

October 4, 2012

WNY Peace Center's Niagara Falls Gigantic Solar Array Project:

Peaceful & Profitable Uses for the Niagara Falls Air Station

With the wars slowly winding down, the need to reduce defense spending is widely recognized, but we're understandably loath to put the Niagara Falls Air Station (NFAS) on the chopping block. In his Aug 9 speech at NFAS Defense Secretary Leon Panetta said he is committed to keeping the base open while ominously adding the final decision rests in the hands of the base closing commission (1). This is the second time in 7 years NFAS has been threatened by Pentagon budget cutters.

New jobs are needed in Niagara Falls and we should begin thinking outside the military box about how to do that: the jobs need to be good paying, long lasting and the Buffalo-Niagara region needs to do its part in reducing the need to burn fossil fuels for electricity.

Towards these ends, the WNY Peace Center proposes the construction of two gigantic solar arrays: one at the Niagara Falls air base and the other on top of the Lewiston Pump Storage Reservoir. The combined output of both arrays could power 195,000 homes (2) in Western NY and increase the clean energy output of Niagara Falls by 50%, and increase the current U.S. solar electrical generating capacity by 34% (3). Both utility-sized arrays would need maintenance and that employment ranges between 220 and 1,000 -- excellent paying (ave. \$60,000) (4), never-going-away jobs. On-site construction jobs lasting several years total 6,180 (5). Annual income from both arrays would range between \$574 - \$656 million, dwarfing current Pentagon expenditures -- \$170 million -- at the Niagara Falls Air Station (6).

The combined cost to build both arrays is \$4.62 billion (7). Where could the money come from? The choices are federal, state, private, and foreign, or some combination of the four. (a) If we could stop the war spending in Afghanistan for 15 days...(8) (b) The feds could borrow the money and pay \$208 million in interest annually, just a tad more than current Pentagon expenditures (i.e., total economic impact) at NFAS. In effect, the money now being spent to support military operations at Niagara Falls Air Base could pay the interest on borrowed \$4.62 billion to build the solar arrays (6,9). (c) NY State could temporarily cease returning the stock transfer tax to Wall Street firms. Our state collects this tax when shares of stock are sold and bought on Wall Street. In 2011 the state collected and returned in its entirety \$13.8 billion to Wall Street (10). If NY State retained 88 trading-days worth, construction of both solar arrays could be funded without borrowing a dime. Alternatively, the state could pay the annual interest on borrowed \$4.62 billion by keeping 4 days worth of the stock transfer tax every year. (d) We

need to encourage private investment in renewable energy and the well-tested vehicle for that is a feed-in tariff (FIT). Governor Cuomo could make FIT law by the stroke of his pen unleashing private money for both solar arrays. Investors would be guaranteed an excellent return, about 7% profit. The extra electricity costs to NY State households would be about 1 Dunkin Donut per week, or 1/3 of a pack of cigarettes per month (6,11).

And finally, the fine folks at NFAS who lose their jobs as a result of the inevitable Pentagon cutbacks should be given first preference for construction and long term jobs at both solar arrays.

Renewable energy offers plentiful, well-paying, never-goning-away, peaceful jobs. Let us begin...

A copy of this essay with supporting documentation is available at: www.WNYPeace.org

Charley Bowman
Interim Executive Director
WNY Peace Center, Inc.
1272 Delaware Ave
Buffalo NY 14209
716-332-3904 (office)
716-908-8227 (my cell)

Notes

TW = 1 tera Watts (10^{12})

MW = 1 million Watts (10^6)

