OpenEnergyMonitor

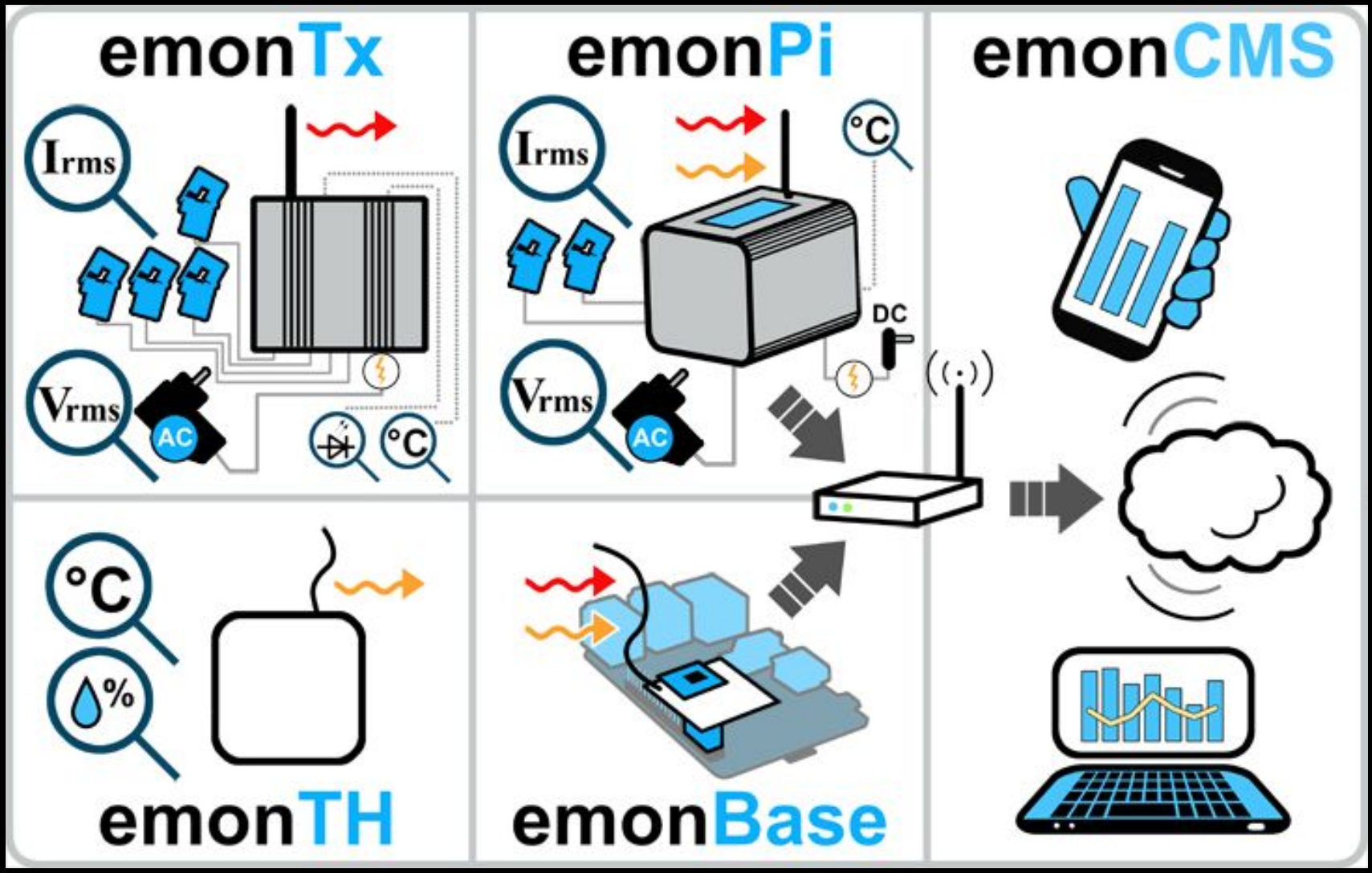
EcoHome Lab: From Monitoring to Control

Using emonPi with integrated MQTT, Node-RED and openHAB

@openenergymon Glyn Hudson 11th Aug 16

https://www.meetup.com/Eco-Home-Lab-Manchester/events/230714252/

OpenEnergyMonitor is a project to develop open-source tools to help us relate to our use of energy, our energy systems and the challenge of sustainable energy.


emonTx
Irms
Vrms
AC
°C
emonPi
Irms
°C
DC
Vrms
AC
emonCMS
°C
%
emonTH
emonBase

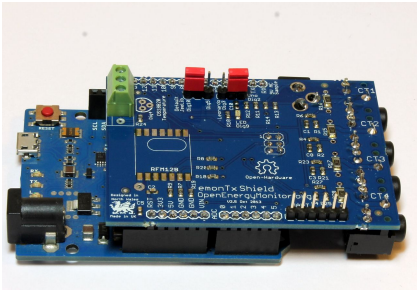
OpenEnergyMonitor Hardware

emonTx
- 4x AC circuits

emonTH
Wireless Temperature & Humidity

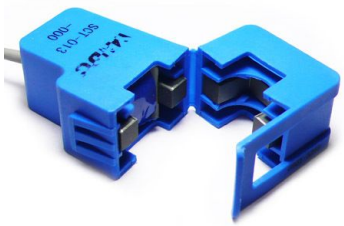
Sensors
- Optical Pulse

emonTx Shield
- 4x AC circuits
- Arduino shield footprint



emonPi
Raspberry Pi based all-in-one energy monitor
2 x AC Circuits

- Clip - on CT

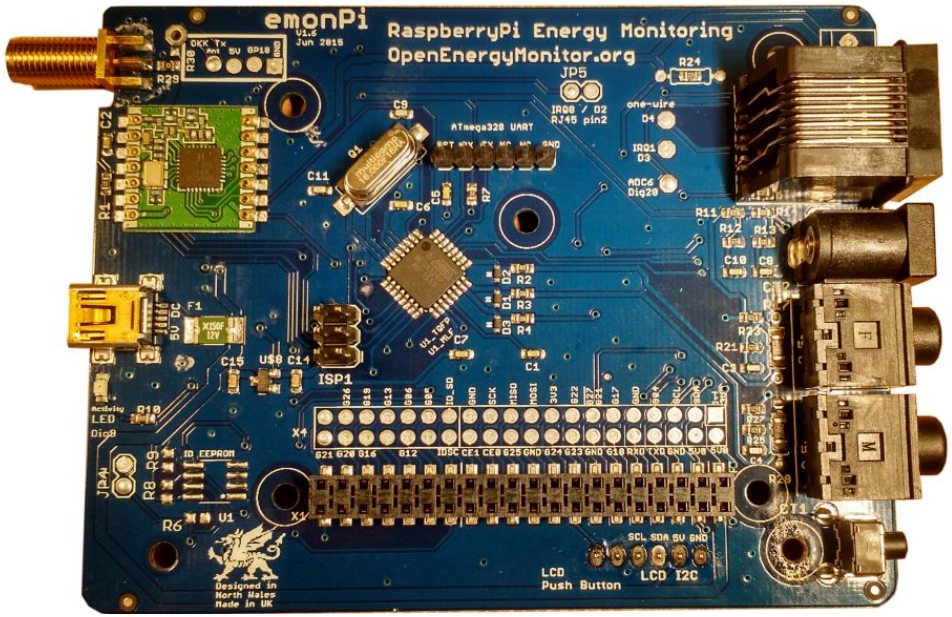


emonPi

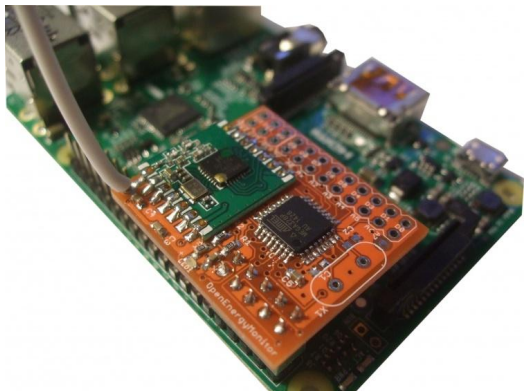
Energy Monitor & web connected base station

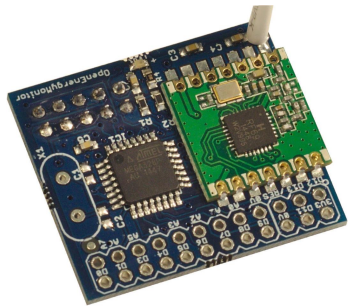
Hardware

- 2 x CT channels
- 1 x AC-AC voltage sensor channel
- Optical pulse & multi temperature sensors
- Atmega328p
- RFM69CW RF - (Receive data from other RF nodes e.g. emonTx, emonTH)
- OOK RF (optional) - RF plug control
- Communicate with Raspberry Pi 2 via serial GPIO
- USB WiFi Adapter (optional) / or 3G



emonBase: RasPi + RFM69Pi





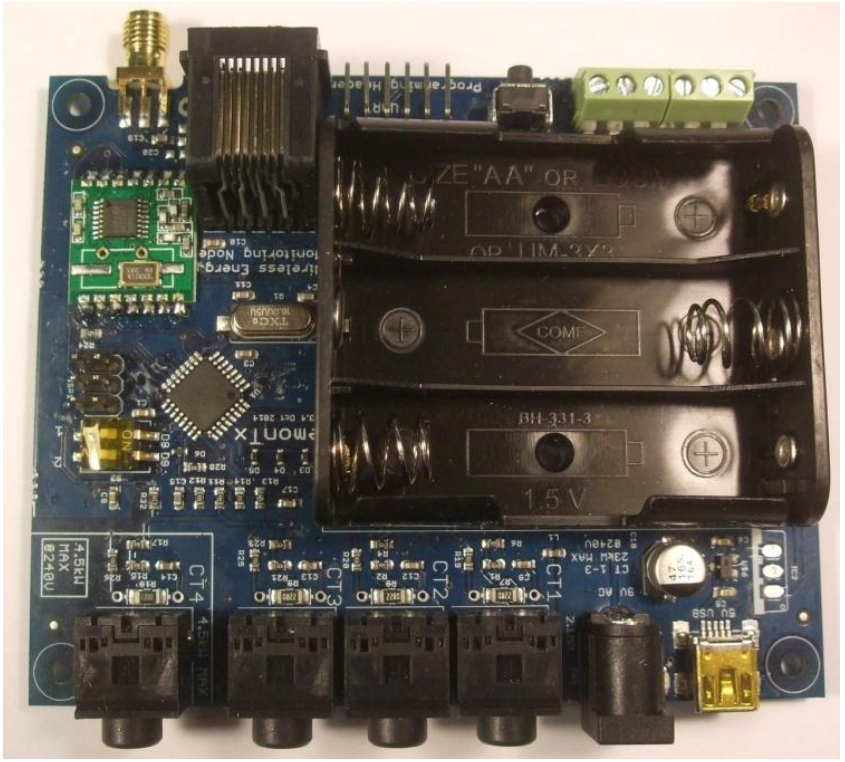
emonTx V3

Remote energy monitoring node

Hardware

- 4 x CT channels
- 1 x AC-AC voltage sensor channel
- Optical pulse & multi temperature sensors
- Atmega328p - Arduino compatible firmware
- RFM69CW
- Powered via AC-AC adapter, 3x AA battery or USB 5V

Transmits power data every 10s via RF to be received with emonPi / emonBase.



