Navid Alinejadian

Navid Alinejadian | Materials and Additive Manufacturing Specialist

4TU.Energy

University of Twente | KTH Royal Institute of Technology

Background and Techniques

- Electroplating of 2D materials and Nanocomposites
- Mass production of Graphene-based nanomaterials
- Electrochemical Energy Storage Systems

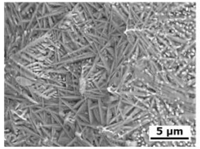
GREEN NANOSCALE TECHNOLOGY

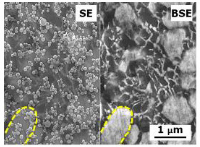
IASBS

2018 PhD

TAL TECH

KTH VETENSKAP OCH KONST



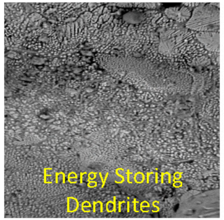


2024 Postdoc

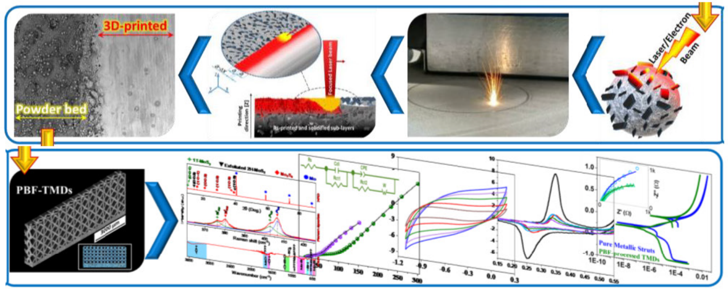
esa

UNIVERSITY OF TWENTE.

KTH VETENSKAP OCH KONST



- **Materials Development**
- **Manufacturing Process Optimization**
- **Energy-based Application Development**
- **Functional Composite Industrialization**



Research Goals / Future Plans

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Cost Effective

- 3D Transition Metal Sulfides
- 3D Transition Metal Oxides
- High-Temp. Nanocomposites

3 Li Lithium 6.94

H_2 HYDROGEN

11 Na Sodium 22.98976928(2)

7 AFFORDABLE AND CLEAN ENERGY

11 SUSTAINABLE CITIES AND COMMUNITIES

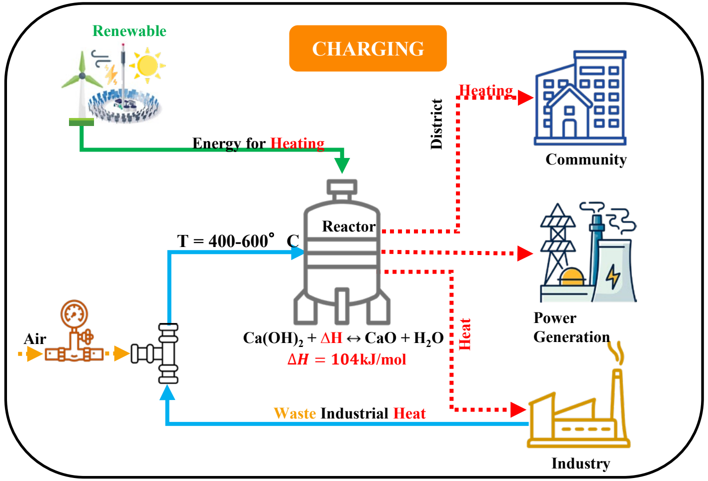
13 CLIMATE ACTION

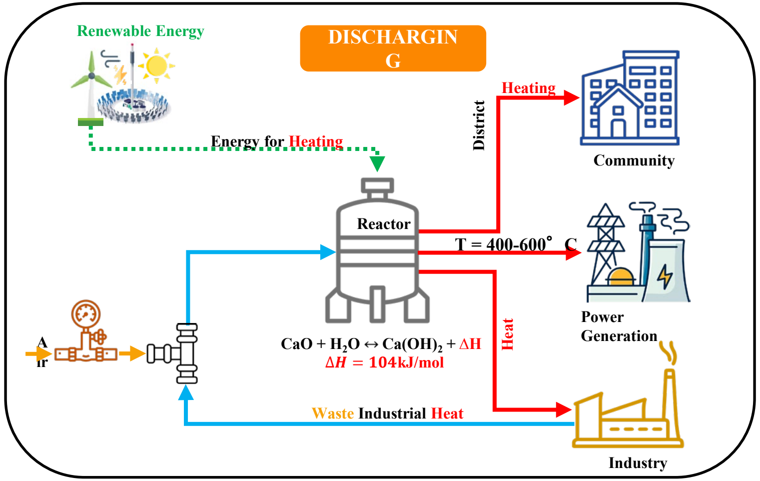
Khushwant Singh Chauhan

4TU.Energy

KHUSHWANT SINGH CHAUHAN
(UNIVERSITY OF TWENTE)

- Energy is essential, yet reliance on fossil fuels is driving greenhouse gas emissions.
- Renewable energy (solar, wind) is intermittent. Long duration Energy Storage is essential for continuous, reliable supply.
- Demonstration of 5 kW LONG DURATION HIGH TEMPERATURE THERMOCHEMICAL HEAT STORAGE system.





Builds reactor models, tests performance.

Optimizes materials with additive manufacturing.

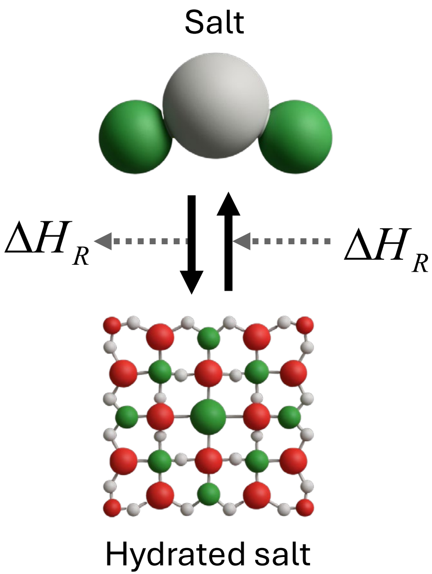
Supports LCS, economics, and policy analysis.

Funded by the European Union's Horizon Europe research and innovation programme under grant agreement No. 20004016. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the institutions of the European Union.

