CROWDTHERMAL DELIVERABLE 3.2

ALTERNATIVE FINANCE RISK INVENTORY

Summary:

This Deliverable summarizes the activities and findings of CROWDTHERMAL's Task 3.2 "Alternative finance risk mitigation". It compiles the key advantages, potential risks and possible risk mitigation measures for the alternative finance methods crowdfunding (general), crowdfunding (loans), crowdfunding (shares/equity), crowdfunding (reward-based), direct lending and leasing, each from a project developer's and from a community investor's perspective.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement nº 857830.

Title:	Alternative finance risk inventory
Lead beneficiary:	GeoThermal Engineering GmbH (GeoT)
Other beneficiaries:	CFH
Due date:	31.08.2020
Nature:	Public
Diffusion:	All Partners
Status:	Final

Revision history	Author	Delivery date	Summary of changes and comments
Version 01	Christina Baisch	03.06.2020	First Draft
Version 02	Christina Baisch	05.08.2020	Draft for Internal Review
Version 03	Christina Baisch	17.08.2020	Draft Final
Final version	Christina Baisch	31.08.2020	Final for Submission

Approval status

	Name	Function	Date	Signature
Deliverable responsible	Christina Baisch	Project Manager	31.08.2020	Baisch
WP leader	Christina Baisch	Project Manager	31.08.2020	Baisch
Reviewer	Ronald Kleverlaan	Project Partner (CFH)	10.08.2020	
Reviewer	Gauthier Quinonez	Project Partner (LPRC)	24.08.2020	
Project Coordinator	Isabel Fernandez	Project Coordinator (EFG)	31.08.2020	

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GLOSSARY

Name	Definition
Bond	A bond is a special form of loan. The main difference to a loan is that a bond is usually tradable. The ownership of this instrument can be transferred in a secondary market (i.e. can be bought, for example from the state and sold to others for a price determined in the secondary market).
Community funding	Community funding is a financing method where funding is raised from the public, meaning that the funding is delivered by the community. Community funding is the umbrella for alternative finance methods for community projects.
Community Investors	Private individuals (or sometimes also small businesses) who, in the context of sustainable and responsible investing, participate in the financing of a geothermal project, with small contributions to crowdfunding or direct lending campaigns, usually in the order of magnitude of a few hundred or a few thousand Euros.
Convertible loan	A loan that can be converted into equity if needed. This means that the amount of the loan does not have to be repaid, and the rate of return is linked to the profit made in the project and not to a fixed rate of return per year.
Crowdfunding	Crowdfunding is the most commonly used form of community funding where funds are raised directly from the community without going through a bank in return for a set interest rate (loan), dividends (equity), or rewards (reward-based). Depending on the contract set up, crowdfunding can either be risk-sharing or risk-absorbing.
Debt / Loan	Debt is capital that is given in the form of a loan for which an interest rate has to be paid. The main amount has to be repaid after a certain time. Community funding method examples of debt financing are crowdfunding (loan), direct lending and leasing.
Direct lending	Direct lending is lending by a financial intermediary without a banking license that attracts funding and uses this funding to give out loans to other parties.
Donation	A donation is giving gifts (e.g. money) to a charity, public institution, or project without returns.
Equity	Equity, as opposed to debt, refers to the amount of capital contributed by the owners of a company, usually in the form of shares. By buying shares of a company, the shareholder becomes part-owner of the company and shares in its profits and losses. A community funding method example of equity financing is crowdfunding (equity).
Guarantee	A third party (e.g. the government) can give a guarantee, which means they guarantee that they will repay e.g. a loan if the original borrower cannot repay it. This provides more security to the lender that the loan will be repaid.
IPP	Independent Power Producer
PPA	A Power Purchase Agreement is an often long-term power supply contract between two parties, usually between a power producer and a consumer (electricity consumer or trader). The PPA sets out all the terms and conditions, such as the amount of electricity to be supplied, the prices negotiated, the accounting procedures and the penalties for non-compliance with the contract.

Project Developer	The public or private entity (or even individual) developing a geothermal project. This can for example be a municipal utility or a specialised geothermal development company. In many cases, the project developer is also the main investor of the geothermal project. The project developer may also have external main investors, e.g. institutional investors such as pension funds or banks.
Reserves	Reserves are retained profits kept to cover expected costs, or as a safety measure for costs that may occur.
Risk-absorbing capital	Capital that shares the risks or even takes over all the risks in case the project goes wrong. Examples are government or NGO subsidies, guarantees or grants; or a government that pre-finances the costs of a certain phase, which is paid back later if the project can be continued successfully.
Risk-sharing capital	Capital that shares equally in the risk of the project developer. This can be for example equity or a convertible loan.
SPV	Special Purpose Vehicle
UDDGP	United Downs Deep Geothermal Power project, Cornwall, UK

1 EXECUTIVE SUMMARY

Despite its huge potential to supply sustainable, decentralised and low-carbon baseload energy for electricity, heating and cooling, deep geothermal still plays a marginal role in the European energy mix. The high resource risk that is typically present in the early stages of geothermal project development makes it difficult to mobilise the required capital for funding early exploration surveys and first drillings through traditional bank finance.

Alternative finance methods can be vital elements of the funding plan for these high-risk and cost-intensive project phases. However, the new approaches to finance for geothermal developments also bring about new types of risks. They necessitate the expansion of risk mitigation concepts beyond what has been traditionally considered within the geothermal sector.

The objective of CROWDHTERMAL's Task 3.2 "Alternative finance risk mitigation" is therefore a better understanding of alternative finance risks and the associated mitigation options for geothermal projects.

In this Deliverable 3.2 "Alternative finance risk inventory", we present the key advantages, potential risks and possible risk mitigation measures for the alternative finance methods crowdfunding (general), crowdfunding (loans), crowdfunding (shares/equity), crowdfunding (reward-based), direct lending and leasing both from a project developer's and from a community investor's perspective.

Opportunities, risks and risk mitigation options of a specific finance method belong together in many ways. This Deliverable is thus not limited to the topic of risks only, but summarizes all activities and findings of CROWDTHERMAL's Task 3.2 in a comprehensive way. The subsequent Deliverable 3.3 "Alternative finance risks' mitigation tools" then is a condensed, tabular summary synopsis of the results presented here.

The basis of our risk analysis is an understanding of the technical workflow of a deep geothermal project and the associated resource-related risks. The main project development phases (project definition, exploration, drilling, construction, operation and decommissioning & post-closure) are explained highlighting the most critical and cost-intensive phases and showing why and where community funding can play an important role. An integrated three-level diagram is presented that aligns technical and financial as well as social phases along the course of geothermal developments.

Against this background, we analyse the potential risks and possible mitigation strategies for the different alternative finance methods. We base our research on case studies, a close interaction with WP2, interviews with geothermal as well as alternative finance experts and Advisory Board consultation.

We present nine case studies from both shallow and deep geothermal projects for both geothermal heat and power production. They show that alternative finance can be successfully used for different geothermal project and technology types as well as various investment sizes. The case studies also include one negative example of financial fraud.

Our analysis confirmed that community funding can play an important role to initiate and support geothermal projects by raising additional funds. Especially in the early project development phases, alternative finance methods can enable more geothermal projects to be brought to life. Community funding can also achieve public engagement and increase acceptance. In the light of the massive investments needed, especially for deep geothermal power projects, community funding is yet not considered to be functional entirely on its own, but rather in combination with other (conventional) forms of finance.

The most suitable alternative finance method very much depends on the individual project characteristics and context. At the early project development stages, especially crowdfunding (shares/equity or reward-based) can be attractive options to achieve community co-ownership and to enhance project support. The high resource-related risk in the early phases however leads to high return expectation of investors. Community funding is generally less risky in the construction and operation phases, but the potential returns at these stages are also less attractive.

One of the main challenges for project developers is the high-risk drilling phase. When community funding is used for this phase, the involvement of the public can turn negative in case the wells are not performing as planned, unless the performance is covered by e.g. an insurance or public funds. Loan-based models pose a large financial risk to project developers in this phase, as the fixed interest rate of a loan has to be paid independent of the project results.

For project developers, direct lending and leasing are two more alternative finance strategies especially suitable at the late project stages. They offer the opportunity of easier access to funding than through conventional bank finance (direct lending) and the advantage that the resource risk is taken off the project developer (leasing), respectively.

The overview of advantages, risks and mitigation tools presented in this Deliverable allows project developers and community investors alike to systematically improve their risk management and decision-making processes. Before choosing a specific form of alternative finance fundraising or investment, it is recommended to evaluate all possible options along with the associated opportunities and risks in the individual context of a geothermal project.

On the basis of our analysis, we stress the importance of risk mitigation strategies like trust fund concepts, governmental guarantees or earmarked insurance products. We further recommend following best practice strategies to build and keep trust as prerequisite for successful and sustainable financial community engagement. Examples are the involvement of well-known experts or reputable institutions, for example through match funding.

Understanding and developing a project in a holistic way, taking into consideration technical, financial, and social dimensions as well as their interdependency is another important risk mitigation measure for project developers. It reduces the risk of interface problems and increases the chances for a Social License to Operate as well as for technical and economic success.

2 INTRODUCTION

2.1 GENERAL CONTEXT

Despite its huge potential to supply sustainable, decentralised and low-carbon baseload energy for electricity, heating and cooling, deep geothermal still plays a marginal role in the European energy mix. The high exploration risk that is typically present in the early stages of geothermal project development makes it difficult to mobilise the required risk capital for funding early exploration surveys and first drillings.

The drilling of deep geothermal wells is the most challenging and cost-intensive part of deep geothermal project development. A large amount of risk capital (10-20 Mio. €) is needed and associated with a high risk of project failure, being the main reason why traditional financing methods are difficult to obtain in this phase.

Alternative financing methods can be vital elements of the financing plan for this cost-intensive project phase. But even for the preceding and subsequent geothermal project development phases, community financing can be an important means both for fundraising and for community engagement and support. The financial ownership of participating local people/investors can ensure that the project is welcome and supported by the general public as well as local political decision-makers.

Each project phase requires different amounts and types of capital. This results in different possible alternative finance methods with the related individual risks and mitigation measures. The different financing methods can be applied by different business models. While the overall challenge of optimising the business model and financing portfolio with the help of alternative finance is addressed in WP2, WP3 focusses on optimising the associated risk mitigation.

The new approaches to finance (WP2) and public engagement (WP1) for geothermal developments necessitate the expansion of risk mitigation concepts beyond what has been traditionally considered within the geothermal sector. This includes mitigating the risks of all stakeholders and investors, communities and private individuals (community investors) who will participate in the financing of these projects.

Any type of community funding will be most effective when it both helps to contribute to the business case and when the investor gets a return on investment whether it be monetary or a product. In this document, we therefore analyse the perspectives of both the project developers and the community investors separately.

With project developers, we mean the public or private entity (or even individual) developing a geothermal project. This can for example be a municipal utility or a specialised geothermal development company. In many cases, the project developer is also the main investor of the geothermal project. The project developer may also have external main investors, e.g. institutional investors such as pension funds or banks.

With community investors, we mean private individuals (or sometimes also small businesses) who, in the context of sustainable and responsible investing, participate in the financing of a geothermal project, with small contributions to crowdfunding or direct lending campaigns, usually in the order of magnitude of a few hundred or a few thousand Euros.

2.2 DELIVERABLE OBJECTIVES

This Deliverable 3.2 “Alternative finance risk inventory” summarizes the activities and findings of CROWDTHERMAL’s Task 3.2 “Alternative finance risk mitigation”.

The focus of Task 3.2 is the analysis of alternative finance methods that can be used in geothermal projects. The objective of this Task is a better understanding of alternative finance risks and the associated mitigation measures for geothermal projects.

Task 3.2 draws upon lessons learned from experiences of geothermal projects using alternative finance methods and considers any new types of risks that may be associated with such alternative finance. Many of them are connected to the specific challenges associated with the variety and number of involved actors.

As risks and risk mitigation belong together in many ways and need to be understood in the same context, we decided to not only focus on risks, but to already include the findings with regard to alternative finance risk mitigation in this Deliverable 3.2.

Deliverable 3.3 "Alternative finance risks' mitigation tools" subsequently is a more systematic, tabular synopsis of the findings of Task 3.2.

Task 2.3 "New approaches for innovative finance mechanisms for geothermal energy" (CFH) will expand on the results of Task 3.2 by developing additional, new options and models for alternative finance in geothermal.

In Task 3.3 "Design of auxiliary and alternative pathways to risk mitigation" (M1-M18), GeoT will give recommendations for a novel risk mitigation component that will be complementing the alternative finance solutions brought forward by CROWDTHERMAL.

The results of all WP3 Tasks will eventually feed into the CROWDTHERMAL Core Services in WP4.

3 METHODOLOGY

Each geothermal project phase has a different level of risk. In order to evaluate different alternative finance methods and their risks for both project developers and community investors it is essential to not only investigate the alternative finance method alone but to consider the timing and purpose of the investment during the project development phases.

One of the first sub-tasks within Task 3.2 was therefore the project-internal discussion and definition of geothermal project development phases to be referred to within the CROWDTHERMAL consortium. The agreed technical phases and their risk characteristics are explained in detail in Section 4. In co-operation with the consortium, a three-level diagram was developed aligning the technical, financial and social levels of geothermal developments (Section 5).

Following the classification determined within WP5, the most common forms of alternative finance methods that can be used along the course of geothermal project developments are crowdfunding (loans), crowdfunding (shares/equity), crowdfunding (reward-based), direct lending and leasing.

In close interaction with WP2, new types of risks and mitigation measures were identified that can be associated with the different alternative finance methods, each from a project developer and community investor perspective (Section 5).

We use an inductive approach in which we first analyse specific case studies that have applied alternative finance in geothermal and then infer general risk characteristics for the different financing methods.

We analyse nine geothermal case studies as examples for different types of community funding. The case studies are located in France, the UK, the Netherlands (2), Spain, Iceland, Germany, Kenya and Romania. They include one negative example of financial fraud in order to demonstrate what happens if the risk occurs and to avoid future repetition. Besides eight deep geothermal case studies, we analyse the CROWDTHERMAL case study from Madrid as a positive example for crowdfunding for shallow geothermal developments.

For the UK case study, we liaised with the United Downs Deep Geothermal Power project in Cornwall, whose Project Manager Ryan Law is member of the CROWDTHERMAL Advisory Board. The information on the United Downs crowdfunding experience was gathered in the framework of an online interview. The full interview can be found in the Appendix.

Already within the scope of Task 3.1, networking interviews on the subject of geothermal risk mitigation and alternative finance were conducted with key experts being involved in important past and ongoing geothermal risk mitigation schemes as well as community financing projects. Within Task 3.2, their opinion on alternative finance opportunities and risks was further analysed.

Interviews with the following experts were integrated into Section 5 of this Deliverable:

- Gordon Bloomquist, international geothermal expert and technical consultant to the GRMF
- Katrin Brandes, Senior Project Manager, KfW Development Bank (German Reconstruction Loan Corporation)
- Dr. Burghard Flieger, CEO of innova eG, CEO of Solar-Bürger-Genossenschaft eG, and formerly CEO of Energie in Bürgerhand eG
- Magnus Gehringer, CEO Consent Energy LLC, Consultant to World Bank Group

- Franca Schwarz, Head Sub-Department International Cooperation, BGR (Geological Survey of Germany)
- Meseret Zemedkun, ARGeo Program Manager (Regional Office for Africa), UNEP (United Nations Environment Programme)

Further aspects on alternative finance risks and mitigation options were drawn from feedbacks of the following four members of the CROWDTHERMAL Advisory Board:

- Marit Brommer, Executive Director, IGA
- Philippe Dumas, Secretary General, EGEC
- Janos Szanyi, Associate Professor, University of Szeged (Hungary)
- Matthias Tönnis, Underwriter, Munich RE

In Section 6 we consider best practice strategies to build and keep trust as a prerequisite for successful and sustainable financial community engagement like match funding, the involvement of experts and certificates or labels. They result from literature research as well as from co-operation with the CROWDTHERMAL case study Madrid.

In Section 7 we present additional aspects that should be considered for foreign alternative finance investments. Our recommendations are based on international project development expertise (e.g. from Indonesia) and include suggestions on how to best secure PPAs (Power Purchase Agreements) and how to assess country and permit risks.

The conclusions of this Deliverable are summarized in Section 8.

