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CONGRESSIONAL TESTIMONY

The Status of Ivanpah and Other Federal Loan-Guaranteed Solar Energy Projects on Bureau of Land Management Lands

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Essentially all advocates for conventional fuels acknowledge that eventually there will be a transition to alternatives—maybe in 20 years or maybe in 120 years. On the other hand, all but the least reasonable advocates for alternative energy recognize that the switch cannot be done instantly and costlessly. So, the question is how do we manage the transition? Do we force a transition with a top-down, centrally controlled program based on politically determined mandates and subsidies or do we give people the freedom to innovate and allow consumers the freedom to choose the best energy products given their budget and their needs?

The Ivanpah solar project argues against the former—the top-down, politically driven system of preferential tax credits, subsidies, and mandates.

Owned by a consortium of firms with an aggregate market capitalization in excess of $1 trillion, Ivanpah nevertheless received a federal loan guarantee of $1.6 billion, a federal grant in lieu of tax credit in excess of $500 million, and contracts to sell power output at 4 to 5 times the market rate for electricity. In addition, it uses significant quantities of natural gas to generate electricity, but sells all of its output at preferentially higher solar prices.

Big Government Helping Big Business

The Ivanpah solar power plants are owned by NRG Energy, BrightSource Energy, and Google.[1] BrightSource is itself owned by a consortium of firms whose members include:[2]

- Google
- General Electric
- Chevron
- BP Alternative Energy
- StatoilHydro Venture
- Morgan Stanley
- Black River Asset Management
- Draper Fisher Jurvetson
- Vantage Point Capital Partners
- Riverwood Capital
- Double Bottom Line Venture Capital
- California State Teachers' Retirement System

These entities and their parent companies have a market capitalization in excess of $1,000,000,000,000. It seems highly unlikely that these investors could not fund a truly market-viable project without a $1,600,000,000 federal loan guarantee and a $500,000,000 treasury grant. In addition to several of the world's largest corporations, the list include a virtual who's who of sophisticated

[1]Ivanpah Solar, http://www.ivanpahsolar.com/ (accessed July 11, 2016).
[2]BrightSource Energy, "Investors," http://www.brightsourceenergy.com/investors#.V4OzofkrK70 (accessed July 11, 2016).

finance and venture capital firms. Ivanpah is an example of big-government programs benefiting big and influential economic actors for politically preferred projects.

Ivanpah's investors have the assets, credit rating, and financial sophistication to have undertaken the project without subsidies from taxpayers and ratepayers. If the project is viable, these financial preferences are simply an unjustified wealth transfer to large an influential actors. If the project is not viable, it should not be undertaken in the first place.

Note for clarification, the criticism here is not that there are large firms. Nor is the criticism intended to disparage the firms that have invested in Ivanpah. Rather the criticism is of government direction of capital flows and of mandates that force consumers and taxpayers to pay for products they would not choose if they had the choice.

Renewable Energy Alchemy

The advantages provided to Ivanpah's investors do not end with loan subsidies and treasury grants. With obfuscation and very favorable rulings, Ivanpah uses smoke and mirrors to turn natural gas into sunlight.

Unlike solar photovoltaic (PV) plants that use solar cells to convert sunlight directly to electricity, Ivanpah is a solar thermal plant that uses mirrors to concentrate sunlight to create steam that then drives turbines in a fashion similar to that of coal, natural gas, or nuclear power plants.

A problem unique to solar power is sunset. This is true for both solar PV and for solar thermal without thermal storage (as is the case for Ivanpah) and neither can generate power without sufficient sunshine.

Because Ivanpah's water cools down at night, it must be re-heated before it can generate electricity. Unlike solar PV, Ivanpah has a lag between first sunlight and first solar power production. This is an inherent drawback of solar thermal without storage. Ivanpah fights the darkness with natural gas. Overnight it burns natural gas to reduce or eliminate the necessity for reheating the cooled water. This means that Ivanpah is really a hybrid solar-gas power plant.

