Creating Jobs With 'Green' Power Sources

By

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Introduction

Green energy has some important advantages over conventional fossil fuels. Improving energy efficiency or expanding renewable energy sources reduces the risks of both combusting carbon-based fossil fuels and relying too much on potentially vulnerable oil and natural gas supplies.

In the wake of the recent financial melt-down, green energy is also widely promoted for its ability to create jobs. If green energy power projects provide more new jobs than conventional energy projects, they may stimulate more additional jobs as incomes expand. This possibility provides green energy with a "two-for-one" possibility. Governments should advance these technologies, because they stimulate the economy as well as protect against global climate change and energy insecurity.

This note evaluates some widely quoted estimates supporting the substantial benefits of renewable energy jobs and places them in the context of other possible government responses. Most importantly, it provides a framework for comparing claims for job-creation on a consistent basis. As technologies develop and costs change, these principles can guide policy discussions on this topic.

The analysis below concludes that the advantages of increased jobs from renewable energy are vastly overstated at costs prevailing today.[1] It will require dramatic break-through in costs if renewable energy is to become a job generator. Given the uncertainty about all the assumptions that enter such calculations, the best guess is that the job impact will be relatively small and the direction unknown at current costs. This conclusion, of course, says nothing about whether the government should promote green energy for energy and environmental reasons. But it does suggest strongly that governments should pay much more attention to economic costs than to job creation.

Job-Creation Estimates

The original job-creation estimates for power generation options are derived from the Kammen, Kapadia & Fripp (2006) survey (hereafter, KKF) of other studies.[2] They compared two estimates each for solar photovoltaic (PV), wind and biomass with single estimates for coal and natural gas. The authors provided a clear exposition of their assumptions and kept the analysis transparent by focusing on the direct, first-round employment impacts. These direct impacts include additional employment from construction, manufacturing and installation of new facilities as well as the operations and management as well as fuel-processing costs of generating power. They exclude the indirect, inter-industry impacts where new facilities may require additional inputs (e.g., more steel), which may be important for many renewable options, except biomass. As KKF correctly note, however, it is difficult to tease out these inter-industry effects for each generation option (solar versus wind) from simulations reported by input-output models of the economy. Even ignoring these effects, however, the KKF estimates show renewable energy sources to be major job-generators.

The KKF also exclude the indirect impacts from additional spending from the higher direct earnings (the economy's multiplier effect). Excluding the expenditure multiplier effects is appropriate for comparing the options if the multipliers are similar for clean and conventional energy sources, which seems reasonable. Empirical estimates of the fiscal multiplier for the U.S. economy range between 1.5 and 2.5 (Wyckoff, 1981: p. 101). The average fiscal multiplier for eleven different macroeconomic models was 1.5 after the first year, before fading to essentially zero in the longer run (Adams and Klein, 1991).

Job-Creation Standardized by Generation

KKF calibrated their job-creation effects by standardizing on megawatts of capacity, adjusted for the percent of time each option was used over a typical year. They called these estimates megawatts averaged over the year, or MWa. Since they assumed that a coal plant with one megawatt of capacity was used 80 percent of the time, the 1 MW capacity was converted to 0.8 MWa. Similarly, since they assumed that a solar PV plant with one megawatt of capacity was used a little more than 20 percent of the time, the 1 MW capacity of solar was converted to about 0.2 MWa. They made these conversions in order to emphasize how much each option was used to generate electricity rather than how much capacity was available. Their estimates of the jobs per MWa are reported in the first column of Table 1.

The top four entries for renewable energy sources look extremely attractive relative to those for natural gas and coal. The job ratios shown in column (5) are the ratio of job creation for each technology relative to that for natural gas. These estimates suggest that solar PV may be about 8-11 times more effective in creating jobs than either coal or natural gas.

Job-Creation Standardized by Costs

The KKF normalization on MWa makes sense if you think that it is important to compare options based upon their generation of power. The argument about jobs, however, has very little to do with equating energy use across generation options. Instead, it is an economic argument and should be related to the foregone opportu-

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See footnotes at end of text.

Table 1. Job Creation Associated with Different Generation Technologies

	(1)	(2)	(3)	(4)	(5)	(6)
					---Job Ratio---	
	Jobs/MWa	Jobs/GWh	Jobs/$MM	$/KWh	MWh	$
Solar PV	7.41	0.846	3.18	$0.2664	7.80	1.55
Solar PV	10.56	1.205	4.53	$0.2664	11.12	2.21
Wind	0.71	0.081	1.64	$0.0495	0.75	0.80
Wind	2.79	0.318	6.43	$0.0495	2.94	3.14
Biomass	0.78	0.089	1.80	$0.0496	0.82	0.88
Biomass	2.84	0.324	6.54	$0.0496	2.99	3.19
Coal	1.01	0.115	3.72	$0.0310	1.06	1.81
Natural Gas	0.95	0.108	2.05	$0.0529	1.00	1.00

Explanation:
Column (1), source: Kammen, Kapadia & Fripp (2006).
Column (2) = column (1) * (10^6) / 8760.
Column (3) = column (2) / column (4).
Column (4), source: Metcalf (2005), converted from cents per KWh.
Columns (5) & (6): Jobs Index (where natural gas equals 1.00).