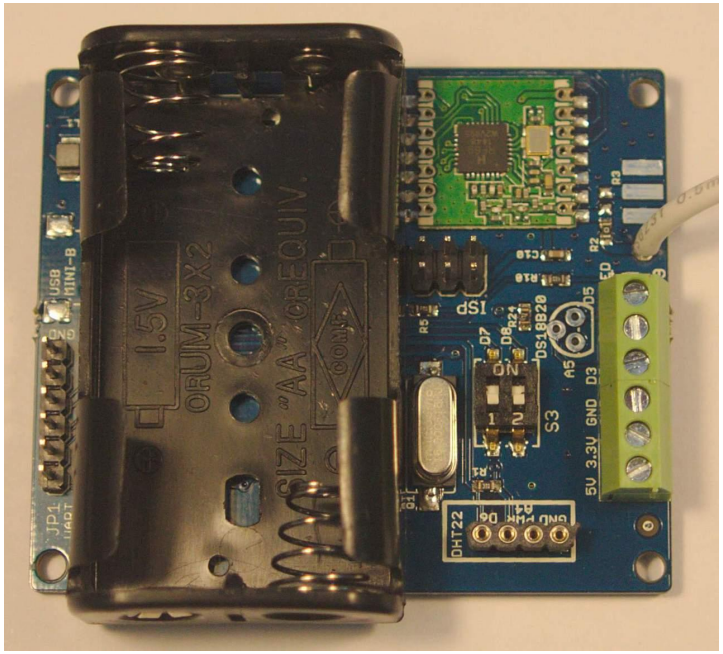
emonTH

Low power remote temperature & humidity room node

Hardware

- ATmega328p
- RFm69CW
- DHT22 / DS18B20 (multiple)
- 2 x AA batteries 7-10 months battery

Transmits temperature data every 60s via RF to be received with emonPi / emonBase.



Emoncms.org

Emoncms is a powerful open-source web-app for processing, logging and visualising energy, temperature and other environmental data.

Part of the OpenEnergyMonitor.org project.

Emoncms.org Login

Username:

Password:

Remember me

Login or register

Forgotten password

Docs

Documentation for how to install, upgrade, use and backup emoncms is available on the emoncms github repository.

Github

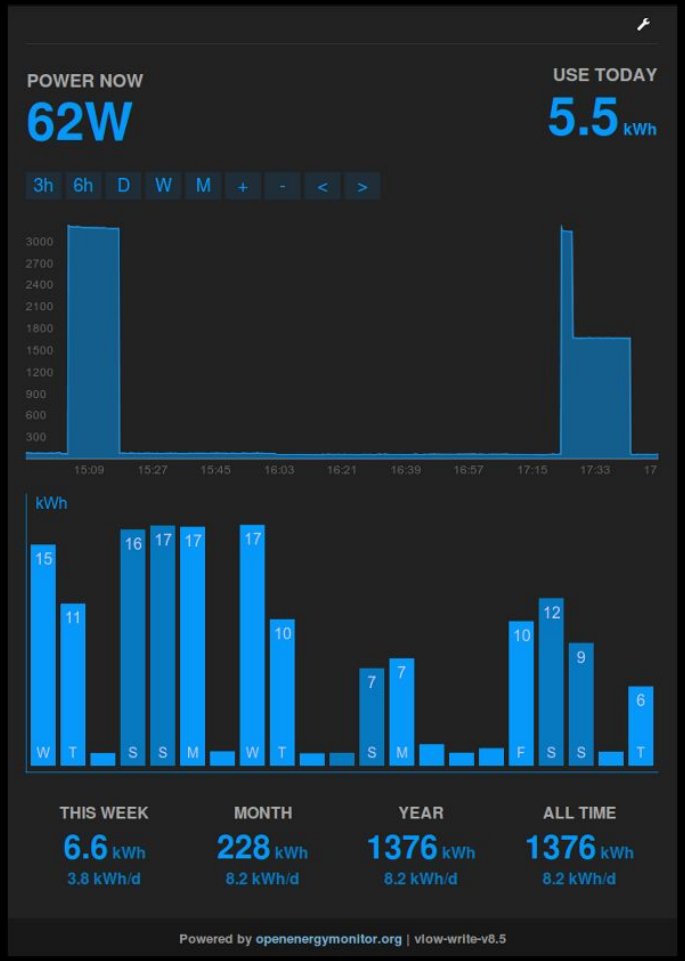
We believe open source is a better way of doing things. Emoncms is available under the GPL Affero licence (AGPL).

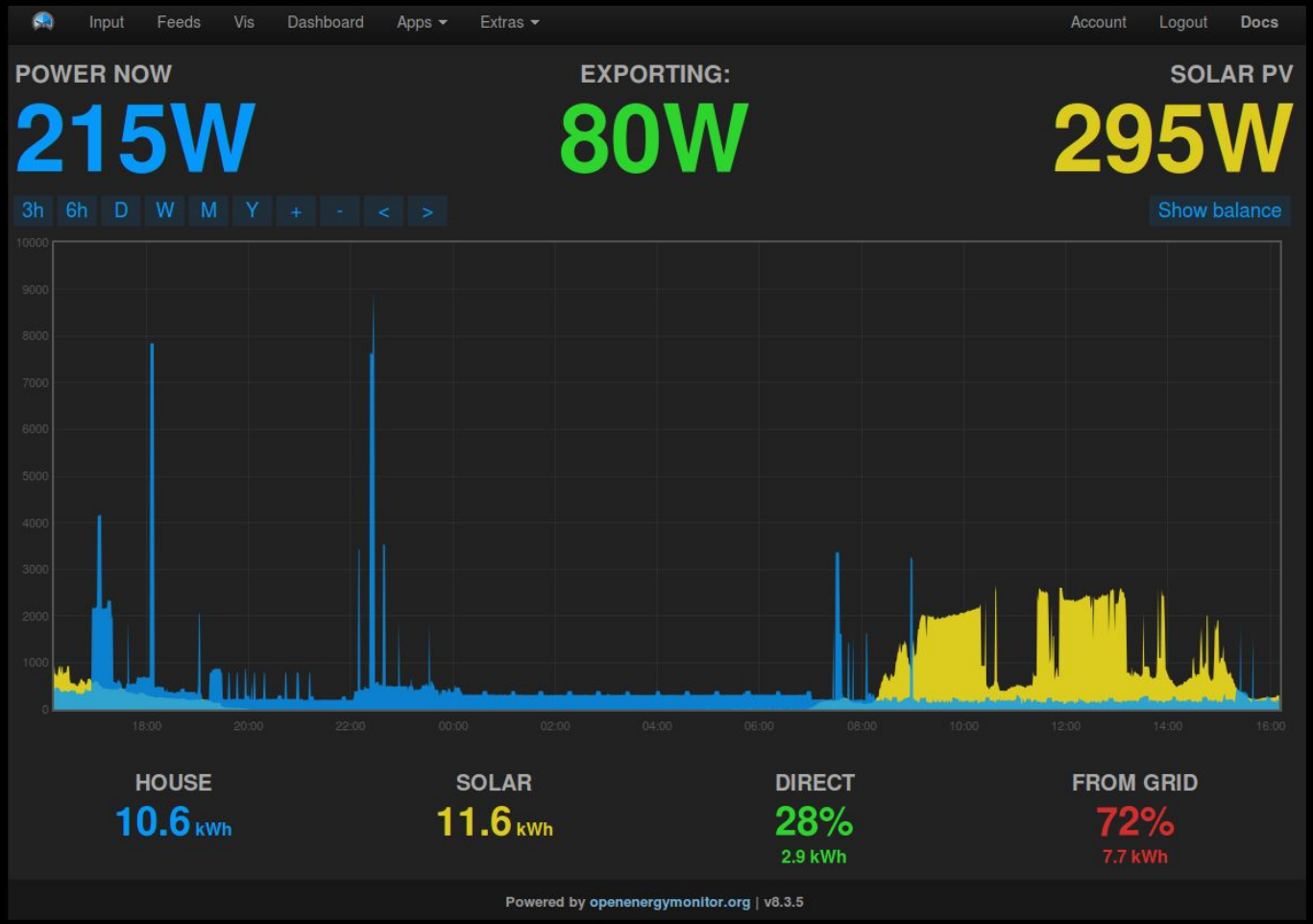
Install

Install emoncms on a RaspberryPi, home computer or web server. With emoncms you can have full control of your data.

https://emoncms.org

Emoncms





https://emoncms.org

Emoncms

OpenEnergyMonitor Tools

19

PEGI 3

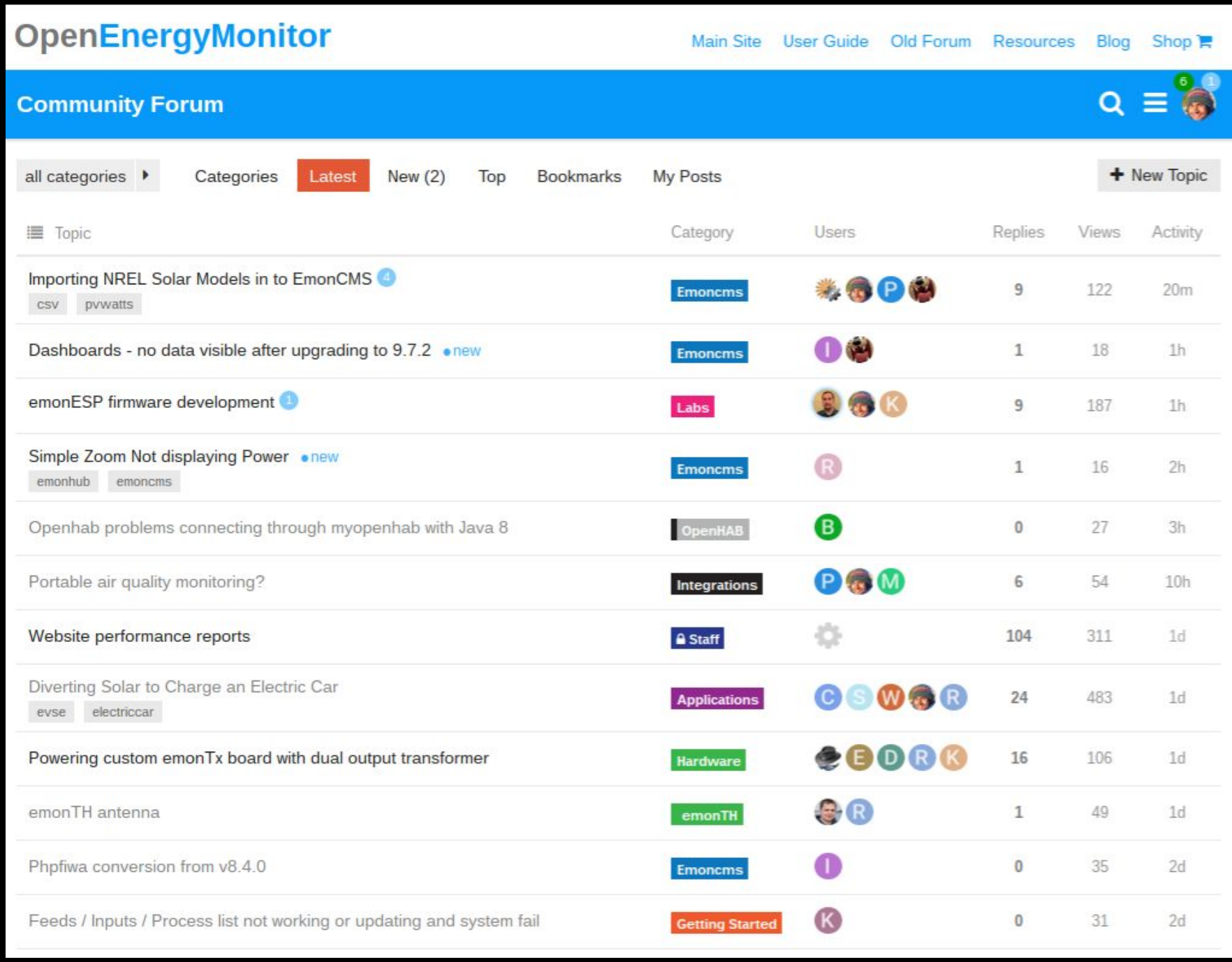
This app is compatible with all of your devices.

