

## John Slater's Prelude

My house uses just over 10 MWh of electrical energy per year. And from the very limited data from Tina Regehr, her 6 PV solar panels generate 1.42 MWh per year. Thus, if I had a similar system on my house, I would need  $10/1.42 \times 6$  panels = 42 panels to generate 10 MWh per year, based on the assumption that I would have same orientation and tilt of the panels facing south as does Tina. To accomplish the necessary exposure to the sun, I would have to cut down all the trees on the east, south and west sides of my property (as well as the neighbours), which is a total of 8 trees. These trees are all conifers, each of which accounts for about 35 lbs of Carbon Offset, or total of 280 lbs per year.

If I extrapolate my house requirements to City of Medicine Hat, then for 20,000 residential homes  $\times$  10 MWh per year = 200,000 MWh  $\times$  42 panels = 8,400,000 panels. Now there is some guessing that each panel area is 10 square feet. Thus  $8,400,000 \text{ sq ft total} / 43,560 \text{ sq ft per acre} = 1930$  acres or 3 section of land.

However, if I use instead the information and Website I received from David Gue (given below), that the average Alberta household uses 7.2 MWh per year, then the consumption requirement for 20,000 homes in Medicine Hat is =  $144,000 \text{ MWh} \times 42 \text{ panels} = 6,050,000$  panels. Thus the area of land needed to be covered by solar panels is  $1930 \text{ acres} \times 7.2/10 = 1390$  acres or 2.2 section of land.

"In 2014, the average Canadian household used 11,135 kWh of electricity per year. The average household in Alberta uses 7,200 kWh per year. (This lower figure is offset by a higher usage of natural gas.)"

Source: <https://energyrates.ca/residential-electricity-natural-gas/>

Using another approach, with data on the internet, it is interesting that Rob Gardner came up with an estimate of land area for solar panels of 2 sq miles (or 2 sections), which is very close to my value of 2.2 sections for generating sufficient residential electrical energy.

Now, if the average demand for the city, including business/commercial/light industry and heavy industry, is up to 370% of residential, the total consumption requirement would be up to 533,000 MWh; thus 22,400,000 panels on just over 8 sections of land. This is about the area of land near Methanex and Cdn Fertilizer Plant as well as what was the old Westco fertilizer land.

In addition to the information above for residential electrical energy requirement, Rob also mentioned that HatSmart has a website with data on the 3-turbine Box Spring Wind Farm.

<https://www.medicinehat.ca/government/departments/utility-sustainability/hat-smart/city-initiatives/box-springs>

The 3 turbines generate 16,000 MWh of energy to power 2,000 homes. This represents about 3% of the city's total electrical need. Thus,  $16,000 / .03 = 533,000$  MWh. Note, this is very close to 533,000 MWh determined above for solar panels, so this gives some confidence for the above calculations.

Also, it is interesting to note, that since 3 turbines give 3% of city's energy needs, then 1 turbine gives 1%; thus 100 turbines would be required to supply the total 100% of city's needs.

Well, that is all I can give now with the calculations on the basis of data from Tina and information from David Gue and Rob Gardner.

PS. David & Martha lent me a copy of the Spring 2019 UofA Alumni Magazine "New Trail". There are various interesting articles. In one article on Energy Storage, Miles Skinner (a Graduate Student) says "Energy generation and energy storage will be multi-faceted. We have to ask how can we maximize the benefits to get the most of various sources (of energy). No single one is the best, but all of them will have their place". "The winning formula will come from interactions among multiple energy sources and the ways we integrate the new ones into our energy infrastructure. The magic of how we power ourselves in the future is at this point of interplay".

### SUMMARY

Average Alberta Household Electrical Energy Consumption is 7,200 kWh per year

Consider 20,000 homes in Medicine Hat, the total Electrical Energy Required would be

$$7,200 \times 20,000 = 144,000,000 \text{ kWh (or 144,000 MWh) per year}$$

Thus number of Solar Panels for 20,000 homes in Medicine Hat 6,050,000 panels

Approximate Area of Land needed for Solar Farm is nearly 1400 acres or 2.2 sections of land.

If Commercial, Light Industry & Heavy Industry requires are included, then total Electrical Energy requirement would be 533,000 MWh per year.

Thus number of solar panels for total city electrical energy generation would be 22,400,000 panels

Approximate area of land needed for Solar Farm would be just over 5000 acres or 8 sections of land.

Also, on the basis of the Box Spring Wind Farm, 100 wind turbines would be needed to supply the total annual energy for the City.