Hidden Costs of Wind and Solar Power

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The two-pronged attack on non-renewable energy sources

- The *direct* “war on fossil fuels” has taken many forms including:
  - Regulations inhibiting coal production and use
  - Closing prospective offshore areas to oil and gas development
  - Stopping unconventional oil and gas on government land
  - Bans on other attempts to regulate fracking on spurious grounds
  - Opposition to oil and gas pipelines

- The direct attacks have extended to conventional hydro based on reservoirs

- The many measures aimed at promoting wind and solar are also an *indirect* attack on fossil fuels (and nuclear)
Policies promoting wind and solar generation

- Dsire database lists 674 different Federal, State, Local and utility policies or programs that promote wind generation in the US
  - They include financial incentives (tax, tariffs, subsidies and other), mandated purchases of output, and exemptions from other laws
- For solar PV: 977 policies or programs; for solar thermal electric 377 and many other solar programs for water/pool/space/process heating etc. not directly related to electricity
- Other countries in the OECD have similar types of subsidies, tax and tariff concessions, mandates, and exemptions from other policies
  - Most (in)famous perhaps is the German Energiewende
  - Although the South Australian program is rapidly gaining in “reputation”
US primary energy consumption by source

Source: Energy Information Administration
Wind generation does not match the load profile, is uncontrollable, and highly variable

- Wind generation cannot be dispatched when needed
- Daily peak wind output tends to be in the middle of the night when electricity demand is low
- Seasonally, wind output tends to be low when air conditioning load is high
- Output is zero at wind speeds that are either too low or too high and over much of the range of common wind speeds; output fluctuates substantially over short intervals
- Wind generation thus exacerbates the need for ancillary services to stabilize the grid and cannot supply them
- Wind generation reduces the utilization of backup capacity, raising its cost
  - Extreme case – negative wholesale prices
  - Curtailing base load plant reduces its efficiency and raises conventional pollution
  - Gas turbines are flexible backup supply, but reduce efficiency of natural gas use relative to combined cycle plants
Wind capacity factor and ERCOT load, 2016

Source: ERCOT
Typical wind power curve 1500kW rated turbine
Other problems with wind generation

- Wind generators have comparatively low load factors on average
  - GWEC statistics for 2015 imply average US load factors of 30.9% and 26.5% in the EU
- Wind resources are often remote from load centers
  - New transmission lines also are used at low load factors
- Wind turbines have a comparatively short life-span
- Wind turbines and wind farms have their own environmental problems
  - Bird and bat kill
  - Vibrations and noise
  - Visual “pollution” from hilltop and coastal headland locations
  - Exotic materials cause pollution when mined and disposed of
Some problems with solar generation

- Utility-scale solar is currently even more expensive than wind
- Peak output is not coincident with early evening demand peak
  - Solar does not save on required thermal generating capacity and increases “peakiness” of load
  - A commercial evaluation of solar would compare its capital cost to the present value of energy cost savings only
- Customer installation of PV panels saves the consumer from buying electricity at retail prices
  - The customer is rewarded as if PV saves on generating capacity and fixed network and administration costs
  - Remaining customers bear more of the fixed costs, causing more to switch – an unstable feedback mechanism
  - Net metering exacerbates the problem
- Generation in the low voltage part of the network can require upgrades to cope with reverse flow
- Solar panels also contain exotic materials that cause pollution when mined and disposed of
States with more wind, solar tend to have higher electricity prices but...

- Many of them also tend to have more natural gas plants and those costs are currently low
- Trade in electricity lessens the effect of expensive generation in any one state
  - Trade tends to raise prices in the exporting state, reduce them in the importing one
  - Transmission constraints limiting arbitrage allow measured effects to remain
- Legacy fossil fuel plants need only cover operating costs to remain in business
  - Average wholesale prices are lower as a result
  - Legacy plants will be retired as investment is needed to keep them operating
  - Capacity shortages are leading to additional capacity markets
- Explicit subsidies and tax concessions to renewables lower their apparent costs
  - Subsidies through the tax system, unlike mandated supply, are not reflected in prices
Concluding comments

- Especially in high fossil fuel producing states, people are now aware of the “war on fossil fuels”
- But public sentiment in favor of wind and solar power remains strong
- People have not been well-informed of the deficiencies of these forms of power
- Some of the costs of promoting wind and solar have been hidden by legacy fossil fuel plants, the low cost of natural gas and interstate trade in electricity
- A more general hidden cost of “picking winners” is that resources are wasted on rent seeking
- The proposal to offset some of the damage by subsidizing coal and nuclear generation is not the best response – instead eliminate the distortionary policies