Focus session
Renewable Energy Research Eindhoven

Room: Auditorium 8
Session chair: Mark Boneschanscher (TU/e, EIRES)

Eindhoven is a hotspot for physics-driven renewable energy research. Researchers from DIFFER and TU/e work on topics like nuclear fusion, photovoltaics, batteries, solar fuels, or modeling of energy flows in buildings. In this session researchers from both institutes explain how they contribute to solving some of the big, current challenges in the energy transition.

The future of electrolysis
Mihalis Tsampas (DIFFER, Eindhoven)

As more countries take initiatives towards decarbonisation, hydrogen will have a critical role to play. This will be particularly the case in hard-to-abate sectors and where direct electrification is challenging, such as in heavy industry (e.g. steel, chemicals) and long-haul transport (e.g. marine, aviation). In this context, hydrogen should present a low or zero carbon footprint, ideally being green (i.e. produced by water electrolysis which is powered by renewable electricity). However, green hydrogen is still more expensive than blue hydrogen (produced from fossil fuels with carbon capture and storage) due to the cost of (i) the renewable electricity and (ii) the electrolysis facilities. In this contribution, we will discuss the different electrolysis technologies, sustainability issues, strategies for reducing investment costs for electrolysis plants and opportunities for producing competitive green hydrogen [1,2].

[1] IRENA (2020), Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.5^{o}C Climate Goal
[2] F.M. Sapountzi et al, Electrocatalysts for the generation of hydrogen, oxygen and synthesis gas, Progress in Energy and Combustion Science, 58, (2017) 1-35

The future of fusion - putting the sun in a box
T.W. Morgan (DIFFER, Eindhoven)

Nuclear fusion shows great promise as a CO2-free method for continuous electricity production supporting the expected transition and growth in energy demand in the 21st century. Huge progress has been made in bringing this vision to fruition since fusion energy development started more than 70 years ago. ITER, the first magnetic confinement device capable of generating more energy than is used to sustain it, is nearing completion. At the same time, many private companies have proliferated in the last few years aiming to deliver fusion faster, smaller and cheaper. Nonetheless many challenges remain to be overcome. This contribution will look at the status and outlook for the fusion field, and how some of these challenges are being tackled.

Perspective on materials and interfaces in next-generation energy conversion and storage devices
Adriana Creatore (Eindhoven University of Technology)

In this contribution I will discuss the state-of-the art and challenges yet to be met in material and interface science for the next-generation photovoltaics and batteries for mobility. Specifically, I will address metal halide perovskite-based photovoltaics and high energy density Li- and post-Li ion batteries. Next to the overarching challenge of sustainability in material supply chain, manufacturing line and recycling prospects, both energy technologies share the need for interfaces which are selective to the transport of a specific charge (holes, electrons, or ions), as well as (electro-)chemically and mechanically stable. To this purpose, I will end the contribution by reflecting on the merits and opportunities offered by gas phase deposition technologies in addressing the above-mentioned challenges.

Future of Energy in the Built Environment -
Hamid Montazeri (Department of the Built Environment, Eindhoven University of Technology)

The future of energy is shifting towards decentralization, responding to the complexities and vulnerabilities of centralized energy systems. In this perspective, addressing inherent challenges in energy decentralization is imperative, focusing on developing sustainable solutions for renewable energy systems. Along this journey, consideration should be given to the real-world performance characterization of renewable energy systems by understanding the crucial role of wind flow patterns and other environmental phenomena in the built environment, as the security of future energy supply depends on our capacity to foresee and comprehend the complexities of urban wind phenomena. This talk aims to bridge the gap between decentralization aspirations and the critical importance of precise environmental predictions for sustainable energy transition using multi-physics and multi-scale computational approaches, laying the foundation for a resilient production to end-use chain in the built environment.