PV SOLAR AND WIND POWER IN GERMANY by Willem Post, dated August 11, 2010
http://www.coalitionforenergysolutions.org/

INTRODUCTION
Germany's 10-year experience with renewable energy promotion is often cited as a model to be emulated elsewhere, being based on a combination of far-reaching energy and environmental laws that stretch back nearly two decades. During the past ten years, 2000-2010, generous feed-in tariff, FITs, were used to stimulate the installed capacity of PV solar and wind.

FIT DRIVEN INVESTMENTS
Over the 10-year FIT period, the PV solar power subsidies may total 53 billion Euros ($73.2 billion) for systems installed between 2000 and 2010.
Over the 10-year FIT period, the wind power subsidies may total 20.3 billion Euros ($28.1 billion) for wind turbines installed between 2000 and 2010.

By the end of 2009 the FITs led to Germany having 9,830 MW of PV solar, ahead of Spain 3,520 MW, Japan 2,633 MW, the US 1,650 MW, and Italy 1,167 MW and having 25,777 MW of wind, behind the US 35,159 MW.

http://en.wikipedia.org/wiki/Solar_power
http://en.wikipedia.org/wiki/Wind_power_in_the_United_States
http://en.wikipedia.org/wiki/Wind_power_in_Germany
http://1bog.org/top-10-countries-using-solar-power/
http://en.wikipedia.org/wiki/Wind_power

FIT DRIVEN PRODUCTION
However, installed capacity is not the same as power production. In 2008, Germany's power production was 611.9 TWh, of which about 40.4 TWh, or 6.6%, was from wind, about 22 TWh, or 3.6%, was from biomass (mostly wood), about 21 TWh, or 3.4%, was from hydro, and about 4.5 TWh, or 0.7%, was from PV solar. In 2009 the PV solar production was about 7.1 TWh, or 1.1%.

The German experience shows the economics of utility-size wind and PV solar power are such that utility-size wind provides about 6 times the power of PV solar for less than one third the subsidies spent on PV solar. Go Solar?

Whereas PV solar is the most subsidized renewable energy, it is nowhere near ready for "prime time"; it produces too little power per dollar invested.
Vermont, a poor state, should take note of these numbers before trying to emulate Germany, a rich state.

http://www.euronuclear.org/info/encyclopedia/p/pow-gen-ger.htm
http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=2&pid=2&aid=12
http://www.dw-world.de/dw/article/0,,4110890,00.html
http://www.spiegel.de/international/world/0,1518,605957,00.html
http://www.guardian.co.uk/environment/georgemonbiot/2010/mar/11/solar-power-germany-feed-in-tariff
http://online.wsj.com/article/SB125193815050081615.html

NATIONS WITH HIGH WIND POWER PERCENTAGES
At the end of 2009 the ten nations with the highest installed wind power were the US 35,159 MW, Germany 25,777 MW, China 25,104 MW, Spain 19,149 MW
India 10,925, Italy 4,850 MW, France 4,410 MW, The UK 4,070 MW, Portugal 3,535 MW and Denmark 3,465 MW.

Nations with high wind power production percentages are Spain (12% of production), Portugal (15.2%) and Denmark (21% of which 9% is consumed by Denmark, 12% is exported to Sweden and Norway for smoothing by their hydro plants for a fee. In Denmark the power output, on/off status, and many other operating data of each and every wind turbine are monitored from a single command center to control power output and its variation and to schedule maintenance).

The reason these high percentages work for these nations is that a sufficient capacity of quick-responding pumped storage hydro plants are available to economically smooth their wind power. Spain and Portugal are also using quick-responding combined cycle gas turbine, CCGT, plants to smooth their wind power.
CCGT plants are up to 60% efficient vs about 30% efficient for a coal plant, and emit 0.5 lb CO2/kWh vs 2.0 lb/kWh for a coal plant.
CCGT plants can vary their output without damage at about 4%/min and hydro plants at about 100%/min to smooth variable, intermittent wind power.

Portugal's 2009 power production is from gas 38.6%, coal 21.4%, hydro 17.1%, wind 15.2%, and other renewables 6.4%
Pumped storage hydro plants tied in with wind farms is by far the lowest cost renewable power arrangement, as proven by Denmark, Spain and Portugal during the past 10 years.

