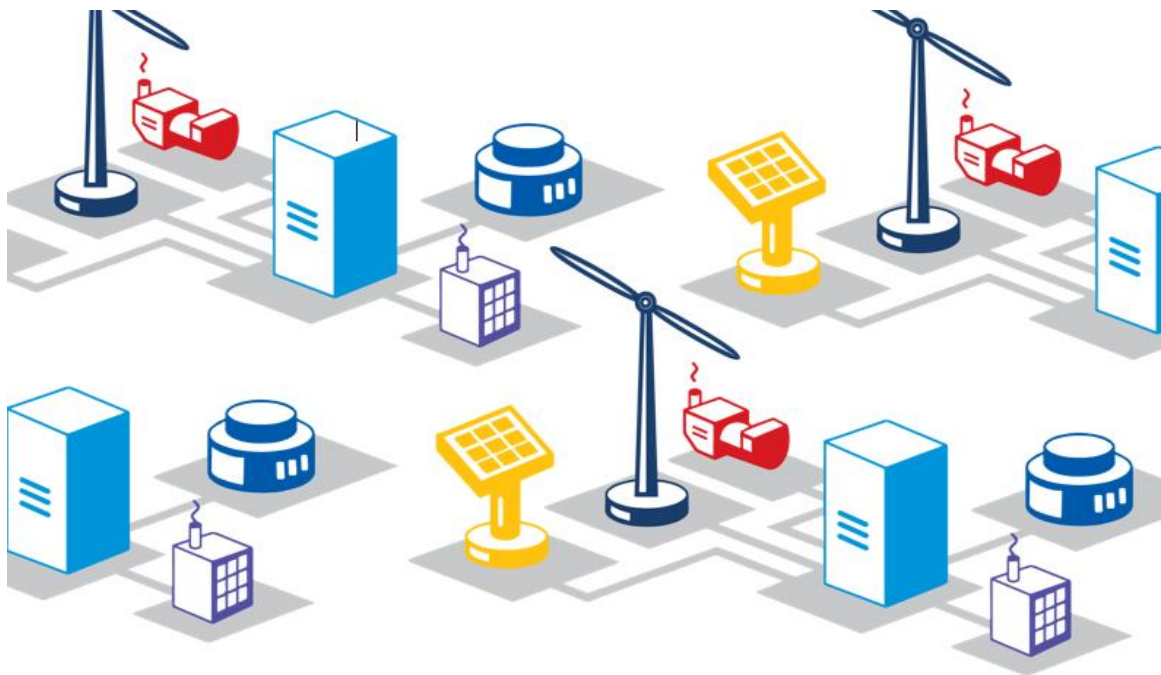


Powered by



Decentralised  
Hybrid  
Energy  
System



## Blueprint / 100 households

Project: Birkenfeld

Date: november-19

## Site information - Location data

### Name

General Case Birkenfeld (GER)

