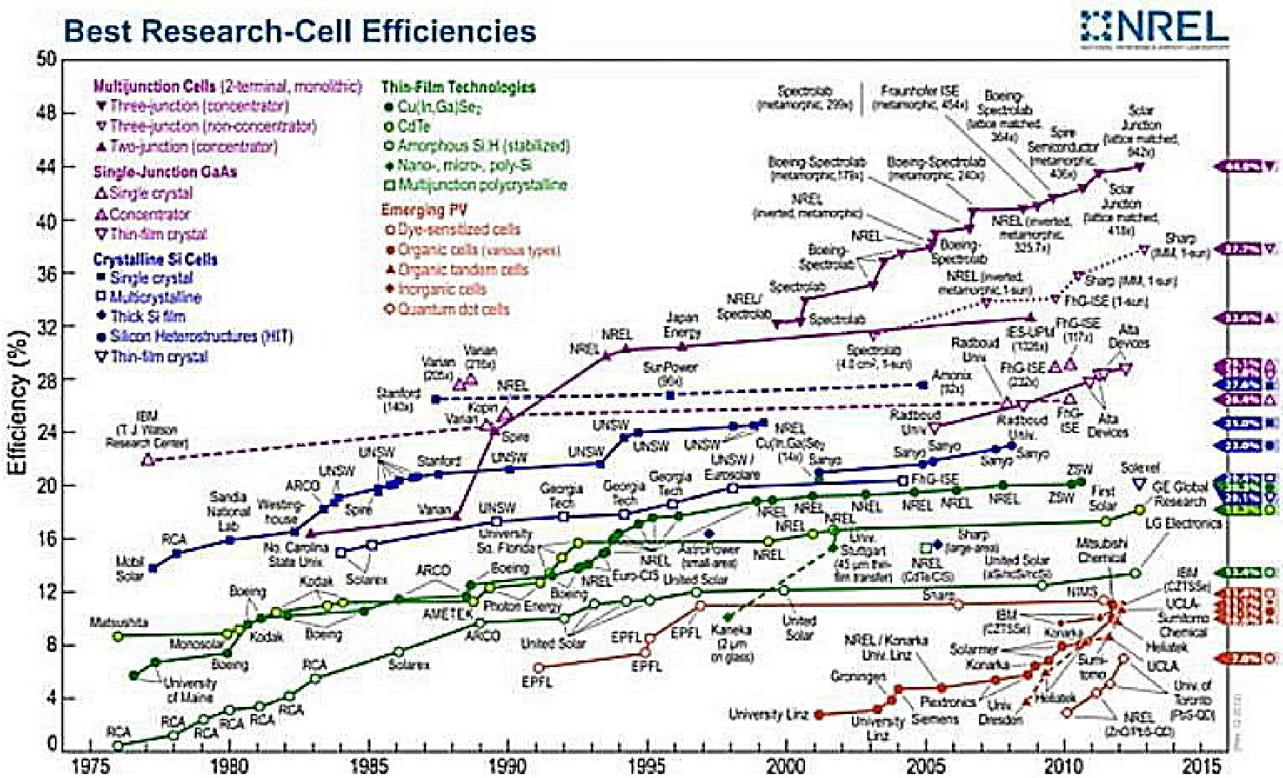
Why the atmosphere may become our biggest and cheapest source of energy

The efficiency of solar PV collectors continues to improve steadily so that in 20 years' time a rooftop array should deliver about twice as much electricity as present day arrays.



An explanation can be found [here](http://www.renewableenergyworld.com/rea/news/article/2013/01/solar-cell-efficiency-round-up-thin-film-is-closing-the-gap-with-silicon?cmpid=SolarNL-Saturday-January26-2013) .
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In the previous article it was shown that a city block containing 60 homes could generate up to 480,000 kWh of electricity using existing technology, which suggests that a future block of homes will deliver about 1,000,000 kWh per year because of improved collector efficiency. The question is: "How can that electricity best be used?"

One of the options may appear to be somewhat strange - use the electricity to run heat pumps that transfer heat from the low temperature storage zone of a concentric store to the high temperature zone. The heat pumps would only operate when there is surplus power available but they would run both during the day and at night. The consequences are that all of the solar power being generated (within the design limits) could always be used, with any surplus energy being stored for the future in thermal form, and the full capacity of the solar generators would always be available for meeting peak electric loads since temporarily stopping the heat pumps would not interfere with their objective. The energy in the low temperature zone (mostly extracted from the atmosphere) is free and the source is unlimited in quantity so for every kWh of electricity used by the heat pumps about 3 kWh of high temperature heat would be stored, of which almost none would be lost in a concentric heat store. Some of that heat would be subsequently degraded to a lower temperature as it flows away from the core (i.e. its exergy is reduced) but the kWh figure remains constant thanks to the first law of thermodynamics.

Such a design eliminates the need for the rooftop solar thermal collectors used in the "City Block" design, thus eliminating the biggest cost element and also simplifying the design. By shifting more of the heat into the high temperature zone it also reduces the volume and cost of the concentric heat store. In the process it makes greater use of heat extracted from the atmosphere, which is abundant and inexpensive to collect. The result is that a concept that was already very cost efficient will become even less expensive.

The heat pumps act like an electric storage battery by absorbing electric energy when it is in surplus and giving it up when there is a need for the electricity elsewhere. The heat pumps can be switched ON and OFF as required in the short term because they only serve the long term objective of moving heat from the outer zone to the core. That ability to match electricity supply and demand is useful for both irregular power sources like solar and wind power and fixed-output sources like nuclear power stations but if the block system is serving as a load shifting facility for an external source of electricity then it will need a means of determining when the supply and demand are mismatched.

The future city blocks would overall export much more power than they import because of the higher collector efficiency but they would still not be totally self sufficient because they will still need power from an external source at night. However Canada has a huge hydro power capacity that could fill that role. The higher nighttime power demand would be particularly useful in Ontario which frequently has difficulty in coping with its present small nighttime demand and with the resulting wide daily swing in the wholesale price of electricity. By increasing the grid load at night and contributing power to the grid during the day such systems would flatten Ontario's diurnal power fluctuations.

Most of the present summer grid load and a large part of the winter load are created by the cooling and heating needs of buildings. Either variant of the City Block design would reduce the annual grid power load because many buildings could be cooled and heated by using heat exchangers instead of using power. Those that use electrically driven heat pumps will be more efficient because their heat pump temperature differentials will be smaller, resulting in higher COP values. Electric water heaters will use less power. Those reductions in electricity demand together with the surplus capacity in electricity production could amount to as much as 2,000,000 kWh per year per 60-house block, or 33,000 kWh per house. There are about 3 million homes in Ontario so if they all used this concept the overall total would be something like 100,000,000 MWh of electricity, which is in addition to the even larger amount of natural energy that would be supplied for heating, cooling and DHW. (n.b. These are "ballpark" estimates, and bear in mind that the precondition is that future solar PV systems will have much higher efficiencies.)

The source of most of that energy is the air around us, which is the cheapest, most readily available energy source of all. Such systems will be silent, invisible, occupy almost no space, and will be completely non-polluting.