

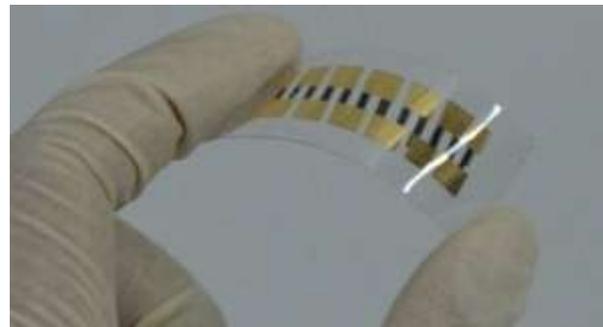
## WHY PARTNER?

World-leading expertise in:

- ▶ Organic material synthesis
- ▶ Material and molecular modeling techniques
- ▶ Thin-film deposition techniques
- ▶ Sheet-to-sheet production of thin-film electronics

**Access to University of Nottingham's state-of-the-art infrastructure**

- ▶ Fully equipped synthetic labs
- ▶ Low Cost advantage of high pure organic materials for device fabrication and performance



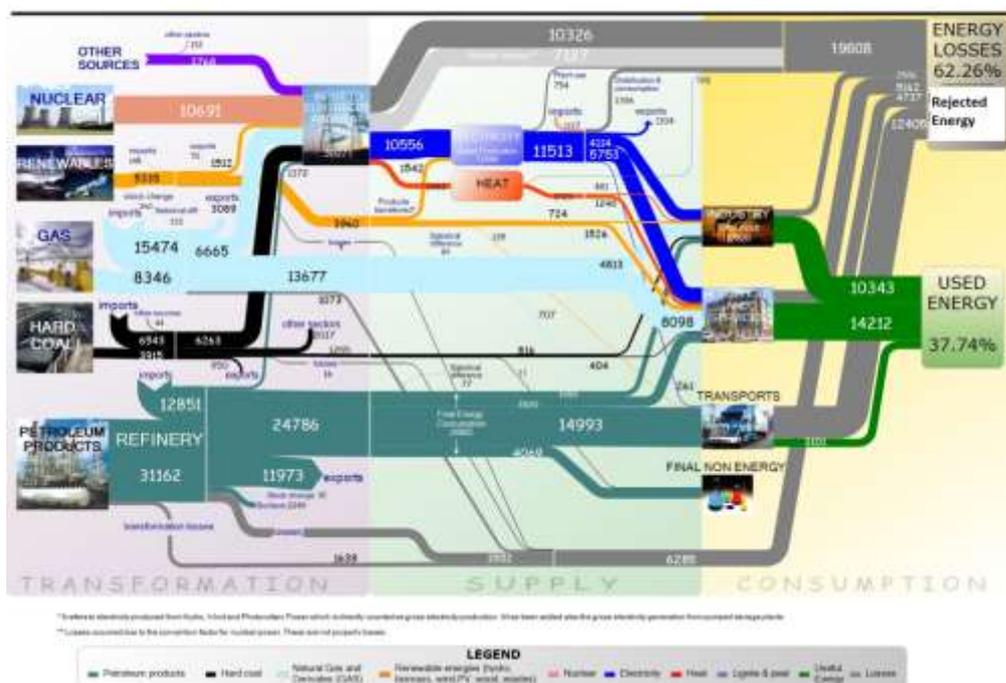
The EU-27 member states consumption in 2012, during which time more than half of the total energy input was immediately converted to waste heat. Moreover, the remaining ~40% which was used to perform work (e.g., transportation, electricity) was eventually converted into waste heat. For example, vehicle kinetic energy used for transportation is eventually converted to waste heat at the car brake when it stops

## HOW CAN YOU PROFIT?

H2ESOT will help you in developing novel organic materials, design, develop and prototype your application.

We tailor the most advanced technology to match your requirements.

Join H2ESOT advisory board.



