Advanced Rail Energy Storage

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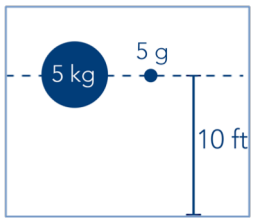
Advanced Rail Energy Storage (ARES) is a method of storing energy by bringing trains up a hill and later having them run down the hill to convert potential energy to electricity through regenerative breaking.

Energy

Potential energy is the energy that all objects with mass inherently possess and is most commonly regarded as the relationship between an object's mass, height, and the force of gravity, where gravity can be assumed to be constant for objects on Earth.



For example, as seen in the image to the left, a 5-kilogram bowling ball that is 10 feet above the ground has more potential energy than a 5-gram marble that is 10 feet above the ground.

Kinetic energy is the relationship between mass and velocity, and potential energy can be converted into kinetic energy. For example, if the bowling ball from the example were dropped, then the potential energy that existed at 10 feet would decrease as the height decreased, but the velocity would increase, causing an increase in kinetic energy.

How does it work?

When demand for energy is low, the ARES systems consumes renewable energy from a like solar or wind power to bring heavily-loaded trains up a hill.

What is **regenerative breaking?**
"When the driver steps on the brake pedal of an electric or hybrid vehicle, these types of brakes put the vehicle's electric motor into reverse mode, causing it to run backwards, thus slowing the car's wheels. While running backwards, the motor also acts as an electric generator, producing electricity that's then fed into the vehicle's batteries." –Christopher Lampton

Later, when energy demand increases beyond what solar or wind power can provide, the trains are rolled down the hill and regenerative breaking converts potential energy to electricity which can be sent to the electrical grid.

What is the **electrical grid?**
The electrical grid is a network that electrically connects producers of power to the consumers who use it.

This idea is similar to someone cooking themselves a meal with explicit intent to eat it for leftovers. They do the bulk of the work of preparing, cooking, and storing on a day when they have the time and energy, so that when they lack the time or energy, they have the leftovers ready to eat.

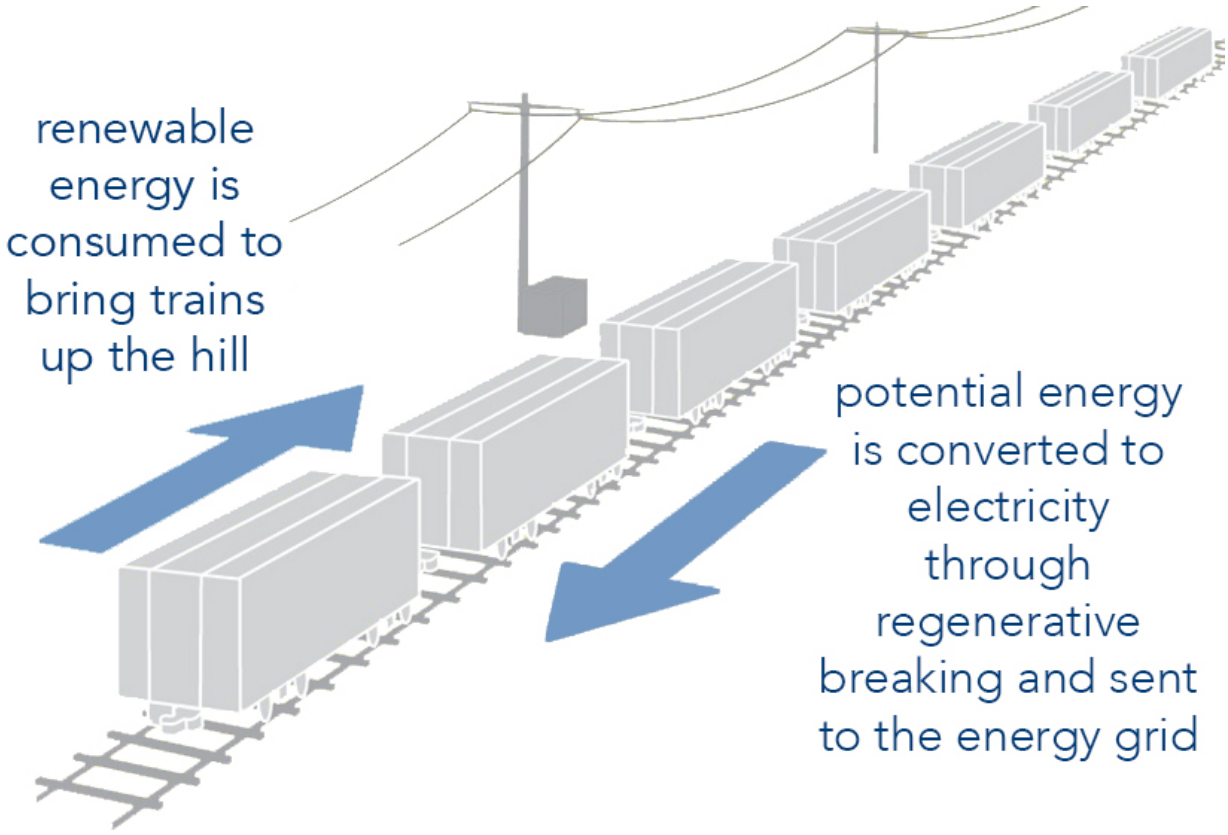


Figure 1

The ARES System: Renewable energy is converted into potential energy, and later potential energy is converted into kinetic energy, which is converted to electricity.

Advantages & Disadvantages

The ability of the ARES system to store energy will help expand use of renewable energy by increasing availability of energy supply while decreasing the need for non-renewable forms of energy. This is important because one of the greatest limiting factors in using renewable energy is how those systems can only produce so much energy due to time and weather constraints. Energy storage systems like ARES help mitigate those limitations to increase accessibility to energy from a renewable source.

Additionally, the ARES system is both highly efficient and significantly less expensive than other energy-storing systems, according to aresnorthamerica.com.

Unfortunately, the ARES system requires hills in remote areas and a lot of space.

Bibliography

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Figure 1 is an altered version of a graphic from Discover Magazine.
Lyderson, Kari. “9 Ways to Store Energy on the Grid.” *Discover Magazine*, 28 May 2015, discovermagazine.com/2015/july-aug/26-power-stash.

The image on the first page was created by the author.