



MRC
TURKEY



Details on the RSM for geothermal resource validation Technical Requirements of Geothermal Exploration in the RSM

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JV Partners



Engineering firm with 125 years of experience in engineering - 17,000 employees

Fields of Expertise:

- Project management
- Feasibility studies and strategic investigations
- Design
- Construction management
- Operations and maintenance



Engineering firm with ten years of experience in engineering - 25 employees, more than 160 project references from 60 customers in Turkey

Fields of Expertise:

- Project management
- Project finance and economics
- Risk mitigation and feasibility studies
- R&D activities
- Energy sector



Geoscience firm with sixty years of experience in geothermal investigation - 75 employees

Fields of Expertise:

- Geothermal Exploration
- Drilling Consultancy
- Drilling Engineering
- Resource assessment
- Resource management
- Geothermal Training



Engineering firm with fifty years of experience in geothermal engineering - 300 employees

Fields of Expertise:

- Project Management
- Geothermal power plant engineering
- Power System Engineering
- District Heating

Eligibility

- In order for a firm to qualify for coverage under the RSM Program, a valid exploration license is required. This license should be valid until the end of the drilling program. Ideally, a license that remains valid for 18 months from the application date will be accepted.
- Applications for RSM coverage will be considered once the applicant has identified optimal locations for exploration wells and drilling targets at depth. Exploration drilling program supported by the RSM may cover up to three full size production wells or up to three slim hole wells or a combination thereof
- The RSM will only support acceptable well costs as described in the Beneficiary Manual
- The same developer can submit multiple applications for drilling programs related to different license areas as long as they constitute independent projects

