

CLEAN ENERGY BY SWEDEN



How to build a renewable microgrid

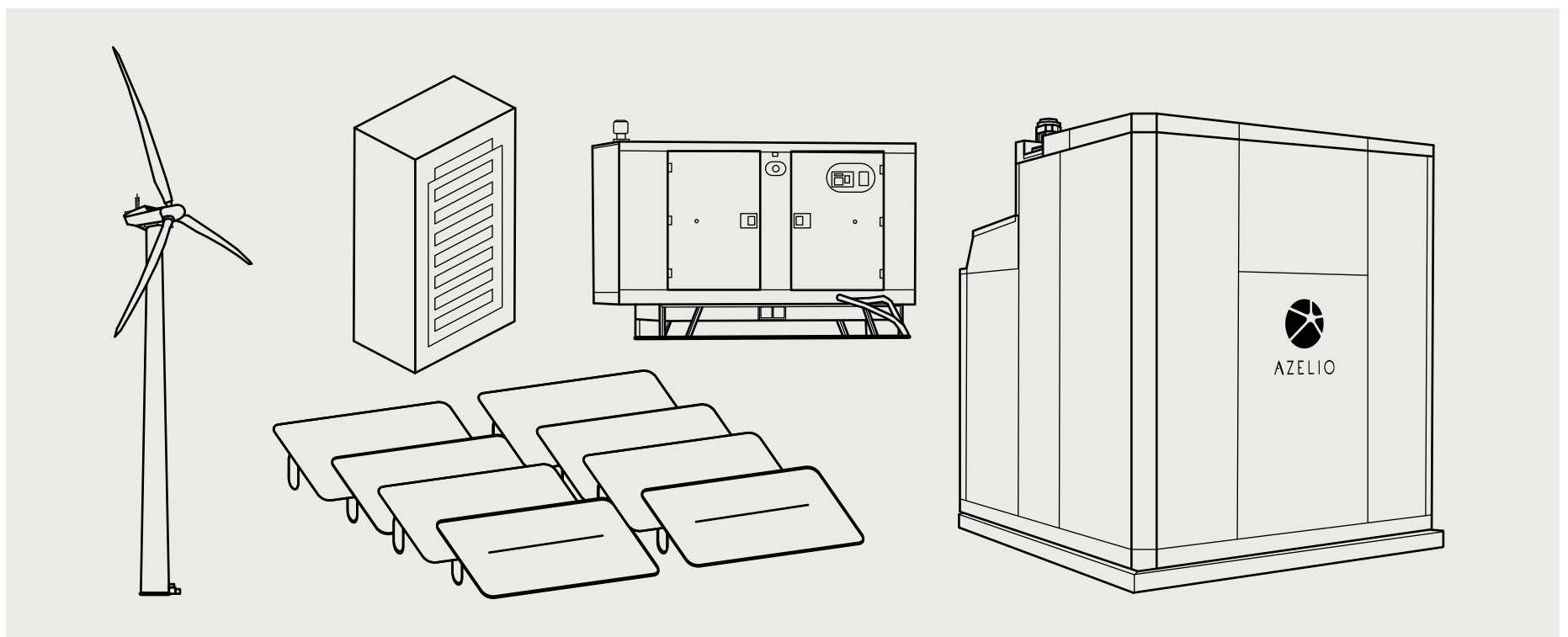
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Powering the evolution of the microgrid

What is a renewable hybrid system or microgrid, and why is long-duration energy storage a key component? Azelio breaks down everything you need to know

What is a microgrid?

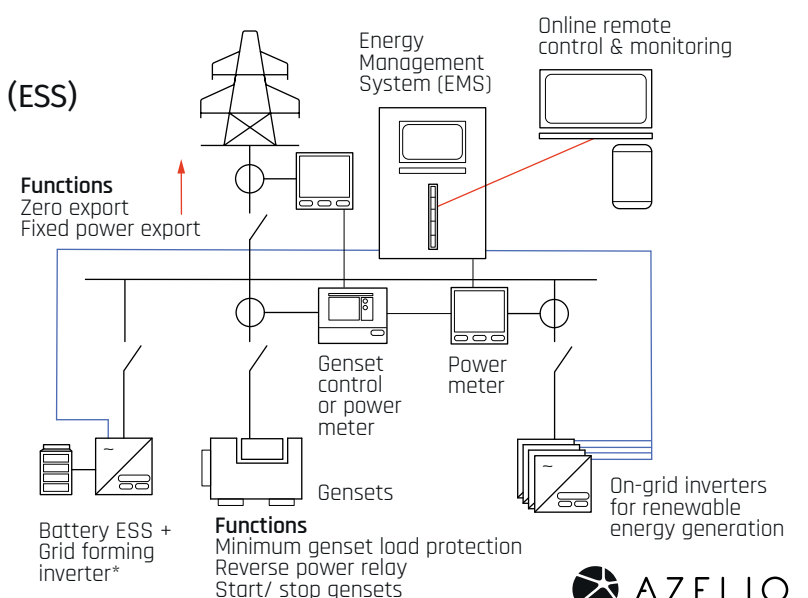
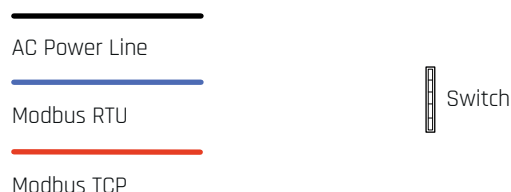
Microgrids can combine renewable energy with diesel or gas generator sets, and energy storage capabilities that deliver clean and affordable electricity to locations with limited or no access to reliable power.



