



Driven by the Sun --“Powerful” Thoughts on PCS Development

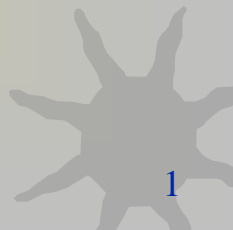
Brief Information and Opinions

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Future Grid– Gotta Happen, Gonna Happen:

- ❖ Back-to-Back DC links inserted in major AC ties
- ❖ New major Transmission is DC
- ❖ Widely dispersed DG (primarily solar)
- ❖ Reactive power control via PCS
- ❖ Ancillary services via PCS
- ❖ Improved System Stability
- ❖ Resistance to Fault Induced Delayed Voltage Recovery (FIDVR)



Behold: The “asynchronization” of the Grid....²





Why?

COST

RISK

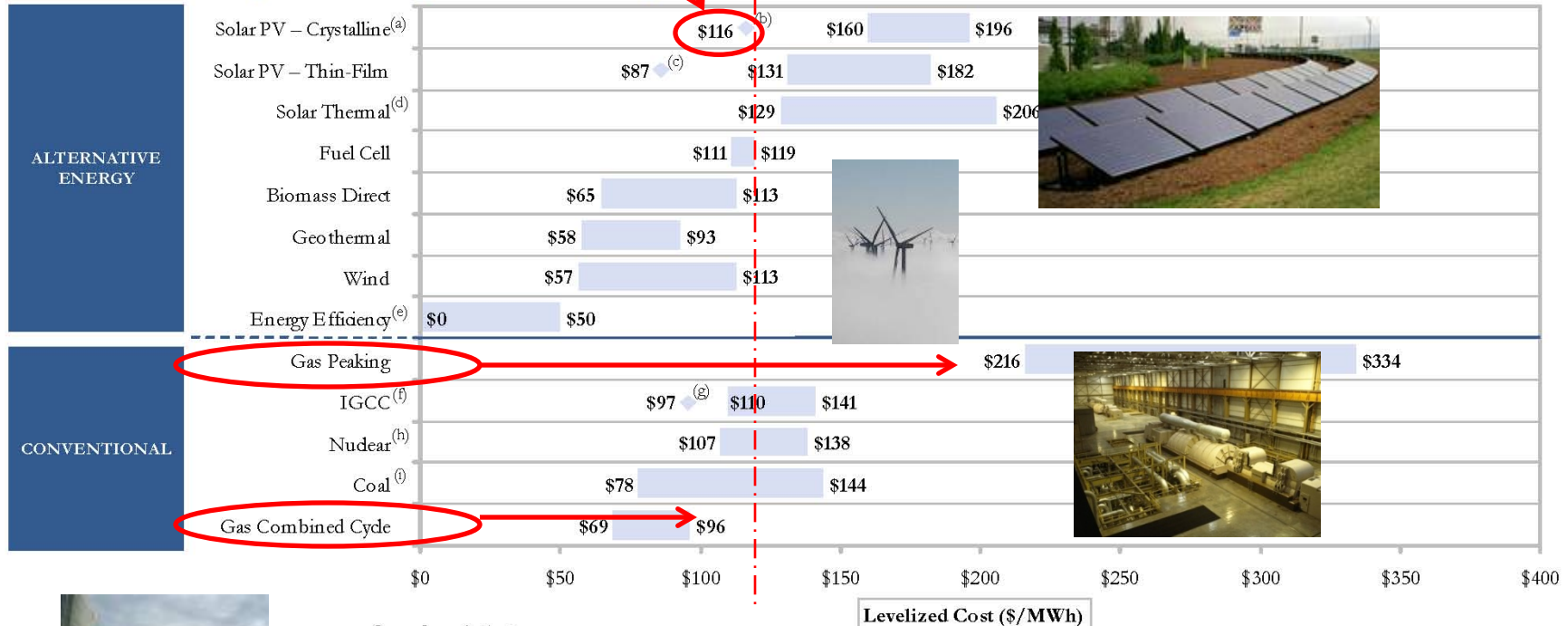


--So Energy Cost will not be the key determinant in PV penetration

2009 Study – Today we are HERE – (with really cheap gas!)

Levelized Cost of Energy Comparison

Certain Alternative Energy generation technologies are becoming increasingly cost-competitive with conventional generation technologies under some scenarios, before factoring in environmental and other externalities (e.g., RECs, potential carbon emission costs, transmission and back-up generation/system reliability costs) as well as construction and fuel costs dynamics affecting conventional generation technologies



