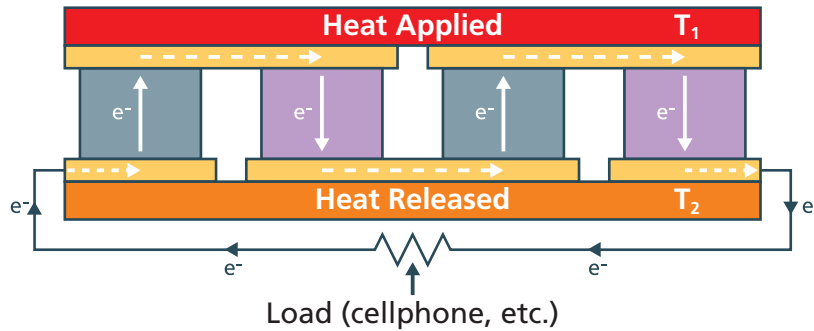


# Thermoelectrics for Energy Harvesting

CDT is developing materials and processes for energy harvesting purposes where flexibility and form factor enables new applications

## Thermoelectric Generator

e<sup>-</sup> = electron  
T = Temperature  
T<sub>1</sub> > T<sub>2</sub>

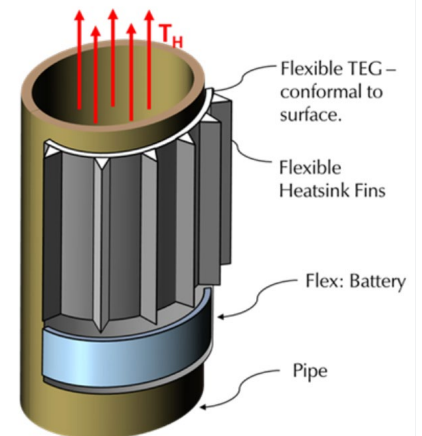


## Thermoelectric modules

- Thermoelectric generators are used to harvest energy from small temperature differences typically between a hot or cold surface and the ambient environment.
- Example heat sources include: industrial processes and equipment, domestic or commercial heating and hot water systems and body heat.

### Thermoelectric energy harvesting can address a wide variety of application areas:

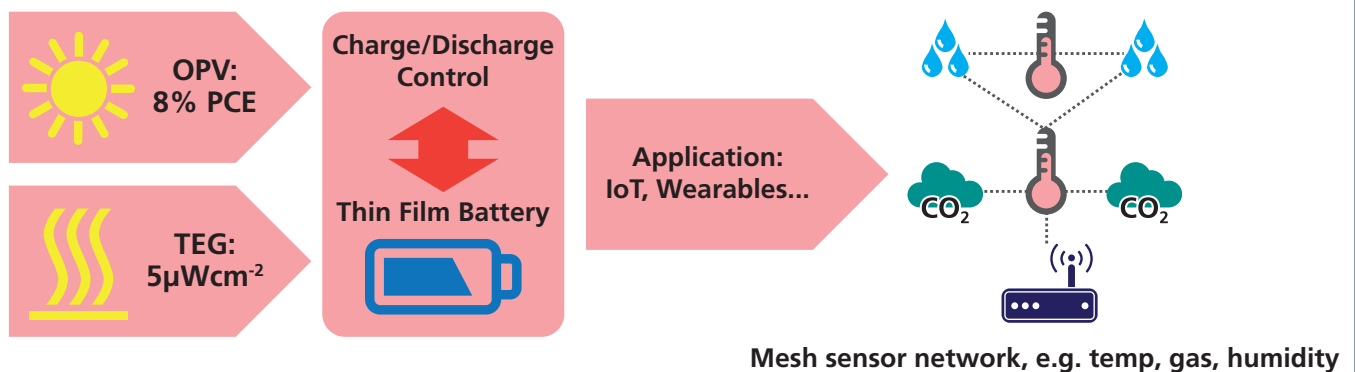
- Power source for autonomous IOT devices
- Battery life extension in small devices



Concept for integrated energy harvesting sensor node

## Integrated Energy Harvesting Systems

Fully printable and flexible energy harvesting and storage system as power supply for IoT and wearables



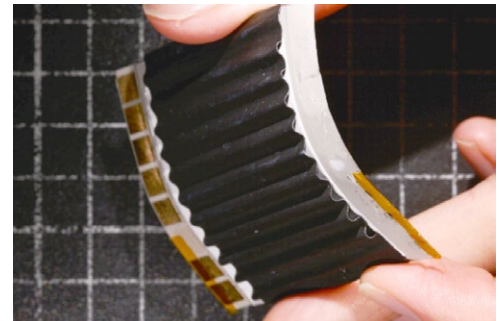
Mesh sensor network, e.g. temp, gas, humidity

## Thermoelectric Generator Module

Thermoelectric energy harvester for providing battery free power in low-powered wireless sensor networks.

### Technology Features

- Printable materials enable low cost manufacture.
- Low profile, fully conformable device and heat sink for ease of integration.
- Compatible with a wide range of heat sources e.g. pipework, boilers, radiators.
- Sufficient power output for battery free sensing and wireless transmission of data.
- Device performance continues to improve



CDT Printed TEG with Flexible Heatsink

### CDT Printed TEG Process



1

Active material ink formulation



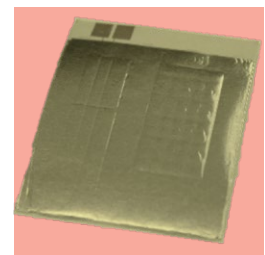
2

Foil Substrate with metal track and photoresist bank



3

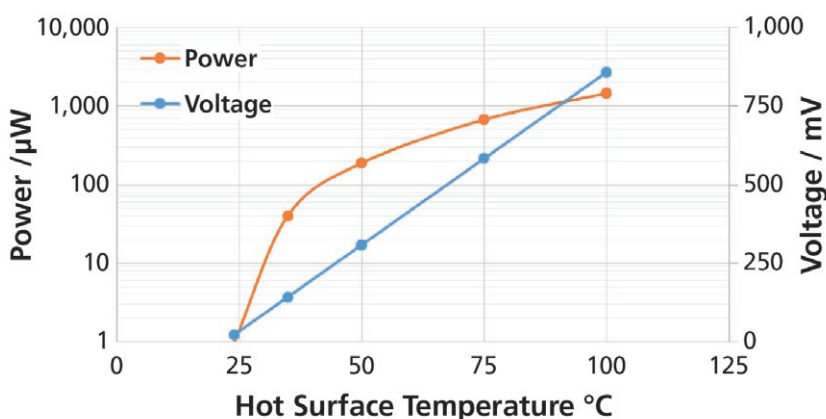
Print active materials from ink



4

Encapsulate with 2<sup>nd</sup> foil substrate

### 100cm<sup>2</sup> Module



Projected Performance with Current Materials and Process: (Passive Cooling in Ambient Conditions)

100cm <sup>2</sup> Module	Power µW	Voltage V
50°C	190	0.3
75°C	670	0.6