Sergio Enrique Cruz Lopez

Micro-HS: THS Reactor Design Using Novel TCM.

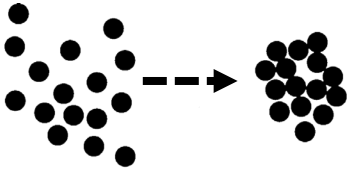
Theoretical principle



Challenges

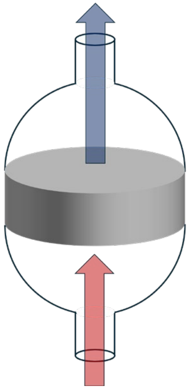
Deliquescence

Agglomeration



Hypothesized strategies

- Operational conditions



- Internal arrangement

NWO NOBIAN IamFluidics ARES systems

Fluid Mechanics for Functional Materials

UNIVERSITY OF TWENTE.

Mediya Etemadi

Shaping the Future: Back-End Nuclear Fuel Cycle Strategies in the Energy Transition

Mediya Etemadi

Principal supervisor: Prof. dr. Nasser Kalantar-Nayestanaki

Second supervisor: Prof. dr. Machteld van den Broek

Energy and Sustainability Research Institute of Groningen,

University of Groningen,

The Netherlands.

9th November 2023

The role of nuclear energy in the Energy mix

Nuclear Energy

Advantages

Energy sufficiency

- High energy density
- Stability and Reliability

Environmental impact

- No direct CO2 emissions
- Fuel availability

Disadvantages

Safety

- Potential of accidents
- Proliferation risk

Radioactive waste

- management
- Recycling and Reusing
- cost

Public perception

- negative public perception

Nuclear Energy

Advantages

Energy sufficiency

- High energy density
- Stability and Reliability

Environmental impact

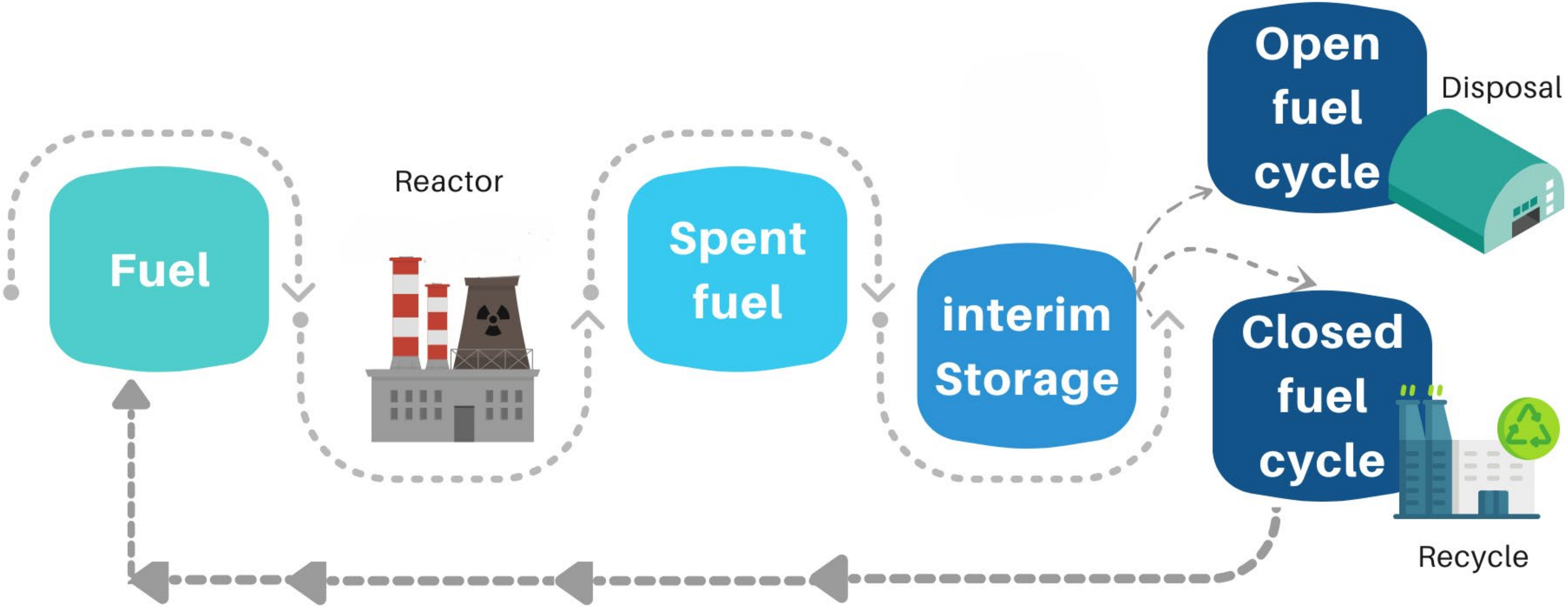
- No direct CO2 emissions
- Fuel availability

Disadvantages

Radioactive waste

- management
- Recycling and Reusing
- cost

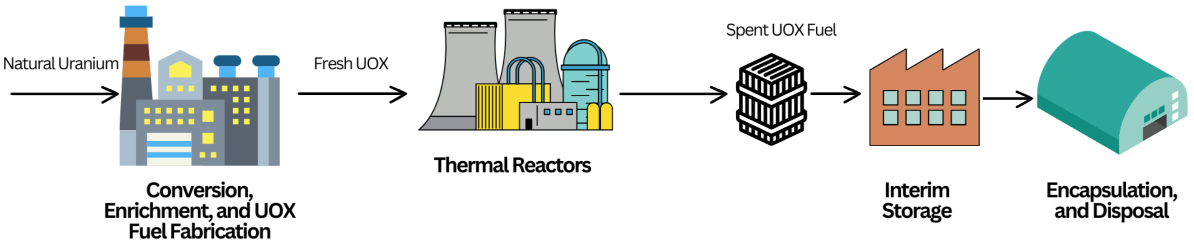
Open or Closed Nuclear Fuel Cycle:

