Renewable Energy Finance Tracking Initiative (REFTI): Snapshot of Recent Geothermal Financing Terms

Fourth Quarter 2009 – Second Half 2011

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Michael Mendelsohn, and Karlynn Cory

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September 2012

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Preface

The following is a review of geothermal project financial terms as reported in the National Renewable Energy Laboratory's Renewable Energy Finance Tracking Initiative (REFTI). The data were collected over seven analysis periods from the fourth quarter (Q4) of 2009 to the second half (2H) of 2011. All REFTI data were provided voluntarily, and measures were taken to ensure that it remains confidential (for example, answer choices on the REFTI questionnaire are formatted as ranges and not specific point values). Accordingly, there are limitations to the scope of the REFTI project as well as the analyses that can be performed given the dataset. Notwithstanding, REFTI offers rare insight into renewable energy project financial terms and can offer emerging developers, financiers, policymakers, and other renewable energy stakeholders a storehouse of information on which to evaluate their projects and investments.

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Table of Contents

List of Figures

List of Tables

1 The Renewable Energy Finance Tracking Initiative

Successful policy design, financing, and development of renewable energy (RE) projects require information to guide the decision-making process. Much of this information, however, is not widely available. Project financial terms are especially difficult to come by as many of these terms are often negotiated between two or more private entities. This lack of transparency may impede effective policy design, competition, and potentially industry growth if important information is known by only a few market participants.

To improve project finance term transparency and assist public and private renewable energy participants, the National Renewable Energy Laboratory (NREL) created the renewable energy finance tracking initiative (REFTI). REFTI data participants include new and existing developers, financiers, insurance companies, policymakers, and market research participants. REFTI data is used by NREL and the U.S. Department of Energy (DOE) and is publicly available for use in financial models and pro formas.

A total of 831 participants disclosed their role in the RE industry during the REFTI reporting periods (Q4 2009–2H 2011[1]). Almost 40% of respondents described themselves as Developers/Installers/Integrators of renewable energy projects (see Figure 1). The second and third largest classes of participants were Counsel/Consultants (15%) and Government/Research/ Advocacy (12%). Equity and Debt Financiers together accounted for a modest 6% of respondents. Information and data constitute competitive advantage for financiers, and the desire to protect that advantage likely limited participation from this group.

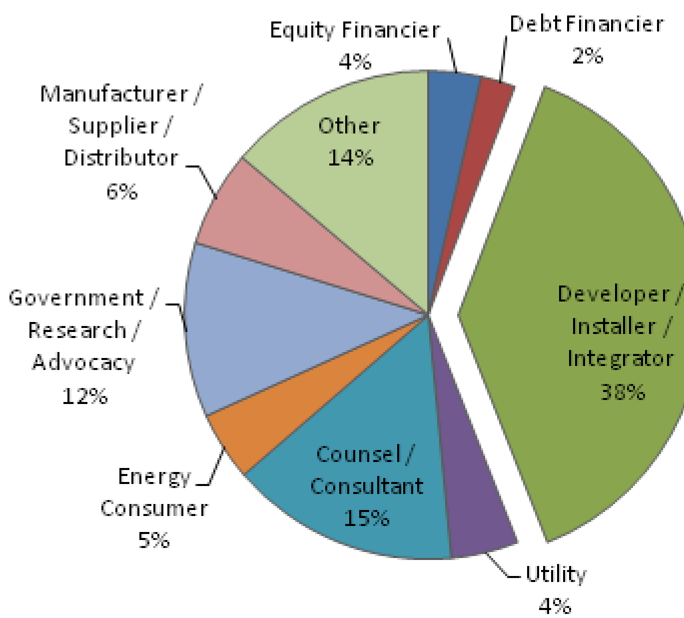

Figure 1. Proportion of REFTI respondents and their roles role in the RE industry
n = 831

[1] The REFTI questionnaire was administered once per quarter from Q4 2009 through Q4 2010. Beginning in 2011, only two questionnaires were administered: one in the first half of the year and the other in the second.

2 A Word on the Data

The principal method of data collection for REFTI has been an online questionnaire. NREL reports the questionnaire responses and conducts various trend and comparative analyses on the data. Much of the data collected is proprietary and complex in nature. It is important to note that NREL does not confirm the accuracy of participants' responses for a number of reasons, including the assurance of confidentiality.

The REFTI questionnaire was administered on a voluntary basis, and data collected for several of the technologies could not be substantiated by sample sizes sufficient to produce statistical significance. REFTI geothermal data are characterized by such limitations, though the low participation rate is not entirely inconsistent with the pace of geothermal development in the United States. From Q1 2010 through Q1 2012, only six geothermal power plants representing approximately 100 MW of new capacity[2] came online in the United States (GEA 2012; Jennejohn 2011). Geothermal's long development lead times and its unique risks during the exploration drilling phase are factors that can restrict deal flow and prevent many of the projects currently in the pre-construction phase from reaching completion.

