Energy production systems to power the WI-SOS 480 4G Gateway

Photovoltaic, Wind Turbine and Hybrid Systems

Version 1.0

Table of contents

Introduction

The purpose of this document is to share with our clients our recommendations on alternative ways to power the low-consumption WI-SOS 480 4G Gateway. When the gateway is installed on a site where it cannot be powered by mains power, a photovoltaic system or a wind turbine are reliable options to power the device. We did the calculations to offer the best compromise to power our gateway between performance, price and compactness. This document presents the results of this study with some explanations and with a purchase list of components. This list only groups components that meet all the requirements to power the gateway and that we could at best recommend their use.

Data

Gateway Power Consumption

In the factory, we measured the power consumption of the gateway. The nominal power is Around $5\ Watts$. We based our calculations to determine the characteristics of the components of the following production systems on this value and for a system working 24h / 365 days. The daily consumption for the WI-SOS 480 4G Gateway is $120\ W.h$.

Location

The components presented below were sized for an installation near London in the countryside between London and Birmingham.

Tool

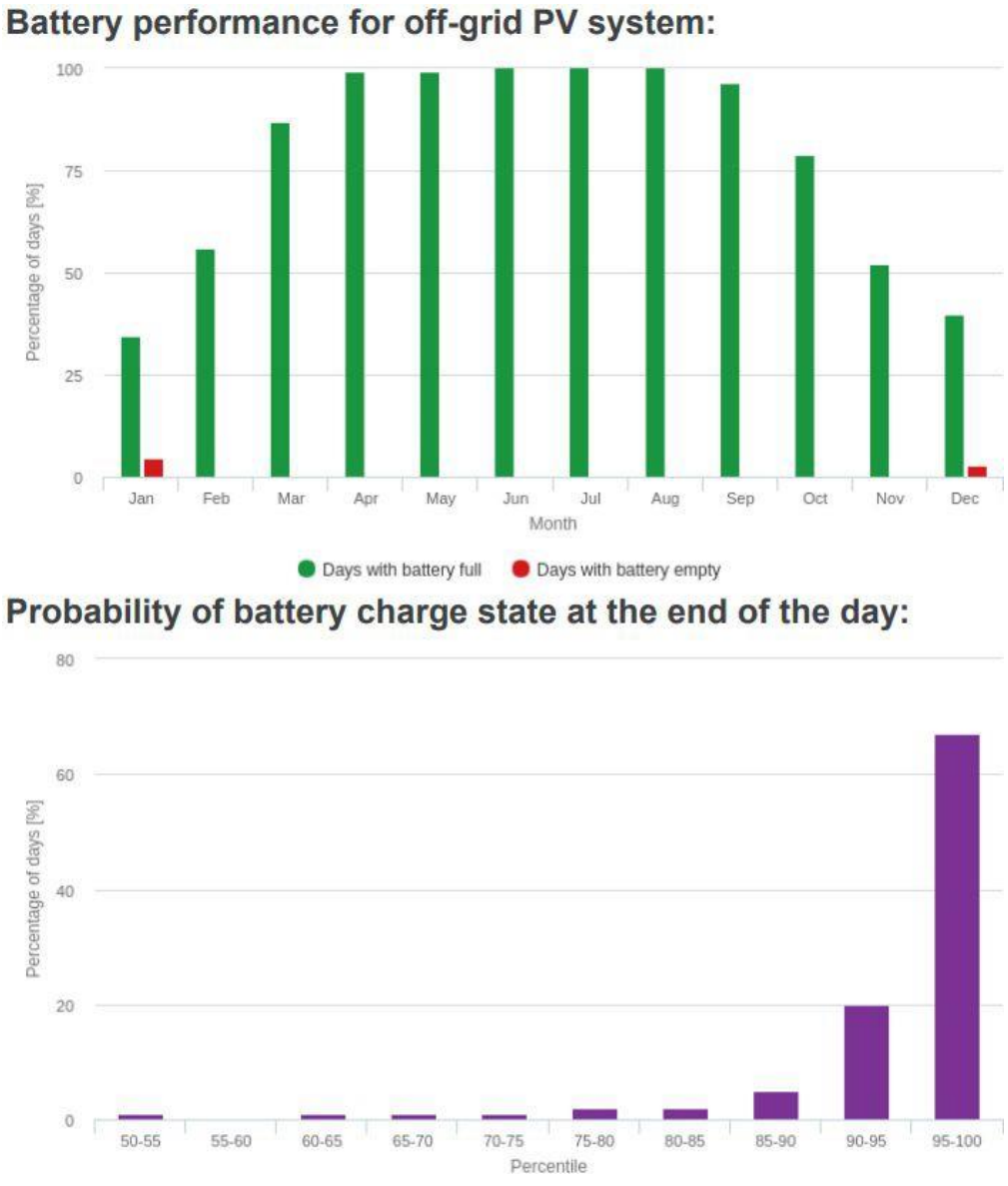
The studies were realized with data available on the PVGIS tool from the European Union which gives you solar radiation for photovoltaic systems and wind speed for wind turbine systems among others.