Application Procedure

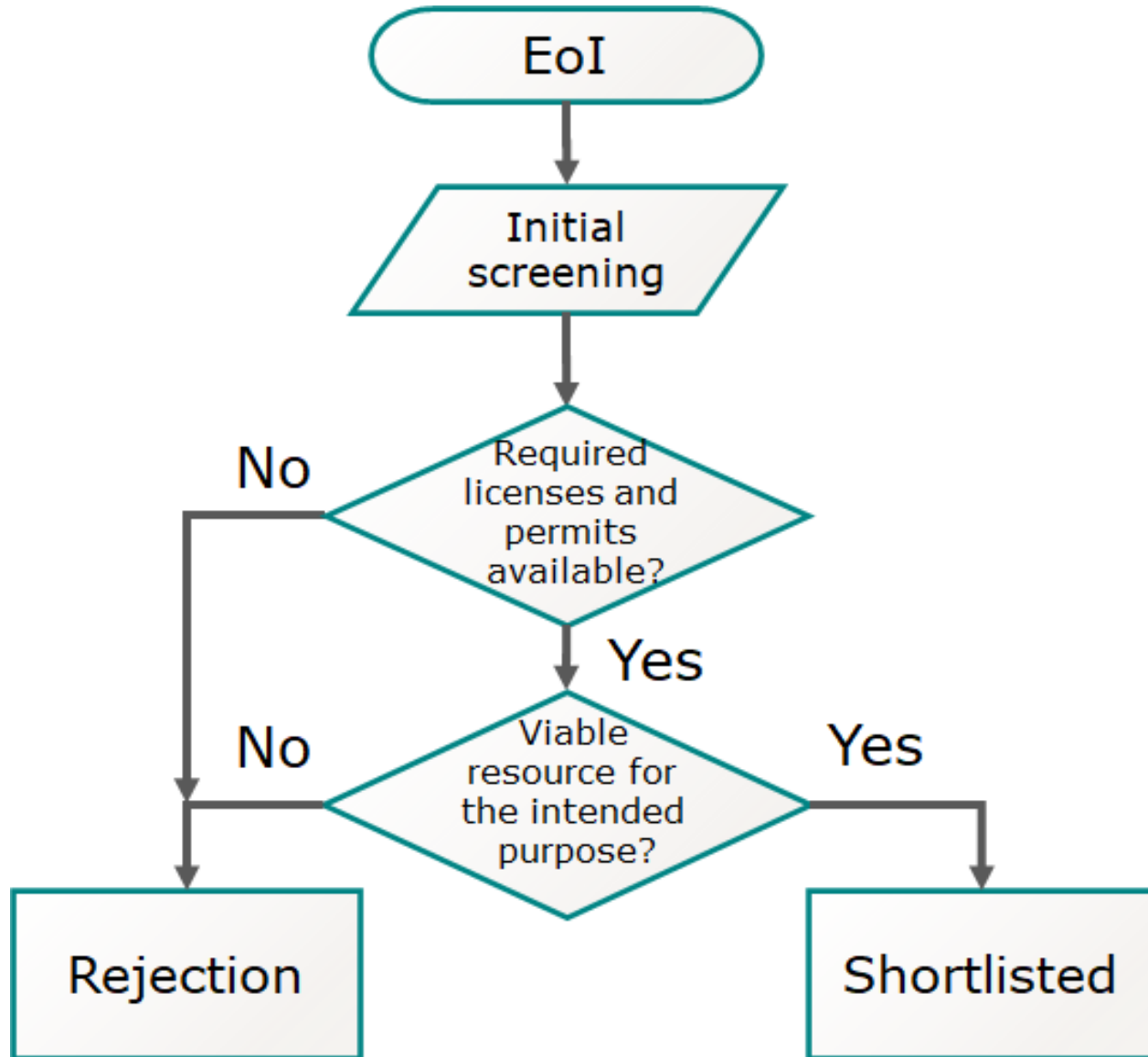
Two-stage process

- RSM applications will go through a **two-stage process**.
- In the first stage, **Expression of Interest (EoI)** is requested. The EoI evaluation will be used to shortlist potential Applicants that submit an EoI for a potentially favorable area, provide a promising business plan and necessary licenses.
- In the second stage, EoI Applicants which are shortlisted, will be invited to prepare a **full proposal** in line with the criteria as set out in this BM. The full proposal will be scored and ranked.

Expression of Interest (EoI)

1. Hold a valid exploration licenses, permits and certificates.
2. Have carried out surface exploration, including geological, geophysical, and geochemical exploration. Cost of the surface exploration studies in areas with 60% coverage and projects proposing direct use applications can be included in the AWC, however with a maximum.
3. Have constructed initial Conceptual Geothermal System Model (simple or extensive).
4. Have selected drilling targets, indicating possible output (depth, flow rate, temperatures), well types (shallow/deep and vertical/directional) and conceptual well design.
5. Have prepared a business plan (at least a simple one).
6. Have completed the TKYB form as available from the RSM website.

Expression of Interest (EoI)

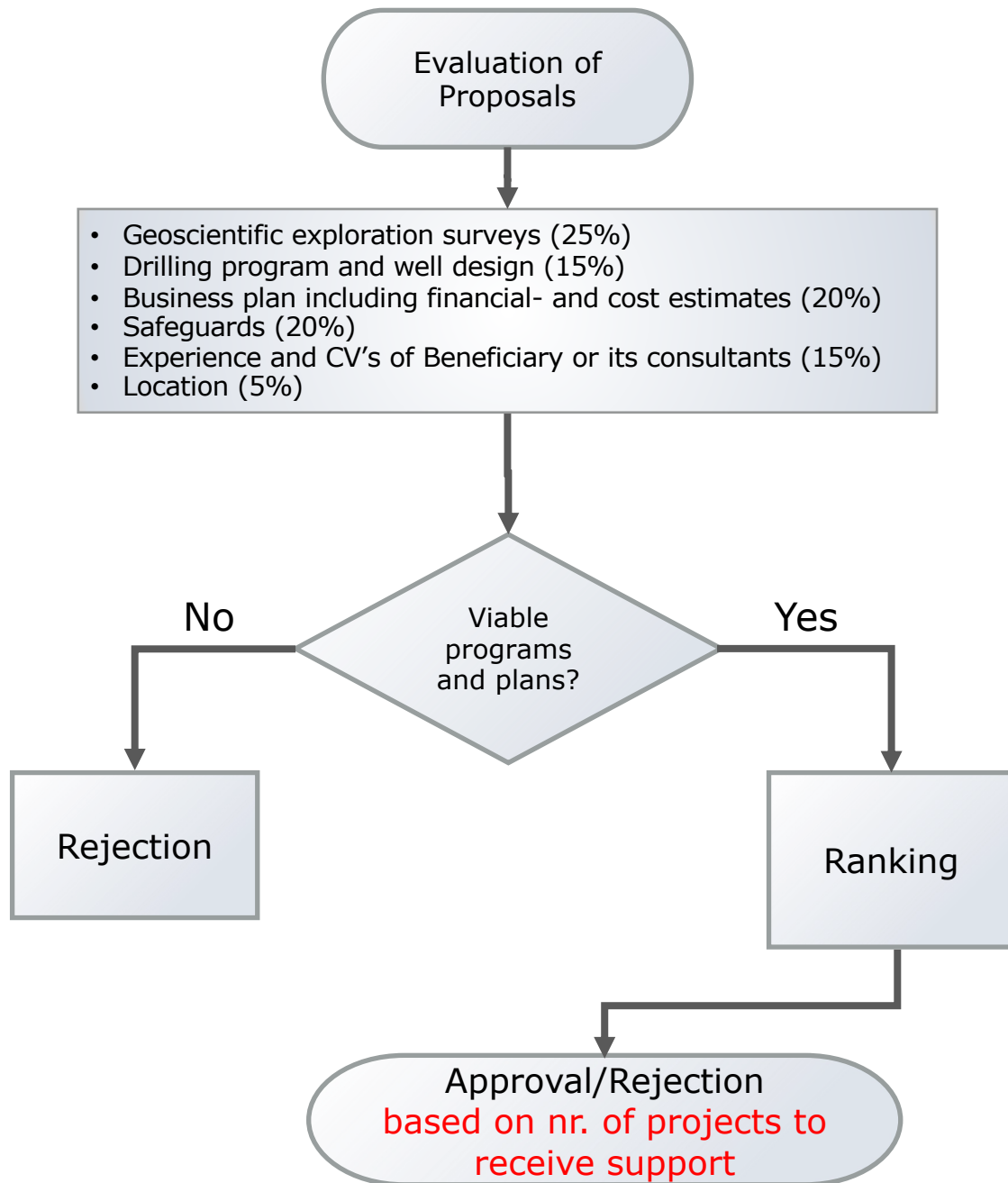


Initial screening is twofold:

1. based on licenses, permits and certificates.
2. Screening based on probability of finding a viable resource, business plan, experience, etc.

