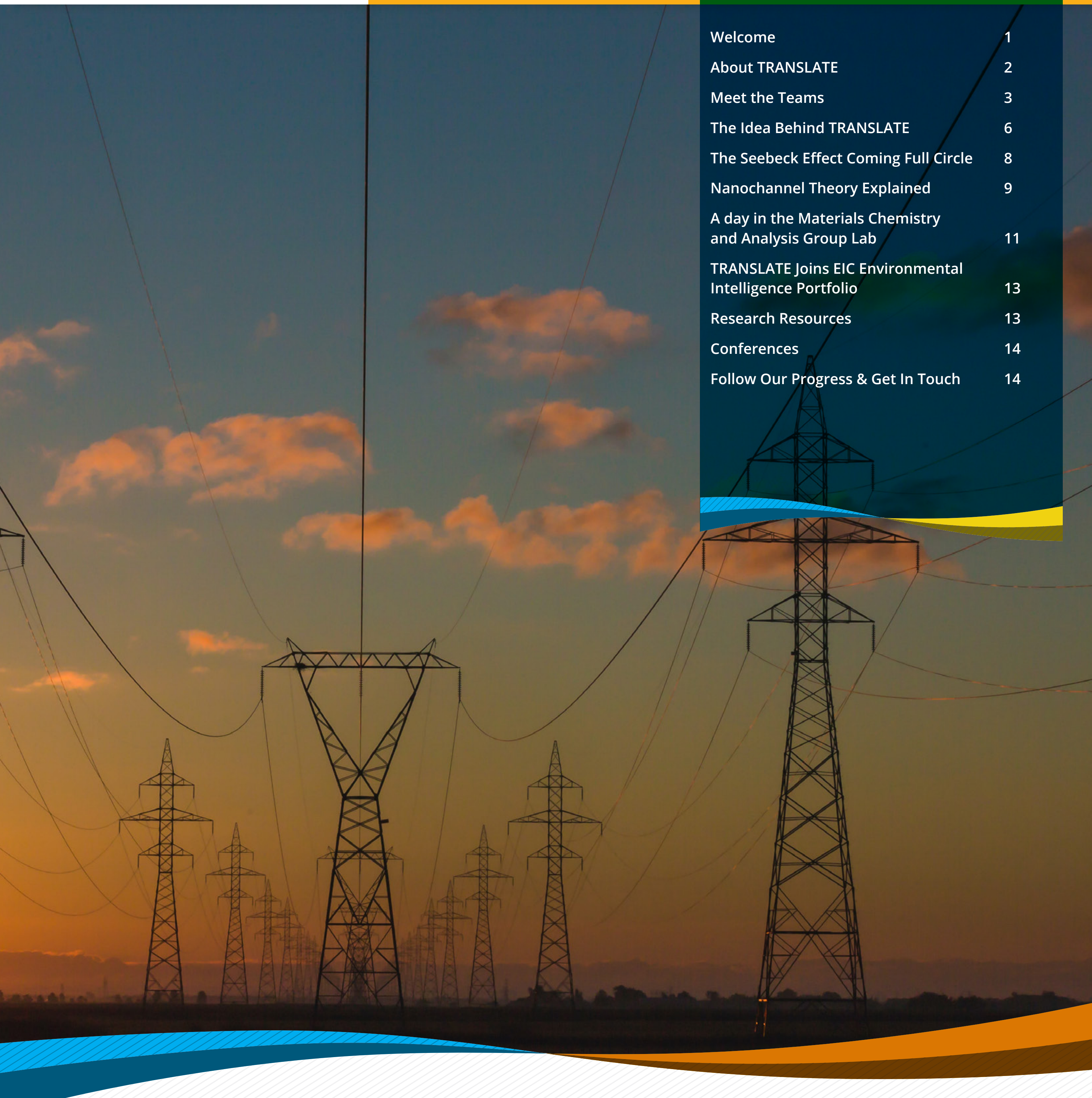
translate
waste heat to electricity

newsletter

ISSUE 1 – MAY 2022



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 964251.

Welcome

Professor Justin Holmes

Professor Justin Holmes

Welcome to the first TRANSLATE project newsletter. Our project aims to use porous membranes to convert waste heat into electricity. 70% of all energy generated daily is lost as heat. Most current technologies are not suitable for converting low-grade heat into electricity.

There is therefore a clear need to produce a cheap and sustainable way to capture and store waste heat and use it as a source of electricity.

The TRANSLATE team has made good progress over the last 12 months. Research highlights include the fabrication of nanoporous membranes by the University of Latvia, which are essential for 'energy harvesting', and the design and assembly of our first TRANSLATE 'cells' in the lab at University College Cork, which gives an early demonstration of how our prototype device may operate. Experiments were guided by computer simulations from the team at Technische Universität Darmstadt.

Cidete, our SME partner in the project, supplied electrical modules used in these first-generation devices, whilst the team at the Tyndall National Institute have been characterising and modelling the thermal and electrical properties of materials used in the TRANSLATE cells.

Our achievements over the last year have been made possible by the great project management and communications support provided by UCC Academy.

We hope you enjoy the newsletter and if you want to know more about TRANSLATE then please follow us on Twitter or LinkedIn, or get in touch by sending an email to translate@ucc.ie

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70% of all energy generated daily is lost as heat. Most current technologies are not suitable for converting low-grade heat into electricity.