2 | LAZARD

Source: Lazard estimates

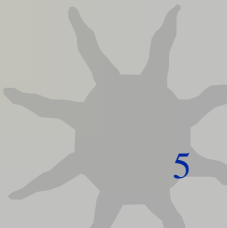
Note: Reflects production tax credit, investment tax credit and accelerated asset depreciation, as applicable. Assumes 2008 dollars, 20-year economic life, 40% tax rate and 5-20 year tax life. Assumes 30% debt at 8.0% interest rate, 40% tax equity at 8.5% cost and 30% common equity at 12% cost for Alternative Energy generation technologies. Assumes 60% debt at 8.0% interest rate and 40% equity at 12% cost for conventional generation technologies. Assumes coal price of \$2.50 per MMBtu and natural gas price of \$6.00 per MMBtu.

- (a) Low end represents single-axis tracking crystalline. High end represents fixed installation.
- (b) Represents estimated implied levelized cost of energy in 2012, assuming a total system cost of \$3.50 per watt for single-axis tracking crystalline.
- (c) Represents a leading thin-film company's targeted implied levelized cost of energy in 2012, assuming a total system cost of \$2.00 per watt.
- (d) Low end represents solar tower. High end represents solar trough.
- (e) Estimates per National Action Plan for Energy Efficiency; actual cost for various initiatives varies widely.
- (f) High end incorporates 90% carbon capture and compression.
- (g) Represents estimated implied levelized cost of energy for Southern Company's proposed IGCC facility in Mississippi that is expected to be in service in 2013, assuming a total system cost of \$3.00 per watt and 50% carbon capture, per Southern Company public comments.
- (h) Does not reflect decommissioning costs or potential economic impact of federal loan guarantees or other subsidies.
- (i) Based on advanced supercritical pulverized coal. High end incorporates 90% carbon capture and compression.



Why PV?

- ❖ No Fuel
- ❖ No O&M
- ❖ Mostly capital – rate based (IOU), bond finance (public power)
- ❖ Incremental Commitments (low risk)
- ❖ No/low land issues
- ❖ No/low aesthetic issues





Why PCS at Transmission Level?

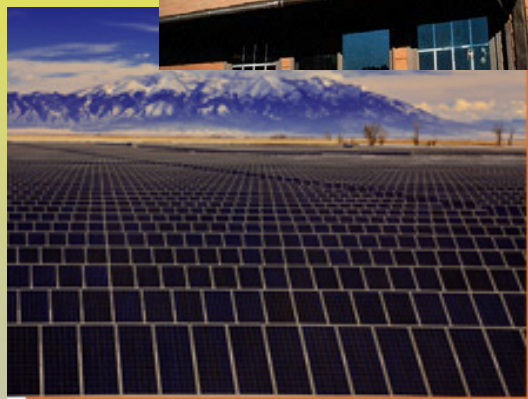


- ❖ Realities of Reactance
- ❖ Realities of ROW
- ❖ Realities of Reliability
- ❖ Realities of Retrofit





Way Better than Today



Advanced Communications & Control of Inverters to Enable PV to Behave like Conventional Generation



“WLAD”

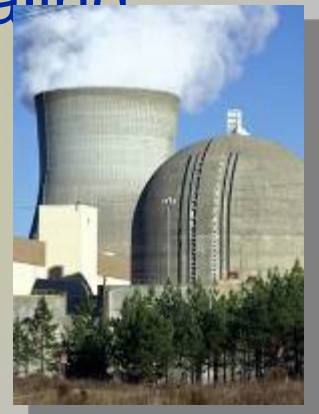




Given High Power PCS at Transmission Level, Note:



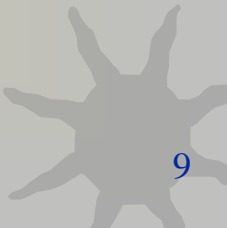
- ▶ Distributed Systems can have same characteristics
- ▶ DG can/will be centrally controlled, but with highly autonomous powers
- ▶ Distributed PCS can/will replace capacitors, regulators
- ▶ A truly coordinated, inherently stable, self-healing grid





“The Solar Effect”

- Lower PV costs drive
- Lower/Better PCS (beginning with inverters), driving lower cost
- For PCS throughout the Grid.....





(at the) Florida Solar Energy Center

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A HUGE Argument for Doing It!

