geothermal systems could have different reasons in the different partner countries. The project GeoPLASMA-CE can contribute to improve the situation. A first step in this direction is this stakeholder survey.

3. Stakeholder survey

3.1. The purpose of the survey

The survey investigated key parameters and information needed to plan, assess, and manage shallow geothermal energy including applied data formats by the involvement of stakeholders. It was addressed to professionals working in the field of shallow geothermal energy like consultants and designers, drilling companies, equipment producers, architects, licensing authorities and politicians in the 6 states contributing in GeoPLASMA-CE.

3.2. Questions and mode of answers

The survey mainly consisted of single choice questions and two multiple choice questions (for the local, regional or international scale of maps and query reports). The questionnaire is attached in **Annex 2** of this document. Four main questions were asked, in order to find out, whether information material, electronic administration systems and decision support is required. If the main questions were answered with yes, an additional catalogue of questions with details was answered by the participants, for example, whether an overview over legal frameworks and quality requirements or object-related quality measures are needed, whether maps of geothermal and conflict potential are needed, which parameters should be displayed on



them and which scale of these maps is required by the stakeholders. In total, 65 variables were registered.

3.3. The survey

The questionnaire template was developed to ensure the standardized query of the stakeholder requirements.

A first draft of questionnaire template was developed by the work package leader in English language and was distributed to all project partners. Additionally, it was distributed to all country representatives for review, discussion and adaption. As result, a harmonized template of the stakeholder query was developed in form of an offline pdf-form-file (English version see [Annex 2](#)). The finalized harmonized standardized query was translated by country representatives and was distributed via e-mail to country specific stakeholders. The survey started on 13th of October 2016 and terminated on 31th of October.

A stakeholder list was developed by each project partner to reach the most participants. Finally the main stakeholder groups were defined as licensing authority, political stakeholder (e.g. ministry, urban and regional planning), consultant, designer for shallow geothermal plants, drilling company, equipment manufacturer and architects.

3.4. The sample

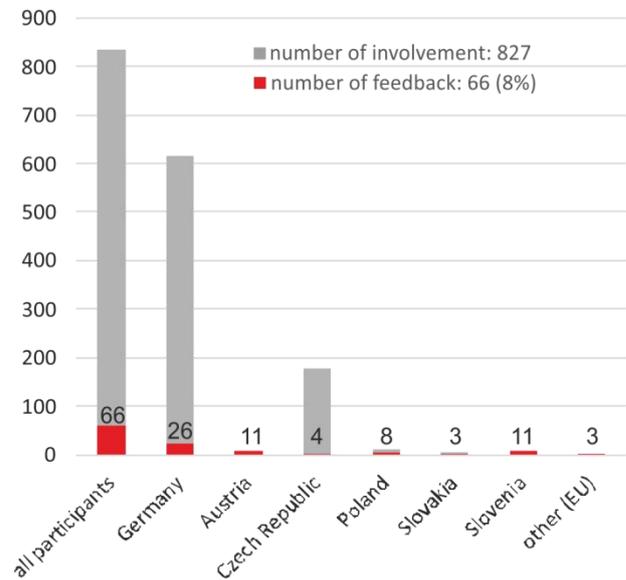
827 stakeholders were asked to fill the questionnaire ([Figure 1](#)). A feedback of 7.6% (65 questionnaires) was received. We thank all participants for their effort. While some stakeholder groups and states gave a lot of feedback, others are represented by only 3 or 4 participants. These are the equipment producers, the Czech Republic and Slovakia. These groups were also included into the data analysis, however, it has to be emphasised that these small groups may bias the results of the data analysis, since not all professional groups or states are represented in these groups.



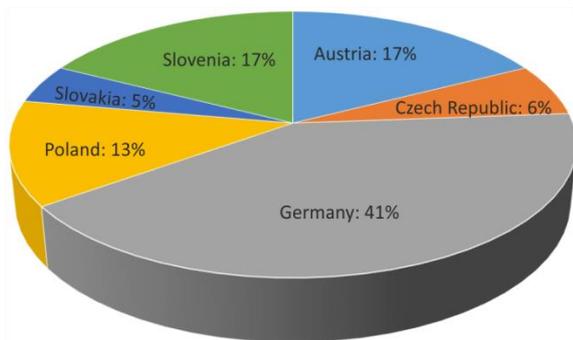
participants



feedback



portions of states



portions of interest groups

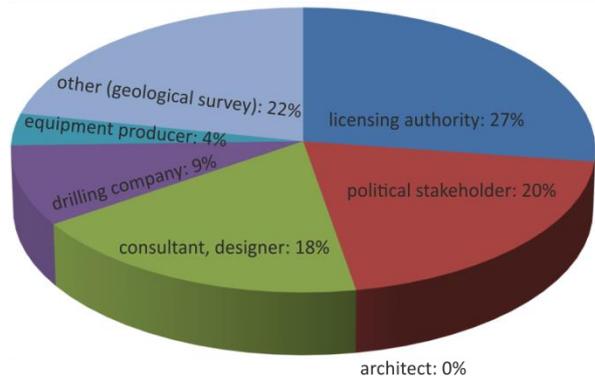


Figure 1: States and interest groups participating in the survey.

4. Data analysis

4.1. Methodology

The returned PDF-file-files of the questionnaires were counted manually. The data were classified with respect to the state and the interest group a stakeholder belongs to, which gives 12 categories to be used for interpretation. Since the survey consisted mainly of single choice questions, the percentage of participants voting with “yes” was used for the analysis of the results.

Descriptive statistic methods were used to describe the value of one variable. The percentage of each category describes the portion of participants, which is interested in one information or parameter. The median was used to describe the unskewed average of all categories. It was used instead of the arithmetic mean, because it is robust to extremely large or small values, which were obtained from the groups with less than five participants. Additionally, we used the quartiles and the 1,5-quartile range as measures for the variability.



Differences between the value of two variables have to be tested with statistical hypothesis testing in order to show, whether a difference can be considered as random or as a characteristic of the sample. In this study, we used the Wilcoxon test, which tests whether the medians of two variables are equal. If the hypothesis of equality can be rejected, the medians are significantly different on a certain confidence level. The test statistics is dependent on the sample size; if the sample size is small, greater differences are needed to reject the hypothesis. Since we have only 12 samples (the categories), the difference in the value of two variables could sometimes not be proofed to be statistically significant. So, this difference can be evaluated as the result of this one survey, but cannot be generalised.

The Pearson's correlation coefficient is the measure for the strength of the linear relationship between two variables. A correlation coefficient of zero indicates that there is no relation between the variables. The stronger the association between the two variables, the greater is the amount of the correlation coefficient. For small correlation coefficients a statistical significance test can be used to test the hypothesis, that no linear relationship is existing. For our dataset, all correlation coefficients of $r > |0.56|$ are significant at a 95% level of significance. The corresponding variables can be considered as correlated.

Since the correlation matrix is very big (65 x 65), a principal component analysis was performed to convert a set of correlated variables into a set of uncorrelated variables called principal components. The principal components are determined by an eigenvalue decomposition of the correlation matrix, the first component represents the axis of the largest variance of the data set. This transformation reveals the internal structure of the data in a way that best explains the variance of the data.

4.2. Visualizations

For visualisation of the results, we use bar charts displaying the percentage of one category and boxplots. A boxplot visualises the median as central value and the quartiles as measures of variance. Additionally, the boxplot displays whiskers, which represent the value of the sample which is closest to the 1.5-interquartile range. Values outside of the 1.5-interquartile range are displayed as points representing outliers. If the variability of one set of variables was big, we added tables displaying the variables in each category. The values were categorised in 20% steps for visualisation and a good comparability.

The correlation between two variables was plotted either as scatter plot to show the linear relation of the data referring to one variable or as line plots in order to compare several correlation coefficients. Additionally, the data set was plotted in the principal component space, which allows for grouping of variables.

5. Univariate data analysis

5.1. Main questions

Our participants were asked four main questions, if one of these questions was answered with “yes”, more detailed questions were asked. The main questions were:

- Is any supporting information helpful to foster the use of shallow geothermal energy with focus to an environmentally friendly and sustainable climate and energy policy at local, national and international levels (**general information**)?
- Is an administration system required, combining e.g. electronic filling of applications and filling of monitoring data (**electronic administration system**)?



- Is a decision support and information required for the planning and the licensing of a geothermal heat-pipe system (**decision support for closed loop systems**)?
- Is a decision support and information required for the planning and the licensing of a groundwater heat-pump system (**decision support for open loop systems**)?

All stakeholder groups are interested in supporting information, an electronic administration system and in decision support (**Figure 2, Table 1**). Stakeholders in most states, except the Czech and Slovakian Republic, are interested in supporting information, an administration system and in decision support.

Political stakeholders, drilling companies, equipment manufacturers and others are strongly interested in general information. Licencing authorities and consultants/designers are less interested in general information. Licencing authorities, drilling companies and equipment manufacturers are strongly interested in electronic administration systems. Political stakeholders, consultants/designers and others are less interested in electronic administration systems.

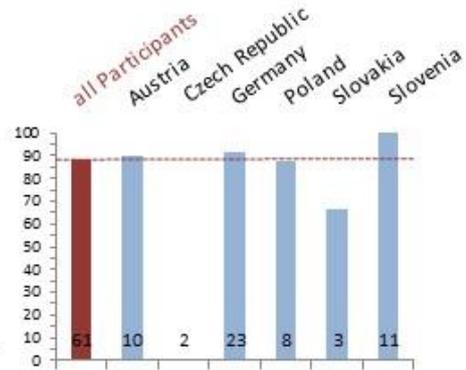
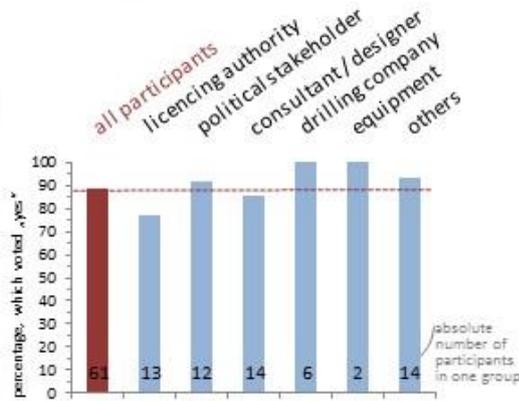
Consultants/designers, drilling companies and equipment manufacturers are strongly interested in decision support for both open and closed loop systems. Licencing authorities, political stakeholders and others are less interested in decision support.