Installed

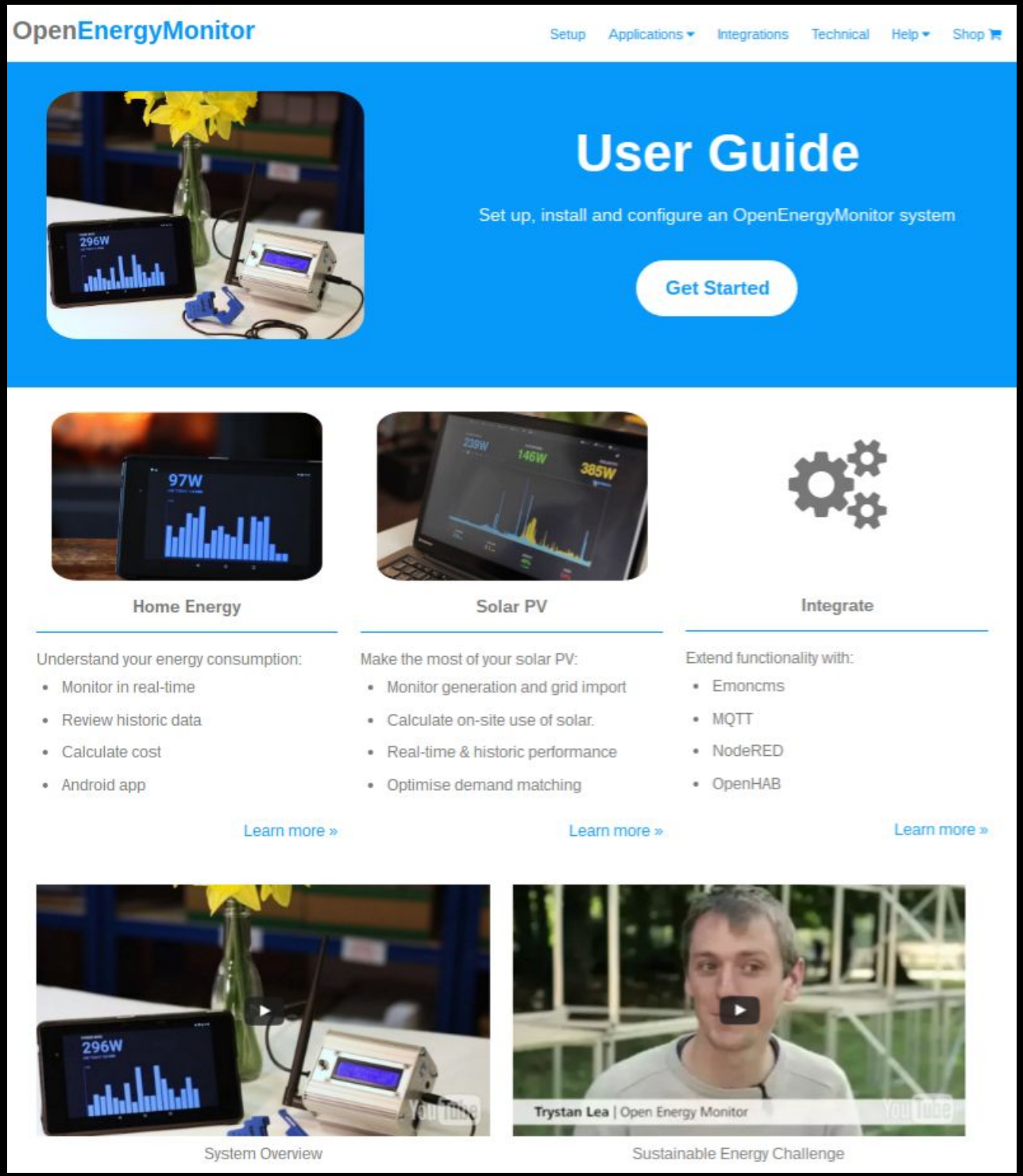
Open-source Emoncms dashboard viewer.
View MyElectric Emoncms dashboards from http://emoncms.org or any other Emoncms server.

Emoncms is an open-source web application for processing, logging and visualising energy, temperature and other environmental data developed as part of the http://openenergymonitor.org project.

READ MORE



https://community.openenergymonitor.org



New user guide helps make getting started easier

https://guide.openenergymonitor.org

// Connect

Edit on GitHub
Edit on GitHub Prose

« Previous step: Required Hardware

Next step: Install »

First Boot

Important

This guide assumes you are using an emonPi / emonBase pre-built SD card.

This SD card can be purchased from the shop or downloaded:

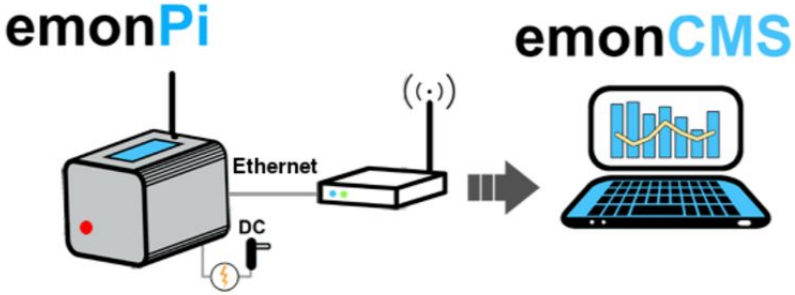
- Pre-build SD card download & Change Log
- Instructions to flash image to SD card (RaspberryPi)

The emonPi runs Emoncms data logging web-app locally from emonPi's internal web sever. Using Emoncms data can be logged locally to the emonPi's SD card and (optionally) posted remotely to the Emoncms.org cloud server.

Important

Emoncms local: Emoncms instance running locally on the emonPi
Emoncms remote: Emoncms.org cloud server.

1. Connect Ethernet and USB power



New user guide helps make getting started easier

https://guide.openenergymonitor.org/setup/connect

Auto Detect

2 devices detected:

Emoncms setup wizard in development...

emonTx v3
Energy Monitoring Node

Select your configuration:

- Home Energy Monitor
- Solar PV Monitor

Configure

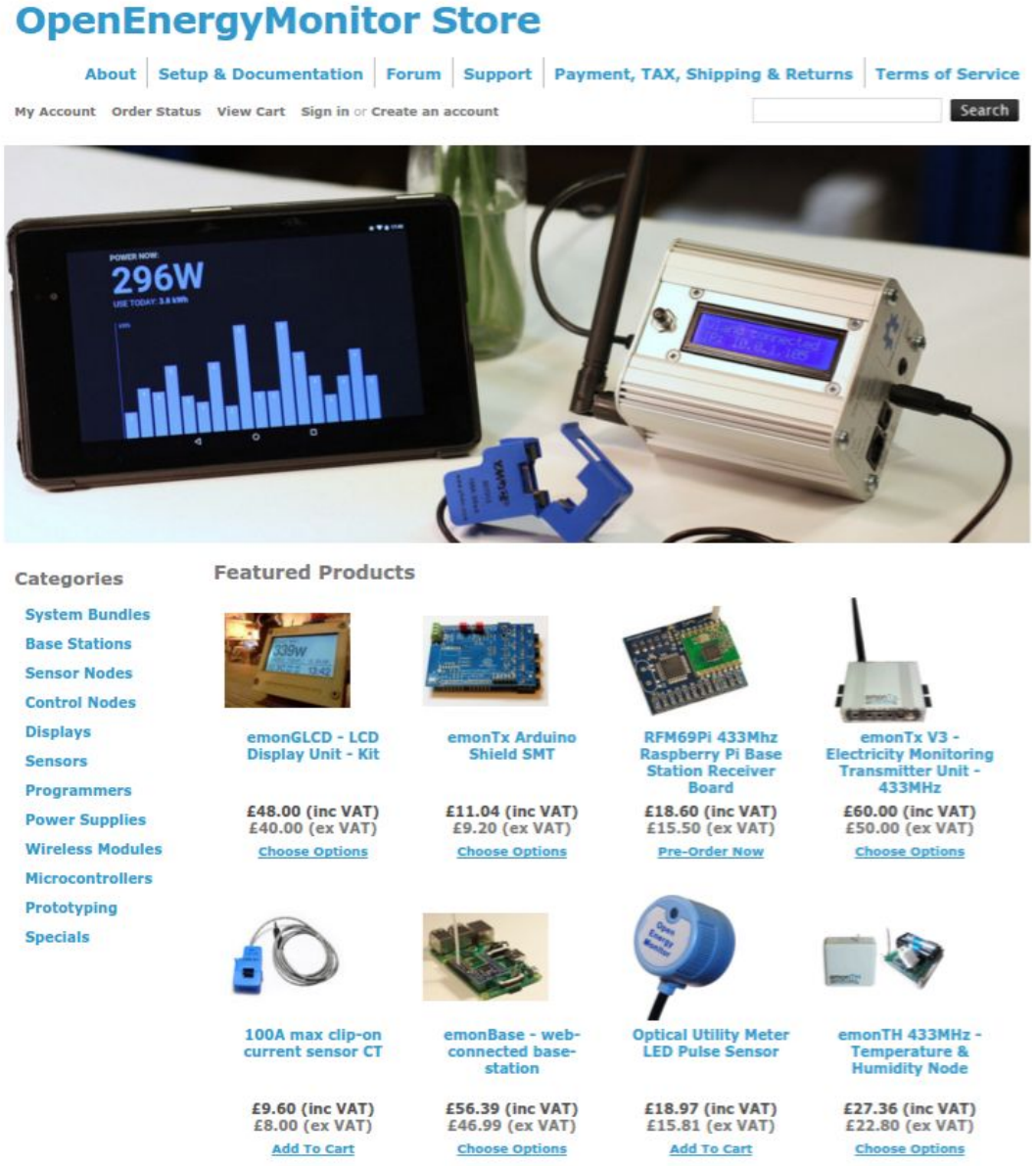
emonTx v3
Energy Monitoring Node

Select your configuration:

- Home Energy Monitor
- Solar PV Monitor

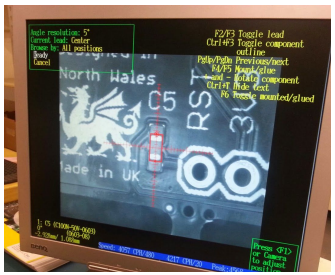
Configure

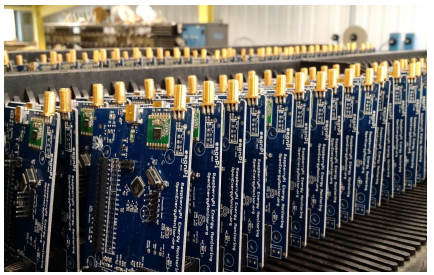
https://github.com/emoncms/autoconfig



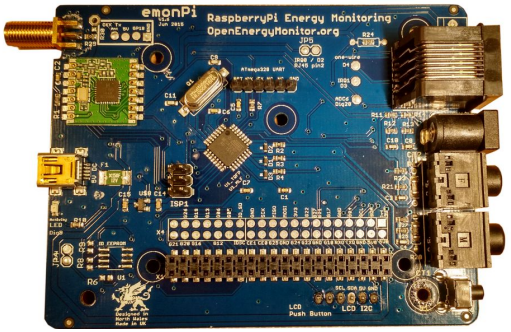
Open Hardware Business (Megni)

- Local Manufacture: PCB's manufacture in UK, SMT assembly in Bangor, N.Wales.
- Worldwide shipping: Over 10,000 orders to over 70 different countries over past 3 years.
- Open hardware business is an effective model for making and distributing technology, providing employment and supporting open-source development.
- Blurs the traditional lines between “business”, academic research and education.



