

Energy Harvesting Powered IoT Devices for Commercial Buildings

Indoor solar and multi-source ambient energy powered IoT edge devices

Challenge

The world will have 1 trillion IoT devices within the next few years all needing a power source. Most of these will be wireless sensors at the 'edge' using a 'battery'.

We need to make the battery outlive the device it powers to minimize downtime, maintenance overheads and risk of data loss.

Some applications have harvestable ambient energies available and these can be used to prolong battery life and in some cases eliminate

Solution

Whilst Tyndall already develops world leading energy harvesting, storage and CMOS based micro-power management solutions in the interim there are commercially available parts that when combined using Tyndall knowhow and innovative discrete power management circuits can provide ready to use solutions. Two manifestations of successful work undertaken by Tyndall for real life commercial building applications are presented in this technology offering.

- Indoor solar powered Wireless sensor node measuring temperature, light and humidity that runs indefinitely
- Multi-ambient energy source that can indefinitely power a condition monitoring diagnostics unit

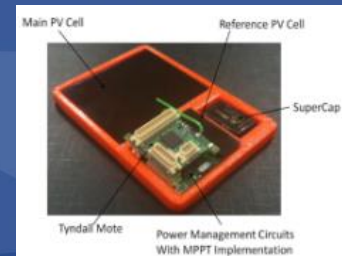
These platforms can easily be adapted for other applications based on sensory needs and ambient energies available.

Benefits Summary

Ambient energies are used to extend battery life or eliminate entirely the need for battery replacement, depending on IoT device power requirement and ambient energies available. The technology platforms use Tyndall circuit innovation and 'power IoT' and system integration knowhow but leverage from COTS parts, thereby the technology is available for immediate usage.

The platforms have been developed as part of Science Foundation Ireland (ITOBO project) and MOSYCOUSIS, an EU project comprising technology providers and SMEs developing condition monitoring solutions for industrial applications. We are the perfect development partner to bring this technology to market.

1. Indoor solar powered WSN device



ITOBO

Figure 1. Indoor solar power WSN node

- Credit card size, no battery required
- Innovate max. power point tracking circuit maximizes power conversion from the PV cell
- Powers a Tyndall WSN node measuring temperature, light and humidity every 5 mins.
- Needs just 350Lux for 8hrs/day to operate indefinitely
- Runs for 72hrs in darkness & auto-starts after 2 hrs.
- Generates approx. 150uW average power.

2. Multi-ambient energy source for a condition monitoring diagnostic unit

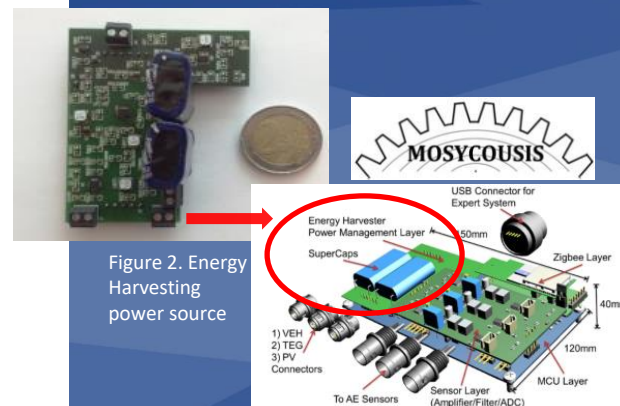


Figure 2. Energy Harvesting power source

Figure 3. Condition monitoring diagnostic unit* (developed by project partners on the EU MOSYCOUSIS project)

- Compatible with commercial off the shelf (COTS) transducers for light, vibrations and temperature
- Generates >2mW of power from vibrations or heat from a compressor, sufficient to power the MOSYCOUSIS diagnostic unit (ref. overleaf).
- Indoor solar compatible, power from uWs to mWs available depending on lighting conditions.

Applications

- Extending battery life of wireless BEM (building energy management) wireless sensors in commercial buildings
- Extending battery life of wireless condition monitoring devices commercial buildings, industrial settings and factories
- Broadly applicable to a broad range of wireless IoT edge devices, particularly in the sub mW power range

Technical specifications

1. Indoor solar demonstrator

- Power harvested with 350Lux ~500uW, averages at 130uW over 24 hours period with 8hrs 'lights on' per day
- Amorphous silicon PV cell 1.8x2.2" (5x6cm)
- 6F supercap gives 72hrs operation in darkness
- Start up circuit can re-boot device within 2 hrs.

2. Multi-source power module

- 3.6mW thermoelectric power harvested based on δT of 36°C using 8x8cm TEG
- 2.68mW vibrational power harvested using Perpetuum
- 120uW harvested to power a temperature and humidity sensor

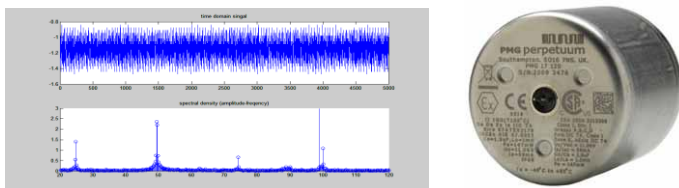


Figure 4. 2.68mW power harvested based on compressor resonances at 50 & 100Hz

Commercial Status:

Tyndall are looking at expanding the remit beyond commercial buildings and factories to micro-grid components (PV panels, batteries, wind turbines, etc.) and systems. We are looking for co-developers, system integrators and end users to explore licensing collaborations across the full supply-chain.

Intellectual Property:

More than €30M invested in Energy Harvesting and WSN (wireless sensor network) research over the past 20 years resulting in extensive IP & know-how in design and integration of energy harvesting powered multi-sensor multi-radio WSN platforms for applications including buildings, micro-grids, environmental, industrial and medtech. Tyndall has an established track record in licensing IP related to IoT devices to SMEs, start-ups and multi-nationals.

Development Stage:

1. The **indoor solar device** has been tested and proven to work indefinitely for 5 continuous months in an office environment
2. The **multi-source device** was tested with COTS TEGs (thermoelectric generators) and vibrational energy harvesters (from Perpetuum) with Irish industry partner Endeco (now known as GridBeyond) on a compressor in a cold store in the EU MOSYCOUSIS project.



Figure 5. Compressor (left) used as a thermoelectric & vibrational ambient energy source. Indoor cold room lighting (250 Lux) also used as PV source for temperature & humidity sensors