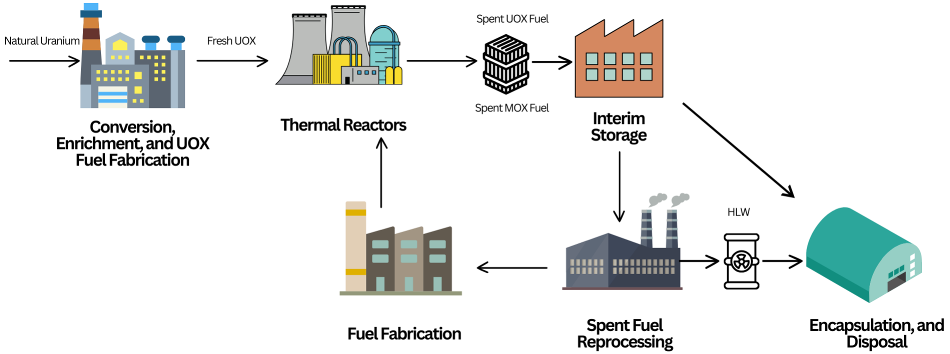


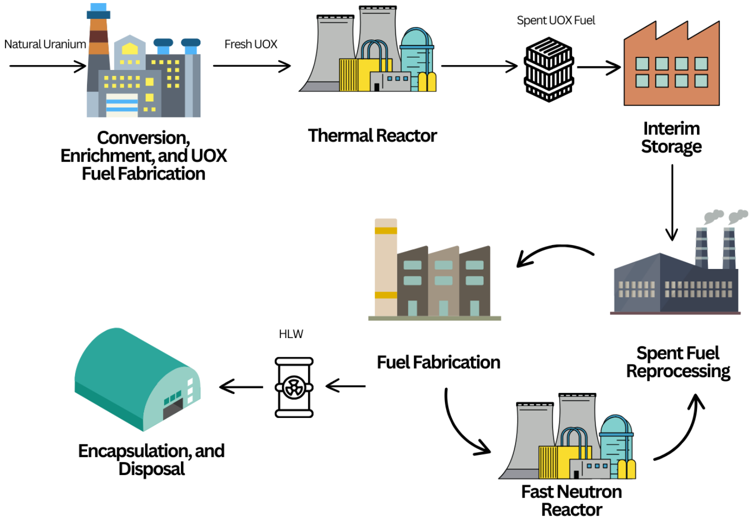
Nuclear Fuel Cycle Strategies:

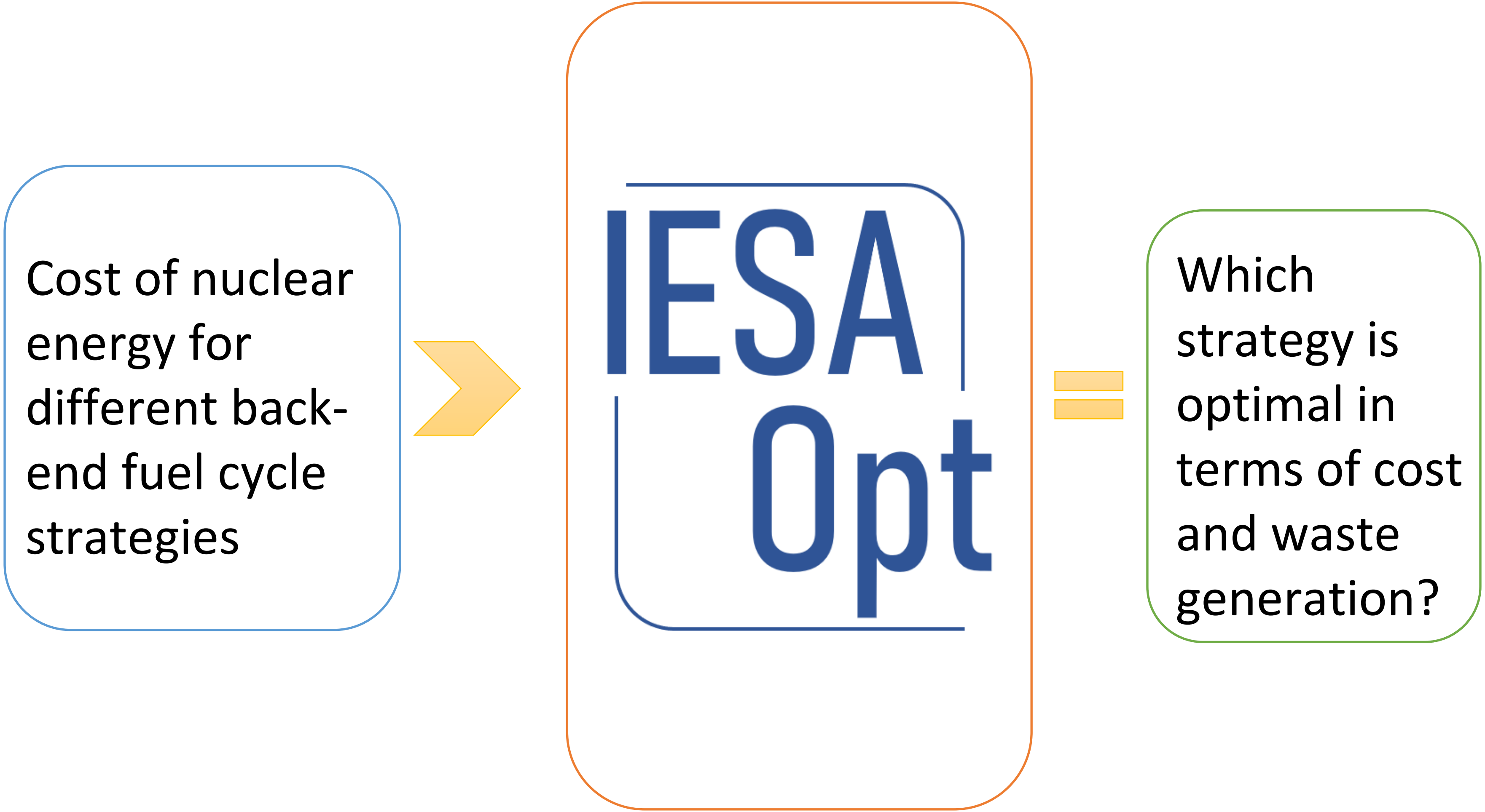
Open fuel cycle:
- Direct disposal (OTC)

Closed fuel cycle:
- Partial Recycling (TTC)
- Advanced Recycling (AFC)