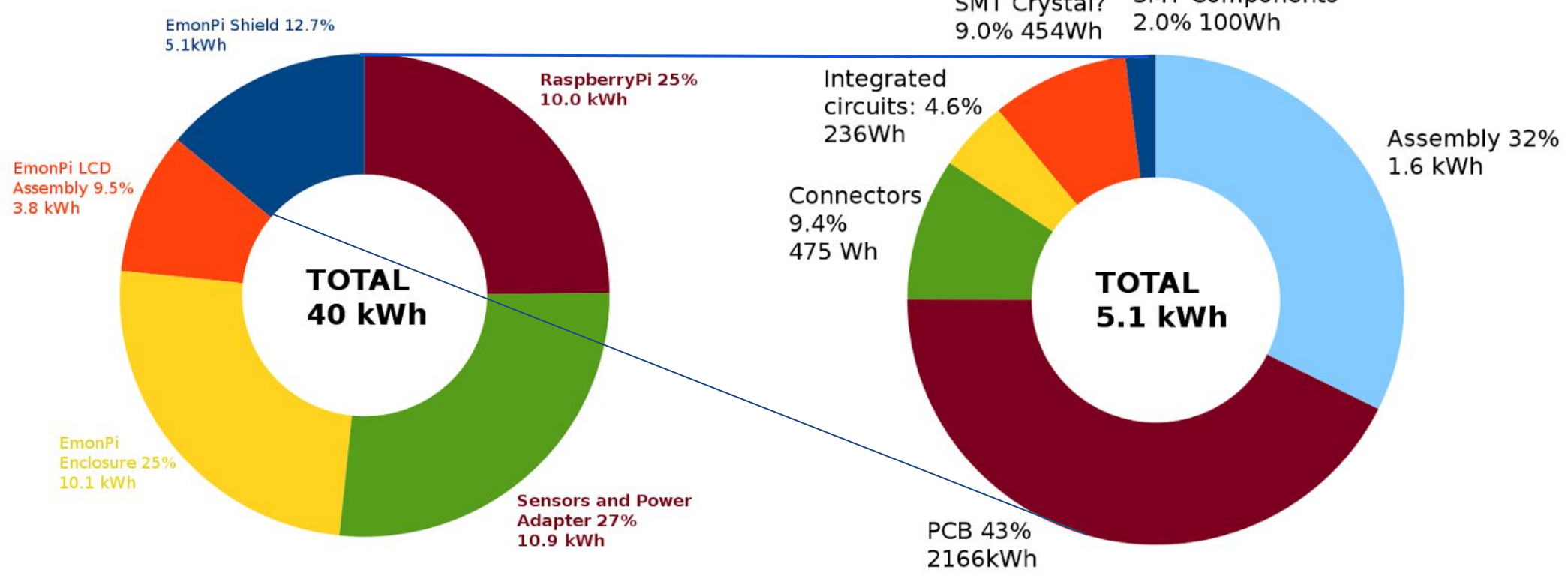


emonPi Embodied Energy



EmonPi Full

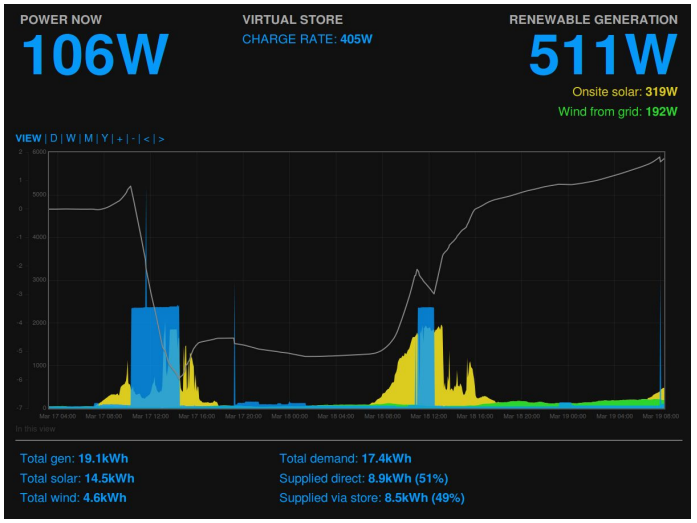
EmonPi Shield only

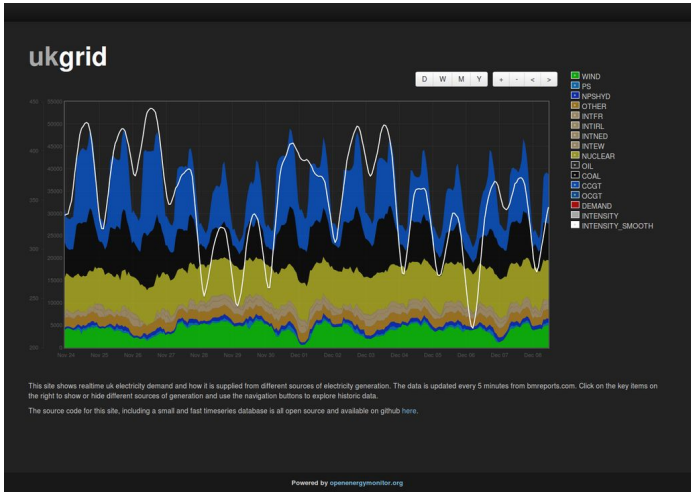


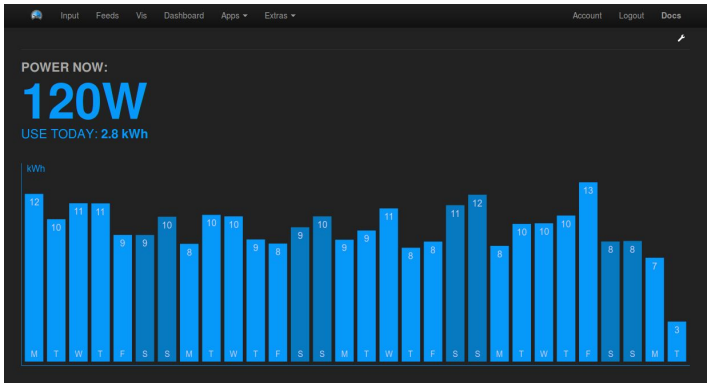
Assuming installing in average household, if a 5% reduction in energy can be achieved the emonPi will save the amount of energy used in it's manufacture in 3 months.

https://blog.openenergymonitor.org/2015/07/open-source-circular-economy-oscedays/
https://blog.openenergymonitor.org/2015/06/investigating-embodied-energy-of-emonpi/

OSCE DAYS







- How much energy do I use?
- How can I reduce my energy use?
- How does my energy use compare to other people?
- Is my electricity coming from renewable energy now?
- When is a good time to do my washing or charge my car today?
- How much solar, wind turbines, hydro do I need to supply my demand?
- How much energy storage do I need?
- How can I intelligently control my heating?

Open source energy monitoring and associated energy planning tools can help us understand, plan, test and manage our new zero-carbon energy system in an open way that empowers people to get involved with where their energy comes from and how it is used.

OpenEnergyMonitor

Setup | Applications | Integrations | Technical | Help | Shop

User Guide

Set up, install and configure an OpenEnergyMonitor system

Get Started

Home Energy

Understand your energy consumption:

- Monitor in real-time
- Review historic data
- Calculate cost
- Android app

Learn more »

Solar PV

Make the most of your solar PV:

- Monitor generation and grid import
- Calculate on-site use of solar.
- Real-time & historic performance
- Optimise demand matching

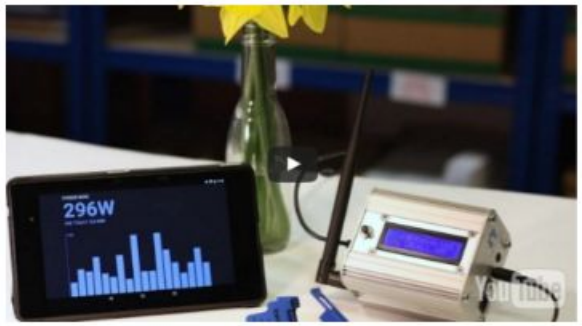
Learn more »

Integrate

Extend functionality with:

- Emoncms
- MQTT
- NodeRED
- OpenHAB

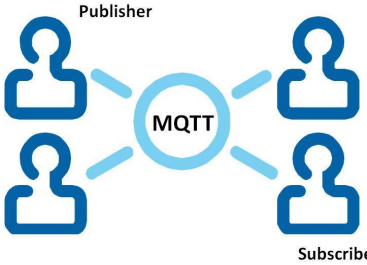
Learn more »