As a next step, the results of this alternative finance risk analysis are compiled in a summary inventory to be presented in Deliverable 3.3.

4 GEOTHERMAL PROJECT PHASES

The development of a geothermal project can be divided into different technical phases. Figure 1 shows the technical phases to develop a geothermal project as they were agreed upon within the CROWDTHERMAL consortium: project definition, exploration, drilling, construction, operation and decommissioning & post-closure.

The phases are described in more detail below and can include sub-phases as well, depending on the specific project requirements. Even though the technical details of the phases are described for a deep geothermal project here, the general phases can be transferred to shallow geothermal projects in a similar way (compare to Section 5.3.3 and Figure 8).

All technical phases have different risk characteristics and require different additional actions related to financial, social, environmental and legal aspects.

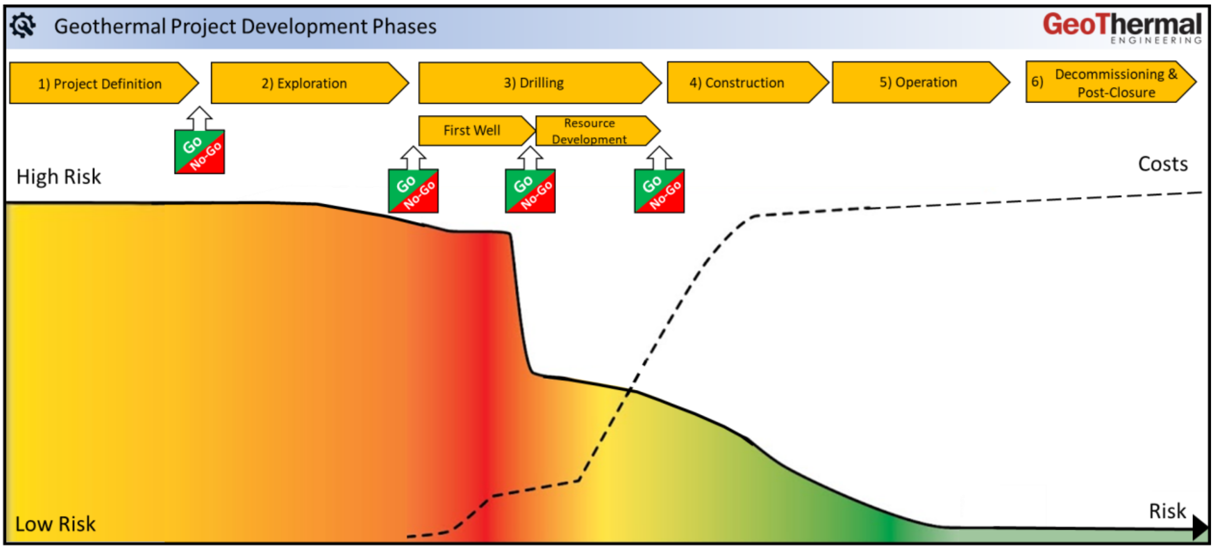

Figure 1: Technical project development phases, resource risk and costs of deep geothermal projects (modified after ESMAP 2012).

As can be seen from the development of the resource-related risk levels as well as the cumulative costs in Figure 1, the first phases of a deep geothermal project (until the first successful well is drilled) have the highest risk of failure. Risk capital is required in these early phases. After a first successful well has been drilled, the resource-related risk gradually decreases and access to bank finance becomes easier.

The first four technical phases are divided by go/no-go decision points (or project decision gates). These checkpoints allow the investor/project developer to make key decisions based on pre-defined criteria and to stop the project in case of non-promising results before too much money has been spent.

4.1 Project Definition

In the project definition phase, all available data is studied in order to prioritize areas of interest and select one or several areas for application of one or several exploration licenses. As this phase primarily consists of desktop work, the involved costs (and thus financial risks) are relatively low. The project definition phase comprises the following tasks:

- **Economic and legal framework.**
  This is the first part of the project definition phase focusing on the evaluation of the economic and legal conditions. Economic conditions can be FITs (feed-in-tariffs) which vary for each country, or power purchase agreements. Other aspects are the type of energy that will be produced by the geothermal project (e.g. heat, electricity or heat and electricity) and its implications for the business plan. The legal framework deals with the mining law, permits and other regulatory conditions that are associated with geothermal developments.

- **Data mining**
  This step includes the gathering of existing data. Especially data like offset wells, seismic surveys, temperature logs or any other reference information is helpful to understand the subsurface better. The geoscientific data interpreted in this first project development phase is very often legacy data from the hydrocarbon industry (e.g. 2D seismic lines). Occasionally access to modern 3D seismic data is available, which is frequently the case in the Netherlands. Depending on the type of data and on the country's regulations with regard to data access, data has to be bought from the data owners, involving low to moderate costs.

- **Evaluation of existing geoscientific data.**
  Experience and specialized software packages are needed to evaluate and integrate the existing geoscientific dataset. This analysis reveals if a potential geothermal target (e.g. faults) or lithologies and temperatures are expected to be present in a larger area.

- **Area of interest identification**
  The presence of potential geothermal targets is the key criterion in defining the area of interest. But also information about the surface conditions, infrastructure, industrial sites, heat customers, power grid, or protected areas like nature reserves are essential factors and need to be included in the assessment.

- **Securing exploration license**
  If the results of the previous steps are promising and the project developer decides to move on with the project (go/no-go decision point), the application for the exploration license is the next task.

4.2 Exploration

In the second phase, different methods of surface exploration are used to gather information about the subsurface, to define drilling targets and to plan the wells. The most appropriate exploration method(s) will depend on the type of resource and the geoscientific boundary conditions.

- **Acquiring new geoscientific data**
  The legacy geoscientific data that could be used for the preliminary interpretation is often not disposable or not of sufficient quality. Also, the focus of hydrocarbon data is usually towards shallower intervals where the gas or oil accumulations are trapped. The acquiring of new geoscientific data like a 3D-seismic survey is therefore often an essential part of the geothermal exploration phase. This is the first point in time when significant amounts of funds are required in the order of several million Euros for a large 3D-seismic survey (e.g. approx. 2.250.000 € for 100 km^2 of 3D seismic; Kraml et al. 2014) and the first time when community funding could play an important role.

- **Evaluation of newly acquired data**
  The newly acquired data is analysed using modern software packages and workflows. The aim is to refine the preliminary interpretation and to establish an improved understanding of the subsurface.

- **Integration with existing datasets**
  The integration of additional subsurface data is another important step in the workflow to obtain a more detailed subsurface model and to reduce geological risks. Depending on the available data, conceptual, geological and/or thermo-hydraulic models can be developed.

- **Identification of potential geothermal targets (e.g. structures, faults, aquifers)**
  Once the geological/conceptual model has reached the desired quality standards, the identification of the potential geothermal target is the next task. Targets can be fault zones but also any other zone or layer in the reservoir with the potential to produce high flow rates of hot geothermal water.

- **Drill site identification**
  The identification of a suitable drill site not only depends on the location of the geothermal targets, but also on the surface conditions. Especially in urbanized areas (usually where the geothermal heat/energy is needed), this can be challenging because there is hardly any free land available or it may not be classified for industrial use. Other aspects are nature conservation areas or residential areas. The proximities to existing heating networks and/or the power grid are also essential factors that need to be considered when choosing a drill site.

- **Well path planning**
  Based on the location of the drill site and the identified geothermal targets, the actual wells are planned. Often highly deviated wells are needed to reach the specified targets in the subsurface.

- **Securing drilling and testing permits**
  Provided that all data available to this point allows for a positive go/no-go decision, drilling and testing permits are applied for according to the respective regulatory conditions. In case of a go decision also e.g. the environmental impact study for the drilling, public relation events and the most important financial phase for securing the funding for the drilling of the wells has to be done.

4.3 Drilling

For deep geothermal projects, the most critical project development phase of drilling the deep geothermal wells requires large amounts of funds (order of magnitude of ten to tens of million Euros). In this capital-intensive and high risk project development phase, community funding can play an essential role.

The design of most deep geothermal systems in Europe (apart from high enthalpy geothermal regions) consists of two wells (doublet). One well produces the hot water, and the other well re-injects the cooled water into the aquifer in order to maintain the reservoir pressure (economic argument) and to prevent the environment from pollution in case the thermal water is salty (ecological argument).

Once a first well is drilled and tested successfully, the exploration risk of the second and any other subsequent wells significantly decreases with the increased knowledge of the local subsurface. The drilling phase is therefore subdivided into two consecutive phases divided by a go/no-go decision point: a) the drilling and testing of the first well to confirm the feasibility to utilize geothermal energy and to assess the available thermal energy for the implementation of the project and b) the resource development via the second and if applicable subsequent wells.

4.3.1 First Well

- **Drill pad construction**
  Before the drilling operations can start, the ground needs to be cleared and prepared. A concrete dill pad is constructed to accommodate the heavy drilling machinery and to comply with HSE rules.

- **Drilling and completion of the first well.**
  The first well is drilled to reach the identified geothermal target. This is one of the most critical tasks (high costs, high technical/geological risks).

- **Logging, testing (production and injection test) and sampling**
  This step provides confirmations and conclusions on the geology (proof of concept of the geological model and conceptual model), temperature, water chemistry, and if there is an aquifer that can produce brine at expected flow-rates.

- **If applicable: well and/or reservoir enhancement**
  If the flow rates are below expectations, different techniques can be applied to stimulate the reservoir and to enhance permeability. These techniques can include chemical (acidification) and/or hydraulic stimulations to enhance fluid pathways or the drilling of a side-track to reach alternative geothermal targets in the subsurface. At the end of this step, there is another go/no-go decision point for project developers whether or not to go ahead with the project.

4.3.2 Resource Development

- **Drilling and completion of the subsequent well(s)**
  The following well(s) are targeting other identified high permeability zones in order to allow for a reinjection of the cooled brine and the most efficient resource exploitation. In case of a doublet the resource development consists only of the injection well.

- **Logging, testing, sampling and if applicable: enhancement**
  Similar to the previously described steps, the same procedures are applied to the other well(s) in order to confirm the resource characteristics.

- **Surface installation of the thermal water cycle**
  A surface pipe is constructed to connect the wellheads of the geothermal production and injection well and to establish the geothermal circuit.

- **Circulation test**
  The circulation test reveals if the injectivity of the injector well can accommodate the flow rates of the producing well. During this test, the pressure and flow rates are evaluated to maintain sustainable production and to minimise e.g. the risk of induced seismicity.

- **Securing construction permits**
  Provided that all data available to this point allows for a positive go/no-go decision the permits for the construction of the power/heat plant are secured hand in hand with plant design, negotiations and tendering.

4.4 Construction

The next step is the construction of the power or heat plant and heating/cooling facilities. In this phase, the resource-related and associated financial risks have significantly decreased. Access to traditional bank financing is therefore much easier than in the previous project development phases.

- **Construction of the plant (power/heating)**
  Once the permits for the construction of the power/heat plant are secured and the plant contract is finalized, the manufacturing and building of the power or heat plant can begin.

- **If applicable: new construction or extension of district heating network**
  When a new district heating network needs to be constructed or major extensions are required, high costs (in the order of magnitude of tens of million Euros) are involved. Community funding can therefore play an important role in this project development phase.

- **Connection to the grid or district heating network**
  Depending on the type of energy (heat or electricity), a connection to the power grid or district heating network needs to be established to deliver the produced energy to the market.

- **Securing operation permits**
  The license to operate is secured and depends, among other aspects, on the results of the circulation test.

4.5 Operation

The operation phase is commonly planned for 20 years from an economic point of view. For sustainability reasons, operation should be envisaged as long as possible. For the project developer, this is the point in time when a positive cash flow is generated and e.g. loans can more easily be paid back. Besides the operation, also maintenance needs to be considered. Maintenance costs play a big role in the geothermal industry in Europe mainly based on small projects.

- **Power and/or heat production**

  During this phase, power is produced and delivered to the market. From a financial perspective, this is the first time when a positive cash flow is generated.

- **Maintenance**
  To maintain geothermal production, regular maintenance is needed. Scaling and/or corrosion can reduce the performance over time. Especially the pumps need to be checked regularly as they are very sensitive and expensive components, Different adjustments can be applied maintain and improve the efficiency of the geothermal system.

- **Monitoring**

  Constant monitoring of water chemistry, gases, reservoir pressure, and possible induced seismicity is required to comply with the safety standards.

4.6 Decommissioning & Post-Closure

The decommissioning and post-closure phase it is an important stage from both a financial and a liability perspective. A project developer is required to put some money aside at the beginning of the project to take care of the ecologically correct project end. The reserves deposited for the dismantling phase of the installations shall ensure leaving the environment in a safe status after the technical lifetime of the wells. This requirement is an in perpetuity obligation.

- **Plug and abandon of wells**
  When the geothermal wells reach the end of their technical and economic lifetime, or there are other reasons to end the production, the wells need to be permanently plugged. Several cement plugs are placed in the wellbore to isolate the reservoir and prevent any potential contamination of the groundwater.

- **Decommissioning of the plant**
  The power and/or heat plant is dismantled, and any chemicals stored on-site are properly disposed of.

- **Monitoring of the abandoned wells**
  The plugged and abandoned wells need to be continuously monitored to ensure permanent isolation of the reservoir.

5 ALTERNATIVE FINANCE METHODS

The following section presents different alternative finance methods that can be used in geothermal projects. Some of them have been used in the case studies presented in Deliverable 2.1 by CFH and Deliverable 3.1 by GeoT (GEOPLAT case study risk assessment), or in other international geothermal projects, which are summarized hereafter.

The financial aspects of different community funding methods and the relationship to the project development phases are shown in an individual flowchart for each case study.

All different alternative finance methods have distinct advantages and risks. It is difficult to give a description of the advantages and risks of a financing method in general, as they are highly dependent on the specific project. The effective risks and most suitable risk mitigation measures depend on the characteristics of the project like technical details, financial characteristics and social context, and the project phase in which the community funding is used.

A good overview of the most important managerial, socio-economic, operational, geological and drilling risks that developers of deep geothermal projects can potentially face is given by the GEORISK tool (https://www.georisk-project.eu/georisk-tool/). In this study, we focus on the risks and mitigation measures associated with alternative finance.

We first give a general description of the alternative finance method, then analyse specific case studies and finally derive more general advantages, risks and possible mitigation measures of the respective financing method.

In Section 4 the technical project phases have been defined for deep geothermal projects. These phases can be understood as financing phases as well as they have different characteristics that are important for financing.

The analysis of the financial characteristics per project phase allows identifying which type of community finance could be used for a certain phase of a project to add most value for both project developers and community investors.

To evaluate the actual financial risks for the investors, it is essential to understand the specific purpose of the investment and the amount of capital that is needed during the different geothermal project development phases.

The three following financial characteristics can be used to give a general description of the financial situation per phase:

1. **Type of capital required.** Four types of investment capital are distinguished: (1) risk-absorbing, (2) risk-sharing, (3) debt and (4) reserves. Some geothermal development phases require capital that not only shares the risk but also compensates project developers for the financial risk. Other project phases can be financed by using debt financing or reserves.

2. **The financial risk in a certain phase**. The financial risk is defined by the chance that the investment will be lost in this phase. Three general levels of financial risk are defined: (1) low, (2) medium and (3) high.

3. **The relative amount of capital**. The six geothermal project phases described in Section 4 require different amounts of capital. Some phases require a limited amount of capital, but

others like the drilling phase require large amounts of capital (e.g. 10-20 Mio. € per well). For this analysis the amount of capital is subdivided into three simple categories: (1) low = up to 200.000 €, (2) medium = between 200.000 € and 2 Mio. € and (3) high = more than 2 Mio. €.

The financial characteristics can later be combined with project-specific social information and country-specific experience with (alternative) finance to define which forms of community funding could be best used in a certain project. This analysis will be done in Deliverable 2.3., expanding on the basic structure developed here.

Table 1 below shows the technical geothermal project development phases as well as the corresponding financial characteristics. It also lists the (alternative) finance methods that best suit the respective project phase and financial characteristics.

Figure 2 is a graphical interpretation of this data. It shows the most appropriate type of alternative finance as a function of the geothermal project phases, the associated risks and costs. The resource-related risk has a direct impact on the community investors' financial risk as well as the financial development and success of the project.

Table 1: Financial characteristics per geothermal project development phase.

