SSi | ENERGY

INNOVATIVE ENERGY SOLUTIONS FOR REMOTE COMMUNITIES

Imagine meeting all of your community's heat and power needs at a fraction of the current costs and with greatly reduced emissions. This CAN be achieved – by applying new and innovative technologies, by storing and using energy on demand, and by burning much less fuel. This is the SSi Energy Solution for rural and remote communities.

THE CHALLENGE

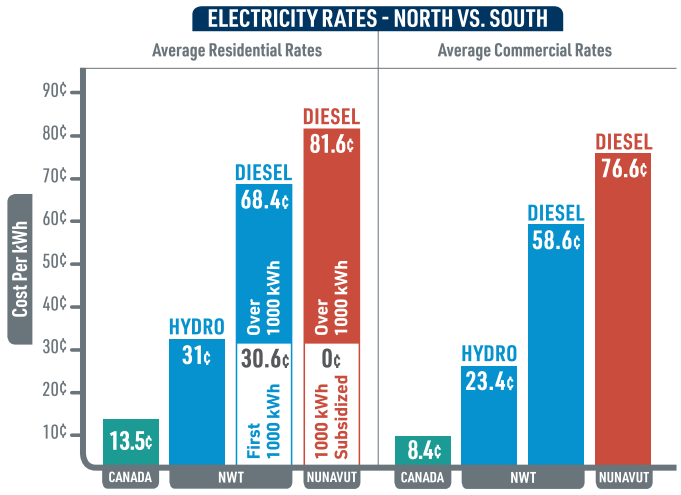
Reducing the Total Cost of Energy and Emissions

The cost of sustaining our communities is extremely expensive given the high rates charged for heat and power, which directly affects local businesses, employers and the number of jobs in these communities. One of the reasons that costs are so high is that there is no common utility grid connecting most remote locations. Those communities rely on a local micro-grid for power, which traditionally uses diesel-fueled generators. Home heating fuel, propane and/or wood pellets are required to supplement heating sources most of the year. All these fuels must be transported long distances, by ship or truck, at significant expense and environmental risk. As a result, the total cost of energy and greenhouse gas emissions are dramatically higher than in southern Canada.

Improving Power Plant Efficiencies

Making matters worse, most of the diesel power plants operating in these communities today are aging and inefficient. For every litre of diesel fuel consumed by these plants, roughly 33% is converted into electricity, while the remaining 67% is lost as heat, friction and noise. In the North, where heating accounts for 60% of the cost of energy this extremely valuable heat byproduct is literally disappearing into thin air.

The inefficiency of the diesel power plants is made even worse because they burn large amounts of fuel even when the community's electrical requirements are low, such as in the middle of the night. This further reduces plant efficiency to 20% at best. There is a lot of room to improve!

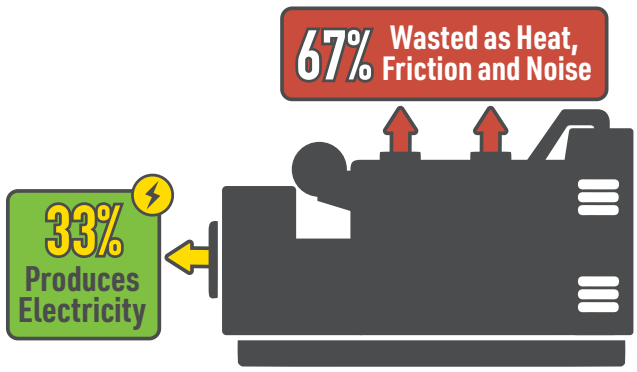


NWT HYDRO (NT Power corp)
9 communities have access to hydro electricity.
Average Residential Rate – $18 monthly service charge + 31¢
Average Commercial Rate – $40monthly service charge + 23.4 ¢.

NUNAVUT DIESEL (Qulliq Energy)
All 25 communities rely on diesel power plants.
Average Residential Rate 81.6¢ over 1000 kWh.
Average Commercial Rate 76.6¢

NWT DIESEL (NT Power corp)
25 communities rely on diesel power plants.
Average Residential Rate – $18 monthly service charge + 30.6¢ under 1000kWh, 68.4¢ over 1000kWh.
Average Commercial Rate – $40 monthly service charge + 58.6¢.