Contents of the full proposals to RSM

Item	Requirement as described in the Beneficiary Manual (BM)
1	Certificate of incorporation as evidence that the Applicant exists as a legal entity. In the case of joint ventures, all partners need to submit certificates of incorporation.
2	Proof of necessary permits, licenses (including exploration licenses) and unobstructed rights to the concession (see Appendix 1 for details).
3	Surface exploration information and data that meet RSM requirement for participation in the program (see Appendix 2 for details).
4	Conceptual model and resource capacity evaluation (see details in Appendix 3).
5	A professionally prepared BP showing how the geothermal energy will be utilized and geothermal resource energy requirements necessary to meet such plan (see Section 3).
6	A professionally prepared drilling and testing program for the exploration wells, including cost estimates, and technical specifications for drill rigs to be used (see Section 5 and Appendix 4 and 5).
7	The financials and governing documents of the legal entity that will be the Beneficiary of RSM funds as well as clarification of any liabilities facing the legal entity.
8	Environmental and Social Safeguards: applicable environmental and social impact studies and management plans (see Appendix 9 and onwards)
9	A well-documented statement of technical capacity of the legal entity as it pertains to the successful management of the project, including key personnel and references (see Appendix 6).
10	TKYB Application Forms (as published on the website rpmjeoturkiye.com)



Evaluation of Proposals: Scoring and ranking of Viable Projects*

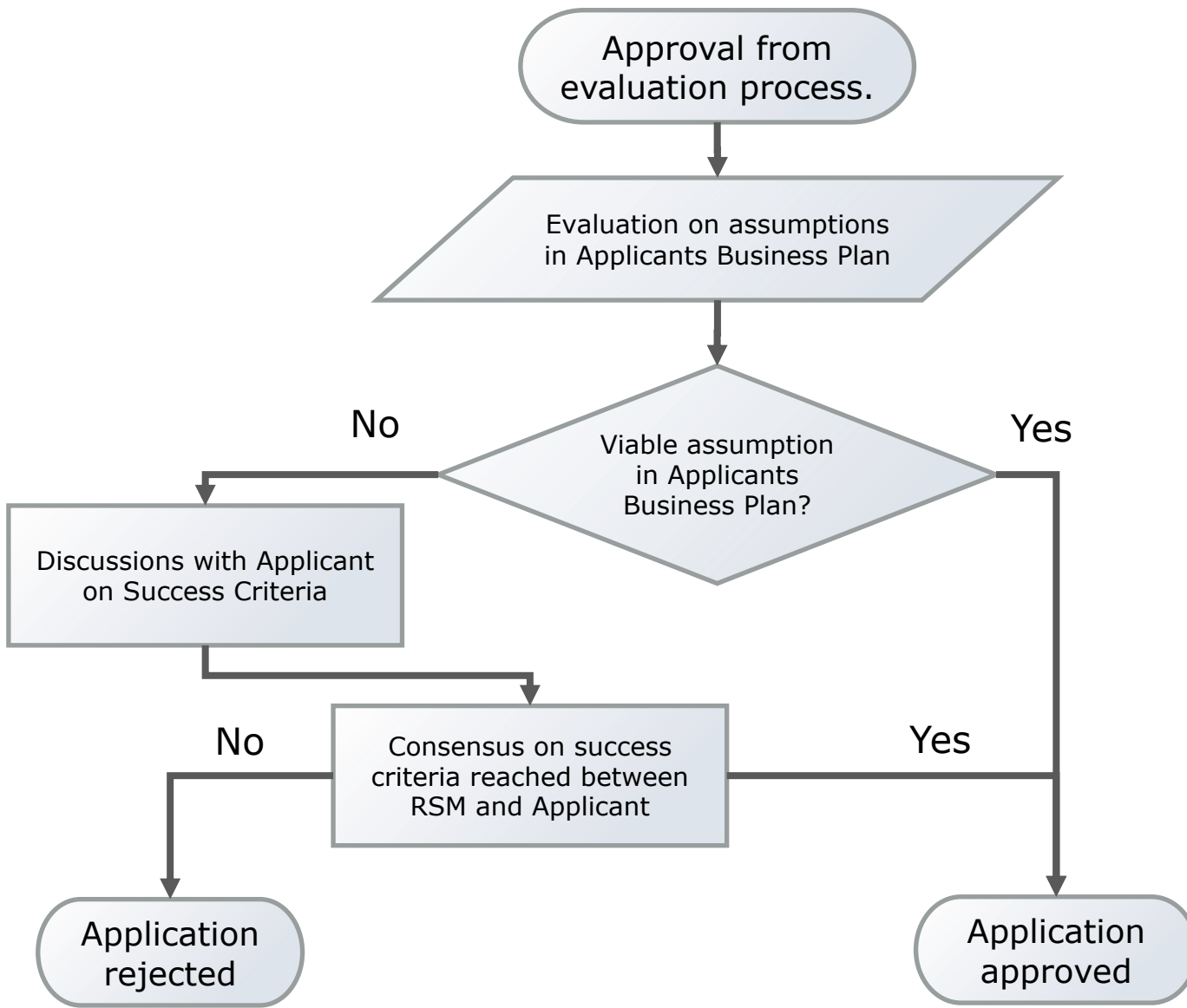
* For more details on scoring and ranking of viable projects, see chapter 3 in the Beneficiary Manual