kW = 1,000 Watts

kWh = 1,000 Watt - hoursa measure of energy

kWh/year = 1,000 Watt - hours per yearamount of energy produced in one year

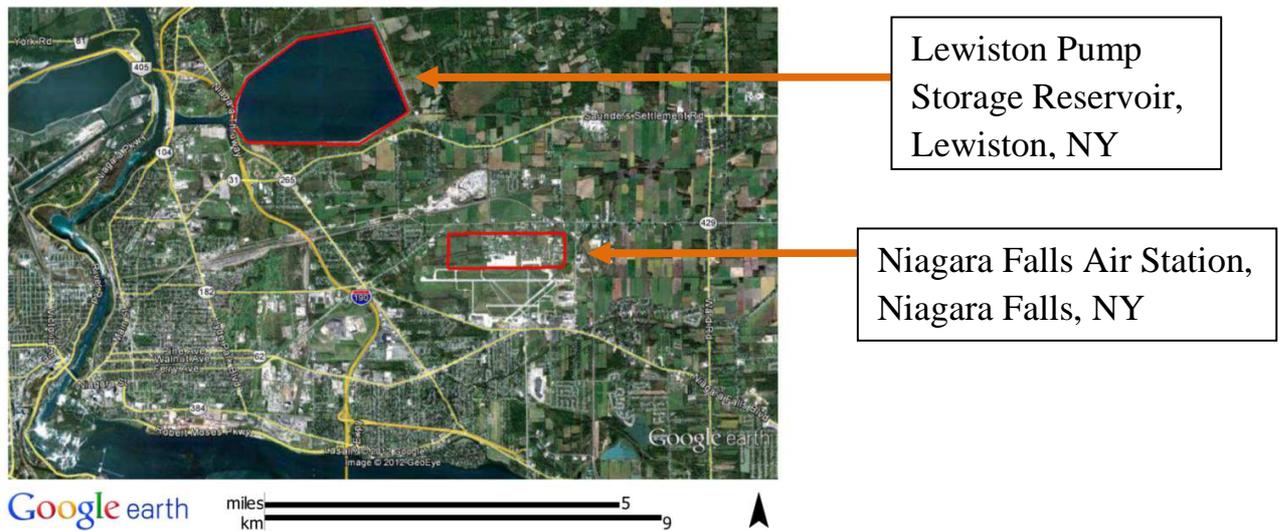
1 MWh/year = 1 million Watt hours per year

DC = Direct Current; solar panels make this kind of electricity

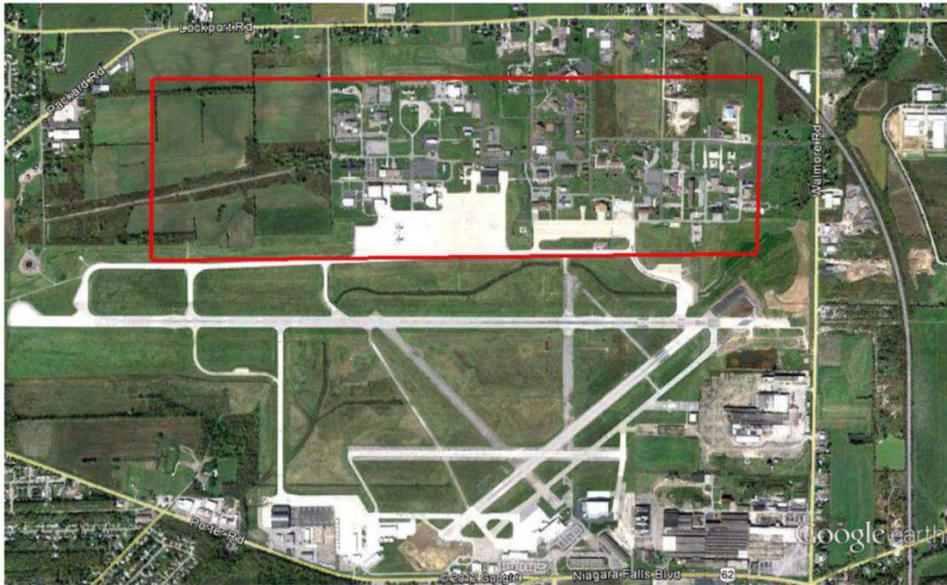
AC = Alternating Current, the kind of electricity that runs your refrigerator, etc.

NFAS = Niagara Falls Air Station

Niagara Falls Solar Array Project



Niagara Falls Air Station



Array is 2.63 km x
0.767 km (494 acres)

283,000 kW

0.338 TWh/year

Google earth

miles 1
km 2



Lewiston Pump Storage Reservoir



1,902 acres

1,090,000 kW

1,302,000,000 kWh/year

1.302 TWh/year

Google earth

miles 2
km 4



General Assumptions Common to Both Solar Arrays:

80% of the available area covered by solar panels

Solar array tilted southward at 43 degrees

Solar Irradiation: 0.177 kW/meter² (see below for calculation)

Solar panels make direct current and this has to be converted to AC. Conversion efficiency is 0.77 (23% loss)

Average daily solar radiation in the Buffalo-Niagara region is 4.25 kWh/meter²/ day, determined using the PVWatts software (version 2) available from the National Renewable Energy Laboratory.