Sources: Hydro Quebec, Qulliq Energy Corp., NWT Power Corp., Northland Utilities. Energyhub.org



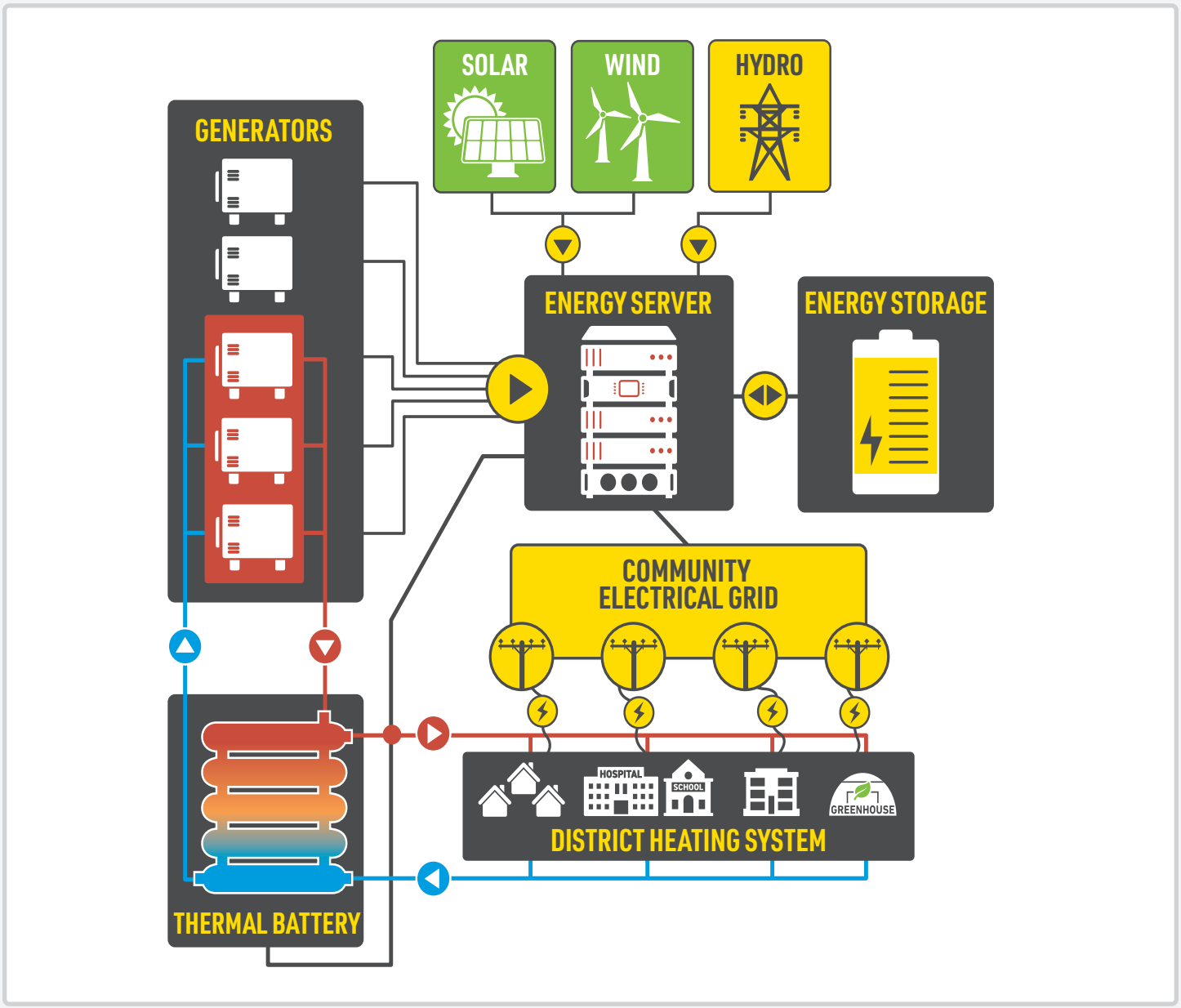
Taking Advantage of Heat Capture

Capturing the heat emitted by the old diesel power plants would seem like a great idea. Unfortunately, given the size of the old engines, heat capture is often not practical. To do so would require very large heat exchangers that are costly and difficult to install. And during the warmer months of the year there is little need for the heat, which means the exchangers would have to be removed. In remote locations this would require significant time, effort and expense.