Project Phase	Type of Capital	Financial Risk	Capital required	Suitable (Alternative) Finance Methods
1.Project Definition	Risk-absorbing, Risk-sharing	High	Low	Subsidies/grants/donations, crowdfunding (E/R*), direct lending combined with governmental guarantee, governmental lease
2. Exploration	Risk-absorbing, Risk-sharing	High	Medium	Subsidies/grants/donations, crowdfunding (E/R*), direct lending combined with governmental guarantee, governmental lease
3. Drilling A) First Well	Risk-absorbing, Risk-sharing	High	High	Subsidies/grants, crowdfunding (E/(L)/R*), governmental lease, direct lending combined with governmental guarantee, green bond, regular loan, regular bond, equity
B) Resource Development	Debt	High/ Medium	High	Crowdfunding ((E)/L/R*), governmental lease, direct lending, green bond, regular loan, regular bond, equity
4. Construction	Debt	Low	High	Crowdfunding (L/R*), direct lending, leasing
5. Operation	Debt	Low	Medium	Crowdfunding (L/R*), direct lending, leasing
6. Decommissioning & Post-Closure	Reserves, Risk-absorbing (Government)	Medium	Low	Retained profits, governmental funds

* E=Equity, L=Loan, R=Reward-based

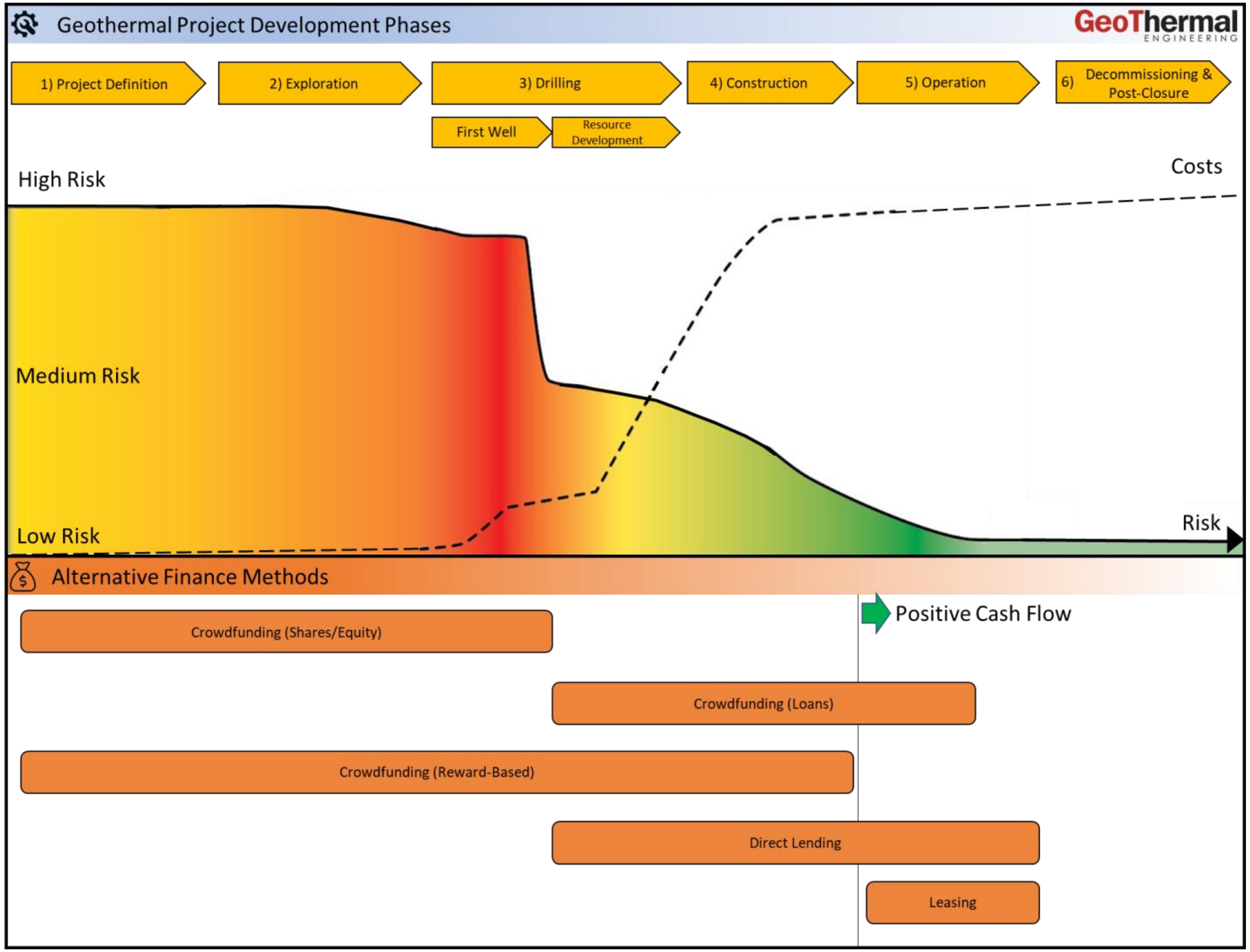

Figure 2: Technical geothermal project development phases, associated risks, costs and most appropriate alternative finance methods (modified after ESMAP 2012 and ALTFinator.eu 2020).

It must, however, be noted that it is not possible to fully generalize this classification. The most suitable (alternative) finance method depends on several factors, as well as their interconnection. The most important governing factors are:

- Specific geothermal project characteristics, mainly the risk profile and timeline of technical project development phases
- Financial characteristics
- Social factors

Figure 3 shows a synopsis of these three project levels which are also highly interlinked. It visualizes the integration of the technical, financial and social project levels and provides an overview of how the technical phases are linked with financial risks and challenges as well as social engagement options. Understanding and developing a project in a holistic way, taking into consideration all three dimensions and their interdependency is an important risk mitigation measure for project developers. It reduces the risk of interface problems and increases the chances for a Social License to Operate and for both technical and economic success.

Figure 3 also shows that most capital is required for technical phases 3 and 4. The financial risk for phase 4 is low, and therefore, phase 3, the drilling phase, is the most critical phase and the most significant hurdle for developing a geothermal project. The following Sections 5.1 to 5.6 focus on alternative finance methods that can be implemented to de-risk this critical financial phase.

Table 2 shows a summary of the geothermal case studies analysed in Section 5. It also highlights the type of alternative finance method that is used in the examples and the corresponding project phases.

Table 2: Case studies type and project phase of geothermal community funding.

Case Study	Type of Community Funding	Project Phases
France, Champs-sur-Marne	Crowdfunding (Loans)	3
UK, United Downs	Crowdfunding (Loans)	2/3
The Netherlands, Koekoekspolder (Zwolle) Phase 1	Crowdfunding (Shares/Equity)	1/2
The Netherlands, Koekoekspolder (Zwolle) Phase 2	Crowdfunding (Shares/Equity and Loans)	2/3
Spain, Shallow Geothermal Cooperatives in Madrid	Crowdfunding (Shares/Equity)	1
Iceland, Reykjavik Energy (OR)	Direct Lending (Green Bonds)	5
Germany, Kirchweidach	Direct Lending	1-5
Kenya, Olkaria III	Leasing	4/5
Romania, Lovrin	Leasing (potential)	4

Technical Level

GeoThermal ENGINEERING

1) Project Definition	2) Exploration	3) Drilling: First Well	3) Drilling: Resource Development	4) Construction	5) Operation	6) Decommissioning & Post-Closure
• Economic (e.g. FIT) and legal (e.g. mining law) framework • Data mining • Evaluation of existing geoscientific data • Area of interest identification • Securing exploration license	• Acquiring of new geoscientific data, like 3D seismic survey • Evaluation of newly acquired data • Integration with existing datasets • Identification of potential geothermal targets (e.g. structures, faults, aquifers) • Drill site identification • Well path planning • Securing drilling and testing permits	• Drill pad construction • Drilling and completion of the first well • Logging, testing (production and injection test) and sampling • If applicable: well and/or reservoir enhancement	• Drilling and completion of subsequent well(s) • Logging, testing, sampling and if applicable: enhancement • Circulation test • Securing construction permits	• Construction of the plant (power/heating) • If applicable: construction or extension of district heating network • Connection to the grid or district heating network • Securing operation permits	• Power and/or heat production • Maintenance • Monitoring	• Plug and abandon of wells • Decommissioning of the plant • Monitoring of the abandoned wells

Financial Level

	1) Project Definition	2) Exploration	3) Drilling: First Well	3) Drilling: Resource Development	4) Construction	5) Operation	6) Decommissioning & Post-Closure
Type of capital:	• Risk-absorbing • Risk-sharing	• Risk-absorbing • Risk-sharing	• Risk-sharing	• Debt	• Debt	• Debt	• Reserves • Risk-absorbing (Government)
Financial risk	• high	• high	• high	• medium to high	• low	• low	• medium
Capital required	• low	• medium	• high	• high	• high	• medium	• low

Social Level

1) Project Definition	2) Exploration	3) Drilling	4) Construction	5) Operation	6) Decommissioning & Post-Closure
• Announcement of the project to the public and relevant stakeholders • Asking for need of information and communication • Asking for interest in financial participation	• Offering regional information markets, topical tables (risks, financing, environmental impacts etc.) • Offering dialogue groups • Offering financial participation opportunities	• Offering site visits of existing projects / video / VR / 3-D presentations • Keeping dialogue groups	• Establishing local office with sufficient consultation times • Keeping dialogue groups	• Operation starting party • “Local energy festival” on a yearly base • Providing operation diary, website showing produced energy / saved CO_2-emissions • Initiating spin-off to other joint energy projects (RES, efficiency)	

Figure 3: Integration of technical, financial and social project levels.

5.1 CROWDFUNDING (GENERAL)

Crowdfunding is a form of community funding that is already a demonstrated and proven form of finance in geothermal energy (applied for example in the deep geothermal projects Champs-sur-Marne in the Paris Basin (see Section 5.2.1) and United Downs in the UK (see Section 5.2.2)). In other types of renewable energy projects such as solar and wind energy crowdfunding is used in a lot of projects.

The funds are raised directly from the community, without going through a bank. The community (=community investors) can receive reciprocation in several forms for the raised funds. This can be, for example:

1. A set interest rate, which is paid yearly or at the end (crowdfunding loans)
2. A dividend, which is tied to the financial result of the company/project that is funded (crowdfunding shares/equity)
3. A reward like a reduction in the energy prices (crowdfunding reward-based).

Crowdfunding is mostly raised via an accredited crowdfunding platform. Such "matchmaker" crowdfunding platforms usually investigate the risks on behalf of their investors. Similar to a bank, the Crowdfunding platforms will evaluate the project proposal of a geothermal project developer, as well as the feasibility and the associated risks for the community investors.

When raising capital via a platform, the funding is stored on a separate account that works like a trust fund. Only when the complete funding is raised, the money is transferred to the project owner/project developer.

5.1.1 Project Developers' Perspective

For the three major types of crowdfunding, many advantages and risks are the same. Some will, however, be different due to the different financial structures and products. From the project developer's perspective, the following general advantages, risks and mitigation measures of crowdfunding are present:

Advantages:

- Crowdfunding is an interesting way of funding the high-risk phase of a geothermal project when it is challenging to get access to conventional funds. Assuming a positive investment analysis of a crowdfunding platform and enough interest of the public, crowdfunding can, in principle, raise extra funding for the project developer in the high-risk phase of a project up to the legal maximum crowdfunding threshold limit. This is considered the biggest advantage of this form of alternative finance for project developers.
- Financial participation of community investors via crowdfunding can also enhance the social acceptance of a project, even though this does not necessarily need to be the case if the public more acts like an investor interested in the rate of return.

Risks:

- One major disadvantage for a project developer compared to traditional financing methods is that crowdfunding is relatively costly. Because the technical risk of finding a hot aquifer is high, the investors usually expect high return rates.

- The project developer still owns the exploration risk unless a geothermal risk mitigation insurance or fund is in place.
- Another disadvantage for project developers is the crowdfunding maximum size limit of projects. The maximum amount to raise from equity crowdfunding is 5 Mio. € in Europe (MiFID II). For crowdfunding loans the maximum amounts are different in every European country. With the new European crowdfunding regulation (ECSP) this will be harmonised in Europe and the maximum amount will be raised to 5 Mio. €. Higher amounts are possible, but only with a full prospectus. For reward-based crowdfunding there are no limitations in Europe. A crowdfunding platform cannot increase the limits set by the regulations. Against the background of the massive amount of money needed for deep geothermal projects, the crowdfunding limits are relatively low. In the case of the United Downs Deep Geothermal Power project (UDDGP) in the UK, for example, crowdfunding was legally limited to 5 Mio. £ (similar to other EU countries). In this specific case, however the crowdfunding limit should have been approximately twice as high in order to enable a significant contribution to the project's financing plan. This is valid for most deep geothermal projects, which are very capital-intensive.
- The possible maximum size of crowdfunding not only depends on the legal regulations but also on the investment analysis of the respective crowdfunding platform. Once the crowdfunding limit is set, it cannot be increased anymore. This is a restriction for project developers choosing this financing option.
- Another main risk of crowdfunding for the project developer is the risk of insufficient interest of the public to invest in a geothermal project. Even if the investment analysis of a crowdfunding platform is positive, the risk of not reaching a desired crowdfunding target still remains. If not enough money is raised at a certain time, the crowdfunding platform will not fund the project, assuming there is not enough interest in it. A lack of interest for financial participation can be due to a lack of knowledge, inexperience with crowdfunding or unfamiliarity with geothermal in general. It can also be due to a possible bad image of geothermal investments stemming from negative case studies in the past that were made public by the media (compare to Section 5.5.2).
- The legal obligations when using crowdfunding in the order of magnitude of several million Euros are substantial. Securities for investors need to be provided and individual investor's rights have to be understood and taken care of. Even when using a professional crowdfunding platform, it takes time and thus money to understand the legal framework and implications for a project developer.
- Managing a group of hundreds or even more individual crowdfunding investors can also be a challenge.
- Crowdfunding via a platform requires to pay a platform fee. Do it yourself crowdfunding also involves a legal fee.
- Another risk associated with crowdfunding is the insufficient security of data and the intellectual property of the project or applied technology. Because the platforms perform a due diligence of a project, also to determine the maximum size limit of the crowdfunding amount, project developers need to provide insights into their financial situation as well as technical details of the project.
- The insolvency risk of the crowdfunding platform with regard to e.g. the protection of client's assets also needs to be considered.

Mitigation measures:

- Know the governing laws regarding business model, financing and energy regulations before deciding on the alternative finance instrument to be chosen.

- The involvement of own lawyers helps to mitigate the legal risks associated with crowdfunding.
- Also working with an accredited and experienced crowdfunding platform will help reduce these risks.
- Use a professional platform ideally experienced in supporting geothermal projects (e.g. Abundance, Lumo, OnePlanetCrowd) or other renewable energy platforms.
- Try to avoid complexity. The financing model should be as simple as possible.
- Be aware that involving people and making them enthusiastic about a project requires time and energy.
- Start early with professional marketing and public relation activities.
- Communication and information should be publicly available to ensure sufficient participation.
- Clearly and openly communicate the goals, potential benefits, risks and the schedule of the project.
- Do not promise unattainably high revenues, but rather focus on investors that are not only looking for financial return, but also want to support the energy transition and/or local projects (so-called impact investors).
- Start with a small core group for "inside out" community building.
- Engage the community through events, workshops and other social engagement formats.
- Consider allowing contributions at a low level e.g. at only a few Euro and use new IT technologies e.g. PayPal or per text message (SMS).
- A good example for the engagement of the local community is to restrict the (early) participation in community funding to inhabitants of the community or region and to apply different conditions depending on the proximity to the project (compare to Section 5.2.1).
- Utilizing the heat from a geothermal project commonly enhances the local engagement of the public, because the community can directly see and feel the merits of the geothermal energy as opposed to power that is fed into a central grid.
- Keep local governments involved from the beginning and throughout all project phases.
- Discuss municipal green 'speed' passes for administrative procedures or tax-saving in municipal taxes.
- A high degree of trust/confidence in the integrity of the project developer and its key personnel / board members is essential. It is favorable to involve locally well-known individuals, experts of the renewable energy community and/or reputable institutions for trust building and credibility increase.
- In order to prevent illegal activities, crowdfunding projects should install additional technical measures like a good supervisory board with geothermal experts being able to verify a sound project development, to identify risks and to inform investors independently. It might even be worthwhile to pay an expert advisory board. Should any problems arise during exploration, drilling, construction or operation such an expert body might be able to help - mainly for the local government which have a very low level of knowledge about geothermal systems in most cases.
- Try to apply match funding with a trustworthy platform or public institution to increase both credibility and the amount of funding (see Section 6).
- Check for best practise de-risking measures (e.g. https://www.georisk-project.eu/georisk-tool/ and https://www.geoenvi.eu/publications/report-on-mitigation-measures/) as well as potential geothermal risk mitigation schemes (e.g. https://www.georisk-project.eu/publications/review-of-existing-derisking-schemes-for-geothermal-energy/) helping to offset the resource-related risk.
- Also check for opportunities of governmental guarantees or insurance products within crowdfunding platforms.

