Guidelines
Sustainable Remote Power Systems

Diesel, Wind and Solar

Basis of document:

- These guidelines may be freely distributed, but without alteration/deletion, and with full acknowledgement of the Author
- This information and other technical information can be found on our web-site, for the benefit of all designers and Clients. www.understandingenergy.com.au
- In a general document like this cost-effectiveness cannot be readily categorised. Your designer may be able to assist you in investigating the options. Alternatively the technical staff at Healey Engineering can assist.
- We offer no guarantee for your own assessment of your facilities, and professional help is recommended to overview your findings and to implement them effectively.

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1. AN HOLISTIC APPROACH

Remote powers systems are known as "RAPS" remote area power systems or "SPS" stand-alone power systems. These usually serve isolated communities, but also apply to city locations where houses are stand-alone. Housing loads usually dominate the total load, unless this is an industrial or mine site.

A small independent power system is not "city power" coming off an infinite plug from the sky.

Without all stake holders involved, the systems will be a failure. The Installer, the Designer, the Client, the Operator, the Service Tech, and the Occupants all have responsibilities to discharge that cannot be delivered by other parties. If all cannot do their role, then the system will not deliver.

1.1 The Diesel Engine

With low cost renewables the need for the diesel is misunderstood. On a solar installation, a diesel can be replaced by a large battery bank, but the economic analysis usually tells us that a combination of solar-battery-diesel gives greatest resilience and flexibility, and the best NPV (net present value).

The diesel is a clean highly efficient component of a sustainable power system, capable of long maintenance intervals, and incredible reliability. The challenge to a renewable system designer is to beat the high benchmark of an efficient diesel.

The visual nightmare of the dirty unreliable diesel is the result of incompetence.

1.2 The Single-Diesel System – Hidden Costs

Numerous locations rely on one diesel genset operating "24/7" for many months. There may even be a large genset for the "wet", with maybe another genset for the remainder of the year. This is usually energy inefficient, and unsustainable, as these gensets are always oversized and under-loaded.

A severely under-loaded genset lasts only 6 months (4,000 hours) before catastrophically failing, while a correctly loaded diesel can give more than 6 times this life, reliably, and more with normal maintenance.

The "un-sustainability" is usually hidden. These are the places where lights and appliances are deliberately left on to "give some load" to the genset. The high fuel costs (20% to 55% higher than need be) is paid from a different account than the repairs, and a different account than the purchase of a new machine. The result has been power that is expensive to build, expensive to run, and less reliable than necessary.

Management time is almost never recorded. The time in solving problems are "free" because the time of valuable people is not recorded (they could be doing other valuable things). Unreliability is never costed, but costs. Time is wasted writing purchase orders for failing equipment, and the boss's time is wasted. These costs are never fully brought together, so the real cost is never acknowledged.

1.3 Genset Over-Sizing

Numerous remote locations in the past, have had grossly oversized power systems, again resulting in under-loading. This is the result of applying overly conservative "city" electrical design processes to remote area systems.

Sizing power systems with emphasis on Electrical Maximum Demand (MD) kW for the genset sizing is engineering conservatism and "safe" design, but only safe for the designer. It is a disaster for the system. The hours of operation at peak loads are very brief, and the minimum loads are dramatically below the peak. The minimum loads in small communities may be 5% of the MD peak, or even less, and the minimums are very sustained.

There sometimes are reasons for this conservative approach. Some sites have a gross phase imbalance, and some sites have the large DOL (direct-on-line) punch of a large motor on start-up. Together these can require double the size genset than would otherwise be required. Some of these aspects of overdesign can be "engineered" out of a system by dealing with the whole site (holistic).

An attitude change is needed to accept that if a system is overloaded, it SHOULD shut down. This is not a failure but a valid signal to the community occupants to manage their load.

1.4 Load Estimation – Growth

Most communities have a likely steady progressive growth. A long window of growth must be accounted for in the fixed long-life assets:

- Total Planning
- Site location
- Power Sheds
- Power lines
- Switchboards.

Where the prediction of growth is uncertain a plan can be developed for a no-growth and a plan for a linear growth, and decision points on capital works set out.

Solar modules can (usually) be readily expanded. Gensets can be sized for the loads required within their periodic replacement window, with a decision at their minor overhaul and major overhaul points. Each site is different, with the Clients' capital works and maintenance policies relevant also.

1.5 Energy & Load Management

Efficient site management practices are of major importance. Mismanagement is a major barrier and personnel that cannot change are a dead weight to even the best designed system. At the time of development of the capital plan for a power station, it may be efficient to undertake a load audit and spend money replacing inefficient items.

Once the efficient power system is in place the occupants of the remote facility have a responsibility to manage their load and energy use. We cannot do this for them. Where government subsidies and rebates have been provided there is a legal obligation to manage competently. In all installations there is an ethical responsibility to society to manage competently.

1.6 Fuel Savings - Small Power Systems

A renewable power system (genset + solar hybrid) is efficient delivery 24 hour power. A genset-only system is not efficient for 24 hour power supply. For genset-only systems it is recommended to shut off power overnight.

Significant fuel saving and full genset service life can be achieved by restricting power to 2 periods a day of 5 to 6 hours each run. For genset-only sites consider solar lights in public areas and central paths to reduce the need for overnight genset operation.

2. VERY REMOTE SITES

Some very remote locations may in fact be inappropriate due to the greater complexity of renewables, a difficult conundrum to resolve. Small sites give a quicker financial return on a solar power system, compared to medium and larger sites.

3. REDUNDANCY

3.1 Small Power Systems

These are usually built with limited backup power. This is possible if the water supply is from an independent power source (say: solar). If water pumps depend on the power station, at least 2 gensets are required for redundant power.

- Consider a separate dedicated feeder to supply power to water bores.
- Does the water treatment (eg UV) need 24 hour power?

3.2 Medium & Large Power Systems

Large power systems usually already have redundant power (that is: backup gensets). Consider what will occur if the backup genset available is smaller than the total load. Some 'non-essential" power will have to be turned off. This can be difficult unless pre-planned with a feeder independent of the feeders to residential buildings. Provide separate dedicated feeder to supply power to:

- Essential services such as water and sewer
- Offices shop, clinic, school

4. ENERGY "SUPPLY & DEMAND AUDITS" FOR ISOLATED COMMUNITIES

The energy audit investigates and models the energy use patterns of remote sites including Resorts, National Parks, Rural Properties and Remote Towns & Communities.

In these projects the delivery of power and the use of power have to be analysed through energy 'supply and demand" audit studies.

The payment methods, cost recovery and the affordability and equity issues associated with energy metering and cost recovery must be assessed. Where metering and payment are not present then the power is "free" and there is no incentive for efficiency.