Although the data-gathering company (surveymonkey.com) restricts participants from completing the questionnaire more than once from the same IP address, it is still possible for more than one respondent (e.g., a financier, a developer, and an insurer) to submit data on the same project without NREL's knowledge of the duplication, which could result in an unequal weighting of certain projects over others.[3] Response counts are calculated from the best available data and are noted as "n" in the charts and tables.

To ensure respondent confidentiality and facilitate questionnaire completion, numerical answer choices are formatted as range-bound, multiple-choice questions. To then perform comparative, trend, and aggregate analyses, median values are assigned to each bin range answer choice in order to calculate weighted averages.[4] Unless otherwise indicated, all numerical values contained in the report are weighted average calculations.[5]

The complete, publicly accessible dataset is available for review at: www.financere.nrel.gov/finance/refti.

[2] U.S. Geothermal replaced about 5 MW of existing generation equipment when they constructed a 12.75-MW generating facility at their San Emidio site.
[3] All REFTI data is provided confidentially unless the participant opts to disclose specific information about his/her project or company, for example.
[4] Weightings were applied by response count. The highest answer choice was assigned a median value of its numerical value plus the difference between its value and the prior median value. For example, if the answer choice was "10+" and the previous bin range value was "8–10," then a median value of 11 was assigned.
[5] As with all weighted average calculations, the fewer number of total responses will increase the influence each response has on the final weighted average.

3 Overview

3.1 Project Information

Until Q4 2010, the REFTI questionnaire asked participants how many projects and how much capacity they currently had in development, in addition to asking about their projects that had closed financing. Based on the development responses, NREL estimates that 87 geothermal projects with an average capacity of 646 MW were reported as “under development” in REFTI (see Figure 2 for the ranges of these calculations). Only an estimated six projects had reached some form of financial closure during the REFTI analysis period, representing a total estimated capacity of 26 MW[6] (see Figure 3 for the ranges of these calculations).

