Energy management
Guideline

2012

Logistics Department
Action Against Hunger

Document revision history:

Revision date	Author	Summary of changes
2012	Logistic Department	Initial release

Notes:

Table of contents:

1 - Foreword

This document provides technical insight but also a presentation and explanation of Action Against Hunger standards when existing.

There are two levels of standards:

(Mandatory) indicates a standard intended to ensure uniformity and safety of Action Against Hunger's installations. Derogation may be possible under special circumstances (emergency, etc.) after validation by the energy referent at the HQ.

(Recommended) indicates a recommendation: derogations are possible according to local constraints without validation from the HQ. However be careful as these recommendations, usually lesson-learned from past Action Against Hunger's experiences, are intended to guarantee simplicity and availability of energy systems on the long-run in real field conditions.

Indicates a point of attention or a cause of common mistake

Hurried readers can refer directly to the annex 1 where all standards are summed-up.

2 - Introduction

2.1 Scope

This guideline is intent ended to help those in charge to improve the energy management of a building with 2 main goals:

- Reduce costs,
- Reduce nuisance and environmental impact.

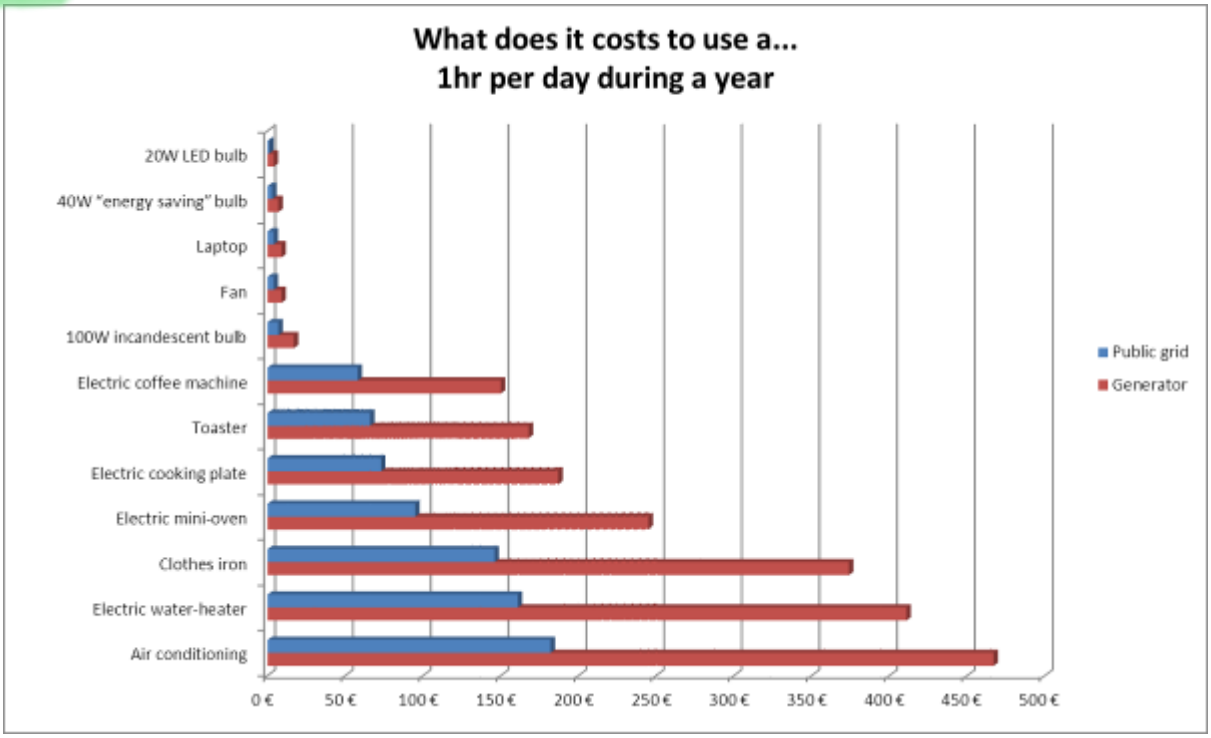
2.2 Why does it matter to manage energy?

2.2.1 Capital expenditure

Due to poor availability and reliability of the public grid, almost all Action Against Hunger bases are equipped with at least one independent power supply (mainly generator) and often with a second one as back-up (generator, solar or battery systems).
This requires significant investments that could be reduced through better sizing and energy demand management.

2.2.1 Running costs

Using an electrical appliance may seem free but electricity, whether purchased from the public electrical company or produced by a generator, is expensive.



It is often possible to reduce electricity consumption without degrading the quality of service.

In addition, on a typical Action Against Hunger installation, electricity price varies with the hour and day. It depends of course on the availability of the public grid: running an appliance on generator will be at least two times expensive than wait for the public grid to come back and run it on public electricity.
But even with the same power supply, the amount of money needed to power an appliance is not the same if this appliance is used during a peak period (as the generator is already above its optimal utilization rate or even above its nominal power), during the night or on Sunday when the generator will have to run only for this appliance or during a period of average consumption. As a result, another way to reduce electricity bill is to consume electricity when it is the cheapest.

2.2.2 Nuisance and environmental impact

Beside its cost, energy consumption has significant environmental and social impacts.

If you are using a generator:
- Local nuisances: noise, vibration, odor…
- Atmospheric (CO, NOx, etc.) and soil (oil leakage…) local pollution
- Contribution to global warming
- Consumption of non-renewables resources (petroleum)

If you are using electricity from a public electricity company:
- Pollution and water overconsumption: most of the electricity produced in the world (and especially in developing countries) come from thermal plants (coal, fuel, etc.) which have an heavy impact on local environment
- Consumption of non-renewable fossil-fuel
- Contribution to global warming
- Usage conflict: many developing countries encounter power shortage, as the electricity you use will not be available to other users, by over-consuming electricity you may be indirectly responsible for power outages in less favored part of the city.

2.3 How can you decrease your energy bill?

There are 2 complementary ways to improve energy management on a base:
- **Energy demand management**: minimize energy consumption without reducing quality of service and avoid unnecessary energy consumption.
- **Energy supply management**: choose the best main and back-up power supplies according to your particular situation and size them properly to optimize investment and running costs.

3 - Energy diagnostic

3.1 What is the energy diagnostic?

The energy diagnostic is necessary to understand the power and energy needs of your installation. It will be necessary at each step of the energy management process, mainly:

- To calculate your total energy and power needs and help sizing your power supplies (generator, solar…),
- To identify the appliances and services that account for a significant part of your total energy and power needs,
- To understand the variation of your power and energy needs within a day and identify the peak periods,

It will also serve as a standard data gathering form for HQ support if required.

For these reasons, it is important to fill the energy diagnostic and to update it in case of evolution on supply (purchase of a new generator…) or demand (building extension, purchase of new appliances…) sides.

(Mandatory) The energy diagnostic must be filled (or if necessary updated) before any new investment in power supply. It must be updated in case of significant modifications on the demand side.

3.2 Instructions for use

Only the orange-colored area can be modified. Areas with other colors must not be altered.