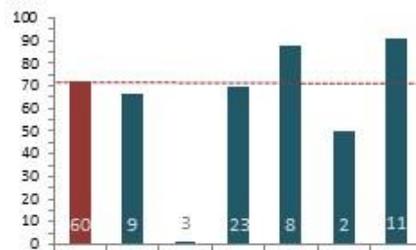
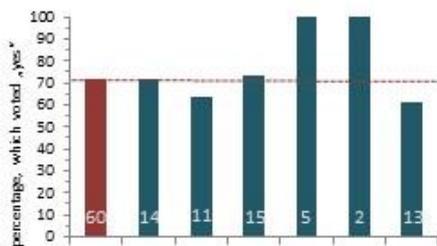
Answers to the main questions

Stakeholders wish:

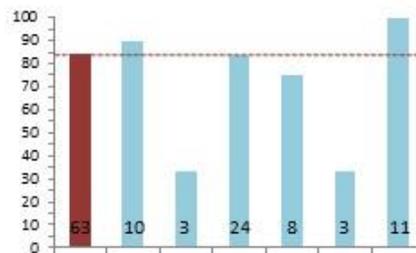
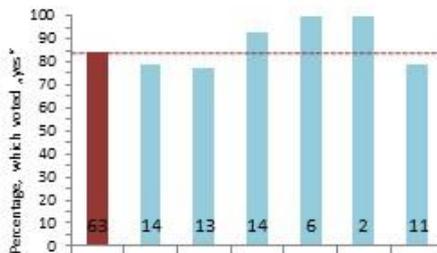
general supporting information



electronic administration system



decision support for closed systems



decision support for open systems

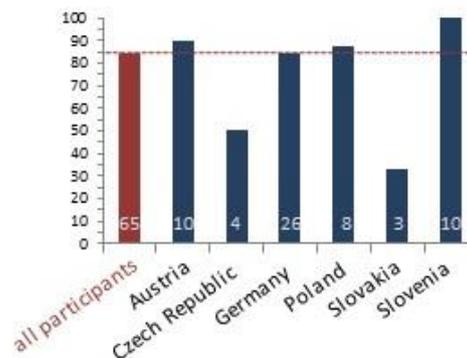
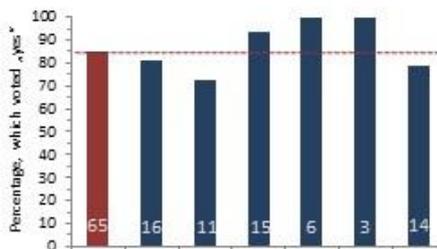


Figure 2: Answers to the main questions.



	general supporting information	administration system	decision support (closed loop systems)	decision support (open loop systems)
licensing authority	X X	X X	X X	X X X
political stakeholder	X X X	X X	X X	X X
consultant, designer	X X X	X X	X X X	X X X
drilling company	X X X	X X X	X X X	X X X
equipment producer	X X X	X X X	X X X	X X X
others	X X X	X X	X X	X X
Austria	X X X	X X	X X X	X X X
Czech Republik	O O	O O	O	X
Germany	X X X	X X	X X X	X X X
Poland	X X X	X X X	X X	X X X
Slovakia	X X	X	O	O
Slovenia	X X X	X X X	X X X	X X X

X X X strongly interested (>80%)
 X X interested (60-80%)
 X less interested (40-60%)
O uninterested (20-40%)
 O O no interest (0-20%)

Table 1: Answers to the main questions.

5.2. Detailed questions

5.2.1. Information material

We asked our participants, which information material on shallow thermal systems they would like to have:

- general information material,
- overviews over national legal frameworks,
- approval related and quality requirements for installation, operation and monitoring of shallow geothermal plants,
- overviews of the suitability of different forms of geothermal industry,
- information about the geological units,
- information about existing usage.

While approx. 70% of the whole sample is interested in all kinds of information material, great differences in interest appear in the categories of professional groups and states (**Figure 3, Table 2**). Licensing authorities are interested in geology and existing usage; less interested in general information material and information about the suitability of different forms of geothermal industry and in information on legal frameworks and requirements. In contrast, political stakeholders are less interested or uninterested in



information about geology and existing use, but are interested in general information material, information about the suitability and requirements. Consultants/designers, drilling companies and equipment producers are strongly interested in all kinds of information material. Participant from the Czech Republic are uninterested in any kind of information material, participants from Slovakia are interested in general information material and uninterested in all other kinds of information material. In contrast, participants from Austria are interested in all kinds of material. Therefore, the set of information material should be tailored to the needs of each country and should consider the different groups of interest.

	information material	legal frame-works and requirements	suitability of forms of geothermal energy	geological units	existing usage
licensing authority	X	X	X	XX	XX
political stakeholder	XX	XX	X	O	X
consultant/designer	XX	XX	XX	XXX	XX
drilling company	XXX	XXX	XXX	XXX	XXX
equipment producer	XXX	XXX	XXX	XX	XXX
others	XX	XX	XX	XX	XX
Austria	XX	XX	XX	XX	XXX
Czech Republic	OO	OO	OO	O	O
Germany	XX	XXX	X	XX	XX
Poland	X	XX	XX	XX	XX
Slovakia	XX	OO	O	O	OO
Slovenia	XXX	XXX	XXX	XX	XX

XXX	strongly interested (>80%)	XX	interested (60-80%)	X	less interested (40-60%)
O	uninterested (20-40%)	OO	no interest (0-20%)		



Table 2: Information material on shallow geothermal systems.
Information material on shallow geothermal systems

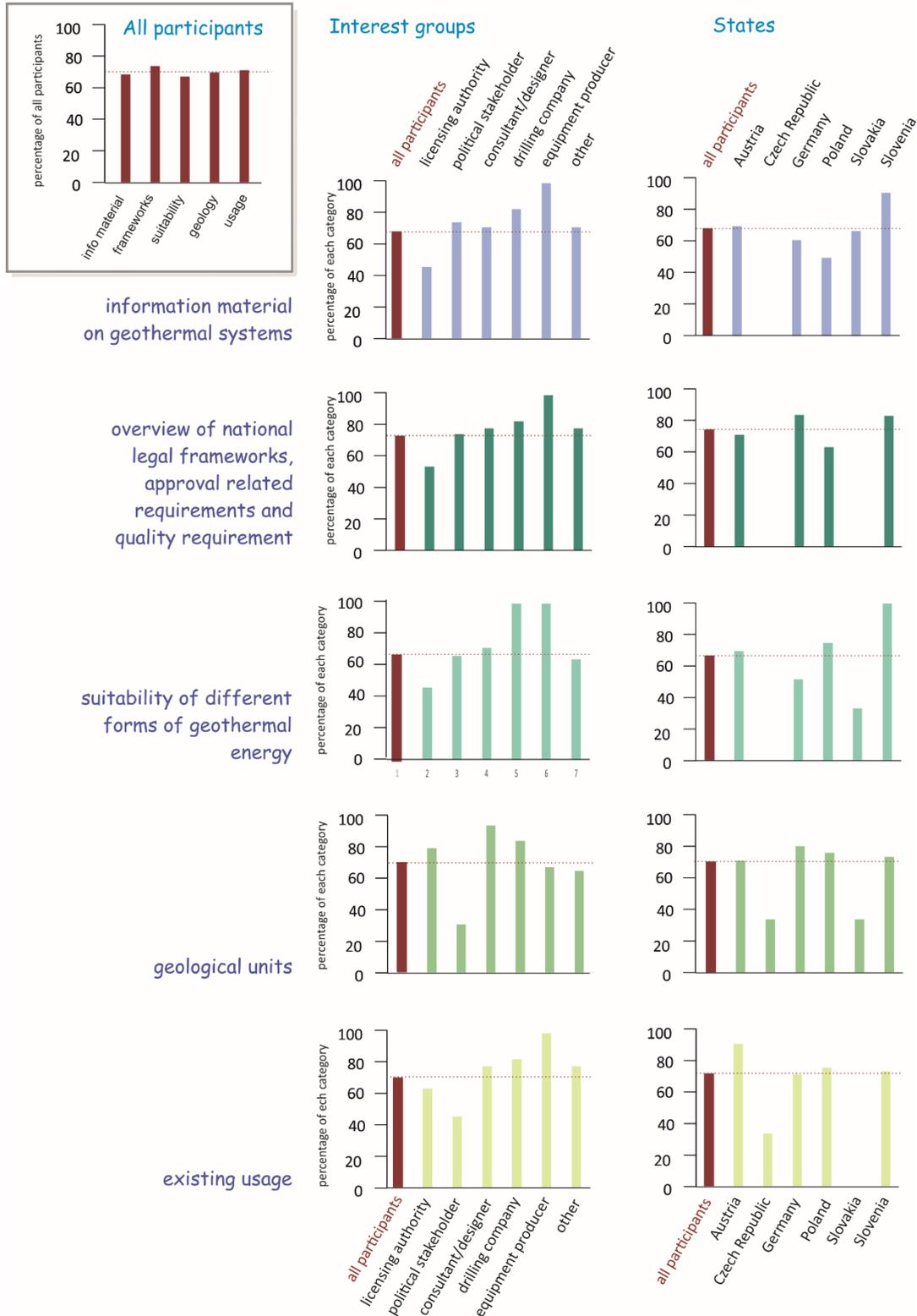


Figure 3: Information material on shallow geothermal systems



5.2.2. Location queries in report form

72% of the stakeholders would like to perform location queries with results presented in report form on a local administrative scale. 40% of the participants would like to get these reports on a national scale, 10% on an international scale (Figure 4). The results of this block are significantly different with a confidence level of 98% (one-sided Wilcoxon and t-tests). Exceptions are drilling companies, which are interested in location queries on all scales and the stakeholders from Austria, who are more interested in queries on a regional scale than on a local scale.