THE SSi ENERGY SOLUTION

The Future of Heat and Power Generation

The SSi Energy solution is a compilation of leading edge technologies for heat and power production, storage and deployment. Heat is captured from multiple generators and stored in a thermal battery, to be accessed as needed by the community's district heating system. The thermal battery can also be charged using renewable energy should there not be enough excess heat from the power plant. The electricity produced from generators, solar and wind is stored in graphene-based supercapacitor storage units. If the community has access to hydro electricity, fewer generators are required and will be used primarily as a backup power source and to generate heat as required. All power is distributed to the grid through the "energy server" which provides voltage and frequency stability.

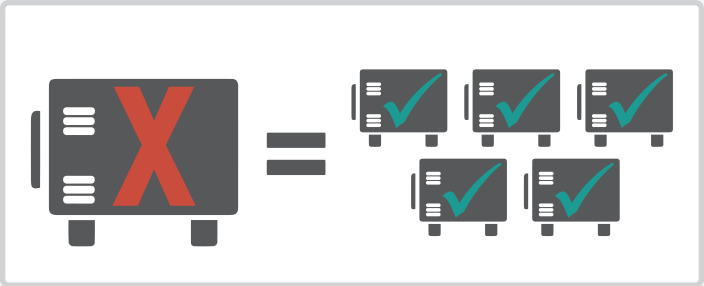


This innovative new heat and power system will dramatically reduce diesel consumption and decrease the total cost of energy in diesel microgrid communities by at least 40%, while enabling immense potential for long-term social, economic and environmental sustainability. In hydro communities, our system provides distinct cost-saving advantages for the production of heat, and manages peak shifting by efficiently drawing the least amount of hydro electricity required to maintain an electrical storage charge.

Multiple Smaller Generators

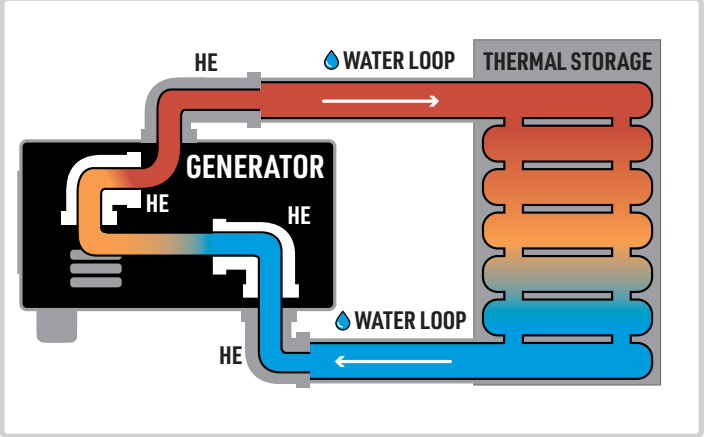
By replacing large generators with multiple small units we gain significant advantages:

- When the load is low (at night) or when renewable energy is available generators can be shut off;
- Heat capture is easier and more practical to implement on small engines;
- Units with heat capture would run in winter, and those without would run in summer, eliminating the need to remove the heat exchangers every year;
- Smaller units are less expensive and much easier to transport and install;
- Multiple units provide greater redundancy in the event of an engine failure;
- Multiple units provide the ability to split assets between two locations to provide additional redundancy; and
- Local diesel mechanics can maintain these smaller units, while the big generators require flying in specialized mechanics and specific tools.



