the PowerRouter
you're **in charge**

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The Solution to Managing Energy Supply And Demand

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Introduction

This paper is written to introduce Nedap's MyGrid, the solution to help you manage energy supply and demand.

Our climate changes are becoming an increasing world wide concern, oil prices are soaring and our fossil fuel resources, which currently power our entire lives, are being depleted. With our dependency on fossil fuels constantly increasing, and availability reducing, it stands to reason that energy costs will be priced out of reach for the common individual homeowner in the future. There is an increase in government bodies supporting the drive toward an expansion in renewable energy incentives, legislation, and commercialization.

It is a fact that we are depleting our fossil fuel resources. It is also a certainty that additional developments and new technologies will be available in the future for generating usable energy.

Our awareness of the need for alternative energy sources has led to many initiatives and technologies for the generation and storage of energy in large and small amounts at various locations. Large solar plants and wind farms are being built to keep up with the growing demand. Solar photovoltaic panels or small wind turbines are also widely accepted. These systems are proof that it is possible to provide sufficient energy locally for a household. Other promising technologies are also emerging, such as fuel cell and micro CHP (combined heat and power) generators.

With growing awareness that we are running out of fossil fuels, environmentally conscientious individuals are making the time and investment necessary to generate their own energy independently. Passive houses[1] and zero-energy houses exhibit the fact that sufficient energy can be generated locally to provide households with clean energy all year long. Local legislation has sanctioned the construction of these houses. A further incentive for local energy generation is a growing desire for consumers to manage their own energy consumption and consequently manage the costs.

This document describes the issues related to local generation and storage of various renewable sources. To make useable and manageable energy out of those sources, allowing price negotiation, cost savings, and building virtual power plants.

Renewable Energy Definition

Renewable energy is a regenerated energy resource produced naturally in a relatively small time frame. This natural generation of energy can come directly from the sun as thermal, photoelectric, or photochemical energies. Alternatively, energy can be gathered from wind and hydropower, or it can be derived from tidal and geothermal energy and traditional wood burning, or biomass. Renewable energy is not defined as being derived from waste or fossil fuel products or sources.

Renewable means "replenished naturally" and the source will never be depleted.

Wind and sun power are the leading sources of renewable energy, used extensively Worldwide.

Solar Energy

The sun, or solar energy is used to produce electricity, to heat water, and for heating, cooling and lighting buildings. A photovoltaic (PV) system will capture the energy from the sun converting that

[1] A passive house approaches the heating challenge by using ultra-thick insulation, and elaborate doors and windows. The architect designs the structure encased and airtight making it so that almost no heat can escape and almost no cold can seep inside. Warmed by the sun, and by using appliances, and body heat, it effectively recycles heat. They cost an insignificant percentage more to build than a regular house.

energy instantly into electricity. It is possible to focus the sun's light using mirrors producing highly intense heat, then electricity is generated via a heat engine or steam turbine.

Wind Energy

Wind energy makes use of the wind through wind mills to directly generate electricity, and can also be used to charge backup batteries, or for pumping water.

Smaller wind turbines are sufficient to meet energy requirements limited to a small area, where larger modern day wind turbines are combined and work together in wind farms for the production of electricity for utilities.

Many of the world's environmental projects involving wind or solar power systems are big business, but is increasingly popular with individual homeowners and smaller off grid usage in remote or rural locations.

Although the industry and technology has its critics, the renewable energy market is growing in significant proportions.

The use of energy from renewable resources will reduce disruptions in power, which is particularly beneficial when used by essential services, like hospitals, police or fire departments, etc. Reduction in industries and individuals dependence on electricity means less harmful emissions of greenhouse gasses and pollutants.

Historical Performance Problems

Energy companies must purchase their energy well in advance (sometimes even years) and they must make assumptions regarding the amount of energy that will be consumed. These predictions can only be adjusted within certain boundaries and cannot be altered within a 15-minute window before actual providing energy to their customers. The result is a constant discrepancy between the energy they purchased and the amount sold. In case there are shortages, additional energy must be purchased at the Power Exchange at high prices. It is possible to sell energy surpluses to the Power Exchange but at an extremely low price. Energy companies can loose a lot of money due to these discrepancies. Since Electricity plants can not react within 15 minutes on fluctuations, Energy companies can not manage their energy demand accurately.