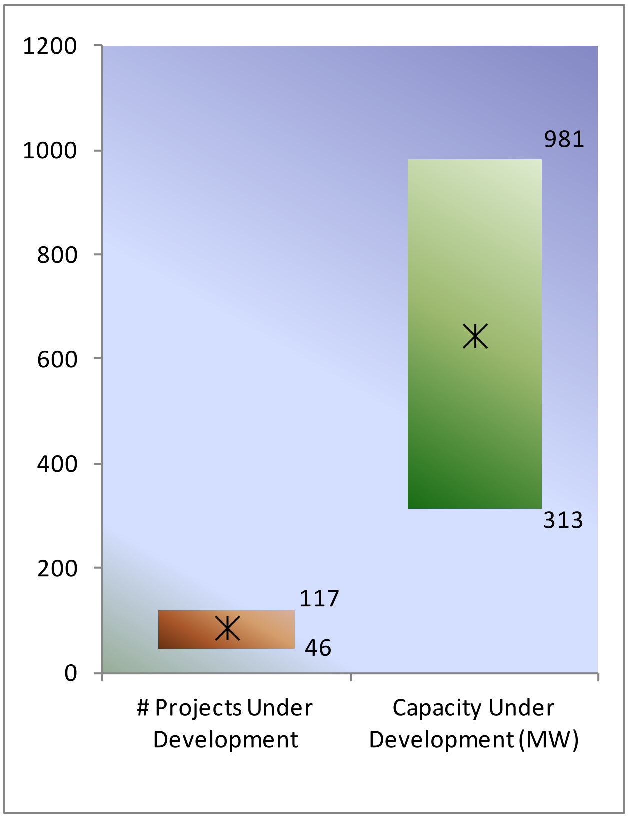

Figure 2. Data ranges for geothermal projects under development Q4 2009–Q4 2010

Projects n = 21
Capacity n = 19

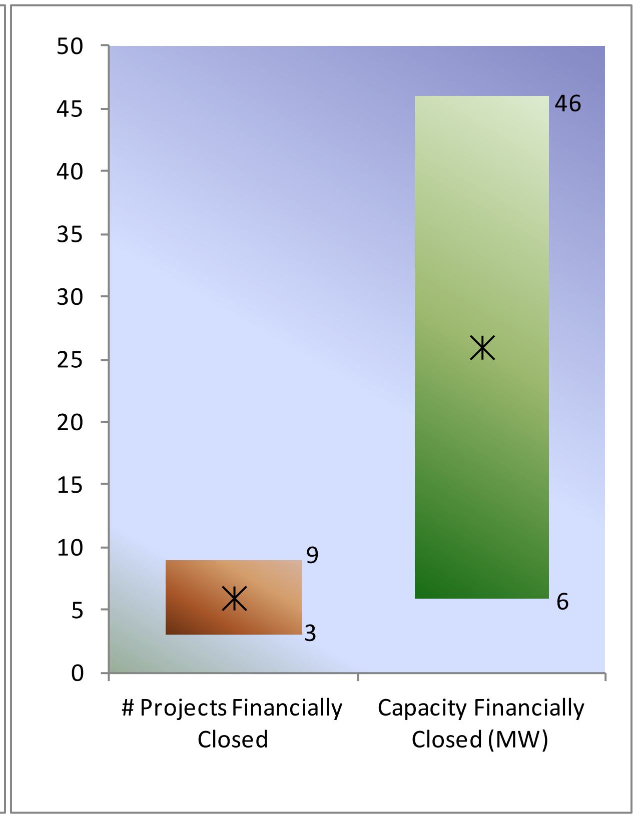

Figure 3. Data ranges for geothermal projects having reached financial close Q4 2009–2H 2011

Projects n = 17
Capacity n = 15

[6] With a total capacity of 26 MW, the six projects are likely binary cycle plants as these facilities generally have lower production capacities than the two other hydrothermal technologies (i.e., dry steam and flash).

3.2 Barriers

The "Barriers" section in REFTI drew the most geothermal respondents out of any other in the questionnaire (29 reporting).[7]

As shown in Figure 4, tax equity registered as a primary concern among respondents. Also notable was the number of respondents (seven in total) who chose the "Other" category and noted the challenge of raising equity for the early high-risk drilling phase of the project when prompted to explain. The impact of the economic downturn in 2008–2009 on the availability of finance was also cited by more than one participant. In the aggregate, financial hurdles (i.e., "Project Economics," "Creditworthiness of Power Purchaser," "Finding Tax Equity Investor," and "Raising Capital") accounted for 42% of all barriers to geothermal project development. Policy barriers (i.e. "Environmental Permitting" and "Accessing Government Incentive Programs") accounted for 20%. Taken together, policy and financial challenges represented over 60% of all reported barriers to geothermal development.[8]

Nearly half of respondents identified project delays of one year or more as the primary impact of the above-mentioned barriers (see Figure 5). Taken together, both these longer-term delays and shorter-term delays (less than one year) accounted for over three-quarters of the responses to the barrier impacts section.

[7] Note: Concentrating solar power (CSP), another technology with a small market and limited participation in REFTI, also received overwhelmingly more responses in the barriers section—34 contrasted with 7 respondents reporting financial closure from Q4 2009 to 2H 2011.

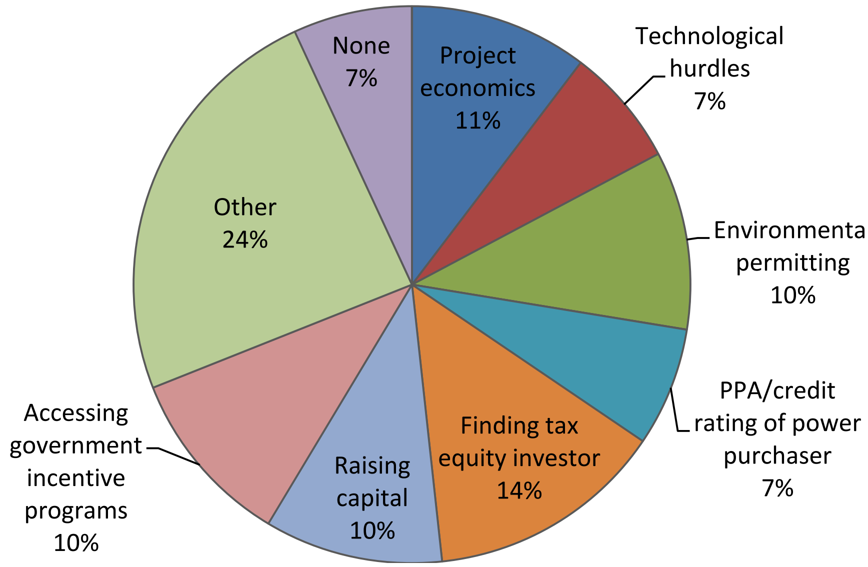

Figure 4. Geothermal project barriers, Q4 2009–2H 2011

n = 29

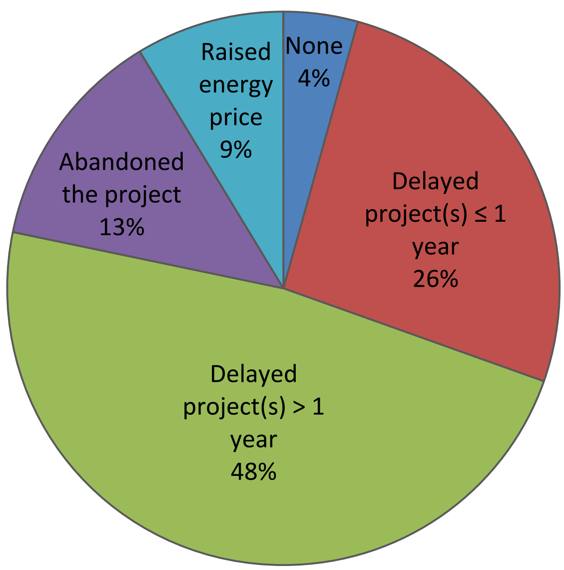

Figure 5. Geothermal barrier impacts, Q4 2009–2H 2011

n = 23

4 Incentives

Geothermal respondents reported either no use or “Other” use when queried about state-level incentives. Of the five that reported Other, only one provided an explanation, which was “a research and development grant to investigate geology.” There were nine total geothermal respondents for the state-level incentive section.