Germany's power plant capacity is about 133,000 MW. Germany's electric power grid is strongly connected to nearby grids. It is designed as they do their cars, etc., unlike the grid of the US which is a state-by-state patchwork of public-private grids. As a result Germany can handle 6.6% of variable, intermittent wind power AND have one of the lowest outage rates in the world. Germany has insufficient hydro plants and relies mostly on CCGT plants and a well-designed electric power grid to smooth its wind power.
Vermont, a poor state, should take note of the practices of other nations.

http://en.wikipedia.org/wiki/Wind_power
http://www.aeeolica.es/userfiles/file/notas-de-prensa/100105-NP-Wind-Energy-has-consolidated-as-the-third-technology-of-the-power-system.pdf

GERMANY'S WIND AND PV SOLAR A SUCCESS?
Germany's wind and PV solar programs are a success for vendors, developers, etc., but from a power production viewpoint, the production results are dismal, especially for PV solar. The definition of renewables success is not installed capacity, but competitive power production.

Germany, realizing the huge investment in PV solar and the small quantity of variable, intermittent and expensive power from it, decided to significantly reduce its PV solar FITs.

Spain is much more favorable for concentrated solar power, CSP, and PV solar power than Germany and Vermont. In 2009, the combined production of CSP and PV solar was 2.8% of Spain's total production. Spain, a poor state relative to Germany and with significant budget problems, followed Germany's lead by significantly reducing its FITs for PV solar.

The above indicates Germany's renewable energy policy and the FIT scheme have failed to ensure a viable and cost-effective introduction of renewables energies into the German energy portfolio.

http://www.rwi-essen.de/pls/portal30/docs/FOLDER/PUBLIKATIONEN/GUTACHTEN/P_RENEWABLE+ENERGY+REPORT+RWI+FORMAT.PDF
http://en.wikipedia.org/wiki/Solar_power_in_Germany

SHOULD VERMONT EMULATE GERMANY?
Renewables proponents claim Germany's wind and PV solar programs are a success. Solar proponents say that if solar is a "success" in Germany, Vermont with so much better sun should emulate Germany. In fact both are marginal for PV solar. The PV solar capacity factor in Southern Germany is about 0.120 vs 0.143 in Vermont. Northern Germany, too cloudy for PV and thermal solar, is more favorable for wind power, especially near and on the Baltic Sea.

Example of a recently installed small PV solar system:
A 58 kW DC, fixed-tilt, PV solar system located in a meadow, all-in owner cost $450,000, or $7,759/kW, for Farmway, Bradford, VT, supplied by groSolar, White River Junction, VT.
Farmway records show it produced 72,050 kWh during the 12 month period March 2009-February 2010.
Capacity Factor = 72,050 kWh/yr/(58 kW DC x 8,760 hr/yr) = 0.1418; the lower CF may be due to the panels having some dust and/or snow on them.
Efficiency = 72,050 kWh/yr/(58 kW DC x 4.3 avg peak sun hrs/d x 365 d/yr) = 0.79
Farmway could have purchased the 72,050 kWh for about $8,646, adjusted simple payback = {(72,050 kWh/yr x $0.12/kWh x 1.25)/$450,000} x 100% = 2.40%/yr.
The Clean Energy Development Fund, CEDF, provided a $226,000 taxpayer/ratepayer funded grant to help this "poor" business owner make expensive power.
http://view2.fatspaniel.net/PV2Web/merge?&view=PV/standard/Simple&eid=222370

Whereas Germany is a rich state that can afford to waste money on expensive renewables that produce just a little of variable, intermittent and expensive power, Vermont is a poor state struggling with multi-year deficits and cannot afford to emulate Germany by wasting its scarce resources on expensive renewables.
Vermonters would be better served if Vermont's economy became more efficient by investing its scarce resources in energy efficiency projects that have 1-5 year payback periods.

RENEWABLES JOB CREATION IN VERMONT
According to a December 2009 VT-DPS white paper, about 35% of the $228 million to build 50 MW of expensive renewables that produce just a little of expensive power would be supplied by

Vermont sources, the rest by non-Vermont sources which creates jobs elsewhere. For example: PV panels from China and inverters from Germany are about 70% of a PV system's materials cost which cretes jobs in China and Germany.

According to the white paper, there would be spike of job creation during the 1-3 year construction stage (good for vendors) which would flatten to a permanent net gain of 13 full-time jobs (jobs are lost in other economic sectors) during the operation and maintenance stage. In essence jobs are created in one sector (renewables) of the Vermont economy at the expense other sectors.

It appears following the lead of Germany and using scarce ratepayer/taxpayer funds for renewables that are expensive and produce just a little of variable, intermittent and expensive power, while good for vendors and developers, is NOT the jobs creation panacea so much talked about by proponents of renewables.

