



# **Power to the People**

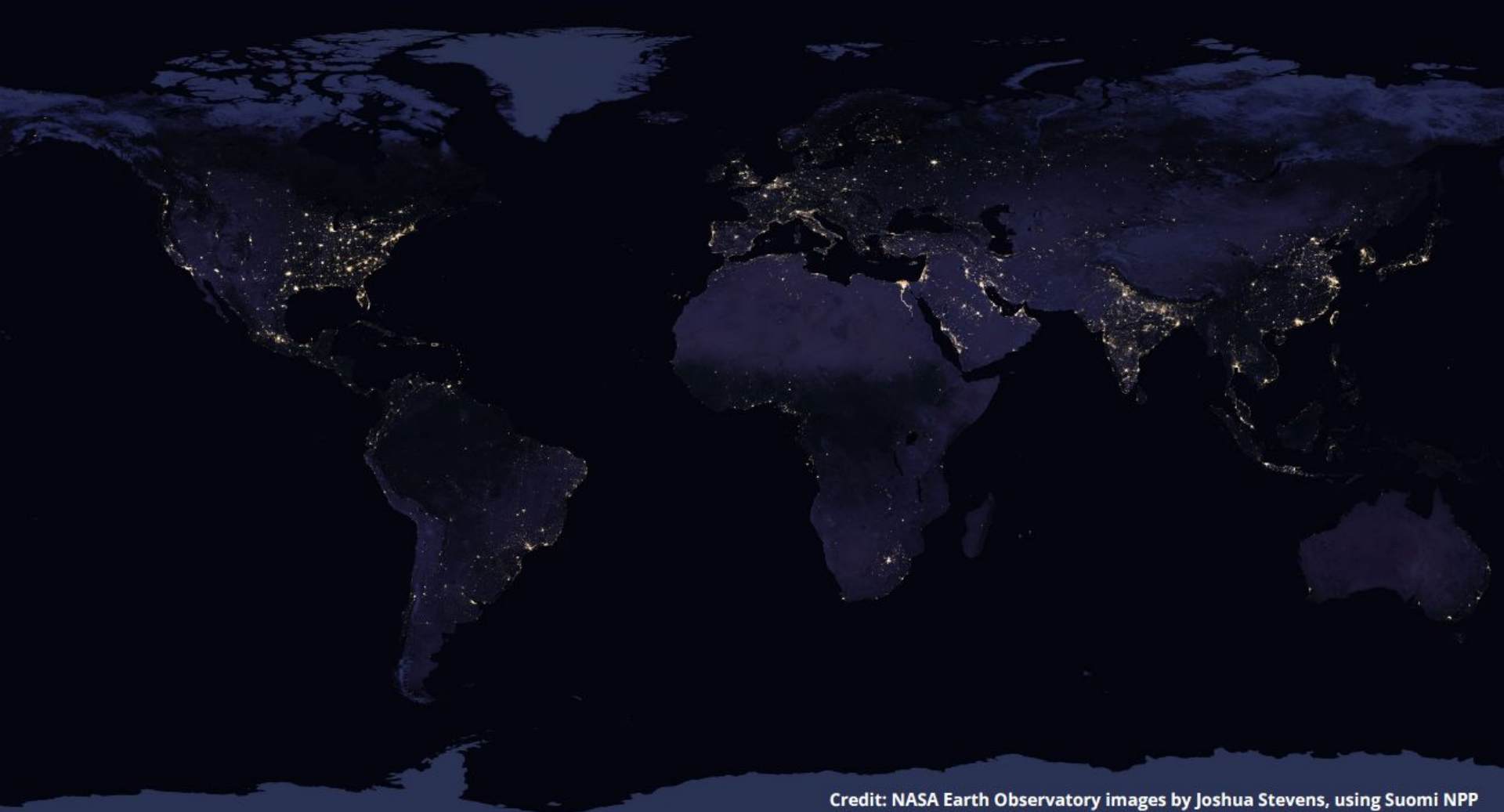
## **Technology for Access to Energy**

Vivien Barnier & Martin Jäger  
FOSDEM 2024

# Agenda

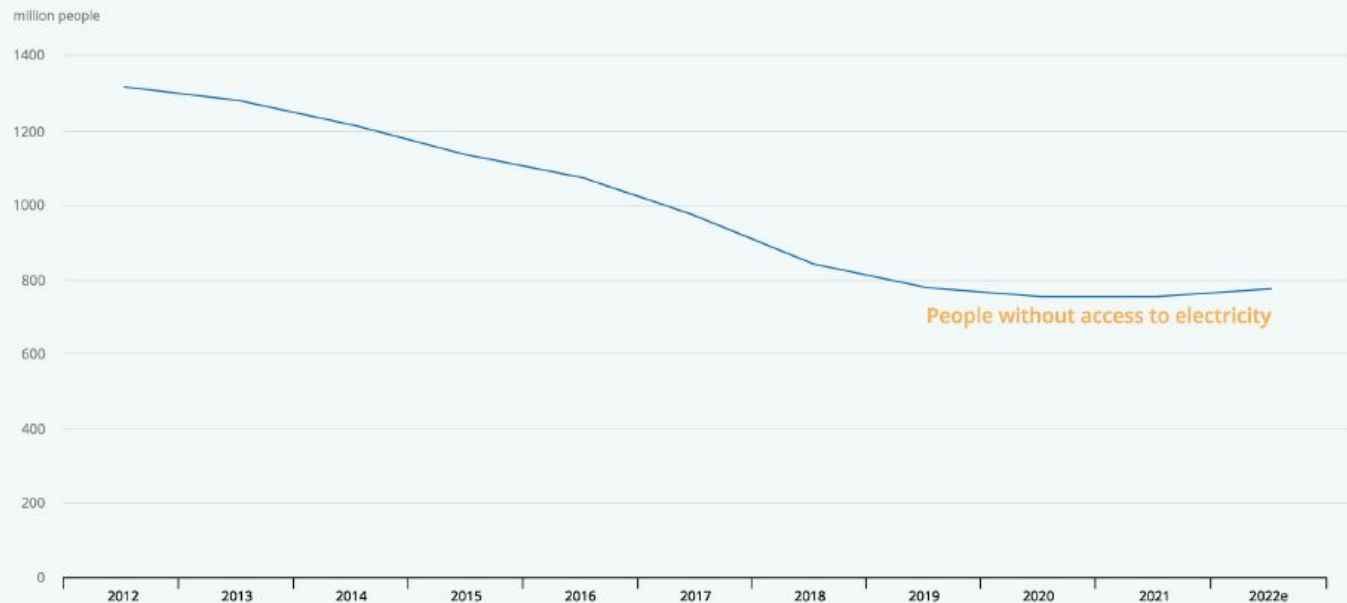
- ● **Introduction and Context**
  - Energy Access Challenges
  - Open Source for Energy Access
  - EnAccess activities and mission
- **Open Source Hardware - Libre Solar BMS C1**
  - Battery Management System Overview
  - Used Open Source Technology
  - Manufacturing
  - Adoption & Community
- **Summary and Q&A**
  - Prepare your questions





Credit: NASA Earth Observatory images by Joshua Stevens, using Suomi NPP VIIRS data from Miguel Román, NASA's Goddard Space Flight Center