- An upfront alternative finance concept needs to be in place in case the crowdfunding cannot provide sufficient capital. It should be planned hand in hand with traditional financing in order to achieve a robust overall financing plan.
- Include a financial go/no go decision point at the point in time when it is clear whether the desired crowdfunding threshold value can be reached or not.
- Careful contingency planning should be applied in the overall financing plan, especially with regard to the drilling costs, which are very hard to predict and very prone to additional costs due to time delays and/or technical drilling risks.
- A possible way to scale up the total amount of crowdfunding for a project developer can be "serial-crowdfunding," as explained in Kleverlaan and de Jonge (2016). Here a series of funding opportunities or crowdfunding (equity/loan) rounds are used as a continuous source of funding throughout the lifetime of a business. For geothermal project applications, these additional funding rounds could, for example, be used to finance the drilling of the second or even third well. Yet, the timing of the serial-crowdfunding might be a critical factor. The example from Kleverlaan and de Jonge (2016) showed a two-year interval between the funding rounds. In order to finance the drilling of subsequent wells in a geothermal project, the funding of a new round would, however, be requested within several weeks to a few months rather than years.
- One measure to mitigate the risk of not reaching a crowdfunding target is private fund co-investing. In this case, platforms have their own fund that will co-invest in crowdfunding deals. For example, the crowdfunding platform October will invest 51% of the loan from this fund when the loan is approved and opens the loan to crowdfunding investors after that. If the crowdfunding loan is not fully funded by the crowdfunding investors, the fund will finance the rest. This way, there is no risk for the project owner for not reaching its target goal.
- In order to avoid the extensive equity or debt regulations present in most countries and to avoid any possible crowdfunding size limits, project developers can also try to work with donations. Donations can raise amounts even exceeding envisaged threshold values like shown in the German example of "Energie in Bürgerhand" (compare to Deliverable 2.1).

5.1.2 Community Investors' Perspective

From the community investors' perspective, the following general advantages, risks and mitigation measures of crowdfunding geothermal projects are present:

Advantages:

- By contributing to the crowdfunding of geothermal projects, community investors can promote local renewable energy sources.
- They also have a chance of high financial returns when investing in a high-risk project like the early phases of deep geothermal developments as opposed to less risky projects.

Risks:

- Poor returns or losses are the biggest risks from a community investor's perspective.
- The small investors face the possibilities of a lower than expected yield in case of a deviation in the original project plan (e.g. in the UDDGP case: 2 % instead of 12%, see Appendix) or even full loss of their investment in case of project failure / dry wells unless an insurance mechanism is in place.
- Even though mostly covered by regulations, potential illicit activities of the platforms need to be considered.
- The theft of assets (financial fraud) can also cause a direct loss to crowdfunding investors.

- As crowdfunding is a relatively new form of alternative finance, there are risks relating to market inexperience and untested professional liability of crowdfunding platforms.
- A possible insolvency of the crowdfunding platform could affect the continuous servicing of e.g. interest payments.

Mitigation Measures:
To a certain degree, community investors have to accept the high risks associated with investments in exchange for a chance of high returns. An investment in low-risk phases like the construction phase, for example, would yield only low returns. It is however recommended to (adapted from Kleverlaan 2020):

- Invest only in what you understand in order to better estimate risks, challenges and opportunities of an investment. Seek publicly available communication and information material to allow informed decision-making.
- Be aware of the high resource-related risks in the early project phases of deep geothermal developments.
- Understand risk/return ratios with regard to the fact that riskier investments will pay higher returns, but also have a larger chance of e.g. bankruptcy of a company or failure of a project.
- A basic level of understanding of best practices in geothermal project development / PPA negotiations is an advantage.
- Check the country risk prior to investment (see Section 7). Even within Europe, there is a large variety ranking from Denmark (4) to Greece (79).
- Be aware that the revenue stream does not start before the end of the project implementation timeline which can last many years.
- Invest with spare money not needed on short term and that can be missed in case anything goes wrong.
- Invest small amounts over a long period in order to spread the risk across positive and negative economic cycles.
- Diversify the investment portfolio into different risk levels and types of assets.
- Spread the investment to reduce the chances of losing all investment in case of default of one project or company.
- Make sure to use a professional platform with a good reputation and high quality standards with regard to their license, affiliation to professional associations, code of conduct, track-record, average default rate, due diligence practise on projects and continuation plan for servicing repayments in case of platform failure. Check the credibility of the crowdfunding platform carefully.
- Ask for investor protection products i.e. a minimum level of insurance.
- Ask for possible governmental guarantees.
- Request a good supervisory board with geothermal experts.

5.2 CROWDFUNDING (LOANS)

A loan is the lending of money by one or more individuals, organizations, or other entities to other individuals, organizations etc. The recipient (i.e. the borrower) incurs a debt and is usually liable to pay interest on that debt until it is repaid as well as to repay the principal amount borrowed.

Crowdfunding loans (or peer-2-peer lending), is a financing model where a business raises debt finance directly from investors. In return, the investors obtain a loan or bond. This is done through a crowdfunding portal directly, without going through a bank.

In this Section, we investigate two case studies where this type of alternative finance method was successfully used. The risks from a project developer's perspective and from a community investor's perspective are discussed afterwards as well as possible mitigation measures.

5.2.1 Case Study: France, Champs-sur-Marne

In the GéoMarne project developed by the energy company Engie, the aim is to create a geothermal heat plant in Champs-sur-Marne in the Paris Basin that will supply 10,000 housing equivalents with clean, local, renewable heating and sanitary hot water. It will be 82% fuelled by geothermal energy. Both geothermal wells are already successfully drilled. The aquifer temperature and the flow rates are as expected and the construction phase is scheduled for September 2020 (Figure 4).

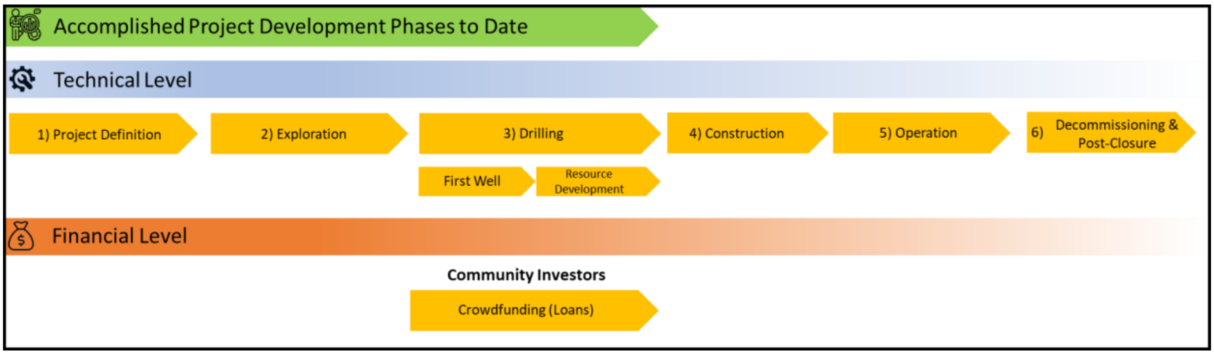

Figure 4: Technical phase and type of alternative finance for case study Champs-sur-Marne.

To improve the financing of the very cost-intensive drilling program for the two geothermal wells, additional money was raised via crowdfunding through the platform Lumo. A total of 1.000.000 € according to 4 % of the CAPEX was collected from 283 small investors. The average investment was approximately 3.610 € per person. The investment was given out in single bonds and shall be re-payed after 3 year with an interest rate of 6% remuneration for the inhabitants of the Urban Community of Paris Valley of the Marne and 5% for the inhabitants of the Region Ile de France (Engie 2019), resulting in an average return of investment of 500 € per person.

Under French law, Engie had the possibility to restrain the funding to local communities first and then enlarge the purchase later on. Participation was reserved to inhabitants of the Territory « Paris Vallée de la Marne » and Paris suburbs:

- Open 1st December 2019 to inhabitants of Champs sur Marne and Noisiel
- Open 1st January 2020 to inhabitants of Territory « Agglomération Paris Vallée de la Marne »
- Open 1st February 2020 to inhabitants Paris suburbs « Ile de France »

The crowdfunding used in Champs-sur-Marne was dedicated to the drilling of the geothermal wells and has therefore a very high financial risk. For Engie, crowdfunding is a solution for project acceptance and they do not perceive any risks for themselves as project developer associated with crowdfunding (Engie 2019).

5.2.2 Case Study: United Kingdom, United Downs

Funding by the European regional fund, Cornwall council and the public has allowed geothermal project developer Geothermal Engineering Limited (GEL) to drill two deep geothermal wells on its site at United Downs, near Redruth in Cornwall. The wells are currently being tested. A 1-3 MW power plant is planned to be built in order to supply both electricity and heat from geothermal energy (Figure 5).

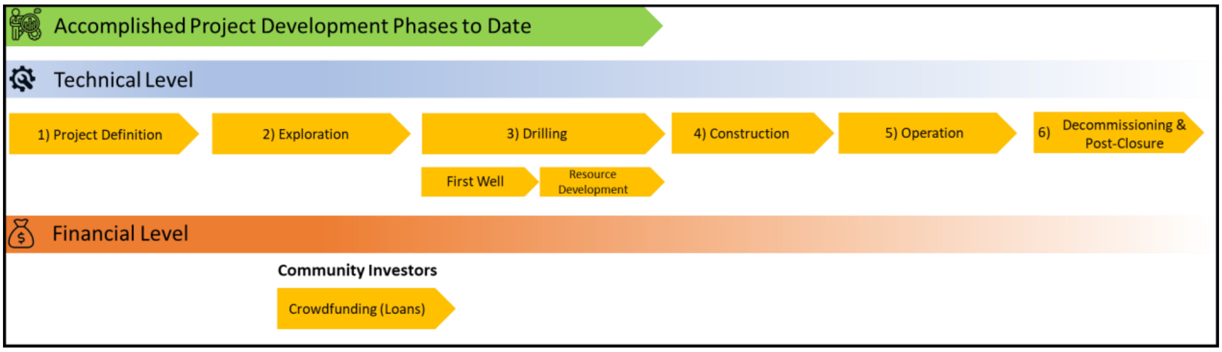

Figure 5: Technical phase and type of alternative finance for case study UDDGP.

With the help of crowdfunding platform Abundance, 5.2 million pounds were raised to support the UDDGP project via crowdfunding in 10 days. The type of crowdfunding was a bond with duration of 18 months and a fixed interest of 12% per year. It started in the exploration phase prior to drilling the first well. The bond was however prematurely terminated after about one year duration. The funds were not used, but returned to the investors with a yield of 2 % interest a year.

At the time of repayment, the drilling of the first well had just begun, very much behind schedule (drilling started in November 2018 instead of early 2018 as originally planned). Because of the time delay, the project risked an accidental default due to the time constraints of the bond. The termination of the bond was subject to the agreement of the majority of bond holders. The majority of bond holders accepted the decision.

5.2.3 Project Developers' Perspective

Advantages:

- As opposed to crowdfunding equity, crowdfunding loans do not require relinquishing part of the ownership of the project to investors.
- The interest paid on crowdfunding loans is fixed. As such, there is no upward risk in the cost of capital for the project developer.
- Project developers have the ability to decide when the loan is funded. This means that both the point in time where funds are made available to the project as well as the point in time when the funds need to be repaid are clear and can be planned. The timing of the cash flow is easier to control as for example with crowdfunding equity.

Risks:

- Crowdfunding loans are less flexible than crowdfunding equity.
- Crowdfunding loans are challenging in the early project phases, when it is difficult to predict the project time component. A delay in the project is a risk that needs to be considered. Especially during complex operations, like drilling, unexpected issues can occur, and the

project time frame extends. This delays the point in time when the geothermal field is brought into operation, and when a positive cash flow is generated. However, the fixed interest rate of a crowdfunding loan or bond must be paid in time.
- Another risk is the unclear result of the geothermal project. A well may be dry or less productive than planned. If the temperatures or the flow rates are lower than anticipated, the power output (electricity/heat) is also less than expected. Therefore the amount of energy that can be sold on the market is smaller and less revenue can be generated. The revenue might not be enough to pay the fixed interest rate of the loan.
- The loan has to be refinanced after the duration has expired.
- A further disadvantage of this method can be that community investors are less committed to a project when funding through a loan (as opposed to equity or reward-based methods).
- People that participate in crowdfunding (loans) are typically the ones that are generally interested in investing in new, renewable energy projects. Reaching local people and thus increasing local acceptance might therefore require additional social engagement tools.

Mitigation Measures:
- Equity or reward-based crowdfunding are typically more suited for the early geothermal project development phases.
- The project developer should investigate if the government will guarantee the loan to reduce the risks for the community.
- Raising funds through a convertible loan that can be converted into equity, if needed, could be another strategy to mitigate the risk.

5.2.4 Community Investors' Perspective

Advantages:
- For community investors, there is a lower financial risk compared to crowdfunding equity. The investor should get an interest through debt repayment, independent of the economic success of a project. This is especially important considering the very large project size of geothermal projects, which involves high financial risk.

Risks:
- If a project/company fails to repay its investment, normally, there is no guarantee fund for losses. This is the risk for investment. For the community investors this can mean that the loan may fold and cannot be repaid.
- With crowdfunding loans, the return is limited to the interest rate agreed in the loan agreement. If a project is above expectations, the return is thus still limited to the interest rates set out in the loan agreement, as opposed to shares that take the increased profits into account.
- Crowdfunding loan investors have no say in the strategy or risk choice of the company/project.
- Most platforms ask for a fee for managing the loan for the community investors.

Mitigation Measures:
- Community investors can look for a guarantee schemes for defaults. Some national governments and the European Commission via the European Investment Bank or the European Investment Fund provide guarantee funds that cover some of the losses in case of default (e.g. Kleverlaan 2020, EIF 2019). Since the Covid pandemic, the Dutch crowdfunding platforms October, OnePlanetCrowd and GeldvoorElkaar are for example accredited for the Dutch guarantee scheme BMKB-C to cover for losses due to Covid-19. Individual investors will have a guarantee of 67,5% of the losses of loans (i.e. a 67,5 % guarantee for the amount

liable) provided to SMEs. The BMKB-C is however geared towards smaller loans for liquidity problems.

- Additionally, they can ask for possible securities, e.g. collaterals provided by project developers, so alternative finance platforms have some value left if a company has to fold or cannot repay the loan.
- It is important to choose the crowdfunding platform carefully and compare the individual terms and conditions.
- Some crowdfunding platforms offer private financial instruments to mitigate the financial risk for their community investors: they can for example keep a financial buffer of a few months of payments in a separate trust fund. This way the investors will also get a repayment when the company/project developer is missing one or two repayments on their loan. The platform can use this time to negotiate a new deal with the company/project developer.
- Some platforms use a platform risk fund to mitigate the risks. In this case a small percentage from every crowdfunding deal is saved in a fund. This platform guarantee fund will pay investors when a company/project developer gets into default.

5.3 CROWDFUNDING (SHARES/EQUITY)

Crowdfunding shares/equity is an alternative finance model where a business raises funds in return for equity/shares in that business. This is done directly without going through a bank, for example, via crowdfunding platforms.

Crowdfunding equity investors participate directly or indirectly in the shares of a company or project. In most cases, crowdfunding shares are grouped in a Special Purpose Vehicle (SPV) as one new shareholder in a company where voting is delegated to the chair of the SPV. This way the business will only have one additional shareholder to discuss issues and voting.

According to Kleverlaan and de Jonge (2016), equity crowdfunding is growing very rapidly, especially in the US and the UK, and will continue to grow in Europe as well.

We investigate three case studies first, and discuss advantages and disadvantages from project developer's and community investor's perspective, as well as possible mitigation measures.