Heat Exchangers

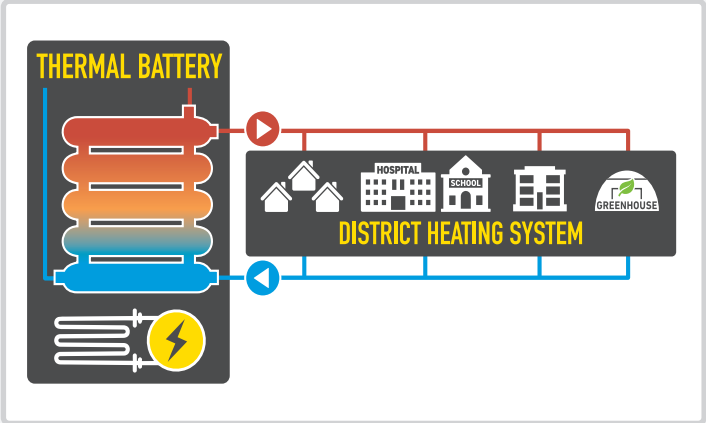
Modern heat exchangers (HE) enable heat capture from the exhaust, turbo charger, water jacket and oil cooler, and these can be easily implemented on smaller generators. Heat exchangers capture this rejected heat using water, which then flows in a closed loop to a thermal storage device where we can store the heat.



Thermal Storage Batteries

Thermal batteries absorb and store heat energy using a technology called Phase Change Material (PCM). When the PCM comes in contact with heat, it changes from solid to liquid and stores the heat until needed. When the stored heat is released the PCM transforms back to a solid and the process is repeated.

With the SSi Energy Solution, the thermal battery is heated (recharged) using waste heat from the generators or can be recharged with excess renewable energy such as solar or wind. This heat is then distributed through a community district heating system to commercial buildings, greenhouses and affordable housing units.



District Heating System

The Thermal Battery provides heat to the main facilities in the communities via a closed loop utilidor system that circulates heated water on demand to the various buildings. The average community will have enough energy to heat 400,000 square feet of building space, which is typically more than that comprised by the school, arena, health centre and offices combined.

Solar Panels and Wind Turbines

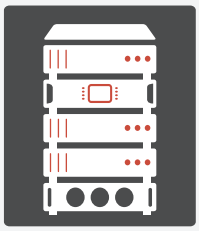
With multiple small generators it becomes possible to incorporate renewable energy sources such as solar panels and wind turbines. This is possible because we can shut down one or more of the engines – reducing energy production – and take advantage of solar or wind when available. This will further reduce the cost of fuel and emissions levels.

The Thermal Battery can also be charged with electricity through a built-in heating element should there be an excess of solar or wind energy available.

Electrical Energy Storage
Supercapacitor energy storage units are used to store excess electricity for later use, when needed. This revolutionary new energy storage technology can be used for everything from residential solar installations to large community grid scale applications. Unlike conventional chemical batteries, this new technology uses graphene supercapacitors to distinct advantage:

- Scalability – Supercapacitor energy storage can scale from a few kilowatts to multiple megawatts;
- Grid Stabilization – frequency & voltage stability, eliminating spikes and brownouts;
- Environmental – able to operate from -30C to +85C;
- Environmental Safety – 95% carbon, completely non-toxic, clean and recyclable;
- Longevity – 1,000,000+ cycles and a 10+ year shelf life (45+ years operational);
- Safety – remote monitoring of all operational parameters.

While the old diesel power plants produce electricity at 20% efficiency, wasting energy by burning large amounts of fuel even when the community's load is low, our supercapacitor storage technology allows us to run multiple generators at full load and store the excess electricity. This maximizes the 33% electrical production efficiency of the generators.