Stakeholders wish location queries in report form

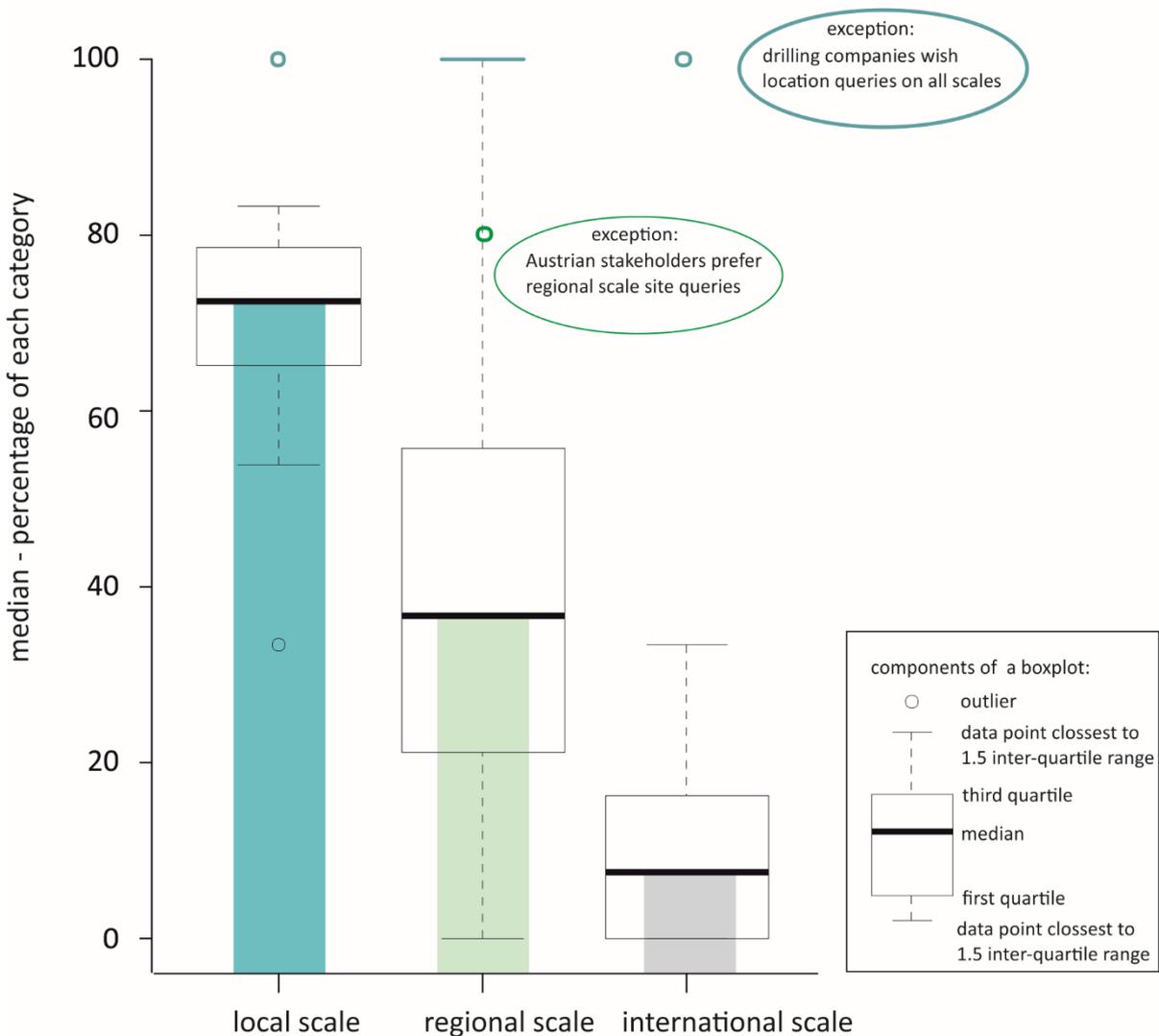


Figure 4: Interest of stakeholders in location queries in report form.



5.2.3. Maps of geothermal potential

The participants were asked, whether they were interested in maps displaying the geothermal potential (Figure 5). 79% percent of the participants wish support by this sort of maps, 59% would like to have them on various depth levels. The participants from all states and stakeholder groups are mainly interested in information on the local administrative scale and less interested in maps of decreasing scale (national and European overviews). An exception is the group of the consultants and designers, which are strongly interested in national overview maps.

A visualization of the temperature is requested by 73% of the participants, additionally 57% are interested in the specific heat conductivity and 54% in the specific heat extraction rate. Apart from this general result, the stakeholder groups of licensing authorities and of drilling companies prefer a visualization of specific heat extraction rates. 48% of the participants are interested in information about natural and anthropogenic influences on the temperature.

Maps of geothermal potential

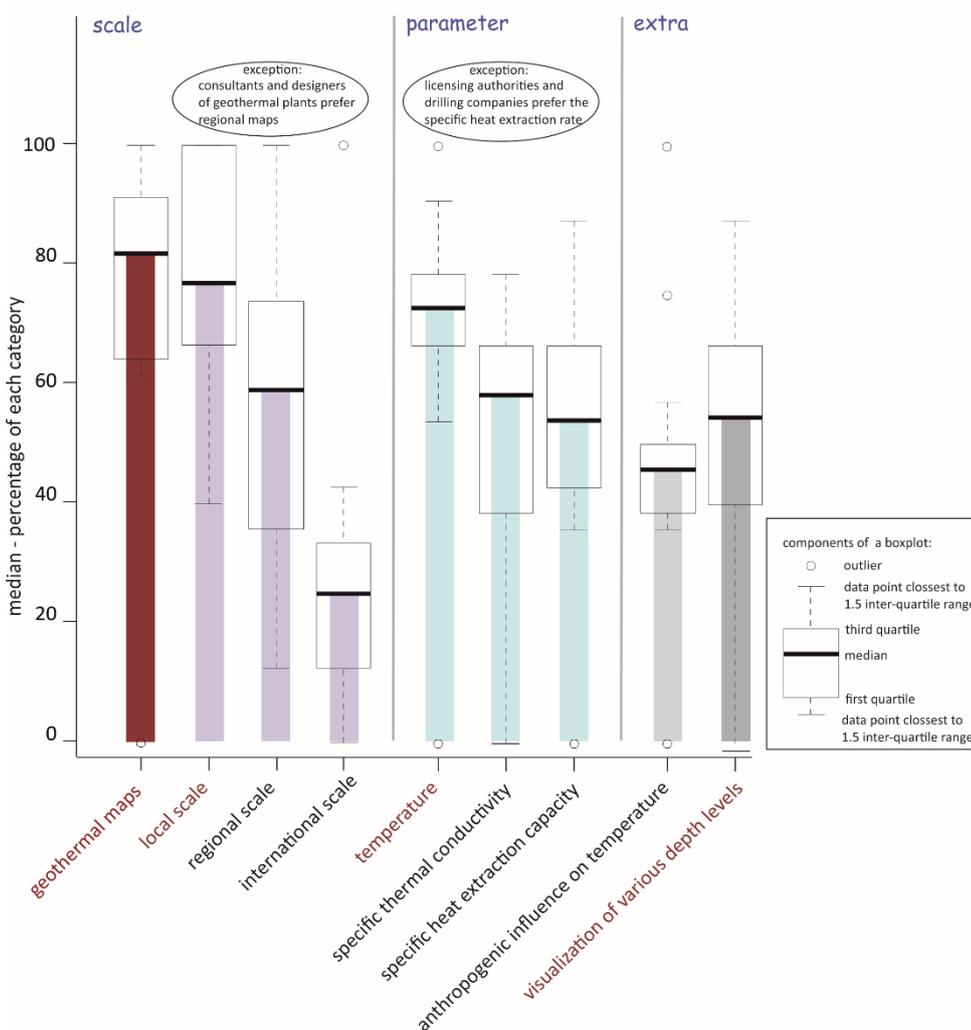


Figure 5: Interest of stakeholders in maps displaying the geothermal potential.



5.2.4. Maps of conflict and risk potential

80% of the stakeholders are interested in maps showing land-use conflicts and restriction zones for geothermal usage (Figure 6). Factors describing possible conflicts and restrictions were registered separately for open and closed loop geothermal systems. The results for stakeholders using one of the both systems are statistically equal within the 95% confidence interval (Wilcox test), with exception of the risk factor of cavities. The stakeholders are very interested (60-80%) in information about limitations of drilling depths, drinking water protection zones, cavities, protection zones for curative water, confined, artesian and hydraulically separated aquifers. They are less interested (<60%) in information about electric and pipelines, tectonic faults, karst systems, swellable rocks and natural reserves. Exceptions are the interest groups of consultants/designers and drilling companies, who are strongly interested in information about faults and karst (83%) and about electric and pipelines (79%).

Maps about land-use conflicts and risks

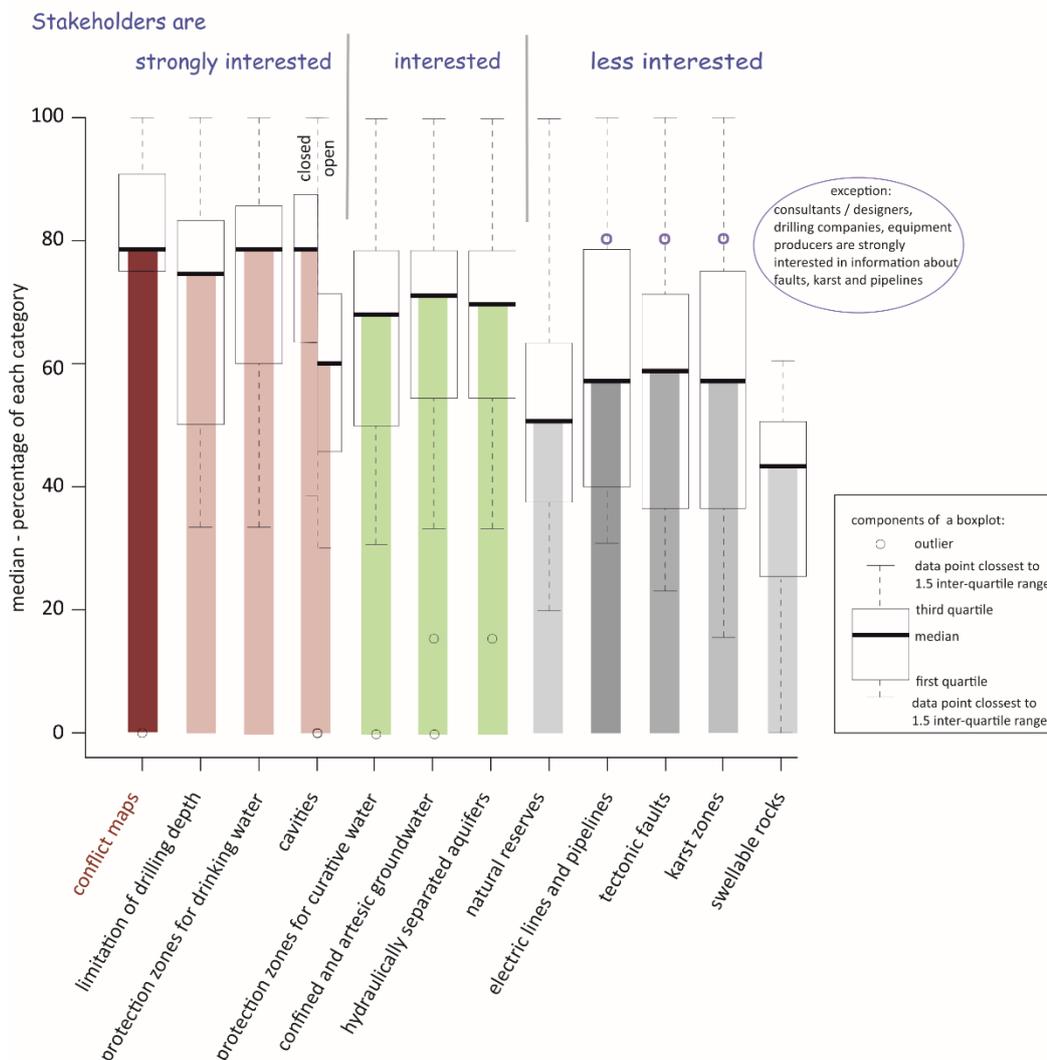


Figure 6: Interest of stakeholders in land-use conflict and risk factors.