5.3.1 Case Study: The Netherlands, Koekoekspolder (Zwolle) Phase 1

Close to the city of Kampen, in a rural area called the Koekoekspolder, in the Netherlands, a group of three professional gardeners wanted to use sustainable energy for the heating of their greenhouses. Together with the local government and the province, they started the geothermal project (Figure 6). Two wells were drilled (1950 m and 1924 m), generating around 7.4 MW (water 73°C). The project started in 2010. By 2012 the first greenhouses were heated. In 2015 two more gardeners were linked to the heating infrastructure. A second project is underway in the vicinity.

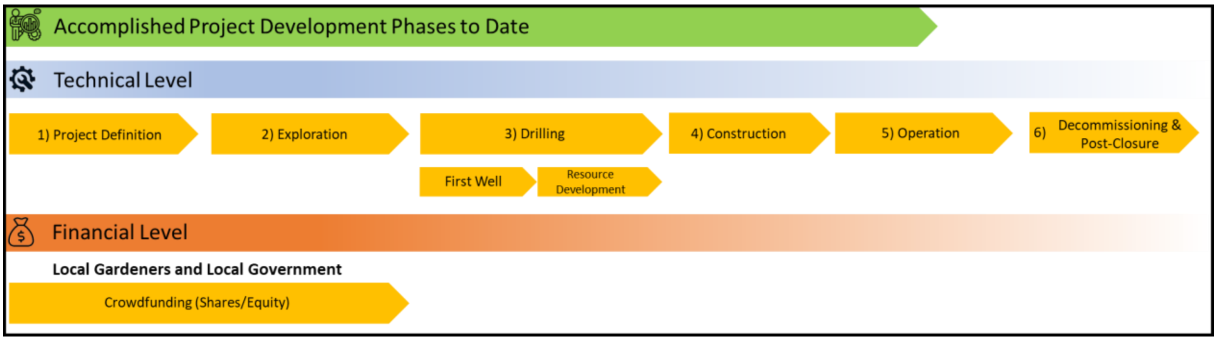

Figure 6: Technical phase and type of alternative finance for case study Koekoekspolder, Phase 1.

For the Koekoekspolder geothermal project (Phase 1) equity crowdfunding was used for the technical phases 1 (project definition) and phase 2 (exploration). The financial risk for these early phases is high because the further course of the project depends on the results from the exploration phase. If the results are disappointing, the project is terminated, and the investment is lost.

5.3.2 Case Study: The Netherlands, Koekoekspolder (Zwolle) Phase 2

After the success of the first geothermal project in Koekoekspolder a second project was launched close to the site of the first one. The goal was to provide more professional gardeners with geothermal heating. Extra challenges were: would there be enough energy to be generated close to the site of the first project? And could local community and government be involved again? Advantages were that the project definition and parts of the exploration phase were not necessary and permits to drill the new wells can be realized quicker (Figure 7).

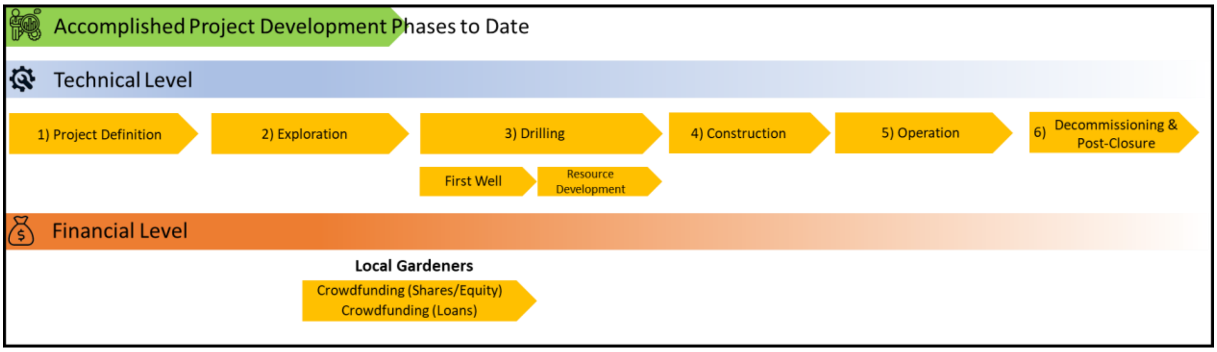

Figure 7: Technical phase and type of alternative finance for case study Koekoekspolder, Phase 2.

Because the first geothermal project Koekoekspolder (Phase 1) was successful, parts of the project definition and exploration phase were already accomplished. Therefore, crowdfunding (equity and loan) was raised to finance the drilling phase. Because the distribution and connectivity of a prolific aquifer in the subsurface can be very heterogeneous, there is still a high financial risk for the drilling phase. If the well is dry or flow rates are below expectations, the investment is lost.

Veldenkamp (2015) showed that the geothermal reservoir of Koekoekspolder is a heterogeneous Lower Permian Rotliegend sandstone with patchy anhydrite cementation causing reduced flow rates. The geological complexity of the reservoir inhibited a fast development of Phase 2, which is still under development (nine years after completion of Phase 1).

5.3.3 Case Study: Spain, Shallow Geothermal Cooperatives in Madrid

The CROWDTHERMAL case studies “Arroyo Bodonal Cooperative” and “EAI310 Cooperative” in Madrid (ES) are two examples of local housing co-operatives that use shallow geothermal to provide heating, cooling and domestic hot water. The projects were entirely financed by about 80 / 220 members. Similar to the Koekoekspolder case, these groups of people raised equity through community finance. They collected crowdfunding equity in exchange for shares in the respective co-operative. The own funds of approx. 30 % of the investment were used to buy the land / property for the buildings. The co-operative then applied for a traditional bank loan in order to fund the remaining part of the projects (Figure 8).

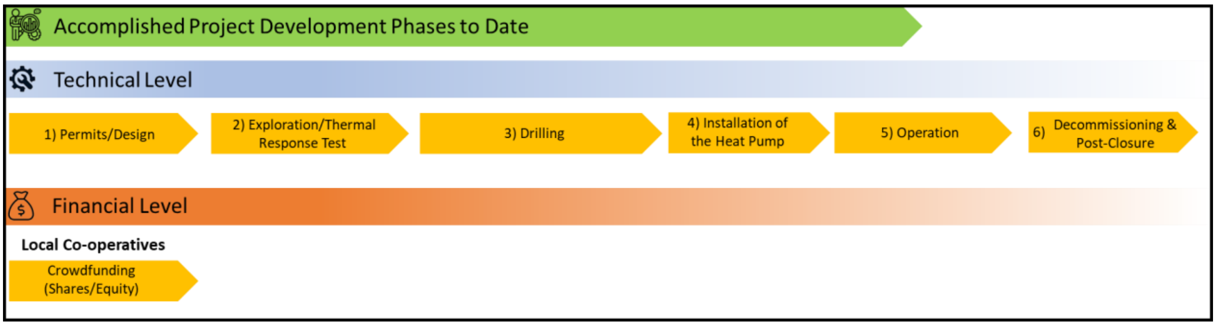

Figure 8: Technical phase and type of alternative finance for case study Madrid.

The largest perceived risk in this crowdfunding equity example was the lack of trust and credibility vis-à-vis financial entities (reluctant to finance the project), city councils (reluctant to issue permits) and construction companies (trying to change the concept). In this context, it was very important to co-operate with an expert or consultant with deep knowledge on geothermal (here the architect), to obtain the LEED platinum certification as an objective proof of efficiency and sustainability in the Arroyo Bodonal case and to follow the Trias Energetica Concept as a sustainability model in the EAI310 case.

5.3.4 Project Developers' Perspective

Advantages:

- Crowdfunding equity is a promising concept to obtain a Social License to Operate from the community.
- Crowdfunding (equity) is usually generated in a committed investor group, which supports the project development financially, but also ideologically (e.g. renewable energy projects).
- Another advantage is that the risk of the investment is shared with the community investors.
- The return on equity does not have to be paid until a profit is realized. For a geothermal project this means that the return is only payed back after the very expensive wells are drilled, the power plant is constructed, and the energy is sold on the market (positive cash flow).
- A large and possibly local commitment of the community investors also forms an opportunity for the project developer to attract additional larger, non-community investors. Local banks or pension funds for example might be more motivated to invest in a project and more prepared to take on risks if the community investors form a risk base (and e.g. in the case of energy companies also a client base) for the project.

Risks:

- Shares/equity require relinquishing a part of the ownership.
- The return is not limited to an interest rate, but grows with the profit of the project.
- Before drilling, it is also difficult to judge what the project and thus the shares/equity are worth and to find a balance between the amount of crowd investors' interest and the equity level.

- A larger duty of care is needed compared to traditional financing methods, because equity investors often want to be integrated into the decision making process.
- The involvement of many different small investors implies a governance risk. General assembly rules need to be followed.
- The amount of reporting requested for equity models is high.
- Having to give a say to equity investors can be staff- and time-consuming. Co-ownership of a few hundred individuals as opposed to a small number of large investors bears the risk of tedious decision-making processes, making the timing to a risk itself.
- In crowdfunding equity, a project developer's commitment towards the shareholders needs to last from the beginning of the funding until the end of the project (inability to exit investments.). Equity can only be bought back if the investors are willing to give it back.
- The uncertain outcome of a geothermal project can lead to a conflict of interest between the project developer, the crowdfunding platform and the community investors and needs to be accounted for right from the beginning.
- If the results of the project are below expectations, it might be difficult to find investors for possible future projects.
- Illicit activities of the platforms like financial fraud need to be considered.
- Finally, the legal requirements for crowdfunding equity are more complicated than for crowdfunding loans.

Mitigation measures:

- The presence and conditions of insurance that protects from financial losses and its effects from a project developer's perspective should be investigated.
- Project developers should think in advance about the financial structure and shareholder involvement (i.e. to which degree and in which format shareholders are involved in the decision making). A nominee structure instead of a direct shareholding structure can add benefit to project developers in that they only deal with one shareholder (the nominee, see Kleverlaan and de Jonge 2016, p. 11).
- A low to moderate maximum crowdfunding proportion (maximum 10-15%) of the overall project financing plan can reduce the governance risk.
- Tools that can increase confidence and credibility of a crowdfunded geothermal project towards all stakeholders are considered an important mitigation measure in crowdfunding equity. Possible examples are official sustainability certifications/concepts/labels, institutional match funding, patronage of well-known persons from the renewable energy community and the involvement of geothermal experts.
- In order to increase local support, crowdfunding equity can be a very suitable means for a sense of local project ownership. This could e.g. be achieved by offering local community shareholding / equity for free or for a low price to inhabitants of a certain radius around the project site.

5.3.5 Community Investors' Perspective

Advantages:

- Shareholding involves a sense of ownership and control. For the community investors, the crowdfunding equity/shares financing method provides a clear and bigger role to participate in the project. It allows to be involved in the decision making process and to take more responsibility.
- A share in profits is realized once the project is successfully operating.

Risks:

- Crowdfunding equity investors basically face the same risks as project developers with regard to the exploration risk, offtake risk, currency risks, dependence on support mechanisms like feed-in tariffs, tax changes, the sustainability of the resource, etc.
- In most cases, shares of an equity crowdfunding campaign are difficult to trade as the shares are not listed on a public exchange. The inability to exit the investment (due to the lack of a secondary market) is considered as one of the major risks according to Kleverlaan and de Jonge (2016). Community investors have to wait for a formal exit to retrieve investment and profit.
- If the project fails (e.g. due to a dry well), the invested amount will not be paid back and is lost. Therefore, there is a risk that no reward will be realized.
- Even with a successful project, the return from a geothermal project can only be expected after a minimum of 5-7 years.
- The dilution of investment is another aspect that needs to be considered by the community investor. The project developer might seek multiple crowdfunding rounds (serial crowdfunding), which impacts the proportion of shares in total and poses a return risk to the community investor.
- There have been negative examples of financial fraud associated with crowdfunding equity in the past.
- In the case of a co-operative model, low credibility vis-à-vis banks, regulatory bodies, or partners can be a hurdle.

Mitigation measures:

- A good information policy and transparency about the project and the details of the financial aspects are fundamental so that the community investor is well informed about the risks and possible rewards.
- It is also recommended to choose the crowdfunding platform carefully before investing.
- Another risk mitigation strategy for the community investors is to look for a governmental or institutional guarantee, a trust fund, risk mitigation scheme or insurance product. This can be especially important during the high-risk phases of a geothermal project.
- An example of an insurance product earmarked for equity crowdfunding platforms is the global insurance organization AIG's Crowdfunding Fidelity coverage. This policy covers the potential theft of assets that can cause business failure and financial loss to investors (see Figure 9).
- Shareholder rights in the form of potential voting rights can be a risk mitigation measure because of a certain degree of participation in the decision making progress and the involvement in important processes.
- In the case of a co-operative model, tools that can increase the confidence and credibility of a crowdfunded geothermal project can be applied like specified for the project developers' perspective.

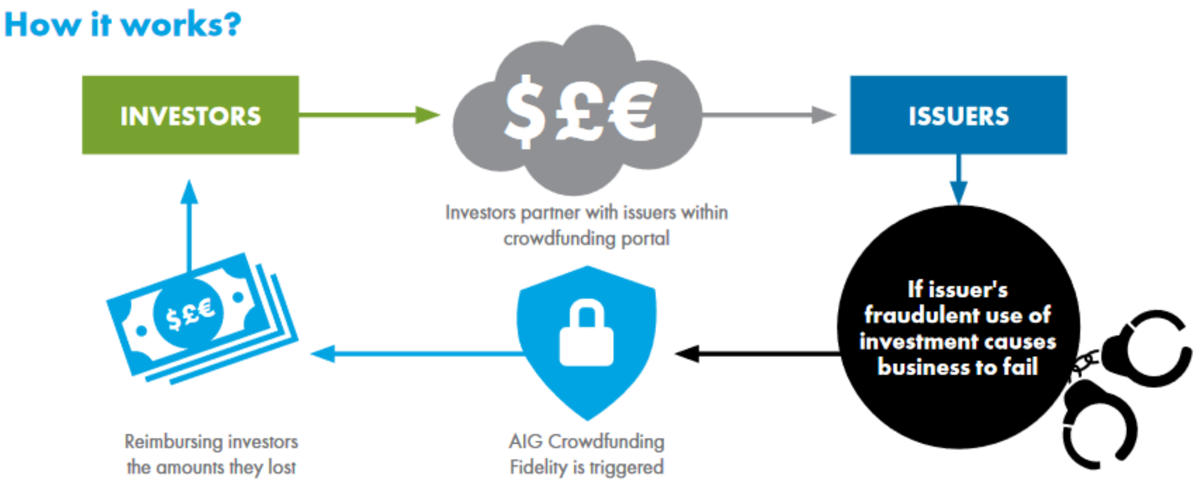

Figure 9: AIG's Crowdfunding Fidelity coverage product (AIG 2016).

5.4 CROWDFUNDING (REWARD-BASED)

Reward-based crowdfunding is a financing model where a business raises funds directly from the community without going through a bank in return for non-monetary rewards. These rewards can be products or, in the case of geothermal development, a reduction of the personal energy costs for the investors (heat/electricity). As we have not found a case example of reward-based crowdfunding associated with the development of deep geothermal projects, the following aspects are only of generic nature.

5.4.1 Project Developers' Perspective

Advantages:

- Reward-based crowdfunding is a promising approach to enhance local project ownership and to obtain a Social License to Operate.
- The reward only has to be given when the project is realized. Repayment of the funding is therefore not always necessary.
- If the project takes longer than expected, there is no liquidity problem.
- No monetary return has to be paid.
- The community investors are the customers at the same time, e.g. heat or electricity consumers. The commitment of the crowd is therefore proven, and investors will be mostly local.

Risks:

- Reward-based crowdfunding has not been applied in the geothermal industry yet.
- There is a risk for the project developers that investors are not satisfied with the realized reward.
- There is also a reputation risk concerning the treatment of the crowdfunding investors.
- There is also a risk that a potential second round of funding may not be filled if the reward offered is not as expected, e.g. the geothermal wells deliver less water and temperature than anticipated.
- If a geothermal project does not deliver as much energy as originally planned, the project developer might have to buy the energy elsewhere to provide the promised rewards to the community, with all associated costs.
- It is difficult to raise high amounts of funding through this usually very local method.

Mitigation measures:

- It is recommended research upfront what the potential reward-based crowdfunding investors are interested in most and what specific interest in the project they pursue.
- Communication is a key element for this form of usually very local crowdfunding.