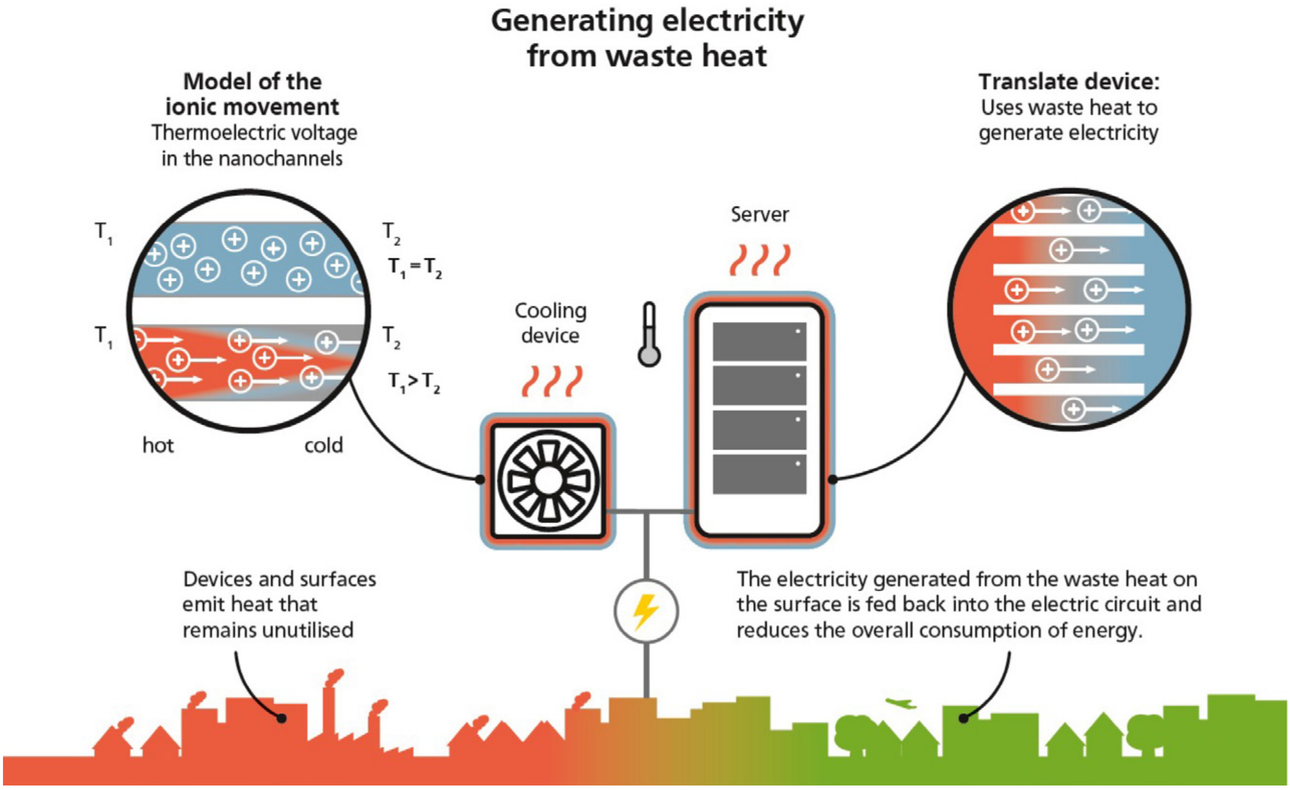
About TRANSLATE

The Recycling of Waste Heat Through the Application of Nanofluidic Channels: Advances in the Conversion of Thermal to Electrical Energy

TRANSLATE is a €3.4 million EU-funded research project that aims to develop a new nanofluidic platform technology to effectively convert waste heat to electricity.

This technology has the potential to improve the energy efficiency of many devices and systems and provide a radically new zero-emission power source.

Waste heat energy discharged into the atmosphere is one of the largest sources of clean, fuel-free, and inexpensive energies available. Although technologies for converting waste heat into electrical energy have been around for a long time, there is still no environmentally sustainable and efficient technology platform available for the harvesting of low-grade waste heat.



Credit: Helga Jordan

Accessing this largely untapped energy source could help tackle some of the biggest economic and social challenges we face today including climate change and the depletion of natural resources.

The TRANSLATE project is a collaboration between multidisciplinary partners across Europe including University College of Cork (Ireland), Tyndall National Institute (Ireland), TU Darmstadt (Germany), University of Latvia, Cidete (Spain), and UCC Academy (Ireland).

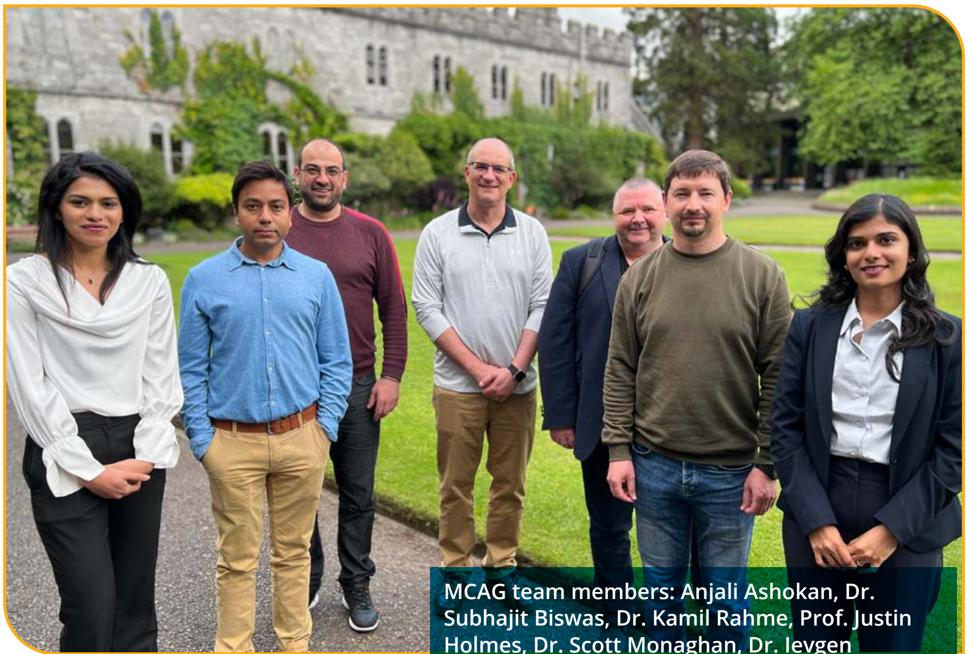
Meet the teams

Responsibilities of the teams

1. **Modelling & Simulation**
2. **Fabrication & Exploration**
3. **Development & Optimisation**
4. **Dissemination & Communication**

UCC Materials Chemistry and Analysis Group

The Materials Chemistry and Analysis Group (MCAG), led by Professor Justin Holmes, is primarily based within the School of Chemistry at University College Cork. The primary research focus of MCAG is to develop functional and sustainable nanomaterials and devices for electronics, optoelectronics, energy harvesting, energy storage, catalysis, and plastic recycling.



MCAG team members: Anjali Ashokan, Dr. Subhajit Biswas, Dr. Kamil Rahme, Prof. Justin Holmes, Dr. Scott Monaghan, Dr. Ievgen Nedrygailov, Rupa Ranjani

MCAG is a large interdisciplinary research group and houses researchers from different research backgrounds such as synthetic chemistry, surface chemistry, materials chemistry and physics, nanoelectronics and more.

MCAG has published more than 400 research articles on the fabrication and surface functionalisation of nanomaterials, exploration of physical (including electrical transport in nanostructure) and chemical properties of nanomaterials and nanomaterial devices.

MCAG researchers will deploy their previously demonstrated expertise in nanostructure and nanoporous materials including mesoporous silica and anodic aluminium oxide, surface passivation, modification of semiconductor surfaces, and nanowire devices to develop appropriate nanofluidic thermal energy harvester devices with high figures of merit, in collaboration with University of Latvia and Tyndall.

With its in-house facilities, MCAG researchers will also provide general materials, surface and chemical analysis including XPS, surface IR and Raman, as well as the required electrical, and thermo electrochemical measurements.

MCAG along with the help of Tyndall will perform electrical and thermoelectric measurements and contribute towards the fabrication and optimisation of the low-grade waste heat harvesting nanofluidic devices based on cheap and widely available materials such as silica, alumina, and cellulose.

www.ucc.ie/en/mcag/

Meet the teams

Advanced Energy Materials Group, Tyndall National Institute

Credit: Tyndall.ie

The Advanced Energy Materials Group (AEMG) is an interdisciplinary research group that hosts researchers from several disciplines including materials chemistry and physics, electrochemistry, electronics, and nanotechnology.