1. Open the Excel file and save it as « Diagnostic energie – Countryname Basename building – ddmmyyyy » (ex : « Diagnostic energie – Liberia Monrovia Office – 23062012 »)

2. Fill the information required in the « Info base » tab

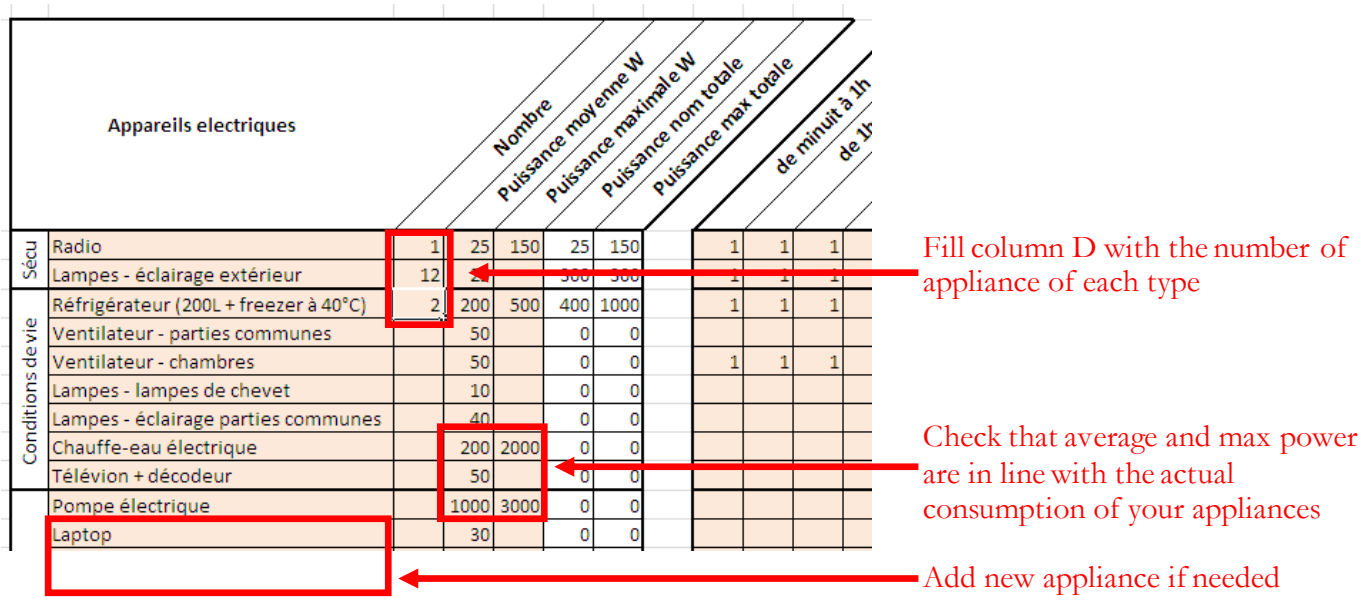
3. In the « Conso » tab, most common appliances were prefilled with typical consumption values.

Check that prefilled consumptions are consistent with those of your appliances (electrical consumption can be found on the identification tag of the appliance or in the user manual, it can also be measured using a wattmeter).
If needed add other appliances in the blank lines of column C.

The **average power** (column E) is the average power consumption when the alliance is switched on. Average power is usually equal to nominal power.

The **max power** (column F) is the highest input power that can be required by the appliance, for example the starting power for an electric engine or the emission power for a radio. If max power is equal to average power, this cell can be left empty.

On each line (column D) put the number of appliance of each type used in your installation (0 if you do not use this type of appliance).



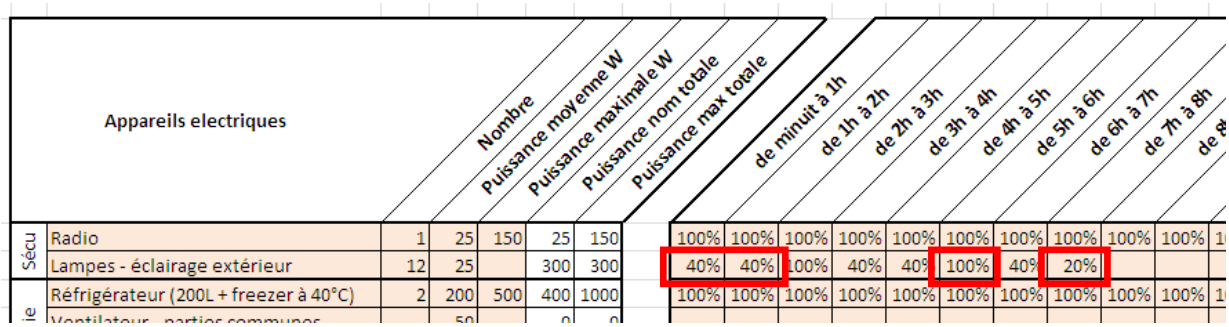
4. In the « Conso » tab, for each type of appliance fill the utilization rate during each time slot.

Utilization rate:

- 100% means that all appliances of the considered type are running during the full time slot (1 hour).
- 50% means, for example, that half of the appliance are running during 1 hour or that all appliance are running during 30 minutes
- 0% means that all appliance of the considered type are off during 1 hour (in that case, the cell can be left blank)

Evaluate utilization rates seriously and honestly, there is no need to add security margin at that point.

Example:



A base has a security lighting system with 12 25W LED bulbs. Five bulbs are on during the whole night, then the utilization rate is:

$$5 / 12 = 0.42 \approx 40\%$$

Every 3 hours, all bulbs are switched on for the watchman to do its patrol, as a result, the utilization rate is 100% from 2am to 3am and from 5am to 6am.
The sun rise and lights are switched off at 7:30. From 7 to 8, the utilization rate is:

$$40\% / 2 = 20\%$$

Radio and fridge are on 24/7: their utilization rate is always 100%.

5. Have a look at your data.

In the « Conso » tab, column AI and AJ allow you to see the share of each type of appliance in the total energy consumption (AI) and in the total power consumption (AJ).
In the « Graphes conso » tab, you see the evolution of the power consumption (in red) and the evolution of the energy consumption (blue) during the day.

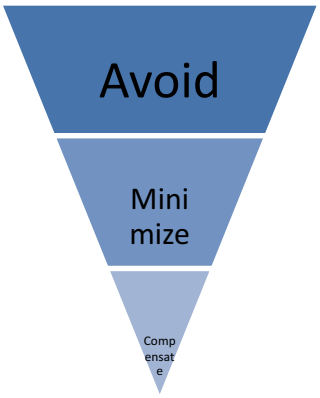
You can use these indications to cross-check the consistency of your data: bedside bulbs should not use a significant part of the power, if the building is a guest-house, the peak hour must be in the evening…

4 - Energy demand management

4.1 How does EDM work? A general approach

4.1.1 Goal and principle

As for any environmental impact reduction, the process goes through 3 steps:



1. **Avoid**: try to prevent partially or totally the environmental impact for example by reconsidering a project, adopting a different methodology, etc.

2. **Minimize**: when an impact cannot be prevented, try to reduce its magnitude and extension.

3. **Compensate**: when an impact cannot be prevented and that every measures have been taken to reduce it; try to compensate this impact through rehabilitation or restoration projects

This is an ordered approach as avoiding an impact usually cost nothing and is more environment friendly than minimizing it and minimizing is still less costly and more efficient than compensation.

The goal of energy demand management is to avoid unnecessary energy consumptions and to minimize inevitable consumptions without degrading quality of service. Compensation will not be addressed in this guideline.