Photovoltaic System

To determine the right solar panel power and size, we did the calculations with $120\ W.h$ assuming 14% of losses for more security. Using the PVGIS tool in the Off-Grid data section, we optimized the system to find the best compromise between three main features:

- The performance
- The price
- The compactness

Study results



Graphs results from the PVGIS tool for a 175Wp panel with a 110 Ah battery, cutoff 50%

In the first graph, we can see the percentage of days where at the end of the day, the battery is full and empty. In total, the percentage of days where the battery is empty represents 2,7 days, one in December and one in January. We assume that is an acceptable performance for our gateway. We could improve those results by raising the power of the solar panel but 175Wp is the maximum power for a solar panel in 12V. That means, for more power, we would have to install 2 solar panels. We could also raise the capacity of the battery. For example, change the 110Ah battery for a 165Ah one, the price will be 1,5 times more expensive, the battery is 1.5 times wider and you still have one day with no battery remaining.

Moreover, on the second graph, we see the percentage of days for each state of charge percentile. The state of charge never goes down 50% that will protect the battery and extend its life.

Material recommendation

Purchasing the material below is not mandatory, these are our recommendations based on the characteristics of each component to fulfill the requirements of our study.

Components	Description
Solar Panel • Power: 175 Wp • Voltage: 12V • Solar Cell Type: Monocrystalline	Supplier example • Weight: 11kg • Dimensions: 1485 x 668 x 30 mm • Indicated price: £136.39
Battery • Capacity: 110Ah • Voltage: 12V • Battery type: Gel	Supplier example • Weight: 33kg • Dimensions: 330 x 171 x 220 mm • Indicated price: £278.22
Controller/Charger • 12V, 8A • Output: Passive PoE 30W	Supplier example • The gateway is powered by a PoE 30W or in 48V DC. It is not easy to find a converter 12V to 48V, we highly recommend to use this charger/controller we test to power the gateway through the passive PoE. • Indicated price: £61.13
Waterproof Enclosure • Minimum Height: 350 mm • Minimum Width: 350 mm • Minimum Depth: 200 mm	