Researchers in AEMG have expertise in the fabrication of nanostructure and nanoporous materials in anodised aluminium oxide and polycarbonate membranes via electrodeposition to demonstrate nanowire based electrochemical devices, which can be extremely valuable for continuously powering electronic devices such as sensors and wearable electronics.

As low-grade waste heat is projected to be one of the most sustainable, clean, and promising energy sources, AEMG researchers are conducting active research in energy harvesting from low-grade waste heat utilising the Seebeck effect (heat to electricity) and the Soret effect (temperature dependent electrochemical redox potential).

AEMG members in the Tyndall National Institute along with MCAG will validate the fabricated thermochemical cell in the team's self-designed standard thermocharacteristic system focusing to achieve a high thermovoltage (>25 mV/K) and high ZT (>1) for a low temperature gradient (ΔT 5K), and low operating temperature regime for continuous operation.

www.tyndall.ie/Advanced-Energy-Materials

Institute for Nano and Microfluidics, Technische Universität Darmstadt

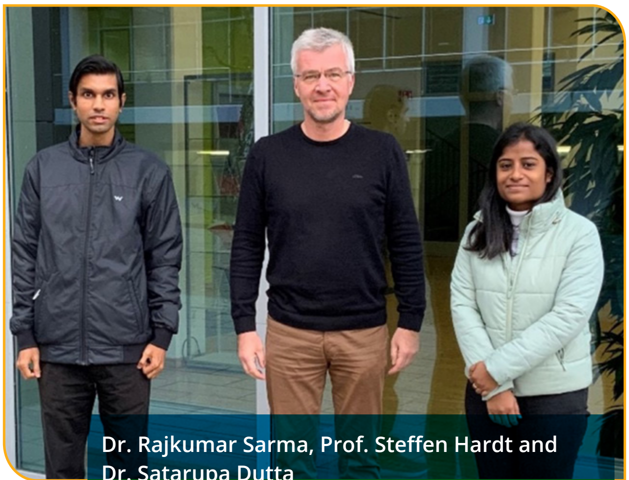
The Institute for Nano and Microfluidics at Technische Universität Darmstadt (TUD) is led by Professor Steffen Hardt. Their research covers a broad range of topics and combines experimental, theoretical, and numerical approaches. The fields of work include gas kinetics on the nanoscale, transport processes in electrolyte solutions and at liquid interfaces, wetting phenomena, and separation processes for biomolecules.

For the TRANSLATE project, TUD will utilise their expertise in the modelling and simulation of transport processes in nanopores and nanochannels. A few years ago, TUD discovered that a liquid-filled nanochannel with different temperatures at its two ends creates an electric field.

TUD's goal is to find out how to maximize the output of electrical energy, that is, which channel designs and liquids should be used to extract the maximum electrical power for a given temperature difference.

To this end, TUD will use computer simulations to solve the differential equations describing the transport of heat, mass, and ionic species.

www.nmf.tu-darmstadt.de/nmf/index.en.jsp



Dr. Rajkumar Sarma, Prof. Steffen Hardt and Dr. Satarupa Dutta

Meet the teams

University of Latvia

The project team from the University of Latvia (UL) includes research groups from the Institute of Chemical Physics (ICP) and the Institute of Solid-State Physics (ISSP).

The nanotechnology group of the UL ICP, led by Professor Donats Erts, works in the field of nanoscience. They have a wide range of expertise, including the synthesis and fabrication of nanostructured materials, and the investigation of their structure, properties, and potential applications. Application areas include, but are not limited to, lithium and sodium ion batteries, thermoelectrics, sensors, and nanoelectronics.

The group of the UL ISSP is led by Dr. Gints Kucinskis and is working in the field of research of materials for lithium and sodium ion batteries. The project team has a wide range of experience in the synthesis of battery materials, electrochemical characterisation, electrode formulation, and the development of electrochemical methods and techniques in general.

For the TRANSLATE project, UL researchers will use their expertise in the formation of nanoporous membranes to experimentally validate the theoretical models for optimising parameters for energy harvesting via nanofluidic channels, developed by TUD. UL will work closely with UCC researchers to fabricate nanoporous membranes filled with electrolyte for thermovoltage generation. UL will also provide materials and perform structural analysis, as well as conducting the required electrical and thermoelectrical measurements.

Dr. Raimonds Meija, Prof. Donats Erts, Dr. Jana Andžāne, Dr. Gints Kucinskis, Elīna Kerre and Dr. Valerii Malyshev

UL will lead Work Package 3, which is the “Development of Na ion intercalative energy harvester battery cell”. The main objectives of this WP are the development and fabrication of electrode materials, determination of the optimal electrolyte composition, preparation of intercalation-based battery-like test cells, and the characterisation and benchmarking of nanofluidic battery-like storage cells.

www.lu.lv/en/

Cidete

Cidete Ingenieros Sociedad Limitada (Cidete) is an SME that manufactures thermoelectric cooling and power generator devices. Cidete also develops engineering projects for cooling applications in various sectors such as electro-medicine, telecommunications, and aerospace. Cidete started working in EU projects in 2001, as a partner in the NANOTHERMEL project. The company has over 175 publications in international and European thermoelectric journals.

The Cidete team is spread across two locations. The Barcelona facility has six staff members and includes thermoelectric laboratories for the analysis of thermoelectric materials, and a manufacturing facility.

The Tenerife facility is where administrative work for the company takes place. Furthermore, Cidete have a contractual agreement with the University of La Laguna, where testing and analysis of thermoelectric materials is undertaken.

On the TRANSLATE project, Cidete will use their world class suite of equipment to work closely with UL and UCC with WP 2 and 3. Their responsibilities include assisting in the electrical and thermal characterisation of nanofluidic platforms, preparing and characterising suitable electrode materials for intercalative energy harvesting cells, and testing prototype devices.

www.cidete.com

Meet the teams

UCC Academy

UCC Academy was established in 2014 to support University College Cork achieve its strategic goals as the university's in-house consultancy. TRANSLATE project team members are part of the PrimeUCC (Project Research and Innovation Management Enterprise) business unit, which offers a specific service focused on enhancing the competitiveness of UCC-led Horizon 2020/EU proposals, as well as providing a bespoke, post-award project management and communication service.

Dr. Tamela Maciel & John Buckley, UCC Academy

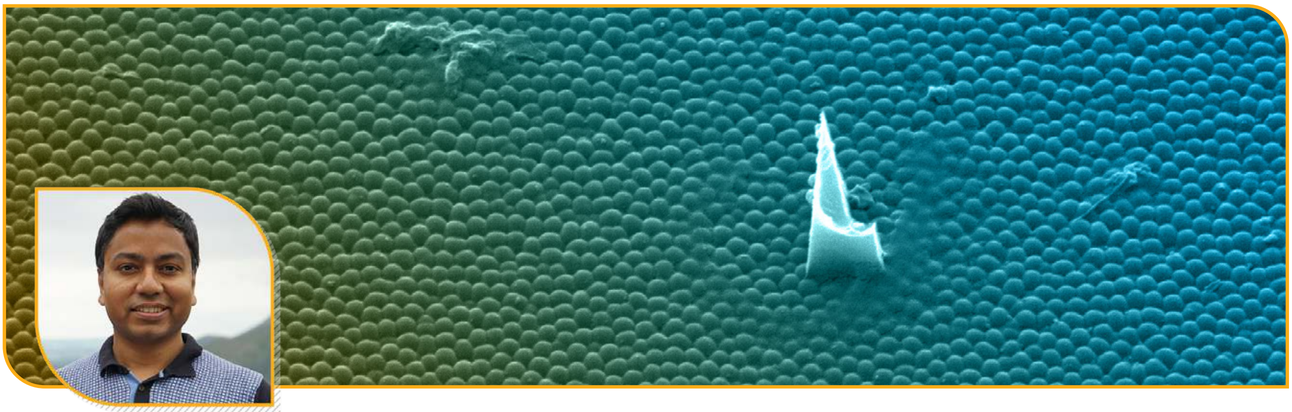
UCC Academy's primary role on the TRANSLATE project is as science communications partner as part of Work Package 4, where they ensure members of the scientific community, public, and industry are kept up to date on project progress.