Available solar radiation in the Buffalo-Niagara Region is 4.25 kWh/meter²/day x 1 day/24 hours = 0.177 kW/meter²

Average number of hours of sunshine per day in the Buffalo-Niagara Region: 4.25 hours

Lewiston Pump Storage Reservoir:

Total Area: 7.7 million square meters (1,902 acres) (determined using Google Earth and integrating)

80% of the total area x 0.177 kW/meters² x 7.7 x 10⁶ meters² = 1,090,000 kW generated at high noon at the Lewiston Pump Storage Reservoir

Total annual output of Lewiston Pump Storage Reservoir Solar Array: 1,090,000 kW x 4.25 sun-hours per day x 365 days/year x 0.77 = 1,302,000,000 kWh/year, or 1,302,000 MWh/year, or 1.302 TWh/year

Niagara Falls Air Station:

Total Area: 2 million square meters, or 494 acres (determined using Google Earth)

80% of the total area x 0.177 kW/meters² x 2 x 10⁶ meters² = 283,000 kW generated at high noon.

Total annual output of Niagara Falls Air Station: 283,000 kW x 4.25 sun-hours/day x 365 days/year x 0.77 = 338,032,000 kWh/year, or 338,032 MWh/year, or 0.338 TWh/year

Total annual energy output from both solar arrays: 1.302 TWh/year + 0.338 TWh/year = 1.64 tera Wh/year, or 1.64 x 10¹² Wh/year

References and Notes

1. Remarks by Defense Secretary Panetta at Niagara Falls Air Reserve Station, August 9, 2012. www.defense.gov/transcripts/transcript.aspx?transcriptid=5098

2. The solar array at NFAS and the Lewiston Pump Storage reservoir would generate 338,032,000 kWh/year and 1,302,000,000 kWh/year, respectively. Average home in Western NY uses 8,400 kWh/year. So, $1,640,000,000 \text{ kWh/year} / 8,400 \text{ kWh/year/home} = 195,000$ homes

3. The Robert Moses Plant currently generates 2,525 MW and the Lewiston Pump Storage Reservoir, 240 MW; totaling 2,765 MW.

http://en.wikipedia.org/wiki/Robert_Moses_Niagara_Hydroelectric_Power_Station

The solar arrays would add 283 MW (NFAS) and 1,090 MW (Lewiston Pump Storage Reservoir), totaling 1,373 MW.

$1,373 \text{ MW} / (2,765 \text{ MW}) \times 100 = 50\%$.

Total peak electrical power from both solar arrays: $1,090,000 \text{ kW} + 283,000 \text{ kW} = 1,373,000 \text{ kW}$. The proposed Niagara Falls Solar Array Project would increase current US solar capacity (3,995,000 kW, as of 2011, see www.wind-works.org, August 30, 2012) by 34%.

4. Job estimates come from the Jobs and Economic Development Impact Model (JEDI) available from the National Renewable Energy Laboratory, a part of the U.S. Department of Energy (www.nrel.gov). The JEDI model, called "02D_PV_Model_rel._PV10.17.11", runs an Excel spreadsheet, and is freely available from: http://www.nrel.gov/analysis/jedi/about_jedi.html

JEDI calculates the number of long term jobs needed to maintain/operate the array...there is some disagreement on the Operation and Maintenance costs of utility sized solar arrays and the jobs estimates depend heavily on the O&M number. JEDI says O&M costs run 0.54% of the total installation costs, while others believe that figure runs up to 2.5% of O&M costs, according to renewable energy expert Paul Gipe (so says Buffalo renewable energy expert, Dave Bradley, in an email to me). This uncertainty strongly affects the estimated number of long term jobs at both solar arrays. The WNY Peace Center reports the minimum and maximum job estimates, while taking no position in this debate.

A recent study of maintenance jobs created by the German solar investments over the last 20 years finds that 0.3 maintenance jobs are created per MW installed solar PV (Solar Power Generation in the US: Too Expensive, or a Bargain? by Richard Perez et al. <http://www.asrc.cestm.albany.edu/perez/2011/solval.pdf>). For Niagara Falls Solar Array, there

would be 412 full time jobs, each paying \$70,000. Total job impacts equate to 1.66 jobs/MW, or 2,300 jobs created by the solar investment in Niagara Falls.

