U.S. WIND AND SOLAR ARE MUCH LESS EFFICIENT DECARBONIZERS THAN COMBINED CYCLE GAS TURBINES

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BASIC ASSUMPTIONS

- Following Joskow, we do separate analyses for peak and off-peak generation
- This study borrows heavily from a 2014 Brookings Working Paper by Charles R. Frank, “The Net Benefits of Low and No-carbon Electricity Technologies. However, we use updated 2016 data.
- The basic data for this study is the annual census of electricity generation conducted by the Energy Information Agency (EIA) of the U.S. Department of Energy.
- One advantage of using the EIA data is that it measures the costs of electricity production on a “real resource cost basis.” That is, the data do not incorporate the large U.S. government subsidies paid to the owner/operators of U.S. wind and solar electricity plants.
- The federal subsidy to solar energy is 30% of capital cost. The federal “production tax credit” (PDC) for wind began at $.023 per kwh, but has complex annual yearly inflation adjustments.

OTHER BASIC ASSUMPTIONS

- A new low-carbon (wind, solar, or CCGT) plant replaces a coal plant off-peak and a simple cycle gas turbine on-peak.
- The price of natural gas is the average price paid by electric utilities
- The cost of capital is 7.5%.
- The emissions from a new CCGT plant are grossed up to account for fugitive from the production and transport of natural gas.
- We include “balancing and cycling costs.” These are the extra cost that electric utilities incur to accommodate the intermittent nature of wind and solar.

THE CONCEPT OF “DECARBONIZATION EFFICIENCY”

- Decarbonization cost is the differential cost of producing a MW year of electricity via coal plants and three other technologies—wind, solar, and combined cycle gas turbines (CCGTs), divided by the differential CO2 emissions (measured in tonnes per year)

Total net cost savings in 2016 of switching from coal to:

Wind $4,340 per MW year
Solar $98,826 per MW year
CCGTs $237,684 per MW year

Tonnes of CO2 emissions per MW year avoided by switching from coal to:

Wind 3,418

Solar 2,241

CCGTs 4,686

Net cost savings per tonne of emissions avoided

Wind $1.27

Solar −$44.11

CCGTs $50.72

DEAD WEIGHT ECONOMIC LOSS

- *Of a decision to switch from coal to wind instead of to CCGTs:*

  $49.45 per tonne of emissions avoided

- *Of a decision to switch from coal to solar instead of to CCGTs:*

  $94.83 per tonne of emissions avoided

- *Conclusion: Switching to either wind or solar instead of to CCGTs involves a dead weight economic loss. However, the dead weight economic loss is twice as great for a switch to solar instead of a switch to wind*

A SCENARIO OF DECARBONIZATION

- In recent years, U.S. CO2 emissions have been about 5,8 billion tonnes per year.
- Suppose a goal of reducing those emissions by 10% or about 58 billion tonnes.
- As shown before, substitution of wind for coal achieves a cost saving of $1.27 per tonne of CO2 reduction, or $.74 billion in this decarbonization scenario.
- As shown before, substitution of solar for coal results in extra costs of $44.11 per tonne of CO2 reduction, or $25.58 billion if all the investment was in solar.
- However, if all the investment were done in CCGTs, then the total cost savings would be $29.42. So, the cost savings are larger when all the investment is in CCGTs. The differences in cost savings are the amount of "dead weight economic loss" from investing in wind or solar instead of CCGTs.
- These equations could be turned around to calculate, for a given fixed outlay of costs, what would be the "foregone CO2 emissions opportunity" from investing in wind or solar instead of CCGTs.

OTHER ALLEGED "SIDE BENEFITS OR COSTS" OF RENEWABLES

- Job creation. Many of the jobs creates by renewables are at the installation or capital goods production stages. The inherent capital intensivity of renewables limit their job creation potential.
- Infant industry learning. This was a label invented by Argentine economist Raul Prebisch to argue for tariff protection for industry in less developed countries. However, those tariffs often lead to "soft industries" that became dependent on the tariffs and did not focus on increased efficiency. A higher gain results from investing in specialized R&D activity.
- Siting issues. Renewables progress over time from more favorable wind and solar sites that involve higher cost per kwh produced. A classic example of "diminishing economic returns." CCGTs are smaller physical plants, which can be sited close to natural gas supply or end use electricity users.

BROADER ISSUES OF RENEWABLES v. CCGTs

- Should CCGTs be eligible to receive federal tax credits analogous to the current federal tax subsidies to wind and solar? No. This would be doubling down on a bad federal policy. CCGTs do not need subsidies. They can out compete wind and solar on their own.
- The states mainly follow a policy of "renewables mandates" placed on regulated utilities. The utilities don't resist these mandates very hard because the system of a fixed return on "utility rate base" largely eliminates the incentives to lower costs via investment in CCGTs. This pattern is a classic example of political "confusion of ends and means." If the goal of electricity policy at the state level is reducing CO2 emissions, then the state should not intervene to put CCGTs at a disadvantage.