5.4.2 Community Investors' Perspective

Advantages:

- The advantage for the community investors is that they are involved in the project and can support a local environmentally friendly technology with their investment.
- Additionally, they have a reward based on the successful implementation of the project, i.e. a geothermal heat plant that delivers decentralized energy for domestic heating, making the community investors to a certain degree independent from large trans-regional energy companies.

Risks:

- For the community investors, there is a risk that the reward is less than expected. In case the project fails, it can even be worthless or non-existent.
- In the case of project failure, the investment will not be repaid.

Mitigation measures:

- It is recommended to only invest money that can be missed and is not needed for own expenses or on the short term.

5.5 DIRECT LENDING

Direct lending is a way of financing where an entrepreneur or company attracts funding for the company without going through a bank (or any other finance company that has a banking licence). The entrepreneur can attract this funding in the form of a loan or by giving out (green) bonds. The advantage of a bond is that it is tradable in a secondary market. The funding can be attracted directly in the market or through a financial intermediary (without a banking licence).

A direct lending platform can be such an intermediary. It can use several lending models for example a normal loan with or without collateral. Like in crowdfunding, the amount of funding will be determined on the basis of a feasibility analysis by the financing company/intermediary. Once the financial intermediary has decided how much they want to contribute to a specific project, the amount will usually be provided in full as a lump sum.

Special forms of direct lending can be social or green bonds. As they can be interesting funding strategies for geothermal projects, we consider them here in the context of direct lending. If such a bond is used it means the project or company (this can be the developer as an entrepreneur or a co-operative which wants to realize a project) gives out the bonds itself. They can also use a financial intermediary to reach the market, for example a bond platform.

Both social and green bonds are a form of loan with very strict regulations. A social bond is a financial instrument for projects that will create better social outcomes. Usually the payment to investors is flexible, based on the achieved savings. A green bond is a bond that is specifically earmarked to raise money for climate and environmental projects. Both instruments focus on impact investors. The "green" quality label can help convince "green investors" to participate in case of green bonds. In some countries, social and green bonds also offer the advantage that there can be tax-incentives connected to them.

5.5.1 Case Study: Iceland, Reykjavik Energy (OR) Green Bonds

To improve and accelerate geothermal development, the Icelandic geothermal utility Reykjavik Energy (Orkuveita Reykjavikur) started a green bond offering (Figure 10). The purpose is to use capital to overcome financial barriers typically associated with green projects and to finance several environmentally friendly projects, including the CarbFix project at the Hellisheidi geothermal power plant (mbl.is 2019). The green bond offering has a maturity of 36 years and pays a fixed real interest rate. The series has a semi-annual annuity amortization schedule and a final maturity on 18 February 2055.

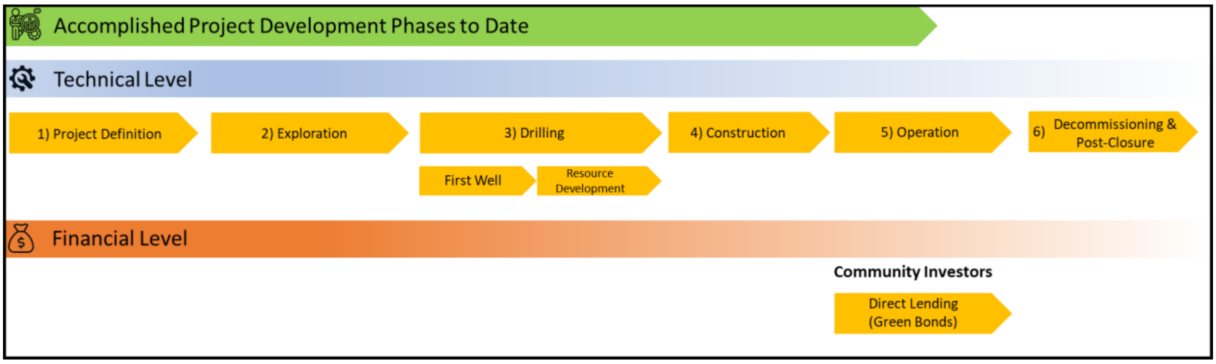

Figure 10: Technical phase and type of alternative finance for case study Reykjavik Energy.

The issue of the green bond was very successful and attracted bids up to $52.7 million at a yield of 2.50%-2.70%. The capital raised via the bonds will be invested in an array of green projects. This is part of Reykjavikur strategy to reduce carbon emissions by 60% by 2030. Projects to be funded include:

- The CarbFix project at the Hellisheidi geothermal power plant. In this project, CO_2 is captured, injected into the subsurface where it reacts to solid rocks.
- Technologies that support smart grid applications
- Renewable energy, energy distribution and expansion of the district heating system

Based on Orkuveita Reykjavikur experience with the green bond offering and their knowledge gain, they established a Green Bond Framework – the so-called Reykjavik Energy Green Bond Framework. This Green Bond Framework commits to the established „Green Bond Principles" guidelines put forward by ICMA (International Capital Market Association).

CICERO Green, which is an independent review agency, analysed and evaluated the Green Bond Framework and rated it with the highest possible rating of „dark green". It stands for the best environmental performance and of the projects and an additional rating of „excellent" for the governance structure of the framework.

5.5.2 Case Study: Germany, Kirchweidach – Negative Example Financial Fraud

The business model of the SAM (Swiss Asset Management) AG, with subsidiaries in Munich and Regensburg, was based on the hopes of small investors for improved returns by investing in sustainable, innovative, state-of-the-art projects, for example the development of deep geothermal energy (Liebl 2018; Dezer et al. 2017; Krall and Moßbruckner 2016).

In 2009/2010, SAM convinced small investors to terminate their existing financial investments (e.g. life insurance), which had relatively low interest rates, and to transfer the money into the funds managed by the SAM AG. They promised double-digit returns, because of their innovative, renewable and sustainable portfolio with key future technologies.

SAM AG raised almost 50 million euros from 4500 small investors (average of 11.000 € per investor). Over 20 million euros were assigned to the Regensburger FG Group.

The FG Group subsidiary GEOKRAFTWERKE.de GmbH / Fröschl Geo Kraftwerke GmbH itself also sold fixed-interest „Namensschuldverschreibungen“ (non-tradable, registered bonds) to small investors on the German market, promising 7,25 % of annual return as base interest rate, conditional to enough annual surplus, plus a possible (fixed) interest rate on profits (Fröschl GeoKraftWerke 2010).

From the so-collected money, the aim was to invest in different geothermal projects in Germany, so loans were given out to different project corporations. Part of the investors’ money was used to build a geothermal energy plant in Kirchweidach, in Bavaria. The small community with 2000 inhabitants had very high hopes for the promising power station to generate climate-friendly energy.

However, problems arose right from the start. The drilling took much longer than expected and therefore costs were higher than planned. When the aquifer was finally reached, pressure and temperature of the hot water were much lower than expected. The construction of the power plant was postponed again and again. At the end, the low flow rates allowed only the construction of a pump station for direct heat use (Figure 11).

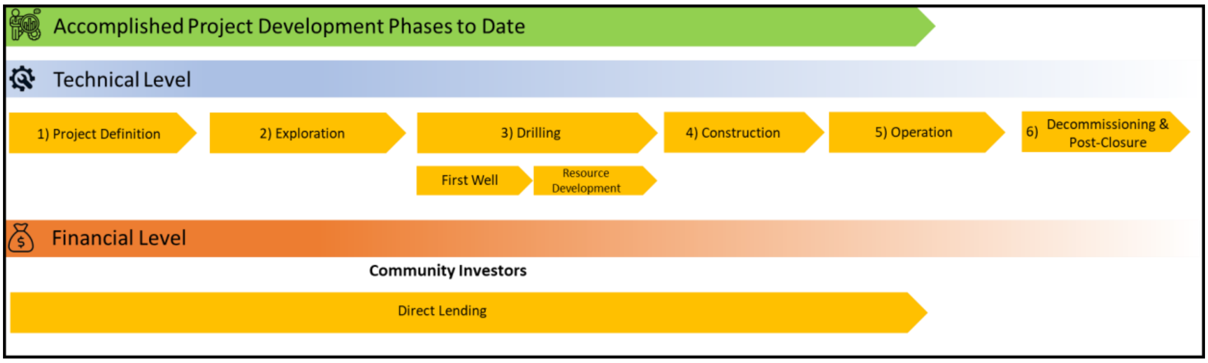

Figure 11: Technical phase and type of alternative finance for case study Kirchweidach.

The vegetable farmer Josef Steiner from Austria becomes aware of the pump station in Kirchweidach. He plans a climate-neutral greenhouse for sustainable and regionally grown fruit and vegetables. Together with the community and the local energy company Kirchweidach Energie GmbH, Josef Steiner builds and operates two huge greenhouses, heated thanks to geothermal energy. Additionally, the pump station also supplies part of the small town with district heating. For the community of Kirchweidach, there is a small happy end.

For the 4500 investors aiming to support the development of renewable energy, it is a different story. The SAM AG frequently changed their company name and transferred the remaining 30 million euros via phantom companies to bank accounts in Panama. In 2017, four executive employees of the SAM AG were sentenced to imprisonment. However, it is almost hopeless to get the money back. The investments are lost.

Despite this course of events, the Regensburger FG Gruppe (which received money from the SAM AG) is still operating in Germany. By now, they have not been able to realize any of the anticipated geothermal power plant projects, and the project Kirchweidach yields much less returns than originally planned. The interest on the loans given out to the project corporations by

GEOKRAFTWERKE.de GmbH has not been paid back, because the different projects have not generated profit yet. As Geokraftwerke has got no income either, no interest has been paid back to their small investors.

In the last years, the conditions for crowdfunding/fundraising in Germany have become more strictly defined. The acquisition is now only allowed using specific platforms and the persons in the executive board are requested to have the necessary qualification.

Although there is now a commercial use of the produced geothermal water, the development of the geothermal resource was influenced by the unclear financing structure, the illegal activities of subsidiaries of SAM AG and the resulting legal consequences. The image of geothermal development was severely damaged.

5.5.3 Project Developers' Perspective

Advantages:

- It may be easier to attract funding through direct lending than through a bank.

Additional advantages if a financial intermediary is used to provide the direct lending:

- The use of a financial intermediary can help in the process of direct lending, as they have an existing network which makes it easier to reach potential investors than for a project developer.
- As opposed to crowdfunding, direct lending through a financial intermediary does not involve the risk of incomplete funding.
- If using a financial intermediary, the risk of repayment to the community lies with the financial intermediary, not with the project developer directly.
- The project developer only has to deal with one investor (the financial intermediary).

Additional advantages if green bonds as one possible direct lending instrument are used:

- Green bonds can be effective in pre-financing the early project development phases to help a project get off the ground.
- The "green" quality label can help convince "green investors" to participate.
- There might also be tax incentives associated with green bonds.

Risks:

- A risk when using direct lending is that the result of the project (i.e. flow rate and temperature) may not be enough to pay the fixed interest rate of the loan.
- Due to unexpected delays of the project (e.g. drilling risks or citizen initiatives), the projects can be delayed while the fixed interest rate must be paid in time.
- The loan has to be refinanced after the duration has expired, which also limits the flexibility during project development.

Additional risks if a financial intermediary is used to provide the direct lending:

- A financial intermediary may ask for a high level of collateral, especially in risky phases (e.g. the drilling of the geothermal wells). However, this collateral may not be available. As a consequence, the financial intermediary may not accept the level of risk, which is involved in developing a geothermal project.

Additional risks if green bonds as one possible direct lending instrument are used:

- Green bonds might not be applicable for single geothermal projects, so they may require the pooling of projects in a portfolio approach.

Mitigation measures:

- One mitigation measure could be to raise funds through a convertible loan that can be converted into equity. This increases the potential of an upward return for investors and thus makes the loan more attractive for investors. It also increases the flexibility of repayments for the project developer which can be useful if the project results are delayed.

Additional mitigation measures if a financial intermediary is used to provide the direct lending:

- Another mitigation measure is a (governmental) guarantee, so the loan can be repaid to the financial intermediary even if the project does not generate enough income (in time) for repayment. A common way is using a “first-loss” model. Such a model is also used by the European Investment Fund (EIF 2019) for providing guarantees to micro-credit loans. This way the investors will get (a part of) their investment back.
- Collaterals can be used to guarantee investors that a means to generate repayments is still available.

Additional mitigation measures if green bonds as one possible direct lending instrument are used:

- Project developers can pool own projects or projects from several developers/investors in order to create risk profiles in line with the objectives of financial intermediaries. Bundling projects can reduce transaction costs and streamline investments.

5.5.4 Community Investors’ Perspective

Advantages:

- In direct lending, community investors can to a certain degree choose in which projects they want to invest. For example if the project (entrepreneur) raises funds directly, they can invest into this project. If a financial intermediary arranges the direct lending, they can choose an intermediary with a risk and return profile that matches their preferences.
- Through direct lending, investors can participate in projects that would normally not be available to them as investment opportunities.

Additional advantages if a financial intermediary is used to provide the direct lending:

- If funds are raised through a financial intermediary, the intermediary can combine projects. The investment risk can be diversified between different projects which reduces the risk for the community investors.

Additional advantages if green bonds as one possible direct lending instrument are used:

- When using (social or green) bonds, an additional advantage is that they are transferrable, which provides more liquidity and less risk for investors.

Risks:

- If a loan attracted directly in the market folds, there is no guarantee that investors will be repaid. The investment might be lost.
- By investing in a loan or bond, there is no form of participation in the strategy or risk choice of the company/project.
- The rewards are limited to the (fixed) return agreed in advance, as no shares in its profits are involved if the project is successful.
- Direct lending investors might not be able to invest in a specific project of own choosing, e.g. a local renewable energy project.

Additional risks if a financial intermediary is used to provide the direct lending:

- If going through a financial intermediary, part of the revenue will go to the financial intermediary in the form of cost or profit.

Mitigation measures:

- A (governmental) guarantee would be a possible mitigation measure, so the loan can be repaid if the project does not generate enough income for repayment.

Additional mitigation measures if a financial intermediary is used to provide the direct lending:

- If the direct lending was attracted through the balance sheet of a financial intermediary, the intermediary can be responsible for the repayment. Non-bank financial intermediaries however do not fall under the nationwide guarantee of 100.000 € per bank account.

5.6 LEASING

A lease is a contract that permits the use of an asset. A licensed leasing company (the "Lessor") purchases an asset on behalf of its customer (the "Lessee") in return for a contractually agreed series of payments, which usually include an element of interest.

In case of a financial lease, the Lessee immediately becomes economical owner of the goods, bearing all costs and risks associated with the use of the leased asset. The Lessee enjoys the use of the asset for the duration of the lease agreement, usually accompanied by an option to buy the asset for and agreed price at the end of the contract. In case of an operational lease, the Lessor remains the owner of the asset. The maintenance and repair costs and risks also stay with the Lessor.

If a lease financing goes wrong, the ownership of the asset usually transfers to the party who has supplied the finance. This use of an asset as collateral in leasing is a financial risk mitigation measure in itself.

Two case studies from Kenya and Romania are shown below where an operational lease model is or could conveniently be applied at a late stage of geothermal developments i.e. in the operation phase. The advantages, risks and mitigation measures are discussed specifically for each case study and in general for leasing as an alternative finance method afterwards.

In the examples presented here, national governments or governmental bodies developed the geothermal projects until one or more successful wells had been drilled. The government thus acts as the (potential) “Lessor” and a private company (in case of Kenya) or the community (in case of Romania) acts or would act as the “Lessee”.

A lease agreement could in principle also be concluded between a public or private project developer as a Lessor and a community or group of community investors as a Lessee where – depending on the agreement – the wells could even be owned by the community investors in the end.

5.6.1 Case Study: Kenya, Olkaria III

The geothermal site Olkaria III is located in Kenya in the East African rift valley. Olkaria III is a large geothermal power plant with an installed electricity generating capacity of 139 MW. KPLC is the governmental Electricity Transmission and Distribution Company. KenGen is the governmental Electricity Generating Company. KenGen investigated the Olkaria area and drilled the wells. In this case study, they sold the steam of six productive wells in the Olkaria field via "steam supply agreement" (i.e. the lease agreement) to the private Independent Power Producer (IPP, in this case the company ORMAT = binary power plant manufacturer). The IPP sold the electricity of the first small plant (8 MW commissioned in 2000 which was later modularly expanded) via PPA (Power Purchase Agreement) to KPLC (Figure 12).