From National Renewable Energy Laboratory:

On-site Maintenance Jobs:

NFAS: 45 - 210

Lewiston Pump Storage Reservoir: 175 - 790

Total: 220 - 1,000 Jobs

Local Revenue and supply chain Impacts + Induced Impacts:

Lewiston Pump Storage Reservoir:

NFAS:

Total:

Grand Total:

5. Number of construction jobs:

NFAS on-site construction jobs: 1,270

Lewiston Pump Storage Reservoir on-site construction jobs: 4910

Total on-site construction: 6,180 jobs.

NFAS: construction and installation related jobs:

Lewiston Pump Storage Reservoir: construction and installation related jobs:

Total construction and installation related jobs:

Module and Supply Chain Job Impacts + Induced Job Impact:

NFAS:

Lewiston Pump Storage Reservoir:

Total Module and Supply Chain Job Impacts + Induced Job Impacts:

Grand total number of construction related jobs:

6. The current cost of electricity in NY State and beyond is insufficient to support the building a this solar array. Assuming \$0.11/kWh x (1,302,000,000 kWh/year + 338,032,000 kWh/year) = \$180 million annually, there would be an uninspiring 4% return (before taking maintenance costs) on investment of \$4.6 billion construction costs. It's highly unlikely investors will be found at that rate of return. Salaries for maintenance workers would range between \$25 million and \$115 million. And if salaries are 75% of total maintenance costs, investors would pay an

additional \$19 - \$86 million annually. The final rate of return on investment would fall below 1% . Clearly there's a problem at \$0.11/kWh supporting the array.

This is where a Feed-In-Tariff (FIT) comes to the rescue. A New York State FIT will assure investors in this solar array a guaranteed long term rate of return for each kWh produced. FITs have been well-tested in Europe, Asia and Canada. Investment in renewable energy is exploding in each of these regions as a result.

In Ontario Canada, FIT for utility sized 10 MW solar arrays are about \$0.44/kWh for 20 years (<http://fit.powerauthority.on.ca/quick-facts-table-0>). A FIT for the Niagara Falls gigantic solar arrays -- totaling 1,373 MW -- would likely be less than that due to its huge size. If FIT ranged between \$0.35/kWh and \$0.40/kWh, annual income would range between \$574 million and \$656 million, an inspiring 12.4% - 14.2% return on investment guaranteed for 20 years.

Where would the FIT money come from? New York State households, commercial establishments, industrial and transportation sectors. Combined electricity use in NY State is 170 billion kWh/year, costing NY State users \$24.3 billion annually. NY State electricity cost averages \$0.143/kWh (calculated from Table 5.4.A and Table 5.6.A., Electric Power Monthly, Sept 2012 for July 2012, www.EIA.gov). Electricity rates for each sector in NY State varies: average residential rate is \$0.1857/kWh; commercial rate is \$0.1642/kWh; industrial rate is \$0.0796/kWh; and the transportation rate is \$0.1479/kWh.

To support the proposed FIT for the Niagara Falls Solar Array at \$0.35/kWh -- generating an annual income of \$575 million --- or \$0.40/kWh -- generating an income of \$656 million -- the electrical rates for each New York State sector would increase. The combined rate increase would range between 2.4% - 2.7%: Residential folks would see a \$0.004/kWh - \$0.005/kWh increase (\$2.80 - \$3.51 per month for each household using 700 kWh/month); Commercial enterprises would increase \$0.004/kWh - \$0.005/kWh; Industrial: \$0.00191/kWh - \$0.00215/kWh; Transportation sector:\$ 0.0036/kWh - \$0.00399/kWh increase.

Residential rate payers would pay the equivalent of 1 Dunkin Donut each week to support the gigantic Niagara Falls Solar Array (cost of one Dunkin Donut is \$0.833 when buying a half-dozen). The increased monthly cost would be less than 1/3 of a pack of cigarettes in NY State (1 pack costs about \$11.90).

If investors received \$575 million annually from the array, and they borrowed \$4.6 billion at 4% their rate of return would be an enticing 7.5% after paying 4% on their borrowed money. Of course, the borrower could be the NY State government or a group of private investors.