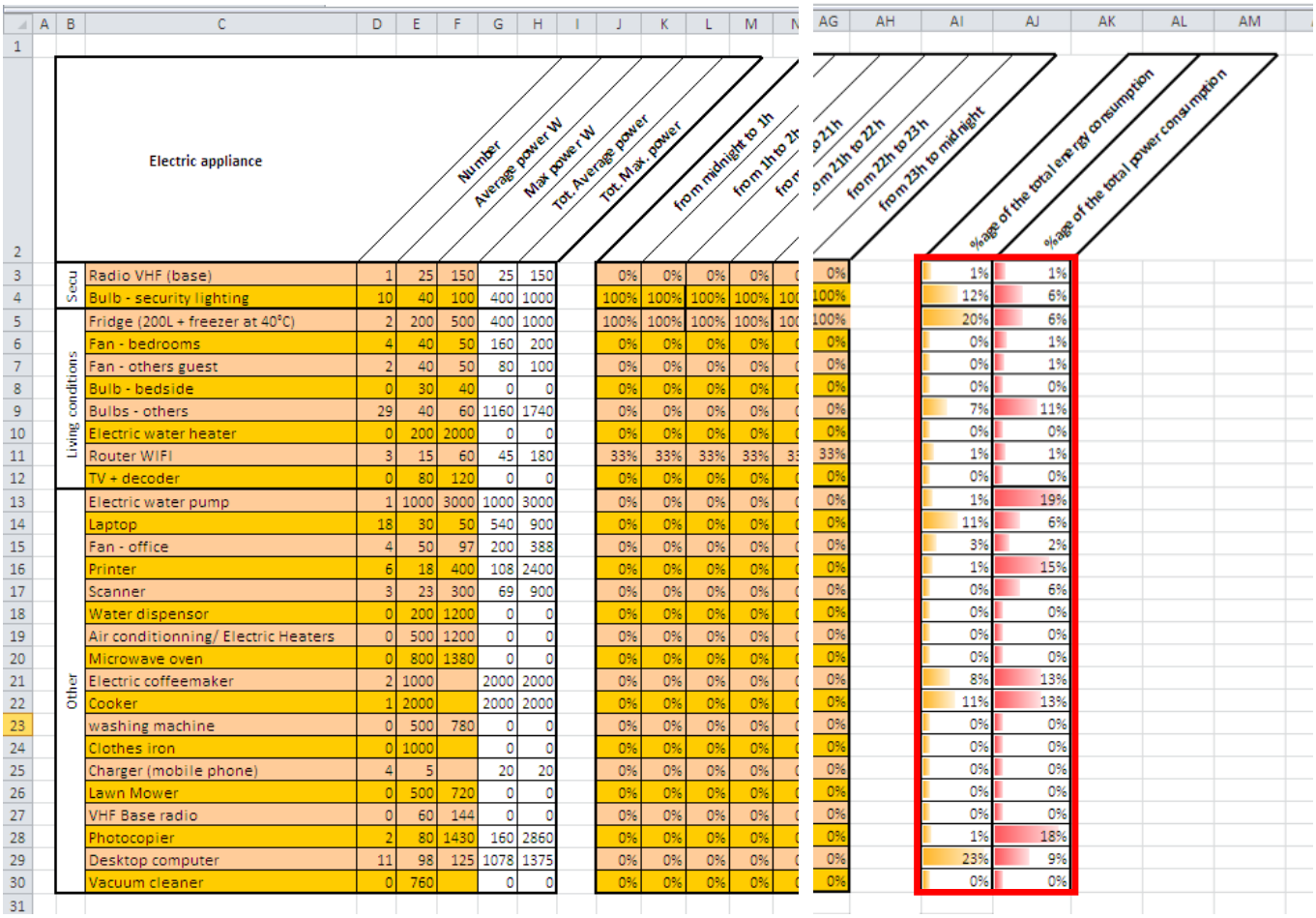
The main idea of the approach proposed here is to think in term of services instead of devices (for example you don't need air conditioning, you need a fresh place to rest) and to try to find the most effective way(s) to fulfill this service (place bedrooms on the shady side of the building, install white curtains and keep them close during the afternoon, enhance insulation, install ground-coupled heat exchanger or, possibly, air conditioning)

In this section, you will have a general overview of energy demand management process. More specific actions will be proposed in the next sections.

4.1.2 Step 1: Identify high-impact services

The first thing to do is to understand what services have a significant impact on your power or energy consumption.

The energy diagnostic will help you on that task: for each appliance, the percentage of their consumptions in the total power and energy consumption of your installation appear in rows AI and AJ.



	Electric appliance	Number	Average power W	Max power W	Tot. Average power	Tot. Max. power	from midnight to 1h	from 1h to 2h	from 21h to 22h	from 22h to 23h	from 23h to midnight	%age of the total energy consumption	%age of the total power consumption
Secu	Radio VHF (base)	1	25	150	25	150	0%	0%	0%	0%	0%	1%	1%
Secu	Bulb - security lighting	10	40	100	400	1000	100%	100%	100%	100%	100%	12%	6%
Living conditions	Fridge (200L + freezer at 40°C)	2	200	500	400	1000	100%	100%	100%	100%	100%	20%	6%
Living conditions	Fan - bedrooms	4	40	50	160	200	0%	0%	0%	0%	0%	0%	1%
Living conditions	Fan - others guest	2	40	50	80	100	0%	0%	0%	0%	0%	0%	1%
Living conditions	Bulb - bedside	0	30	40	0	0	0%	0%	0%	0%	0%	0%	0%
Living conditions	Bulbs - others	29	40	60	1160	1740	0%	0%	0%	0%	0%	7%	11%
Living conditions	Electric water heater	0	200	2000	0	0	0%	0%	0%	0%	0%	0%	0%
Living conditions	Router WIFI	3	15	60	45	180	33%	33%	33%	33%	33%	1%	1%
Living conditions	TV + decoder	0	80	120	0	0	0%	0%	0%	0%	0%	0%	0%
Other	Electric water pump	1	1000	3000	1000	3000	0%	0%	0%	0%	0%	1%	19%
Other	Laptop	18	30	50	540	900	0%	0%	0%	0%	0%	11%	6%
Other	Fan - office	4	50	97	200	388	0%	0%	0%	0%	0%	3%	2%
Other	Printer	6	18	400	108	2400	0%	0%	0%	0%	0%	1%	15%
Other	Scanner	3	23	300	69	900	0%	0%	0%	0%	0%	0%	6%
Other	Water dispensor	0	200	1200	0	0	0%	0%	0%	0%	0%	0%	0%
Other	Air conditionning/ Electric Heaters	0	500	1200	0	0	0%	0%	0%	0%	0%	0%	0%
Other	Microwave oven	0	800	1380	0	0	0%	0%	0%	0%	0%	0%	0%
Other	Electric coffeemaker	2	1000		2000	2000	0%	0%	0%	0%	0%	8%	13%
Other	Cooker	1	2000		2000	2000	0%	0%	0%	0%	0%	11%	13%
Other	washing machine	0	500	780	0	0	0%	0%	0%	0%	0%	0%	0%
Other	Clothes iron	0	1000		0	0	0%	0%	0%	0%	0%	0%	0%
Other	Charger (mobile phone)	4	5		20	20	0%	0%	0%	0%	0%	0%	0%
Other	Lawn Mower	0	500	720	0	0	0%	0%	0%	0%	0%	0%	0%
Other	VHF Base radio	0	60	144	0	0	0%	0%	0%	0%	0%	0%	0%
Other	Photocopier	2	80	1430	160	2860	0%	0%	0%	0%	0%	1%	18%
Other	Desktop computer	11	98	125	1078	1375	0%	0%	0%	0%	0%	23%	9%
Other	Vacuum cleaner	0	760		0	0	0%	0%	0%	0%	0%	0%	0%

Note that appliances with limited power consumption may have a significant energy consumption if their are used for a long time and that, on the contrary, a very powerful appliance which is rarely used will not consume much energy.
Both energy and power consumptions have to be taken into account to identify priorities. Of course priority must go to services that have an high consumuption on both, then to services with an high consumption of energy only and finally to those with an high consumption of power only.

Example:
On the energy diagnostic displayed above, we can see that the most important energy consumers are by order of magnitude:

1. Desktop computers,
2. Fridge,
3. Security lighting,
4. Cooker,
5. Laptop,
6. Coffee machine,
7. Lighting (other than security)

On the next row, we see that the biggest power consumers are :

1. Water pump,
2. Photocopier,
3. Printer,
4. Cooker,

5. Coffee machine,
6. Lighting (other than security),
7. Desktop.

Thus it may be insteresting to go into the following services :
- Office working tools,
- Refrigeration,
- Lighting,
- Cooking,
- Coffee making,
- Water pumping.

4.1.3 Step 2: Examine potential alternatives

To fulfill some needs, you may have no other choice than consuming electricity. It is obviously the case for office working tools (nobody will ask you to use typewriter instead of computer and copier to reduce energy consumption), refrigeration (fridge is the only solution), light…
It may also be difficult to replace costly equipment when your building is already equipped.

But for some needs – such as cooking, inner cooling, hot water, etc. – there are a variety of solutions. In that case, take time to list possible solutions and to find the best one according to:
- Feasibility and initial cost,
- Energy consumption and other running costs,
- Service quality.

Example: Coffee making (a not so anecdotic example as on many Action Against Hunger bases this activity is in the top 5 power consumption)

Service need: fresh coffee twice a day

Possible solutions:
- Electric coffee maker
- Instant coffee + vacuum bottle
- French press + vacuum bottle
- Moka pot + cooking plate
- Partnership with neighboring coffeehouse

Cost advantage analysis:

	Cost	Energy cons.	Service quality
Electric coffee maker	++	+++	++
Instant coffee + vacuum bottle	+	+	+
French press + vacuum bottle[1]	++	+	+++
Moka pot + cooking plate	++	++	+++
Coffeehouse	+++	+	++

4.1.4 Step 3: Reduce losses, increase efficiency

Once you have chosen the best available solution, you can still try to improve its efficiency:

[1] By the way next time you come to Paris come to our office say hello and taste some freshly pressed coffee.

