

1. The following statistics from EIA are for the US for 2006

Electric Generating Capacity (GW)

- Total 970
- Renewable 97
- Solar 0.400
- Wind 12

Electric Energy Generation (Billion kWh)

- Total 4,000
- Coal 2,000
- NG 710
- Oil 122
- Nuclear 790
- Renewable 360
- Wind 30
- PV 0.6

Find similar statistics for Connecticut and write a brief essay about Connecticut electricity capacity and generation. Include per capita calculations and comparison between Connecticut and US figures.

US (pop 300 million)		Connecticut (pop 3.5 million)	
Electric Generating Capacity	(MW)	Electric Generating Capacity	(MW)
• Total	978,000 ¹	• Total	7,960 ⁶
• Renewable	120,000 ¹	• Renewable	342 ⁶
• Solar	400 ²	• Solar	1.6 ⁷
• Wind	12,000 ³	• Wind	0
Electric Energy Generation (billion kWh)		Electric Energy Generation (billion kWh)	
• Total	4,050 ⁴	• Total	33.5 ⁸
• Coal	2,010 ⁴	• Coal	4.0 ⁸
• NG	758 ⁴	• NG	8.9 ⁸
• Oil	123 ⁴	• Oil	3.2 ⁸
• Nuclear	782 ⁴	• Nuclear	16.5 ⁸
• RE	358 ⁴	• RE	1.2 ⁸
• Wind	31 ³	• Wind	0
• PV	0.58 ⁵	• PV	0.003 ⁹

1. <http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html>
2. <http://www.eia.doe.gov/cneaf/solar.renewables/page/trends/table11.html>
3. http://www.awea.org/newsroom/pdf/Wind_Energy_Basics.pdf
4. <http://www.eia.doe.gov/cneaf/electricity/epa/epat1p1.html>
5. <http://www.eia.doe.gov/cneaf/solar.renewables/page/trends/table11.html>
6. http://www.eia.doe.gov/cneaf/electricity/st_profiles/sept04ct.xls
7. <http://www.solarconnecticut.org/index.php>
8. http://www.eia.doe.gov/cneaf/electricity/st_profiles/sept05ct.xls
9. Estimate: 4.4 hours/day*365 days*1.6 MW

Starting with this data, rewrite your answer to this question as homework.

2. *Read the Hartford Courant article “Why it Shocks”. Using this article as a starting point, explain why coal and nuclear power plants may become more important future electric power generators in Connecticut.*

Natural gas and oil fuel prices continue to increase as demand increases and supply decreases. Coal and nuclear fuel are cheaper. The major problems with coal are pollution and CO2 emissions; so, its widespread use in CT may depend on cost-effective clean coal technologies. Since nuclear is already so important in CT, it may be possible to add another unit at Millstone.

3. *Explain how time of day pricing could help solve Connecticut’s electric congestion problem without actually reducing fossil fuel consumption.*

Electric congestion occurs when a more costly generator is used instead of a less costly one because there isn't adequate transmission capacity to get the generation from the less costly plant to the load center (in southwestern Connecticut) that needs it. This problem could be solved by building new generators close to the load centers in SWCT, by building new transmission lines to serve SWCT, or by reducing peak demand throughout the state.

Electric power use peaks during daytime hours; nighttime use is usually low. When residences and businesses are charged less for off-peak hours (typically 8 PM to 8 AM), some customers will switch energy-intensive activities to those time. For example, a homeowner might delay clothes washing and drying and use of dishwashers, or they might control thermostats to reduce peak load charges. Electric water heaters can be set on a cycle to do their heating during off-peak hours. When there is a substantially differential between peak and off-peak pricing, some residential customers purchase thermal storage systems to store off-peak energy as hot or chilled water (or ice) for use during peak hours. Some industries have more discretion in shifting energy-intensive activities to off-peak hours.

Shifting the same activities to off-peak hours will not change the amount of electric energy consumed, but may result in less primary energy consumption and less fossil fuel consumption. In Connecticut, shifting energy consumption to off-peak means that nuclear power or more efficient and cleaner-burning generators will generate more of the power. In other areas, reducing peak demand means the utility can save money by using coal, which is inexpensive, rather than natural gas or oil, which are expensive, to generate power.

CL&P offers a time of day (TOD) rate to residential customers: Rate 7. This rate would save a residential Rate 1 customer money if the customer uses at least 500 kWh per month and consumes more than 58% of their electricity in off-peak hours. This is mainly aimed at customers who do not use electric heat, but do use AC and would be willing to set their daytime thermostat up to 78 during the day. <http://www.cl-p.com/online/residential/aboutbill/genratesinfo.asp>

4. *Two disadvantages of DG systems are frequently cited: higher cost and greater air pollution relative to their central-station counterparts. Discuss these potential disadvantages for DG systems that use fossil fuel but not CHP, DG systems that use fossil fuels and CHP, and DG systems that use renewable energy.*
- DG that uses fossil fuel but do not employ CHP technology offer greater reliability to the customer and eliminate the power losses associated with the grid. This reliability would typically cost the customer more than relying on the grid and the customer would typically continue to pay for a grid-connection. Depending on the fossil fuel used, the DG user might generate more emissions than a central utility. The central utility would be more likely to have state-of-the-art pollution abatement equipment, the engineering staff to maintain systems at peak efficiency, and are located away from population concentrations. DG systems using clean-burning fuels – natural gas – would not increase air pollution. For example, a gas generator or a fuel cell system using natural gas could supply a reliable source of power for crucial industrial or service applications. In SW Connecticut, these systems could have the advantage of reducing electric congestion by serving as modern, efficient, clean-burning generators during periods of peak energy consumption.
 - DG that uses fossil fuel with CHP technology not only offers greater reliability, but much higher system efficiency (up to 85% overall efficiency). When the heat generated by the DG systems replaces heat that would be generated by the customer's heating system boilers or process heat steam generators, then the customer will typically use less energy and generate directly or indirectly less pollution. Cooling systems can be powered from this waste heat, but the technology (absorption chillers) is not standard. CT classifies the electricity produced by a CHP DG system with at least 50% efficiency as a Class III renewable energy resource. Power companies (e.g. CL&P) must include Class III renewable energy resources in their RPS (Renewable Portfolio Standard). Utilities will need to get 4% of their power from Class III renewables by 2010. (<http://www.retailenergy.com/statelin/0512olsn.htm>) Although the capital cost of these systems is high, the payback period is typically very short. Government incentive systems help reduce costs. There are 88 CHP DG projects in CT and these projects account for 500 MW of generating capacity.
 - DG systems that use renewable energy, such as a residential PV system and small hydroelectric generators, create little or no pollution, but the costs may be high and the payback period may be long. Wind can serve as a DG source for remote locations or for community scale wind systems (i.e. Hull, Mass.) DG relying on biofuels such as biodiesel, methane production from agricultural wastes, and landfill gas can be practical and reduce GHG emissions, but may have air pollution problems.
5. *A major electric power resource for Connecticut is increased efficiency and conservation. Describe the state programs which encourage increased efficiency and conservation.*

The utilities have incentive programs for increasing the energy efficiency of businesses, institutions, and homes.^{1,2}

The Connecticut Energy Efficiency Fund and the utilities offer a variety of programs for businesses, institutions and homes to increase energy efficiency.³

1. <http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=CT&RE=1&EE=1>
2. <http://www.cl-p.com/clmres/indexclmres.asp>
3. <http://www.ctsavesenergy.org/programs/home.php>