Even at \$0.11/kWh, the predicted income from the arrays far exceeds the current annual Pentagon expenditures to support Niagara Falls Air Base -- \$168 million -- the total "input to the local economy" (Merrell Lane, Another Voice, Buffalo News, January 26, 2012). \$88 million of

that is in salaries; the rest presumably used to support the 12 C-130s stationed at the base, but that figure seems not to be available.

Let's do an estimate of the non-salary Pentagon spending at NFAS:

At \$15,000 per hour flying cost -- if each C-130 flew 9 hours per week for 52 weeks per year, flying costs would total \$85 million annually

Flying costs for C-130 aircraft are posted at: <http://www.flightglobal.com/blogs/the-dewline/2011/08/exclusive-us-air-force-combat.html>

7. Costs to build both solar arrays: \$3,370/kW_{DC} See "*Cost and Performance Data for Power Generation Technologies*, February 2012. (page 38)....cost estimates to build utility sized solar arrays. Name of document: nrel-cost-report.pdf.

For NFAS: 283,000 kW x \$3371/kW = \$954 million.

Lewiston Pump Storage Reservoir: 1,090,000 kW x \$3371/kW = \$3.67 billion.

(Solar panels would need underwater support structures...I have not estimated the additional costs to build that support; hence, the cost of building the Lewiston project is a minimum.)

Total: \$4.62 billion.

8. FY 2012 Afghan War spending: \$113.7 billion, or \$311 million per day. \$4.62 billion/0.311 billion/day = 15 days. Source:

THE U.S. COST OF THE AFGHAN WAR: FY2002-FY2013 by Anthony H. Cordesman, May 15, 2012. http://csis.org/files/publication/120515_US_Spending_Afghan_War_SIGAR.pdf

9. Feds could borrow \$4.62 billion and pay 4.5% APR, or \$208 million annually.

10. 2010-2011 New York State Tax Collections *Statistical Summaries and Historical Tables*, page 51. The name of the file:

2010_11_annual_statistical_report_of_ny_state_tax_collections.pdf

Available at:

http://www.tax.ny.gov/pdf/stats/stat_fy/2010_11_annual_statistical_report_of_ny_state_tax_collections.pdf

In 2011, NY State returned \$13.8 billion to Wall Street, or \$52.3 million per trading day....there are 264 trading days per year (none on weekends...I have not counted holidays). Hence, \$4.62 billion could be retained by NY State in 88 trading days. NY State has been returning this money to Wall Street since the early 1980's.

I assume 4.5% APR on \$4.62 billion borrowed by NY State, creating annual interest payments of \$208 million. Hence, \$208 million/\$52 million/trading day = 4 days.

11. Feed-in Tariff (FIT). FIT provides for guaranteed access to the grid, long-term contracts for the electricity produced, and purchase prices based on the cost of generation. Many countries now use this. Ontario Canada instituted a FIT in 2009 and now has \$9 billion invested by a consortium of Asian companies to make solar panels and wind turbines in Ontario, using expensive Canadian labor. This investment is a result of FIT. Please note those companies chose to invest in Ontario Ca, not cheap-labor China. We need a similar FIT in NY State and Governor Cuomo could sign it into law, administratively.

More info: http://en.wikipedia.org/wiki/Feed-in_tariff

<http://growwny.org/component/taxonomy/term/summary/284/4>

There is a detailed analysis of feed-in tariffs (FIT): Bill Nowack's *Clean FIT Clean Local Energy Accessible Now – Feed In Tariff: A Program to Unleash Renewable Energy and Create Jobs in New York State*. <http://newyork.sierraclub.org/documents/Clean-fitreport.pdf>

Acknowledgments:

I thank WNY Peace Center member and solar energy expert Walter Simpson for crucial guidance in the early stages of this study. And I thank WNY Peace Center member Lynda Schneekloth -- also of the Sierra Club Niagara Group, for help during later stages. I thank Dave Bradley for his extensive reply to my question about O&M costs of utility-sized solar arrays and Jack Karnack, President Weathermedic, Inc. for insights on the average daily sunshine in the Buffalo-Niagara region.

Any remaining errors are my own.

Charley Bowman
Interim Executive Director
WNY Peace Center, Inc.
1272 Delaware Ave
Buffalo NY 14209
August 23, 2012