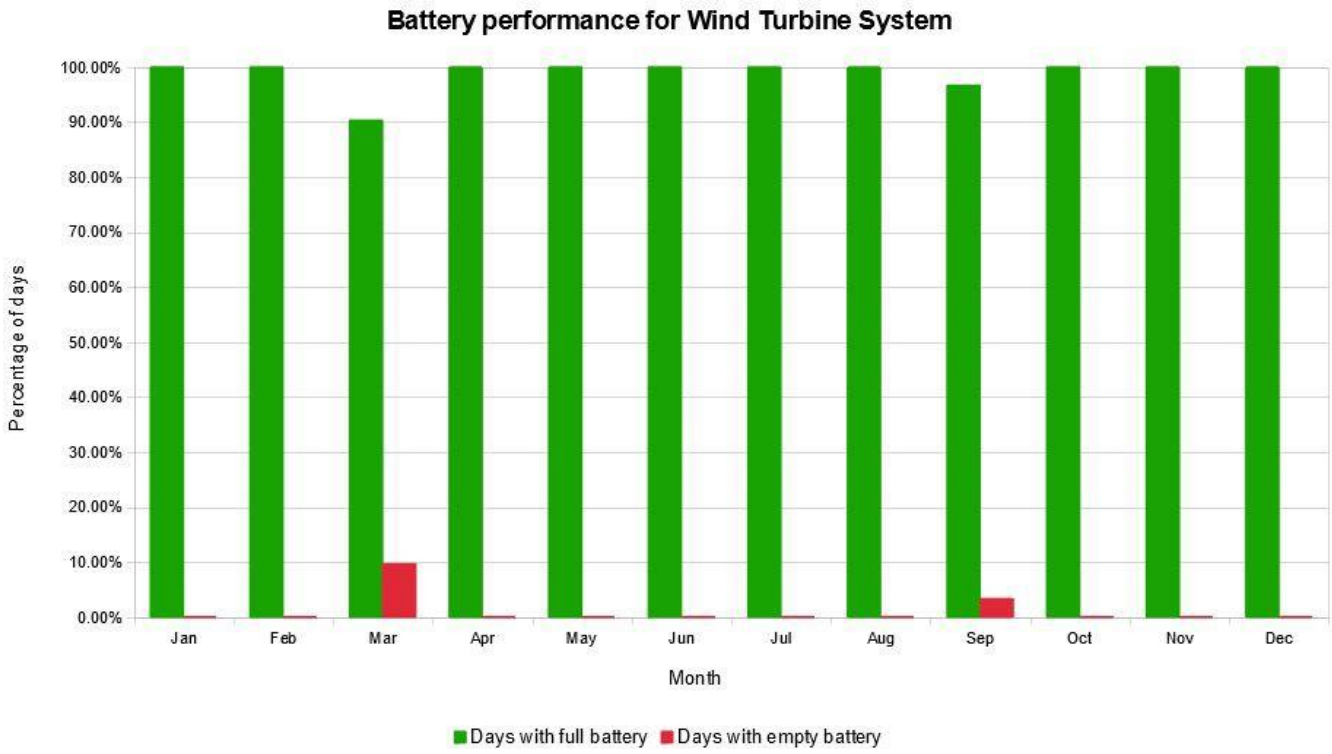
Wind Turbine System

To determine the right wind turbine power and size, we did the calculations with $120\ W.h$ assuming 14% of losses for more security. Using the PVGIS tool, in the Typical Meteorological Year data, we optimized the system to find the best compromise between three main features:

- The performance
- The price
- The compactness

We compared 5 different wind turbines to find the one who meets our requirements. For each one, we use their power curve giving the produced power in function of the wind speed. We combined this curve with the wind speed distribution on the location for each hour of the year. The following section presents the best compromise we found.

Study results



Graph results for a 105W Wind Turbine at 8 m/s with a 60 Ah battery, cutoff 50%

In this graph, we can see the percentage of days where at the end of the day, the battery is full and empty. In total, the percentage of days where the battery is empty represents 4 days, three in March and one in September. We assume that is an acceptable performance for our gateway. The wind turbine range is not as developed as the solar panel range that is why to improve those results, we will have to double at least the power of the wind turbine. The size of such a wind turbine is 1,5 times bigger than the chosen one and 2,5 days with an empty battery would still remain.

Material recommendation

Purchasing the material below is not mandatory, these are our recommendations based on the characteristics of each component to fulfill the requirements of our study.

