

spotlight

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COSTS OF NUCLEAR V. SOLAR POWER *It's No Contest*

KEY FACTS: • A study by the North Carolina Waste Awareness Network (NC WARN), an anti-nuclear power advocacy group, argues that solar power today is less expensive than nuclear power.

- Media have embraced this study despite its absurd conclusion and its arbitrary use of subsidies in calculating the costs of competing energy sources.

- NC WARN calculates solar power's costs at 35 cents per kWh then drastically lowers it by applying two subsidies (federal and state tax credits).

- Subsidies may reduce *the price to consumers*, but they do not reduce *the cost of generating electricity*. Otherwise, a 100 percent tax credit would make the generation of solar power completely free.

- Even so, NC WARN does not apply subsidies to lower the cost of nuclear power. Therefore, their report unfairly gives solar power the "benefit" of subsidies while denying it to nuclear power.

- The U.S. Energy Information Administration (EIA) estimates that new solar power costs over three times as much as nuclear power. One of NC WARN's own sources acknowledges that solar is not cost competitive and that several studies find solar power to be two to five times as expensive as nuclear.

- NC WARN gives the impression that there is a choice between solar power and nuclear power. This is a fallacy because even if solar power is used, conventional sources of electricity such as nuclear power will still be necessary.

- NC WARN says they are concerned with low-cost and reliable electricity. If true, there should be no reason for them not to promote the lowest-cost electricity sources, such as coal and natural gas.

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a new study on solar and nuclear power in North Carolina has gained significant public attention. The study by the North Carolina Waste Awareness Network (NC WARN), an anti-nuclear power advocacy group, argues that the cost of solar power *today* is less expensive than nuclear power.¹

Note: This report was developed in conjunction with Istituto Bruno Leoni.

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In response to this bold conclusion, *The New York Times* ran an article² highlighting the study, leading the Italian daily *Corriere della sera* to provide broad coverage to it as well.³ The *Times* article was so biased that the editors later provided what amounted to an apology⁴ for its shoddy reporting (*Corriere della sera*, however, did not run any correction). This parroting of NC WARN's absurd conclusions is what created the need for this report.

This report explains why the NC WARN study is deeply flawed and clarifies the obvious: nuclear power is less expensive than solar power.

NC WARN Improperly Applied Subsidies

The most glaring problem with NC WARN's report is its use of subsidies in calculating the costs of electricity. NC WARN treated energy subsidies arbitrarily, including them for solar power to calculate its costs to consumers but at the same time not taking them into account with respect to nuclear power.

By NC WARN's own calculations, solar power costs 35 cents per kilowatt-hour (kWh) without first taking into account subsidies.⁵ NC WARN applied two state and federal subsidies to lower that cost significantly. With the 30 percent federal tax credit and the 35 percent state tax credit for solar power, the cost per kWh is reduced to 15.9 cents per kWh, which makes it less than NC WARN's estimates of the costs of nuclear power (discussed below).⁶

Taking this approach to its logical extreme, a 100 percent tax credit would make the generation of solar power completely free. They ignore the fact that there are still costs for generating solar power or nuclear power regardless of subsidies: subsidies may reduce or even eliminate the price to consumers, but they do not reduce the cost of generating electricity.

It is true that electricity customers may pay less as a result of the subsidies, but that is only in their capacity as electricity customers. They will still pay for those costs as taxpayers through the taxes required to provide those subsidies to solar power providers. This fact may have undesirable wealth-transfer consequences; for example, considering that the well-off usually have larger houses (and larger roofs), the installation of rooftop solar panels (explicitly promoted by NC WARN) is likely to result in a wealth transfer from the poor to the rich.

To be clear, subsidies neither eliminate nor reduce costs; they only *shift* costs. There could perhaps be good reasons for government to mandate cost shifting, but those are matters of politics and have nothing to do with the technical or economic efficiency of different energy sources.

By itself, the use of subsidies in their methodology undermines NC WARN's entire report. Even using their own approach to subsidies, NC WARN do not indicate how subsidies reduce the costs of nuclear power in the same manner as solar power. In the report, they detail the subsidies to nuclear power,⁷ but never explain how those subsidies translate into a lower cost for nuclear power. Therefore, their report unfairly gives solar power the "benefit" of subsidies, but nuclear power does not receive the same benefit.