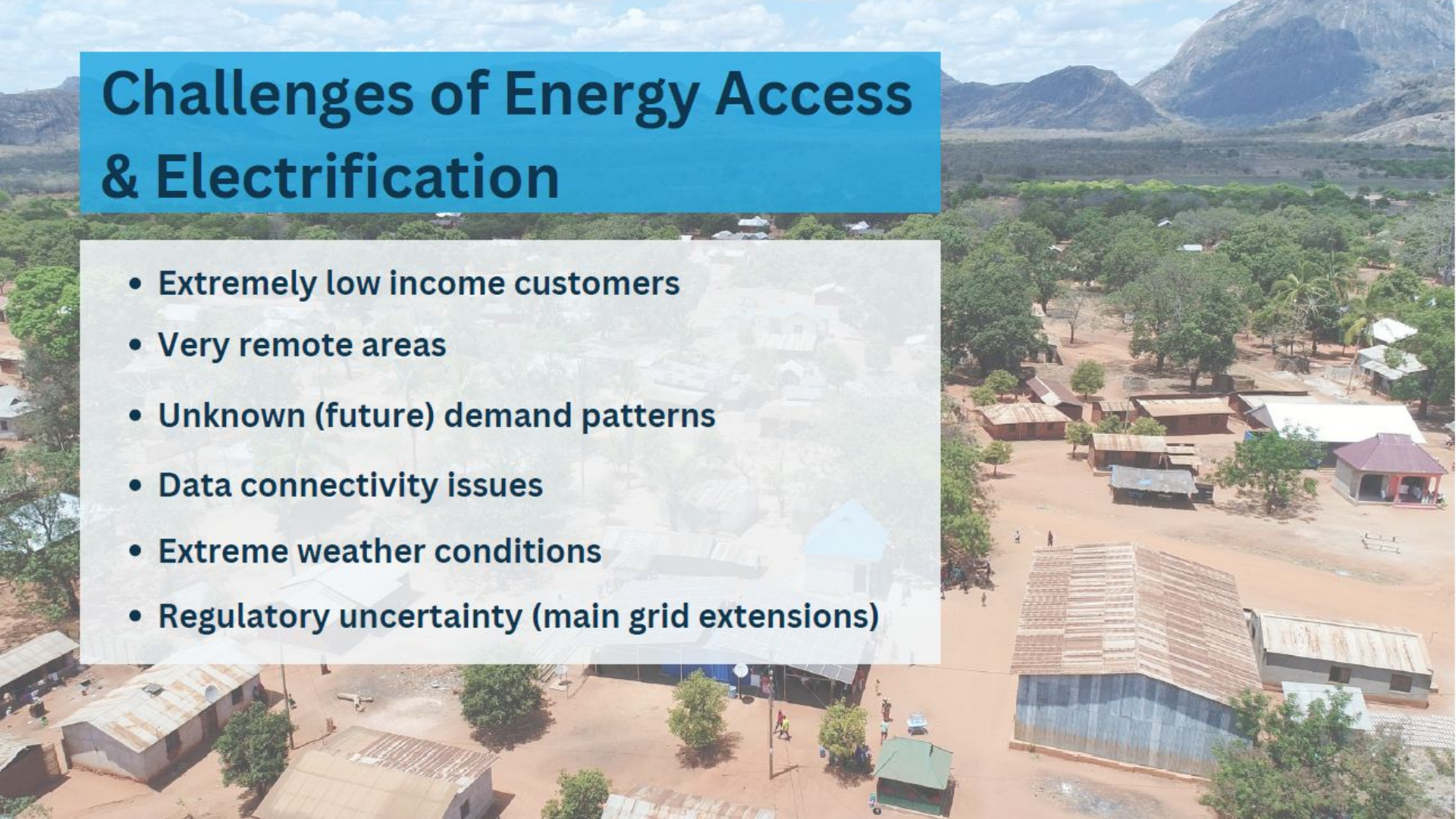
# In 2022, the number of people off-grid and without electricity increased for the first time in decades



IEA, Licence: CC BY 4.0

# Challenges of Energy Access & Electrification

- Extremely low income customers
- Very remote areas
- Unknown (future) demand patterns
- Data connectivity issues
- Extreme weather conditions
- Regulatory uncertainty (main grid extensions)



# Low-cost, resilient technology is necessary for Universal Energy Access

Sector players frequently re-invent the wheel using public donor money & private equity



# What, how and for what

EnAccess **supports and promotes** the development and **adoption** of Open Source Tools for **Energy Access**








to build

- an efficient and **equitable ecosystems**
- with more **local companies/actors** participating
- Resilient and adaptable infrastructure

contributing towards **universal energy access!**



# Funded & Released Innovations








Software		<p>AirLink BLE App and Backend Coms</p>  Simusolar	<p>OpenPAYGO Token</p>  SOLARIS OFFGRID
Hardware		<p>Open Smart Meter</p>  <b>First Electric</b> Solar Power - EV Infrastructure - Automation	<p>Cicada-IoT FW &amp; HW</p>  <b>OKRA</b> <p>BMS FW &amp; HW</p> <p>LIBRESOLAR</p> 
Business Model	<p>The D-REC Initiative</p>  <b>D-REC</b> INITIATIVE		<p>AgriGrid Energy-Agri-Nexus Operational model</p>  <b>ANKA</b> MADAGASCAR