Numerous small solar and wind generators could build a virtual power plant that can react within seconds. However, the unpredictable fluctuating behavior of solar and wind energy makes it difficult for a utility company to fit these renewable energy sources into their energy demand. This is due to the fact that availability can not be predicted and is not assured and therefore, energy storage is required. Furthermore, large-scale storage in batteries is not feasible due to the enourmous amount of batteries required to build the equivalent of a power plant and not all landscapes are suitable for hydropower.

Previous Options

The current available solar or wind inverter[2] technologies feed their energy in an uncontrolled manner directly into the grid for a fixed price. The owner has no option to negotiate regarding the conditions or the prices of the energy delivered. This means that the utility company must deal with the transport of the energy and manage the energy demand by increasing or reduction of the power generated by conventional power plants.

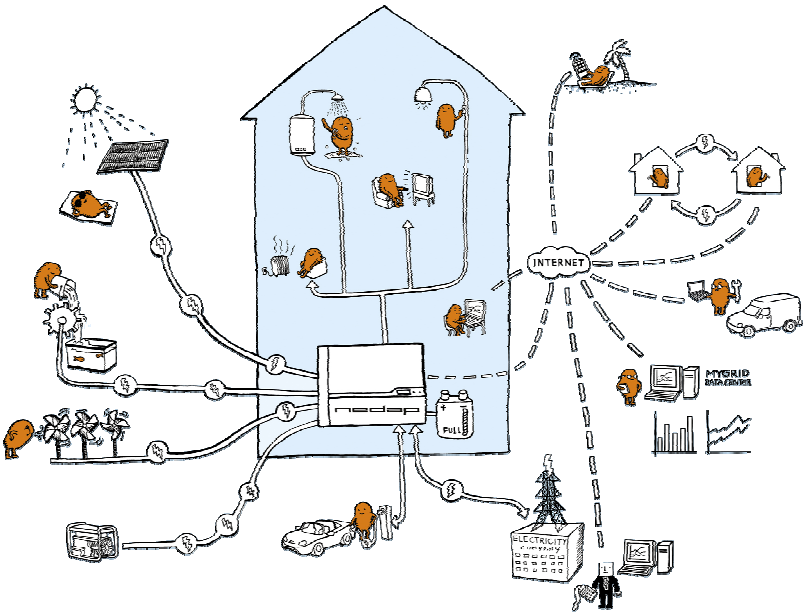
Owners of a solar or wind plant are reimbursed for the generated energy via the feed-in tariff[3]. The tariff is a highly successful stimulation method which made renewable energy popular causing major breakthroughs in use and technological advancements. These very popular inverters need the utility grid. By law, they have to switch-off when the utility grid fails. Which means that in the event of a power breakdown, the generated energy can not be used. Consequently, these types of inverters are not suitable for off-grid applications.

In areas with large amounts of locally generated renewable energy, it is even possible for the utility to switch off the inverters remotely. During a grid failure, a large capacity of energy is available, but cannot be used by the owner. Energy also cannot be stored and used later, or fed back to the grid at a later time.

[2] Definition of an inverter - a device used for transforming direct current (DC) into alternating current (AC). The inverter takes the DC electricity from solar panels, batteries, fuel cells and converts it to AC electricity. Grid tie inverter units return energy into the distribution network as they generate alternating current of the same frequency and wave-shape as is being supplied by the distribution system and turn off automatically if a blackout occurs.

[3] A Feed-in Tariff or a FiT, also called a Feed-in Law or a FiL, is a solar premium, also called Renewable Tariff or renewable energy payments. FiT was adopted as an incentive plan to encourage the implementation of renewable energy by way of government legislation. Electricity companies are required to purchase renewable electricity generated from solar PVs, biomass, wind, hydro and geothermal power at higher than market price. This price is meant to offset the disadvantage regarding the costs of implementing renewable energy sources and the rates differ depending on the type of source used to generate power

Nedap's Solution



Nedap PowerRouters convert solar and/or wind power and feed it back to the grid like a regular inverter. This provides payback revenue on the investment via the feed-in tariff.
However, when the grid fails, the inverter is not switched off, but rather, disconnected from the grid as required by law. The connected loads remain energized and are supplied by the generated energy. Even though the grid will still be disconnected, it will continue feeding the loads off-grid, the switchover is within 20msec., making it so fast it is unnoticeable to any user. When there is a surplus of generated energy, the surplus will be stored in the batteries. When there is a shortage, the energy of the battery will be used to support the generated energy or to replace it.