- **By choosing efficient and well-sized appliances**: when you buy a household appliance, consider its energy consumption. User manual or energy label (such as European energy efficiency rating) often mention approximate yearly energy consumption in kWh. Consider global costs and not only initial cost: as a rule of thumb, if your main power supply is a public electricity grid, electricity will cost around 0.2€/kWh, if you are using a generator as main power supply fuel and maintenance costs will be around 0.5€/kWh.
  Pay attention to the sizing as well: there is usually no need to buy a 250L fridge for 2 persons.

- **By using your appliances in a way that maximizes their efficiency**. There are a lot of ways to do so depending on the considered appliance but most of them could be labeled as common sense : keep appliance clean (no dust in AC filter or on fridge condenser, etc.), close door and window when using AC, etc.

Example: Fridge
Fridge is one of the big energy consummer that can be find on almost all Action Against Hunger bases and it is not uncommon to measure consumption as high as 1500kWh/year. A B class fridge would need approximately 250kWh/year, not to mention a A+++ class frigde (most efficient available so far) that would only need around 100kWh/year.

4.1.5 Step 4: Reduce unnecessary use

Once you have chosen the most efficient solution and maximized its efficiency, you can still reduce the energy consumption by avoiding unnecessary use : switch-off appliances and light when leaving a room, unplug water-heater when not in use…

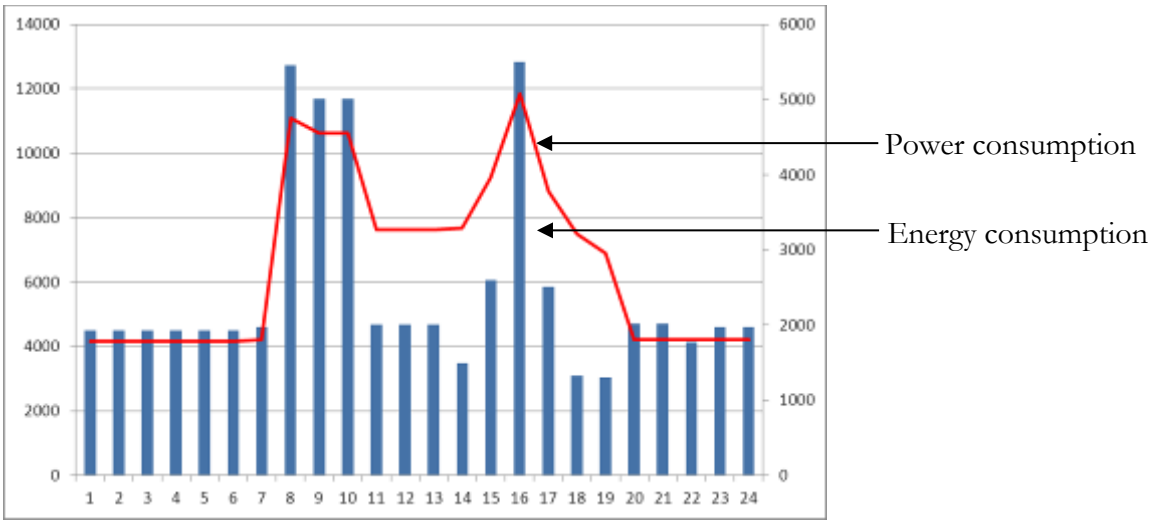
(Mandatory) Users must be trained to energy saving and must be aware its benefices. Energy saving posters (see annex 2 for example) or leaflet must be displayed inside the building.

4.1.6 Step 5: Optimize consumption over time

The energy diagnostic shows your energy and power consumption within in a day and allows to spot peak energy and power consumption period.

Peak periods are usally:
- during working hours for an office,
- Between 7pm and 11pm for a guest-house,
- At the end of the afternoon and in the evening for a compound with both office and guest-house

Example:
Extract from a energy diagnostic:



In that case peak periods are located during working hours in the morning and the afternoon.

During peak period, try to use by order of preference:

1. public grid,
2. generator,
3. Battery or solar system only in last resort as batteries would be quickly discharged by the high energy consumption.

If possible, avoid using the most powerful appliances during peak periods or when your installation is running on battery/solar back-up. As far as possible try to postpone the usage of these appliances until the end of the peak period or the return of the grid.

To help user understand, which appliances they should use with caution, it is recommended to mark powerful appliances which usage can be postponed with red stickers.
It is important to distinguish between postponable services (used for comfort or non-urgent tasks) and non-postponable one (used for work, security, communication…). Only the first one must be marked with a red sticker. These appliances include (but may not be limited to):

- Electric water-heater,
- Keetle,
- Microwave oven,
- Electric oven,
- Electric cooking plate,
- Air conditionning,
- Electric heaters,
- Washing machine,
- Clothes iron,
- Toaster,
- Electric coffee machine.

Other appliances, that could be used during peak period or when the installation runs on batteries, should be marked with a green sticker.
A notice is proposed in annex 2 to be displaied inside buildings for users information on that point.

(Mandatory) If your installation is using battery and solar system as back-up, the powerful appliances which usage can be delayed must be marked with a red sticker. Unless they have no other choice, users should not use these appliances when the main power supply is off.

(Recommended) If your installation is not using battery and solar system, powerful appliance which usage can be delayed should be marked with a red sticker and users should be encouraged to avoid using them when the main power supply is off.

4.2 Tips by services

In this section, you will find ideas and advices to reduce consumption of some of the services that represents significant power and/or energy consumption on Action Against Hunger missions.

4.2.1 Light

Light is one of the most popular application of electricity but, as long as it is used reasonably, it will not have much impact on your energy and power consumption.

Security lighting systems are an exception to this rule: as they are switched on all night long, they can have very significant energy consumption. It is especially interesting to try to decrease this consumption if your installation is working on batteries during the night.

Type	Usage	Yearly energy consumption	Approx. yearly running cost	
			Public grid	generator
Prodigal : 20 x 100W energy saving bulbs	8 hrs/day	5840kWh	1168€	2990€
Reasonable : 12 x 40W energy saving bulbs	8 hrs/day	1400kWh	280€	717€
Sober : 8 x 20W LED bulbs	8 hrs/day	470kWh	94€	241€

4.2.1.1 Alternatives

There is of course no alternative to a good security lighting system.

However it is possible to reduce the energy consumption by:

- **Choosing more efficient bulbs**: preferably LED bulbs then "energy saving" bulbs instead of incandescent bulb or fluorescent tubes.
- Using flood lights, reflector or other devises to **focus light beam on the requested area** and protect bulbs. It is possible to improvise this type of system with local materials.
- **Adapting the lighting system to your actual needs and removing unnecessary bulbs**. If you suspect think that a bulb may be removed, simply try it for one night.

4.2.1.2 Good practices

Keep bulbs clean: dust may decrease the luminous intensity of a bulb by as much as 40%.

Make sure that household bulbs are switched-off when unnecessary, especially in common area. If raising awareness is not enough, technical solutions, such as timer or presence sensor, can be found.

Make sure that security lighting is switched off as soon as possible after sunrise.

4.2.2 Air conditioning and ventilation

Air conditioning involves extravagant energy consumption: using AC 1 hour a day during a year represents a consumption of 730kWh (equivalent of the yearly average consumption of an inhabitant of Morocco or Viet-Nam). One hour of air conditioning every day cost around 150€/year if electricity is supplied by a local power company and more than 400€/year in fuel and maintenance if it is produced by a generator.

(Recommended) Air conditioning should be reserved to building exposed to extreme heat and with access to a public electricity grid.

Ventilation (fan) is much more frugal: one hour a day during a year represent a consumption of 19kWh, 40 times less than air conditioning.

(Recommended) Rooms equipped with AC should be equipped with fans too and users should be encouraged to use AC only when fan is not sufficient.

4.2.2.1 Alternatives

Building organization: First and most obvious thing to do whenever it is possible: place rooms where fresh air is more important (like offices and bedrooms) on the shady sides of the building. Usually the hottest side of a building is west (as it is exposed to afternoon sun).

Building environment: It is possible to decrease temperature inside a building by avoiding direct solar radiation, for example using vegetation or screen. It is especially important to protect aperture (windows and doors).