MW = megawatts = capacity.
MWa = used capacity averaged over the year = (% capacity factor) x (capacity).
GWh = 1000 * megawatt hours = (1000) x (24 hours) x (365 days) x (% capacity factor) x (capacity).
GWh = MWa x 1000 x 8760.

nities associated with selecting a particular generation type. If it costs 5 to 8 times more to select solar PV than coal or natural gas, the savvy consumer will realize that he is spending 5 to 8 times as much money for one option than for another. Thus, he should expect 5 to 8 times more value for the green rather than the conventional option. If generation costs vary dramatically across options, a reasonable approach would be to normalize the job-creation estimates on the basis of dollars, as one would do for any other commodity in the marketplace.

The adjustment for costs is best done through an important intermediate step. Column (2) makes a very simple adjustment to derive jobs per gigawatt-hour (GWh). Any 1 MW capacity would generate 8,760 megawatt-hours, or 8.76 GWh, if it could be operated continuously over the full year. The estimates in column (1) are already adjusted for the capacity factor (percent of time in operation) for each technology option. Dividing these estimates by 8.76 reveals a new set of job-creation estimates expressed in terms of gigawatt hours of generation by each technology type. Note that this adjustment does not change the ratio of the job creation for one technology type relative to another. The top solar PV estimate remains about 7.8 times the natural gas estimate in each of the first two columns.

The cost-based estimates of job creation in column (3) are computed by dividing the jobs-per-gigawatt hour estimates in column (2) by costs per kilowatt hour shown in column (4). The cost estimates are derived by Metcalf (2005) in his careful analysis of the federal tax code on the levelized electricity costs for different generation options.[3] Columns (2) and (4) are both standardized by some multiple of watt hours, which cancel each other when the two estimates are divided. Thus, column (3) shows job creation per million dollars spent on using capacity of a particular energy type.

The job-creation estimates for solar PV capacity are now not nearly as attractive as they were in the first column. The relative positions of wind and biomass remain pretty much the same, because these sources are competitive with natural gas at current prices. Once solar PV, wind and biomass are connected to the grid, only one of the two job-creation estimates for each technology lies above the range (2.05-3.72 jobs per million dollars) for conventional fuels. Since these estimates are sensitive to assumptions about capital costs, fuel prices and plant capacity factors, it would seem that the relatively small differences between generation types in their job-creation impact may not be robust to a full uncertainty analysis.

One must view these cost-adjusted job-creation measures as only approximate for several reasons. First, they result from combining the direct job impacts from a set of technical studies with the cost estimates from an economic study. Each technical study and the economic study may be using different assumptions about the technical performance and the labor and other input costs for each generation option. The preferred approach would be to develop both the employment impacts and the economic cost from the same analytical framework using common assumptions. Hopefully, future studies of the job-creation issue will include the total economic costs in their analysis.

Second, costs are measured at current rather than future levels. If future costs for renewable sources decline due to learning or other effects, more jobs would be created for each dollar spent. However, this possibility really underscores the importance of including costs rather than employment. If their costs decline, renewable sources will be more attractive for a number of reasons. Exclusive focus on jobs tends to hide this important point.

Net Job Creation

The strongest argument against promoting green generation for purely job reasons, however, is shown

in Figure 1. Each bar shows the net job gain for any option, after reducing each estimate by the average 9.78 jobs per million dollars for the U.S. economy, as provided by U.S. Bureau of Economic Analysis data. When governments provide additional incentives (subsidies) or funds to expand more expensive conventional or renewable electricity generation, resources need to shift away from other sectors in the economy. On average, a decline in these sectors will lose 9.78 jobs for every million dollars. Electricity generation across all sources creates far fewer jobs than other activities in the economy; the estimates in the figure suggest that they range between 17-67 percent of the average job-creation in the economy. These net job losses mean that subsidies to either green or conventional sources will detract rather than expand the economy's job base, because they will shift investments from other sectors that will create more employment.

It might be possible to expand clean electric generation without immediately losing jobs elsewhere, because the economy is currently in a recession. Even these investments, however, require governments to borrow funds today and repay these loans to institutions or foreign governments in the future. The shift in resources occurs over time rather than across sectors in today's economy. For these situations, the government foregoes the opportunities to invest in other industries, such as roads, infrastructure, or health care. Figure 2 repeats the same calculations as those for Figure 1, but assumes that the lost jobs appear in the construction industry (losing 12.06 rather than 9.78 jobs per million dollars). Estimates based upon the health care and social insurance sector (15.51 jobs per million dollars) would require even larger losses; those relative to transit and ground passenger transportation (22.27 jobs per million dollars) would be substantially higher.

