

The Best Solar Energy Storage on the Planet and for the Planet

The Industrial Revolution came about solely because fossil fuels are not only literally powerful, they are the most conveniently stored and versatile source of energy ever discovered. They seemed the perfect commodity until it became apparent that their emissions and our addiction to them are choking the life out of our planet.

Solar panels are a widely used alternative to fossil fuels. However, they require battery storage to compete effectively. Some battery constituents are critical mineralsⁱ such as lithiumⁱⁱ, which is toxic and thermally unstable. In any event, each of their ingredients needs sourcing, mining, refining, and delivery to the manufacturer who creates a finished product which must then be sold, distributed and installed. These many steps involve different companies, specialised skills and equipment, profit taking, and shipping to different, sometimes distant locations, all of which creates often overlooked environmental costs. Yet, this is only the first part of their story.

Battery capacity slowly degrades over time. Developers of large-scale grid applications face costly complete replacements every 10 to 15 yearsⁱⁱⁱ. Recycling is possible, but will be complicated and will require an entirely different set of specialised plants and processes. “Lithium-ion batteries create a recycling challenge. The EPA is working to improve lithium battery recycling processes”^{iv}. Recent fires make the point^v. In other words, batteries used at the utility scale would be a large strain on the budget and the environment, even as they prevent further emissions.

Batteries’ greatest value is that they are familiar, in most cases perfect for small (and mobile) applications, and available now at a price that has been dropping, and as such, because of climate imperatives and a lack of affordable alternatives, they are the current dominant storage method for both solar and wind energy.

However, in sunny areas there are other solar options in use, ones less known to the general public in Canada: Concentrated Solar Power, or CSP^{vi}. All forms of this technology focus sunlight on specialised collectors to create heat and store it for later conversion to electricity. Current CSP methods rely on using various liquids such as thermal oils for collection and molten salts^{vii} for storage, both of which are

environmentally damaging, and create insurmountable temperature limitations as these liquids become unstable at around 390°C and 560°C, respectively.

Even less well known are storage units called packed beds. They use sands and gravels composed of silicate minerals such as quartz sand used by a German company, Storasol GmbH^{viii}. Packed beds represent the best solar energy storage on the planet, and for the planet. They are environmentally benign by comparison to conventional methods, and they far exceed the temperature limitations of thermal oils and molten salts.

To acquaint you with the essence of packed bed storage technology, I want to take you to the beach, Sandbanks south of Kingston, or Long Beach south of Tofino. It's the middle of July. You must keep moving your feet, the sand is so hot. You run into the water to cool off body and sole(s). When back in your beach chair, you twist your feet and work their way down to that cool sand layer only a few centimeters below. That is it. The signature of the oldest and best heat energy storage on the planet. Right under your feet. Quartz sand^{ix} is great, but many common silicates from weathered metamorphic rocks would do.

At least seven reasons make packed beds the best heat storage for the purpose. Firstly, silicates' very high melting points mean one can pack a great deal more heat into them per unit mass than conventional CSP storage. Secondly, they retain heat very well and conduct it very slowly, which is why you could find the cool layer for relief on the beach, and why, since time immemorial, humans have used fire pit rocks as space heaters. Thirdly, appropriate silicates are readily available in surface deposits throughout the world. Fourthly, packed beds' productive lifespan is many decades longer than batteries. Fifthly, they are chemically stable and non-toxic. Sixthly, in many cases and sometimes to a high degree, the related economic activity and benefits would be local, not distant or overseas. And lastly, if it ever needs to be done, the recycling of packed beds is simple and environmentally safe.

However, packed beds are also the least used type of heat storage because they need a very hot gas to feed them properly, and gasses transport heat so inefficiently that conventional designers conscientiously avoid them. But air or nitrogen can reach very high temperatures, and, as you recall, high temperatures mean more energy stored per unit mass. A pilot plant in Morocco^x pioneered the approach of coupling a trough collector using air and packed bed storage. With a unique and patented solar trough,

its design has been far exceeded by a small Edmonton company, [SunDraco Power Inc.](#), but that is a topic for another blog.

With the right solar collectors, massive packed beds of an infrastructural scale are possible. Think of them as carefully managed geothermal bodies with thick, cheap, fire-brick insulation, topped up whenever the sun is out. They would operate much like small hydro dams but with a different kind of reservoir. Such plants would be highly versatile when it comes to size and location within a sunny area. Communities, institutions, and data centres all can have reliable power independently collected and delivered locally.

Eventually, these massive solar/packed bed utilities would work alongside solar panels and battery packs dispersed throughout communities. At night and throughout weeks of sunless weather, packed-beds, the greenest storage technology on the planet and for the planet, would supply baseload power, completely replacing the need for combusting fossil fuels.

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ⁱ <https://www.iea.org/topics/critical-minerals>

ⁱⁱ <https://batteryuniversity.com/article/bu-204-how-do-lithium-batteries-work>

ⁱⁱⁱ [What Is the Life Expectancy of a Solar Battery? - Renogy United States](#)

^{iv} [Methods for recycling solar panels and batteries | PVcase](#)

^v <https://www.cbsnews.com/philadelphia/news/lithium-ion-battery-caused-junkyard-fire-camden-emr-metal-recycling/>

^{vi} https://en.wikipedia.org/wiki/Concentrated_solar_power

^{vii} <https://www.solarpaces.org/how-csp-thermal-energy-storage-works/>

^{viii} <https://storasol.com/en>

^{ix} <https://www.nmfiltermedia.com/facts-about-quartz-silica-sand>

^x <https://solarpaces.nrel.gov/project/airlight-energy-ait-baha-pilot-plant>