At the federal level, displayed in Figure 6, REFTI data indicate that the now-expired 1603 Treasury grant and the investment tax credit were the incentives of choice for geothermal developers respondents. Again, however, a high proportion of respondents (37%) indicated no incentive use.

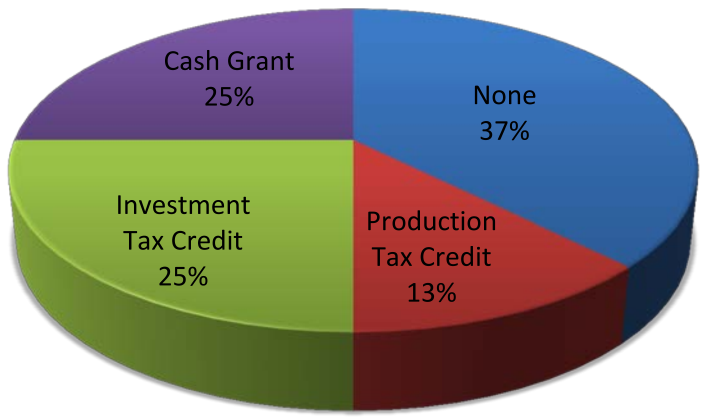

Figure 6. Federal incentive use Q4 2009–2H 2011

n = 8

5 Energy Costs

5.1 Levelized Cost of Energy and Installed Costs

As shown in Table 1, the weighted average levelized cost of energy (LCOE) for geothermal projects was substantially less than those for all other utility-scale technologies reported in REFTI. Geothermal power's scale of generation and the consistency of its resource (which increases capacity factor) contribute to a lower LCOE. Moreover, many geothermal generators compete in the baseload market—which is characterized by lower electricity prices—and to ensure the viability of a project in this space, developers must achieve a competitive LCOE.

Table 1. Weighted Average for Installed Costs (Before Incentives) and LCOE (After Incentives) by Technology, Q4 2009–2H 2011

Technology	Installed Costs ($/W net output)	n	LCOE ($/kWh)	n
Geothermal	$4.25	4	$0.067	3
Solar CSP	$3.67	13	$0.093	11
Large-scale PV (≥ 1 MW)	$4.41	61	$0.132	46
Wind	$3.26	18	$0.076	12

Interestingly, while geothermal reported the lowest average LCOE of the other illustrated technologies, it also had the second-highest installed costs. This low ratio of installed costs to LCOE illustrates the role that a high capacity factor can have in offsetting project costs.

5.2 Power Purchase Agreement

All geothermal participants that reported financial closures in Q4 2010 signed 20-year power purchase agreements (PPAs). Compared to the other utility-scale technologies reported in REFTI, geothermal acquired the longest PPAs, on average, throughout the analysis timeframe. As illustrated in Figure 7, the weighted average first-year PPA price for geothermal projects was $0.098/kWh, which is within the range of LCOEs presented within NREL's Transparent Cost Database (OpenEI 2012).

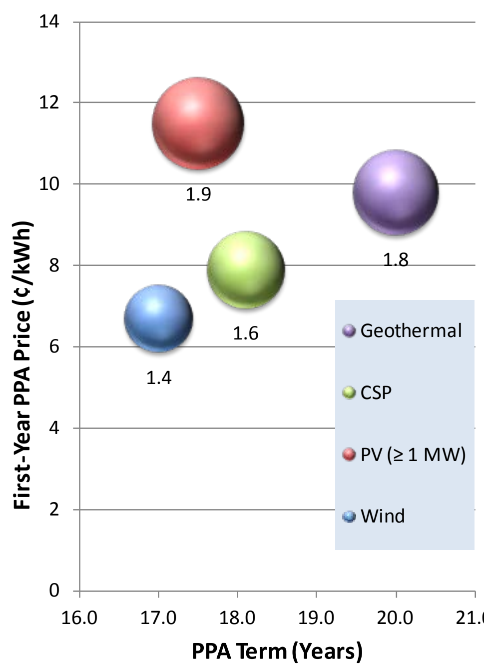

Figure 7. Average PPA term, first-year price, and percent escalation rate (measured in size of bubble) by technology, Q4 2009–2H 2011

*See text for sample size information

Sample Sizes (n) for Figure 7 are as follows*: Geothermal had four respondents for each category (PPA price, term, and escalation rate); CSP had seven respondents for each category; large-scale PV had 52 respondents for PPA price and escalation rate and 59 for PPA term; and wind had 14 respondents for PPA price and escalation rate and 17 for PPA term.