System Overview

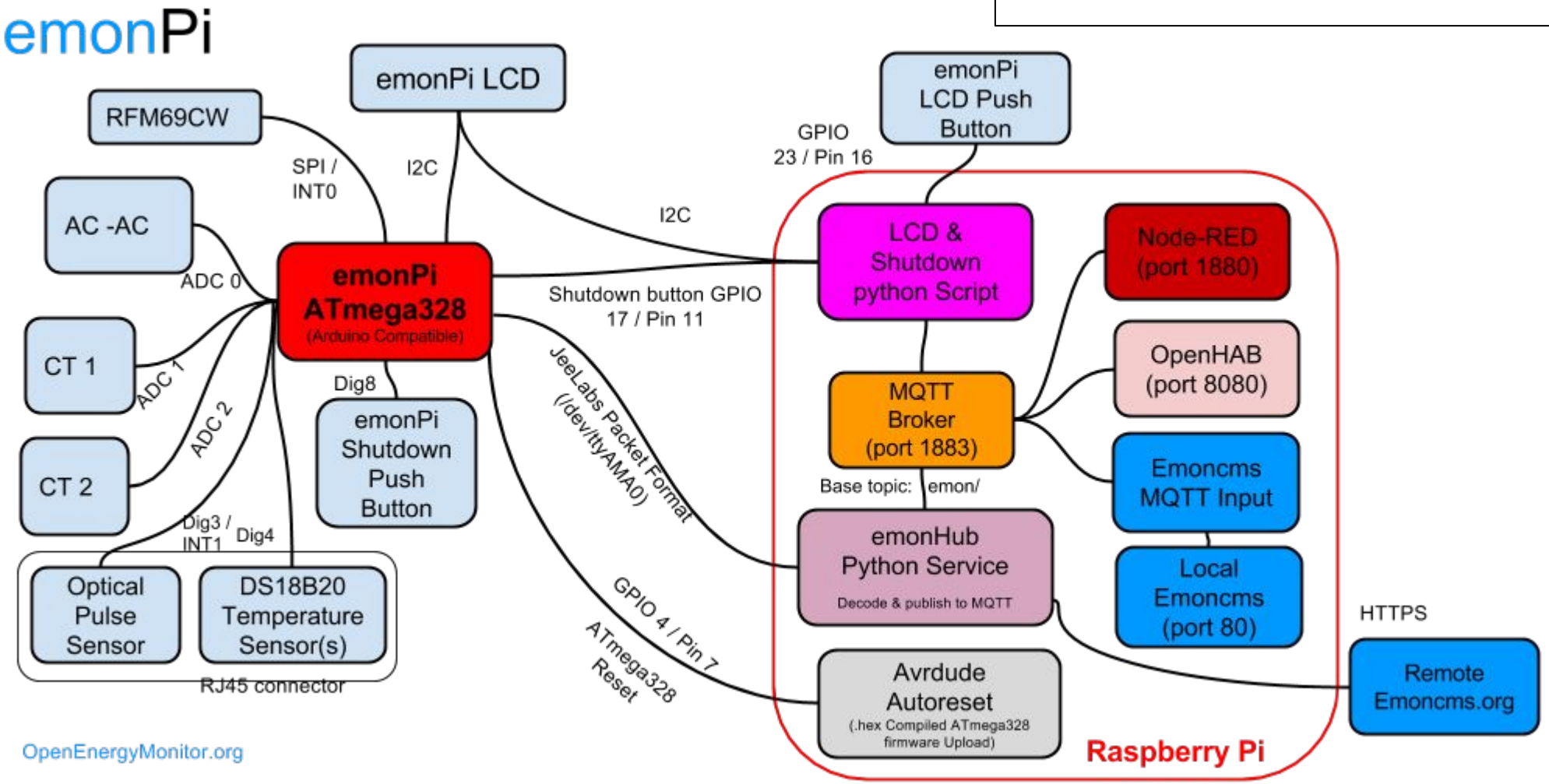
Sustainable Energy Challenge

The glue of Internet of Things...#1



- M2M publish / subscribe message transport protocol
- Runs over TCP/IP
- Lightweight, open, simple and secure
- Used in Facebook messenger, Illy coffee machines and emonPi energy monitor :-)

MQTT topic:
emon/<nodename>/<keyname>
e.g. emon/emontx/power1



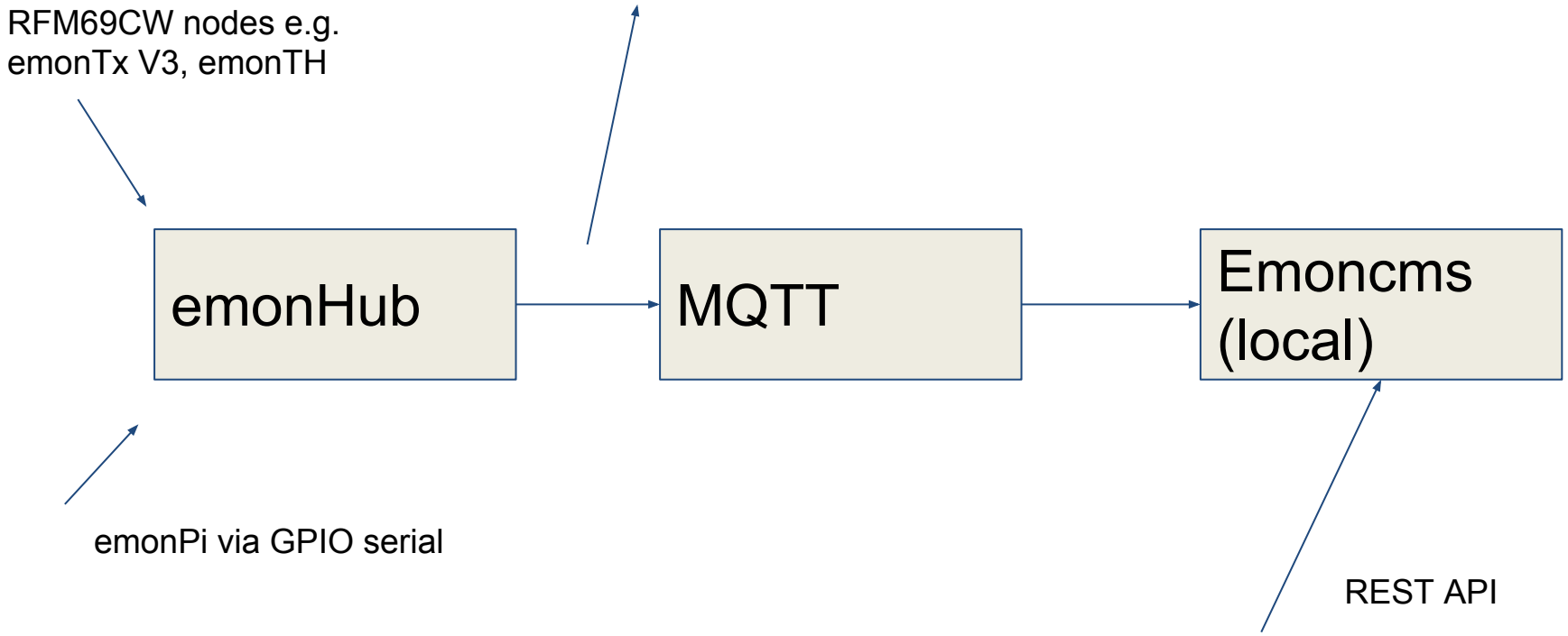
http://guide.openenergymonitor.org/technical/mqtt/

MQTT Interface

emonHub publishes data to MQTT topics:

emon/<nodename>/<keyname>

e.g. emon/emontx/power1



Note: Emoncms.org does not yet support MQTT direclty

http://guide.openenergymonitor.org/technical/mqtt/

// Integrations

Pre Installed on emonPi

Assuming pre-build SD card image emonSD-03-May16 or later

Node-RED

Node-RED is a tool for wiring together hardware devices, APIs and online services in new and interesting ways. Using NodeRED the emonPi can become a central hub for home automation, control and notification.

OpenHAB

Open Home Automation Bus (OpenHAB) is "a vendor and technology agnostic open source automation software for your home". OpenHAB is java based and can run on an emonPi (Raspberry Pi) and is very flexible and can be configured for just about any home automation task

LightWaveRF Control

LightWaveRF produce a variety of RF plugs and relays which can be controlled via OOK (on-off-keying RF. The LightWaveRF OOK protocol is also compatible with some lower cost un-branded OOK learning receivers relays.

No Installation Required

WiFi MQTT Control Relay Thermostat

Multi-purpose Wifi connected relay control board. Applications include: remote heating an A/C systems control via nodeRED, openHAB and Android Tasker etc.

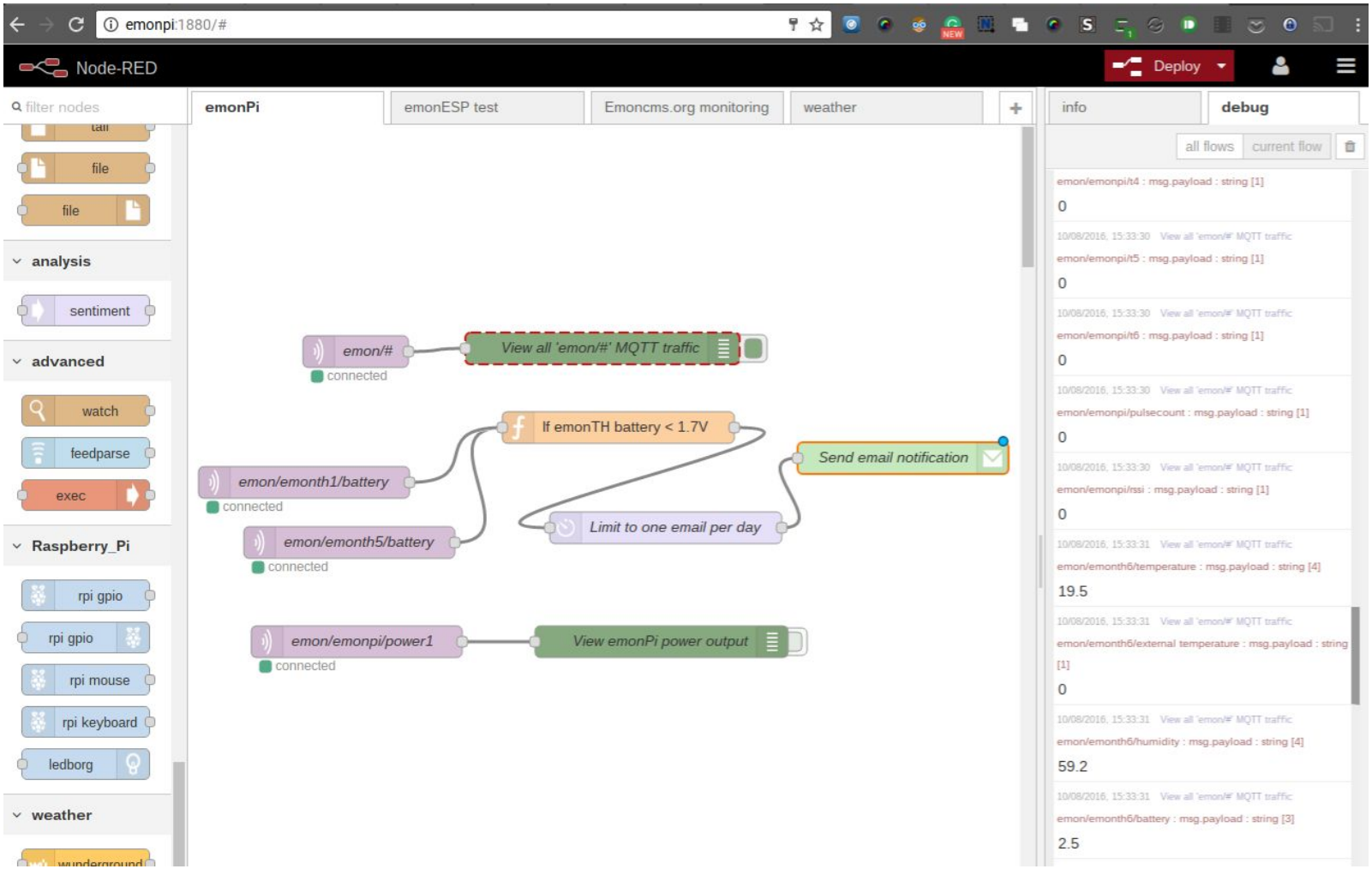
Installation Required

Home Assistant

Fully open-source python based home automation platform, similar to openHAB but easier to setup with some nice auto-detection. Tested to work on emonPi (requires install)