Using the $228 million for energy efficiency would create many more jobs than renewables, raise more tax revenues and yield more CO2 reductions than spending it on 50 MW of expensive renewables that mostly benefits a few vendors and a few lottery-winning millionaires at the expense of Vermont's ratepayers. Energy efficiency costs about 5 times less per energy unit saved, saves far more money per dollar spent, and reduces 3 times the CO2 per energy unit saved, AND creates far more jobs per dollar spent. It is a no-brainer! See below.

http://publicservice.vermont.gov/planning/DPS%20White%20Paper%20Feed%20in%20Tariff.pdf

ENERGY EFFICIENCY FIRST, THEN RENEWABLES
It is far less costly to use subsidies to increase energy efficiency and abate CO2 than using the same money for expensive renewables that produce just a little variable, intermittent and expensive power. In case of solar and wind that power is intermittent, variable, and seasonal. Because insufficient storage capacity exists on the grid and because efficient storage systems still need to be developed, PV solar and wind power cannot be stored and is not a reliable, dispatchable power source most of the time. Therefore, steady, 24/7/365 power sources, plus idle standby plants, plus increased capacity spinning standby plants are needed to provide power when variable, intermittent PV solar and wind power is absent and/or insufficient during periods of no wind, too little wind, too much wind, at night, and on cloudy days.

Many of the industrially advanced nations, our competitors, use much less energy per dollar of GDP, more than 50% less in case of Japan, an industrial powerhouse, and Denmark. When energy prices were low that difference did not matter. With rising energy prices, that difference does matter. Currently, it is about $250 billion/yr in extra energy cost which makes products and services more expensive and the US less competitive. These nations performed much greater energy efficiency efforts after the oil price shock of 1973 than the US. For the US to become more competitive, reduce its trade and budget deficits and borrow less from foreigners (Greenspan: "We are in danger of becoming the next Greece"), it needs to use its SCARCE resources to quickly catch up and lower its energy use at least 30% per dollar of GDP BEFORE going into expensive renewables.

This will have all sorts of benefits: less need for exploration, production, distribution and use of fuels, less pollution, better health, more output from healthier workers, less need for existing dirty power plants, less need for new power plants, less need for unsightly transmission systems, unsightly wind farms, unsightly PV solar panels in meadows and on roof tops, etc., AND the future capacities of any renewables systems and their capital costs would need to be much less. Becoming more energy efficient has a major impact AND it is less costly. Doing energy efficiency before renewables is a no-brainer.

http://green.blogs.nytimes.com/2010/07/06/for-a-premier-lab-a-zero-energy-showcase/?ref=business
http://www.treehugger.com/files/2010/07/energy-efficiency-twice-the-impact-of-renewables-nuclear-clean-coal-combined.php?campaign=th_

Proponents of renewables, afraid politicians might shift their subsidies to energy efficiency, often claim the US should do both at the same time. However, there is no money to do both at the same time. It is best to spend scarce money on energy efficiency where it gets the biggest bang for the buck.

Vermont's CO2 emissions are 71% from buildings and transportation. It is Vermont's buildings and transportation that should become more energy efficient and emit less CO2. Vermont needs "Cash for Caulkers and Insulators" and "Cash for Clunkers". For example: to get a subsidy one must scrap any car that gets less than 20 mpg and replace it with a new one that gets 33 mpg or more; the latter mpg rising as higher mileage cars become available.

Example of Residential Energy Efficiency:
Recently, I built an R-40 addition to my house. The southwest-facing room has a 6'w x 6'-10"h slider, a 7'w x 5'h bay window and (2) 3'w x 3'-6"h windows.
While the outside temperature rises from 50F (early morning) to 85F (in the afternoon), the inside temperature rises from 67F to 73F and, by opening some windows, it decreases from 73F to 67F, or lower, during the night; its like having built-in air conditioning for free.

The room is so well sealed and insulated (6 inches foam under the 10,000 lb concrete slab R-30, 8 inches in the walls R-40, and 10 inches in the ceiling R-50) that the warm air cannot infiltrate into the walls to warm them up, as happens in almost all houses, AND the heat cannot get through the insulation. During summer days any heat gain by the room is so small that the concrete slab easily absorbs it by warming up a few degrees. During winter days any heat loss will be so small that the concrete slab easily provides it by cooling down a few degrees. During a prolonged cold spell and no sun, a 0.5 kW electric heater will be sufficient to keep the room at 65F when the outside temperature is 0F or less.