5.2.5. Information on the geological situation

All stakeholders are interested in information on the geological units, but they are less interested in detailed information on floodplains, faults, karst and swellable rocks (Figure 7). There are differences in the interest of the different professional groups and states (Table 3). While licensing authorities and drilling companies are interested in general information on geology, they are less interested or uninterested in detailed information. Equipment producers and consultants/designers are interested in general and in detailed information. The participants from the Czech Republic and Slovakia are less than 40% interested in geological information. Stakeholders from Germany are interested in general information on geology and in information on floodplains, but are less interested in information on karst, faults and swellable rocks. Stakeholders from Austria are not interested in floodplains. So, it seems to depend on the geological situation of the states and on the task of the stakeholder, which sort of information is requested.

	geology	floodplains	swellable rocks	faults	karst
licensing authority	X X	O	O	X	O
political_stakeholder	O	O	O O	O	O O
consultant/designer	X X X	X X	X X	X X	X X
drilling company	X X X	X	X	X	X
equipment producer	X X	X X X	X X X	X X X	X X X
others	X X	X	X	X X	X
Austria	X X	O O	O	X	X
Czech Republic	O	O	O	O	O
Germany	X X	X X	X	X	X
Poland	X X	O	X	X X X	X
Slovakia	O	O O	O O	O	O
Slovenia	X X	X X	X	X X	X

X X X strongly interested (>80%)
O uninterested (20-40%)
X X interested (60-80%)
O O no interest (0-20%)
X less interested (40-60%)

Table 3: Interest of stakeholders in geological information.



Interest on geological information

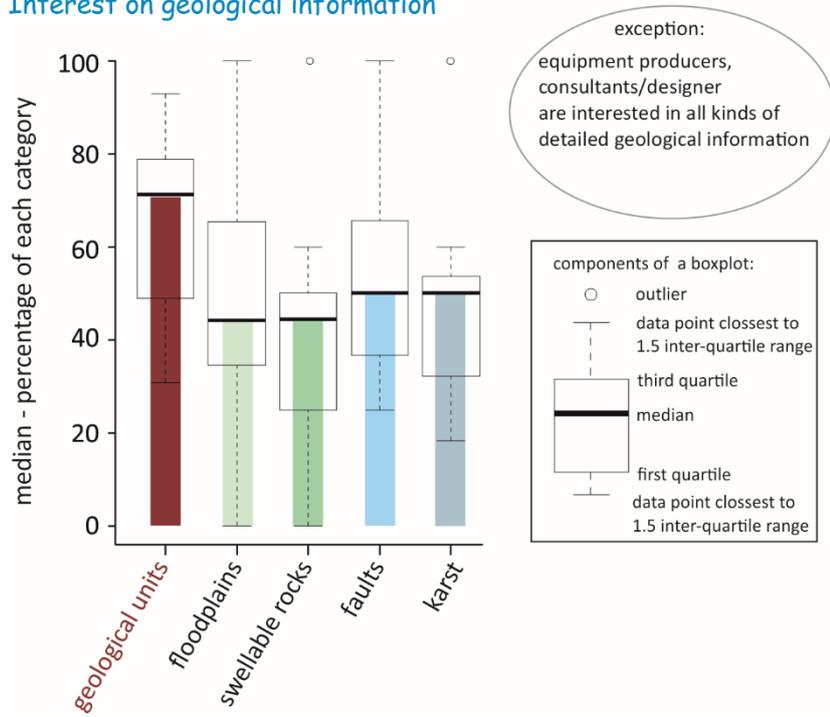


Figure 7: Interest of stakeholders in geological information.



5.2.6. Information on groundwater

All stakeholders are interested or strongly interested in general and detailed information on ground water and aquifers (Figure 8). Exceptions are political stakeholders, who are less interested or uninterested, and the participants from the Czech Republic and Slovakia, who are less than 40% interested in information on groundwater and aquifers.

Information on groundwater and aquifers

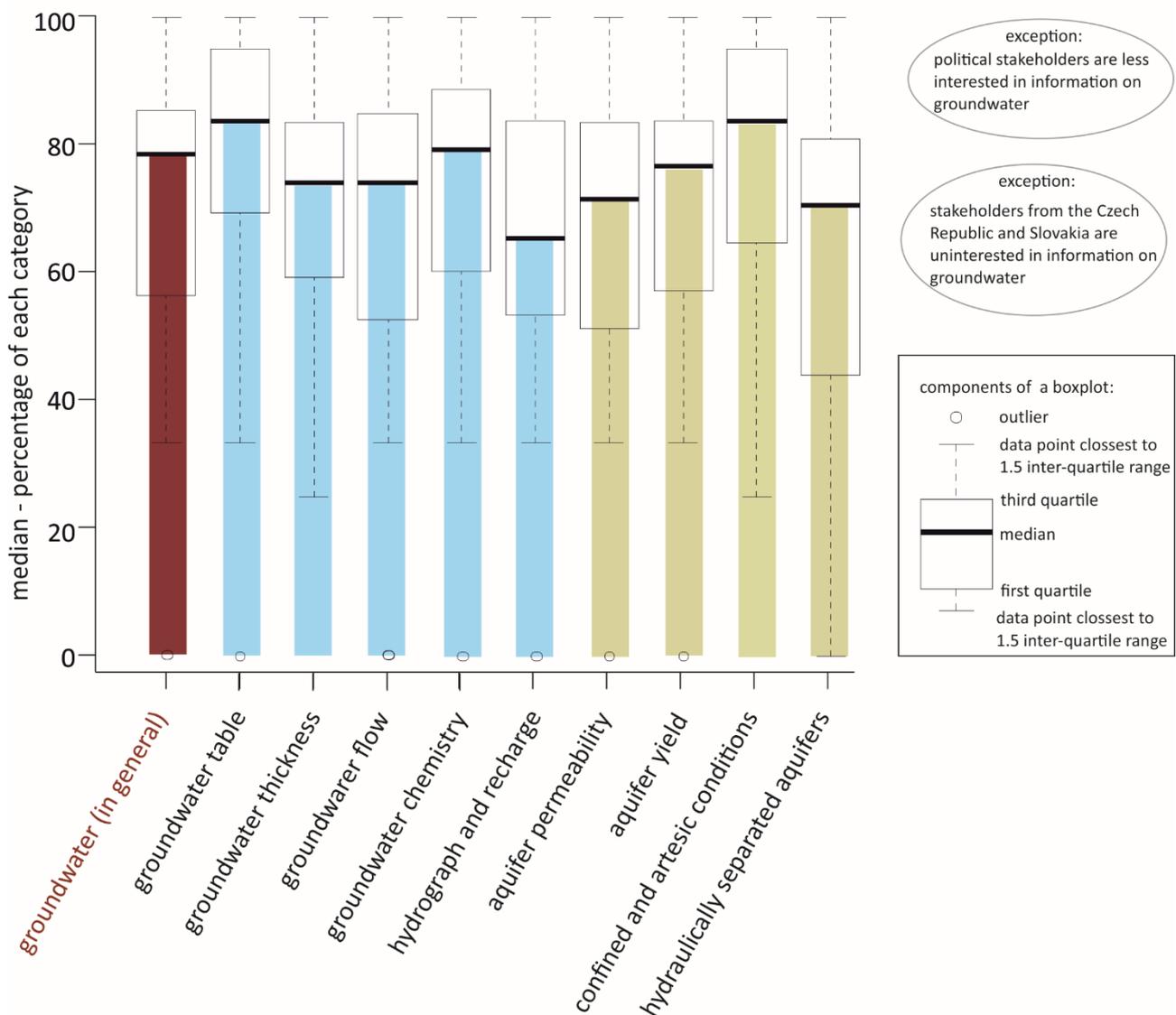


Figure 8: Interest of stakeholders in information on groundwater and aquifers.



5.2.7. Information on object-related quality measures for geothermal plants

While the whole sample is interested or less interested in information on object-related quality measures (**Figure 9**), the different professional groups and states show again great variations in their interest (**Table 4**).

Stakeholders from Poland and Slovenia, licensing authorities, equipment producers and other are interested or strongly interested. Stakeholders from Austria and Germany as well as consultants/designers are less interested. Stakeholders from the Czech Republic and Slovakia as well as political stakeholders are uninterested.