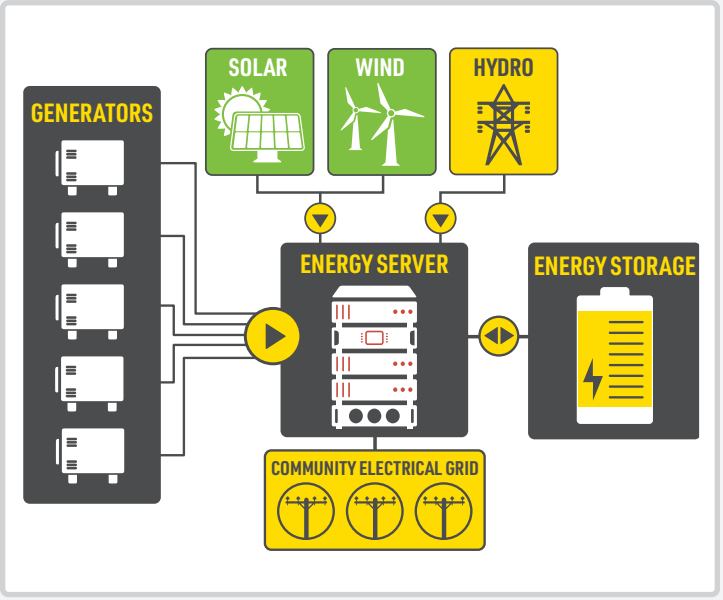


The Energy Server
A key component of the SSi Energy Solution is the Energy Server. This is a fully integrated hardware and software platform that acts as an orchestra conductor, ensuring all components of the solution work together for peak system efficiency. The server is modular and can be deployed in various configurations to manage all of the system components.

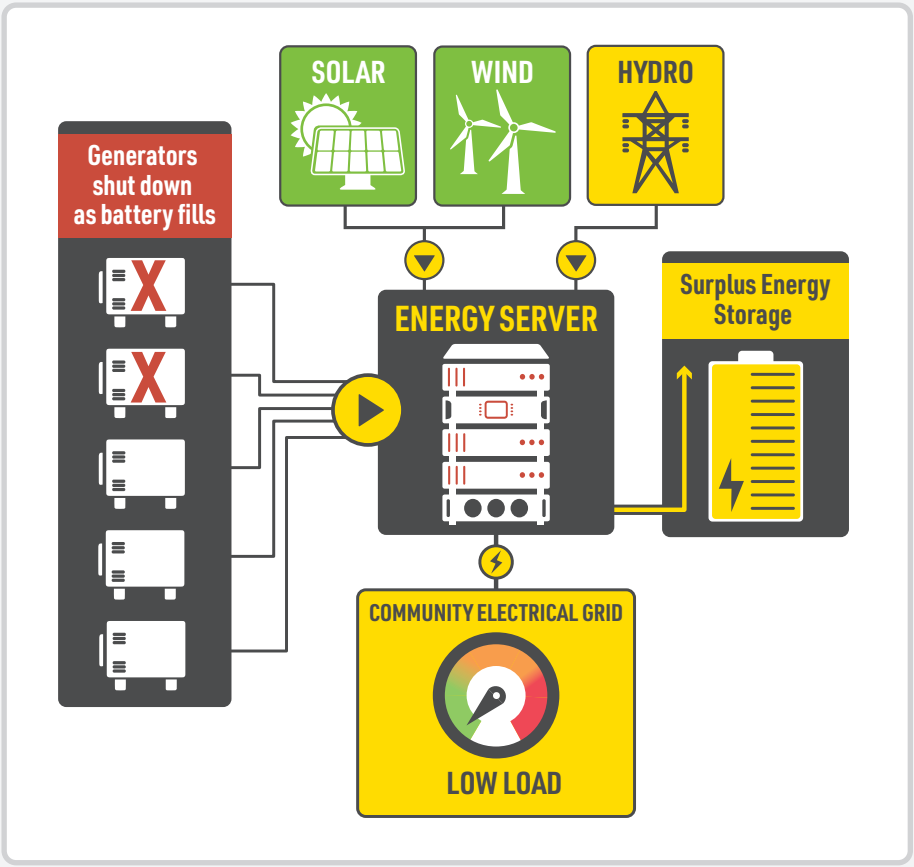
HOW THE SSi ENERGY SOLUTION WORKS

Power Production
With the SSi Energy Solution, all sources of electricity are connected to the Energy Server. This includes the multiple generators, hydro where available, solar panels, wind turbines and the energy storage units. Any excess electricity is stored for use as needed.