Furthermore, the subsidies are arbitrarily applied. For example, NC WARN argue that federal research into nuclear power is a subsidy, but they never take into account the research money that goes to solar power.⁸

NC WARN's Nuclear Estimates Are Problematic

The NC WARN report never provides a clear, definitive estimate of the costs for new nuclear power. In their appendix detailing their methodology, they write:

For kWh prices of nuclear generated electricity from 2001-2008, the authors rely on the Cooper (2009) study of nuclear price trends. Nuclear kWh price projections from 2009-2020 are made by applying a 1.67% annual price level increase to the average of Cooper's 2008 projections.⁹

As they write in their report, Mark Cooper from Vermont Law School “concludes that new nuclear plants will produce electricity at costs of 12-20 cents per kilowatt-hour (with a mid-range of 16 cents) at the plant site, before any transmission charges.”¹⁰

In the graphs used in their report, NC WARN inexplicably shows nuclear power to be about 22-23 cents per kWh in 2010. This cost estimate is inconsistent with their *own* stated methodology of applying a 1.67 annual percent level increase to Cooper’s average projection of 16 cents per kWh. In 2010, the cost per kWh should be projected at 16.54 cents per kWh (see Figure 1).

**Figure 1. Projected Costs for Nuclear Power
Based on NC WARN Methodology**

Year	Projected Cost (cents per kWh)	Year	Projected Cost (cents per kWh)
2009	16.27	2015	17.97
2010	16.54	2016	18.27
2011	16.82	2017	18.57
2012	17.10	2018	18.88
2013	17.38	2019	19.20
2014	17.67	2020	19.52

NC WARN’s higher nuclear power numbers may be due to the application of transmission and distribution costs. In their report, they explain, “We further project that nuclear power from new plants would deliver residential electricity at 22 cents per kilowatt-hour and commercial electricity at 18-19 cents per kilowatt-hour, after adding transmission and distribution costs.”¹¹

Adding those costs would be inconsistent, however, with their own expressly stated methodology of calculating nuclear costs.¹² Furthermore, NC WARN offer no explanation as to how they came up with these transmission and distribution estimates. Even more problematic is once again they calculate numbers in an apples-to-oranges manner to favor solar power. They add the transmission and distribution costs when calculating the costs for nuclear power but not for solar power.

NC WARN’s Estimates Are Inconsistent with Reliable Sources

When a report produces very unusual results, as NC WARN’s report has done when comparing solar power with nuclear power, it needs to explain why the methodology used in it is superior to other credible sources. NC WARN failed to do that.

According to the United States Energy Information Administration (EIA), new solar power costs more than three times as much as nuclear power (as seen in Figure 2).¹³ The EIA estimates solar power to be 39.6 cents per kWh, which actually is in the ballpark of NC WARN’s own estimate (35 cents per kWh) before their misapplication of subsidies.¹⁴ EIA estimates nuclear power to be 11.9 cents per kWh¹⁵ while NC WARN apparently estimates it at anywhere from 16 to 22 cents, depending on what section of the report one is reading.¹⁶ NC WARN’s misapplication of subsidies for solar power is what sets its findings at odds with those of reliable sources. It is very surprising that a study that does not produce original estimates but instead relies on existing literature can produce a result so strikingly different from those of virtually all of the existing studies.

Ironically, the Cooper study (which is also opposed to nuclear power) that NC WARN heavily relies on for calculating nuclear costs draws a fatal conclusion for NC WARN’s purposes:

Solar photovoltaics are not cost competitive at present, with several studies finding them two to five times as expensive as nuclear reactors.¹⁷

NC WARN Exaggerated the Capacity Factor of Solar Power

Capacity factor is a measure of how much electricity is actually produced in a given time period compared with what could have been produced if the electricity source were generating electricity 100 percent of the time. For exam-

ple, if a plant could be generating 1,000 megawatt-hours (MWh) over the course of a year if operating at 100 percent but only generates 200 MWh, then the capacity factor is 20 percent.

Solar power has an extremely low capacity factor. According to Progress Energy, the capacity factor of solar power in North Carolina is only 16 percent¹⁸ (in contrast, nuclear power has a capacity factor of 90 percent).¹⁹ As shown in Appendix A, EIA data show that the capacity factor for solar power in the United States is generally below 16 percent.