**Fig:** EU-27 streamlined energy flow trends – Supply, Transformation and Consumption (2012) **Source:** European Environment Agency (EEA)

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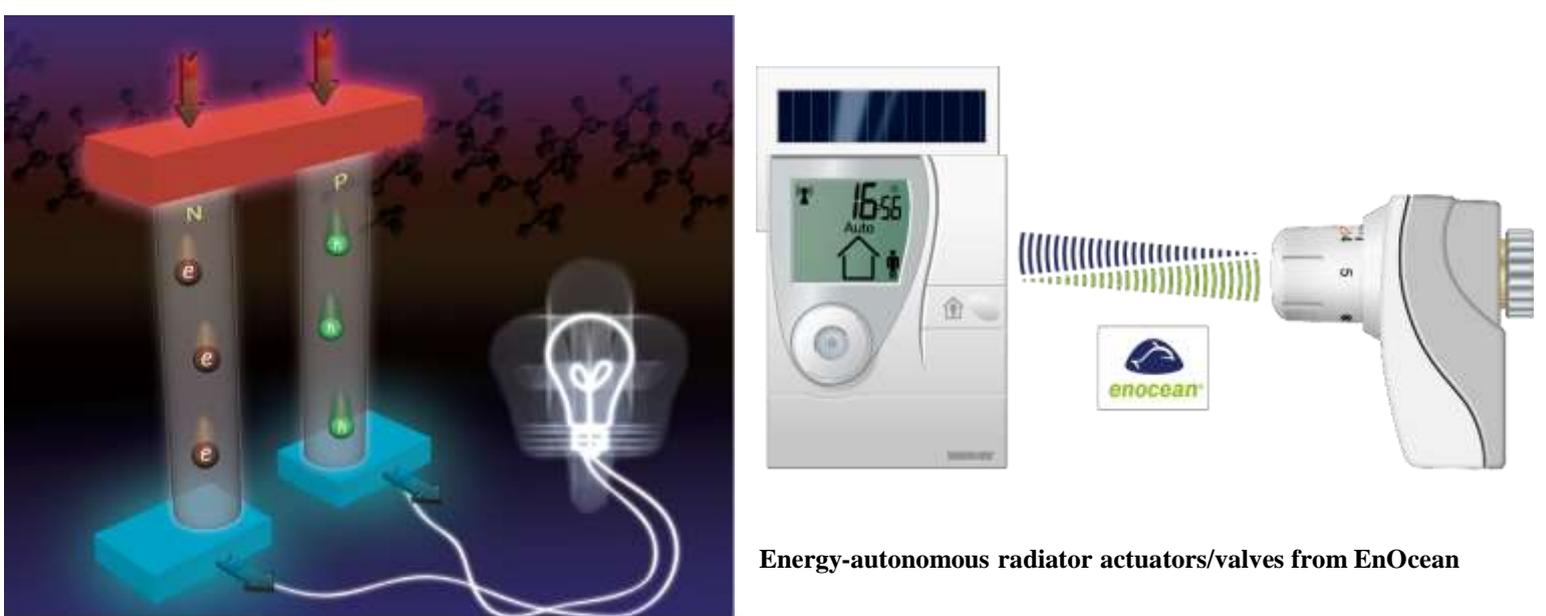
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[www.h2esot.com](http://www.h2esot.com)

h2ESOT is a registered trademark for the partner activities of EU FP-7 Program

## Sustainable Organic Thermo Electric Devices



Energy-autonomous radiator actuators/valves from EnOcean



Source: Ford; Ford's anticipate 500W power output from their thermogenerator

## Organic Thermo Electrics - stretching the limits of imagination

Thermoelectric generators are widely known as very robust and reliable electrical power supplies for deep space probes and planetary landers. The Consortium called H2ESOT for "**Waste Heat to Electrical Energy via Sustainable Organic Thermoelectric Devices**" develops materials and technologies for thermal-to-electric energy conversion aimed at a wide temperature range. Terrestrial applications encompass energy recovery in the automobile by means of exhaust heat-to-electricity conversion, autarkic residential heat supplies and low-power current sources. The spectrum of methods in the department includes materials synthesis, contacting and integration techniques, materials and system characterization as well as numerical simulation and model-based system design.