Determining Success Criteria Parameters

The success criteria will be based on an evaluation of the applicant business model and a consensus between the applicant and RSM on what is a likely minimum output of wells for the business plan to be profitable.

The success criteria will be kept as simple as possible (in terms of MWe gross or MWth for direct use) and will be based on the following parameters and their threshold values (minimum) in terms of the business model:

- Enthalpy/temperature
- Flow rate
- Wellhead pressure or drawdown
- Only temperature at specific depth for slim holes



Determining Success Criteria (SC)

- The minimum power output for a well to be defined as successful will be equal to the minimum average well output for the project to be economically viable as defined in the Beneficiary's BP.
- In other words, the SC should mark the minimum average well output, where the project is no longer profitable ("break even").

Determination of Success/Failure

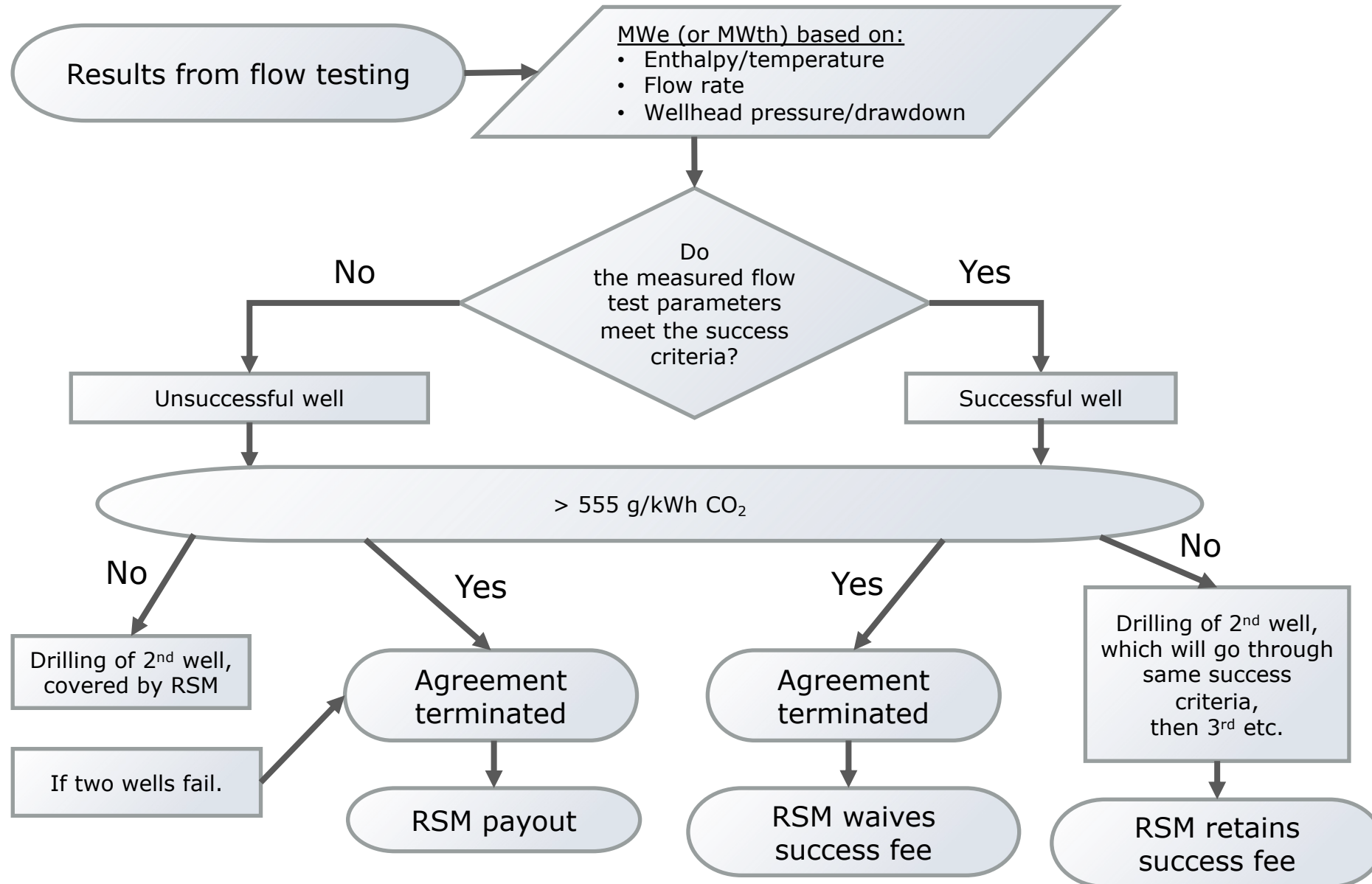
The success for each well will be determined based on comparison between the measured well output, during flow testing, and the success criteria stipulated in the Beneficiary agreement