Information on object-related quality measures

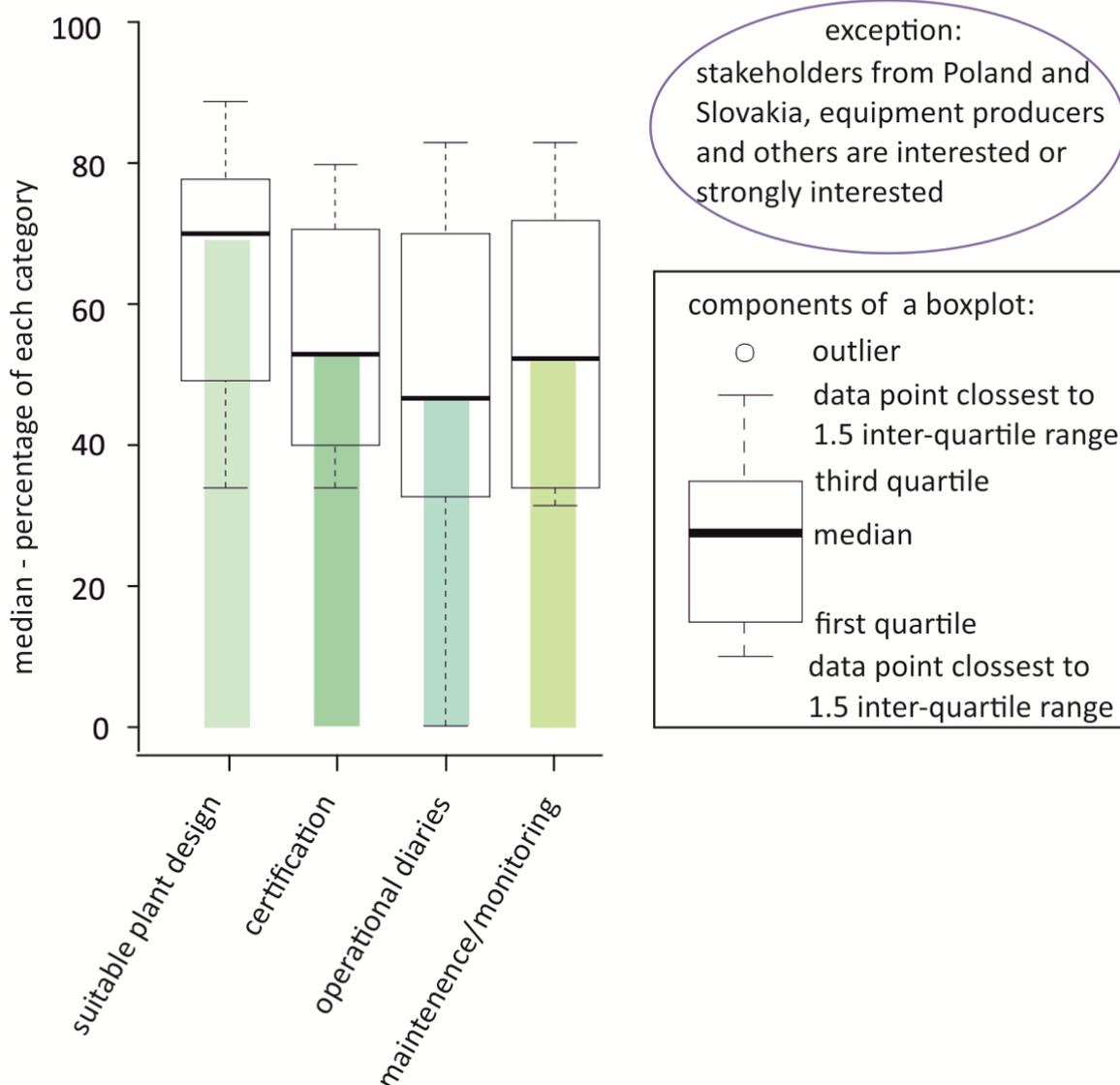


Figure 9: Interest of stakeholders in object-related quality measures.



	suitable plant design	certificates for companies and material	operational diaries	measures for maintenance and plant monitoring
licensing authority	XX	XX	XX	XX
political stakeholder	O	O	O	O
consultant, designer	XX	X	X	XX
drilling company	XXX	X	O	O
equipment producer	XX	XX	XX	XX
others	XX	XX	XX	XX
Austria	XX	X	X	X
Czech Republic	O	O	OO	O
Germany	X	X	X	X
Poland	XXX	XX	XX	XX
Slovakia	O	O	OO	O
Slovenia	XXX	XX	XXX	XXX

XXX

strongly interested (>80%)

XX

interested (60-80%)
no interest (0-20%)

X

less interested (40-60%)

O

uninterested (20-40%)

OO

Table 4: Interest of stakeholders in object-relates quality measures.



5.2.8. Summary of univariate data analysis

Professional groups with commercial interest in geothermal systems (consultants/designers, drilling companies and equipment producers) as well as participants from Slovenia and Poland have the strongest interest in information on shallow geothermal energy (**Figure 10**). Political stakeholders and participants from the Czech Republic and Slovakia need least information on geothermal systems. Detailed questions are often answered differently by various professional groups and states. Therefore, a catalogue comprising the requested information has to be tailored to the needs of each state and should take into consideration the interests of the professional groups. Since too few stakeholders returned the questionnaire, we cannot give recommendations on the parameters needed in every participating state. However, we can give an overall evaluation, which parameters are important and which less.

Sum of interest for the 61 detailed questions

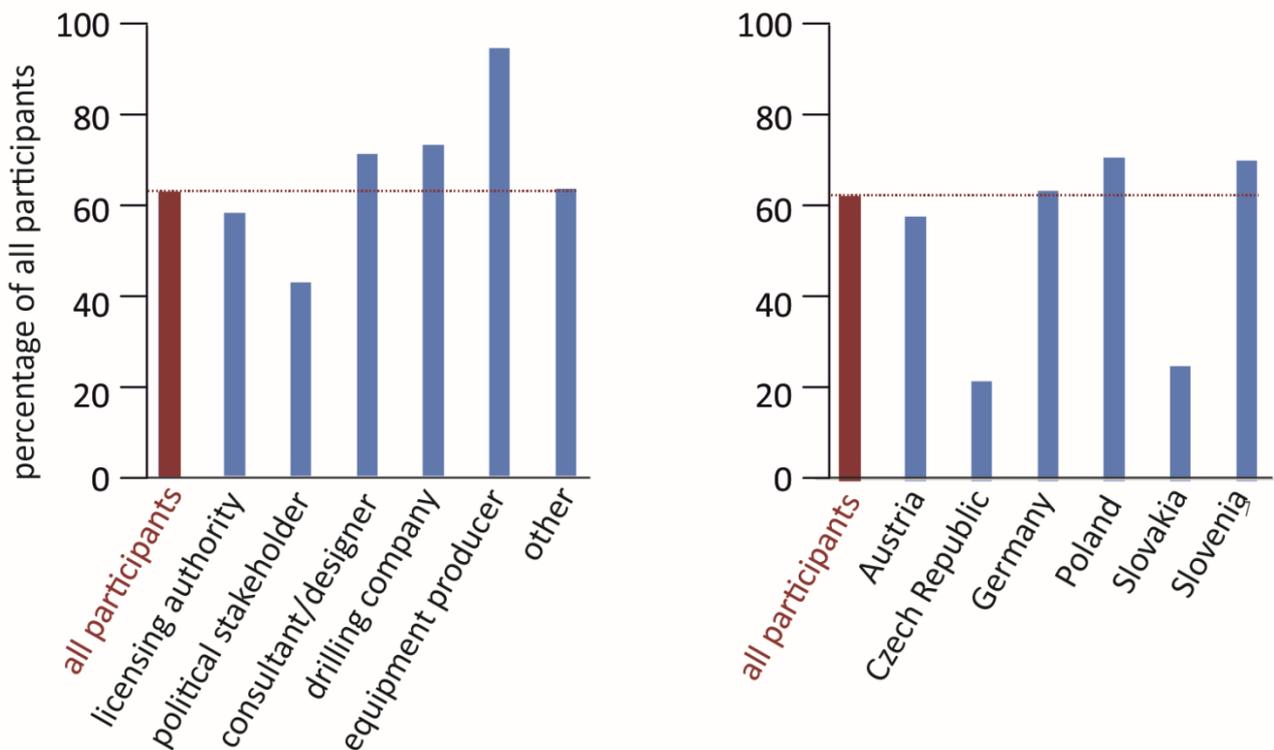


Figure 10: Sum of interest for the 61 detailed questions



very important	important	not important
main questions		
general supporting information decision support (open and closed systems)	electronic administration system	
location query in report form		
local scale	regional scale	international scale
geothermal potential maps		
local scale	regional scale display of temperature display of specific heat extraction capacity display of specific thermal conductivity display of various depth levels	international scale
conflict maps		
limitation of drilling depth protection zones of drinking water cavities	protection zones of curative water confined and artesian groundwater hydraulically separated aquifers	natural reserves electric lines and pipelines faults karst swellable rocks
geological situation		
geological units		faults karst swellable rocks floodplains
groundwater and aquifers		
groundwater table groundwater thickness groundwater chemistry groundwater flow aquifer permeability aquifer yield confined and artesian groundwater hydraulically separated aquifers	hydrograph and recharge rates	
object-related quality measures		
	suitable plant design	certification operational diaries maintenance and monitoring

Table 5: Importance of information and parameters – overview.



6. Correlation and principal component analysis

6.1. Purpose of the analysis

The aim of the bivariate and multivariate data analysis is to find relations between the variables and to answer questions like: If stakeholders are interested in one parameter, which other information is also important for them? If stakeholders are interested in one parameter, which other sort of information is unimportant for them? This analysis may help in composing a catalogue of parameters, which is provided to the stakeholders. Additionally, this analysis can show where interest groups have specific needs, which are not coincident with the needs of other stakeholders.

6.2. Correlation

In this survey, 18 variables were registered twice, once in the context of open and once in the context of closed loop systems. These pairs of variables have correlation coefficients of 0.74-0.98. They are strongly and positively correlated. This means, stakeholders who are interested in one parameter, make the same decision in both contexts. Since the absolute values of the variables are not significantly different except for cavities (Wilcox test, 95% confidence level), the dataset was reduced by the variables registered for the open loop system to 43 variables.



