

# The Investor's Guide to Geothermal Energy

HOW TO CAPITALIZE ON THE HEAT BENEATH YOUR FEET





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#### forseo GmbH

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## Foreword

Renewable energies are expected to provide a significant share of the future global energy mix.

In the European Union, they should make up 20% of the total energy supply by the year 2020. Due to their indigenous nature, they are also important for the security of energy supply.

Advancement of renewable energies will require massive investment that cannot solely rely on public funds, private sector involvement is needed. Incentives for private investor's engagement are increasingly provided by guaranteed feed-in tariffs and risk mitigation schemes.

Developers and investors are essential for renewable energy advancement. Developers need to know their financing options while investors need to have basic knowledge of and confidence in emerging technologies. In addition, a mutual understanding between developers and investors is essential. This is especially true for geothermal energy since this technology usually needs high up-front investments.

"The Investor's Guide to Geothermal Energy" is a timely contribution. The publication summarizes geothermal technology basics, describes various financing options, and explains the various stages along the way – from the initial project evaluation to production and maintenance. It analyzes the current global market, presenting new technology developments like Enhanced Geothermal Systems, which have a great potential for success worldwide.

The International Geothermal Association (IGA) readily endorses forseo's publication hoping that it will pave the way for a rapid increase of the private sector's involvement in financing or co-financing new geothermal projects.



Prof. Dr. Dr.h.c. Ladislaus Rybach  
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## Preface

The geothermal world map today shows many different and interesting sites and markets. For many investors, the territory is still relatively unknown and one might hesitate to explore the opportunities geothermal technology holds. However, the number of investors recognizing the allure of geothermal energy is growing from day to day.

The geothermal journey usually starts with a query: Where is the best location? What do we need to know? What needs to be done? Will we be successful and at what cost? The journey can be long, easily 5–7 years, and many road blocks can obstruct the way. Investors might find themselves at the cross roads, having to decide how to advance further.

But for all that, this venture can lead to a very rewarding investment, if one is well prepared. This publication provides the signposts for all those who are ready to capitalize on the heat beneath their feet. Our roadmap will guide the reader through all project phases, demonstrating the risks and costs and providing comprehensive insight into all important aspects of geothermal development. Detailed market information and a close look at financing options add to this Investor's Guide.

Distinguished experts share their insight and many industry stakeholders give an account of their geothermal experience, making this publication the first of its kind.

forseo has accompanied and supported multiple project developers and companies on their search for know how and capital. Our work at the interface between the geothermal industry and the financial sector has enabled us to get a profound picture of investors' individual needs and perspectives. This publication reflects the different viewpoints and provides a close and diversified look at the art of geothermal. It will serve as a valuable tool for all those that are in or are thinking of entering the geothermal business.



Volker Krauth  
Managing Director, forseo GmbH

## Introduction

This publication's purpose is to serve as a practical reference tool for the growing geothermal community, covering geothermal development, risks and opportunities on a world wide scale.

Taking such a global approach poses quite a bit of a challenge, because the conditions can differ greatly from one location to another.

The chosen structure and many special features of "The Investor's Guide to Geothermal Energy" seek to compensate for the differences in the best possible way, so that it will be valuable to a broad audience and at the same time provide detailed information for the individual decision-making process.

We put a slight emphasis on the utilization of high-enthalpy resources mainly for electricity generation, as the vast majority of geothermal power projects worldwide deal with high-enthalpy resources. However, low-enthalpy projects and applications are also discussed to a great extent.

The geothermal resource conditions are the key determinant for successful project development. Geothermal 101 – Chapter 1, will give the reader a brief but thorough understanding of the elementary differences of geothermal systems and technology. It will lay the groundwork for later chapters and will help navigate through the subsequent sections.

The Roadmap, in Chapter 2, guides the reader from site identification to final operation of a geothermal plant, comprising risk and profitability affecting factors. The next chapters introduce financing tools at the different stages of development and take a look at the global market.

In order to incorporate many perspectives and aspects, the Guide is distinguished by various features:

- Expert's Insight (also Lender's View or Project Developer's Insight) – highlights a topic covered by an industry professional.
- Case Study – introduces real life examples, provided by external contributions.
- A Closer Look – gives a more detailed description of a previously mentioned topic.
- Project Developer's Account – is a short reflection of an expert's personal viewpoint.

As stated above, geothermal development success heavily relies on the particular site and the market conditions, public policy and legal framework. These parameters naturally vary in every country. We focus on four select countries to give a realistic view of the framework conditions with their impact on geothermal project development and investment. Accordingly, these sections are labeled "Focus":

- Focus USA – describes a mature market with high-enthalpy resources.
- Focus Chile – introduces a high-enthalpy region with great potential but no power plants in place yet.
- Focus Germany – shows booming geothermal business in a low-enthalpy region.
- Focus China – demonstrates large scale direct use deployment.

Additionally, we selected a number of countries with interesting, recent development – they are introduced as "Hot Spots". Doubtlessly there are many more countries meriting a closer look, but there are limitations with such a publication. In any case, comments in the chapter on Geothermal Market and Investment make it quite clear, that opportunities await all around the world.