A microgrid typically has the following characteristics:

- Operates independently
- Uses its own power generation
- Connects & communicates with generation components: grid, solar, wind, hydro, diesel generators, & energy storage systems (ESS)

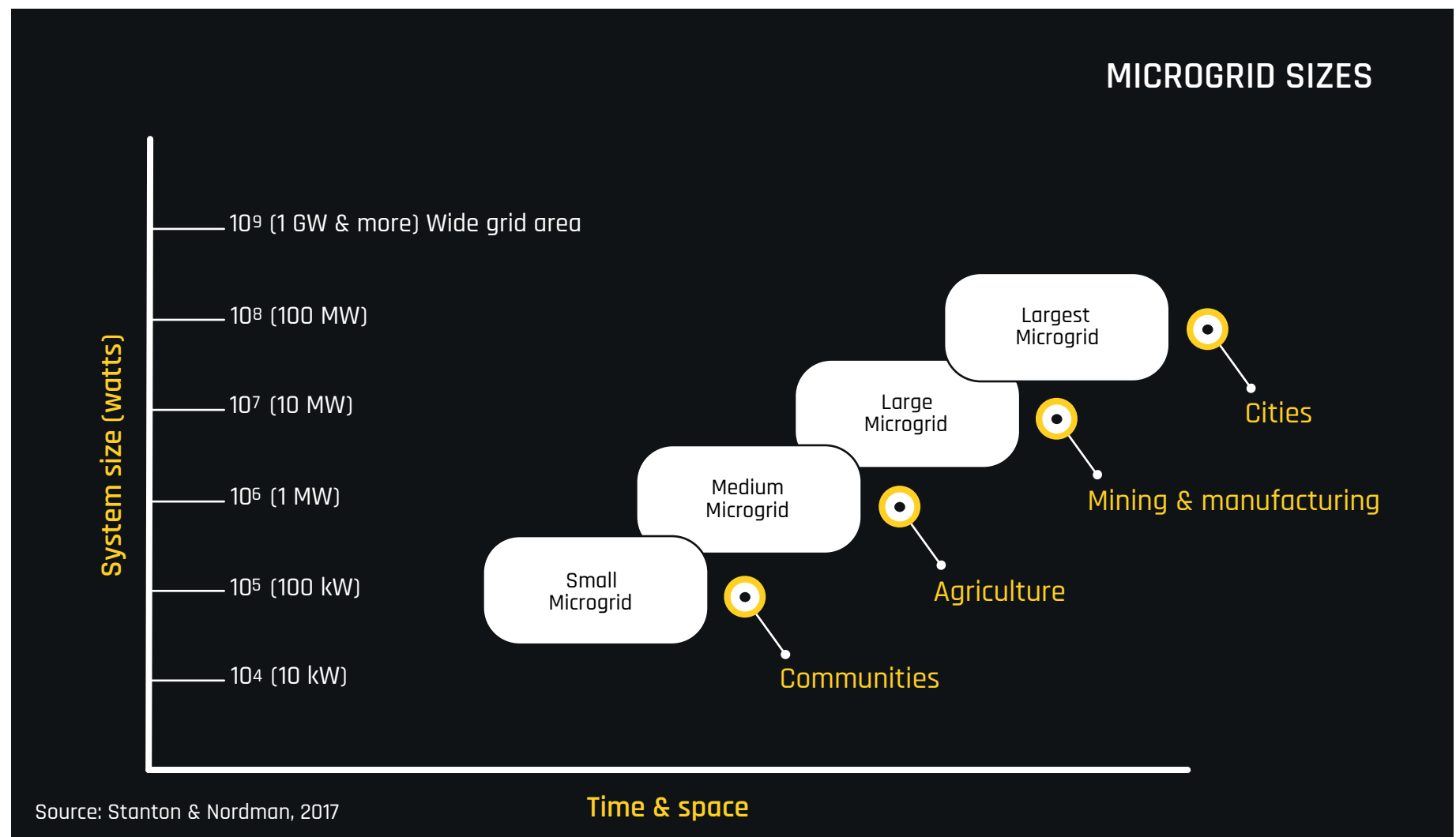
TYPICAL SET-UP:
 + SOLAR PV
 + GRID
 + GENSET
 + BATTERY ESS