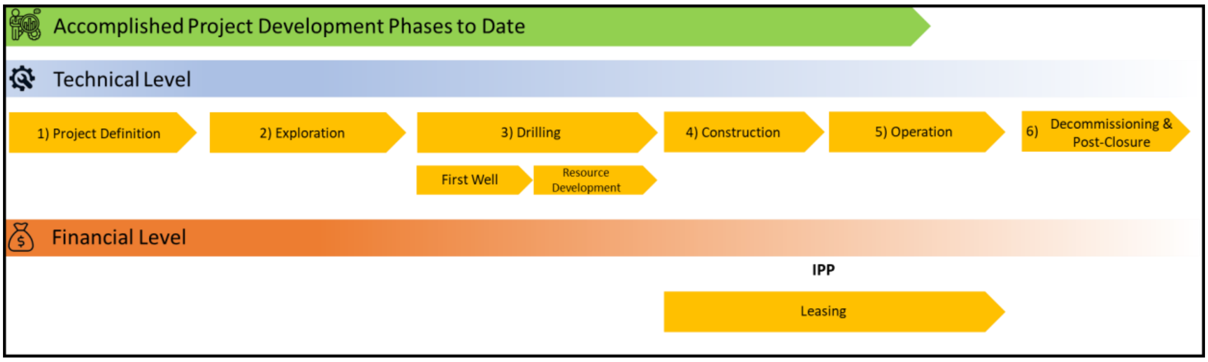

Figure 12: Technical phase and type of alternative finance for case study Olkaria III.

Since 2008 there is the additional player GDC (Geothermal Development Company). GDC is a fully government-owned company in Kenya's energy sector. GDC was formed as a SPV to accelerate the development of geothermal resources in Kenya. GDC is tasked with developing steam fields and selling geothermal steam for electricity generation both to Kenya Electricity Generating Company (KenGen) and to private investors / IPPs (see Figure 13).

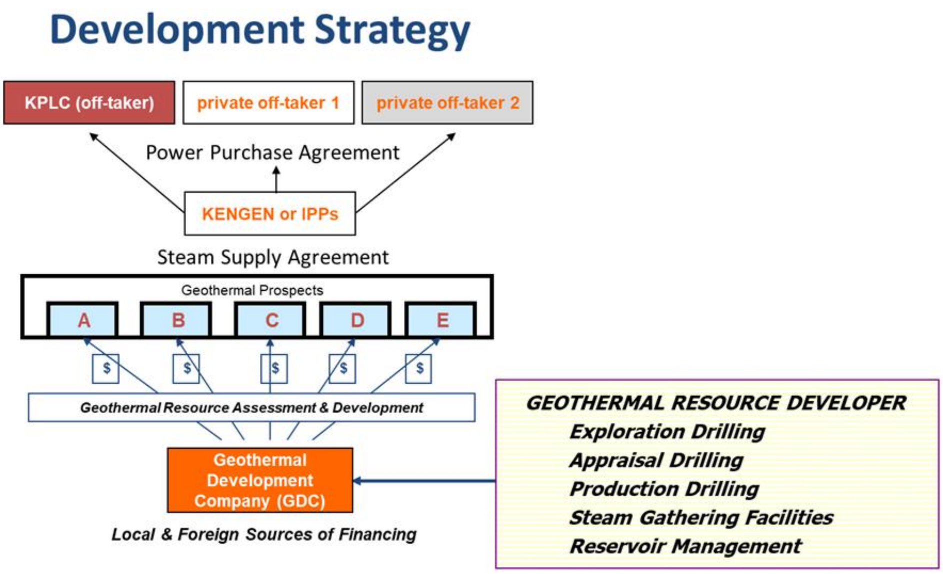

Figure 13: Development strategy Kenya model (GDC, modified after Simiyu, 2012).

The advantage for the IPP/investor in this case study is the absence of the resource-related risk. Because the first and high-risk phases of the geothermal project (project definition, exploration, and drilling) are executed by a government-owned company (i.e. KenGen or GDC), which later sell the geothermal steam via steam supply agreement, there is almost no exploration risk for the power plant developer / IPP. The IPP can therefore plan the finance for power plant construction and operation like for any other energy project. It is thus much easier to get access to traditional bank finance.

The risk for the IPP is that they could have a steam delivery risk in case of problems with the wells. If the Kenyan government could not provide the ca. 350°C hot steam sustainably in the long term, the IPP has no possibility to take care of that problem, and there is no realistic legal measure to get the income loss compensated. There might even be a penalty for delivering less electricity to the national grid than agreed in the PPA.

The advantage for the government is that – after competitive bidding to local and international private and public institutions – the resource or even many resources in parallel (achieving a faster overall growth) will be developed in every case due to the relatively easy access to traditional bank finance for the IPP.

The disadvantage for the government (especially in this case) was that the IPP ORMAT negotiated a higher than usually achieved price per kWh for the electricity they sell via PPA to KPLC. The higher price was due to the less appropriate conversion technology of the binary power plant used. The production costs for electricity are higher than those of conventional steam power plants. Ideally binary plants should only be used for low-temperature resources <190 °C.

5.6.2 Case Study: Romania, Lovrin

Before 1990 (when Romania was a socialist republic), a lot of geothermal wells were drilled in the sandstones of the Pannonian Basin (e.g. 20 wells in the years 1977 to 1984 in the same geological region as the CROWDTHERMAL case study site in Hungary). The hot water was widely utilized for heating greenhouses (the huge amounts of produced vegetables have partly been sold to Russia and other neighbouring countries) and, to a lesser degree, for district heating.

After privatization of the formerly state-owned utilities, the wells plus area around the wells as well as all related subsurface and production test data are owned by private companies. Nowadays, communities wishing to utilize the geothermal energy have to buy the subsurface and well test data (2-3000 Euro per well) and/or the wells (e.g. for 1,000,000 Euro) from those companies.

In 1992/93 most wells were therefore abandoned. Poor communities could not afford the newly introduced payment for the wells. The exception is one production well, which is used until today for district heating and a thermal spa in Lovrin, a small community with about 3200 inhabitants.

Since the budget of the community does not allow buying the entire well, they only "buy" the hot water as long as they use it. The community reduces the production in summer just to maintain their thermal spa; during the winter they produce more water for additionally serving the district heating network. The community has to pay 3000 to 3500 Euro per month in summer and 10.000 Euro per month in winter.

Like in the Kenyan example, there is no resource-related risk for the community in this case. The community however has to pay not only for the utilization of the geothermal water, but additionally for the maintenance of the district heating network. The water is corrosive and precipitates minerals in the pipelines. If corroded or clogged, the pipeline sections have to be replaced. The community cannot make sufficient money for this maintenance from the entrance fee of the thermal spa and practically no money from the provision of the district heating, because the latter is restricted to official buildings like the town hall, school, etc.

An operational lease of the wells like in the Kenyan example, with the maintenance risk kept on the Lessor's side, could be a more suitable and economically more viable option for Lovrin than the current model of "buying hot water" (Figure 14).

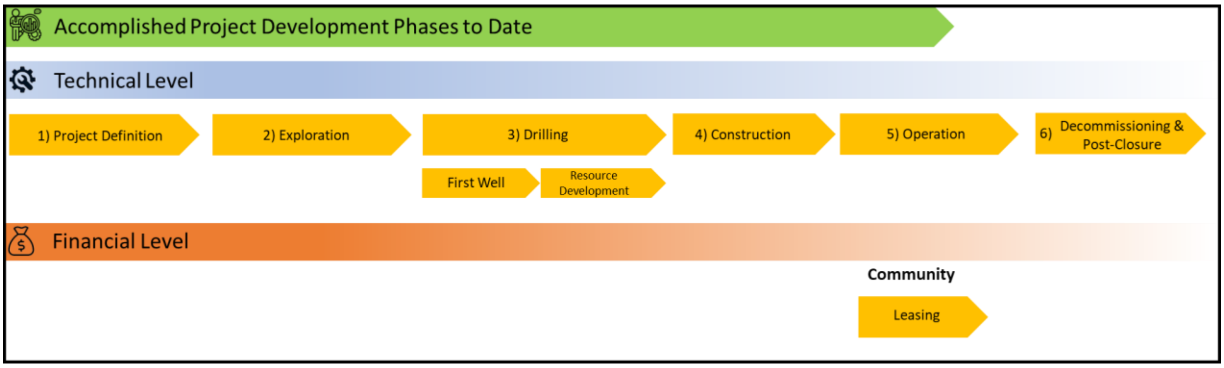

Figure 14: Technical phase and potential type of alternative finance for case study Lovrin.

In case an investor/project developer would want to utilize thermal water in Romania and sell heat to a small community, the earnings would currently be very limited. It is not possible to have too many thermal spas within a relative small area as there are not enough customers for all competing spas. The heat sales prices have to compete with cheap fire wood or coal. This might work only in "rich" industrial communities with big industrial off-takers or bigger cities with more potential customers using oil- or gas-fired burners to heat their houses/flats (like in CROWDTHERMAL's case study Szeged in Hungary). The potential earnings are not high enough to compensate for the exploration risk for new investments. The risk for the government is thus the reduction of geothermal energy utilization, and therefore a higher CO_2 footprint in the country, since most rural communities cannot afford the price for using the wells / the water plus the associated maintenance costs and new private investments are not economically attractive enough.

The Romania case study shows that the geothermal development is currently hindered by the current financial situation. There is, however, a tremendous geothermal potential in the subsurface that would allow a much broader use of this renewable energy source, from district heating to power generation. Alternative finance through an operational lease model like in Kenya could accelerate geothermal developments in Romania. An institutional investor or the government could develop the geothermal resources and lease the wells to an investor for power or heat supply. This would reduce the investment risk significantly, and more local communities could benefit from clean and renewable energy below their feet.

5.6.3 Project Developers' Perspective

<u>Advantages:</u>

- The largest advantage for project developers acting as a Lessee in the late project development phases (i.e. construction or operation phases) is the absence of the resource-related risk. The risky early development phases are carried out by e.g. the government.
- As there is almost no exploration risk for the Lessee in this case, a project developer applying leasing can raise money for the follow-up phases through traditional bank finance like for any other energy project.
- The late development phases of a geothermal project are clearer and less risky, so it is easier to match the maturity of the financial instrument to the costs of the specific project and phase.
- For a geothermal project developer, it can be easier to raise capital via leasing compared to e.g. direct lending, as collateral is arranged in the leasing contract itself. If the lease financing goes wrong, the ownership of the plant or well transfers to the party who has supplied the finance. This is a form of guarantee.

Risks:

- The Lessor may have conditions concerning turnover etc. making it impossible to get access to this form of financing.
- The Lessor can reclaim ownership if payments are not made in time.
- A lot of specific knowledge is required to monitor the project and repayments as they are tied to the leased object or project.
- In the late project development phases, traditional bank loans might be possible at lower costs than leasing.

Mitigation measures:

- Leasing can be understood as a financial mitigation measure in itself. It reduces the risk for the investor, because the asset is used as collateral and can be reclaimed when a business is not paying.

5.6.4 Community Investors' Perspective

Not applicable

6 HOW TO BUILD AND KEEP TRUST

Engaging the public, via both social engagement and financial participation, is a mitigation measure in itself. It reduces the risk of project discontinuation due to public opposition, for example in the form of citizen initiatives.

Successful community funding however requires sustainable trust in the project and the project developer. Building and keeping trust can be achieved in many ways. Early, transparent and continuous communication is a key element for all of them.

In order to build trust in a project, it can be beneficial if the project developer and/or main investor is locally known and embedded, like for example a municipal utility.

Utilizing the heat from a geothermal project also commonly enhances the social acceptance of a project, because the local community can directly see and feel the merits of the geothermal energy as opposed to power that is fed into a central grid.

For community investors it can also be helpful to know that the project developer and/or investor has put a substantial amount of private equity in the project.

Another good example for the appreciation of the local community is to restrict the (early) participation in community funding to inhabitants of the community or region and to apply different conditions depending on the proximity to the project, like shown in the Champs-sur-Marne case in the Paris Basin.

Trust funds as the standard concept of crowdfunding platforms are another good measure to offset the risk for community investors to lose their investment in case a project does not reach its target amount and is not implemented. Earmarked funds kept on a trust fund can for example be paid back or rededicated to other renewable energy projects in case a crowdfunded geothermal project does not take place as originally planned. The existence of a trust fund concept, an insurance or a governmental guarantee increases investors trust.

Another important option mitigating the risk of low trust and credibility in community financed geothermal projects is match funding. Match funding not only helps to increase confidence and credibility vis-à-vis investors, financial entities, regulatory bodies and subcontracted companies, but also increases the overall amount of funds raised.

In match funding, a public or private organization makes funds available to develop a specific area (e.g. energy), then calls for projects in this area and addresses the general public to contribute money. The crowd supports a specific project by small donations and the institution matches it with the same amount (sometimes limited to a certain threshold), thus increasing the total project budget (see Figure 15).

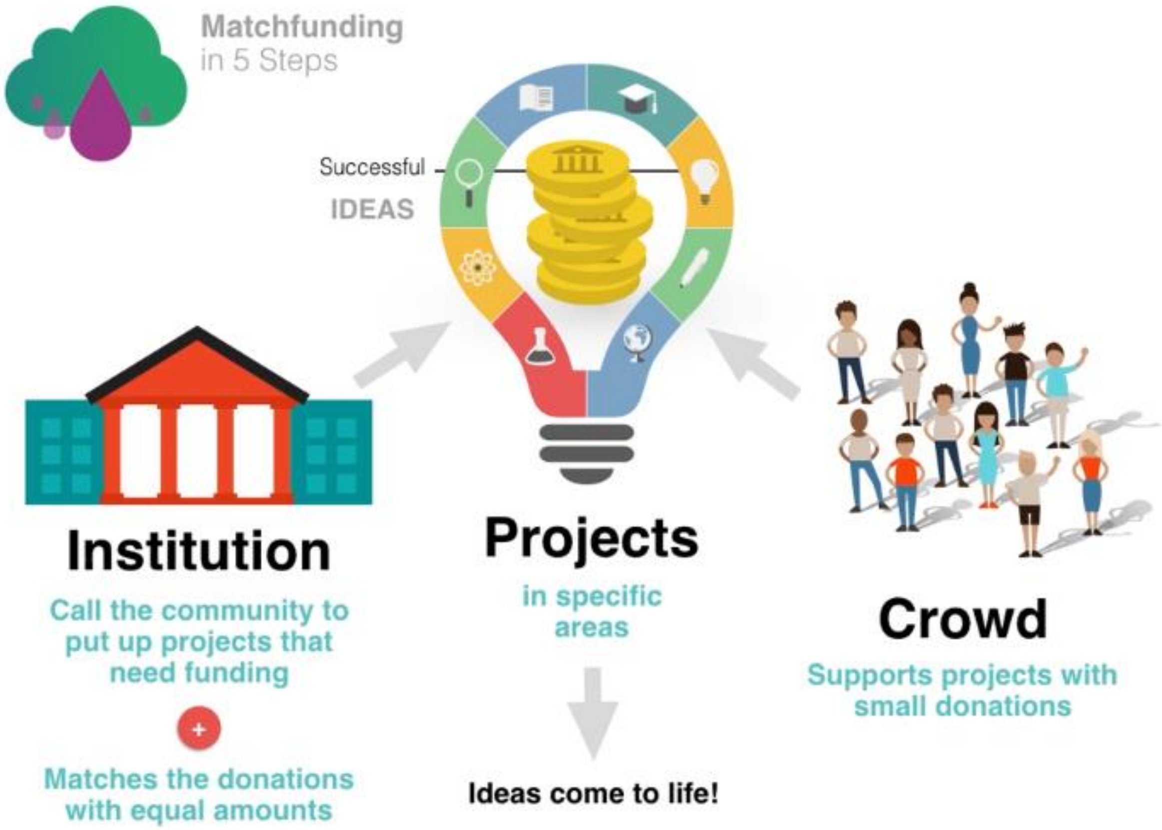

Figure 15: Conceptual matchfunding scheme (Europeana 2020).

Match funding programmes have two distinct positive impacts. On the one hand, the credibility of a crowdfunded project increases with the involvement of a reputable organization. With improved trust of the community, the chances of attracting financial support from the general public equally increases. The more crowd donations received, the higher the matching contribution and the bigger the total project budget.