All Nedap PowerRouters are monitored and managed by way of the Internet. Consumed energy is monitored daily. Generated energy is monitored daily, weekly, monthly, and yearly providing all the vital information on the performance of your system. The condition of the batteries is also monitored. You can share this information with your installer or dealer allowing them to keep a close eye on your system and give you an early warning in the event there is available updates or a malfunction.

The MyGrid can be viewed as an ecosystem of Internet-connected PowerRouters that share information regarding their condition through the MyGrid server. This ecosystem grows into a virtual power plant, empowering the system owners to be in charge of their own household energy.

Within a few years, electricity rates will be differentiated, for example, during the evening 7 ct., and during peak hours 26 cts. per kwh. It is even possible that rates will vary over the day, hour by hour.

Nedap Mygrid enables you to avoid peak hours by disconnecting from the grid and using your own generated or stored energy. (You can charge your batteries for 7 ct. per kwh during the evening.)

Electricity companies welcome this development. During the evening hours there is generally a lot of wind energy available. In order to distribute this energy, conventional power plants need to be reduced, or even switched off which causing the power plant to run in an inefficient mode. This surplus can be stored in a large number of Nedap PowerRouter systems that are part of the MyGrid ecosystem and the connected

battery banks. By way of the Internet, the Electric Company knows the amount of energy that can be stored in the batteries and they know the agreement with the owner regarding allowing usage of their battery bank.

During peak hours, owners can make use of the stored energy themselves, in combination with their generated energy. Depending on the conditions, they may choose to sell their available energy.

Within a household there is equipment that is manageable from an energy consumption point of view. For example a freezer does not need to maintain a constant temperature of -4 degrees Celsius. It can be switched off, provided the temperature does not raises above zero degrees. Also, a dishwasher or washing machine does not need to start right away, as long as the tasks complete within a reasonable time.

Since these appliances are manageable, you may choose to run them during the evening, or if your electricity company made you an interesting offer or advices you a specific timeframe when energy is cheap.

The Nedap PowerRouter gives owners the ability to feed energy back to the grid and use and store the renewable energy. They can also supply loads, or to the grid depending on their conditions.

Through the Nedap Mygrid ecosystem, utilities can run power plants more economically and use renewable energy at their maximum or peak. The Nedap Mygrid provides electricity companies the ability to balance supply and demand more effectively. This will prevent short term purchases and dumping valuable energy. By virually interconnecting a number of Mygrid inverters, the electricity companies have direct acces to locally stored or generated energy. This energy can be fed into the grid instead of a regular powerplant. Thus creating a virtual power plant..

Implementation

Nedap PowerRouters can be used in parallel to existing solar systems, or in new solar, wind, or hybrid systems. Once connected to the Internet, the system data is immediately gathered by the Mygrid data center. This data is accessible to the user, the dealer and/or the utility company, through the web portals allowing full system control and negotiation conditions with your utility or electricity company.

Summary

Renewable energy sources are vital for the world's energy supply in the very near future. However, their unpredictable nature makes it hard to generate reliable energy. With the Nedap Mygrid ecosystem owners not only feed energy back into the grid, but also use, and store (renewable) energy and supply loads, or the grid at their conditions. A number of Nedap PowerRouters creates a smart grid with a large number of controllable loads and sources, allowing full use of renewable energy and economic operation of power plants. This prevents discrepancies between purchased and sold energy by energy companies. With MyGrid, you are in charge.

Nedap can get you started generating your own power with the patented PowerRouter and MyGrid technology. Immediately begin generating renewable energy to reduce the amount of electricity you currently purchase. You can even generate energy where there is no power service.

Wherever you reside, you can harness energy to convert to power. Nedap can guide you with your requirements for energy production since everyone has different needs depending on the area. We can assist you with identifying the benefits and costs of investing in our system.

We are the renewable energy leader, and pride ourselves on helping our customers implement a smart and sustainable environment. We will help you with on-site assessment to determine the specifics for your commercial environment.

Be the first in your area to implement this environmentally conscientious, energy efficient and cost-effective system.

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