Components	Description
Wind Turbine • Voltage:12 V • Nominal Power: 105W at 8 m/s (450W max) • Cut-in-speed: 3 m/s	Supplier example • Weight: 8 kg • Rotor Dimensions: 1 m • Dimensions: 750x340 mm • Indicated price: £749
Battery • Capacity: 60Ah • Voltage: 12V • Battery type: Gel	Supplier example • Weight: 20 kg • Dimensions: 229x138x227 mm • Indicated price: £170.08
Controller/Charger • 12V, 8A • Output: Passive PoE 30W	Supplier example • The gateway is powered by a PoE 30W or in 48V DC. It is not easy to find a converter 12V to 48V, we highly recommend to use this charger/controller we test to power the gateway through the passive PoE • Indicated price: £61.13
Waterproof Enclosure • Minimum Height: 300 mm • Minimum Width: 300 mm • Minimum Depth: 200 mm	

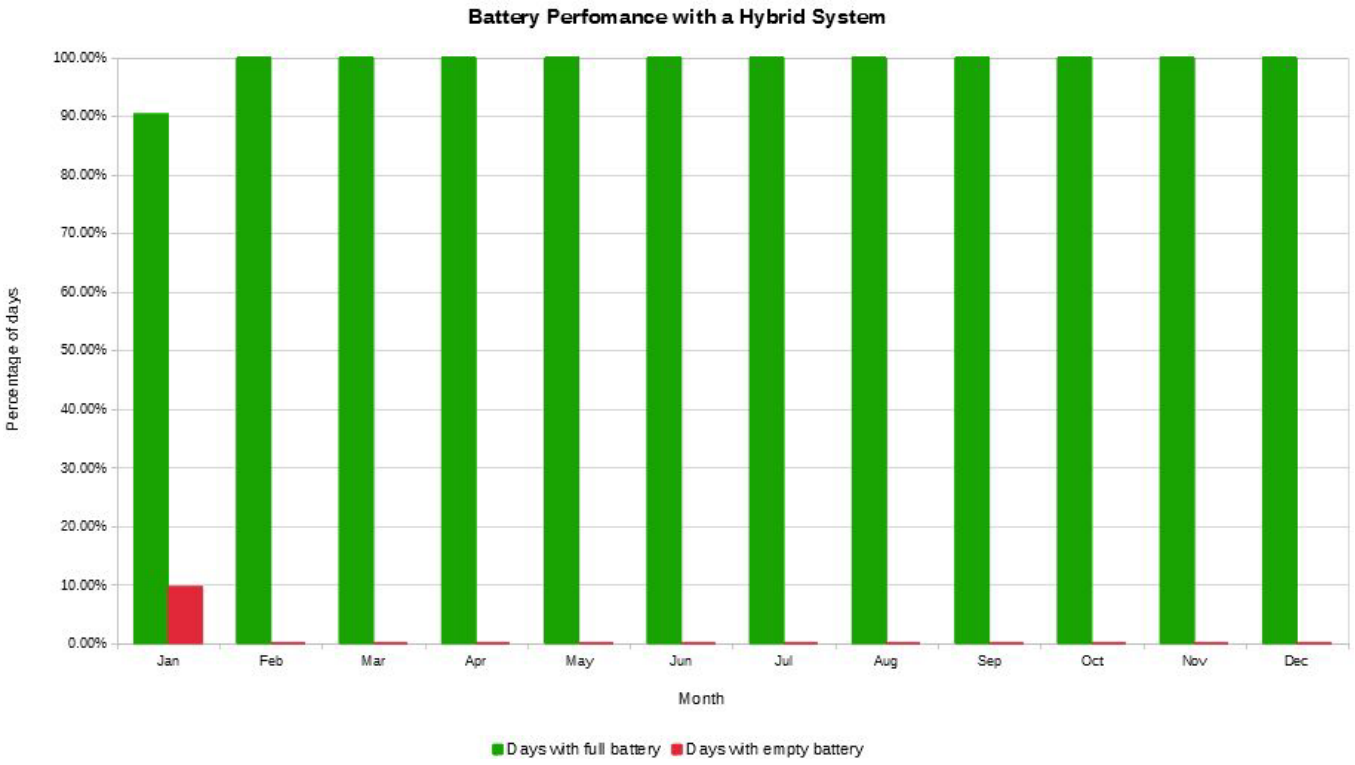
Hybrid System

To determine the right wind turbine power and size, we did the calculations with $120\ W.h$ assuming 14% of losses for more security. Using the PVGIS tool, in the Typical Meteorological Year data and the solar irradiation of the Off-Grid section, we optimized the system to find the best compromise between three main features:

- The performance
- The price
- The compactness

With the hybrid solution, we were able to reduce the size of the solar panel and of the wind turbine also, to have a system more compact. We use the power curve of the wind turbine with the wind speed distribution and the PVGIS tool to get the monthly production of the photovoltaic module.

Study results



Graphs results from the PVGIS tool for a 50Wp panel and a 30W wind turbine at 11 m/s with a 60 Ah battery, cutoff 50%

In this graph, we can see the percentage of days where at the end of the day, the battery is full and empty. In total, the percentage of days where the battery is empty represents 3 days, three in January. We assume that is an acceptable performance for our gateway. With an hybrid system, the idea is to have a smaller solar panel and a smaller wind turbine. Keeping this in mind, we could improve the system performance by raising the solar panel power. For example, if we change the