An additional criterion is raised, which is based on the requirements from Clean Technology Fund (CTF), that the estimated CO₂ emissions during operation shall not exceed a threshold value of **555 g/kWh**.



It is known that CO₂ output can be very high initially, but often decreases rapidly thereafter. Therefore, initial CO₂ estimates from short-term flow-testing should be taken provisionally, until a long-term flow-testing is possible

Determination of Success/Failure



Exploration wells that can be drilled with coverage from the RSM fall into three main categories, each of them to be subject to their own distinct success criteria

Scenario 1: Well drilled to explore productivity and fluid enthalpy where two-phase flow is expected	Scenario 2: Wells drilled to explore productivity and fluid enthalpy where single-phase flow is expected	Scenario 3: Wells drilled to confirm temperature
<ul style="list-style-type: none">• Power output in terms of MWe, based on mass flow and discharge enthalpy• At minimum discharge enthalpy• At minimum well head pressure• At or below the agreed well depth and within the acceptable deviations stated in the drilling program (if well is directional)	<ul style="list-style-type: none">• Power output in terms of MWth, based on mass flow and discharge enthalpy• At minimum discharge enthalpy• At maximum drawdown• At or below the agreed well depth and within the acceptable deviations stated in the drilling program (if well is directional)	<ul style="list-style-type: none">• Temperature• At, or below the agreed well depth and within the acceptable deviations stated in the drilling program

Triggers for Termination of RSM Beneficiary Agreement:

- Drilling of two unsuccessful wells
- RSM pay-out reaches USD 4 million
- CO₂ concentration in fluid of any well will result in emissions in excess of 555 g/kWh
- Failure of Beneficiary to comply with terms and conditions of the Beneficiary Agreement
- Failure of Beneficiary to comply with World Bank Anti-Corruption Guidelines and Turkish Legislation
- The Beneficiary has the right to terminate the RSM Beneficiary Agreement after completion of the well being drilled and before drilling begins on the next consecutive well

All relevant information can be found in the Beneficiary Manual

However, in the appendix to this presentation, an overview of additional information is provided on:

- **Requirements of the BM,**
Well cost, legal agreement, environmental compliance, monitoring, reporting, information and communication
- **Geothermal development,**
- **Application procedures**
- **Application evaluation procedures**
EoI, full application, scoring and ranking
- **Delivery of data**

Thank you!



Appendixes

Acceptable well costs*

Include the following activities on the condition that they are directly associated with the drilling and testing program for the given well:

- Site preparation (well pads and sumps)
- Mobilization and demobilization costs
- Rental or provision of drilling rigs and associated equipment
- Providers of specialist services
- Injectivity testing
- Discharge testing
- Personnel, on-site accommodation and transport including vehicle leasing or rental
- Consumables (e.g. fuel, casing, wellheads, bits, cement, mud)
- Documentation and reports
- Taxes, excluding VAT
- Eligible and reasonable contingencies
- Surface Exploration Cost (roofed and with special conditions – see BM)

* Chapter 5 in BM

Unacceptable well costs paid by the Beneficiary include, but are not limited to

- Infrastructure costs
- All costs in excess of the amount stated in the drilling and testing program estimate
- Developer overheads (e.g. office costs, general management costs)
- Costs of temporary or permanent abandonment of wells
- Third party liability claims, including claims by the drilling contractor and environmental damage or clean-up costs
- Debts and provisions for losses or debts
- Interest
- Purchases of land, buildings or vehicles
- Currency exchange losses
- Cost of preparing applications or cost incurred during negotiations of the RSM contract,
- Costs for participation at meetings and workshops
- Training and capacity building
- Costs incurred prior to contract signing (such as costs of concessions, existing wells, etc.)

— **Standard Legal Agreement Between RSM and Beneficiary**

For an RSM project to take effect, an agreement between the Beneficiary and the RSM Unit must be fully approved and signed by the Parties. The Beneficiary and the RSM Unit have to reach a consensus on the success criteria. That success criterion will be included in the Agreement contract and will serve as the bases for deciding success or failure of the wells after being flow tested.