### City

Birkenfeld

### Country

Germany

### Address

### Zip code

### Average wind speed

4,09 m/s

### Reference height

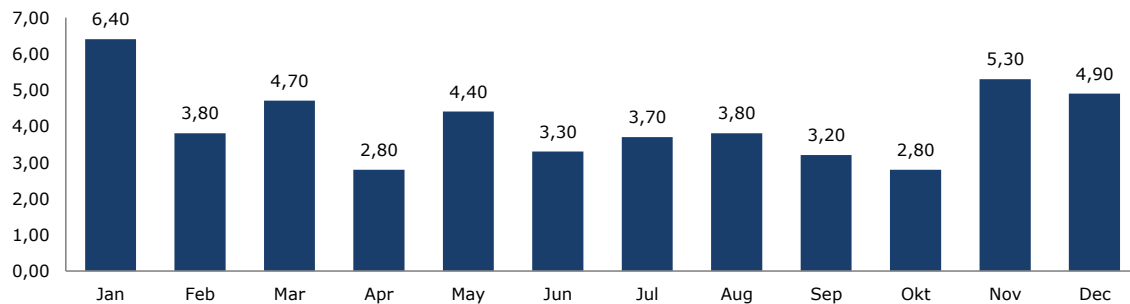
30 m

### PV (kWh/kWp per year)

877

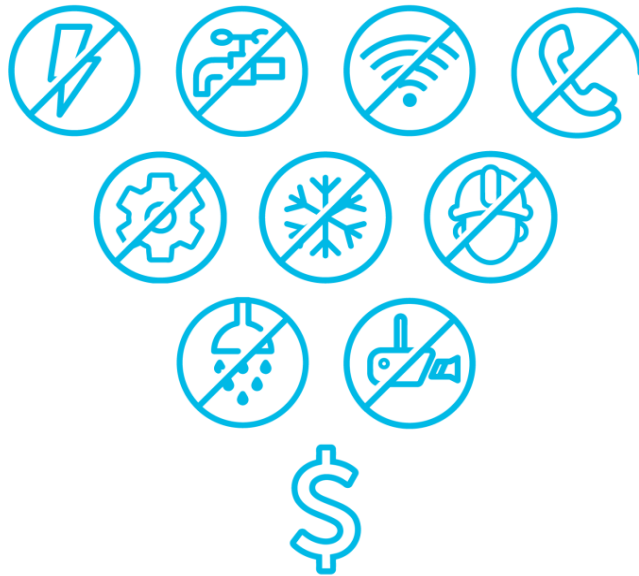


Wind speed per month (m/s)



Note: Wind assumption is constant

## What if there is no reliable energy supply?



### High (hidden) losses

#### What a DHES can do for you - you will discover in this business case

There are a lot of losses if there are power outages. Think about the costs you make and profit you lose, if you don't have energy supply. The icons you see above illustrates the losses you make. OGTC can help you to create an energy supply you can trust and that helps you to reduce the costs you will make in the current situation.

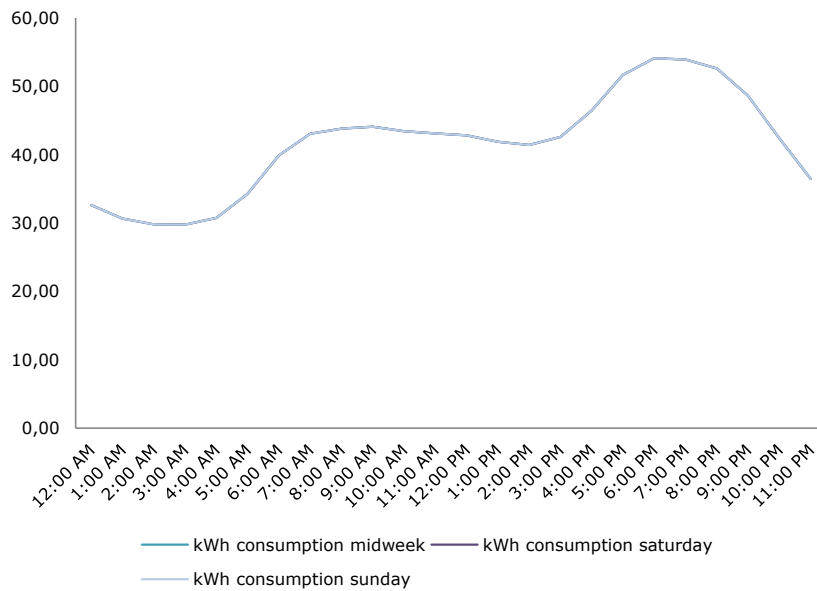
Besides the problems we illustrate above, the cost of energy in the new situation will be low, because of low maintenance and the profit from the natural resources. To make this even better, you will help to build on a better future for this planet!



## Current situation

Energy consumption per day	1.000 kWh
Energy consumption per year	365.250 kWh

<b>Cost of energy per kW/h - total consumption</b>
<b>€ 0,2200</b>
0,249 USD
<b>Percentage grid energy</b>
<b>100%</b>

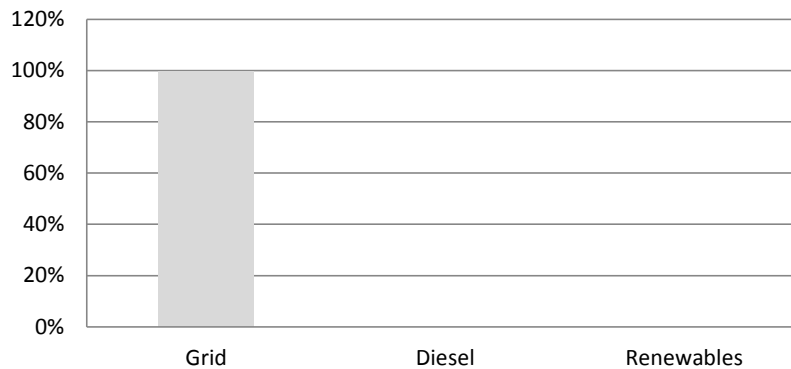


<b>Percentage diesel generator</b>
<b>0%</b>

<b>Percentage renewable</b>
<b>0%</b>

<b>Liters diesel per year</b>
<b>0</b>

## Current sources



There is a lot to win in the current situation. In addition to the problems that can arise if the energy supply fails. The renewable percentage is:

