A Geothermal Incentive Design

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ABSTRACT

Geothermal Power is unique among the renewable energies - it is the only renewable that is base load. Furthermore, it has the smallest footprint, the highest capacity factor and the lowest levelized cost of any renewable. Current subsidies are not appropriate incentives to stimulate new project development. Existing subsidies are back-ended to the online date whereas the bottleneck in geothermal is on the front-end funding the drilling risk. Given the realities of government cost-cutting, we present a tailor-made subsidy for geothermal that costs less than the current subsidies. Our recommendations are intended to get the discussion going rather than be a comprehensive solution.

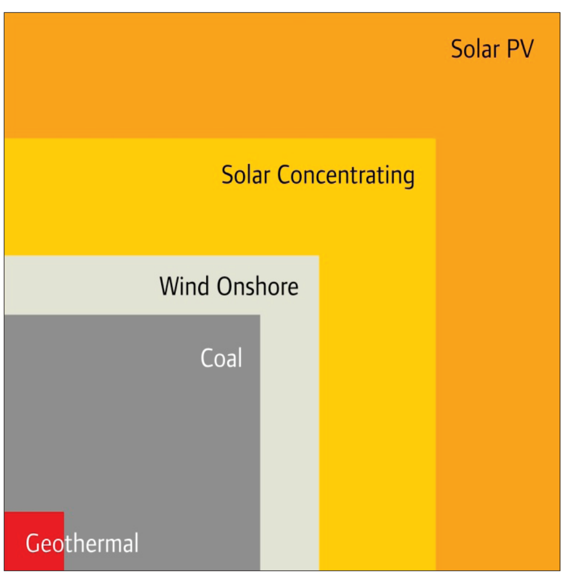

Exhibit 1. Land Use (MWh/Acre) (Source: Jacob Securities).

A Quick Reminder Why We Need More Geothermal Power

Geothermal has the lowest footprint (MWh/acre) of any form of power, including fossil-fuel-fired power (Exhibit 1). Geothermal also has the highest capacity factor of any form of power (Exhibit 2). Geothermal power is base load power. You cannot close a coal plant with intermittent solar or wind. Geothermal heat is everywhere but it varies as to what depth you find it from one mile deep in Nevada to six miles on the US east coast.

A study presented by Scientific American (March 1, 2009) concluded that geothermal power has the lowest levelized cost of power (Exhibit 3, overleaf). The cost advantage would be even greater if we added the cost of emissions.

The Incentives for Energy

In April 2011, Republican House Speaker John Boehner said Congress should consider cutting multibillion-dollar subsidies to oil companies. "It's certainly something we should be looking at," Boehner said in an ABC News interview.

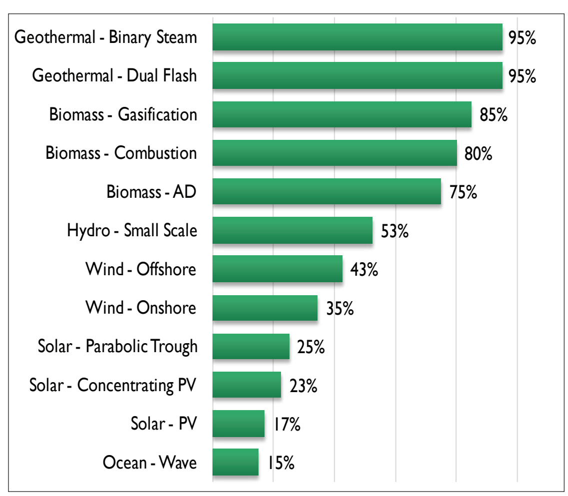

Exhibit 2. Capacity Factors (Source: Jacob Securities).

	Scenario		
	High	Base	Low
Solar PV Chrystalline	201	153	119
Solar PV Thin Film	180	140	110
Fuel Cell DG	117	90	72
Solar Thermal	126	90	69
Coal	66	55	46
NG CCGT	64	52	40
Nuclear	64	62	35
Wind	61	43	29
Geothermal	59	36	22

Exhibit 3. Levelized Cost per MWh. (Source: Scientific American, March 2, 2009).

"We're in a time when the federal government's short on revenues. They ought to be paying their fair share." President Obama tried unsuccessfully during the last Congress to end $3.6 billion in annual oil, natural gas and coal subsidies ($46.2 billion over 10 years) and direct the money to clean energy initiatives.