— **Compliance of Turkish Environmental Impact Assessment regulation and World Bank requirements**

To be discussed in a later presentation

Monitoring and reporting

This includes three main components:

- **Site visits:**

- to monitor progress during drilling, verify that costs are related to activities on site and observe the well testing follow the Beneficiary Agreements.

- The Beneficiary will submit the following **reports:**

- Daily drilling reports
- Daily mudlogging/onsite geological reports
- Well completion reports
- Well testing reports in which the performance of the well is measured against the success criteria
- Any other reports, as stipulated in the drilling program and flow testing procedures.

- **Well data and financial information:**

- The Beneficiary will be obligated to submit invoices and proof of payment to the RSM Unit as expenses are incurred in the exploration drilling projects.

Information and communication

A **RSM website** has been established:

- <http://rpmjeoturkiye.com> and <http://rsmgeoturkey.com>
- All relevant information on RSM (including Beneficiary Manual) are published on these websites.

A **RSM database** will be created which will store all available information provided by Beneficiary as well as data from wells drilled with support from RSM within specific project sites.

- Beneficiaries will need to provide the specified information to feed into the RSM database according to pre-established templates.
- The database will have limited access and no information on specific projects will be made accessible or distributed to the public nor to other beneficiaries, unless with a written and signed permission from the Beneficiary.

Phases of Geothermal Development

- Reconnaissance/ Exploration
- Appraisal/Conformation drilling
- Project Design (concept design)
- Construction and field development
- Operation
 - Monitoring, modelling, management
- Shut-down and abandonment

Steps in geothermal exploration

1. Review and study of existing data
2. Studies of surface manifestations and Geochemical studies
3. Geological Exploration
4. Geophysical Exploration
5. Exploration Drilling and flow testing
6. Preliminary Resources Evaluation

EXPRESSION OF INTEREST

EoI – Technical Information

- Conceptual model and list of data behind the conceptual model.
- Drilling plan
- References demonstrating previous drilling experience and CVs of key experts.
- If there are already exploration wells, provide an indication of the information from these wells.

Indicator	Unit	Value
Gross capacity per well	MWe or MWth	
Gross conversion efficiency (for power plants only)	%	
Expected average flow rate per well	kg/s	
Estimated reservoir temperature	°C	
Estimated depth of the well (True Vertical Depth-TVD)	m (from surface)	
Diameter of the well at target depth	" (inch)	
Well type (vertical/directional)	-	
Wellhead location of the wells under RSM	N E coordinates (ED50-UTM-6° coordinate system)	
Expected/predicted CO2 emissions	g CO2/kWh	

EoI – Conceptual Model

A brief description of the local conceptual model. The conceptual model shall outline the following, if available:

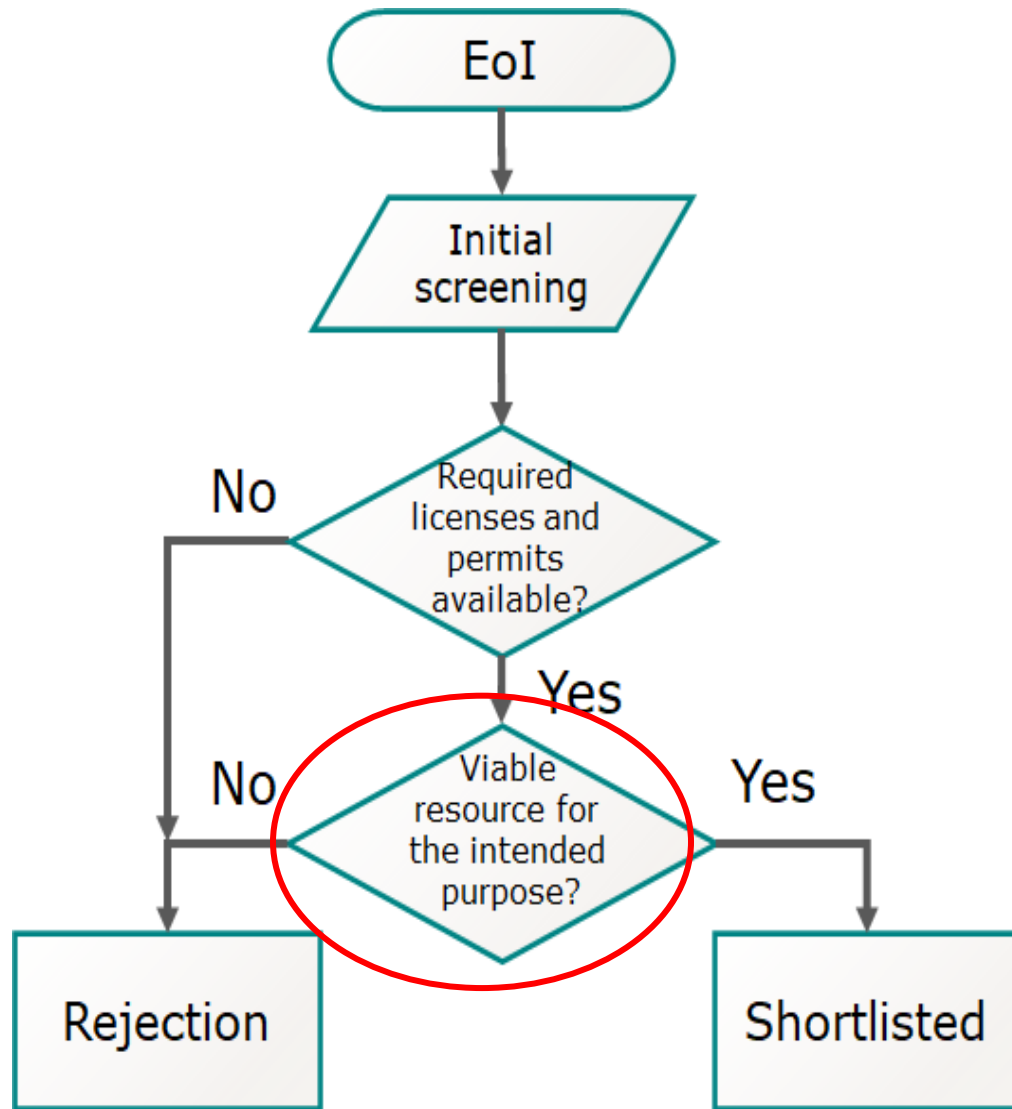
- Regional map showing the concession and surface manifestations
- Structural settings
- Expected stratigraphy
- Expected reservoir rocks and caprock if applicable
- Predicted size and thickness of reservoir (boundaries)
- Conceptual flow dynamics (recharge, up-flow, outflow)
- Well targets