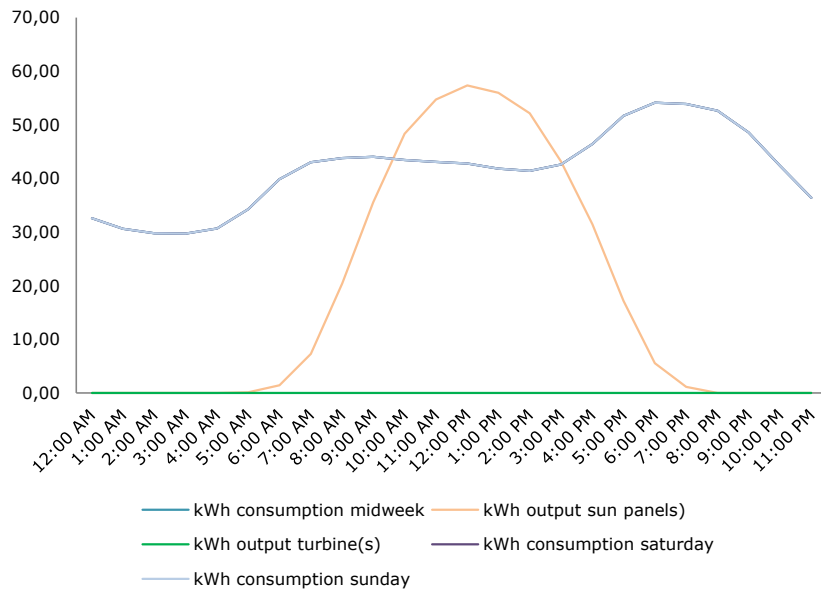
**0%**

Renewables

## New situation

Energy consumption per day	1.000	kWh
Energy consumption per year	365.250	kWh

<b>Cost of energy per kW/h - total consumption</b>
<b>€ 0,1904</b>
0,215 USD
<b>Grid energy</b>
<b>66%</b>

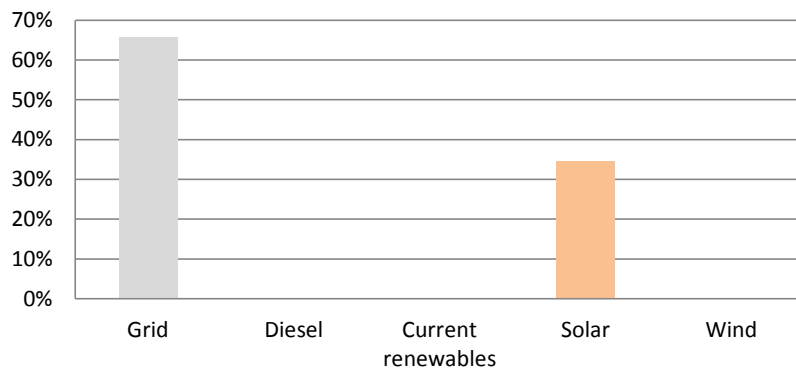


<b>Percentage diesel generator</b>
<b>0%</b>

<b>Solar power</b>
<b>34%</b>

<b>Wind power</b>
<b>0%</b>

### New sources



<b>Battery storage</b>	The energy supply will be very reliable in the new situation. Besides that the energy consumption will become considerably greener. By switching to this solution, your energy consumption will be:	
<b>0%</b>		
<b>Balancing grid energy:</b>		
Export to grid (other):	32.029 kWh	
Import from grid (other)	239.446 kWh	13% green energy