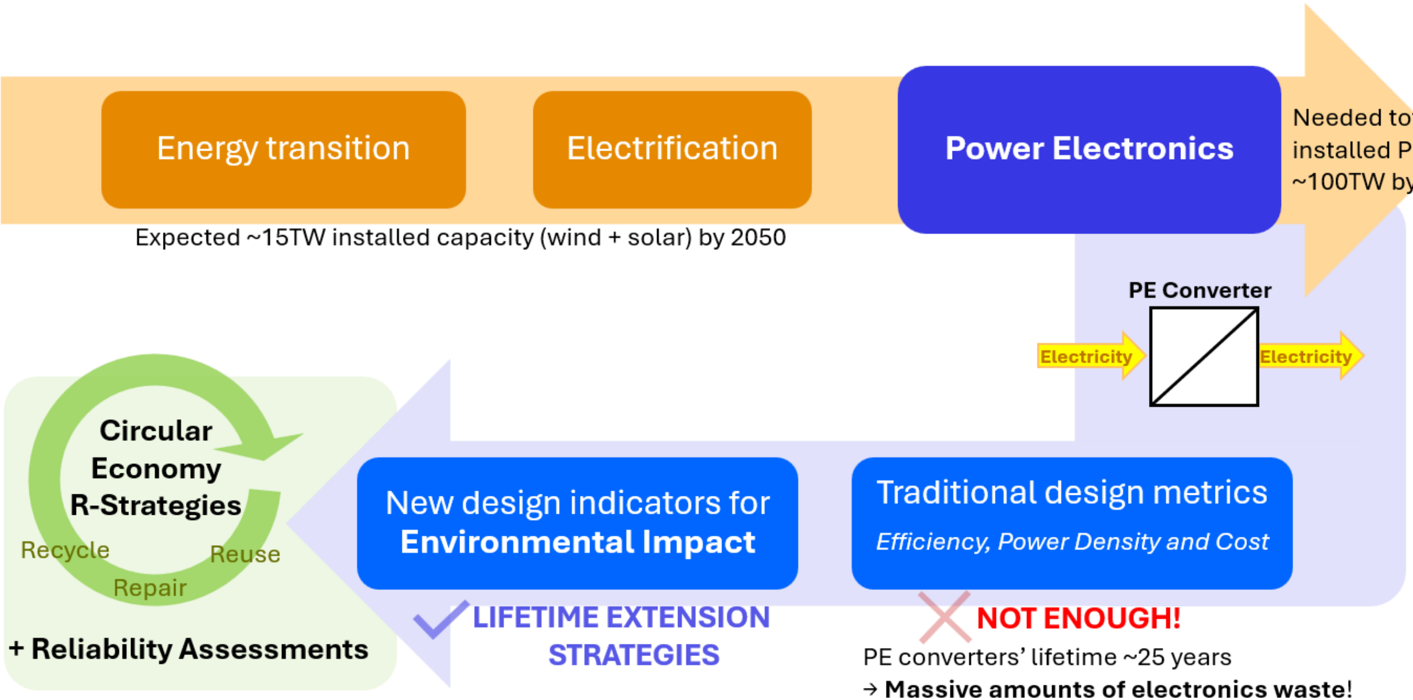


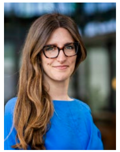

Cost of nuclear energy for different back-end fuel cycle strategies
IESA Opt
Which strategy is optimal in terms of cost and waste generation?

Francesca Grazian

Francesca Grazian | Power Electronics | TU Eindhoven

Circular Economy R-Strategies for Power Electronics





TU/e

Source: *J. Huber, L. Imperiali, D. Menzi, F. Musil and J. W. Kolar, "Energy Efficiency is Not Enough!," in IEEE Power Electronics Magazine, vol. 11, no. 1, pp. 18-31, March 2024.*

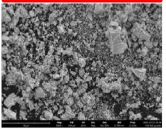
Amin Hodaei

Goals / Research topics

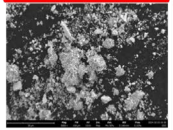
- Additive Manufacturing and fast, facile, and effective post-processing techniques (e.g., ultrafast high-temperature sintering (UHS)) to realize maximum control over the microstructure, properties, and performance of energy systems such as solid oxide fuel cells (SOFCs)

