Rooftop wind turbines: haha or oho ?

A couple of weeks ago our national media wrote about plans of the University of Luxembourg "going green" by planning to install PV panels (yawn…) and **roof top wind turbines** on its buildings at the Belval campus. As the following picture shows, there is only one high-rising building on the campus, the 83m high (18 floors) "Maison du Savoir" on the rather level building ground at approx. 300m asl.

I understand that an university must jump on the subsidy train of the day to bolster its income, and plan every fashionable "planet saving" measure keeping public money flowing in. Nevertheless, the (very old) idea of roof top turbines has never taken off, as simple physics and economics show it being more of a children's play than a serious technology to harvest wind energy at most locations.

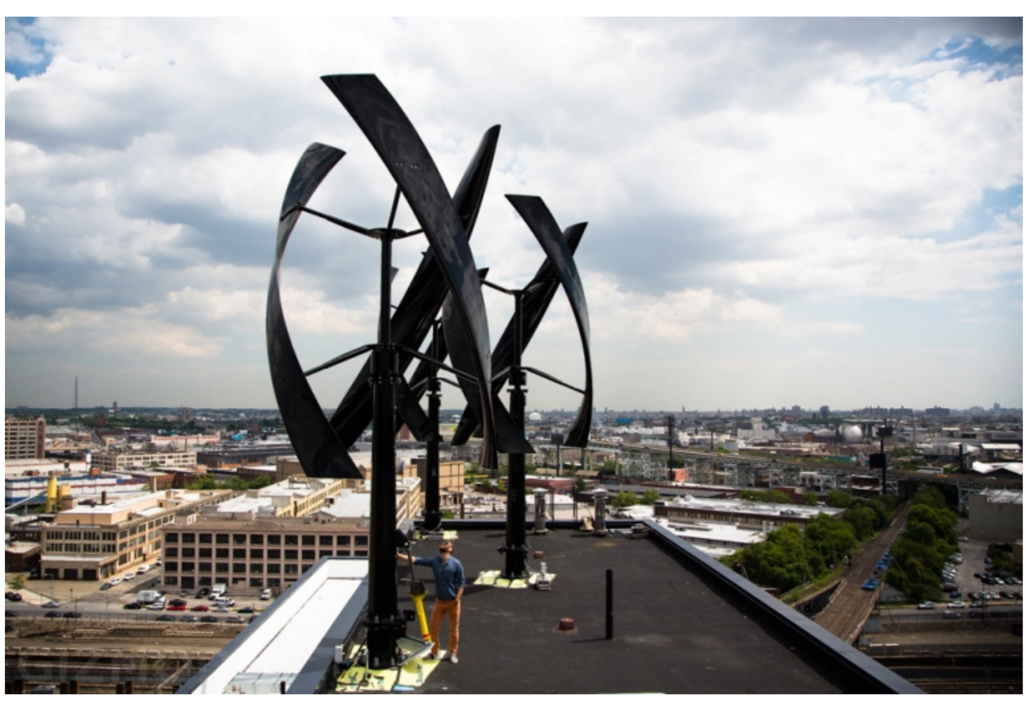
1. **The numbers behind rooftop wind turbines**

There is a very good report on this type of diminutive wind turbines at the Solacity website (**link**) titled "The truth about small wind turbines" which concludes to avoid wind turbines and install PV panels (what had to be expected from a PV manufacturer!). The report gives a lot of very clear data, which I will use in this blog.

Here is the formula to compute the yearly energy (in kWh) to be expected from a turbine with a rotor of a certain diameter and constant windspeed:

E [kWh/year] = 2.09* (diameter2)*(windspeed**3)** with diameter in [m] and windspeed in [m/s]. The ** means "to the power".

With a diameter of 4m and a constant wind speed of 3.5 m/s such a turbine would yield a meager 1434 kWh (value approx. 260 Euro). These data are for horizontal axis turbines, which do not look well on a roof and may cause more severe static problems due to the usual turbulent air flow as does a vertical axis turbine (VAWT, usually a variant of the Darrieus type). The following picture shows two VAWT's on a building in Queensland (link):



The problem is that the efficiency of this VAWT type has been found to be much lower than that of a corresponding horizontal axis turbine, and material cost and fatigue was also higher (see here).

2. The problem with wind speed

All wind turbines have a cut-in minimum wind speed, below which they can not produce any energy. This usually lies around 3 to 5 m/s (10 to 18 km/h). There also is a maximum cut-off speed (around 25 m/s) where they must be stopped to avoid damage, but this is a rare situation in Luxembourg that we may ignore when speaking of collectable energy.