All Vermonters should have such energy efficient housing. It can be done with proper subsidies. It would create jobs, reduce energy use and CO2 emissions far more than installing renewables systems all over the state. It would be NON-POLLUTING and INVISIBLE; no unsightly wind turbines on ridge lines, no unsightly solar panels in meadows and on roof tops and no unsightly additional transmission systems. It would greatly improve Vermont's CO2 profile at a much lower cost than installing renewables.

Example of Residential Energy Efficiency:
Gaye Symington, who owns a 120-yr old poorly-insulated, drafty house in Vermont, spent $12,000 to have a contractor insulate and caulk her house. She reduced her No. 2 fuel consumption from 1,800 gal/yr to 900 gal/yr, for a saving of $2,700/yr, at $3/gal. She wrote about her project in the Valley News. Adjusted simple payback = {($2,700/yr)/$12,000} x 100% x 1.25 = 28.1%/yr. The CO2 abatement cost per ton is $12,000/(900 gal/yr x 22.4 lb CO2/gal x 1 lb/2,000 lb) = $1,190/ton of CO2/yr.

Comparison of Gaye Symington's project with the dismal results of the Vermont Small Scale Renewables Program:
Vermont consumes about 6,000,000,000 kWh/yr and the small scale renewables required a capital cost of $25,676,383 over 6.5 years, or an average of $3.95 million/yr, to produce about 9,099,600 kWh/yr, or 0.15% of Vermont's annual power consumption. If ratepayers had bought this power from the utility, it would have cost 9,099,600 kWh/yr x $0.12/kWh = $1,091,952/yr. Average adjusted simple payback of small scale renewables = {($1,091,952/yr)/$25,676,383} x 100% x 1.25 = 5.3%/yr, one sixth the simple payback of Gaye Symington's project.

The average greenhouse gas emission of all power sources of the ISO-NE grid is about 1.5 lb CO2/kWh.
The CO2 reduction by the small scale installations = 9,099,600 kWh/yr x 1.5 lb CO2/kWh = 13,649,400 lb CO2/yr.
The CO2 abatement cost = $25,676,383/(13,649,400 CO2/yr x 1 lb/2,000 lb) = $3,762/ton of CO2/yr, three times more costly than Gaye Symington's project.

http://en.wikipedia.org/wiki/File:SolarPowerPlantSerpa.jpg
http://www.rerc-vt.org/incentives/reports.htm
http://www.coalitionforenergysolutions.org/vermont_small_scale_renew1.pdf

Energy efficiency measures
- should be done before renewables, because most have simple paybacks of 20 to100 % per year, or 1 to 5 year payback periods, far greater than renewables.
- should be done before renewables because the capacities and capital costs, etc., would need to be much less as a result of the increased energy efficiency.
- would quickly reduce CO2 AND make Vermont more efficient in many areas which will raise living standards, or prevent them from falling further.
- would reduce energy use and CO2 emissions much quicker than renewables. Significant reductions of CO2 emissions from renewables will be years or even decades away.
- would create 2 to 3 times more jobs than renewables, especially for the building and automotive sectors. No studies, research, demonstration and pilot plants will be required.
- are NON-POLLUTING AND INVISIBLE; no wind turbines on ridge lines, no solar panels in meadows and on rooftops, no additional transmission systems.
- are by far the cleanest energy activity anyone can engage in; they are quick, cheap and easy, reduce CO2 at the LOWEST cost.
- would quickly put money in people's pockets, which quickly they would spend, which quickly would raise taxes, which quickly would balance budgets.

Energy efficiency materials, such as for taping, sealing, caulking, insulation, windows, doors, refrigerators, water heaters, furnaces, fans, air conditioners, etc., used to retrofit buildings and building systems are almost entirely made in the US. They represent about 30% of the cost of an energy efficiency project, the rest is mostly labor. If politicians really want to help create jobs, energy efficiency is a less costly, more effective way forward than expensive renewables that produce just a little, but expensive power.

Most Vermonters are smart and frugal. They prefer to maintain or improve their standard of living by investing in systems that involve little paperwork and have HIGH simple paybacks, such as energy efficiency measures.

CEDF should spend its trove on energy efficiency measures with the HIGHEST simple paybacks to get a REAL bang for the people's bucks. CEDF is well within its charter to promote energy efficiency, instead of promoting ineffective renewables programs with miniscule simple paybacks. Why not hold a competition where people propose their HIGHEST simple payback projects and use the CEDF to quickly implement those projects?