Moonshots Concepts

Innovation Pilots



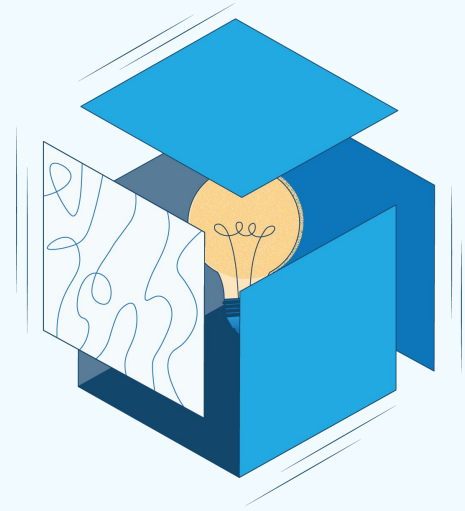
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# Open Source Hardware

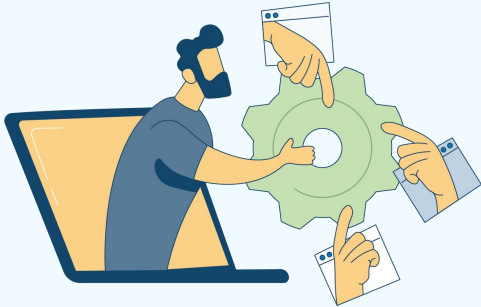


## Libre Solar BMS C1

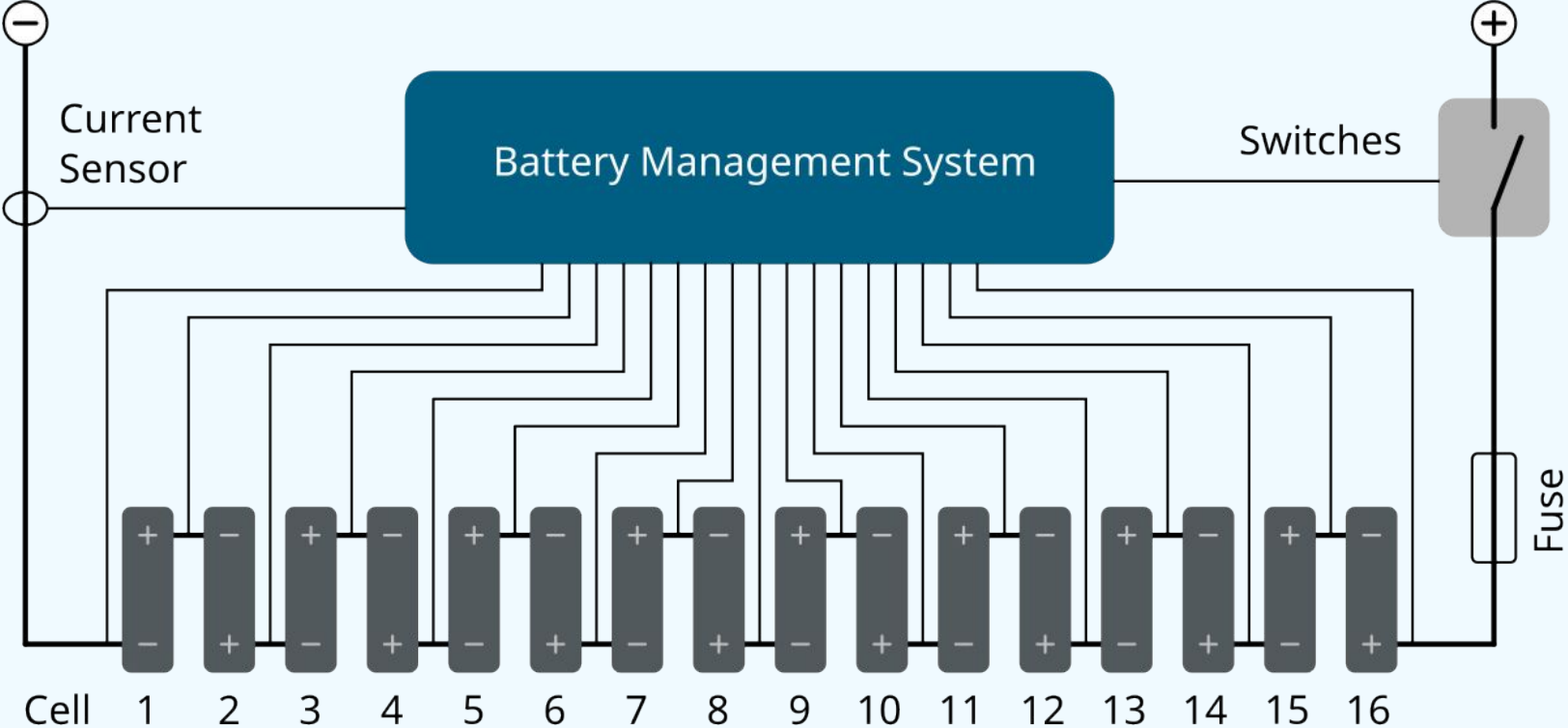
Battery Management System



