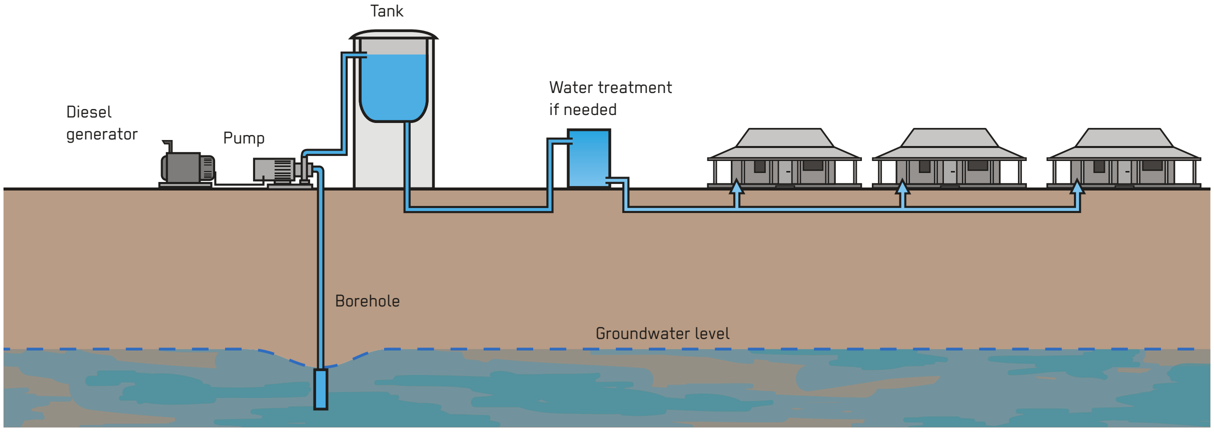
Diesel- and Gasoline-Powered Energy System

Response Phase	Application Level	Management Level	Objectives / Key Features
** Acute Response ** Stabilisation * Recovery	* Household ** Neighbourhood * City	* Household ** Shared ** Public	Abstraction, transport and treatment of water using energy from fossil fuels
Local Availability	**Technical Complexity**	**Maturity Level**	
*** High	** Medium	*** High	



Diesel-Powered Energy Systems use diesel engines directly on site to generate the energy needed to power water pumping, transport or treatment. This energy source is more suited to acute emergencies when grid power might not be immediately available, but it is less suitable in the long term due to the mounting environmental and financial costs.

Diesel engines can be used to either directly drive a pump through mechanical connections (e.g. through a V-belt attached to a spindle or by turning an impeller of a suction pump) or to produce electricity to power pumps. This differs from diesel-produced electricity that is sent to the grid in that the energy production here remains local with no long-distance transmission, though this comes with higher O & M requirements.

Design Considerations: In water supply, diesel is a common energy source for both pumping and supplying energy for other treatment processes (e.g. dosing pumps). A key consideration when designing Diesel-Powered Systems is whether the required supply should be direct current (DC) or alternating current (AC). For the former, a converter will be needed, and for the latter, it should be clear whether single-phase or three-phase is needed. All of these options can be used for water systems, and the choice depends on the context and power requirements **(see S.11 for details)**.
Another important design consideration at the outset is how long the Diesel-Powered supply will be needed. On-site Diesel Power can address the more acute phases of an emergency but should be phased out for the medium- to long-term water supply where possible. A diesel generator for water pumping should be sized correctly, so that enough energy can be supplied to run the pump as well as to start it (when more power is needed). This involves understanding what total equipment will be drawing power

from the generator now and in future, and then sizing it based on the required kW. For pumps, a rule of thumb for required KVA is to multiply the kW of the motor by two. In addition, the power output from diesel engines decreases with an increase in both temperature and altitude. To account for this, 1.3 % is deducted for every 100 metres over the standard altitude (taken as 100 metres), and 2 % is deducted for every 5° C above standard temperature (taken as 25° C). Whilst a generator should be large enough to cope with the starting requirement, over-sizing should be avoided to prevent excessive fuel and oil consumption. A load should be designed to be at least 40 % of the rated generator capacity, as running continuously on a light load risks clogging the injectors over time with carbon deposits from unburnt fuel, which will require a major service to decarbonise. To increase the life of the fuel filters and to protect the fuel injectors when diesel fuel is used directly from drums, the drums should stand for twelve hours before use so that the sediment can settle and then be tilted such that the extraction pipe is away from the sediments.

Materials: In addition to the diesel generator, necessary materials will depend on what type of equipment requiring Diesel-Powered supply is to be used (e.g. pumps) and how water will be stored and distributed.

Applicability: Diesel generators are suited to acute emergencies when power is needed immediately, and grid power might be intermittent or unavailable. In the longer term, other sources of power should be used due to the cumulative environmental and financial costs of using diesel.

Operation and Maintenance: Diesel generators require significant O & M, including oil and oil filter changes every 250 hours (or half that if the air temperature is more than 35° C), an air and fuel filter change every 500 hours (or more frequently depending on local dust conditions and if the fuel is dirty), a major service every 1,000 hours, an overhaul every 10,000 hours, and replacement after 35,000 hours. Trained personnel are needed for these services, yet there is often no focus on this, especially in an emergency. Good practice is to employ one specialist to carry out this service for all generators in a location. The availability of trained personnel also means that problems can be troubleshooted as they arise. Generators can have a host of problems with either the ignition system or engine, and finding remedies based on symptoms requires experience. Otherwise, instead of analysing and then repairing a malfunction, the tendency of untrained electricians or mechanics is to do a 'fix' to get the generator working in the short term (e.g. bypassing safety controls or switches), which can then lead to accidents.

Health and Safety: Only trained personnel should be allowed to work on generators and diesel-engine-driven pumps. The area where the equipment is operating should be off limits to the general public, and there should be shields for fast-moving V-belts in engine-driven pumps. If fuel is not stored and decanted correctly, it may pose a hazard by contaminating groundwater. This can be minimised by storage on bunded concrete platforms and requires suitable drainage to collect any leaks or spills. Generators also emit significant noise and particulate pollution, which can be a health hazard to people living nearby.

Costs: Maintenance costs for diesel systems are at least 25 % higher than for solar or electric (up to 2.8 USD/person/year) due to fuel consumption and the required maintenance, and they do not make economic sense for systems running for more than a few years. For example, a solar-powered system will usually pay back the initial investment in under five years compared to a Diesel-Powered System that will continue to consume financial resources. Environmental costs in terms of carbon emissions are also high with diesel. For example, experience from a refugee camp in South Sudan showed that pumping around 1,000 m^3 per day via 10 boreholes with a 40-metre deep water table consumed over 58,000 litres of diesel per year, equivalent to driving 26 times around the world in a diesel car.

Social and Environmental Considerations: Diesel as an energy source is very common and is well accepted by people. However, if users pay for operation, then higher fuel prices might lead to a preference for renewable options, especially in the longer term. Diesel generators can also be a nuisance due to noise levels.

Strengths and Weaknesses:

(+) Useful where electrical power is unreliable
(+) High performance

(−) High environmental cost
(−) High ongoing financial cost
(−) Significant O & M needed, requiring trained personnel
(−) Noise and particulate pollution, plus pollution risk to soil and water

→ **References and further reading material for this technology can be found on page 214**