The contracts with Ivanpah set upper limits on the amount of natural gas that can be used to create "solar" power. Initially 2 percent, the limits were bumped to 5 percent. However, Ivanpah goes way beyond either cap.

A nonsensical California Energy Commission (CEC) ruling trivializes the significant amount of natural gas used by Ivanpah, which allows Ivanpah to report official compliance with the caps. This ruling allows Ivanpah's operators to totally dismiss the gas used to heat the water unless "the generator breaker is closed."[3] That is, until Ivanpah's water is sufficiently hot to generate electricity, the gas used to heat the water is not counted toward the caps. This ignores out all overnight gas use. Instead, Ivanpah counts only the much smaller amount of gas used during the daytime to help stabilize production during transient losses in sunshine, such as might happen when passing clouds shade the mirrors.

[3]Susan Kraemer, "Newly Released Data Indicates Ivanpah Gas Is Under 5%," *CleanTechnica*, April 25, 2016, http://cleantechnica.com/2016/04/25/newly-released-data-indicates-ivanpah-gas-5-percent/ (accessed July 11, 2016).

A More Realistic Estimate of Gas Use

The CEC's own data show that Ivanpah's gas use is closer to 30 percent of electricity production than it is to 5 percent. CEC tables showing electricity production and natural gas consumption for Ivanpah are copied and pasted in the appendix.[4]

To estimate how much of Ivanpah's electricity is from natural gas, we calculate how much electricity the gas would have generated had it gone through a purely gas-fired power plant. One choice would be the most efficient gas plants, which are combined cycle. According to CEC data, the average thermal efficiency of combined-cycle gas plants in California in 2013 (the latest year reported) was 47 percent.[5] With this as the benchmark, Ivanpah's gas use was 25.7 percent of electricity production in 2015 and 28.6 percent in 2014.[6]

Another benchmark might be the thermal efficiency for all of California's gas-fired power plants, 40 percent. This benchmark includes old plants and plants whose primary function is to provide heat. Nevertheless, using this benchmark, the percent of electricity from gas was 21.9 percent in 2015 and 24.3 percent in 2014. Even these values are well in excess of the 5 percent cap that Ivanpah claims to meet.

Another reasonable benchmark would come from using the thermal efficiency of combined-cycle plants built when Ivanpah was built. Though some of those plants achieved thermal efficiencies in excess of 60 percent, the average was around 58 percent.[7] Using this benchmark, Ivanpah's percent of electricity from gas was 31.7 percent in 2015 and 35.2 percent in 2014.

The Value of Converting Gas Power to Solar Power

In 2015 Ivanpah's electricity sold for an average of about $200 per megawatt hour (MWh) in the summer and about $135 per MWh for the rest of the year.[8] In contrast, the average price of conventional electricity (like that produced in a natural-gas-fired power plant) was around $35 per MWh. Had the natural gas been used to produce electricity in a conventional plant and sold for $35 per MWh, it would have generated revenue of $5.9 million. The same electricity sold at Ivanpah's $135

[4]California Energy Commission, "Power Plant Statistical Information," *Energy Almanac*, 2016, http://energyalmanac.ca.gov/electricity/web_qfer/Power_Plant_Statistical_Information.php (accessed July 11, 2016).
[5]Michael Nyberg, "Thermal Efficiency of Gas-Fired Generation in California: 2014 Update," Staff Paper, California Energy Commission, September 2014, http://www.energy.ca.gov/2014publications/CEC-200-2014-005/CEC-200-2014-005.pdf (accessed July 11, 2016).
[6]Gas consumption in million British thermal units (MMBTUs) is multiplied by 0.293 to calculate the MWh heat equivalent, which is then multiplied by the thermal efficiency to calculate the equivalent electricity production in MWh. The equivalent gas-fired electricity production is divided by Ivanpah's net electricity production to get a percent from gas.
[7]Siemans, "Combined Cycle Power Plants," http://www.siemens.com/about/sustainability/en/environmental-portfolio/products-solutions/fossil-power-generation/combined-cycle-power-plants.htm (accessed July 11, 2016).
[8]Cassandra Sweet, "Ivanpah Solar Plant May Be Forced to Shut Down," *The Wall Street Journal*, March 16, 2016, http://www.wsj.com/articles/ivanpah-solar-plant-may-be-forced-to-shut-down-1458170858 (accessed July 11, 2016).

per MWh would generate revenue of $22.6 million. That is, by financial and political wizardry, the value of natural gas run through Ivanpah quadruples.