This includes activities like designing and maintaining the project website; creating and managing the project's Twitter and LinkedIn channels; creating the project newsletter; and organising public engagement events. Two key deliverables led by UCC Academy are the creation of the project's Dissemination Exploitation and Communication plan, and Data Management Plan.

They also support the Project Coordinator with project management as part of Work Package 5, where they are responsible for the development and implementation of general methodology and tools for the project, and the establishment and maintenance of the project risk register.

www.ucc.ie/en/academy/

The Idea Behind TRANSLATE



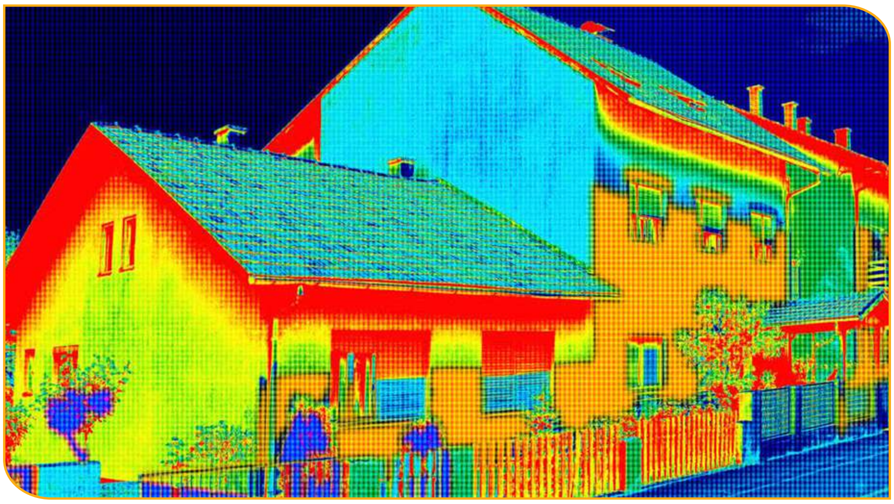
By Dr Subhajit Biswas, UCC

Materials chemist and TRANSLATE consortium member, Dr. Subhajit Biswas, tells the story behind TRANSLATE, and how the idea went from blue-sky thinking to a successfully-funded EU project.

Here at the Materials Chemistry & Analysis Group (MCAG) at University College Cork (UCC), we're always exploring new materials with novel morphologies and functions. In the last ten years, our group has tended to focus on developing and designing materials for microelectronics, such as MOSFET, and energy storage, such as Li-ion battery devices. However, we're always aware of the importance of creating materials for a sustainable future. For example, can we create more efficient, low-cost, and reliable ways of harvesting renewable energy such as solar, thermal, and mechanical energy? It's a huge industry already, so if we are to direct our research towards renewable energy harvesting it must be something radically different from the status quo.

Developing the TRANSLATE idea

Back in 2017-2019, I was working with Justin D. Holmes, Professor of Nanochemistry and head of MCAG, on some selenide and telluride materials for resistive memory devices. Incidentally, these materials are also predicted to be efficient for thermoelectric energy generators (TEGs), which are waste heat harvesters based on the Seebeck effect.



Waste heat energy discharged into the atmosphere is one of the largest sources of clean, fuel-free, and inexpensive energy available. 70% of all energy generated daily is lost as waste heat. A vast amount of untapped energy exists in the form of low-grade heat from sources below 100 °C. Sources of low-grade heat are ubiquitous and include power generation (burning of fossil fuels), industrial processes (oil refining, heat exchangers, boilers, heat pumps etc.), electronics (data centres), automobile engines, biological processes (metabolism), domestic sources such as domestic heating/cooling and refrigeration, and abundant energy sources, like solar thermal energy, geothermal energy, and ocean thermal energy. Generating electrical energy from low-grade waste heat is therefore key to help meet the growing global energy demand.

So, we reached out to Dr. Kafil Razeeb who leads the AEG in the Tyndall National Institute, who could use these selenide and telluride materials that we were already growing in our lab for creating thermoelectric devices. Justin, Razeeb, and I briefly entertained the idea of developing 3D porous thermoelectric architectures to increase the thermoelectric figure-of-merit of materials such as tin selenide, silicon, and bismuth telluride, which are already popular with the thermoelectric research community. But we were not 100% satisfied with this idea, as these materials are already widely researched, and we knew that it would need to be a "blue sky" idea to attract research funding.

The question was, "what could be done that wasn't already ubiquitous within thermoelectric devices?"

At this point, we thought "is it possible to create a highly efficient thermoelectric device from sustainable and earth abundant materials such as wood or glass?" The materials that are currently most popular for TEGs are toxic and drawn from unsustainable sources, and tend to lack the efficiency for commercial implementation. With this in mind, we explored the idea of using the movement of ions under a temperature gradient, instead of electrons and holes in a conventional Seebeck effect-based TEG.

Our initial thought was to develop a hybrid device that uses both electronic movement (in solid-state thermoelectric materials) and ionic movement (in an electrolyte) under the same temperature gradient. However, while entertaining this idea, we realised that it would be more interesting to build a highly efficient waste heat energy harvesting platform entirely from abundant and cheap material such as silica or bio-polymers infiltrated with electrolytes (i.e. liquid or gels with ions). In doing this, we would only rely on ion movement under a temperature differential, in a process known as thermophoresis.

Finalising the idea

While pondering this, we came across a very interesting theoretical paper by Professor Steffen Hardt from TUD (Hardt et. al. Phys. Rev. Lett. 116 (2016) 225901). It predicts selective ion movement driven by a temperature gradient whenever an electrolyte is confined within the channels of nanoscale dimension. We were sure that if Steffen joined our TRANSLATE team, we would be much more likely to create a successful nanofluidic-based waste heat harvester.

Luckily for us, Steffen was keen to take part in this experimental adaptation of his theoretical prediction. From Steffen we learned that the key enabler for achieving high energy conversion efficiency is the formation of a charged layer on the wall of the nanochannels. This electric double layer (EDL) is a diffuse layer of charge accumulation and separation at the interface between a surface (nanochannel wall) and an electrolyte in very narrow channels (of the order of 10 nm). An EDL results in the movement of ions to the hot (or cold) side of the porous material, giving rise to high thermovoltage in this novel device. The expected energy conversion efficiency of such a device promises to be greater than that of the best current thermoelectric materials for low-grade heat.