Methods and Techniques

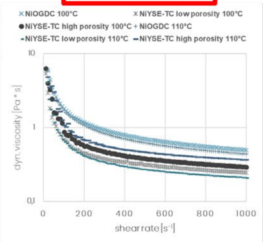
NiO-YSZ Powder



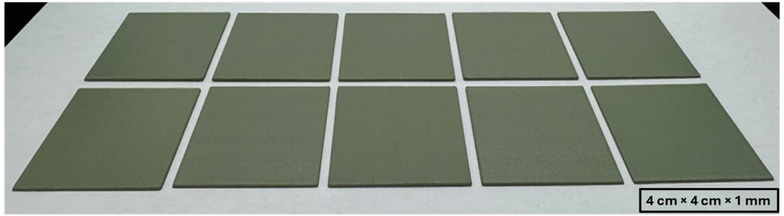
NiO-GDC Powder



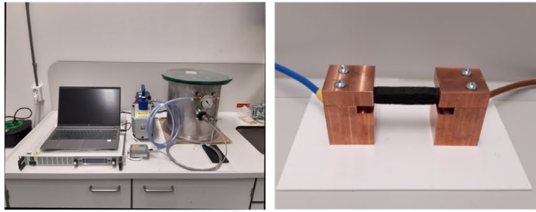
Ink Formulation



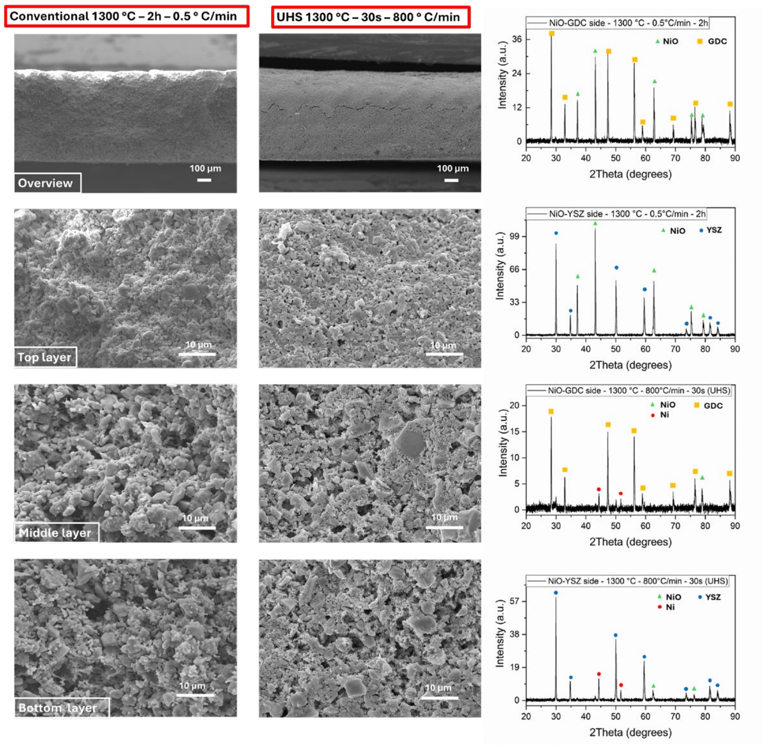
Multi-Material Jet 3D printing of NiO-YSZ/NiO-GDC Layered Structures



UHS Sintering of the NiO-YSZ/NiO-GDC Layered Structures



Results & Discussions



- Tuned microstructure and porosity by UHS
- UHS sintering demonstrated oxygen dissociation from NiO and caused formation of Ni
- Replacement for chemical reduction of NiO in reducing gas environments (e.g., forming gas)
- The total **time of sintering is reduced by > 99% in UHS sintering (~10 min)** compared to conventional sintering
- UHS sintering provides a disruptive pathway for facile and efficient sintering of layered structures for versatile applications, e.g., energy storage and conversion, in only few minutes.

Guang Hu

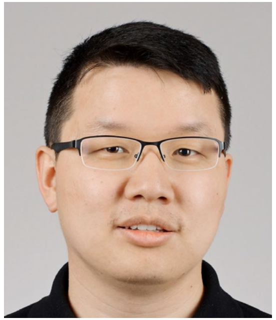
4TU.Energy

Guang Hu| Modeling

(Eindhoven University of Technology)

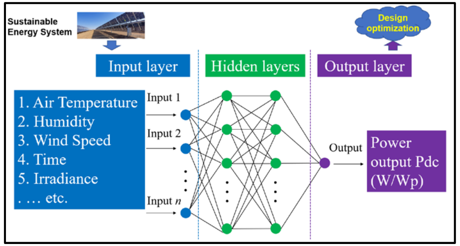
Goals / Research topics

- Machine Learning Applications
- Solar Energy System
- Thermal Energy System



Methods and Techniques

➢ Machine learning applications in PV



Research Description

- ➢ Combining machine learning techniques with physics modeling.
- ➢ Contributing to the development of sustainable energy solutions that are both optimal and suitable for urban cities.
- ➢ Translating 3D models of built environment into data-driven assessment environments.

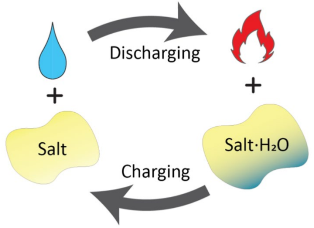
Bram Kieskamp

Bram Kieskamp | Heat Storage
(University of Twente)

Development of a Vacuum Based Heat Battery

Thermochemical material

$$\text{Salt} + H_2O \rightleftharpoons \text{Salt} \cdot H_2O + \text{Heat}$$

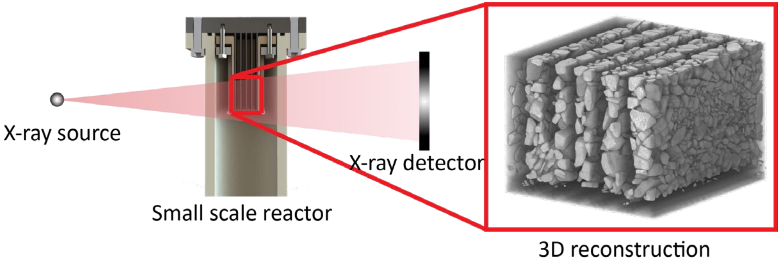


Goals

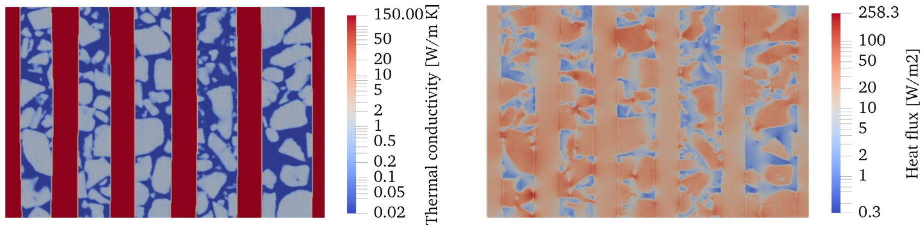
Establish reactor-scale effects of cycling induced volume changes

- Characterise morphological changes
- Influence on heat and mass transfer
- Resulting reactor performance