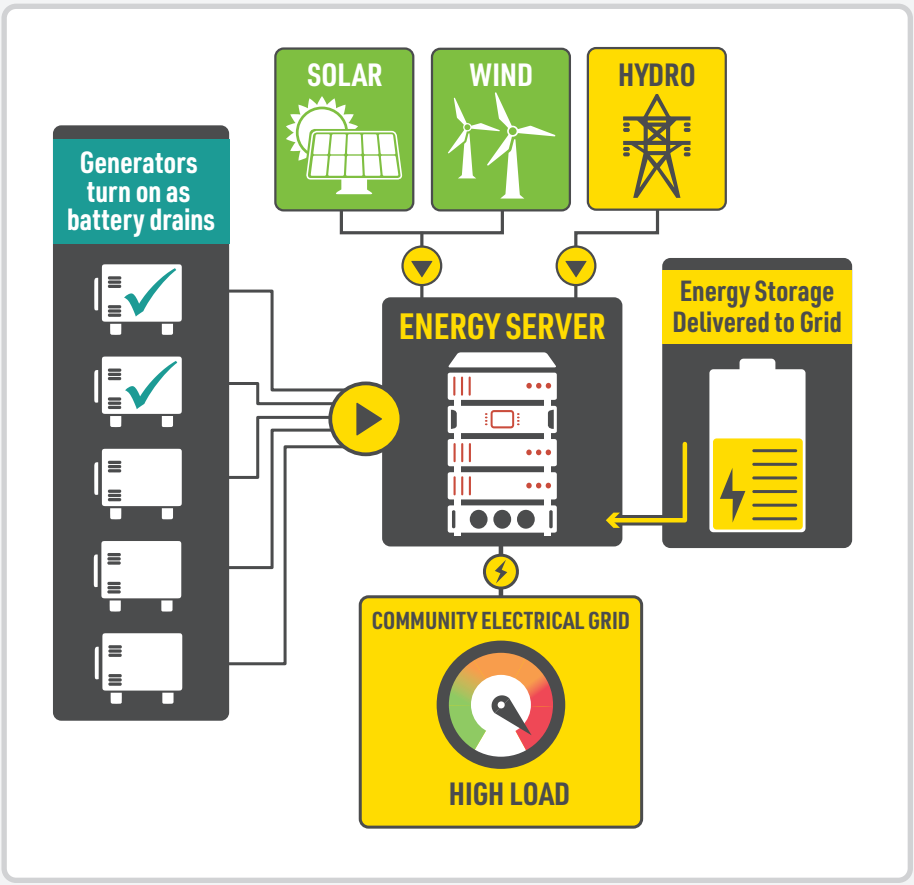
The Energy Server is connected to the electrical grid in the community and manages the flow of energy between all sources and loads as the load changes throughout the day.



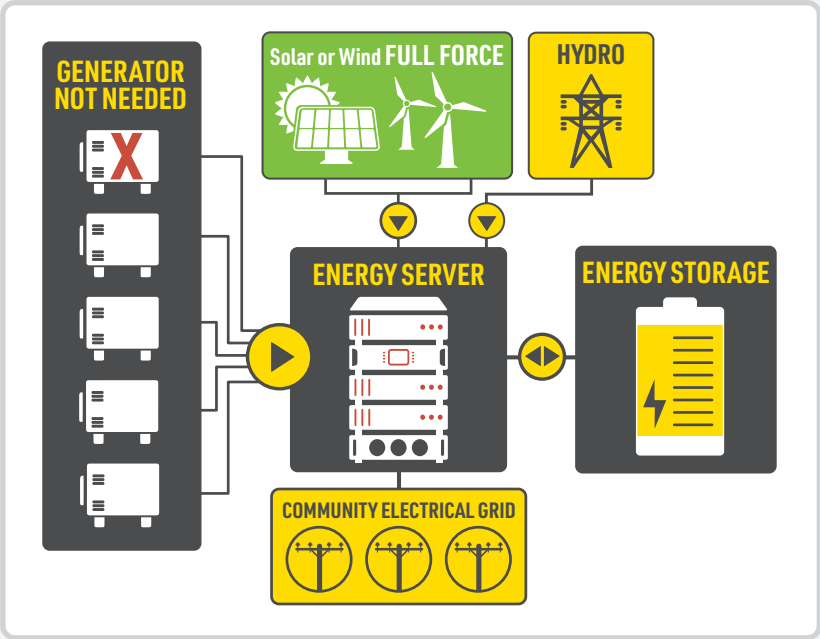
Low Grid Load
When the electrical load of the community grid is low, the Energy Server directs surplus electricity to be stored. Once the energy storage unit is fully charged, generators shut down, further reducing fuel consumption and emissions. In the case of hydro communities, electrical consumption from the hydro grid is temporarily disabled. When the energy storage gets low, generators (or hydro) are brought back online to recharge it (if solar or wind is not sufficient).