The average capacity factor for solar power for the five-year period of 2005-2009 was 15.4 percent.²⁰

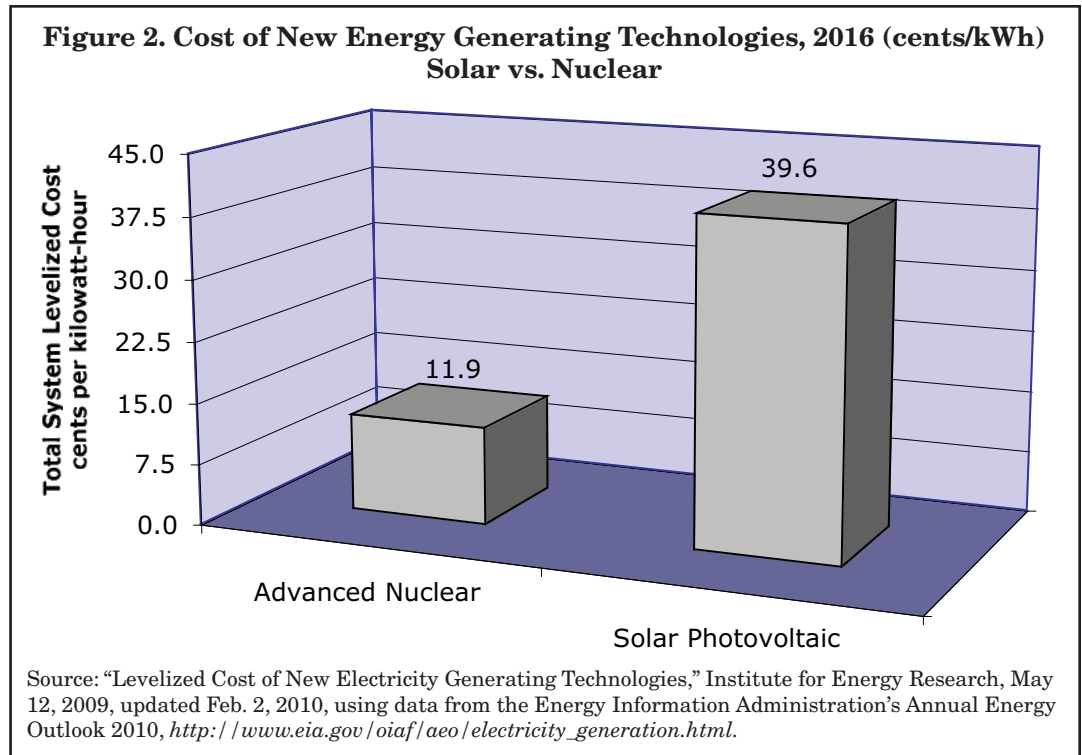
NC WARN, however, assumes a capacity factor of 18 percent for solar power when calculating its costs.²¹ They provide no explanation for their decision to use this higher number. Although that choice may not seem like a big deal, nevertheless, when applying Progress Energy's conservative 16 percent number for capacity factor to the calculations, solar power's cost estimate (without taking into account subsidies) increases from NC WARN's 35 cents per kWh to 39.4 cents per kWh. Coincidentally, the latter is basically the same cost for solar power calculated by the EIA (39.6 cents per kWh).

NC WARN Assumes Utilities Do Not Care About Money

According to NC WARN, solar power is less expensive than nuclear power, but utilities want to hang on to nuclear power and avoid solar power even at their own expense. According to NC WARN, "The state's largest utilities are holding on tenaciously to plans dominated by massive investments in new, risky, and ever-more costly nuclear plants, while they limit or reject offers of more solar electricity."²² They later argue "Duke Energy has turned down a host of competitively priced proposals."²³

If solar power really were less expensive than nuclear power, utility companies would jump at the opportunity to install solar power to the electricity grid. Further, North Carolina's misguided law mandates that utility companies generate 7.5 percent of their electricity from renewable energy.²⁴ Utility companies also are specifically required to generate 0.2 percent of their electricity from solar power.²⁵ To meet those legal requirements, utility companies would not reject the use of solar power but instead would embrace it. The reality is, utility companies do not want to use solar power because *even among renewable energy sources*, solar power is by far the most expensive source of electricity and not remotely competitive (see Figure 3).²⁶

Solar power will succeed only when it will be able to meet some specific need that the market will be willing to reward. NC WARN themselves seem to realize this when they claim that "the trend cost decline in solar technology