Experiments



Numerics



Raheleh Mohammadpour

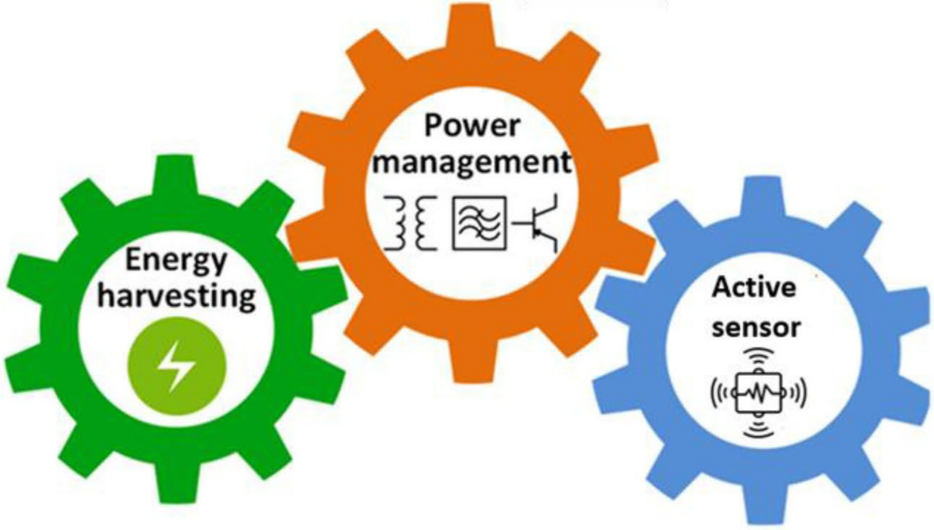
Raheleh Mohammadpour

Sharif University of Technology

Goals / Research topics

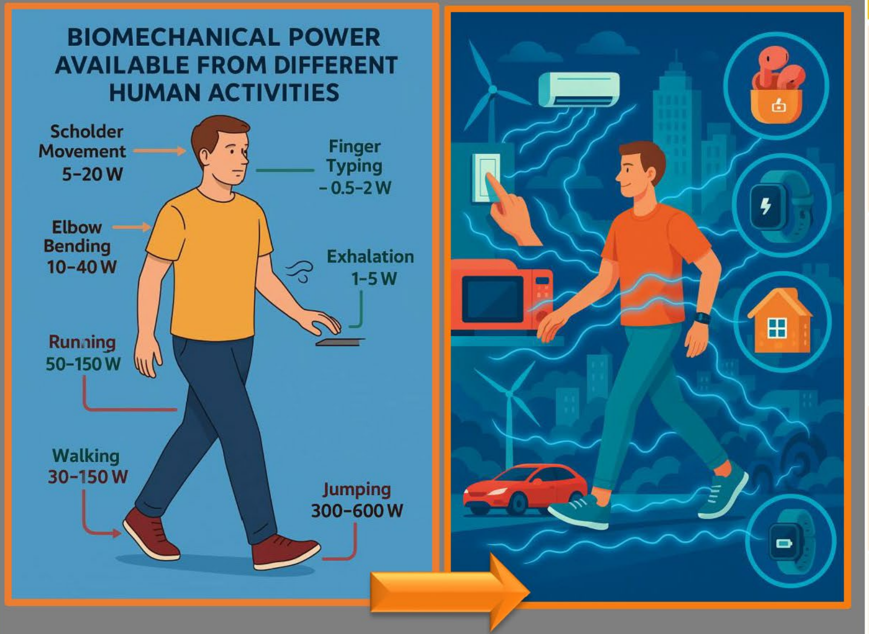
- Hybrid Triboelectric/Magnetoelastic Nanogenerators
- Self-powered sensors

All- in-one Energy Sensor Unit



4TU.Energy

A nanogenerator is a technology that converts mechanical energy—generated by small- or large-scale physical changes—into electricity.



Sources of mechanical energy in the day-to-day surroundings	
Human activity	Walking, running, lifting objects, breathing, heart beat, typing, hand movement, blood flowing through the blood vessels, speaking
Inside home	Door closing and opening, pressing switch, vibrations from household appliances e.g. microwave, air conditioner, refrigerator etc
Outside home	Wind energy, vehicle movement on the roads, vibration from vehicles e.g. engine and chassis, rotational kinetic energy from tires
Industrial plant	Movement of vehicles, vibrations from machines, human movement

Vast amounts of mechanical energy are constantly being generated but remain unused and wasted.

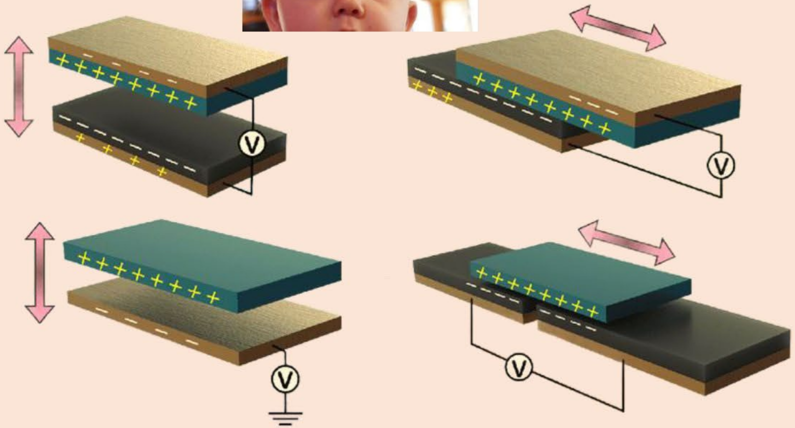
Imagine if we could **harvest this vast amount of energy and convert all or part of it into electricity.**

Picture a world where our wearable devices are seamlessly powered by our own movements, eliminating the need for disposable batteries.
A world where **flexibility, sustainability, and transparency** merge with energy harvesting.

My research is turning this vision into reality.

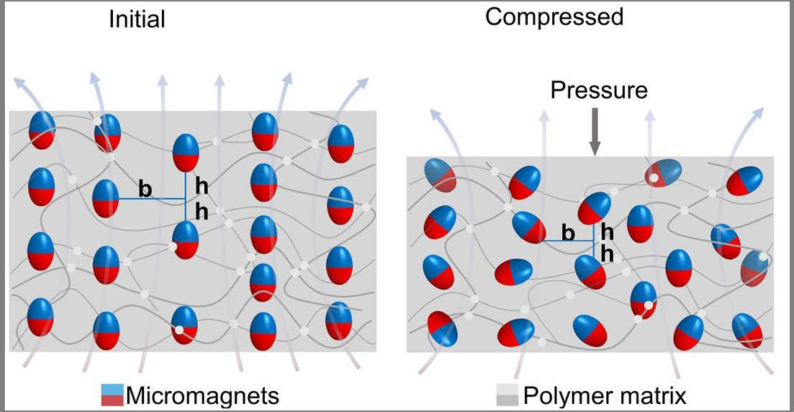
Triboelectric Nanogenerators

The triboelectric effect, known for thousands of years, is the process of electrical charging that occurs when two different materials come into contact through friction. It is a high-impedance generator that produces a high-voltage output, ranging from hundreds of volts to kilovolts per cm².