Thus, the idea for TRANSLATE was born in 2018-19, with Justin, Razeeb, Steffen, and myself as part of the team.

However, further expertise was needed to turn the idea into reality. For example, the high thermovoltages generated in this nanofluidic device would need to be stored and used in the proper way (e.g. a battery-like device). Thus, the team grew to include key external expertise in electrochemistry and charge storage devices from Professor Donats Erts (UL) and electrical measurement expertise from the Tyndall National Institute (led by Professor Paul Hurley), and Spanish tech SME, Cidete. UCC Academy, an in-house consultancy of UCC, also joined to guide the project management and communications for TRANSLATE.

Funding success

The idea of TRANSLATE was finally committed to paper in March 2020, as a proposal to the European Union's Horizon 2020 Research and Innovation Programme, FET-Open. In November 2020, we succeeded, and the project officially started on 1st June 2021.

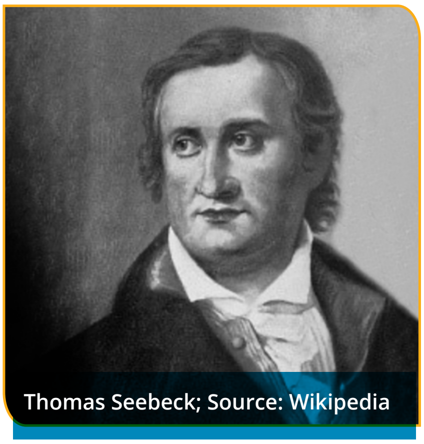
Read more:
www.translate-energy.eu/the-idea-behind-translate/

The Seebeck Effect Coming Full Circle

By Professor Paul Hurley, Tyndall

TRANSLATE consortium member, Professor Paul Hurley, tells us about the origins of our knowledge on global warming and the interesting link with the aim of the TRANSLATE project.

The TRANSLATE consortium are exploring new ways to extract electrical energy from waste heat using the Seebeck effect; and the Seebeck effect was central to the discovery in the middle of the 19th century that carbon dioxide is a greenhouse gas. This post explores the surprising connections linking Thomas Seebeck, John Tyndall, global warming, and the TRANSLATE project which stretch back almost 200 years.



Thomas Seebeck; Source: Wikipedia

The new climate science report by the Intergovernmental Panel on Climate Change (IPCC) now indicates – unequivocally – that humans have caused almost 100% of the global warming which has occurred since the late 1800's. We must drive carbon dioxide emissions to zero. This will take change and innovation in electricity generation, transportation, agriculture, and manufacturing. There is also another opportunity to reduce carbon dioxide emissions that is often overlooked. Around 70% of all the energy we produce in our factories, homes and workplaces is lost in the form of heat, and this is where the TRANSLATE project is focussing its efforts – to develop low-cost technologies which can convert this heat into useable electricity. Accessing this largely untapped energy source could help tackle the biggest challenge for science and society in the 21st century.

Looking back at the origins of our knowledge about global warming, we need to start with Thomas Seebeck who in 1826 first discovered the production of electricity from a temperature difference and connected dissimilar metals. Just 7 years later in 1833, the Italian physicist Macedonio Melloni had used what we now call the "Seebeck" effect to produce a device made from Bismuth and Copper cells which could detect a person from 30 feet away – and a cow from 100 feet away – based on the radiant heat they generate. The device was called a thermopile – and was the first infrared detector.

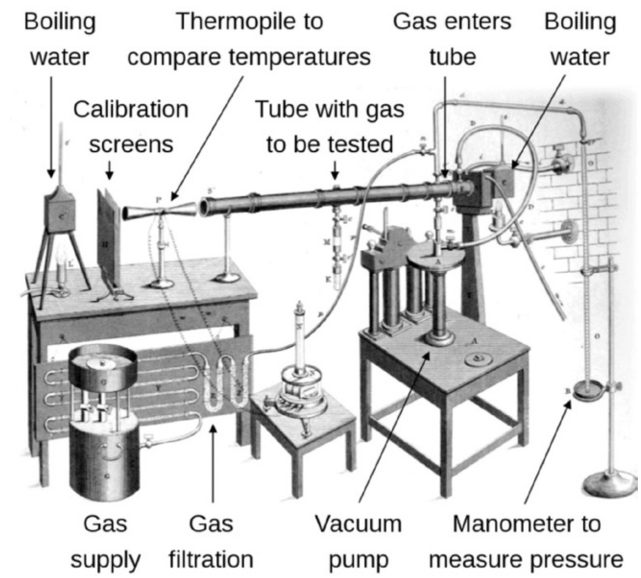
Moving on 26 years, we come to the Irish physicist John Tyndall, whom the Tyndall Institute is named after. Tyndall was investigating the absorption of radiant heat by gases, which he saw as "a perfectly unexplored field of inquiry". Tyndall didn't only have to perform the experiments and analyse the data – he also had come up with the concept of how the heat absorption could be measured – and then build the equipment. Tyndall needed to measure a heat difference between a reference heat source and the same reference heat source which had passed through various gases and vapours. To do this, Tyndall incorporated a thermopile into his new experimental set up - the ratio spectrophotometer.

Using this equipment, Tyndall made the discovery that water vapour and carbonic acid gas (which we now know as carbon dioxide) were strongly absorbing to radiant heat, while oxygen, nitrogen and hydrogen are transparent. These results explained how the Earth was not much colder than expected based on the thermodynamic considerations of John Baptise Fourier.

Carbon dioxide and water vapour in the atmosphere heats the Earth surface by reducing the amount of radiant heat which escapes the Earth's surface into space. In Tyndall's own words, "Remove from a single summer's night the aqueous vapour in the air which overspread this country, and you would assuredly destroy every plant capable of being destroyed by a freezing temperature.

The warmth of our fields and gardens would pour itself unrequited into space and the Sun would rise upon an island held fast in the iron grip of ice". But as we now know, and consistent with Tyndall's experimental results, too much carbon dioxide can increase this heating to levels which can have devastating effects in terms of extreme weather and rising ocean levels.

On the other side of the Atlantic in 1856, Eunice Newton Foote had presented a paper to the American Association on "Circumstances effecting the Heat of the Sun's Rays". In this amazing paper, presented before Tyndall's work in 1859, she reported the findings in two pages,



Tyndall's ratio spectrophotometer; Source: The Ascent of John Tyndall

reporting that, ".... the highest effect the Sun's rays I have found to be is in carbonic acid gas". She also went on to make the striking and far-reaching comment "An atmosphere of that (CO2) gas would give to our Earth a high temperature, and if at some stage in its history the air had mixed with it a larger proportion than at present, an increased temperature from its own action, as well as from increased weight, would surely have occurred".

The work of Eunice Foote and John Tyndall set the foundations of how carbon dioxide in the atmosphere plays a central role in determining the temperature of the Earth's surface. Coming full circle, Tyndall used the Seebeck effect to examine the origins of global warming and the TRANSLATE consortium are now exploring how the Seebeck effect can be used to counter the effects of global warming.