Notably, geothermal is the only technology with an average PPA price that is markedly higher (46%) than its reported LCOE (Table 2). This discrepancy could be the result of two possible conditions: (1) misreported LCOE or (2) dated PPA prices. That is, because geothermal plants have long development cycles (commonly four years or more), projects that are in development now may have signed PPAs several years ago when market conditions were different. Natural gas prices and the costs for renewable energy technologies (namely wind and solar) have both plummeted in recent years, and this has exerted downward pressure on current PPA bids. Several of today's geothermal facilities may therefore have locked in PPAs that reflect a very different set of market conditions.

Table 2. Comparison of LCOE and PPAs Across Technologies

Technology	LCOE ($/kWh)	n	1st Year PPA Price ($/kWh)	n
Geothermal	$0.067	3	$0.098	4
Solar - CSP	$0.093	11	$0.079	7
Large-scale PV	$0.132	46	$0.115	52
Wind	$0.076	12	$0.067	14

6 Equity

6.1 Equity Structure

The weighted average tax equity to developer equity ratio for geothermal projects is 51.7 (see Figure 8). However, this calculation is based on three responses—20, 40, and 95—that are widely divergent, yielding a confidence interval of ± 36. Therefore, the 51.7% ratio should not be interpreted as the typical equity structure for geothermal projects, but rather as the midpoint for a broad range that suggests the variability in geothermal capital structuring.

With larger sample sizes, wind and large-scale PV may be considered more accurate portraits of project equity structures.

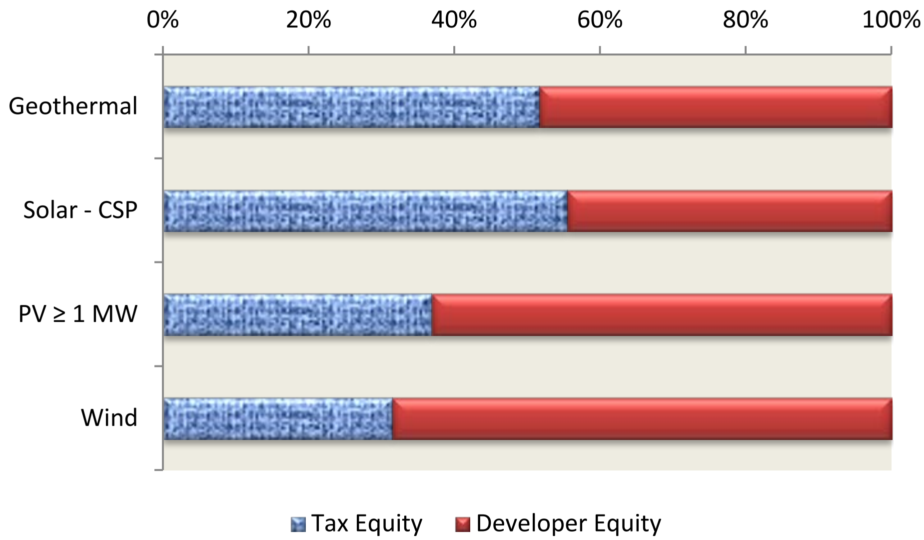

Figure 8. Tax equity to developer equity across technologies, Q4 2009–2H 2011

Geothermal n = 3, Solar CSP n = 10, PV ≥ 1 MW n = 55, Wind n = 18

6.2 Return on Equity

Figures 9 and 10 show that the aggregated expectations for equity returns were highest for geothermal projects, both from the developer and tax equity investor perspectives. The values reported for geothermal projects in REFTI are similar to those reported in other analyses (Mintz 2011).

Tax equity partners may have limited familiarity with geothermal projects (e.g., their risks and ideal financial structures) because of the low deal volume in the geothermal market. This can create higher transaction costs and consequently higher expected tax equity yields. High tax equity yields may also derive from the presence of debt in the financial structure (see Section 8.2). Equity is subordinate to debt, and investors will typically raise their yield rates to compensate for this added risk.

No equity partner for any of the illustrated technologies expected to earn less than 10% on their stake. Across the board, developers expected to earn more on their equity portion than the tax equity investors.