Duplicated questions

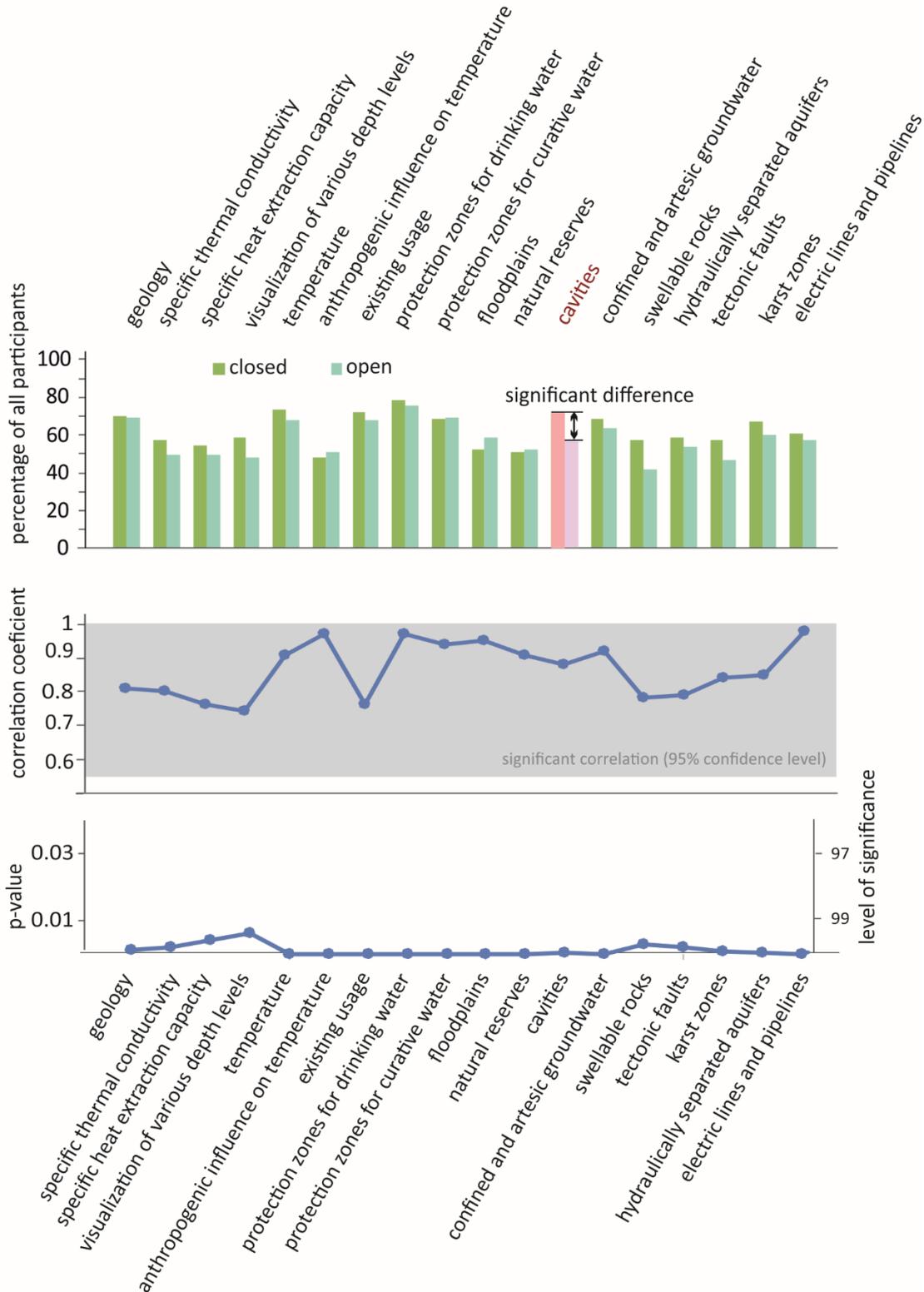


Figure 11: Parameters which were registered twice in the context of open and closed loop systems.

The principal component analysis was performed for these 43 variables. The plot in **Figure 12** displays the loadings, which represent the magnitude of correlation observed between two variables. Short distances indicate a large correlation, large distances a small correlation. The plot clearly shows several groups of variables with a large correlation. This means, that stakeholders who are interested in one variable also are interested in the other parameters of the group.

Data set in the principal component space

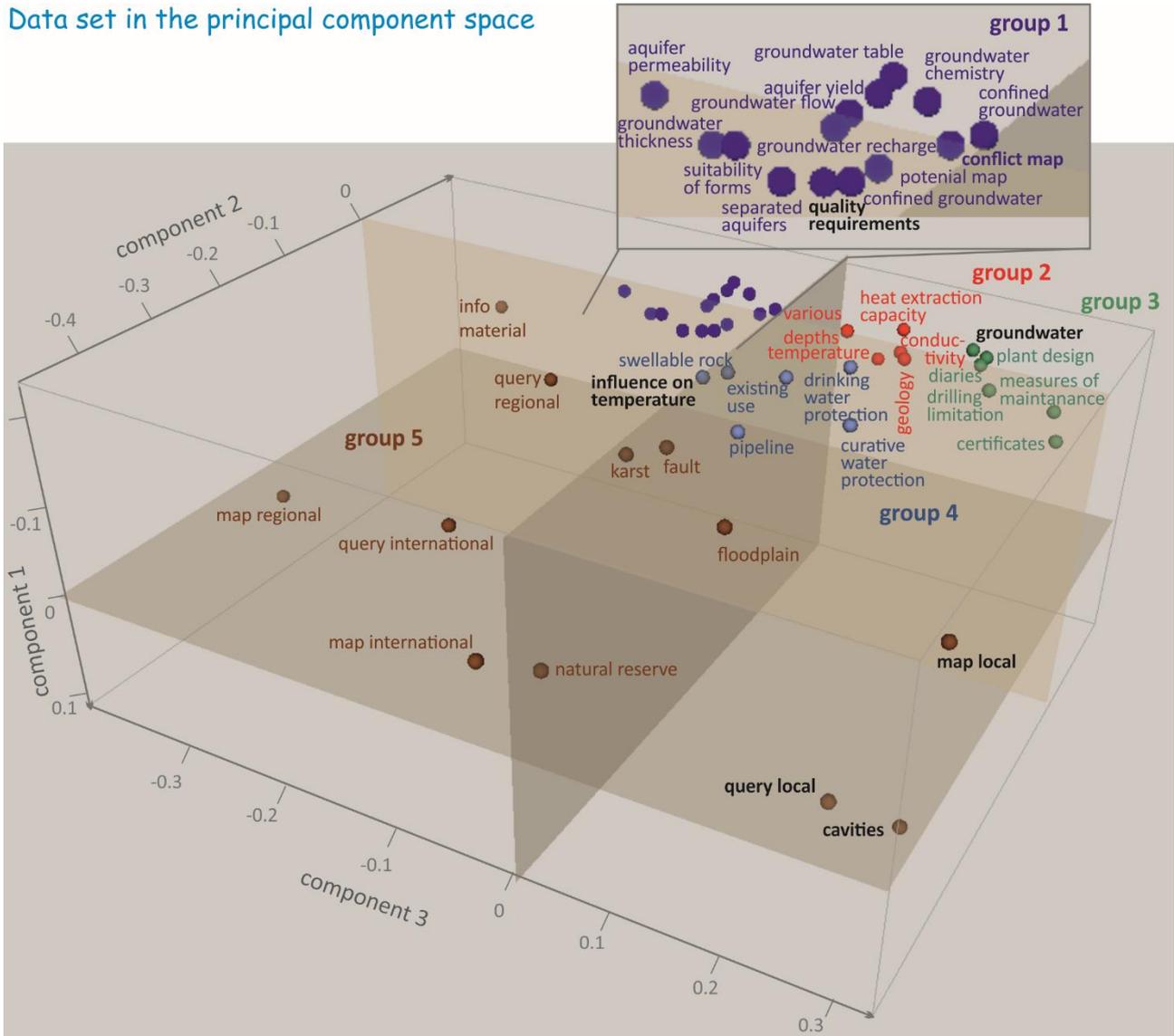


Figure 12: The loadings of the variables in the principal component space. Short distances between two variables indicate a large correlation. Based on this plot, the data set can be divided into 5 groups. Variables with black labels were regrouped after a check for Simpson’s paradoxon.



- Group 1: Stakeholders, who are interested in geothermal potential maps, are also interested in detailed information on groundwater and aquifers, in maps of conflict potential, in information on the suitability of different forms of geothermal energy and in quality and approval related requirements.
- Group 2: Stakeholders who are interested in the physical thermal parameters (temperature, specific thermal conductivity and specific heat extraction capacity) are also interested in visualization on various depth levels and in information on the geology.
- Group 3: Stakeholders, who are interested in object-related quality measures (plant design, certificates for drilling companies and pipe material, operational diaries and measures for maintenance) are also interested in general information on groundwater.
- Group 4: contains some of the risks for drillings and land-use conflicts factors. The correlation inside of this group is smaller than in the groups 1-3.
- Group 5: contains uncorrelated risk and landuse-conflict factors, location site queries and map scales as well general information material.

7. Interpretation

When comparing the univariate and multivariate data analysis, one finds some variables, where the results are contradictory. For example, 80% of all participants wish conflict maps and 74% wish maps of local scale. The correlation coefficient of both variables is -0.7 , which indicates that participants who wish conflict maps do **not** wish visualization on a local scale. So, when interpreting only one of the characteristic numbers, the interpretation will be completely different. This phenomenon is called Simpson's paradoxon and has the cause that one data point is included with different weight into the analysis depending on the number of the samples in the category the data point belongs to. In our survey, we have three groups with only 3-4 participants. If the participants inside one group agree on needing one variable, but not the other a (0,100) point is generated, which controls the correlation although the 3 participants of the group constitute only 5% of the total sample (**Figure 13**). Therefore, it is necessary to interpret the correlation coefficient in common with the percentage of all participants who need the two variables (**Figure 13**). If the Simpson's paradoxon was found, the original data set was checked and if feasible, the variable was assigned to another group than indicated by the principal component analysis. All regrouped variables are labeled in black in **Figure 12**. The Simpson's effect was found for 9 variables, 5 of them were assigned to another group:

- Local query in PDF format → from group 5 to group 1,
- Local map scale → from group 5 to group 1,
- Cavities → from group 5 to group 4
- Quality requirements → from group 1 to group 3
- Anthropogenic influence on temperature → from group 4 to group 5,
- Regional map scale → no regrouping,
- Operational diaries → no regrouping,
- Natural reserve → no regrouping.

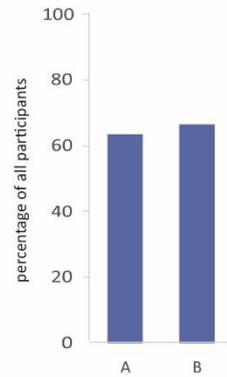
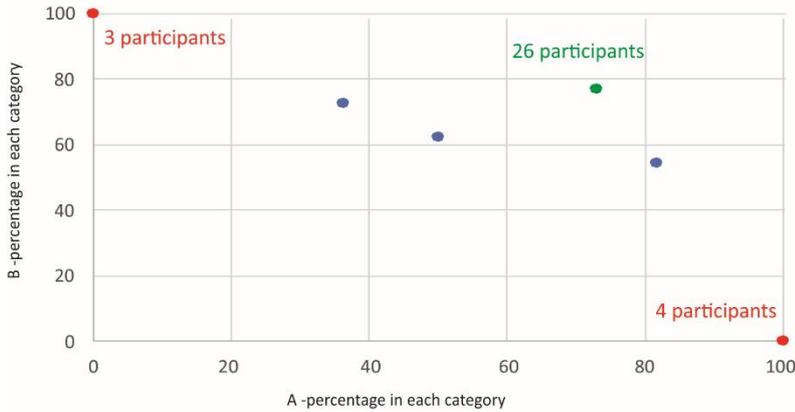
After regrouping, we get a catalogue of variables which are important for all stakeholders, which are important for specific groups and which are not important (**Figure 14**).