Read more:
www.translate-energy.eu/the-seebeck-effect-coming-full-circle/

Nanochannel Theory Explained

By Professor Steffen Hardt

TRANSLATE consortium member and Work Package 1 leader, Professor Steffen Hardt (TUD), tells us about the physics of thermoelectric energy conversion in nanochannels.

Solid-state materials that can convert thermal energy into electric energy have been known for a long time. These thermoelectric materials are based on the Seebeck effect and have so far only found applications in quite specific areas. This is partly due to their low energy conversion efficiencies, but also because the materials involved are expensive and not well suited for large-scale usage. In the past few years, thermoelectric energy conversion based on nanopores or nanochannels filled with an electrolyte solution has emerged as a new paradigm. The underlying physics is only beginning to be understood, and in the following paragraphs some of the key phenomena involved will be explained.

One key phenomenon is the existence of an electric double layer (EDL) at the nanochannel walls. In its simplest form, the EDL consists of electric charges attached to the channel walls and a diffuse layer of mobile charges, which are ions contained in the electrolyte solution. This diffuse layer may have a thickness of the order of 10 nanometers. The ions are attracted to the walls by their counter charges, but they also experience collisions with the surrounding water molecules. As a result, the attractive force is exactly compensated by the tendency of the ions to diffuse away from the walls, and a stationary ion cloud forms.

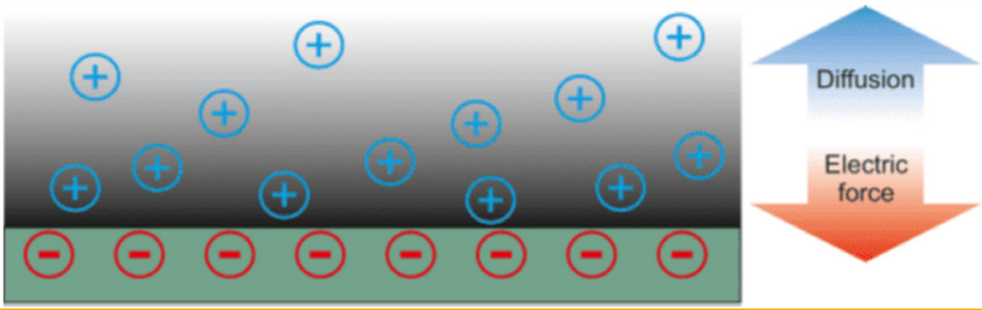


Figure 1 – Electric double layer in equilibrium. Electrostatic attraction and diffusion compensate each other.

This equilibrium configuration of the EDL is disturbed when the temperatures in different sections of a nanochannel are different. In a channel with a hot and a cold end, the EDL usually expands at the hot end and shrinks at the cold end. As a consequence, the ion cloud is no longer in equilibrium, which means that the tendency of the ions to diffuse away from the walls is no longer fully compensated by electrostatic attraction. Instead, concentration gradients form along the channel, which induce ion migration. As a result, a voltage builds up along the channel, indicating that a part of the thermal energy has been converted into electric energy.

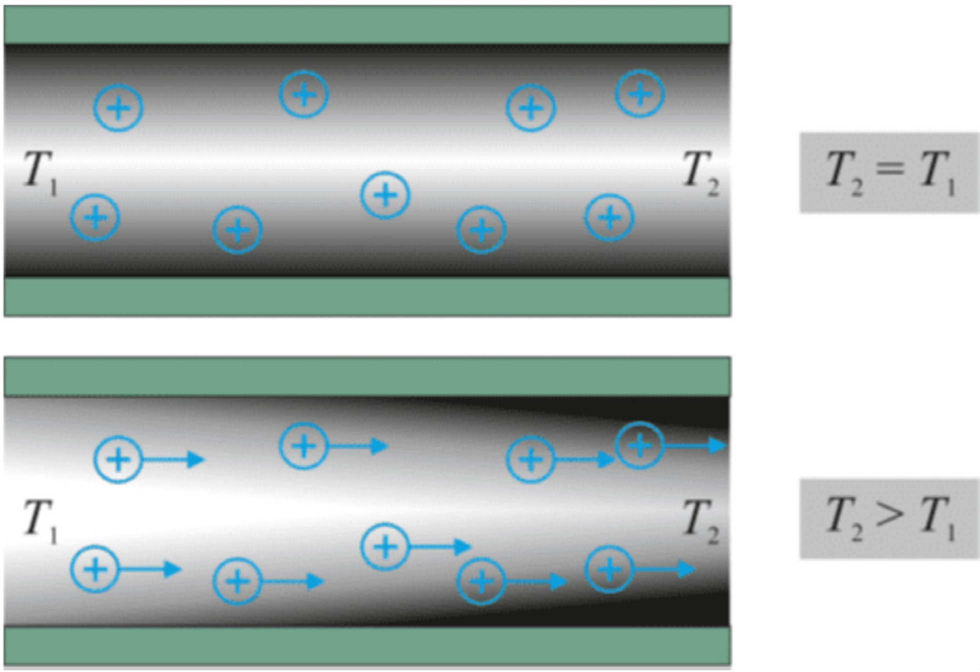


Figure 2 – When the temperatures are the same at the two ends of a nanochannel, the ion cloud in the channel is in equilibrium. This equilibrium is disturbed in the presence of a temperature gradient, which induces ion concentration gradients along the channel.

Within the TRANSLATE project, the goal is to determine nanochannel configurations that result in as-large-as-possible conversion efficiencies. For this purpose, coupled numerical simulations of the flow, the electric field, and the ion concentration fields inside a channel are being conducted.

The strength of the ion flux that finally creates the thermovoltage depends on a superposition of three different effects. Firstly, there is diffusive ion motion due to gradients in the ion concentration field. Secondly, in an electric field, ions migrate relative to the background fluid. Last but not least, usually there will be a fluid flow inside the nanochannel, which results in advective ion transport.

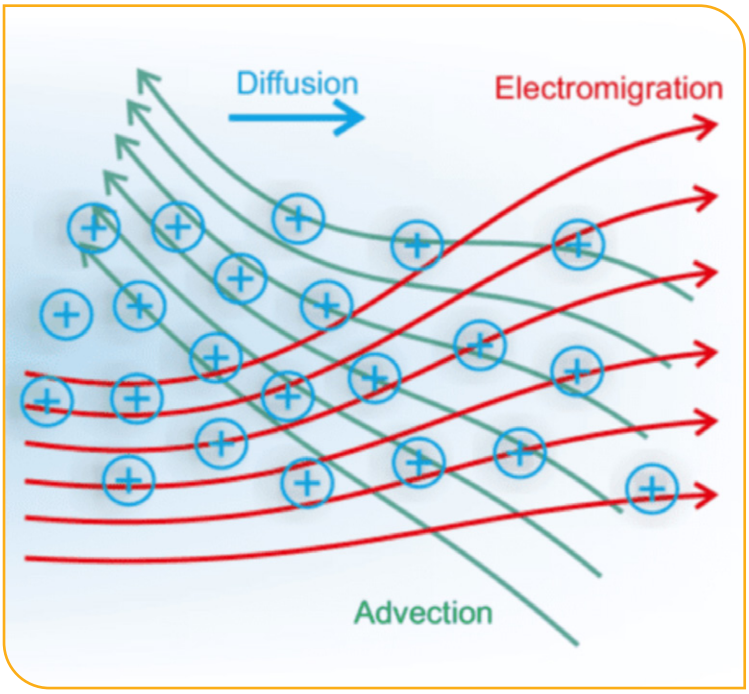


Figure 3 – The three different effects contributing to ion transport, exemplified for cations.