One of the obstacles to reducing or eliminating subsidies is gasoline prices, which are a political hot potato in the US. Many believe ending subsidies could push prices higher. Yet prices in Europe are much higher, more than double those in the US (Exhibit 4), mostly due to higher European fuel taxes. Oil exporting countries have predictably lower prices than the US.

	Belgium	France	Germany	Italy	Neth.	UK	Canada	US
USD/g	8.62	8.36	9.1	8.46	9.21	8.26	3.91	4.03

Exhibit 4. Retail gasoline Prices as at April 11, 2011 (Source: EIA).

Subsidies to electricity production totalled $4.5 billion in 2007 (most recent EIA data available) and $1 billion for renewables (Exhibit 5). Refined coal received a staggering $2.1 billion while the least subsidized non-renewable, natural gas and petrol-liquids, received $227 million. Wind received 72% or $724 million of the renewable subsidy. Geothermal received just $14 million. On a unit of power equivalent, geothermal received $0.92 per MWh, whereas refined coal, solar and wind received over $20/MWh each.

Power Source 2007 Data	Subsidy $m
Refined coal	2,156
Nuclear	1,267
Coal	854
NG and petrol-liquids	227
Non-renw able	4,504
Wind	724
Hydro	174
Unallocated	37
Biomass/Biofuels	36
Geothermal	14
Solar	14
Landfill gas	8
Municipal solid w aste	1
Renew able	1,008

Source: EIA

Power Source 2007 Data	Subsidy $/MWh
Refined coal	29.81
Solar	24.34
Wind	23.37
Nuclear	1.59
Landfill gas	1.37
Geothermal	0.92
Biomass/Biofuels	0.89
Hydro	0.67
Coal	0.44
NG and petrol-liquids	0.25
Municipal solid w aste	0.13

Source: EIA

Exhibit 5. Electricity Production Subsidies.

The $14 million received by geothermal was before the Investment Tax Credit (ITC) grant program was enacted in February 2009 (The Recovery Act, Section 1603). Under The Recovery Act, as of March 31, 2011, wind projects received 81% or $5.6 billion of the total grants. Geothermal received significantly less - 3.8% or $260 million (discussed later in more detail).

Geothermal is Unique and "One Size Fits All" Incentives Do Not Work

Once permitted and financed, solar and wind projects take nine months and one year to commissioning, respectively. Construction risk is generally mitigated by EPC contracts (unless the developer is larger and has in-house EPC capability). Wind and solar often deliver less MWs than site studies predict for (hence less cash flow), which is planned for by establishing a debt service reserve fund. Risk then, is controlled and understood. Preceding the construction stage, there are typically two years when securing land rights, permitting and MW capacity studies are completed. The cost of the pre-construction stage is hundreds of $thousands.

Once permitted and financed, geothermal projects take a minimum of two years to commissioning (the construction stage). This timing in itself is too long for many investors. The geothermal plant construction stage can be EPC contracted as in solar and wind farms. However, preceding construction are four years of securing rights, permits and MW capacity studies. This longer timeframe eliminates many more potential investors. The cost of the pre-construction stage is $millions rather than hundreds of $thousands for wind and solar. These higher costs eliminate still more potential investors.

For example, consider a generic 30 MW geothermal project costing $150 million (Exhibit 6). Third party equity (money managers and strategic corporates) usually wait until one-third of the MWs are drilled before investing (in our example two wells). The cost to get to this stage is $20 million, and it is borne by the developer and friends and family financing. The costs are $1 million to secure rights and permits, $2 million for non-invasive exploration (seismic, infrared, soil and water sampling etc), $2 million for gradient holes, $5 million for slim-holes and $10 million for two production wells.

Third party equity finances the remaining production wells ($20 million in our example). Lending institutions generally will advance construction finance after the production wells are drilled for the balance of the project (plant, injection wells, transmission and gathering system). Thus, the first $20 million is the most difficult to finance and prevents many sites from advancing beyond the rights/permitting stage.