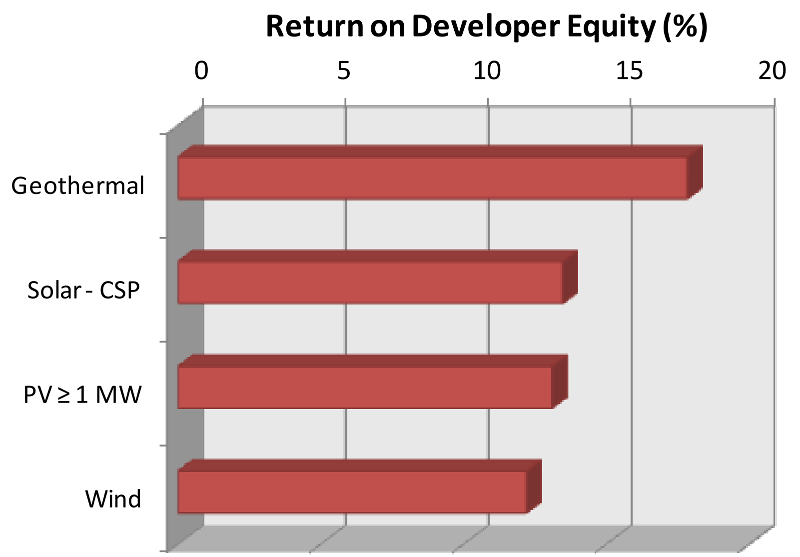

Figure 9. Weighted averages for expected returns on tax equity, Q4 2009–2H 2011

Geothermal n = 3, Solar CSP n = 8, PV ≥ 1 MW n = 54, Wind n = 17

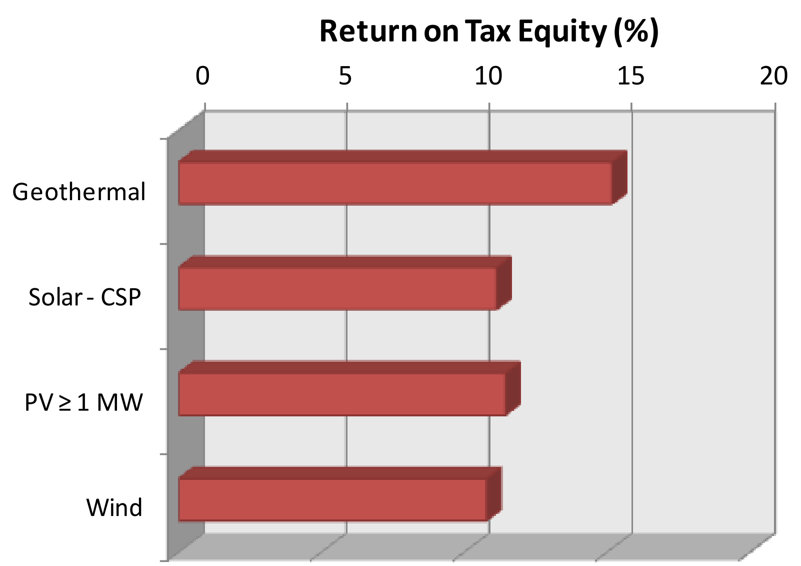

Figure 10. Weighted averages for expected returns on developer equity, Q4 2009–2H 2011

Geothermal n = 3, Solar CSP n = 8, PV ≥ 1 MW n = 52, Wind n = 17

7 Financial Structure

Six geothermal participants reported financial structure information in Q4 2010, two in each category indicated in Figure 11. All respondents that answered “Other,” regardless of their primary technology, indicated there was no financial structure in place at the time of their answer or that it was not applicable to their profession (this response came from a geothermal geologist).

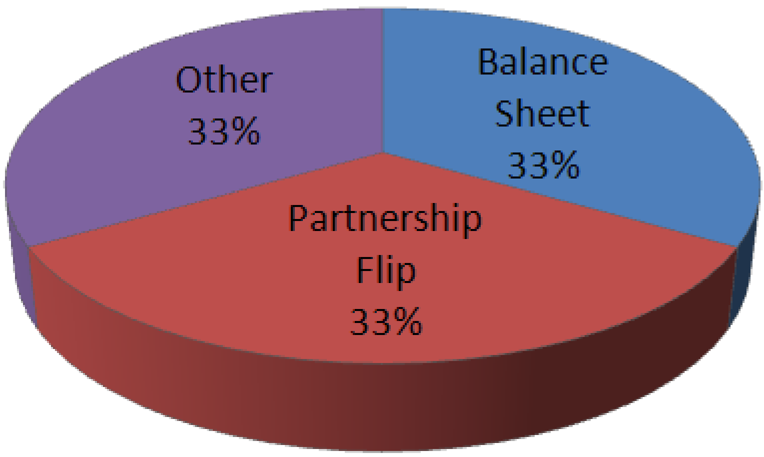

Figure 11. Financial structure for geothermal projects, Q4 2009

n = 6

8 Debt

8.1 Cost of Debt

As displayed in Table 3, the two geothermal responses for cost of debt (i.e., interest rate) were in the 4.0%–5.5% and 5.5%–7.0% bins, resulting in a weighted average of 5.5%. This was the second-lowest cost-of-debt figure in the pool of comparable (by capacity) technologies. Hydro power was the lowest at 4.9%, but like geothermal, there was data from only one REFTI questionnaire cycle.