*Connections can vary based on the microgrid layout, technologies used, and services provided by the ESS.

How big is a microgrid?

Microgrid systems can vary in size, catering for projects between 100kW to 1GW and beyond.



Why develop a microgrid?

Many businesses and communities around the world today don't have a sustainable, dependable, and cost-efficient supply of energy. Whether connected to an unreliable grid or located in a remote area with no access, it's difficult to develop and grow without stable access to electricity.

In many parts of the world, countries are contending with a power crunch. Demand continues to rise, while consumers feel the effect of soaring global energy prices, supply chain disruption, and an increased risk of power outages and interruptions - both due to climate and weather disasters like wildfires, or a mismatch in demand and supply capacity. The infrastructure societies have relied upon for decades is struggling to cope, and oftentimes grid owners and electricity producers push the problem to the end user, which results in high electricity prices.

Reducing the impact of these issues by strengthening the grid is not straightforward. With huge investment required to re-build infrastructure, and rising interest rates, securing the funding for grid improvements or large-scale developments is a challenge.

End users require decentralised renewable energy, and stable and predictable costs. This has led stakeholders in both the public and private sectors to consider microgrids as a viable alternative. Offering flexibility and security for those without a reliable grid-based energy supply, and an expensive petroleum back-up such as diesel, microgrids incorporating renewable sources such as solar, wind, and hydro, enable users to gain clean energy independence, by achieving:

- Reduced energy costs
- Increased potential to reach sustainability targets
- Facility to hedge energy prices
- Potential to reach net-zero carbon emissions

Why is LDES an important part of your microgrid?



Use of renewable energy sources will continue to rise and be incorporated into energy systems, including microgrids. With new streams of energy being introduced, it is important to align production and consumption. In long-duration energy storage (LDES), society has the technology that provides balance and meets a growing need for 8-to-18-hour flexibility to close the full day cycle, providing clean power whenever it's needed, whether as part of a microgrid or larger scope energy system.

LDES can be scaled economically to sustain electricity provision for multiple hours, days, or even weeks. Long-duration solutions complement short-duration storage, fulfilling flexibility needs beyond solutions such as batteries - which aim to provide power for storage with fast response and short-term use - and delivering flexible and reliable clean energy for longer periods of time.



Azelio's TES.POD long-duration energy storage can be deployed in a microgrid system to deliver Combined Heat and Power (CHP) for industries such as agriculture

TES.POD[®] long-duration energy storage

Azelio's technology can be deployed in a microgrid system together with other renewable technologies such as batteries.

It provides an ideal solution for energy needs exceeding 4-6 hours and projects from 0.1 MW up to 20 MW.

RISE Institute Life Cycle Analysis

When analysing environmental impact (CO₂e) Azelio's solution is:

29% cleaner than batteries
96% cleaner diesel gensets

Azelio's TES.POD vs. lithium-ion batteries and diesel generators. Delivering electric power for 13 hours every day, for 25 years. Life Cycle Analysis by RISE Institute, 2020.

Constructing a renewable microgrid



Another way to look at a renewable microgrid is as a collection of loads powered locally by Distributed Energy Resources (DERs) such as solar or wind, instead of a centralised authority or the national grid.

Each component can be controlled independently, isolating and reducing faults, and adding system resiliency. With the help of energy storage, operators can actively control the microgrid power balance to ensure stability.