Insulation: Insulation will help keeping the building fresh during the day. To decrease the effect of sun avoid dark buildings and especially dark roofs (white painted roof absorb 1.5 to 4 times less solar energy than colored or tide roofs).
Some ideas:

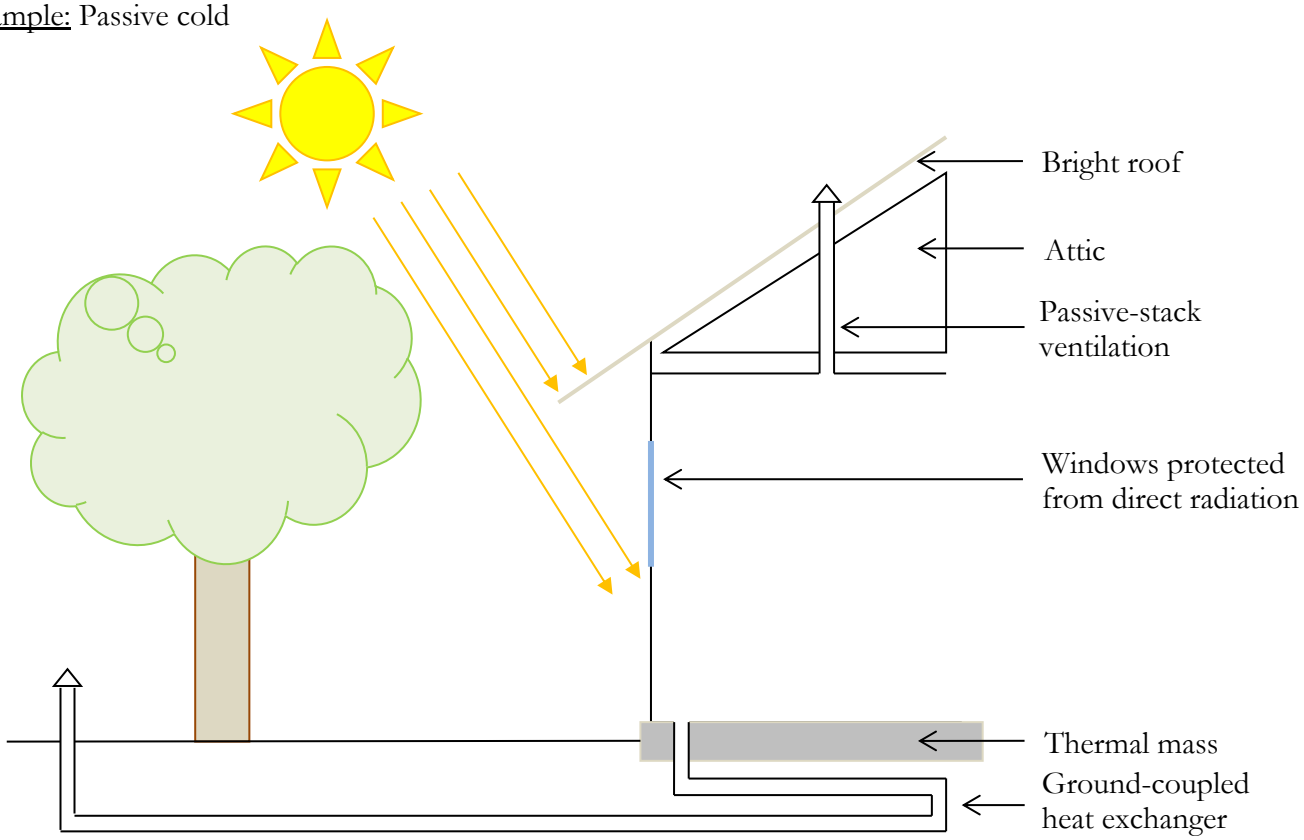
- Use roof extension or awning to protect windows during hottest hours,
- Install white window shades, drapes or blinds to reflect heat away and close them on sun-facing windows during the day.
- Create attic under the roof,
- Insulate attic or, even better, install radiant barrier.

Thermal mass: thermal mass placed on shady and well-ventilated part of the building can help regulating temperature. Thermal mass can be created by using earth-sheltering, clay brick, concrete…

Natural ventilation: Depending of the building, a room can sometimes be ventilated easily through cross-ventilation (i.e. openings on two sides of a room). It is also possible to create a natural ventilation system using cross-ventilation or passive-stack ventilation.

Passive air conditioning: Air conditioning does not necessarily mean energy consumption. One of the most popular zero-energy air conditioning systems is ground-coupled heat exchanger with natural ventilation.

Example: Passive cold



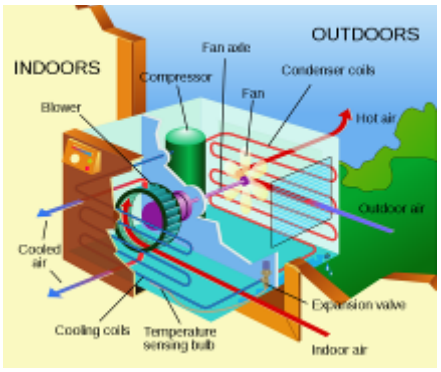
Fan: Fan can be regarded as an alternative to air conditioning. As using AC is 40 time more expensive than using fan, it worth equipping rooms where AC is already installed with fan and encourage user to switch AC on only when fan is not sufficient.

4.2.2.2 Good practices

Do not allow electric devices to produce more heat than necessary: first of all remember that almost all electric devices – including light, computer… – produce heat. Switching them off will help to maintain temperature at a comfortable level.

Keep air-conditioning systems clean: To avoid decreasing efficiency but also for hygiene reasons, air conditioning systems should be maintained at least once a year:

- Make sure that nothing obstructs the airflow on both side of the appliance (furniture, vegetation…)
- Clean cooling (also called evaporator) and condenser coils
- Clean or replace filters
- Check that power cord and switch are in good condition



Use AC only with closed gate and windows

Preset AC: Preset AC temperature as high as is reasonably comfortable (for instance 25°C).

Switch off AC or fan when leaving a room

Make sure all AC and fan are switched-off when leaving a building, after working hours for an office and when leaving guest-house in the morning.

4.2.3 Refrigeration

4.2.3.1 Alternatives

There are barely no alternative to electric fridge for food storage. However, it is possible to decrease energy consumption by choosing a more efficient and well-sized fridge.

Type	Yearly cost (public grid)	Yearly cost (generator)
Average Action Against Hunger fridge	350€	900€
Fridge 200L class B	80€	205€
Fridge 200L class A+++	24€	61€

4.2.3.2 Good practices

Choose a fridge with a good energy rating.

Place fridge in a fresh and ventilated area, a fridge should not be exposed to direct solar radiation. **Keep sufficient place behind the fridge**: the condenser need fresh air to work properly.

Set fridge temperature to 4°C.

Do not let a fridge nearly empty: filling it with water bottles, for example, will give him more inertia and prevent overconsumption due to exchanger stop and go.

Keep fridge in good condition: Make sure your refrigerator door seals are airtight, clean condenser coil and do not let frost accumulate.

4.2.4 Heat water

As cold, heat is very expensive to produce with electricity. Electric water-heaters have a very high energy and power consumption.

4.2.4.1 Alternatives

Solar water-heaters are a highly recommend alternative to electric water-heaters.

(Recommended) Building using battery or solar system should not be equipped with electric water-heater.

Direct passive solar water-heaters (also called "monobloc" water-heater) are cheap, reliable, easy to use and install and able to provide 100% of your hot water needs even under temperate latitudes.
The sizing of a solar heater involve its:

- Volume: ~50L per user are enough to cover all daily needs
- Solar panel surface: 0.5 to 1 m² per user depending on the climate and number of user (surface required per user decreases with the number of user)

Example:
For a small guest-house with 2 expats under temperate climate, a 125L, 2m² solar heater is fine. It will cost between 1000 and 1500€.
For a bigger guest-house with 8 expats under temperate climate, it is possible to choose a 300L solar heater with two 2m² panels. It will cost from 2000 to 2500€.

4.2.4.2 Good practices

Set the thermostat on your water heater to 50°C to get comfortable hot water for most uses without wasting energy.

Insulate your electric hot-water storage tank and the first meter of the hot and cold water pipes without covering the thermostat.

Drain 1L of water from the tank at least twice a year (see user manual or manufacturer website for details).