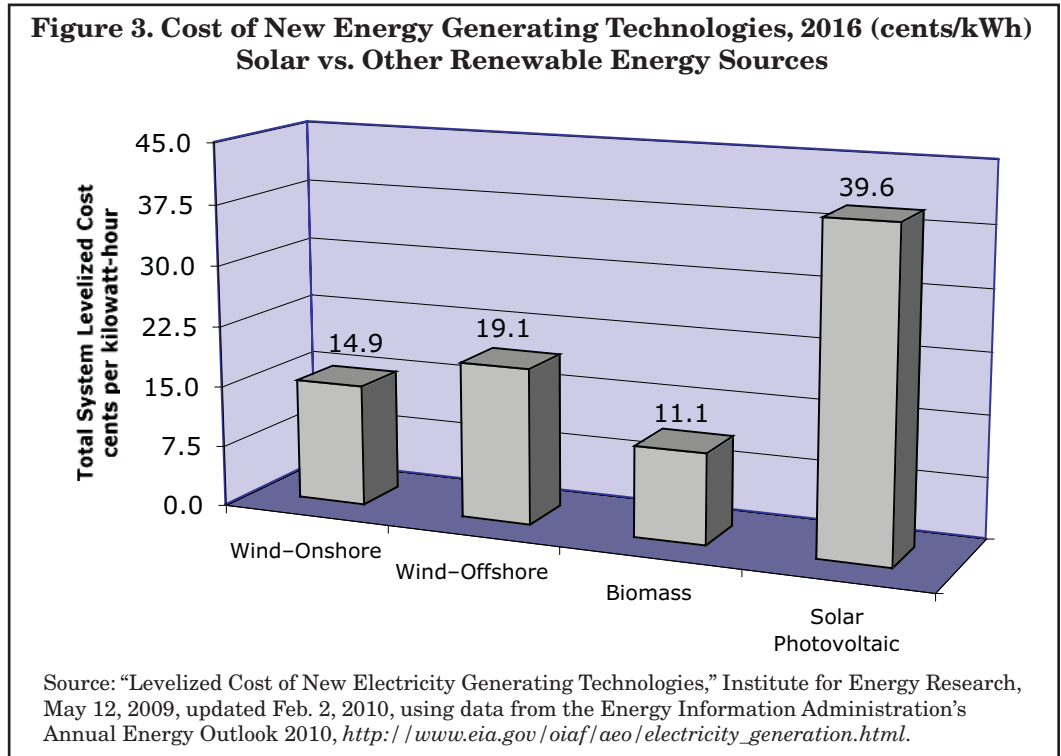
has been so great that solar electricity is fully expected to be cost-competitive *without subsidies* within the decade.²⁷ If that is true, why should the public pay extra costs to install solar photovoltaic panels with an average life expectancy of 25 years, if we supposedly *already know* that solar power will be cheaper a few years from now? Such a question is neither answered nor even considered in their study.

NC WARN Implies Solar and Nuclear Power Are Interchangeable

NC WARN gives the impression that there is a choice between solar power and nuclear power. That is a fallacy because regardless of whether solar power is used, there will still be a need for conventional sources of electricity such as nuclear power.

Solar power, like wind power, is an intermittent and unpredictable source of energy. The sun does not always shine. Solar power often cannot generate electricity (for example, at night or on cloudy days). And the sun sometimes shines when there is not much demand for electricity.

Because solar power is unreliable, it cannot be a source for baseload generation of electricity (the electricity needed to meet regular demand). Because the sun cannot shine on demand, it cannot be an energy source to meet peak demand for electricity (even if peak load is likely to occur around noon). As a result, solar energy is far less valuable than conventional sources of electricity.



NC WARN Say They Care About Costs, But Do They?

The NC WARN report properly explains:

State law requires that the development of the electricity system follow a "least cost" path and that available resources be available as necessary. Less expensive resources are to be added first, then followed by more expensive ones, provided that system reliability is maintained.²⁸

Although North Carolina's renewable energy mandates suggest otherwise, electricity policy in North Carolina is still supposed to be governed by developing low-cost, reliable electricity. That is another reason why high-cost solar power should not be forced into the state's electricity mix.

Nevertheless, the North Carolina legislature forced utility companies to generate renewable energy against their will (and long-time direction from the state) because renewable energy is not cost-competitive or reliable; if it were, there would have been no need for the renewable-energy mandate because utility companies would have voluntarily moved to renewable energy sources.