According to Europeana (2020), a crowdfunding campaign with institutional support receives on average 180% more crowd donations than a campaign without institutional support. At the same time, its success probability (reaching the minimum set campaign/project budget) is increased.
It is therefore recommended to keep match funding instruments and institutions in mind when raising community funding.

Potential match funding institutions can be any organisations interested in promoting and supporting renewable energy projects, sustainability, science and technology and/or engaging communities.
Match funding could also be applied with the support of public / governmental agencies, EU bodies or municipalities.

For example, funds collected from match funding could be used to put it on an account specifically used for later dismantling of the geothermal wells. Investors might not put their highest focus on that point but to raise confidence in geothermal energy amidst the local population it could be a suitable measure to announce that the same amount of money collected by the general public will additionally be provided by the government to ensure a secure dismantling after the technical lifetime of the wells or even earlier, in case a serious problem with the plant affects the area of the neighbouring local population and leads to a permanent shutdown of the plant.

A further tool to increase confidence and credibility could be the patronage, testimonial or involvement of well-known individuals or (renewable energy) experts. In the Madrid EAI310 cooperative as one of the CROWDTHERMAL case studies for example, one of the promoters of the cooperative was an expert in geothermal from the Netherlands. So he was able to inform all the partners of the cooperative when the construction company tried to make them change to a 'traditional' heating and cooling system. He was convinced and was able to keep all the partners convinced along the process despite the barriers they found on their way.

Finally, labels like the LEED platinum certification as an objective proof of efficiency and sustainability in the Arroyo Bodonal case, the Trias Energetica Concept as a sustainability model in the EAI310 case in Madrid or the label FPCV (crowdfunding for green growth) in the Champs-sur-Marne case can help to increase trust and credibility in a community funded project.

7 FOREIGN INVESTMENTS

7.1 COUNTRY / PERMIT RISKS

In addition to all potential risks and mitigation measures presented above, alternative finance investors should be aware of a few additional aspects when investing in geothermal projects internationally.

Especially geothermal power projects can be promising alternative finance investments. In most cases, they are, however, most profitable in volcanic regions, which mainly lie outside Europe.

Foreign investors are always faced with different country risks (including the risk of not obtaining or maintaining the required permits for successful project development) which also should be considered in international alternative finance (e.g. Kraml and Nitardy 2009).

The international comparison and country risk ranking by The World Bank (2020) or similar by the Bertelsmann Stiftung's Transformation Index (2020), for example, shows that there are significant differences in the country risk of specific countries.

The World Bank annually assesses the governance of more than 200 countries worldwide. The country risk is derived from the mean value of the six "Worldwide Governance Indicators": (1) citizen say and accountability, (2) political stability and absence of violence, (3) government performance, (4) quality of regulation, (5) the rule of law and (6) fight against corruption.

The “ease of doing business ranking” (1= best, 190=worst) from The World Bank ranking reveals that it is safer for a project developer or small investor to do business or invest for example in Rwanda (38) rather than in Portugal (39), Polen (40), Czech Republic (41), Netherlands (42), Belgium (46), or Hungary (52). Or for example, in Kenya (56) compared to Italy (58) and Luxemburg (72).

Also, within the European countries, there is a large variety, ranking from Denmark (4) to Greece (79). The risks can be associated with the potential privatization of the energy sector or expropriations. Also, corruption and slow bureaucracy can hinder the successful development of projects.

Community investors should, therefore, assess and be aware of the country and permit risks of the respective project location.

7.2 OPTIONS TO SECURE POWER PURCHASE AGREEMENTS

For power projects, another crucial issue from an economic point of view is the conclusion of a PPA. The most important aspect in PPAs is the negotiated price for the produced electricity. It provides the basis for project implementation both for geothermal developers/investors and for governmental or private energy offtakers.

However, this practice can also slow down the geothermal development. In Indonesia, for example, the signing of a standard PPA with a defined price per generated kWh electricity is common practice. Yet, if the geothermal reservoir conditions are different than expected, which can result in lower temperatures and less steam, the output is lower and related production costs higher. As a consequence, the business plan becomes inconsistent, the return rates for the investors decline, and the break-even point is delayed or not reached within the project's lifetime.

In Indonesia, there is a state-owned oil-company that has its own subsidiary for geothermal development dealing with project implementation in several so-called Geothermal Working Areas. If a private geothermal project developer considers all resource-related risks and calculates a 'realistic' electricity price for the PPA prior to drilling, the private developer might not be successful in winning the bid for developing a Geothermal Working Area.

To overcome this problem, the KfW development bank suggested including an adjustment clause into the PPA for the price per kWh (US$cent/kWh). The idea of this adjustment clause (also called "escalation of electricity", see BAPPENAS 2014, Appendix C, Article 10.) is to define the electricity price within a range based on the predicted reservoir conditions. If the flow rates and temperatures are lower than expected but within the defined range, the electricity prices can be adjusted to represent the real reservoir conditions in the subsurface (i.e. the price can be raised to a certain degree). However, if the reservoir conditions are out of the defined range, the state-owned company still has the possibility to take the ownership of the geothermal field and to develop the geothermal project itself.

Including such an adjustment clause into the PPA facilitates the participation of private geothermal developers in geothermal project implementation and adds flexibility to the business plan. This is a win-win situation for both parties. The project developer can still deliver and sell the energy without losses and the geothermal field is developed serving the rising energy demand of the country while at the same time benefitting the surrounding communities with baseload energy for boosting local businesses. The design of the PPA can thus play a major role in accelerating geothermal project development via attracting foreign investors which might also have access to substantial crowdfunding finance compared to the limited financial possibilities of poorer countries.

Alternative finance investors of international projects should be aware of the importance of a well-negotiated PPA and should know the options to customize them.

8 CONCLUSIONS AND FUTURE STEPS

The financial participation of many small investors via community funding can be beneficial for initiating and implementing geothermal projects. Especially in the early high-risk phases of a geothermal development which represent the bottleneck in traditional financing, alternative finance methods like crowdfunding, direct lending or leasing can close the risk and financing gap until the geothermal resource is proven.

Community funding can also achieve public involvement. The financial ownership of the public can facilitate that the project is welcome and supported by the community and local decision-makers. There are good examples of enhanced social acceptance due to the financial participation of community investors.

The nine case studies presented in this Deliverable show that community funding is applicable to both shallow and deep geothermal projects and different geothermal technologies. A variety of alternative finance methods has already been used in the geothermal market.

The most suitable type of financial instrument depends on many factors like the technical characteristics of a geothermal project, the current project development phase, the specific financial characteristics (i.e. type of capital, financial risk, amount of capital required), and the social context. Before deciding on a specific form of alternative finance method, it is recommended to evaluate all possible options along with the associated opportunities and risks in the individual context of a given geothermal project.

Crowdfunding equity for example is a very suitable concept to raise additional funds in the early high-risk project phases and to increase project support. Though, this method requires relinquishing a part of the ownership, a large duty of care and a long commitment from a project developer's perspective. Crowdfunding loans on the other hand involve less governance risk and have no upward risk in the cost of capital, but they are less flexible and therefore challenging in the early project phases when it is difficult to predict the project time component. Reward-based crowdfunding is a promising approach to enhance local project ownership along the course of geothermal project development. It has, however, not been applied in the geothermal industry yet.

Direct lending is a further alternative finance method that can provide easier access to funding for project developers than bank financing. When a financial intermediary is involved, direct lending can at the same time reduce the investment risk for community investors through a diversified project portfolio. Green bonds as one possible instrument in direct lending can be very effective in pre-financing the early project development phases while also providing the opportunity of tax incentives in some countries. They might however not be applicable for single geothermal projects. Leasing finally has the distinct advantage that it can take the resource risk off the project developer when applied at a late project stage. Yet, in the late project development phases, also traditional bank loans might be possible at lower costs.

Successful community funding thus needs to match the characteristics of individual geothermal projects and the funding requirements of a project developer with the community investors' risk appetite and motivation for involvement.

Besides the chances of community funding for geothermal projects, there are also a number of risks associated with it. One of the main concerns for project developers is the risk of not being able to raise enough money for projecting and drilling through alternative finance. With the very high-risk profiles of deep geothermal projects, taking the crowdfunding route also means having to pay high interest rates to investors. The project developer still owns the exploration risk unless a geothermal risk mitigation insurance or fund is in place. Both crowdfunding loans and direct lending debts need to be repaid by the project developer even in case a geothermal project fails, for example, due to a dry well.

Alternative financing also involves a legal risk. Securities for investors need to be provided, and individual investors' rights have to be understood and taken care of. Country-related risks can also occur in the European Union and impact geothermal development and financial performance. In the case of a co-operative model, low credibility vis-à-vis banks, regulatory bodies, or partners can be another hurdle.

Legal knowledge of local and EU fundraising regulations is crucial to decide on the most appropriate form of business model, alternative finance method and overall financial mix. Project developers choosing to use crowdfunding should partner with a trusted and experienced crowdfunding platform that can help to raise the funds they need.

For sustainable community funding, it is deemed to be most successful to focus on impact investors aiming at supporting the energy transition and/or local projects. Project developers need to be aware that involving people and making them enthusiastic about a project requires time and energy. It is highly recommended to involve the community early and to clearly communicate the goals, the potential risks and the benefits of a project. Especially when taking the risk of getting no return on investment, community investors need to be informed properly upfront.

Community investors need to be certain that their investment will be handled with the utmost care. Building and maintaining trust is therefore a crucial aspect in any form of community funding. Match funding can be an interesting "multiplier" approach both to support the credibility of a project by an institutional hallmark or governmental involvement and to increase the total project funding amount. The involvement of experienced and independent geothermal experts, e.g. in the supervisory board of a crowdfunded project is also highly recommended.

Community financing will, in most cases, only provide a small portion of the overall financing needs of a geothermal project. Alternative finance methods thus have to be integrated with traditional financing methods in order to find the most suitable financing mix for a given project and to achieve a robust finance plan.

Understanding and developing a project in a holistic way, taking into consideration technical, financial, and social dimensions as well as their interdependency is another important risk mitigation measure for project developers. It reduces the risk of interface problems and increases the chances for a Social License to Operate as well as for technical and economic success.

Despite all advantages of community finance there are also bad examples. In the case of a geothermal project in Germany for example, high revenues were promised to small and medium-size investors who eventually lost their investment due to a suboptimal geothermal resource and illegal actions.

Such isolated cases of financial fraud associated with community funding underline the need for risk management as well as the importance of careful due diligence processes (e.g. financial assessment of the project developer, crowdfunding size limits) on the side of all involved parties. Earmarked insurance products that minimize the risks of unexpected events, such as illicit activities, can help to secure confidence and peace of mind for project developers, platform operators, and community investors alike.

Alternative finance investors in geothermal projects need to be aware of the high resource-related risks in the early project development phases. To a certain degree, community investors have to accept these high risks in exchange for a chance of high returns. An investment in low-risk phases like the construction phase, for example, would yield only low returns. Transparent communication of these opportunities and risks is, however, a key aspect and needs to be sought.

Especially with crowdfunding equity, community investors basically share the same risk of project failure as the project developer. Also for other forms of crowdfunding, community investors are in danger of losing their investment as long as the drilling success is not secured by a risk mitigation scheme (e.g. insurance or public funds). The exploration risk is therefore not only one of the main hurdles for deep geothermal project developers, but also the largest risk for community investors in geothermal projects.

For this reason, CROWDTHERMAL's Task 3.3 will include the development of a framework for an exploration risk mitigation component that could facilitate community funding in the challenging, high-risk phases of geothermal developments. Issues regarding the mitigation of the specific exploration risk of deep geothermal projects were as well dealt with in detail in Deliverable 3.1. The increase of public support for geothermal risk mitigation that could flank community funding is currently also requested and facilitated by the H2020 project GEORISK.

The alternative finance risk analysis presented hitherto is the basis for a systematic compilation of the key advantages, risks and possible mitigation measures of the different alternative finance methods in Deliverable 3.3.

In the further course of the project, the results of Task 3.2 can be incorporated into the geothermal risk guide to be developed in our future WP3 and WP4 Tasks. They can also serve as input for the Decision Tree Algorithm and the CROWDTHERMAL Core Services to be developed in WP4.

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APPENDIX

United Downs Deep Geothermal Power Project
Crowdfunding Risks Experience Interview

WP3 – TASK 3.2

ALTERNATIVE FINANCE RISK MITIGATION UNITED DOWNS DEEP GEOTHERMAL POWER CROWDFUNDING RISKS EXPERIENCE

INTERVIEW R. LAW / C. BAISCH

Geothermal Engineering Ltd (GEL) / GeoThermal Engineering GmbH (GeoT)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement nº 857830.

INTERVIEW 02.06.2020 – RYAN LAW (GEL) / CHRISTINA BAISCH (GEOT)

1. UDDGP crowdfunding facts:

- Amount raised by crowdfunding: 5.2 million pounds in 10 days
- Type of crowdfunding used: bond (payable at the end as opposed to monthly paid loan)
- Conditions: 18 month bond, fixed yield of 12% interest a year, extension possibility for 6 months
- Project development phase in which crowdfunding was used: start prior to drilling of first well, termination during drilling of first well

2. When and under which conditions was the crowdfunding terminated?

- The bond was prematurely terminated after about one year duration. The funds were not used, but returned to the investors with a yield of 2 % interest a year. At the time of repayment, the drilling of the first well had just begun, very much behind schedule (drilling started in November 2018 instead of early 2018 as originally planned). Because of the time delay, the project risked an accidental default due to the time constraints of the bond. The termination of the bond was subject to the agreement of the majority of bond holders. The majority of bond holders accepted the decision.

3. From your project developer perspective, what are the advantages of crowdfunding for geothermal projects?

- Crowdfunding is an interesting way of funding the high risk phase of a geothermal project when it is challenging to get access to conventional funds. However, the people that participate in crowdfunding are typically the ones that are generally interested in investing and in new, renewable energy projects. Reaching local people and thus increasing local acceptance therefore requires other mechanisms (see below).

4. What are the challenges / risks of crowdfunding for geothermal project developers

- The legal obligations when using crowdfunding in the order of magnitude of several million Euros are substantial and not ideal. Even when using a professional crowdfunding platform, it takes time and thus money to understand the legal framework and implications for a project developer.
- Against the background of the massive amount of money needed for deep geothermal projects, the crowdfunding limits (circa £5m) are too low and should be e.g. twice as high.
- Another challenge is that a project developer does not know in advance whether or not it will be possible to raise enough money to reach the crowdfunding targets. An alternative financing plan needs to be in place.
- With the very high risk profiles of deep geothermal projects in new regions, taking the crowdfunding route means having to pay high interest rates to the investors.

5. Which mitigation measures are available to project developers to address these risks and what was your experience with them?

- Use of professional and experienced platforms (in this case: Abundance) and involvement of own lawyers

6. Which advantages did you perceive for the small investors who contributed to the crowdfunding for UDDGP?

- Promoting renewable energy sources

7. Which risks did you perceive for the small investors who contributed to the crowdfunding for UDDGP? Have they materialized?

- The small investors face the possibilities of a lower than expected yield in case of a deviation in the original project plan (as in the UDDGP case: 2 % instead of 12%) or even full loss of their investment in case of project failure / dry wells.

8. Are you aware of any mitigation measures that were available to the small investors who participated in the crowdfunding for UDDGP to address these risks and what was your experience with them?

- The small investors have to accept the high risks associated with this kind of investment in return for the high interest rate.

9. From your experience: Which kind of community funding (equity/shares, loans, rewards, etc.) would you think matches the risks in each geothermal project development phase best?

- Crowdfunding loans/bonds are challenging in the early project phases, when it is difficult to predict the project time component. At this early stage, shares / equity can be more suitable. Shares can also be an option to help increase local acceptance and support, e.g. by offering local community shareholding / equity for free or for a low price to inhabitants of a certain radius around the project site.
- Before drilling, it is however difficult to judge what the project and thus the equity / shares are worth and to find a balance between the amount of crowd investors' interest and the equity level. In addition, the amount of reporting requested for equity models is high.
- Crowdfunding loans can be suitable at the power plant stage, but at this stage, also bank loans are possible at far lower costs.

10. Would you replicate the UDDGP case?

- Probably not in the same way. Crowdfunding has its place, but not for the scale of investment needed in deep geothermal power.

11. Has your crowdfunding experience been published anywhere?

- Not yet