Besides the long timeline and capital intensive nature of geothermal, there is drilling risk. You can drill a dry hole. At $5 million each you do not want to do this often. We model one in five holes drilled as

Stage	$m	% of Project	Cum. %	Cum. $m	Finance F&F* $m	Finance Equity $m	Finance Debt $m
Rights & permitting	1	1%	1%	1	1		
Non-invasive tests	2	1%	2%	3	2		
10 gradient holes	2	1%	3%	5	2		
5 slim holes	5	3%	7%	10	5		
2 production w ells	10	7%	13%	20	10		
4 production w ells	20	13%	27%	40		20	
5 injection w ells	20	13%	40%	60			20
Plant	75	50%	90%	135			75
Other**	15	10%	100%	150			15
	150	100%			20	20	110

* F&F - Friends and Family

1. Transmission, building and finance

Exhibit 6. Geothermal Development Stages and Costs (Source: Jacob Securities).

dry, half of which are suitable for injection, resulting in one in 10 being useless. This is why lending institutions do not fund until the production wells are proven and why financial or strategic equity investors do not fund until one-third of the production wells are proven.

The other renewables do not have drilling risk. For solar and wind, if the sun shines and the wind blows power is produced and it just has to be measured in MWs. Similar for small-hydro, biomass, landfill and others, they do not have this unique risk of failure. So why bother with geothermal? Because geothermal is base load renewable power and has a higher capacity factor (95%) than any fossil-fuel-fired power (coal 80%) or nuclear (90%). You cannot replace a coal plant with any other renewable and still meet base load requirements. Some would argue biomass is base load given its 80% capacity factor however its general track record of difficult supply availability at a given price makes us disagree.

Because incentives are back-end loaded and geothermal is difficult to finance on the front-end, the current incentives have far less impact compared to other renewables that have easily measured risk.

	Projects #	$	%	$/Project
Wind	144	5,565,269,905	81.1%	38,647,708
Solar Electricity	1,887	654,836,414	9.5%	347,025
Geothermal	5	260,674,171	3.8%	52,134,834
Solar Thermal	136	190,512,820	2.8%	1,400,830
Biomass	31	118,118,477	1.7%	3,810,273
Landfill Gas	14	29,987,264	0.4%	2,141,947
Fuel Cell	12	12,767,923	0.2%	1,063,994
Hydro	5	6,946,139	0.1%	1,389,228
Small Wind	138	6,541,873	0.1%	47,405
Combined Heat & Pow er	9	5,079,381	0.1%	564,376
Marine	3	616,611	0.0%	205,537
Other	34	10,001,284	0.1%	294,155
Total	2,418	6,861,352,262	100.0%	2,837,615

Source: Treasury Department

Exhibit 7. ITC Grants disbursed as of March 31, 2011 (Source: Treasury Department).

The effectiveness of the ITC grant program for supporting the various renewables is evident from the breakdown of the grant disbursements (Exhibit 7). As of March 31, 2011, wind projects received $5.6 billion or 81% of the total grants. Geothermal received $260 million or 3.8%. The five geothermal projects that received grants had commenced construction before the ITC program was announced and so were not pushed along by the grants. Being familiar with most geothermal projects in the US, our view is that the ITC grant program accelerated some already advanced projects under development (slim hole program completed). However, the grant program did not incentivize any new projects lacking up front funding to enter the drilling stage.

Recommendation for a Tailor-Made Geothermal Incentive Program

The current direct subsidies for a representative 30 MW geothermal project are ~$69m (Exhibit 8). This assumes the project secures a $5 million DOE drilling grant (50/50 cost shared with the developer), a DOE loan guarantee representing an annual 3% interest rate savings (value to the developer of $24 million) and an ITC cash grant of $40 million on a $150 million project ($135 million eligible costs). The company cannot access the ITC cash grant until commercial operation (within 60 days of COD) and the DOE loan guarantee reduces financing costs, but does not provide cash up-front. These subsidies are available for the other renewables, except the drilling grant. We leave depreciation and depletion tax allowances out of the discussion as these programs are available to oil, gas and mining among others, and hence are not specific to renewable programs.

Subsidies on a 30 MW Project	$m
DOE Drilling Grant	5
DOE Loan Guarantee[1]	24
ITC Cash Grant[2]	40
	69

1. 3% interest rate savings, 20 years, 75% loan to value, 7% discount rate
2. 30% of capital cost net of transmission and building cost

Exhibit 8. Geothermal Subsidies (Source: Jacob Securities).