High Grid Load
When the electrical load of the community grid is high, the Energy Server will bring online as many generators as required (or draw from hydro as needed) to meet the demand. Any excess electricity is directed to the energy storage unit so that we are always running the diesel generators (or hydro connection) at peak efficiency. This is called "Peak Shifting".



Renewable Energy Supplement
The energy produced from solar panels and wind turbines will vary depending on sun exposure and wind patterns. At times when either solar or wind sources are available, the Energy Server will prioritize renewable energy and run fewer diesel generators, (or draw less hydro electricity) again further reducing fuel consumption and emissions.

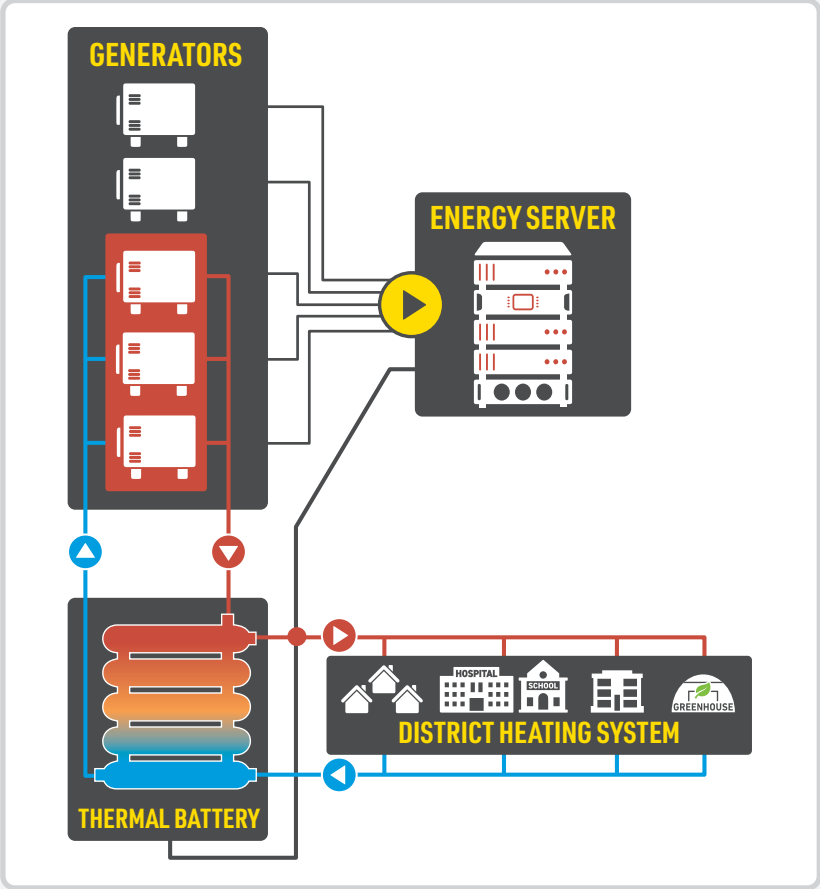


Heat Production
With the SSi Energy Solution, generators with heat capture charge the Thermal Battery using water flow through a closed loop. The Thermal Battery is connected to the community's district heating system using another closed water loop to deliver space heating and hot water to homes and buildings.

The Energy Server is also connected to the Thermal Battery to enable recharging using the built in electrical heating element if no waste heat is available.

As the demand for heat rises and falls throughout the day, and varies from season to season, the Energy Server determines:

- When to start or stop generators with heat exchangers installed;
- When to start or stop generators without heat exchangers installed;
- When to charge the Thermal Battery using surplus electricity.



The SSi Energy Solution is a game changer for rural and remote communities. By reducing the total cost of energy, significant community expenses can be redirected from the overhead burden of heat and power to much needed social and economic developments.

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