Thermoelectric energy converters (TE generators) are gaining more and more importance as they do not involve any mechanically moving parts and thus guarantee high reliability along with noiseless and maintenance-free operation. Moreover, they can be operated over a wide temperature range.

The enormous amount of heat being lost from power plants, factories, vehicles, and residential homes offers a great opportunity for making direct use of this energy. In many energy systems – such as automotive – direct conversion of heat flows into electrical power allows for a reduction of fuel consumption and thus for a sustainable protection of the environment.

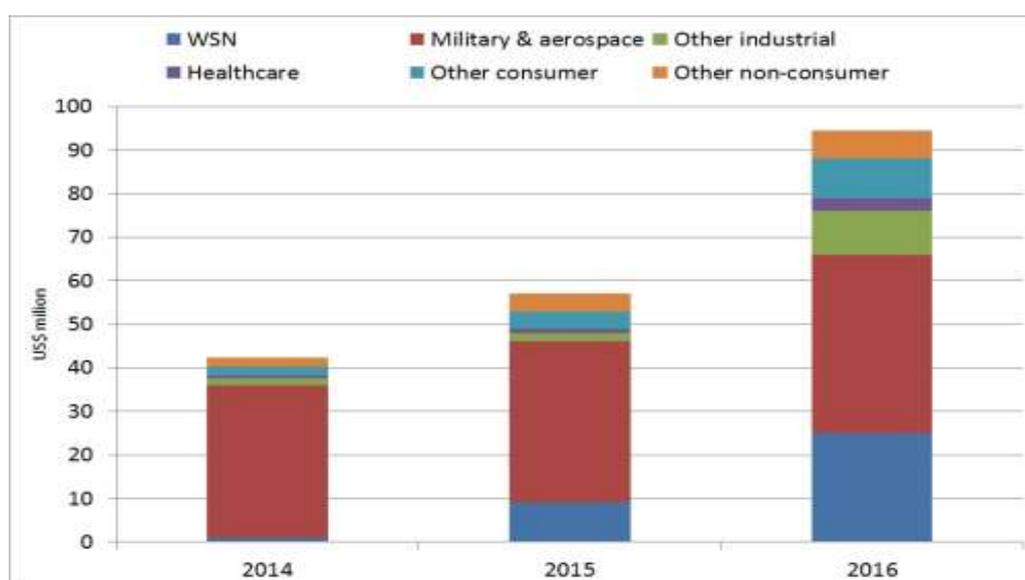
The Technology is getting ready and waiting for your ideas. Come and talk to us to make your product reality. From material selection to design and manufacturing. We can help you!

### What we can offer:

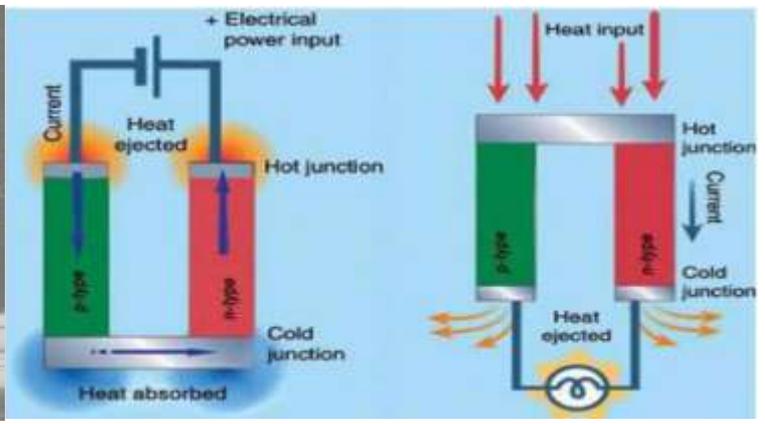
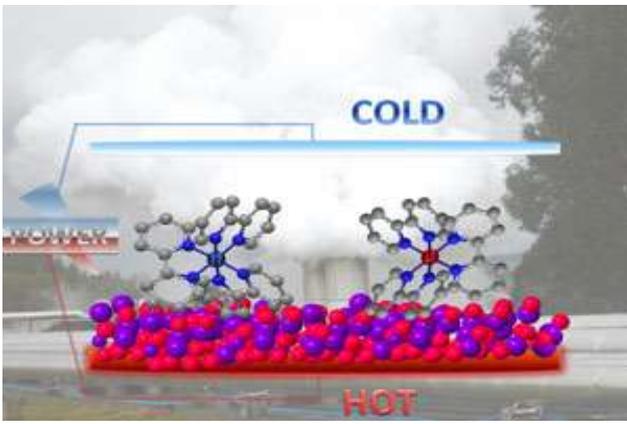
- Easily processable organic materials (very low cost)
- Experienced R&D teams to realise your requirements
- Continuing research to create the best use experience and performance
- A technology platform ready for prototyping