Given that back-ended subsidies do not help finance geothermal projects what is needed is a front-end subsidy. We recommend that the current subsidies for geothermal noted in Exhibit 8 be scrapped in favour of a $17 million front ended program for a 30 MW project. The $17 million represents the $20 million cost that is financed by the developer and friends and family less $3 million borne by the developer for securing rights and permits and non-invasive tests – after all the developer will need to establish the potential of the resource before a qualified person can opine on it. Instead of receiving $69 million in subsidies the developer receives $17 million, which also helps the government's budget-cutting since it is much less than the $45 million in direct subsidies (ITC and DOE grants).

The developer would still have to fund the rights/permits and non-invasive stages totalling $3 million. After all, risk should not be eliminated for the developer. The intent is to fill a funding gap in the market not eliminate risk. $17 million should be enough to complete a gradient and slim hole program, and prove up one-third of the production wells (the point where the market will fund the rest). The funds would be distributed by achieving milestones as certified by independent qualified persons. To adjust for different project sizes the subsidy should be based on the number on MWs or ~$567,000/MW (Exhibit 9).

The proposed subsidy saves $millions versus the existing direct subsidies. To calculate the eliminated subsidy we assumed a $5 million DOE grant and a 27% net eligible ITC grant per project. The new subsidy is about 40% of the existing subsidy but because it is targeted to where the market is weak, it will be more effective.

MW	Developer Spends $million	Subsidy $million	Subsidy $million /MW	Eliminated Subsidy $million	Subsidy Reduction $million
15	1.5	8.5	0.567	25.3	16.8
30	3.0	17.0	0.567	45.5	28.5
50	5.0	28.3	0.567	72.5	44.2
100	10.0	56.7	0.567	140.0	83.3

Exhibit 9. Subsidy per MW (Source: Jacob Securities).

The existing ITC grants and Production Tax Credits have expiry dates. DOE drilling grants will eventually be discontinued. At some point these will not be renewed and will be allowed to expire permanently. A permanent subsidy is needed. Subsidies with an expiration date create uncertainty in the market and leads to a rapid halt in development activity as the expiration nears. The next subsidy should be enacted without an expiration date.

While a non-repayable subsidy is preferred to provide the certainty for developers to accelerate projects, the reality is that a new subsidy will be difficult to pass in today's budget-cutting environment. It may be necessary to structure a self-funding subsidy. The government would need to provide the initial capped funding commitment but thereafter it could be self-funding. The self-funding aspect is the trade-off for not having an expiration date.

Self-funding can work in a variety of ways; royalties from developers that benefit from the subsidy, optional drilling insurance paid for by the developer, or repayment of the subsidy from project-generated cash flow after commissioning.

There will be cases where a project is abandoned and without commissioning there will not be cash flow to repay the subsidy. In this case the subsidy should be forgiven. However the forgiven amount will still need to be recovered for the subsidy to keep its self-funding status. This means that successful wells are "taxed" with a return sufficient to recover forgiven subsidies. If one well in 10 is useless, the "tax" would be less than 10% as not all dry wells will result in an abandoned project.

A developer should be able to live with this. The other option is to not drill at all or seek an equity partner. An equity partner funding gradient and slim hole programs will require a return almost equal to the project IRR, which, depending on the cost of the drilling program is in the range of 15% to 25% (levered and after tax without ITCs or PTCs). Thus a cost of less than 10% can be attractive relative to a market rate of return.

Such a subsidy program may not be attractive to established developers with the cash capacity to absorb the cost of dry wells. In this way the subsidy favours smaller developers. However, there are not enough established developers to fund the 152 confirmed projects identified by the GEA. In fact, we would consider only six developers to have sufficient cash resources to fund a project let alone multiple projects.

The current issues in electricity supply are all about sustainability and predictability. Renewable electricity needs a sustainable and predictable subsidy program.

1. Eliminate the current DOE drilling grants for conventional geothermal, guaranteed loans and tax credits (~$69 million per 30 MW site)
2. Contribute a one-time grant (amount to be determined) to establish a drilling fund
3. Establish a $567,000 per MW drilling subsidy to cover gradient-holes, slim-holes and production wells
4. The subsidy does not have an expiration date and is structured to be self-funding after the initial one-time grant to establish the drilling fund
5. Developer must fund all pre and non drilling expenses
6. Disbursement to occur in stages as approved and certified by independent qualified persons
7. Subsidies applied to abandoned sites are forgiven
8. Successful drilling subsidies are repaid including a return sufficient to recover the forgiven subsidies

Exhibit 10. Program Summary.