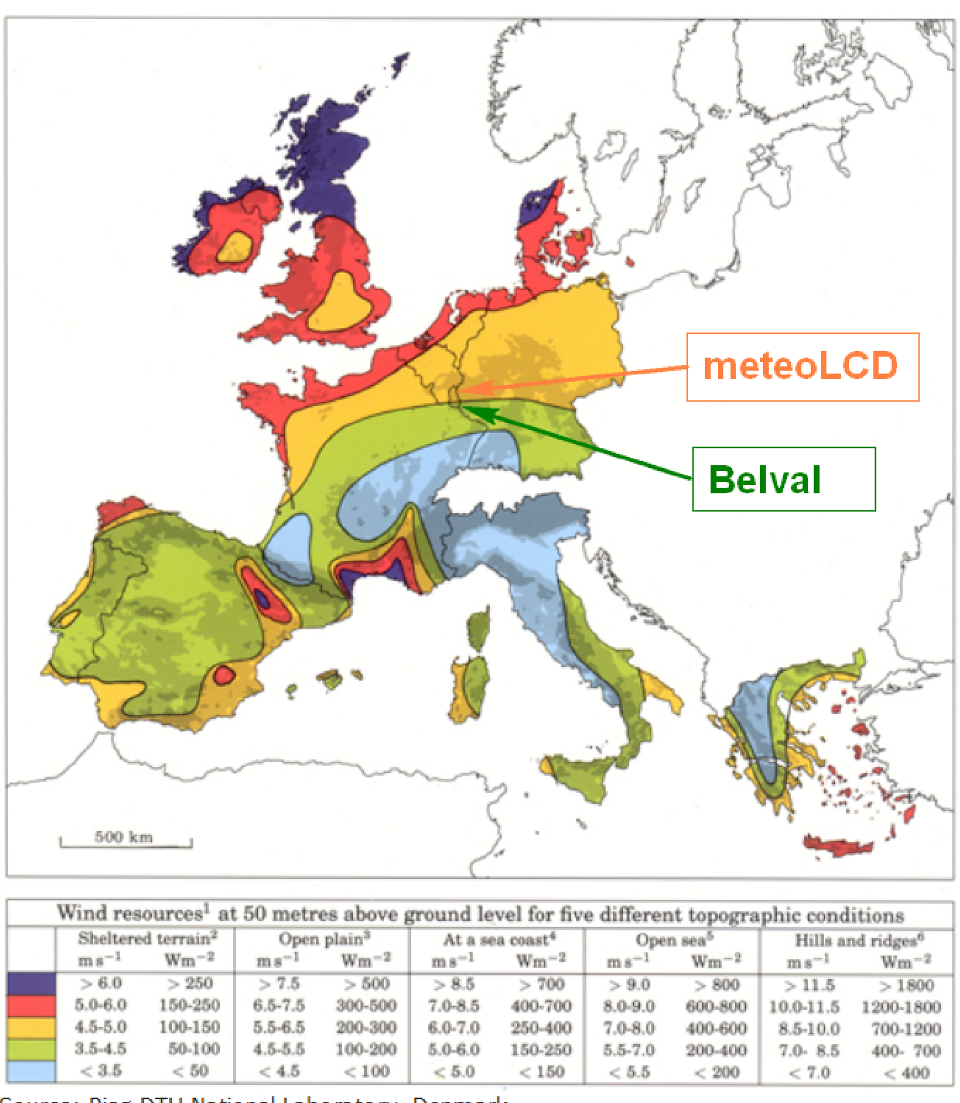
Now depending on your location, speeds above 3 m/s might not be exceptional: if your building is located in the high alps or at the sea-shore, this should not be a big problem. The real situation in continental Luxembourg is quite different. Let me give you the data measured at meteoLCD (Diekirch, about 218m asl) for the last 5 years:

year	avg	GT3	GT4	GT5	GT6	GT7	GT10
2012	1.78	1675	843	399	154	49	3
2013	1.81	1677	748	254	87	27	1
2014	1.62	1311	623	292	123	39	3
2015	1.91	1870	1100	615	303	114	4
2016	1.75	1666	889	416	151	38	2

The "avg" column gives the yearly average of the 17520 half-hour measurements (each half-hour measurement is the average of 30 measurements made every minute). In neither year does this average wind speed (in m/s) exceed the 3 m/s cut-in limit. The GT3 column gives the number of hours (out of the total of 8760) where the wind speed was greater than 3 m/s, and so on for the next columns.

Clearly only in about 1/5 of the time could any wind energy have been produced. The GT4, GT5 etc. columns show that the number of "fertile" hours drops rapidly (approx. by half for each step) and becomes virtually zero for wind speeds greater than 10 m/s. One should not forget that very often the rated power is given for a speed of 11 to 15 m/s.

The European Wind Atlas gives much more optimistic numbers, that in my opinion are the result from modelling and not observations:



Source: Risø DTU National Laboratory, Denmark

According to the "Sheltered terrain" column the Belval wind resource is about 60% lower than the situation at Diekirch (for a measuring height at 50m above ground level; so keeping in mind that the meteoLCD anemometer is about 20m above ground level, and that a possible roof-top wind turbine installed on the "Maison du Savoir" is at 83m, my best guess is that the Belval data will not be vastly different from those at Diekirch, or at the best not more than the double. Using one of the available wind profiles for cities (link) one could speculate that at 83m height the wind speed would be about 60% higher that at 20m, which confirms my intuitive guess.

In this article the (US) author suggests that a typical payback period for a 1 KW roof top HAWT would be about 120 years, not counting repair and maintenance.

3. Conclusion

My reaction is rather "haha". Do not expect any non trivial energy output from roof top turbines at the university of Luxembourg. The university roof top wind turbine will not be more than an expensive gimmick, fooling people into believing that they found a miracle solution for providing "clean" energy.

The funding authorities should at least insist on good observational wind speed data before paying for what seems to me more a publicity stunt than a scientific endeavor.

Related

Wind Report Germany 2013
September 24, 2014

Wind and Solar: Intermittency, backup and storage (part 2)
August 9, 2017

Wind Power
June 30, 2011
With 3 comments

This entry was posted on May 28, 2017 at 15:51 and is filed under Uncategorized. You can follow any responses to this entry through the RSS 2.0 feed. You can leave a response, or trackback from your own site.

Leave a comment