Since NC WARN express concern for low-cost and reliable electricity, but certainly oppose nuclear power, there should be no reason for them not to promote the lowest-cost electricity sources, such as coal and natural gas (see Figure 4).²⁹ If, however, NC WARN does not advocate for those sources, then one must conclude that their stated concern about low-cost and reliable electricity is a façade.

Conclusion

The public and policy-makers need accurate and reliable information about energy costs. They are not well served by extreme and unsupported claims made by anti-nuclear power advocacy groups.

It would be fair to say that there are questions regarding the cost of nuclear power, but they do not diminish the critical importance of nuclear energy and certainly do not change the fact that nuclear power is far less expensive and more reliable than solar power.

Policymakers should not try to pick winners and losers among various technologies. Maybe some day solar power will be cost competitive with nuclear power and have real value for electricity customers. Until that day, however, policymakers should not force solar power into the electricity mix at the expense of low-cost and reliable electricity.

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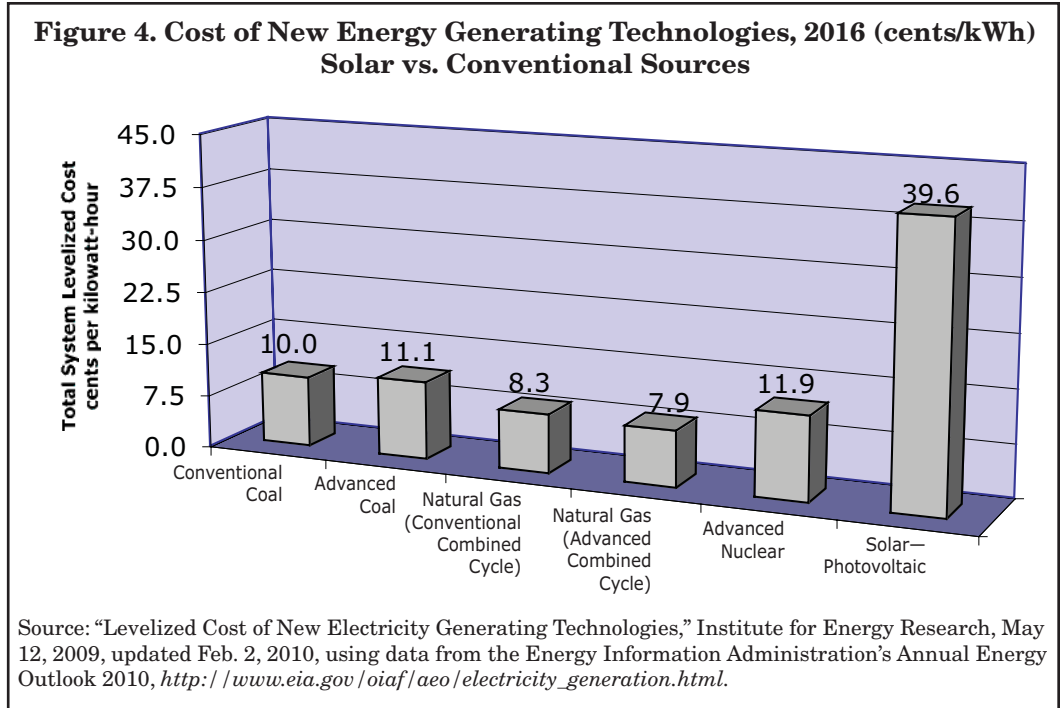


Figure 5. Installed photovoltaic capacity and production in the US.³⁰

	2005	2006	2007	2008	2009
Net Summer Capacity [MW]	411	411	502	536	603
Production [MWh]	550294	507706	611793	864315	807988
Working hours [h]	1339	1235	1219	1612	1340
Capacity factor [%]	15.3	14.1	13.9	18.4	15.3

End Notes

1. John O. Blackburn and Sam Cunningham, “Solar and Nuclear Costs – The Historic Crossover,” NC WARN: North Carolina Waste Awareness & Reduction Network, July 2010.
2. Powers, Diana S, “Nuclear energy loses cost advantage,” *The New York Times*, July 26, 2010, www.nytimes.com/2010/07/27/business/global/27iht-renuke.html.
3. “Il solare costa meno del nucleare,” *Corriere Della Sera*. July 27, 2010, www.corriere.it/scienze_e_tecnologie/energia_e_ambiente/10_luglio_27_solare-costi-nucleare_6c3ac74a-998b-11df-882f-00144f02aabe.shtml.
4. *Op. cit.*, note 2, from *The New York Times*, posted in response to the article:

Editors' Note: August 3, 2010

An article published July 27 in an *Energy Special Report* analyzed the costs of nuclear energy production. It quoted a study that found that electricity from solar photovoltaic systems could now be produced less expensively than electricity from new nuclear power plants.