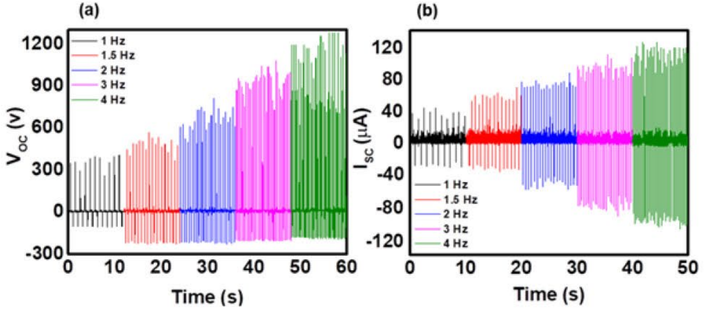
Magnetoelastic Nanogenerators

On the other hand, **magnetoelastic generators** consist of magnetic micro- or nanoparticles embedded in a polymer matrix. When subjected to mechanical stress, such as pressure or deformation, the strain alters the material's magnetic domain structure, leading to variations in the magnetic field.



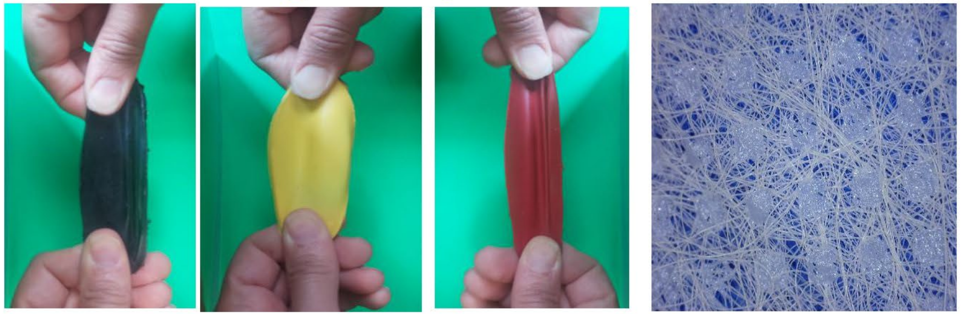
Chen, Guorui et al. Matter, Volume 4, Issue 11, 3725 - 3740

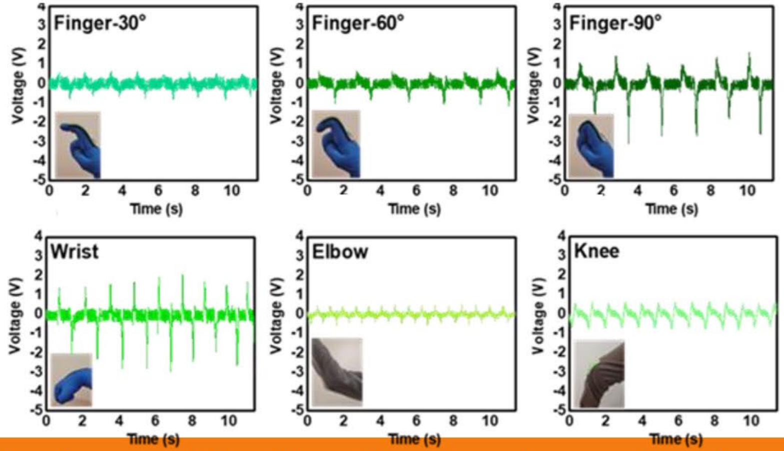
Transparent ultra light-weight TENG based on $BaTiO_3$/Ag/PDMS



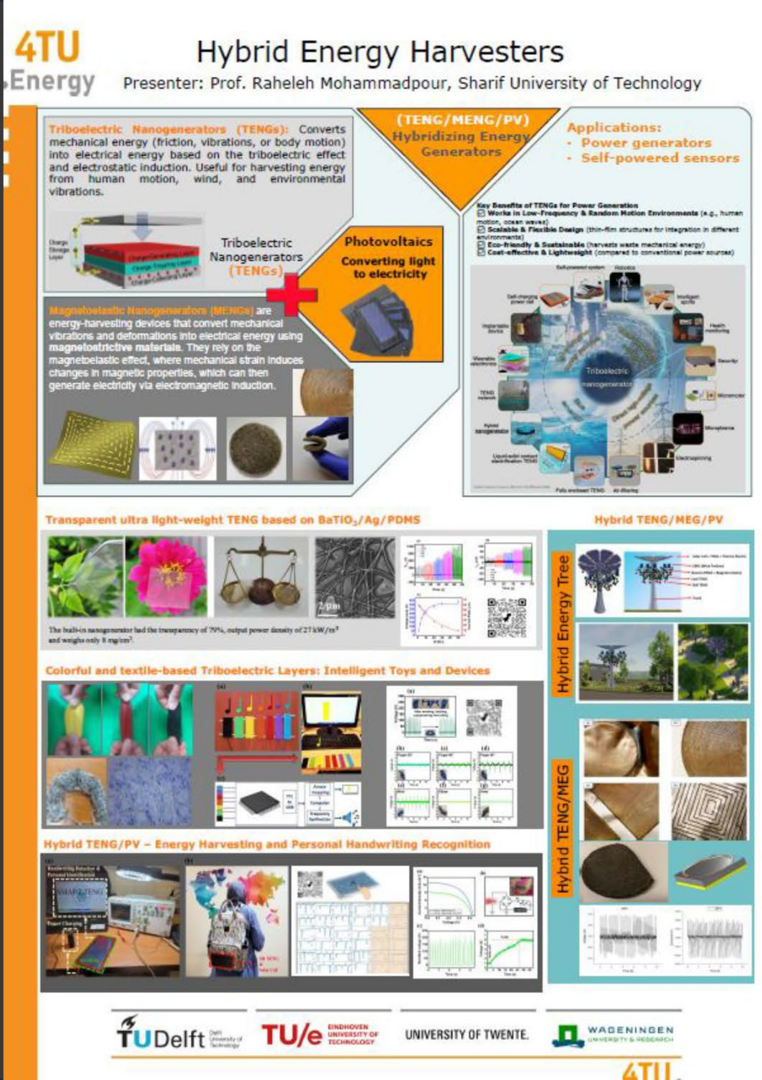
The built-in nanogenerator had the transparency of 79%, output power density of 27 $\mathrm{kW/m^3}$ and weighs only 8 mg/cm^2.

Colorful and textile-based Triboelectric Layers: Intelligent Toys and Devices





Let's collaborate to harness mechanical energy and build a self-powered, sustainable future.



