Mechanically Storing Renewable Energy
at a Residential Scale

by Stefan Lorist

LEFt
Leftover Energy Flywheel technology
by Amstel Engineering

Today, more and more households are generating their own solar power. This helps us to come closer to a circular economy, since less fossil fuels are needed to meet our energy needs. However, excess energy is wasted, since it cannot be transported or stored for later use. Lithium ion batteries provide a solution, however their short lifespan and environmental problems that occur during its production make it far from green.

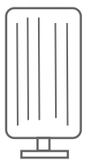
LEFt

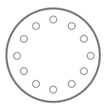
A mechanical storage system was designed. LEFt, which stands for *Leftover Energy Flywheel technology*, is a mechanical battery that stores an excess of residential solar power in the form of kinetic energy by spinning a flywheel in a vacuum. It comes in three main form factors; Flat, Slender and Extra Slender. These types all suit different scenarios and therefore different households.

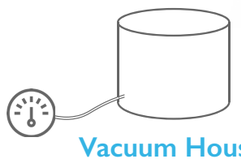
A conceptual design for a flywheel energy storage system was proposed and partially validated. It was concluded to be a better alternative for lithium ion batteries in residential energy storage.
Further development and extensive analysis is required to fully validate and make the design ready for production.

Rotor


Suspension


Motor/Generator


Magnetic Coupler


Vacuum Housing

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Script

Subsystem Approach
LEFt was designed using a subsystem approach to cope with all co-dependent aspects of the system. The most essential part, the flywheel rotor, was dimensioned according to the script.

Rotor
Differently shaped rotors for different household configurations

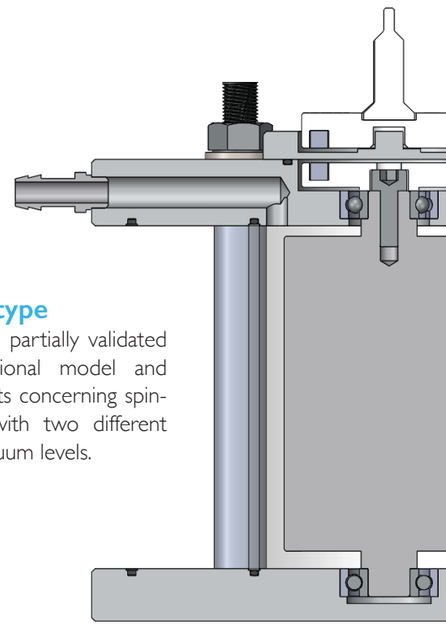
Suspension
Nearly frictionless suspension by magnetic levitation.

Motor/Generator
Single phase motor that can be used to drive the flywheel and to regenerate electricity.

Magnetic Coupler
Allows the rotor to be driven from outside the vacuum, reducing friction in idle state.

Vacuum Housing
Enclosing the flywheel in a low pressure environment, minimizing aerodynamic resistance and increasaing storage times.

Script
Essential calculations were extended into a full simulation script, used to analyze different scenarios of use and system applicability.



Prototype
The script was partially validated using a functional model and performing tests concerning spin-down times with two different rotors and vacuum levels.

Market implementation
Selling LEFt is done best by a lease plan, in collaboration with solar panel suppliers. The full retail price of over 10,000 will be too high for a one-time investment.

Sustainability assessment
The results of an Eco Audit show that the impact of LEFt is lower, since no lithium, cobalt and graphite are used. It is however still significant because of the large amounts of steel that are needed.