EoI – Drilling Plan and Well Design

Brief description of:

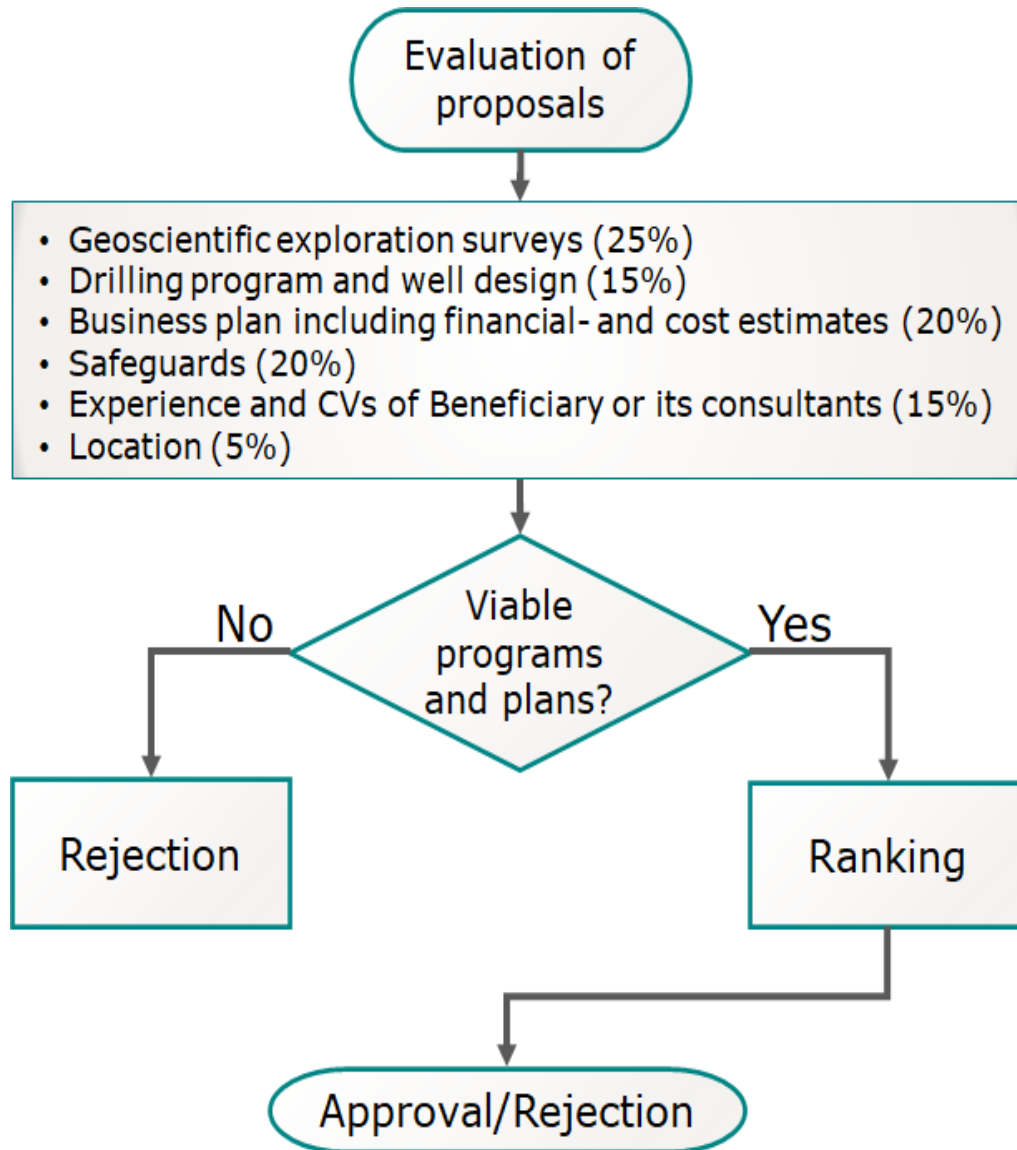
- Depth of wells
- Directional or vertical
- Predicted stratigraphic and structural conditions
- Expected Temperature and Pressure conditions
- Information on offset well data (if available)
- Expected drilling diameters and casing program
- Potential for encountering kicks/gas kicks
- Estimated drilling time
- Water supply available for drilling
- Wastewater handling / storage / disposal
- Drilling mud handling / storage / disposal