And also you had an access to extensive and worldwide partner network covering the complete value chain. Possibility to participate in advanced research while sharing the risks and costs.

University of Nottingham and H2ESOT partners focus on research and prototype development, geared towards the needs and applications of our research partners. These then take care of the technology's actual integration into commercial applications.



Fig, Thermolectric Energy Harvesting 2014-2024: Devices, Applications, Opportunities; **Source:** IDTechEX Reports



## Organic Semiconductors for Thermoelectric applications

Organic semiconductors (OSCs) are based on earth abundant elements (C, H, O) and have many advantages over inorganic semiconductors such as low cost, low weight and mechanical toughness. Their low thermal conductivity is beneficial to thermoelectric conversion efficiency, which is inversely proportional to  $\kappa$  (i.e.,  $ZT = S^2\sigma T/\kappa$ ).

In spite of these advantages, OSCs have not traditionally been considered candidates for thermoelectric materials, since they have historically been poor electrical conductors due to low charge carrier mobility. While  $ZT$  in OSCs had been typically 3 orders of magnitude lower than in heavy-metal alloys, it has rapidly improved since 2011, and now is reaching a value similar to that of the heavy-metal alloys. These are some of the applications Thermoelectric materials work on:

- ▶ Industrial process
- ▶ Stationary power plants
- ▶ Marine, rail and aircraft
- ▶ Industrial process
- ▶ Off-Highway engines
- ▶ Geothermal
- ▶ Wearable electronics
- ▶ Wide range of military applications

## A technology platform to design your product

At H2ESOT we are developing technology in a vertical approach. By first evaluating and selecting suited materials, then developing the most efficient manufacturing processes and libraries of building components, and eventually also implementing selected target applications.

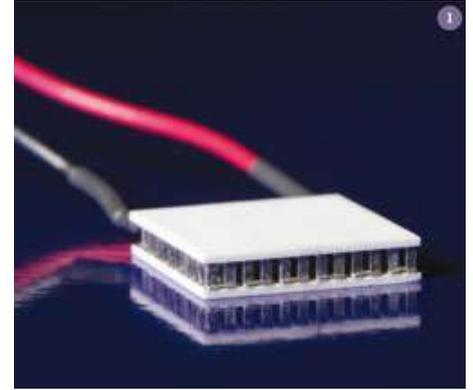
All processes are designed to be fully compatible with the standard production lines available in thin-film foundries. And we work together with several SME's such as **European Thermodynamics Ltd** to offer you prototyping and low-income volume production.

This solid platform will be ready to design and prototype your application. With the best-suited materials available, in state-of-the-art thin-film technology on plastic films. And complemented by an ever-growing library of proven, application-specific components.

## An R&D platform

H2ESOT consortium partners will be developing the thermo electric materials and device fabrication technology

These will be the basis of a wide range of new applications: thermoelectric generators, Whether we design and prototype your product, or you actively participate in our R&D, you will profit from the extensive knowledge and unique experience that we have built at this consortium.



## Continuing research to create the best user experience

Today, we have the technology to make many applications possible. But that's not where it stops. Our researchers are continually looking at new potions, assessing and taking part in the worldwide research. The goal: to continuously improve the user experience, to get more performance out of thin-film electronics, and to find the most efficient fabrication processes.

You can participate in that research. As a partner e.g. looking to develop and commercialise new materials or tools. Or to get a head start in the Internet-of-Everything.