Unplug your electric water-heater if you do not use it for more than half a day. Under hot climate, water-heater may not be necessary, do the test and unplug it if it appears that you do not need it.

4.2.5 Kitchen and cooking

There could be many powerful appliances in a kitchen, for example:

- Electric coffee-machine,
- Cooking plate,
- Toaster,

- Microwave oven,
- Electric oven,
- Kettle.

These appliances are used for short duration, so that they may have a limited impact on your energy consumption but their impact on power consumption is very significant. If you are using a generator, each one of the appliance will force you to increase the rated power of the generator by ~2kVA (let say that you need 6kVA to supply your installation, if in addition you want to use an electric coffee machine and a cooking plate, you will need to buy a 10kVA generator)

What does it cost to use a…	1 hour a day during a year if you are running on…	
	Public grid	Generator
Electric coffee maker	58€	150€
Electric cooking plate	73€	187€
Toaster	66€	168€
Microwave oven	58€	150€
Electric mini-oven	95€	245€
Electric oven	182€	471€

4.2.5.1 Alternatives

Gas range is the main alternative to electric cooking and should be preferred at least for building where the main power supply is generator.

(Recommended) Building using battery or solar system as back-up and/or generator as main power supply should not be equipped with electric oven or electric cooking plate.

4.2.5.2 Good practices

Do not duplicate electric cooking machine: for example prefer a shared coffee-corner per building rather than individual coffee-machine in several rooms.

Try to reduce as far as possible the use of electric cooking: do not preheat, switch-off and finish cooking thank to inertia…

Whenever possible, **use microwave ovens instead of electric oven**. Use pressure cookers if available.

Use vacuum bottles to keep large quantity of water or coffee warm instead preparing several small quantities with kettle, stove or coffee machine.

Do not use electric cooking while your installation is running on battery.

4.2.6 Household appliance

Some household appliances have great impact on power consumption. It is the case for clothes iron, washing machine, lawn mower, vacuum cleaner, etc.

4.2.6.1 Alternatives

Try to find alternative to electrical household appliance especially if the main power supply of your installation is a generator.

When buying a household appliance mind its power and energy consumption.

4.2.6.2 Good practices

Do not duplicate household appliance.

Do not use these appliances while your installation is running on battery.

Try to reduce as far as possible the duration of use.

Laundry tips: **Wash full loads only. Wash your clothes in cold water** using cold-water detergents.

4.2.7 Office working

Office working tools are usually not a problem. However some of them have high power consumption, for example printer and copier, and others, like laptops, have limited power consumption but may represent a significant part of your energy needs as they are used in great number and over protracted periods.

4.2.7.1 Alternatives

There are obviously no alternative to office working tools but it is sometime possible to choose them regarding their power and energy consumption.

4.2.7.2 Good practices

Do not duplicate printers, copier and scanner if not required.

Do not use UPS and regulator if not necessary, for example if your installation is supplied through an inverter-charger.

Encourage users **to put these appliances in sleep mode as often as possible** when they leave workstation for a meeting, a break…
Preset sleep mode on computer after 10 minutes of inactivity. Sleep mode divide the power consumption of a computer by around 50 and will protect computers against unauthorized access. Hibernation mode has lower power consumption but need more time to restart and may be annoying on the long run, on the contrary screensaver mode do not save energy.

Unplug the appliances when you do not use them for some time. Even if they are switched-off, most electronic devices have a residual consumption of a few watts. Do this **especially for laptop** as the transformer in the AC adapter draws power continuously, even when the laptop is not plugged into the adapter.

(Recommended) Plug all appliances from a workstation on a power strip that can be turned off and encourage user to switch it off when leaving the office.

5 - Energy supply management

5.1 Choosing your energy supplies

Whether you open a new base, move to a new building or renew an out-of-order power supply, you will have to choose a main and a back-up power supplies among:

- Public electricity delivered by the local grid company,
- Generator,
- Battery system,
- Solar system.

The combination of main and back-up power supplies you will choose must be able to:

- Deliver enough power for your installation,
- Guarantee a 24/7 availability of electricity in the building,
- Ensure a minimum quality (limited voltage drop or frequency fluctuations),
- Minimize costs,
- Keep the impact on the local environment as low as possible (smoke, vibrations, noise during the night…) to ensure good living and working conditions and prevent neighborhood conflict,
- Minimize the global environmental impact of Action Against Hunger.

Energy demand management is absolutely necessary to have a chance to achieve all these goals simultaneously. Once you have taken all necessary measures to reduce your energy consumption, you can go ahead and try to find the best power supply for your particular situation.

(Mandatory) An energy demand management process must have been carried out before any new investment in energy supply.

5.1.1 Quick indications to choose your main and back-up power supplies

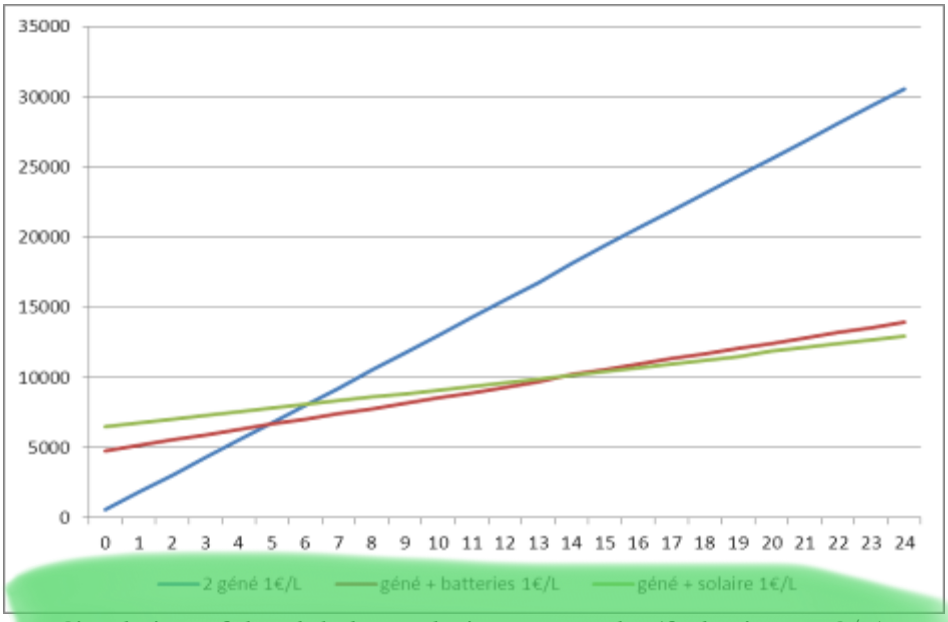
5.1.1.1 Initial and running costs

Buying a generator is not very expensive but it needs fuel and maintenance and its running costs are high. On the other side, battery and solar systems require significant investments but will have very low running costs. When you choose a power supply you must consider both initial and running costs.

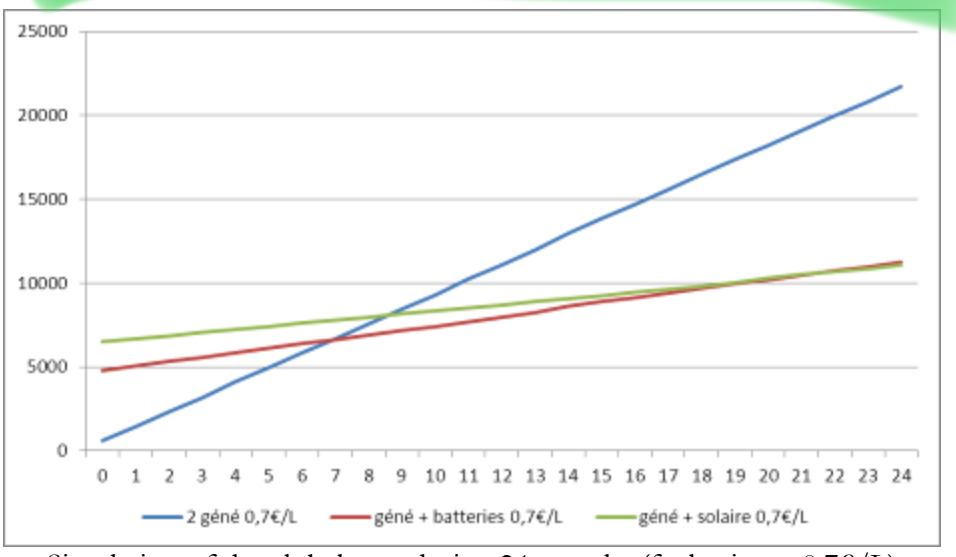
Example: Initial and running cost for a new back-up in RCA

This guest-house has 8 expats and no access to grid so that it was so far running only on an 8kVA generator.