EoI Evaluation



- Data and information from each application will be used to assess the probability of finding a viable resource to support the needs of the applicant’s business plan (items 3 and 4 in Table on slide 5).
- This step of the evaluation process will concentrate on two main aspects of the applicant’s program which include:
 - a) the credibility of the conceptual models based on the surface exploration data
 - b) the intended use of the geothermal energy as described in the business model.

Evaluation Process



Applications will be evaluated using the scoring and ranking protocol described for each of the following categories of information:

- Geoscientific exploration data and the resulting conceptual model
- Drilling programs and well designs
- Business plan, including financial- and cost estimates
- Safeguards
- Geothermal experience of the Beneficiaries or its consultants
- Location

Scoring and Ranking of Applications*

- As the RSM is eligible for developers holding licenses for different resources and different utilization approach, relevant exploration data may vary between projects. Thus, appropriateness of the methods used will be evaluated in each case.
- In general, there are less exploration data requirements for low temperature resources, for direct use applications, than for power production from intermediate to high temperature resources

No.	Items to be evaluated	Points
1	Appropriateness of exploration methods used	20
2	Completeness of surface exploration studies	20
3	Data quality	20
4	Quality of conceptual models and applicability of drilling targets	30
5	Preliminary resource assessments	10

* Chapter 3.2 in BM

Evaluation process

Completeness of surface exploration will be used to evaluate if important methods in one or more geoscientific disciplines is missing

- **Data quality** will be evaluated where possible.
- **Quality of conceptual models** will be evaluated based on data interpretation and completeness of the models.

Information on geology, hydrology and topography

- — Geological maps
- — Structural maps (tectonic maps)
- — Geothermal maps (surface manifestations)
- — Infrastructure maps (roads, licensing area, wells, other relevant infrastructure)
- — Hydrogeological information (groundwater level, flow directions, chemical composition, source regions, etc.)
- Topographic maps
- — Aerial photos, satellite photos, LiDAR data, infrared photos etc. for remote sensing
- Heat-flow maps (both remote sensing and direct soil measurements)

- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Essential items are marked with red arrows (→)

Information on geochemical surface exploration data

- — Chemical analyses from geothermal surface manifestations (solids)
- — Chemical analyses from springs, both hot (water, steam, gas) and cold
- Chemical data interpretation (including use of geothermometers)
- Isotope analyses
- Soil gas-flux analyses (CO₂, H₂S, Radon, etc.)
- Chemical information on rocks

- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Essential items are marked with red arrows (→)

Information on geophysical exploration

- Resistivity (TEM, MT, Schlumberger etc.). Essential for high temperature fields
 - Gravity
 - Reflection seismic (2D/3D) if already available
 - Seismicity (macro- and micro natural seismicity)
 - Magnetic data
-
- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Information on wells in the area (if available)

- list of wells
- location (map)
- design, including depth, diameter, casings, etc.
- temperature logs
- information on testing (flow- and injection testing); mass flow, pressure (water-level or well-head), temperature
- monitoring data (mass flow, pressure (water-level or well-head), temperature) if well has been utilized
- chemical content of fluid
- stratigraphic information
- drilling reports

Information on geothermal resource assessments

- — heat-flow and natural output estimates
 - conceptual models
 - — volumetric assessments (P90)
 - pre-feasibility- or feasibility studies
 - assessments based on well-testing results
 - other modelling studies (simple modelling, numerical modelling, etc.)
- Importance may vary between different resource types (High Temperature, Intermediate Temperature, Low Temperature)

Essential items are marked with red arrows (→)

Delivery of data

- The data submitted to the RSM should be in digital form, such as PDF, Word, Power point, Excel format or as scanned figures and text. All documents shall be delivered through a link on the RSM website. Paper documents are not accepted, unless digitally scanned.
- Tentative English translation of key documents in Turkish is appreciated