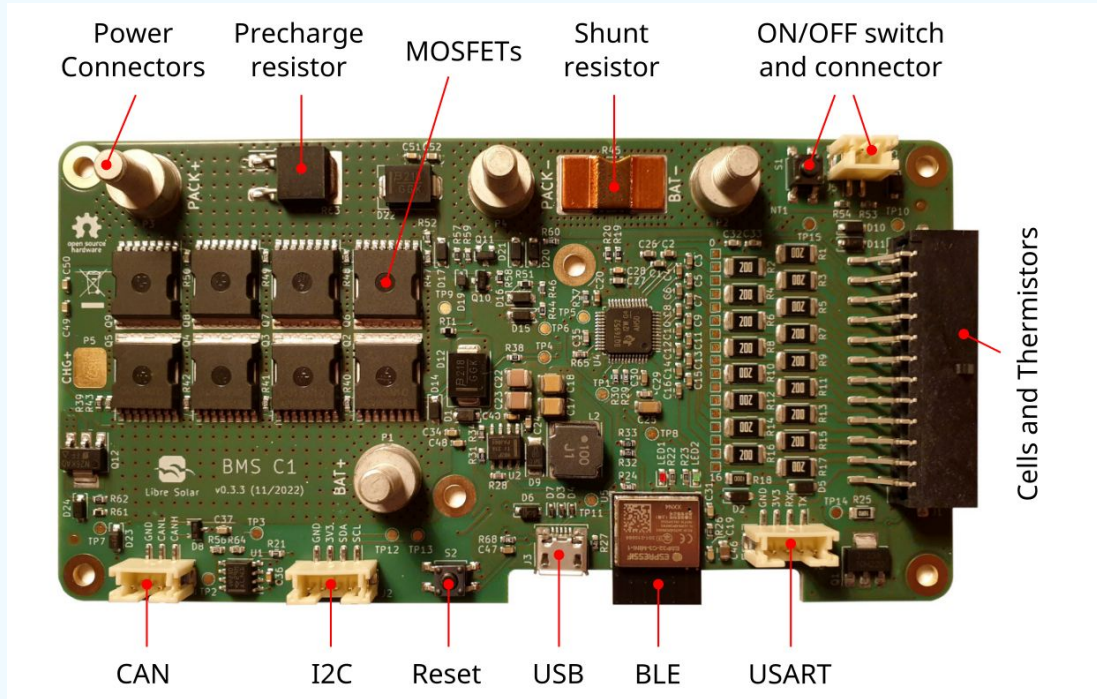
LIBRESOLAR



# What is a Battery Management System?



# The Libre Solar BMS C1



## Highlights

- 12V-48V systems (up to 16s)
- 100A maximum current
- Any cell type (e.g. NMC, LFP)
- Built-in CAN, Serial, Bluetooth, and WiFi communications
- Interface for other communications available