ESSENTIAL TERMS A glossary of the terms associated with renewable microgrids

- | | | |
|---|--|---|
| AC Alternating Current | DSO Distribution System Operator | D&M Operation & Maintenance |
| ACCB AC Circuit Breakers | EMS Energy Management System | PCC Point of Common Coupling |
| ACE Area Control Error | ESP Energy Service Provider | PLS Power Line Signaling |
| AGC Automatic Generation Control | ESS Energy Storage System | PEI Power Electronic Interface |
| ANSI American National Standards Institute | FC Fuel Cell | PEV Plug-in Electric Vehicle |
| BBC Bidirectional Battery Charger | GHG Greenhouse Gas | PFC Primary Frequency Control |
| BEV Battery Electric Vehicle | HPS Hybrid Power System | PU Per Unit |
| CC Constant Current | HV High Voltage | RES Renewable Energy Sources |
| CCGT Combined Cycle Gas Turbine | IBDC Isolated Bidirectional DC-DC Converter | SA Sensitivity Analysis |
| CGU Conventional Generating Unit | ICE Internal Combustion Engine | SC Super Capacitor |
| CHP Combined Heat and Power | ISO Independent System Operator | SCC Short Circuit Current |
| CP Constant Power | LC Local Controller | SOC State of Charge |
| CV Constant Voltage | LFC Load Frequency Control | SS Storage Systems |
| DC Direct Current | LV Low Voltage | THD Total Harmonic Distortion |
| DER Distributed Energy Resources | LVDC Low Voltage DC | TSO Transmission System Operator |
| DG Distributed Generation | MAC Maximum Allowed Current | UBC Unidirectional Battery Charger |
| DMS Distribution Management System | MG Microgrid | UFLS Under Frequency Load Shedding |
| DOD Depth of Discharge | MV Medium Voltage | VPP Virtual Power Plant |
| DSM Demand Side Management | OC Over Current | VSI Voltage Source Inverter |

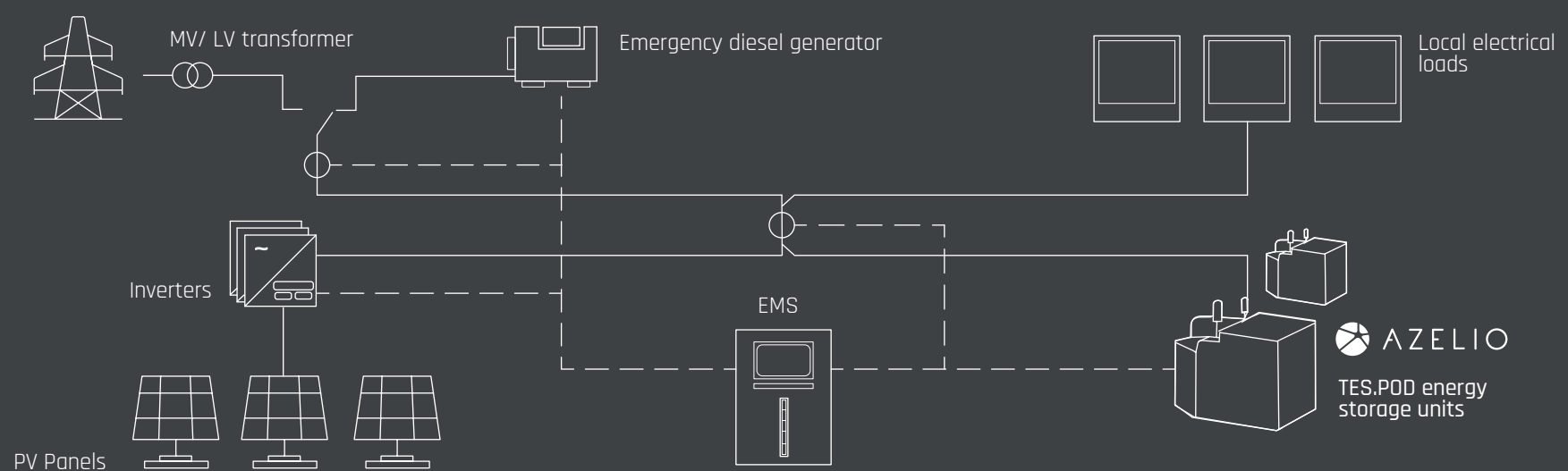


CONCEPT SET-UP

How might your renewable microgrid with energy storage look?

[Find out below](#)

CONCEPT MICROGRID POWER SYSTEM With TES.POD® long-duration energy storage



Azelio – A Swedish cleantech company

Azelio is a Swedish cleantech company with a bespoke long-duration storage innovation for renewable energy. We aim to power the evolution of a renewable society, by solving the urgent need for controllable and affordable clean energy. Founded in 2008 / Award-winning technology / Engineered, designed, and produced in Sweden – deployed worldwide.

FIND OUT YOUR SAVINGS AND THE BENEFITS OF TES.POD WITH AZELIO'S EASY-TO-USE ONLINE VALUE CALCULATOR

[AZELIO.COM/VALUE-CALCULATOR](https://azelio.com/value-calculator)

Want to know more?

TALK TO OUR EXPERTS
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