In raising several questions about this issue and the economics of nuclear power, the article failed to point out, as it should have, that the study was prepared for an environmental advocacy group, which, according to its Web site, is committed to "tackling the accelerating crisis posed by climate change — along with the various risks of nuclear power." The article also failed to take account of other studies that have come to contrasting conclusions, or to include in the mix of authorities quoted any who elaborated on differing analyses of the economics of energy production.

Although the article did quote extensively from the Web site of the Nuclear Energy Institute, an industry group, representatives of the institute were not given an opportunity to respond to the claims of the study. This further contributed to an imbalance in the presentation of this issue.

5. *Op. cit.*, note 1, p. 18.
6. *Ibid.*
7. *Ibid.*, pages 11-13. One of the authors spoke with NC WARN about the application of subsidies to the cost of nuclear power, and they acknowledged that most of the nuclear power subsidies discussed in the report were not taken into consideration.
8. *Ibid.*, p. 12.
9. *Ibid.*, Appendix A: Methodology.
10. *Ibid.*, p. 8.
11. *Ibid.*, p. 9.
12. *Op. cit.*, note 9.
13. "Levelized Cost of New Electricity Generating Technologies," Institute for Energy Research, May 12, 2009, updated Feb. 2, 2010, using data from the Energy Information Administration's Annual Energy Outlook 2010, www.eia.gov/oiad/aef/electricity_generation.html.
14. *Ibid.*
15. *Ibid.*
16. *Ibid.*, p. 8-9.
17. Mark Cooper, "The Economics of Nuclear Reactors: Renaissance or Relapse?," Institute for Energy and the Environment, Vermont Law School, June 2009, p. 43.
18. David Ranii, "WARN: solar power costs less than nuclear," *The News & Observer*, July 9, 2010, www.newsobserver.com/2010/07/09/571948/warn-solar-power-costs-less-than.html.
19. Data taken from the following charts, published by the EIA: "Nuclear Power: 12 percent of America's Generating Capacity, 20 percent of the Electricity" Energy Information Administration (EIA), United States Department of Energy, www.eia.doe.gov/cneaf/nuclear/page/analysis/nuclearpower.html; "Average Capacity Factors by Energy Source", Energy Information Administration (EIA), United States Department of Energy, www.eia.doe.gov/cneaf/electricity/epa/epat5p2.html; "Electric Power Annual", Energy Information Administration (EIA), United States Department of Energy, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html
20. *Ibid.*
21. *Op. cit.*, note 1, p. 14 (endnote 6).
22. NC WARN, "Solar and Nuclear Costs – The Historic Crossover," page 4.
23. *Ibid.*, p. 10.
24. North Carolina Senate Bill 3 (2007), S.L. 2007-397, www.ncga.state.nc.us/gascripts/BillLookup/BillLookup.pl?Session=2007&BillID=sb+3&submitButton=Go.
25. *Ibid.*, Section 2.(a) of the bill that added § 62-133.7.(d).
26. *Op. cit.*, note 13.
27. *Op. cit.*, note 23.
28. *Ibid.*
29. *Op. cit.*, note 13.
30. "Electricity Net Generation From Renewable Energy by Energy Use Sector and Energy Source," Energy Information Administration (EIA), United States Department of Energy, www.eia.doe.gov/cneaf/solar.renewables/page/table3.html; "U.S. Electric Net Summer Capacity," Energy Information Administration (EIA), United States Department of Energy, www.eia.doe.gov/cneaf/solar.renewables/page/table4.html. Calculations can be made by either of the following formulas:

$$\text{Average Capacity Factor} = \frac{\text{Working Hours}}{\text{Total Number of Hours in the Year (8760)}}$$

–OR–

$$\text{Average Capacity Factor} = \frac{\text{Net Generation}}{[(\text{Net Summer Capacity}) * (\text{Number of Hours in the Year})] * 100}$$