Proposed back-up	Initial cost	Total cost after 1 year	Total cost after 2 years
2kVA generator	0.6k€	14.6k€	28.8k€
Battery system	4.8k€	9.3k€	13.9k€
Solar (covering 30% of energy needs)	6.5k€	9.6k€	12.9k€



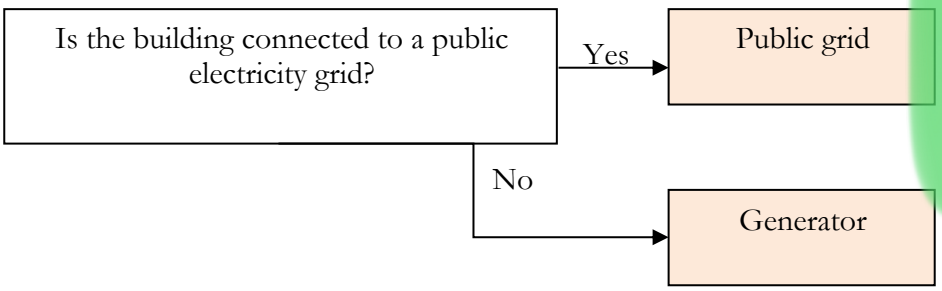
Simulation of the global cost during 24 months (fuel price = 1€/L)



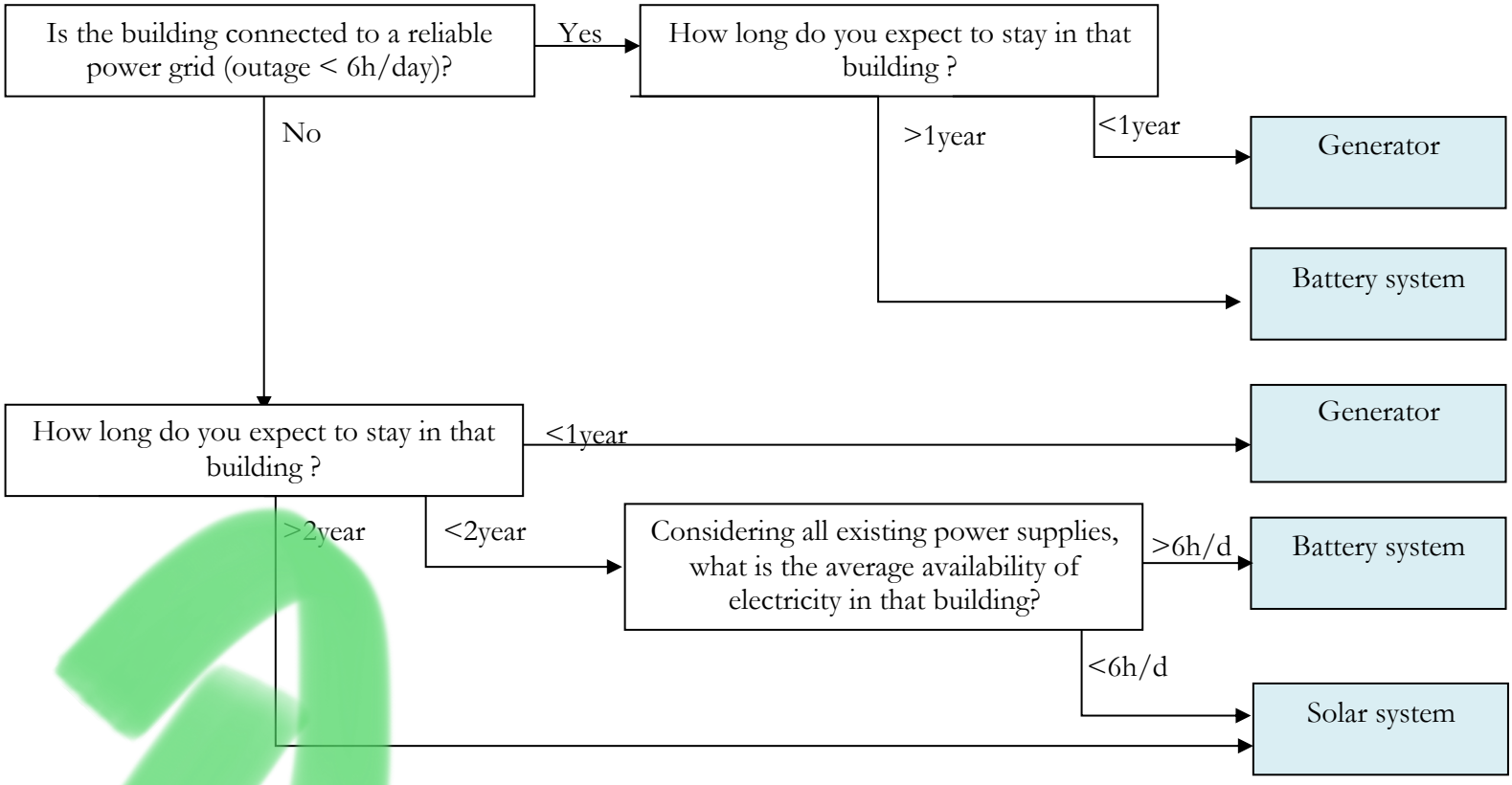
Simulation of the global cost during 24 months (fuel price = 0.7€/L)

5.1.1.2 Decision tree

Choice of the main power supply:



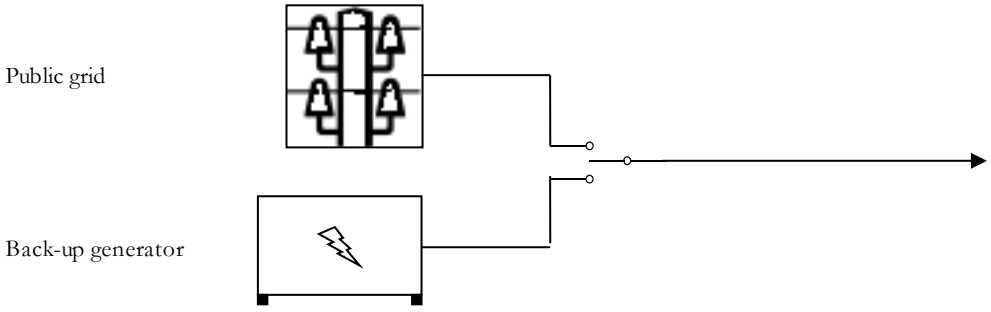
Choice of the back-up power supply:



5.1.2 Detailed overview of each solution

5.1.2.1 Public grid + generator

The electricity provided by the local power company is used as main power supply. A generator is purchased to back-up the installation in case of outage. This generator should be able to cover all electricity needs of the installation excluding appliance marked with red stickers (see 3.1.6).



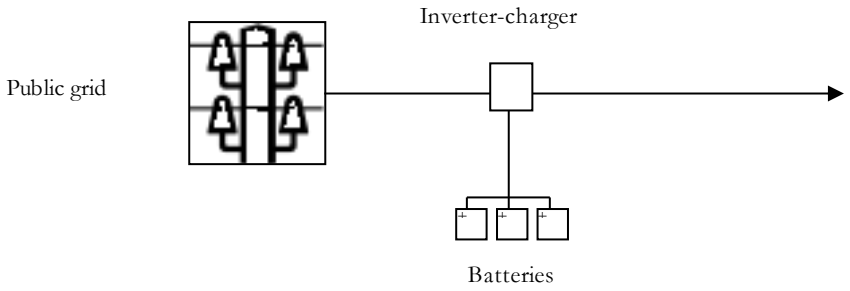
Advantages	Disadvantages
Simple and cheap Locally available Limited nuisances	Short outages as the generator must be started when the grid go down UPS and/or regulator necessary Fuel supply and stock necessary Maintenance required for the generator even if it is rarely used

Recommended for:

- Building connected to a public grid with long unpredictable outages
- Building connected to a public electricity grid in a deteriorated security context
- Building connected to a public electricity grid and used for a limited duration
- Emergency

5.1.2.2 Public grid + battery

The electricity provided by the local power company is used as main power supply. A battery system provides a limited autonomy to the installation in case of outage.