# Open Source Development Tools



## Hardware: KiCad

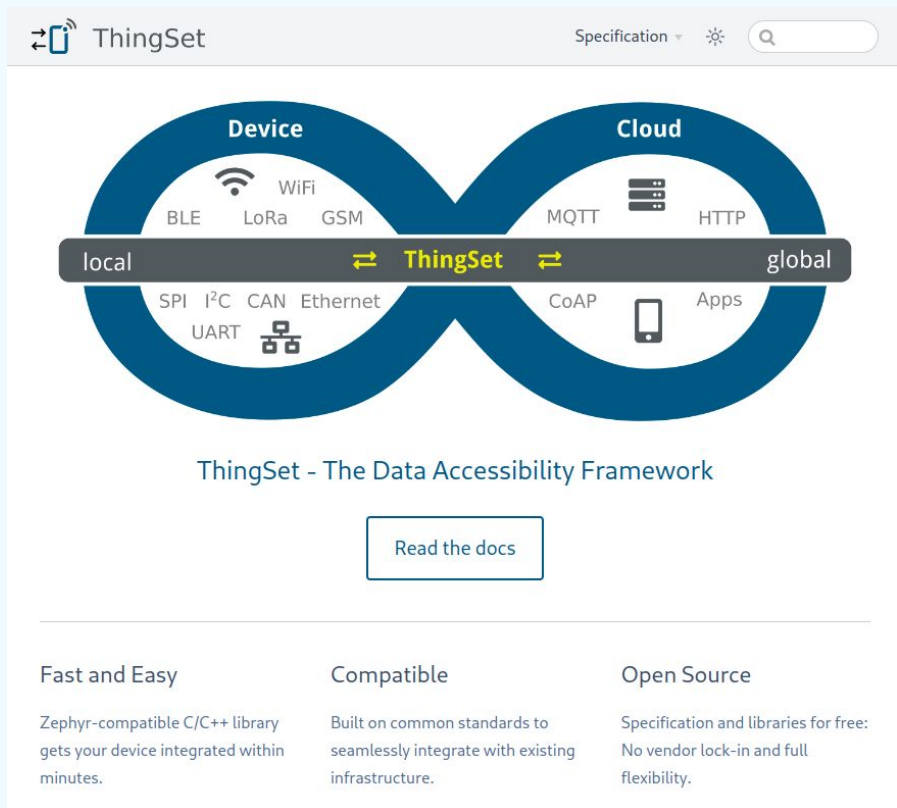
- Professional-grade PCB design
- Nice plugins developed by the community
  - Interactive HTML BOM
  - Schematic and Board diff tools
  - CI integration



## Firmware: Zephyr RTOS

- Any architecture and MCU vendor
- Great hardware abstraction and customization features
  - Strict separation between board definition and application firmware
- Comms working out of the box:
  - Local: BLE, CAN or Modbus
  - Global: GSM modem
  - MQTT or WebSocket
- Great community! (also at FOSDEM)

# ThingSet Communication Protocol



The screenshot shows the ThingSet website with a navigation bar containing the logo, the name 'ThingSet', a 'Specification' dropdown, a search icon, and a search input field. The main content area features a large blue infinity symbol representing the communication protocol. The left loop is labeled 'Device' and lists protocols: BLE, WiFi, LoRa, and GSM. The right loop is labeled 'Cloud' and lists protocols: MQTT, HTTP, CoAP, and Apps. A central horizontal bar labeled 'ThingSet' connects the two loops, with 'local' on the left and 'global' on the right. Below the infinity symbol, the text 'ThingSet - The Data Accessibility Framework' is displayed, followed by a 'Read the docs' button.

**Fast and Easy**  
Zephyr-compatible C/C++ library gets your device integrated within minutes.

**Compatible**  
Built on common standards to seamlessly integrate with existing infrastructure.

**Open Source**  
Specification and libraries for free: No vendor lock-in and full flexibility.

**Example 2:** Retrieve all content of `Bat` path (names + values)

```
?Bat
:85 {"rVoltage_V":12.9,"rCurrent_A":-3.14,"sTargetVoltage_V":14.4}
```

**Example 1:** Disable load output

```
=Load {"wEnable":false}
:84
```

**Example 2:** Attempt to write read-only measurement value (response with optional diagnostic payload)

```
=Bat {"rCurrent_A":0}
:A3 "Item is read-only"
```