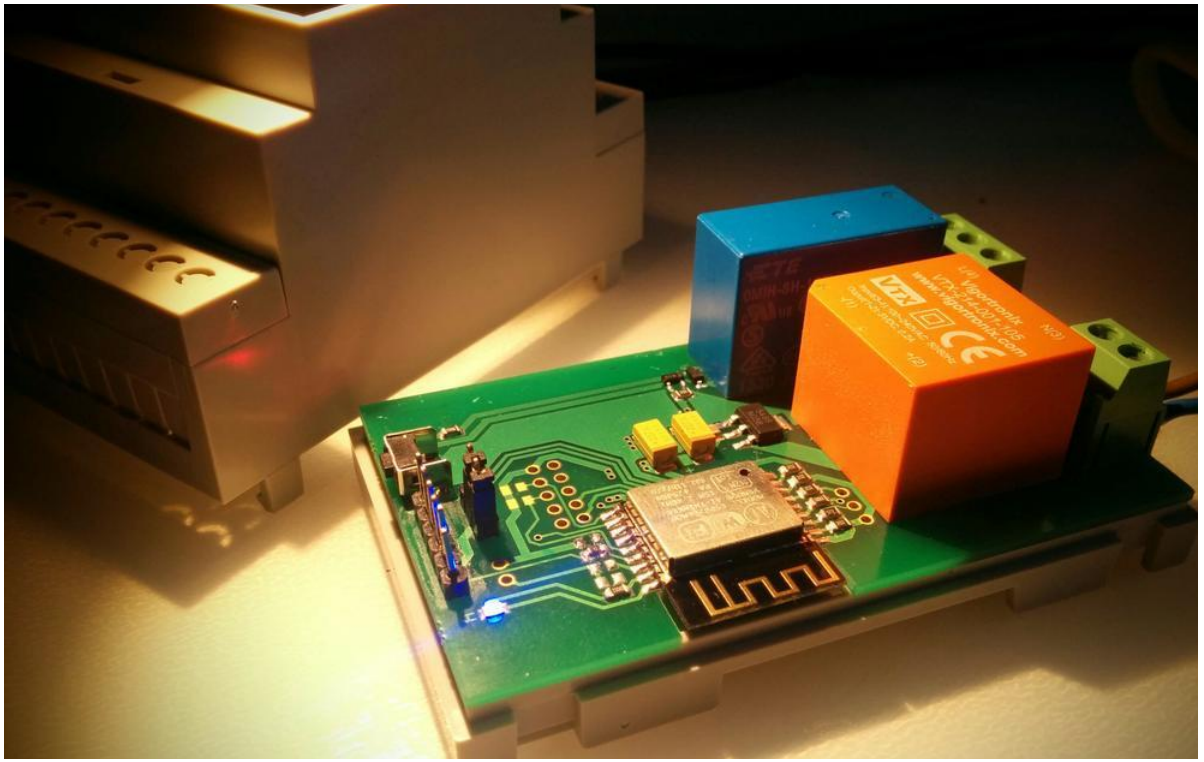
The glue of Internet of Things... #2

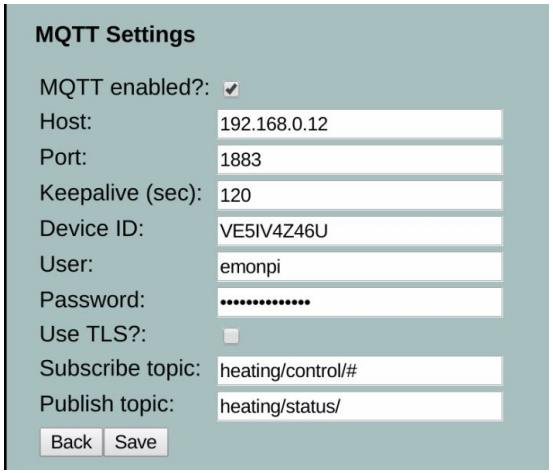
- Tool for wiring together hardware devices, APIs and services in new and interesting ways.
- The emonPi can become central hub for home automation, control and notification.
- Open-source, developed by IBM

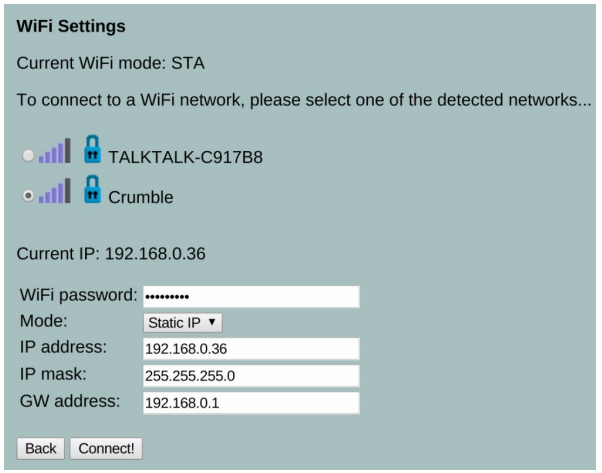


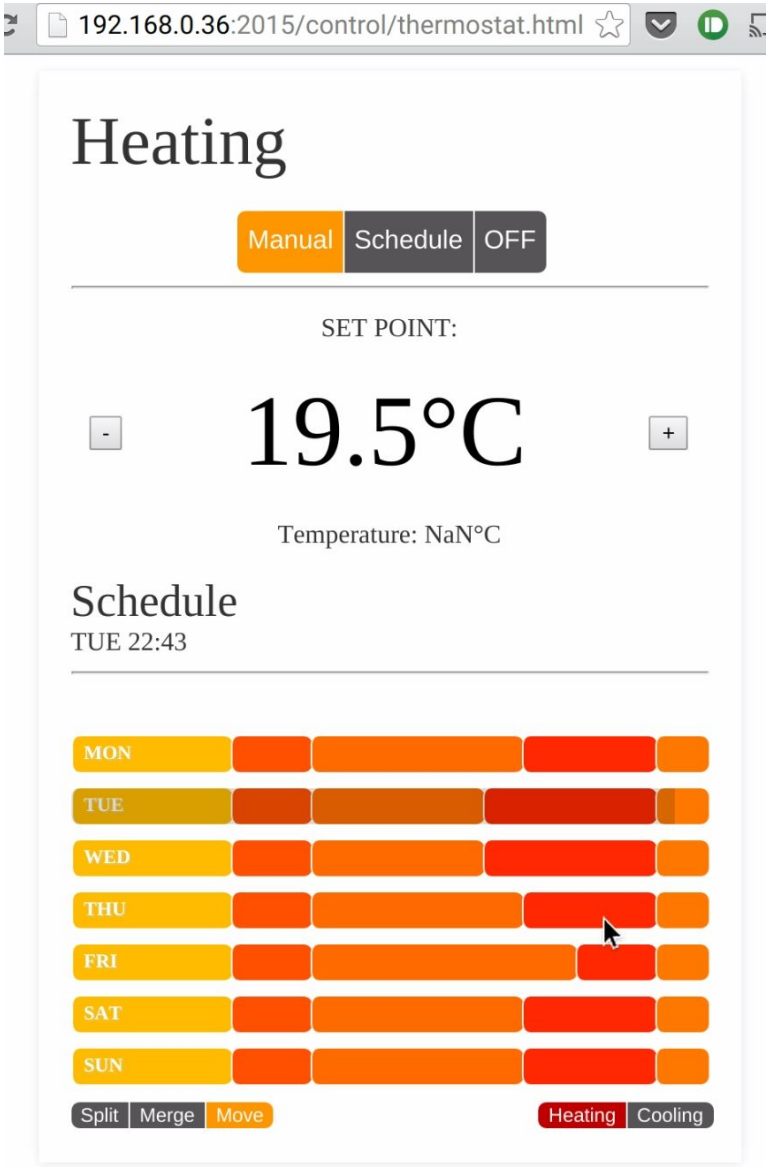
http://guide.openenergymonitor.org/integrations/nodered/

MQTT ESP8266 WiFi Relay / Thermostat







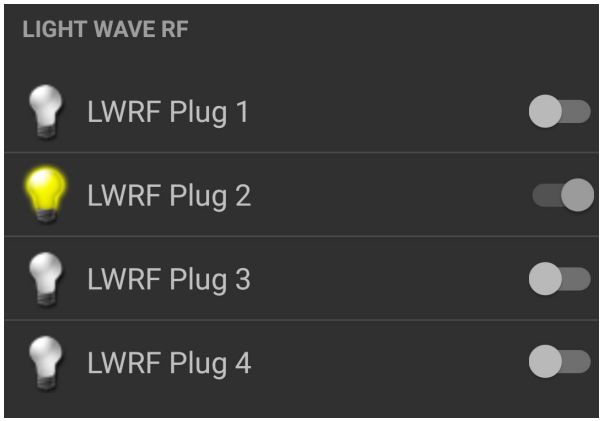


Relay can be controlled by publishing 1 or 0 to the MQTT control topic, default:

'heating/control/relay/1'

https://guide.openenergymonitor.org/integrations/mqtt-relay/

lightwaveRF plug control (OOK RF)



emonPi - Raspberry Pi based energy monitor

OpenHAB
(control interface >
Plug 1 = ON)

Publish

MQTT Server

Suscribe

LightWaveRF
MQTT Service

RF Transmitter
(433Mhz OOK)

"1 1" > "lwrf" topic

RF "ON" Control Signal

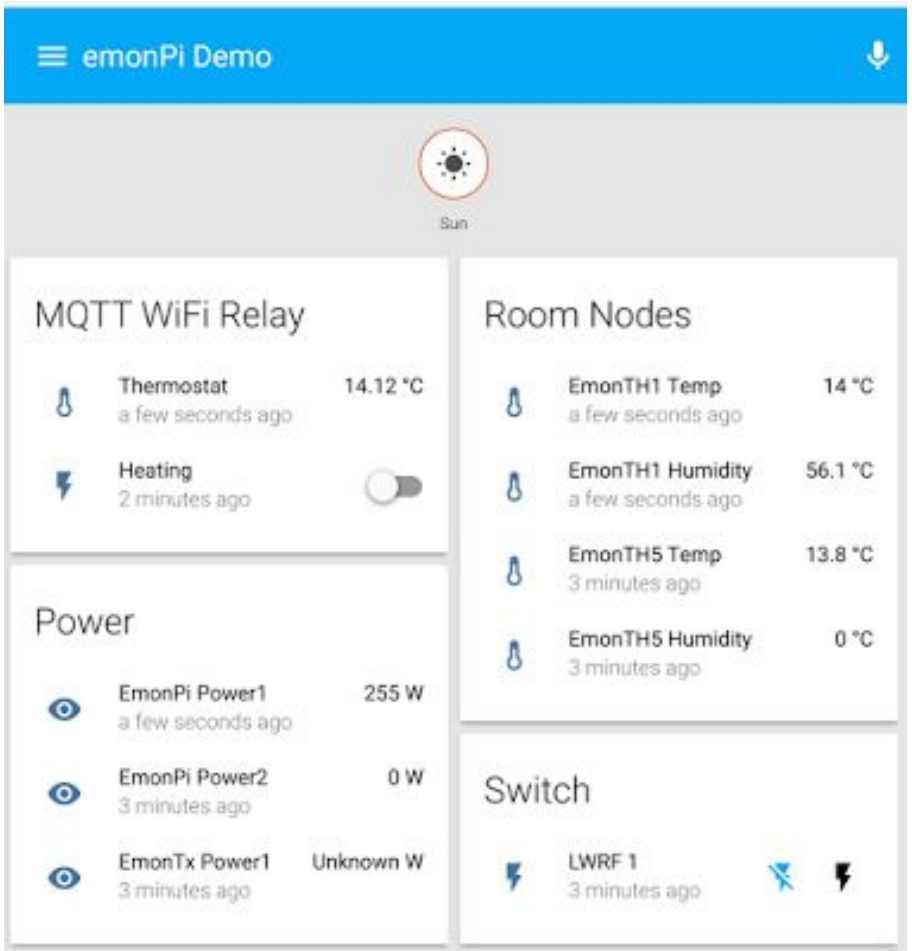
LightWaveRF
(Remote Plug)