Read more here: www.translate-energy.eu/nanochannel-theory-explained/

A day in the Materials Chemistry and Analysis Group L ab

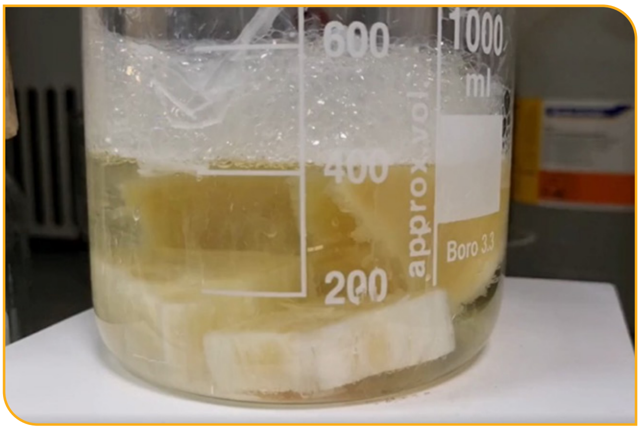
By John Buckley

Recently we had the opportunity to visit our partners, MCAG in their lab. Project coordinator Professor Justin Holmes, and team members Dr Ievgen Nedrygailov* and Dr Scott Monaghan, gave us a taste of what they are currently working on for the TRANSLATE project.

Their team have been looking at the properties of several natural materials, which could be used in our thermoelectric device to conduct electricity as a sustainable alternative to materials used in other existing thermoelectric devices. For our visit, we looked at cellulose – a cheap, environmentally friendly, and completely renewable material that can be obtained from the waste of the wood industry.

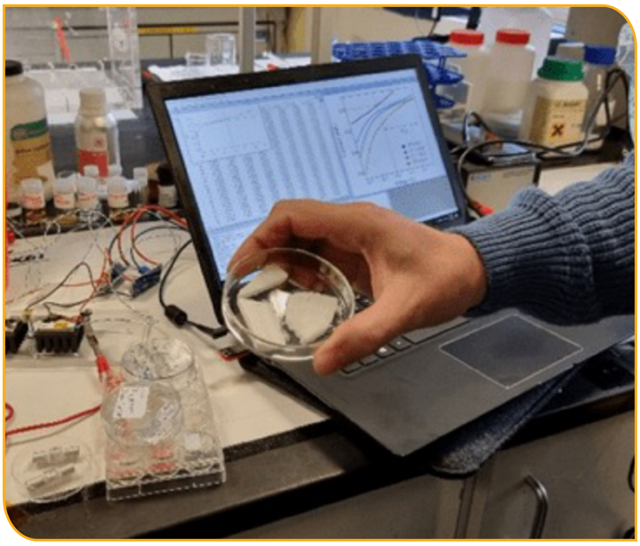
Ievgen showed us a simple chemical process for making cellulose from eucalyptus wood using chemicals available in the kitchen of any household. The idea is that cellulose fibers are naturally occurring nanostructures with unique ionic conduction properties. When these fibers are filled with an electrolyte containing high concentrations of ions (such as sodium and chloride ions produced when table salt is dissolved in water), cellulose becomes a thermoelectric material and can convert heat into electricity.

The process starts with a piece of Eucalyptus bark. The bark is simmered for approximately one week in an oxidising solution (such as hydrogen peroxide).



This process removes lignin and hemicellulose from the bark, leaving cellulose fibers forming a system of channels with a diameter of only a few tens of nanometers.

The bark must be simmered at a low temperature to keep the cellulose channels intact. These nanochannels are critical to the operation of our final prototype.

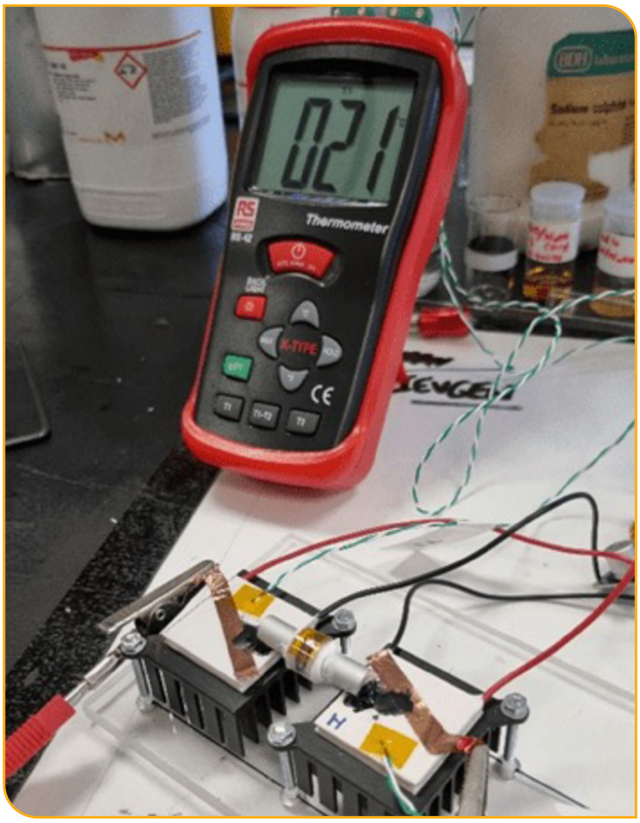


The dried cellulose is placed in a vacuumed cell, filled with salt water (our electrolyte).

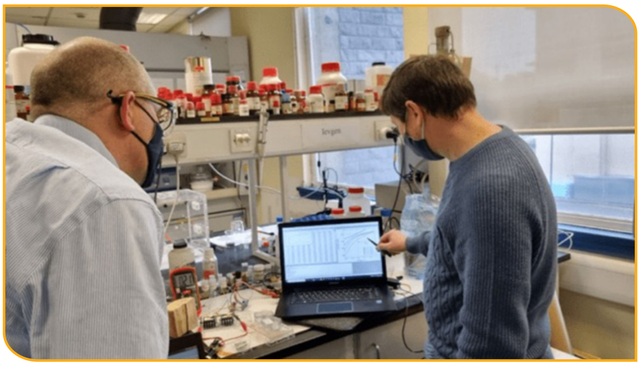
A prototype thermoelectric module is installed on a test platform that can generate a temperature gradient due to the operation of two Peltier elements.

One of these elements serves as a cooler, the other as a heater. The platform also contains a thermocouple for measuring the temperature difference between the cold and hot ends of the thermoelectric module.

A potentiometer is connected to the prototype to measure current, thermopower, and other characteristics.