Simpson's Paradoxon - results calculated from the categories contradict the results calculated from all data

Interpretation: Stakeholders who need A do not need B

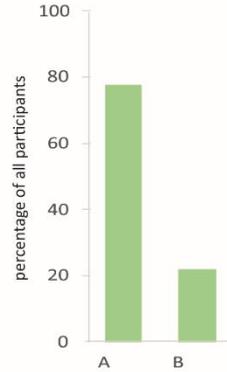
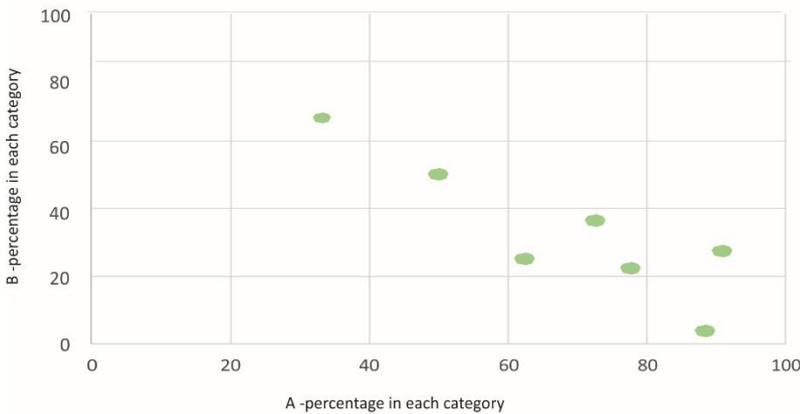
The majority of the stakeholders needs A and B



No Simpson's Paradoxon

Interpretation: Stakeholders who need A do not need B

B is less needed than A



Example for the Simpson's paradoxon in group 5

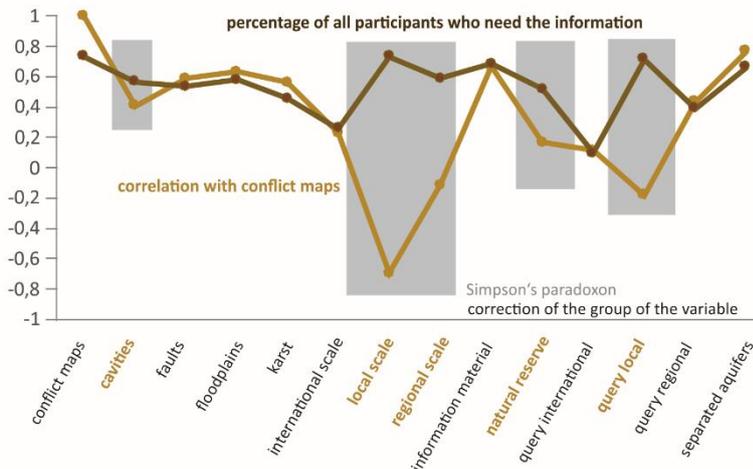
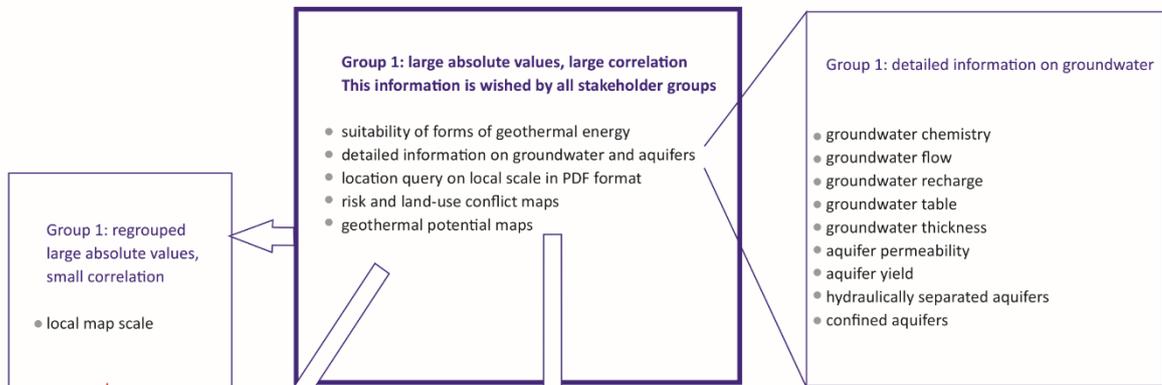


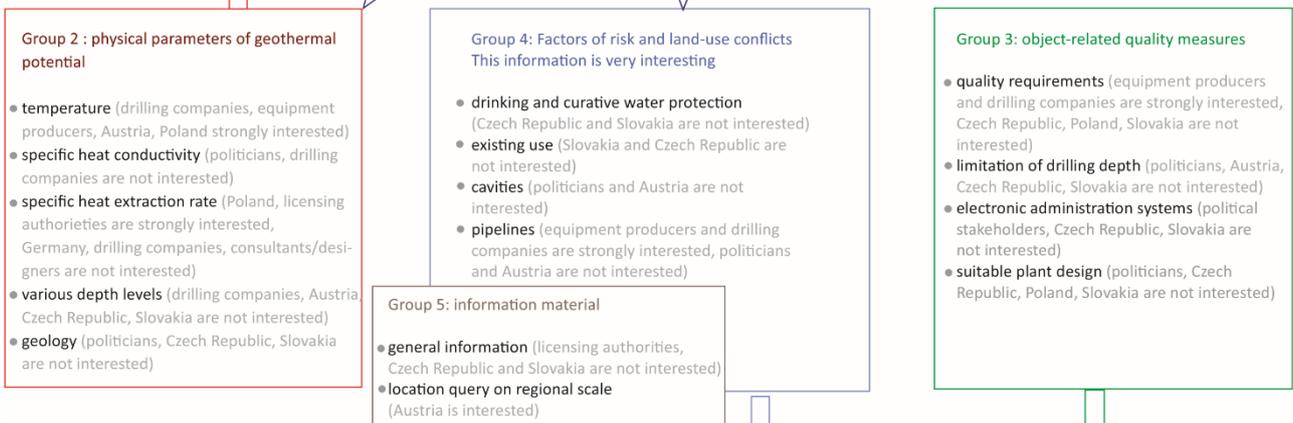
Figure 13: Simpson's paradoxon in our survey.



This information is very interesting for all stakeholder groups



This information is very interesting for some stakeholder groups, for others not



This information is not interesting

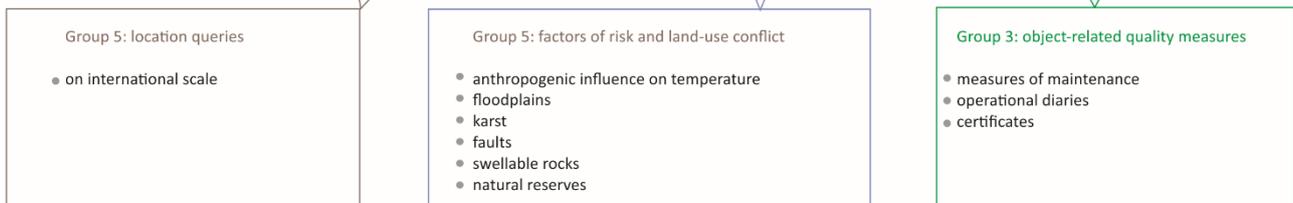


Figure 14: Summary of the importance of the registered variables for the stakeholder groups.



8. Conclusions

The stakeholders of all states participating in GeoPLASMA-CE are interested in:

- supporting information on the suitability of different forms of geothermal energy,
- geothermal potential maps,
- risk and land-use conflict maps,
- information on geology,
- information on existing usage,
- location queries on local scale in PDF format,
- detailed information on groundwater.

However, the states have specific requirements concerning the physical parameters describing the geothermal potential (temperature, specific heat conductivity, specific heat extraction rate) and the risk factors that are important in every state (cavities, floodplains, pipelines, karst, faults). Additionally, stakeholders from Austria wish location queries on regional scale, and stakeholders from Slovenia wish information on limitations of the admissible drilling depth.

The objective of the GeoPLASMA-CE project is the standardization of methods and parameters in order to get useful and comparable products. The products have to be harmonized, but also have to display special needs or conditions of certain states and regions. The result of the survey indicates that a completely standardized workflow is not useful for the GeoPLASMA-CE partners. Therefore, we recommend a workflow consisting of flexible parts, of recommendations and of requirements. An important task of the GeoPLASMA-CE project will be specifying which parts of the workflow should be standardized and which have to be kept flexible.