Conclusion

The Ivanpah solar power plant is an example of subsidies and mandates transferring wealth to big and influential economic actors. Ivanpah's investors received a subsidized loan of $1.6 billion, are eligible for a treasury grant of more than $500 million, and re-label natural gas as solar electricity for a potential addition of about $17 million per year. Further, with the assistance of the California Energy Commission, Ivanpah grossly misstates the actual amount of natural gas they use to generate electricity.

The federal government should quit rigging energy and capital markets and stop forcing high-cost energy on consumers. At the very least they should demand an honest accounting of fuel use by renewable power plants that supplement output with conventional fuels.

Ivanpah's Percent of Electricity from Gas, 2015
For Different Thermal Efficiencies

Benchmark	Percent Electricity from Gas
All California Gas Plants, .40	21.9
All California CC Gas Plants, .48	25.7
Most Modern CC Gas Plants, .58	31.7

Appendix

Ivanpah I (Solar Partners II) - Statistical Information

Plant ID: S0078

Company Name: Solar Partners I II VIII LLC

Location: San Bernardino, CA

Annual Totals

Year	Unit	Category	Status	Start Date	Retire Date	Prime mover ID	Prime Mover Description	Capacity	net MWh	Primary Fuel Use MMBTU	Primary Energy Source	Secondary Fuel Use MMBTU	Secondary Energy Source
2015	Ivanpah 1	S	OP	12/30/2013		ST	Steam Turbine	126	209726	0	SUN	398599	NG
2014	Ivanpah 1	S	OP	12/30/2013		ST	Steam Turbine	126	151973	0	SUN	302522	NG
2013	Ivanpah 1	S	OP	12/30/2013		ST	Steam Turbine	126	2057.11	0	SUN	0	

Ivanpah II (Solar Partners I) - Statistical Information

Plant ID: S0079

Company Name: Solar Partners I II VIII LLC

Location: San Bernardino, CA

Annual Totals

Year	Unit	Category	Status	Start Date	Retire Date	Prime mover ID	Prime Mover Description	Capacity	net MWh	Primary Fuel Use MMBTU	Primary Energy Source	Secondary Fuel Use MMBTU	Secondary Energy Source
2015	Ivanpah 2	S	OP	12/31/2013		ST	Steam Turbine	133	218741	0	SUN	398240	NG
2014	Ivanpah 2	S	OP	12/31/2013		ST	Steam Turbine	133	128248	0	SUN	277205	NG
2013	Ivanpah 2	S	OP	12/31/2013		ST	Steam Turbine	133	689.11	0	SUN	0	

Ivanpah III (Solar Partners VIII) - Statistical Information

Plant ID: S0080

Company Name: Solar Partners I II VIII LLC

Location: San Bernardino, CA

Annual Totals

Year	Unit	Category	Status	Start Date	Retire Date	Prime mover ID	Prime Mover Description	Capacity	net MWh	Primary Fuel Use MMBTU	Primary Energy Source	Secondary Fuel Use MMBTU	Secondary Energy Source
2015	Ivanpah 3	S	OP	12/31/2013		ST	Steam Turbine	133	223990	0	SUN	419768	NG
2014	Ivanpah 3	S	OP	12/31/2013		ST	Steam Turbine	133	137846	0	SUN	287313	NG
2013	Ivanpah 3	S	OP	12/31/2013		ST	Steam Turbine	133	2178.11	0	SUN	0	

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