Table 3. Weighted Averages for All-in Cost of Debt Across Technologies, Q4 2009–2H 2011

Technology	Cost of Debt	n
Geothermal	5.5%	2
Solar - CSP	7.1%	8
Large-scale PV	6.9%	45
Wind	6.7%	15
Hydro	4.9%	5

8.2 Debt-to-Capital Ratio

Both geothermal responses in Q4 2010 indicated debt-to-capital ratios in the 60%–80% range. This rendered its weighted average highest among all the utility-scale technologies reported in REFTI (Figure 12). Wind and large PV each displayed an aggregate debt-to- capital ratio of about 50% (large PV coming in slightly above, wind slightly below), while CSP had the lowest ratio of 40%.

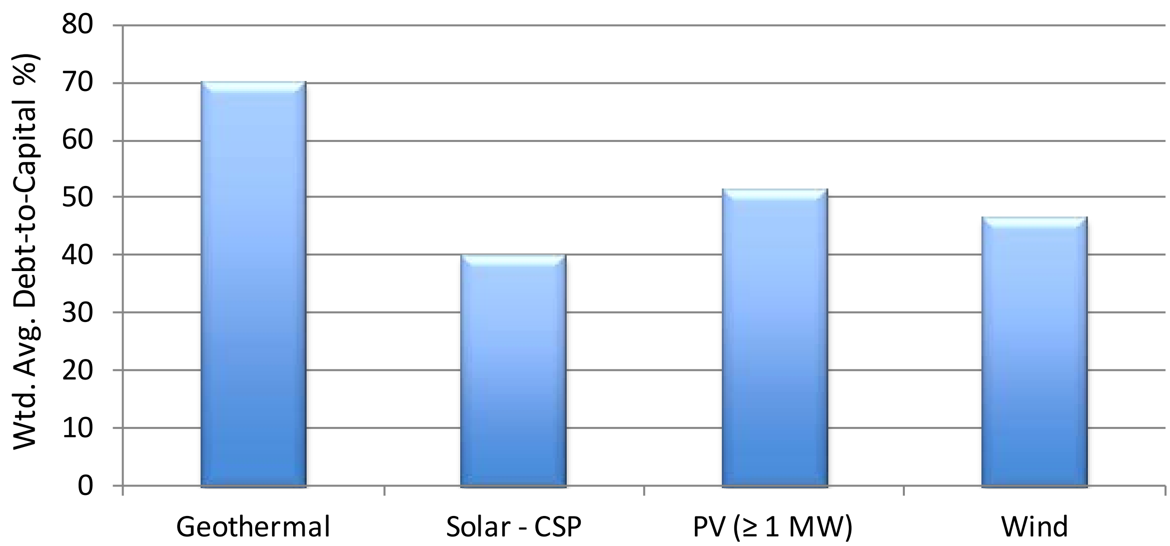

Figure 12. Weighted average for debt to total capital across technologies, Q4 2010–2H 2011

Geothermal n = 2, Solar-CSP n = 8, Large-scale PV n = 47, Wind n = 19

8.3 Debt Term

At 21.8 years, geothermal displayed the highest weighted average debt tenor amongst all technologies of similar scale (see Table 4). NREL estimates this figure may be skewed high, as the debt markets are tight (especially for geothermal lending), and terms (i.e., yield and interest rate) may not be as favorable as reporting indicates. Likely, geothermal is securing debt terms on par with the other technologies listed.

Table 4. Weighted Averages for Debt Terms Across Technologies, Q4 2009–2H 2011

Technology	Debt Term (Years)	n
Geothermal	21.8	2
Solar - CSP	12.1	7
Large PV	18.3	46
Wind	13.1	17

All in all, REFTI geothermal data indicate high debt loads with comparatively lower costs of debt and longer terms. While data caveats apply, these figures could reflect geothermal's relative technological maturity and baseload potential.

While debt terms may be attractive for projects that are working with a proven resource, the initial exploration and drilling phase of a geothermal project usually bears too much risk to finance with debt arrangements. This phase is typically financed with equity, which accounts for the high portion of equity concerns raised in the barriers section (Salmon et al. 2011).

9 Soft Costs

In 2H 2011, REFTI solicited data on "soft costs," or project costs deriving from engineering, construction, and legal fees. Geothermal exhibits the highest proportion of soft costs to total project costs for all reporting technologies, topping 15% (Figure 13). Each of the five categories of soft costs specified in the questionnaire accounted for between 2.5%–3.5% of total geothermal project costs, with the highest reported expense being "Interest During Construction."

Though this chart was based on only two geothermal responses, relatively high soft costs for geothermal appears plausible. The unique conditions that accompany geothermal development—namely the aforementioned long lead times to commercial operation, low deal volume in the marketplace, and the limited number of geothermal investors in the financial community—would likely contribute to increased soft costs including and beyond those measured in this analysis (Salmon 2011).