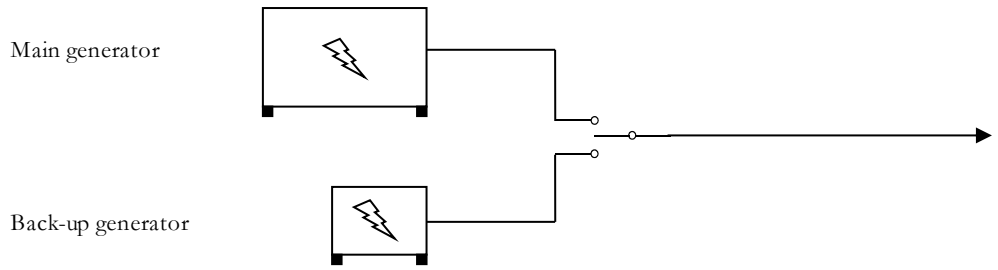
Advantages	Disadvantages
24/7 electricity without outage and micro-outage High reliability Good electricity quality Easy to add solar supply No nuisances	Grid dependent Local purchase and maintenance not always possible Battery room required Higher initial cost than a generator Back-up generator may still be necessary Limited lifespan of the batteries (2 to 5 years) and possible environmental impact of batteries disposal

Recommended for:

- Building connected to a public grid with short and frequent outages
- Building connected to a public grid with night outages

5.1.2.3 Generator + generator

The electricity is provided by a couple of generators. Both generators can have the same power to be used indifferently or one generator can be smaller to be used as a back-up only, in that case it will not need to cover the electricity needs of the appliances marked with red stickers (see 3.1.6).



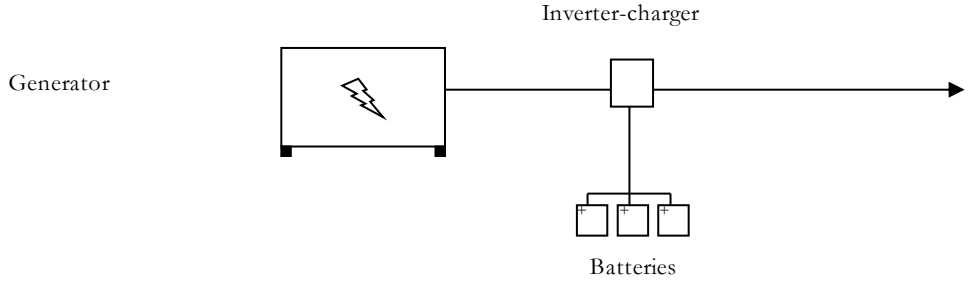
Advantages	disadvantages
Well-known technology Locally available Limited initial costs	Permanent nuisances. High running cost Short outage as generators are switched UPS and/or regulator required Fuel supply and stock required Limited reliability and frequent maintenance

Recommended for:

- Isolated building with high energy needs
- Isolated building used for a limited duration
- Emergency

5.1.2.4 Generator + battery

The electricity is provided by a generator during peak hours. A battery system accumulates electricity when the generator is running and supply the installation during low consumption hours.



Advantages	Disadvantages
24/7 electricity without outage or micro-outage	Fuel supply and stock required Minimum daily running duration for the

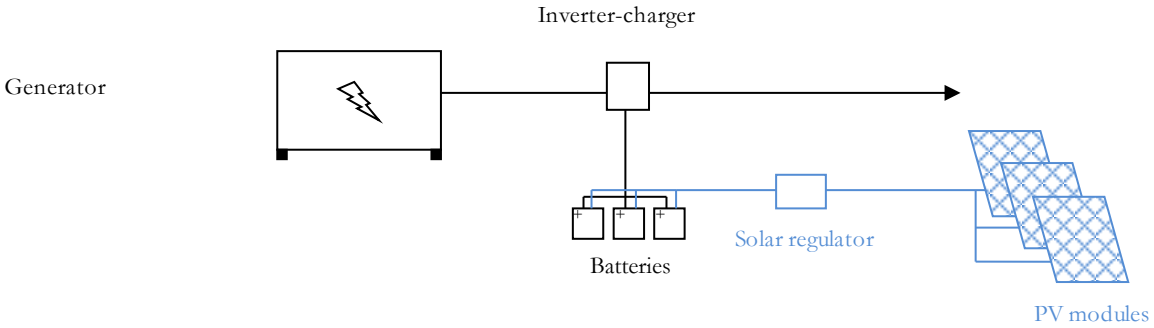
No nuisance during low consumption hours (night…) Good electricity quality Better reliability and service-life of the generator More flexibility on power consumption Easy to add solar supply	generator to reload batteries Local purchase and maintenance may not be possible Battery room required Higher initial cost than generator alone Back-up generator may still be necessary Limited lifespan of the batteries (2 to 5 years) and possible environmental impact of battery disposal

Recommended for:

- Isolated office or compound
- First step toward the installation of a solar system

5.1.2.5 Generator + solar system

The electricity is provided by a generator during peak hours and by solar system during the day. A battery system accumulates electricity from both sources and supply the installation when they are off.



Advantages	Disadvantages
Same as "generator + battery" + Lower nuisances Fuel saving, best cost/efficiency ratio on the long run for isolated building Very reliable back-up power supply	Local purchase and maintenance may not be possible Battery room and a large open surface required High initial cost Limited lifespan of the batteries (2 to 5 years) and possible environmental impact of battery disposal

Recommended for:

- Isolated guest-house
- Isolated building with limited energy needs
- Isolated building with a few years visibility
- Isolated building in area where fuel supply is very difficult and/or very expensive
- Building where security context impose a very reliable and totally autonomous back-up power supply (risk of hibernation…)

5.2 Sizing your energy supplies

A good sizing is necessary to avoid both:

- Over-investment and lower efficiency due to over-sizing,
- Power or energy shortage and degraded lifespan due to under-sizing.

Guidance for proper sizing of each type of power supply (generator, battery and solar) are detailed in the dedicated guidelines. Please refer to the kitlog for further information.

6 - Annexes

Annex 1: Standard overview

Annex 2: Energy saving poster

Standards overview

(Mandatory) The energy diagnostic must be filled (or if necessary updated) before any new investment in power supply. It must be updated in case of significant modifications on the demand side.

(Mandatory) Users must be trained to energy saving and must be aware its benefices. Energy saving posters (see annex 2 for example) or leaflet must be displayed inside the building.

(Mandatory) If your installation is using battery and solar system as back-up, the powerful appliances which usage can be delayed must be marked with a red sticker. Unless they have no other choice, users should not use these appliances when the main power supply is off.

(Recommended) If your installation is not using battery and solar system, powerful appliance which usage can be delayed should be marked with a red sticker and users should be encouraged to avoid using them when the main power supply is off.

(Recommended) Air conditioning should be reserved to building exposed to extreme heat and with access to a public electricity grid.

(Recommended) Rooms equipped with AC should be equipped with fans too and users should be encouraged to use AC only when fan is not sufficient.

(Recommended) Building using battery or solar system should not be equipped with electric water-heater.

(Recommended) Building using battery or solar system as back-up and/or generator as main power supply should not be equipped with electric oven or electric cooking plate.

(Recommended) Plug all appliances from a workstation on a power strip that can be turned off and encourage user to switch it off when leaving the office.

(Mandatory) An energy demand management process must have been carried out before any new investment in energy supply.

Help saving energy and protecting the environment by following some simple rules and encouraging others to do the same.

Be careful with big electricity consumers

- Appliances, marked with **red stickers**, have very high electricity consumption.
- Use them sparingly at any time and, if you can, do not use them when the (complete with main power supply) is off.

Switch off

- Turn things off when you are not in the room such as lights, TVs…
- Put your computer in sleep mode during breaks and meeting and switch it off after working hours.

Unplug

- Unplug unused laptop and phone charger.
- Do not let appliances plugged when you will not use them for a long time

Save energy - Save money

Save the environment