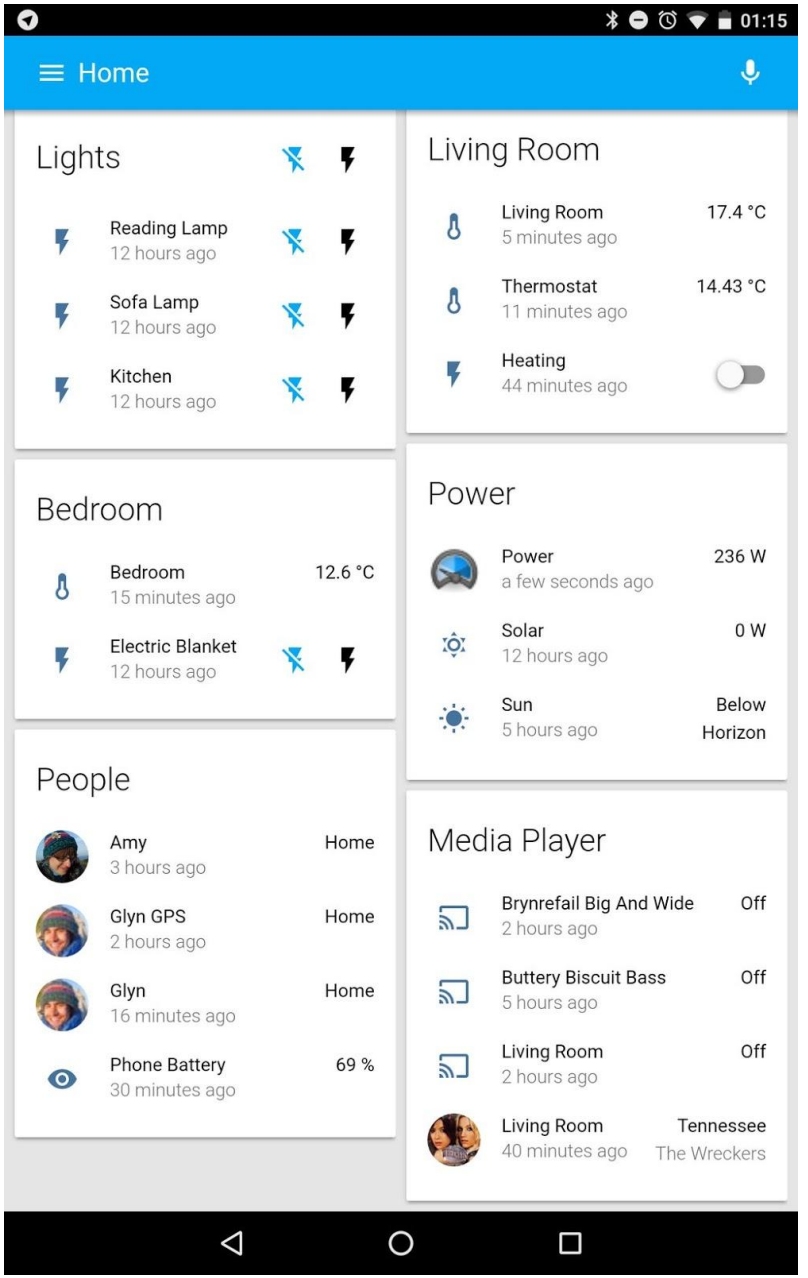
https://guide.openenergymonitor.org/integrations/lightwaverf/