Annex 1: Assessment of shallow geothermal systems used in the participating countries and pilot areas

Assessment of shallow geothermal systems used in the participating countries (Nuts 0)								
amount of geothermal plants	Poland	Czech Republic	Germany (2016)	Austria (2016)	Slovakia	Slovenia (end of 2015)		
closed loop systems	42.750	-	300.700	19.615	-	4.857		
open loop systems	2.250	-	65.500	18.225	-	4.493		
sum/all	45.000	-	366.200	37.840	-	9.350		
Assessment of shallow geothermal systems used in the pilot areas (real pilot areas)								
	Poland		Czech Republic		Germany	Austria	Slovakia	Slovenia
	Krakow	Wałbrzych	Broumov	W-Bohemia	Vogtland	Vienna	Bratislava	Ljubljana
pilot area closed loop systems	40	35	-	-	574	225	-	50
pilot area open loop systems	4	0	-	-	5	509	-	84
sum/all per pilot area	44	35	-	-	579	734	-	134
Assessment of shallow geothermal systems used in the pilot areas (Nuts 1)								
NUTS 0	Poland		Czech Republic		Germany	Austria	Slovakia	Slovenia
NUTS 1	PL2	PL5			Saxony (2016)	Eastern Austria (2016)		subdivisions in NUTS 1
closed loop systems	8.000	7.000	-	-	12.773	3.067	-	
open loop systems	400	375	-	-	250	5.157	-	
sum/all	8.400	7.375	-	-	13.023	8.224	-	0
Assessment of shallow geothermal systems used in the pilot areas (Nuts 2)								
NUTS 0	Poland		Czech Republic		Germany	Austria	Slovakia	Slovenia
NUTS 2	PL21 Małopolskie	PL51 Dołnośląski			Chemnitz	Vienna (2016)		Western Slovenia
closed loop systems	4.000	3.500	-	-	4.115	928	-	450
open loop systems	200	100	-	-	30	650	-	345
sum/all	4.200	3.600	-	-	4.145	1.578	-	795
Assessment of shallow geothermal systems used in the pilot areas (Nuts 3)								
NUTS 0	Poland		Czech Republic		Germany	Austria	Slovakia	Slovenia
NUTS 3	PL213 Kraków	PL517 Wałbrzyski			Vogtlandkreis	Vienna (2016)		Slovenia Statistical
closed loop systems	40	35	-	-	732	928	-	
open loop systems	4	0	-	-	6	650	-	230
sum/all	44	35	-	-	738	1.578	-	230



Annex 2: Template of the stakeholder query (english version)



CE177 - GeoPLASMA-CE

Shallow Geothermal Energy Planning, Assessment and Mapping Strategies in Central Europe

stakeholder query

The aim of the survey is to assess and compile methods, quality standards and regulations to create joint methods and workflows for the planning, assessment, management and monitoring of shallow geothermal use. (<http://www.interreg-central.eu/Content.Node/GeoPLASMA-CE.html>).

The survey addresses key values needed to plan, assess, and manage shallow geothermal use including applied data formats by involvement of stakeholders.

The following query is developed to get information about the stakeholder's requirements on shallow geothermal energy. The results of the survey contribute to a further questionnaire with focus on representation of data. The analyzed outputs of this stakeholder survey will be summarized to a catalogue of requirements for planning, assessment, management and monitoring of shallow geothermal use.

Please return the filled out survey to:

Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie

Dipl. Geoökol. Karina Hofmann

Abteilung 10 Geologie, Referat Rohstoffgeologie, Projektgruppe Geothermie

Halsbrücker Straße 31a

09599 Freiberg

or via e-mail: *karina.hofmann@smul.sachsen.de*

To which interest group (stakeholders) do you belong to?	
licensing authority	
political stakeholder (e.g. ministry, urban and regional planning)	
consultant, designer for shallow geothermal plants	
drilling company	
equipment manufacturer	
architect	
others:	

Please fill out the following questions from the perspective of the stakeholder, that you have selected above.

Multiple choices are allowed.



GeoPLASMA-CE

Is any supporting information helpful to foster the use of shallow geothermal energy with focus to an environmentally friendly and sustainable climate and energy policy at local, national and international levels?		
If „yes“, which of the following?		
information material about shallow geothermal systems		
overview of national legal frameworks and approval related requirements as well as quality requirements for the installation, operation and monitoring of shallow geothermal plants		
overview of the suitability of different forms of geothermal energy (for example: open loop systems (wells), closed loop systems (collectors, pipes))		
maps of geothermal potential		
general maps of land-use-conflict areas and restriction zones for geothermal usages		

Which form of representation of geothermal maps and maps of conflict areas is preferred in different scales?			
kind of representation	local scale (local administrative level)	regional scale (national overview)	EU-zone (transnational overview)
location query with information in report form			
overview via maps (e.g. classes)			
other:			

Is an administration system required, combining e.g. electronic filing of application and filing of monitoring data?		
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Is a decision support and information required for the planning and the licencing of a geothermal heat-pipe system (closed loop system)?		
If „yes“, which of the following?		
information about geological layer structure		
information about groundwater conditions		
information about possible limitations of drilling depths		
information about geothermal potential:		
- representation by thermal conductivities		
- representation by specific heat extraction rate		
- representation for various depths		



GeoPLASMA-CE

thermal parameters:	
- temperature of soil, groundwater, air	
- natural and anthropogenic influences of temperature	
- specific thermal conductivity + heat storage capacity of rocks	
- existing usages	
information about location in protected areas for:	
- drinking water	
- curative water	
- floodplains	
- Natural reserve	
risks of drilling, land-use conflicts:	
- cavity areas (natural, anthropogen)	
- confined, artesian groundwater	
- swellable rocks	
- fault zones	
- karst formations	
- hydraulically separated aquifers by aquitards	
- lines (gas, electricity, water, telephone, ...)	
- landslides	
- shallow gas leakage	
Object-related quality measures (professional, suitable design during the planning, construction, operation and monitoring of geothermal plants)	
- professional design of the geothermal plant	
- certificates (e.g. drilling companies, pipe material)	
- implementation of an operational diary	
- measures for maintenance, monitoring of the plant	
others:	

Is a decision support and information is required for the planning and the licencing of a groundwater heat pump system (open loop system)?		
If „yes“, which of the following?		
information of geological layer structure		
information about location in protected areas for:		
- drinking water		
- curative water		
- floodplains		
- natural reserve		



GeoPLASMA-CE

information about geothermal potential:	
- representation by thermal conductivities	
- representation by specific heat extraction rate	
- representation for various depths	
thermal parameters:	
- temperature of soil, groundwater, air	
- natural and anthropogenic influences of temperature	
- specific thermal conductivity + heat storage capacity of rocks	
- existing usages	
risks of drilling, land-use conflicts:	
- cavity areas (natural, anthropogenic)	
- confined, artesian groundwater	
- swellable rocks	
- fault zones	
- karst formations	
- hydraulically separated aquifers by aquitards	
- lines (gas, electricity, water, telephone, ...)	
information about groundwater conditions:	
- location of groundwater table	
- information if groundwater is free, confined or artesian	
- groundwater thickness	
- permeability of aquifer	
- yield of aquifer	
- groundwater flow direction and flow velocity	
- groundwater chemistry	
- groundwater hydrograph, groundwater recharge rate	
others:	

You like to have news of GeoPLASMA? Please insert your name and e-mail address:

name:

e-mail:

Thank you for your time!

www.geoplasma-ce.eu



Annex 3: catalogues of requirements of partner countries

Catalogue of requirements for Austria

The grey requirements are uniform for all states participating in GeoPLASMA-CE. The green requirements are specific for each state.

- general information material
- suitability of forms of geothermal energy
- quality requirements
- location query on local scale in PDF format
- location query on regional scale in PDF format
- risk and land-use-conflict maps
- geology
- geothermal potential maps
- specific thermal conductivity
- specific heat extraction capacity
- local map scale
- detailed information on groundwater and aquifers
- groundwater chemistry
- groundwater flow
- groundwater recharge
- groundwater table
- groundwater thickness
- drinking water protection zones
- aquifer permeability
- aquifer yield
- hydraulically separated aquifers
- confined aquifers
- existing use



Catalogue of requirements for the Czech Republic

The grey requirements are uniform for all states participating in GeoPLASMA-CE. The green requirements are specific for each state.

- general information material
- suitability of forms of geothermal energy
- quality requirements
- location query on local scale in PDF format
- risk and land-use-conflict maps
- geology
- geothermal potential maps
- temperature
- specific thermal conductivity
- local map scale
- detailed information on groundwater and aquifers
- groundwater chemistry
- groundwater flow
- groundwater recharge
- groundwater table
- groundwater thickness
- drinking water protection zones
- aquifer permeability
- aquifer yield
- hydraulically separated aquifers
- confined aquifers
- existing use
- cavities



Catalogue of requirements for Germany

The grey requirements are uniform for all states participating in GeoPLASMA-CE. The green requirements are specific for each state.

- general information material
- suitability of forms of geothermal energy
- quality requirements
- location query on local scale in PDF format
- risk and land-use-conflict maps
- geology
- geothermal potential maps
- temperature
- specific thermal conductivity
- local map scale
- various depth levels
- detailed information on groundwater and aquifers
- groundwater chemistry
- groundwater flow
- groundwater recharge
- groundwater table
- groundwater thickness
- drinking water protection zones
- curative water protection zones
- aquifer permeability
- aquifer yield
- hydraulically separated aquifers
- confined aquifers
- existing use
- cavities
- swellable rocks
- karst
- faults
- limitation of drilling depth



Catalogue of requirements for Poland

The grey requirements are uniform for all states participating in GeoPLASMA-CE. The green requirements are specific for each state.

- general information material
- suitability of forms of geothermal energy
- quality requirements
- location query on local scale in PDF format
- risk and land-use-conflict maps
- geology
- geothermal potential maps
- temperature
- specific heat extraction capacity
- local map scale
- various depth levels
- detailed information on groundwater and aquifers
- groundwater chemistry
- groundwater flow
- groundwater recharge
- groundwater table
- groundwater thickness
- drinking water protection zones
- curative water protection zones
- aquifer permeability
- aquifer yield
- hydraulically separated aquifers
- confined aquifers
- existing use
- cavities
- faults
- karst
- pipelines
- limitation of drilling depth
- suitable plant design



Catalogue of requirements for Slovakia

The grey requirements are uniform for all states participating in GeoPLASMA-CE. The green requirements are specific for each state.

- general information material
- suitability of forms of geothermal energy
- quality requirements
- location query on local scale in PDF format
- risk and land-use-conflict maps
- geology
- geothermal potential maps
- temperature
- specific thermal conductivity
- local map scale
- detailed information on groundwater and aquifers
- groundwater chemistry
- groundwater flow
- groundwater recharge
- groundwater table
- groundwater thickness
- drinking water protection zones
- aquifer permeability
- aquifer yield
- hydraulically separated aquifers
- confined aquifers
- existing use



Catalogue of requirements for Slovenia

The grey requirements are uniform for all states participating in GeoPLASMA-CE. The green requirements are specific for each state.

- general information material
- suitability of forms of geothermal energy
- quality requirements
- location query on local scale in PDF format
- risk and land-use-conflict maps
- geology
- geothermal potential maps
- specific thermal conductivity
- specific heat extraction capacity
- local map scale
- various depth levels
- detailed information on groundwater and aquifers
- groundwater chemistry
- groundwater flow
- groundwater recharge
- groundwater table
- groundwater thickness
- drinking water protection zones
- curative water protection zones
- aquifer permeability
- aquifer yield
- hydraulically separated aquifers
- confined aquifers
- existing use
- cavities
- floodplains
- pipelines
- limitations of drilling depth
- suitable plant design