50W solar panel for a 90W, the panel is bigger and the weight is almost double but we reduced the days with an empty battery to 0.

Material recommendation

Purchasing the material below is not mandatory, these are our recommendations based on the characteristics of each component to fulfill the requirements of our study.

Components	Description
Wind Turbine • Voltage:12 V • Nominal Power: 29W at 11 m/s (60W max) • Cut-in-speed: 3 m/s	Supplier example • Weight: 3.5 kg • Rotor Dimensions: 510 mm • Dimensions: 440x250 mm • Indicated price: £389.95
Solar Panel • Power: 50 Wp • Voltage: 12V • Solar Type Cell: Monocrystalline	Supplier example • Weight: 3.8 kg • Dimensions: 630x545x25 mm • Indicated price: £35.70
Battery • Capacity: 60Ah • Voltage: 12V • Battery type: Gel	Supplier example • Weight: 20 kg • Dimensions: 229x138x227 mm • Indicated price: £170.08
Controller/Charger • 12V, 8A • Output: Passive PoE 30W	Supplier example • The gateway is powered by a PoE 30W or in 48V DC. It is not easy to find a converter 12V to 48V, we highly recommend to use this charger/controller we test to power the gateway through the passive PoE • Indicated price: £61.13
Waterproof Enclosure • Minimum Height: 300 mm • Minimum Width: 300 mm • Minimum Depth: 200 mm	

Conclusion

To resume, we offer to our client three different ways to power our gateway, each one with their advantages and disadvantages. It is up to the customer to make his own choice and we will be able to provide support in the chosen solution. Any of this material is mandatory, and we can discuss any other possibilities.

All the solutions we recommend present some days with an empty battery and we assume that it would be an acceptable compromise. Of course, it is possible to design a solution with no days without power but the dimensions of the solar panel or the wind turbine also will be much bigger and the price higher also.

Summary of options with less than 5 days of current outage:

	Solar panel	Wind turbine	Battery	Total weight (kg)
Solar	175Wp, 11kg 1485x668x30 mm	-	110Ah, 33kg 330x171x220 mm	44
Wind	-	450 W, 8kg 1000x750x340 mm	60Ah, 20kg 229x138x227 mm	28
Hybrid	50 Wp, 3.8kg 630x545x25 mm	60W, 3.5kg 510x440x250 mm	60Ah, 20kg 229x138x227 mm	27.3