http://www.openhab.org/

http://guide.openenergymonitor.org/integrations/openhab/

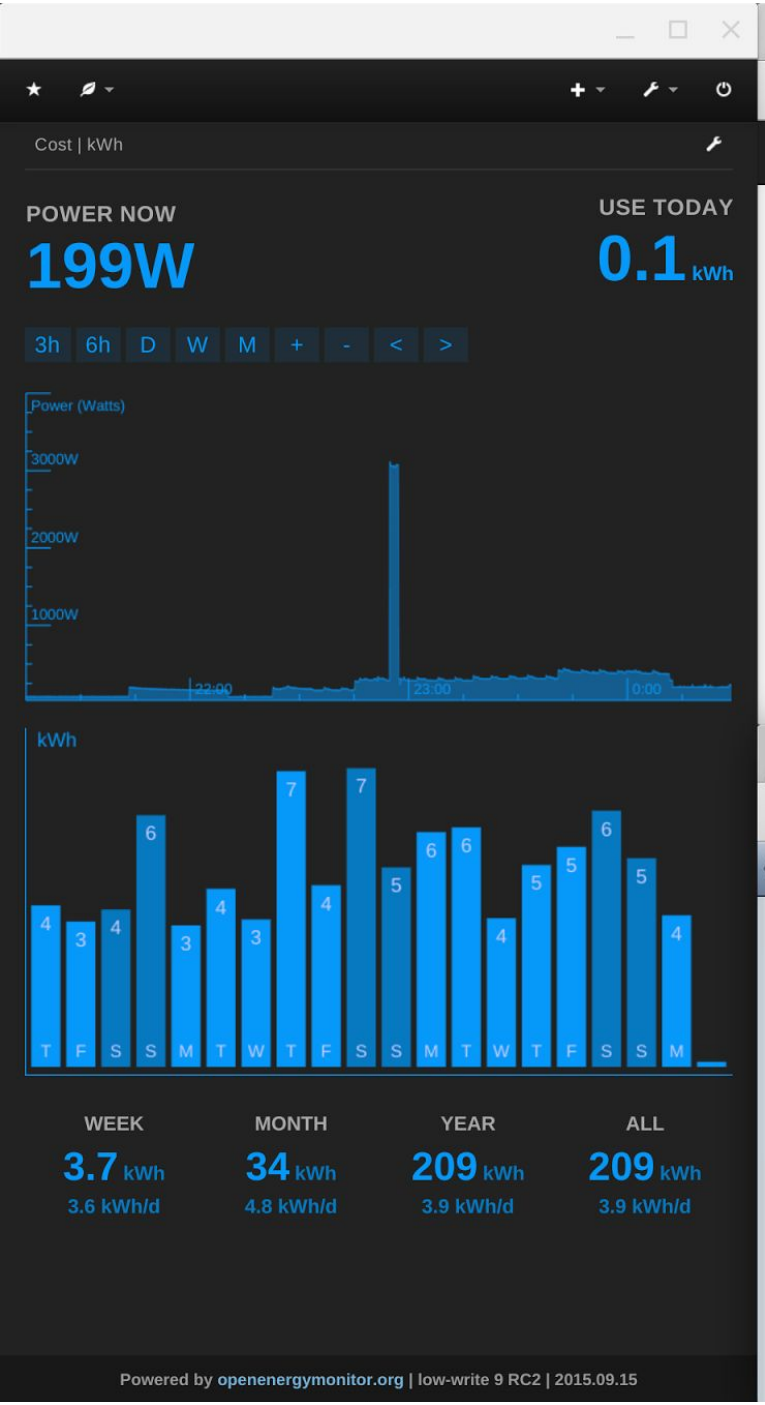
Home Assistant

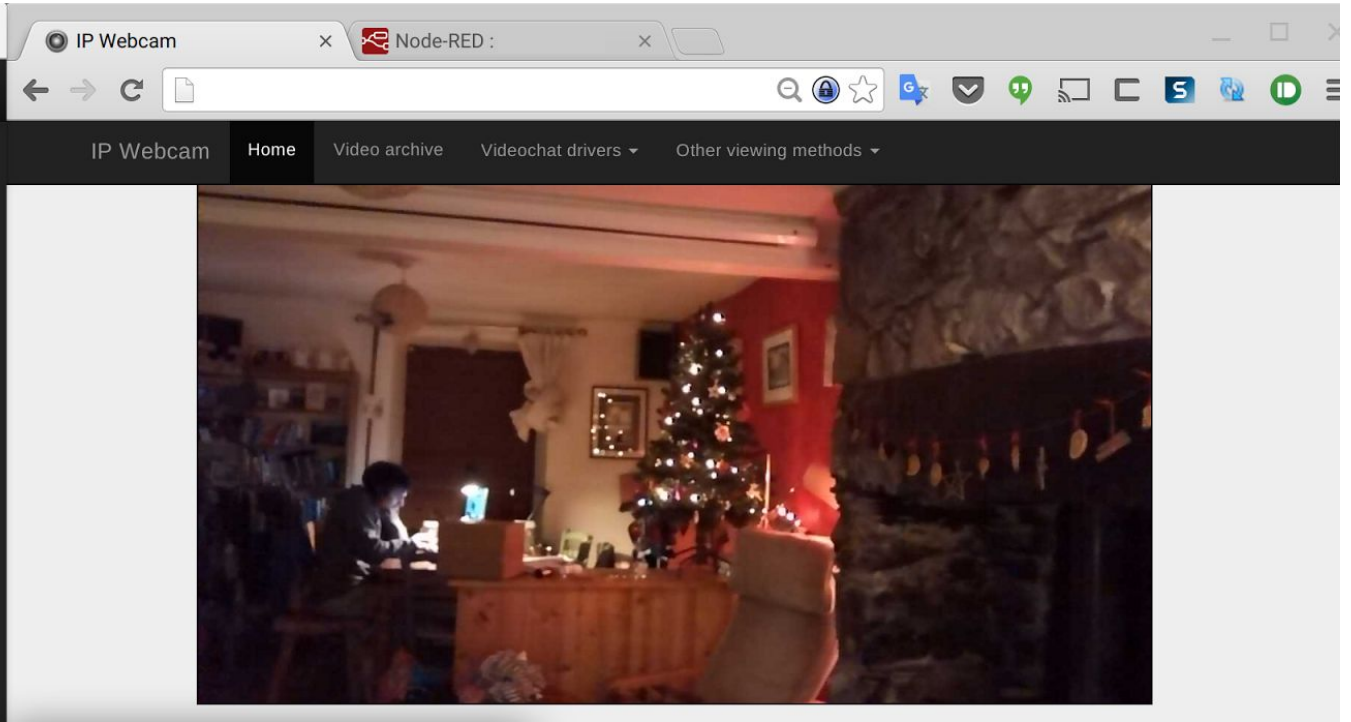


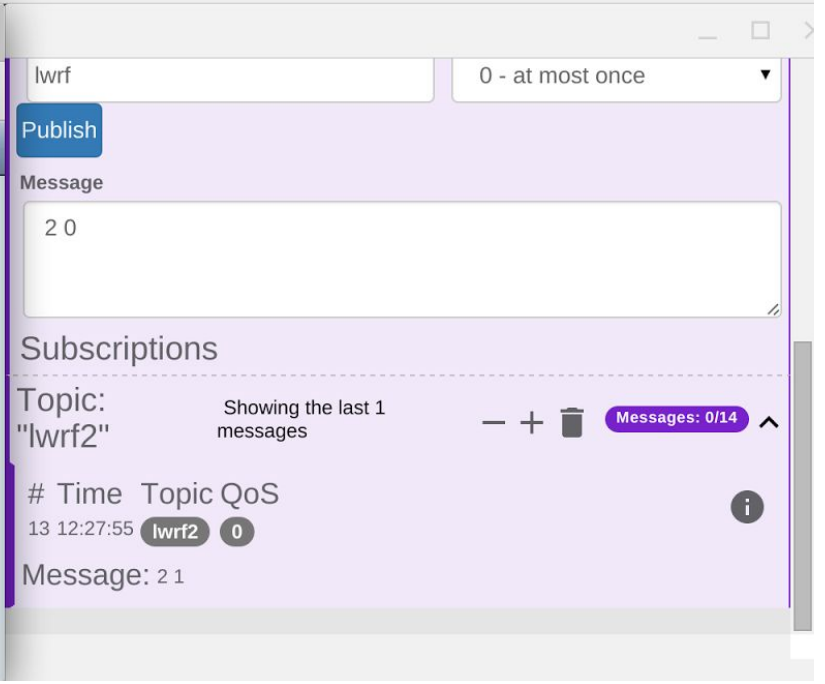


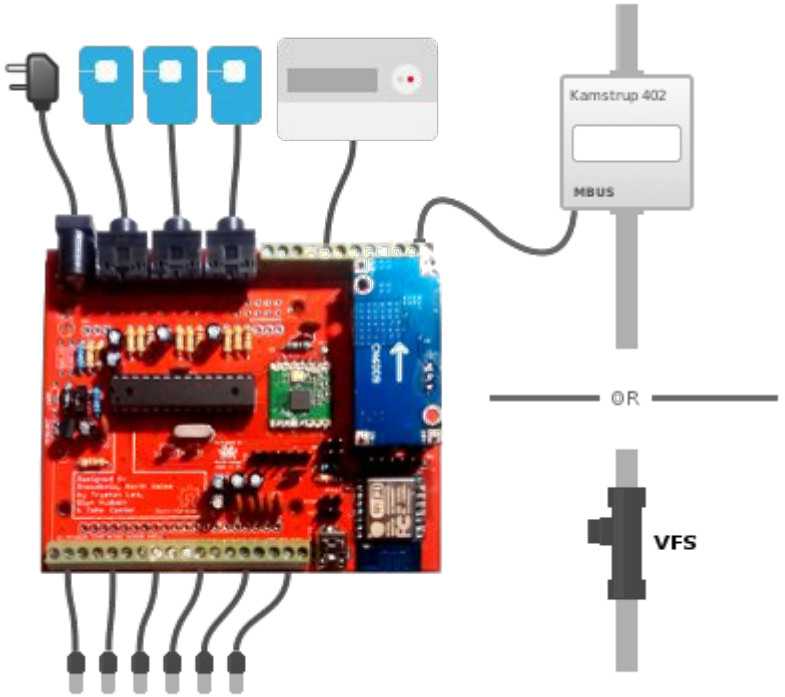
https://home-assistant.io
http://guide.openenergymonitor.org/integrations/

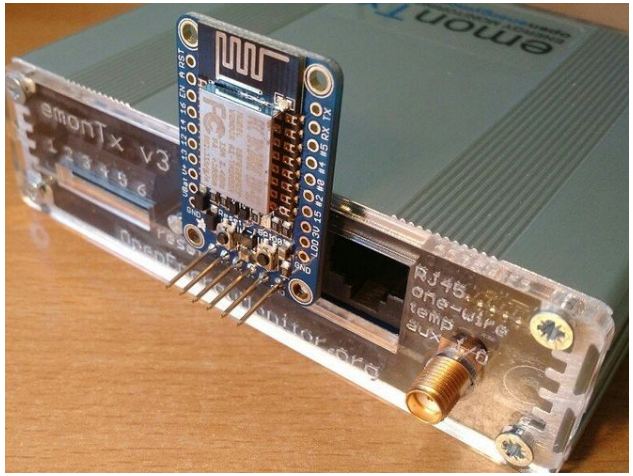
LightWave RF MQTT Light Control Demo











https://community.openenergymonitor.org/t/using-the-emontx-v3-with-the-esp8266-huzzah-wifi-module

https://github.com/openenergymonitor/EmonESP

emonESP

WiFi Emoncms Link

Wifi

Mode: Client (STA)

Network	RSSI dBm
OpenEnergyMonitor	-62

IP Address:
10.0.1.93

Emoncms

Emoncms Server*:
emoncms.org

e.g 'emoncms.org', 'emonpi/emoncms', or '192.168.1.4/emoncms'

Node Name*:
2

E.g 'emonesp' or 'heatpump'

Write apikey*:
••••••••••••••••••••••••••••••••

SSL SSH-1 Fingerprint:
7D:82:15:BE:D7:BC:72:58:87:7D:8E:40:D4:

HTTPS will be enabled if present e.g:

7D:82:15:BE:D7:BC:72:58:87:7D:8E:40:D4:80:BA:1A:9F:8B:8D:DA

Save Connected: Yes

Successful posts: 1 / 1

Firmware

Check for Updates

Upload

MQTT

MQTT Server*:
emonpi

e.g 'emonpi', 'test.mosquitto.org', or '192.168.1.4'

MQTT Topic*:
emon/emonesp

Base topic e.g 'emonesp', 'emon/heatpump'

Username:
emonpi

Leave blank for no authentication

Password:
••••••••••••

Leave blank for no authentication

Save Connected: Yes

Latest Data

Key	Value
CT1	3935W
CT2	325W
T1	12.5°C
T2	16.9°C
T3	11.2°C
T4	34.7°C

System

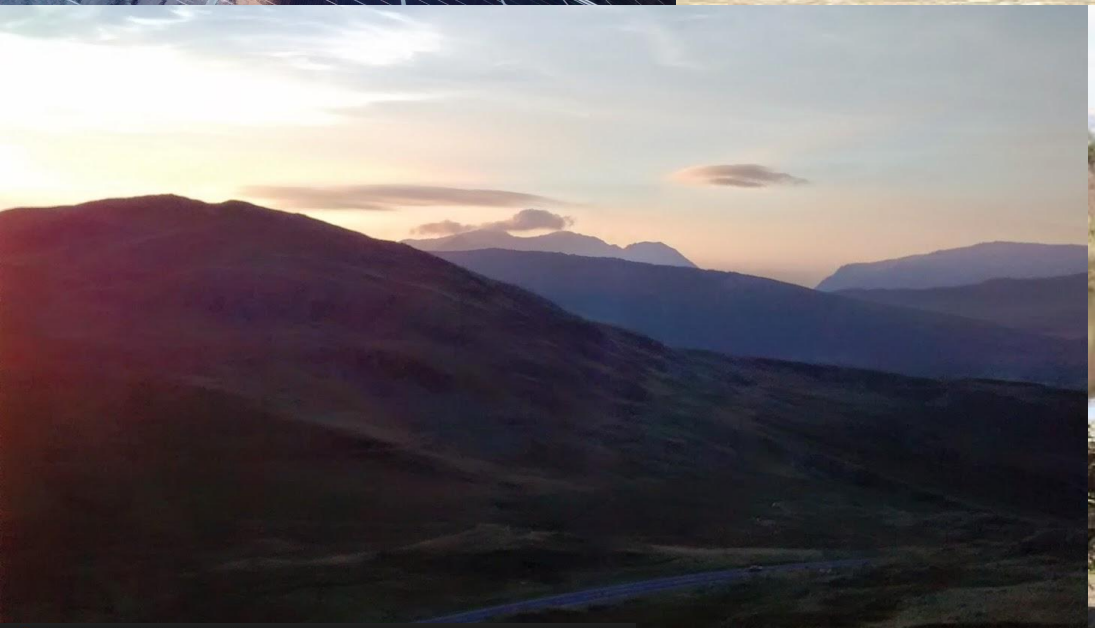
Free RAM:
12168B

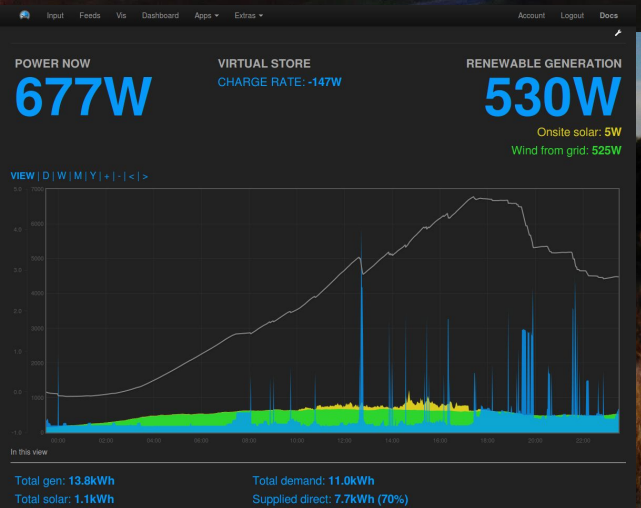
Restart Factory Reset

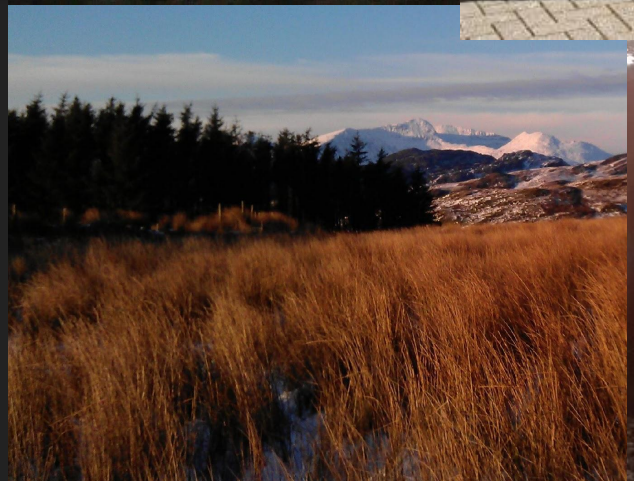
Powered by OpenEnergyMonitor.org


Thank you


296W




Input
Feeds
Vis
Dashboard
Apps
Extras
Account
Logout
Docs
POWER NOW
677W
VIRTUAL STORE
CHARGE RATE: -147W
RENEWABLE GENERATION
530W
Onsite solar: 5W
Wind from grid: 525W
VIEW | D | W | M | Y | + | - | < | >
In this view
Total gen: 13.8kWh
Total solar: 1.1kWh
Total demand: 11.0kWh
Supplied direct: 7.7kWh (70%)

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