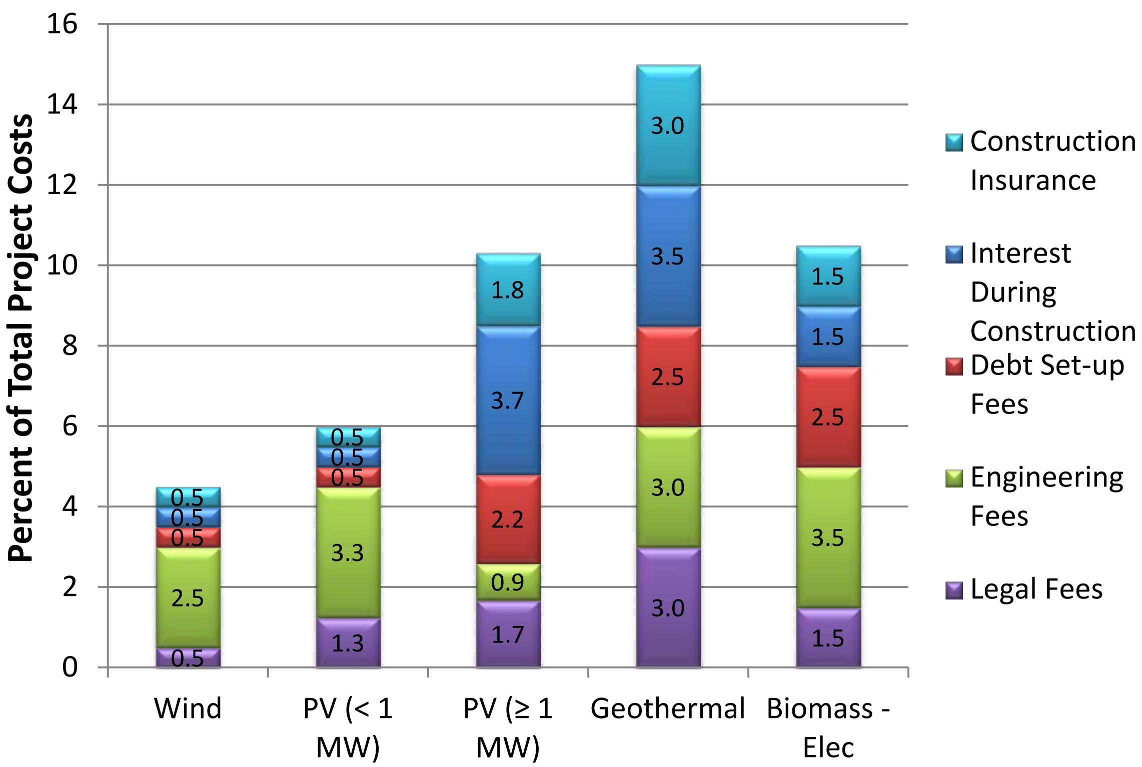

Figure 13. Soft cost readouts for technologies reporting in REFTI

Wind n = 2, Small-scale PV n = 6, Large-scale PV n =14, Geothermal n = 2, Biomass n = 2

10 Summary

While REFTI can provide some insight into the markets which it covers, its results to date do not represent a comprehensive portrait of industry trends, barriers, and other characteristics. With that caveat in mind, some takeaways from the geothermal responses include:

- An estimated six geothermal projects accounting for an average of 26 MW reported financial closure during the REFTI analysis period. An estimated 87 projects accounting for an average of 646 MW were reported as "in development."
- Finding tax equity investors was the single largest reported barrier for geothermal participants. Taken together, financial barriers (including finding tax equity) account for 42% of total geothermal project development barriers.

The following takeaways are based on a smaller set of reported geothermal data and should be noted with caution:

- The production tax credit and the 1603 Treasury Grant were the most utilized federal incentives among REFTI geothermal participants (together comprising 50% of responses), though a high proportion (37%) indicated no incentive use.
- Geothermal projects demonstrated the longest PPA contract periods of technologies of similar generation scale. First-year PPA prices averaged to \$0.098/kWh, which, given an average LCOE of \$0.067/kWh may indicate misreported LCOE or reflect an older set of market conditions.
- Tax equity investors in geothermal projects expected higher returns than investors in other technologies of similar scale. This could be a function of limited geothermal deal flow and/or the relative unfamiliarity that investors have with this renewable technology. This finding has been reported in other industry analyses (Mintz 2011).
- Geothermal respondents reported the highest proportion of soft costs to total project costs of any other technology reported by REFTI. Many of these costs can be attributed to high risks in the early stages of project development as well as long lead times and limited investors.

Historical REFTI data, as well as webinar presentation slides, are available for download at https://financere.nrel.gov/finance/REFTI.

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For a glossary of project finance terms used in this report, please visit the NREL Renewable Energy Project Finance website at https://financere.nrel.gov/finance/content/glossary.