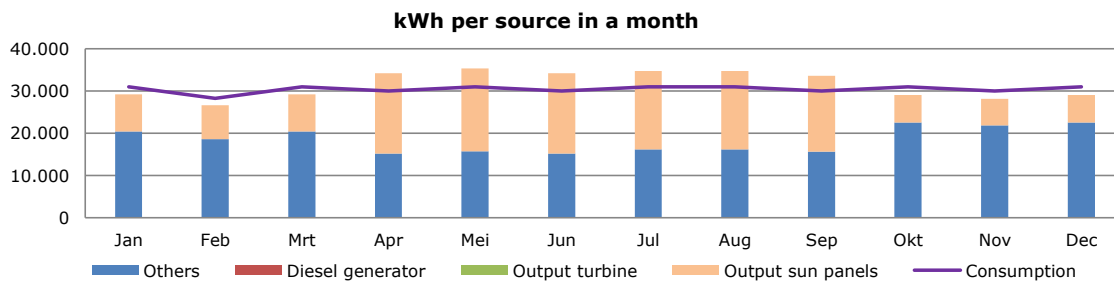
<b>34%</b>
<b>Renewable*</b>
<small>* Inclusive balancing green energy from grid</small>

## Solution

Wind Turbine			
0 x	0 kW	Hub height	30 meters
		Output	0 kWh



The other sources of energy:		Project Period	
<b>Current source</b>	<b>Output</b>	20 years	
	239.446 kWh	<b>Liters diesel saving per year</b>	
<b>Sun panels</b>	<b>Output</b>	-	
180 kWp	157.833 kWh		



Note: Excess of energy can be used for example water threatment

## Solution

### How the energy system will look like - Two key elements:

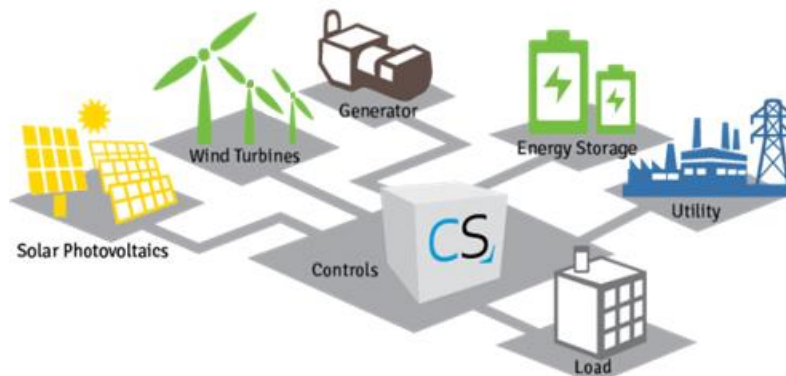
**100% availability of electricity** due to the use of renewable sources and a diesel backup. In many situations the grid is the only source of energy. The costs of a power outage are enormous! The smart combination of both a diesel generator and renewable sources will lower the cost of energy but more important, energy is available at any time.

**Low cost due to the use of a DC based 'smart grid'**. Microgrids have been around for many years. Most of those microgrids use the diesel generator as the main source of energy, where the diesel engine is 'making the grid'. The diesel acts as the 'master' and the other sources act as 'slaves'. As a consequence of this configuration, the diesel has to run all the time. This means that the diesel runs when there is no need for electricity of the diesel and that the diesel runs very inefficient at low RPM (idling). In a DC based system the diesel is not needed to make the grid and will only be used when electricity of the diesel is needed. This saves a lot of fuel!

### The ideal hybrid system: DC based system

#### DC based system - Summary

- The diesel generator(s) only runs if necessary
- Low maintenance cost > decrease cost of energy
- Low fuel cost > decrease cost of energy
- 100% reliable
- Efficient communication between sources