Figure 1
Net Job Creation (Destruction) Relative to All Industries
(Jobs per million dollars)

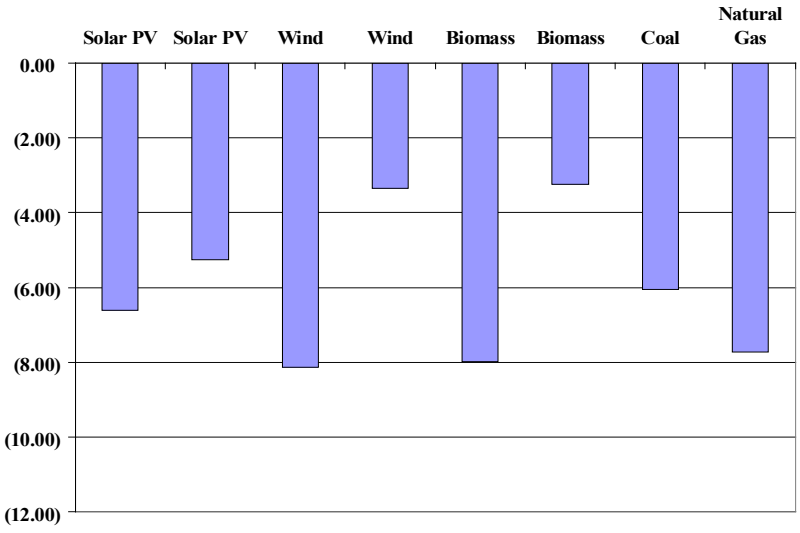
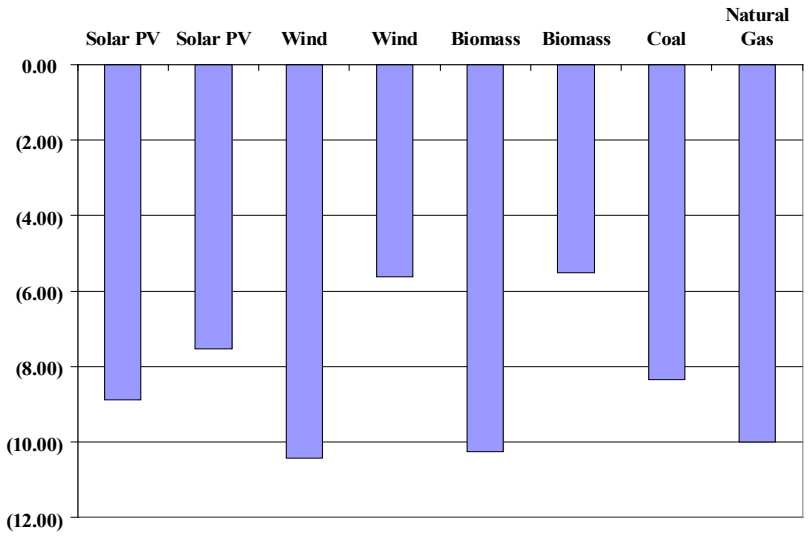


Figure 2
Net Job Creation (Destruction) Relative to Construction Industry
(Jobs per million dollars)



There are other reasons to be skeptical of the job-creation claims. The aggregate job gain reveals nothing about the quality of employment opportunities for each option. A useful example is to compare the relative jobs creation in the chemical and fast food industries. The same U.S. data for deriving the economy-wide impact above reveal that the chemical industry and fast foods industries have about 4 and 31 jobs, respectively, for each million dollars of value added. By implication, shifting a million dollars away from chemicals and towards fast foods would create an additional 27 jobs. How many American citizens would voluntarily leave Dow Chemical to work for McDonald's? Although fast foods employ many more people, the industry pays these employees considerably less because their productivity is substantially lower.

Conclusion

Green power sources are an attractive energy option when their costs are reasonable and the facility is located conveniently to the electric power grid. Under these conditions, it will replace carbon-based fossil fuels and vulnerable petroleum and natural gas supplies on a cost-effective basis.

Green power, however, does not appear to be a game changer on the job front. When job creation is com-

pared to the cost of each power source option, green jobs are sometimes more and sometimes less than conventional energy jobs. More importantly, strategies that subsidize these investments will be shifting the country's scarce resources from sectors that would create more jobs (as well as economic value). This conclusion applies even for an economy in a deep recession and where policy wants to stimulate employment. Investments in roads, ground transportation and health care are likely to stimulate employment considerably more than green electric power generation. Policymakers and government agencies should look askance at the claimed additional job benefits from green energy.

Instead, policymakers should focus their attention on the full costs of different technologies for generating power, including not only the direct investment and operating costs, but also the costs imposed by pollution, climate change and vulnerability to energy interruptions.

Footnotes

[1] Data limitations force the analysis to exclude energy efficiency investments, which could be more effective than green power development in creating jobs per dollar spent for the less-expensive options.

[2] The Center for Energy Economics (2008) has recently compiled a review of four more recent studies and discussed several problems in their methodology and findings.

[3] Costs are expressed in 2004 U.S. dollars. Metcalf assumed that utilities operating gas-fired facilities paid $6 per million Btu for natural gas, which compares closely with the December 2008 estimate ($6.48) from the U.S. Energy Information Administration's website (2008). He has updated these estimates (Metcalf 2008) but he excluded the solar PV and biomass estimates from his recent analysis.

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