

Energy Harvesting Technologies for IoT

The 4E Electronic Devices and Networks Annex (EDNA) provides policy guidance to members and other governments aimed at improving the energy efficiency of connected devices and the systems in which they operate. EDNA is focused on the increased energy consumption that results from devices becoming connected to the internet, and on the optimal operation of systems of devices to save energy.

This briefing summarises the key findings of the EDNA report *Energy Harvesting Technologies for IoT Edge Devices*, which explores the potential to deploy Energy Harvesting Technologies (EHTs) to convert energy from the surroundings into electricity, in order to power small internet of things (IoT) devices.



Observations for Policy Makers

- Many Internet of Things (IoT) edge devices, such as sensors and actuators, are placed in remote locations and so many rely on batteries. One forecast yields a figure of more than 23 billion battery-powered IoT devices being deployed by 2025. The associated energy use and waste from batteries will be considerable.
- Energy harvesting technologies (EHTs) can capture ambient energy from sources such as light, heat, electromagnetic radiation and vibration and convert this into electrical energy to power wireless IoT devices, without the need for batteries and the associated maintenance costs.
- IoT devices currently powered using integrated EHTs include sensors for light, temperature, humidity, air quality, presence and smoke; as well as small valve actuators.
- IoT devices can have enormous benefits for smart buildings and smart infrastructure; facilitating optimal control of lighting, heating and cooling - using EHT powered IoT achieves this more sustainably.
- Integration of EHTs into device design is complex and depends on the technical maturity of EHT components, the availability of ambient energy sources, space for the EHT components within the device, and the resulting costs versus benefits.
- Although some EHT components are suitable for low-cost, mass production, in the foreseeable future the total cost of deployment (harvester, power conditioner, energy storage, etc.) is likely to exceed the cost of a battery.
- To bring EHT-powered IoT devices into the mainstream, policy makers could support demonstration projects and research programs, and use building codes to encourage uptake of EHT-powered IoT devices.

More Information

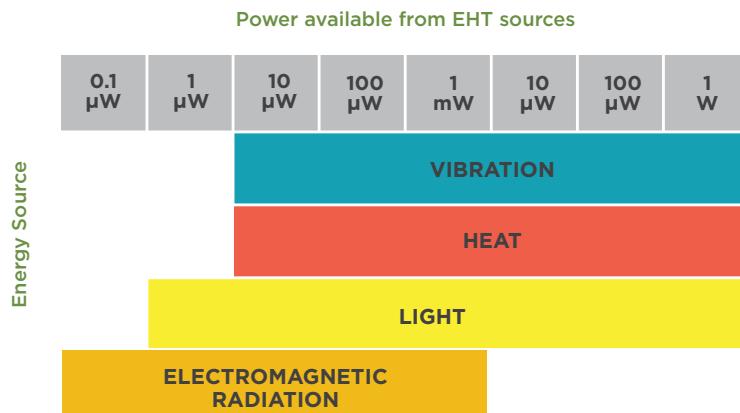
The EDNA report and further information is available from <https://edna.iea-4e.org/tasks/task6> and by contacting the EDNA operating agent at info@edna.iea-4e.org

Key Findings

Power from EHTs: from the low micro-Watt to the milli-Watt range

EHTs exhibit a large range of power delivery capabilities, from around 0.0001 to 500 milliwatts. However this is dependent on the type and availability of ambient energy sources, and the usable space within each EHT device.

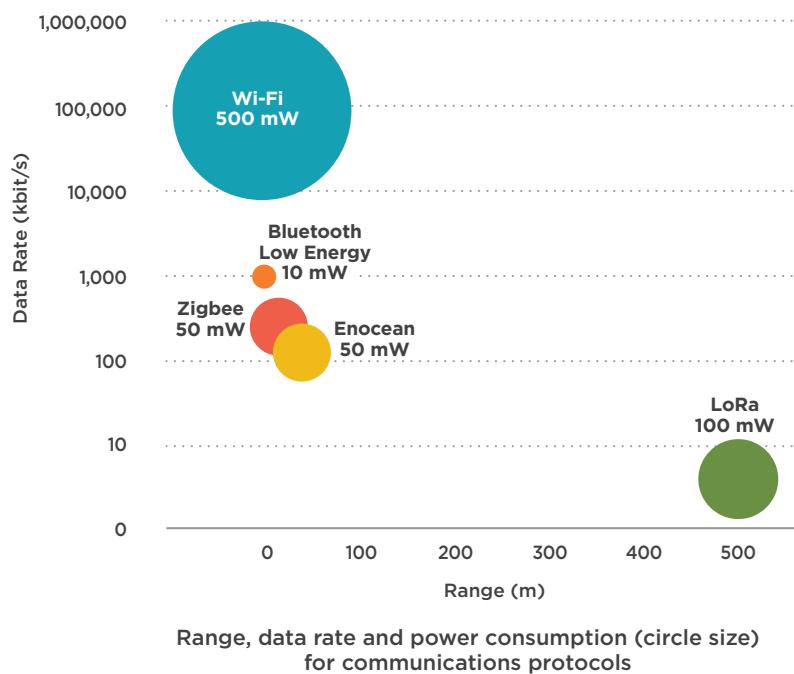
Shifting the paradigm from battery-operated IoT edge devices to autonomous, energy-harvesting IoT systems needs further research and development, especially to improve and miniaturise the harvesters.



Device communications should be optimised to reduce power consumption

Most IoT devices use readily available wireless communication protocols. Some of these protocols have been developed specifically for use with ultra-low power EHT and battery-powered IoT devices for smart home, building automation and industrial applications. Within each protocol, optional functionalities and power-saving modes are also available.

Device manufacturers should choose low power protocols and opt for power saving modes.



Energy storage within devices may be required

In many cases, there is a need for energy storage to buffer the power generated from intermittent energy harvesting, in order to cover the power demand of the IoT device itself. Supercapacitors can be a viable option for this purpose, as they last longer than batteries.