# Financials

Capex		
€	244.080	USD 275.810

Opex		
€	5.085	USD 5.746

Payback Period in years
8,58

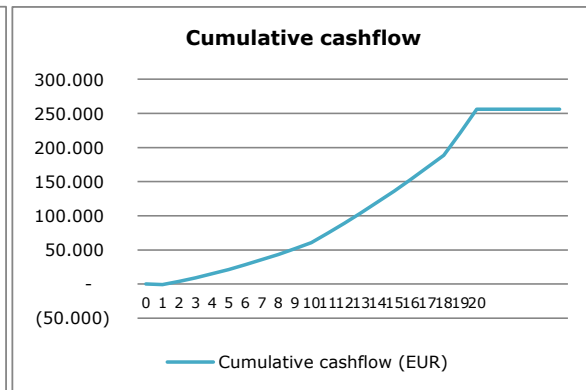
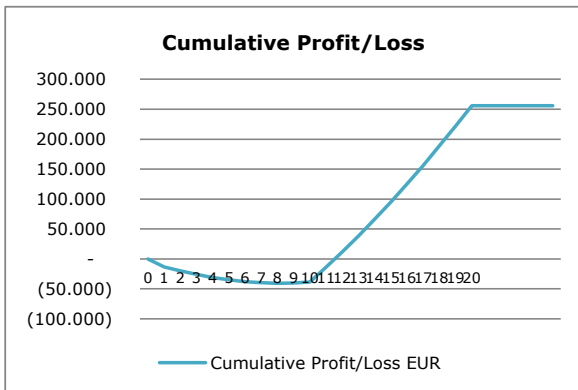
Turnover per year		
€	30.560	USD 34.532

Profit/Loss after period		
€	256.056	USD 289.344

IRR on investment
10,7%

<b>Inflation rate:</b>		2,00%		
<b>Tax rate:</b>		0,00%		
<b>Export tariff:</b>	EUR	0,0900	USD	0,102
<b>Exchange rate:</b>	EUR	1,00	USD	1,13

	Commercial loan	Crowd funding
<b>Amount debt</b>	€ 183.600	€ 32.400
<b>Repayment period</b>	18	10,00
<b>Interest</b>	4,0%	6,0%
<b>Delay repayment</b>	0,00	0,00
<b>Type of repayment</b>	Annuity	Annuity



The 'cumulative profit / loss' and 'cumulative cash flow' is based on a comparison with the costs of the current situation



## Sources in a solution

### Diesel

Several diesel producers have developed systems to combine wind and/or solar power with diesel generators. By applying the reliability of diesel generators in a smart way, these diesel generators maximise renewable power utilization and minimize diesel fuel consumption. An energy management system will distribute the available power.



### Wind

Wind is an intermittent energy source, which cannot make electricity nor be dispatched on demand. It also gives variable power, which is consistent from year to year but varies greatly over shorter time scales. Therefore, it must be used together with other electric power sources or batteries to give a reliable supply. As the proportion of wind power in a region increases, more conventional power sources are needed to back it up (such as fossil fuel power and nuclear power), and the grid may need to be upgraded.



### Solar

Solar is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.



### Storage

In DHES, energy storage is able to perform multiple functions, such as ensuring power quality, including frequency and voltage regulation, smoothing the output of renewable energy sources, providing backup power for the system and playing crucial role in cost optimization. It includes all of chemical, electrical, pressure, gravitational, flywheel, and heat storage technologies. When multiple energy storages with various capacities are available in a DHES, it is preferred to coordinate their charging and discharging such that a smaller energy storage does not discharge faster than those with larger capacities



# Glossary

<b>(Average) Wind speed:</b>	This is the average wind speed taken over a day has blown at the location of the wind turbine. The more specific the wind speed per period, how better the case can be calculated.
<b>Full load hours:</b>	This is a value of the hours the sun panels will do there work at full strenght, based on the average solar radiation on the location. With this value you can calculate the production of the sun panels.
<b>Reference height:</b>	This is the reference height of the wind speed that has been measured to calculate the output of the wind turbine.
<b>Energy consumption:</b>	This is the energy need for which a solution has to be found.
<b>Energy loads:</b>	This is the fluctuation over a day in the energie need. The more specific the energie need per period, the better the case can be calculated.
<b>Capex</b>	The capex is the initital investment. In other words the cost that has to be made at the beginning of the project.
<b>Opex</b>	The opex are the (yearly) costs that will be made when the wind turbine is working. Costs like maintentance and insurance are part of it.
<b>Feed in</b>	This is the tarif that (most of the time) the government will pay tho renewable projects to stimulate a greener world.
<b>Inflation:</b>	Inflation is the sustained increase in the general price level of goods over a period of time.
<b>IRR:</b>	Internal Rate of Return (IRR) is a metric used in capital budgeting to estimate the profitability of potential investments. Internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero.
<b>DSCR:</b>	The Debt-Service Coverage Ratio (DSCR) states net operating income as a multiple of current debt obligations due within one year.
<b>Payback period:</b>	The payback period is the length of time required to recover the cost of an investment.