Protocol Specification:

<https://thingset.io/>

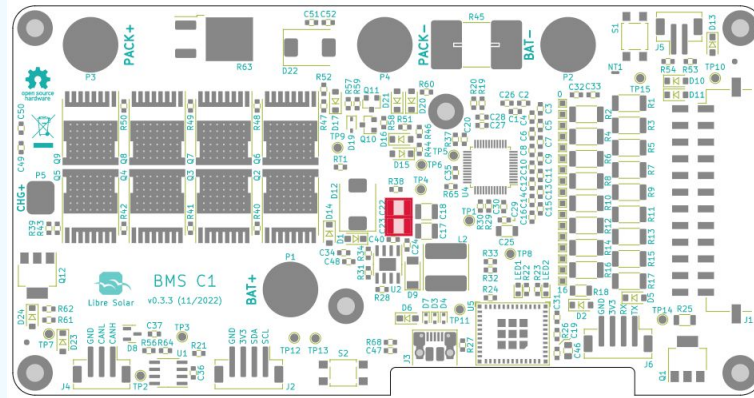
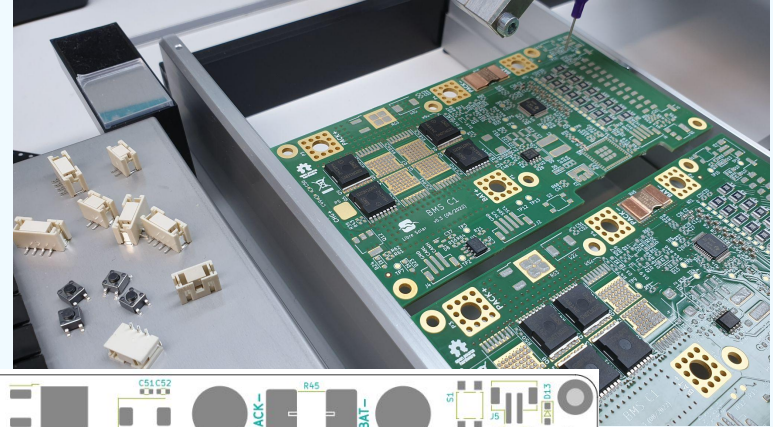
Cross-platform mobile app:

<https://github.com/ThingSet/thingset-app>

# Manufacturing

## Required Equipment

- PCB, Stencil and parts
- Interactive HTML BOM
- Manual pick & place machine or tweezers
- Reflow oven



**Assembled boards will be available soon!**

# Adoption & Community

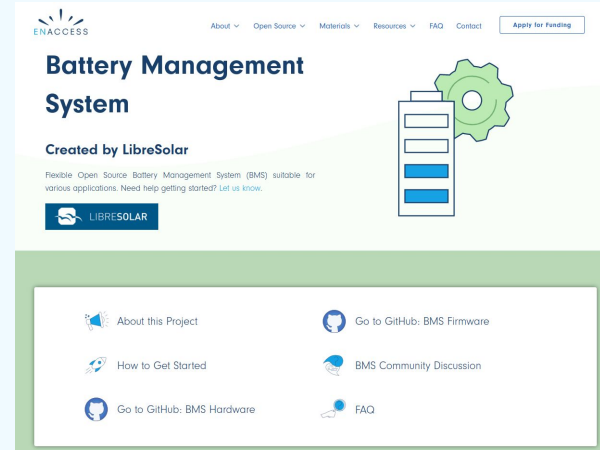
- The BMS has been successfully lab-tested by 10+ potential adopters and field-tested by 5+ companies.
- A lot of valuable community/user feedback went into initial development and the subsequent design iterations during piloting.
- The active contributor community is mainly living on GitHub and in the EnAccess / Libre Solar forums.





# Resources

- EnAccess  
<https://enaccess.org>  
<https://community.enaccess.org>
- Libre Solar  
<https://libre.solar>
- BMS Hardware  
<https://github.com/LibreSolar/bms-c1>
- BMS Firmware  
<https://github.com/LibreSolar/bms-firmware>





**Join us on our journey**  
-  
**Bring Power to the People**



Q&A