When different temperatures are applied to either side of the platform, we generate a voltage and current that could have many useful applications, such as powering a small electronic device. We also see that the power of the electric current we generate is higher when the amount of thermal energy supplied to the module increases.

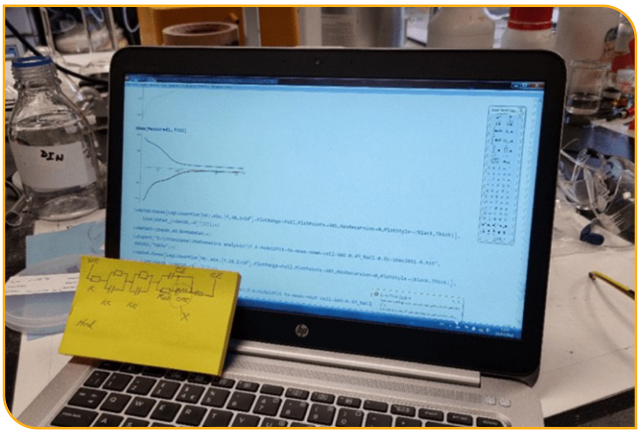


This is the behaviour we expected and hoped for, based on a theory from our project partners at TUD, and it is the first proof of concept for our proposed device in the lab!

If we apply this concept to our device, we can generate electricity from waste heat.

To help us further understand our experiments, Scott has built a model of the circuit using Mathematica. The material, electrolyte, and structure of the cell all relate

A day in the MCAG lab



to a circuit component like a resistor, capacitor, or inductor, and by slowly building up the complexity of the model and matching it to experimental data, we can start to fully understand the system and what elements are responsible for creating the increased voltage.

The next step for the MCAG team will be to study the impedance of materials under a series of frequencies, to further understand the circuit and how it responds to a salt solution.

The team are also exploring more synthetic materials such as aluminium oxide.

This work will help the TRANSLATE team to select optimal materials for our prototype device to generate electricity from waste heat.

Read more: www.translate-energy.eu/a-day-in-the-materials-chemistry-and-analysis-group-lab/

***** Ievgen is funded by the Development of an Ecosystem for Delivery of Next Generation Wood (NXTGENWOOD) project from the Irish Government through the Department of Agriculture, Food and the Marine (Project No.: 2019PROG704). Both NXTGENWOOD and TRANSLATE aim to develop new nanofluidic platform technologies to effectively convert waste heat to electricity.*

TRANSLATE Joins EIC Environmental Intelligence Portfolio

In summer 2021, the project team met with EIC programme managers where information on the project was shared with them. Subsequently, TRANSLATE was accepted to join the EIC 'Energy harvesting, conversion & recovery' portfolio, which will allow the project attend networking events with other similar EU projects, likely to kick off later this year.

European INNOVATION Council

Research Resources

TRANSLATE is committed to Open Access research and is taking part in a European Commission pilot on Open Access to Research Data.

All publications from the TRANSLATE project will be freely accessible and published as open access articles at either gold or green standard.

Our research publications and data are stored in an open-access data repository on Zenodo to enable future researchers toaccess, exploit, reproduce and disseminate our data. This repository is validated as Open Access by OpenAIRE, with an associated OpenAIRE project page.

Access our research publications, datasets, and related communication materials here: https://zenodo.org/communities/translateh2020/

Conferences

80th International Scientific Conference of the University of Latvia

3rd February 2022

Professor Justin Holmes, Professor Steffen Hardt, Dr Satarupa Dutta, and Dr Ievgen Nedrygailov presented an overview of TRANSLATE and results to date at the [80th International Conference of the University of Latvia](#).

[Presentation link](#)

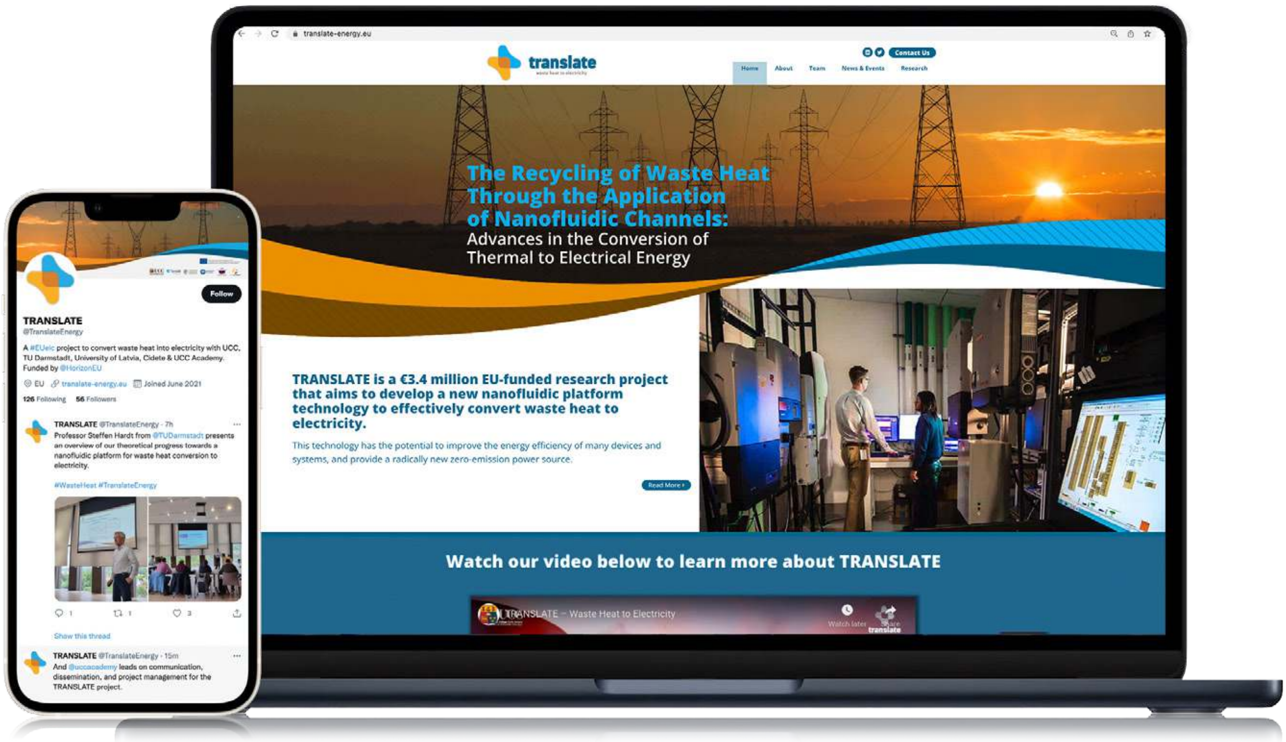
Environ 2022 - 32nd Irish Environmental Researchers Colloquium

20th June 2022

Dr. Ievgen Nedrygailov will present a poster at the Environ 2022 conference entitled 'Converting waste heat into electricity using cellulose membranes'.

[www.esaiweb.org/environ/](#)

Follow Our Progress & Get In Touch



translate@ucc.ie

www.translate-energy.eu/

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UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh
Tyndall National Institute
Technische Universität Darmstadt
University of Latvia
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