Salomé Sanchez

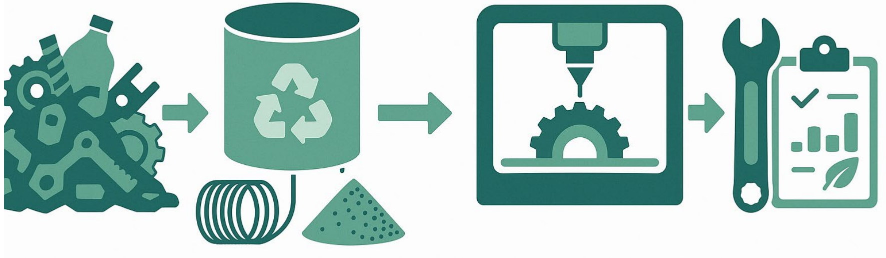
Dr. Salomé Sanchez| Additive Manufacturing

University of Twente

Research topics

- Additive Manufacturing for Sustainable Development
  - Circularity
  - Humanitarian applications

Methods



Projects

3D Printing houses from disaster debris

Circular Laser Powder Bed Fusion

3D Printing consumer polymer waste

Wenli Shi

Wenli Shi| Transportation Electrification

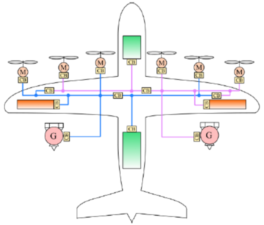
Assistant Professor, DCE&S Group at TU Delft

ElectriFly: electrify the powertrain for sustainable flight!

Energy storage

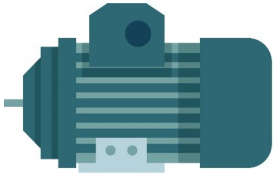
Energy density
Safety

Power distribution



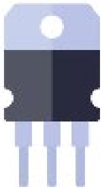
Architectur
e Protection

Electric propulsion



Reliability
Power density

Component reliability



Modeling
Prognostic

Ongoing research:

- Battery system modelling for SOX and RUL estimation.
- Digital model of electric aircraft onboard system.
- DC circuit breaker design for protection.
- Reliability modelling and design of electric drives.

Image source: freepik.com

Henk-Jan van den Brink

Henk-Jan van den Brink | Research Methodology

h.j.vandenbrink@utwente.nl

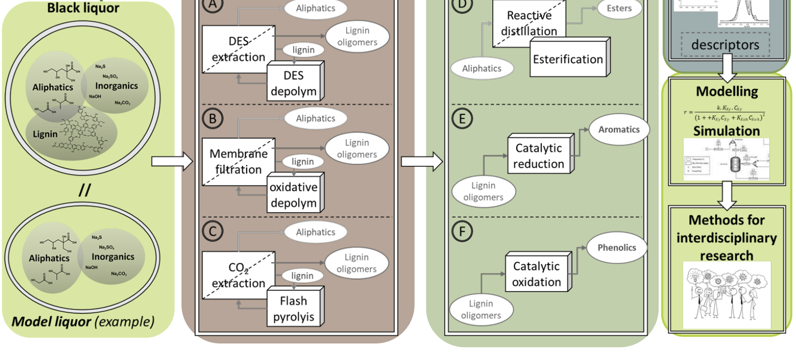
UNIVERSITY OF TWENTE.

EIC Pathfinder Project: DREAM Processing Complex Matrices: Description, REAction-Separation, Modelling

My PhD project in the Philosophy of Science

- **Challenge**: Gap between scientific research and sustainable technology
- **Objective**: Research methodology for interdisciplinary research
- My **background**: Bioprocess Technology (WUR) and Philosophy (PSTS UT)

WP1. Industrial and model liquors



WP2. Analysis & Characterisatio n

WP5. Modelling, Simulation & Interdisciplinarity

WP3. Upstream processes

WP4. Downstream processes

Five work packages in the DREAM Consortium

European Innovation Council
Funded by the European Union
DREAM

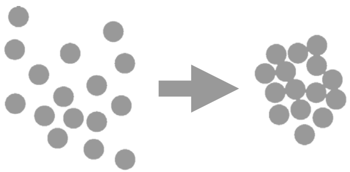
Bart van der Vaart

Micro-HS: Encapsulating salt hydrates using in-air microfluidics

Problem statement

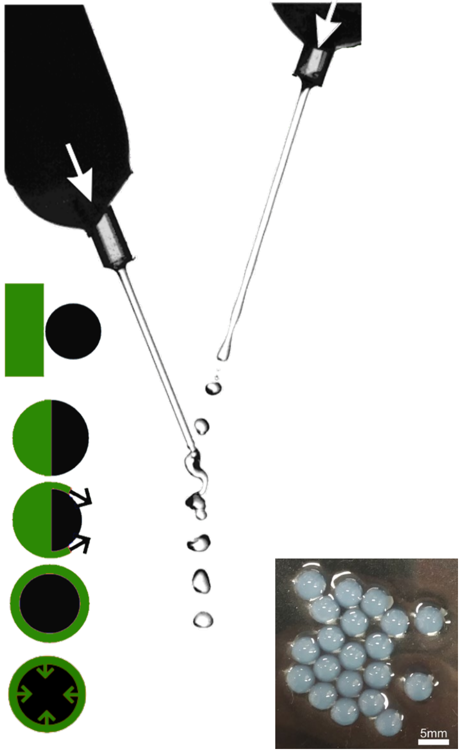
- Store low grade heat using salt hydrates

Deliquescence

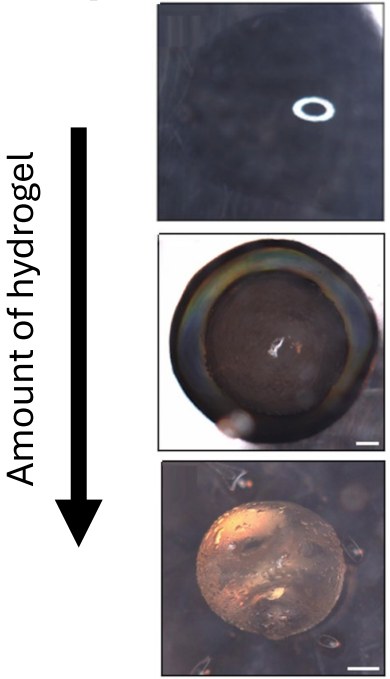


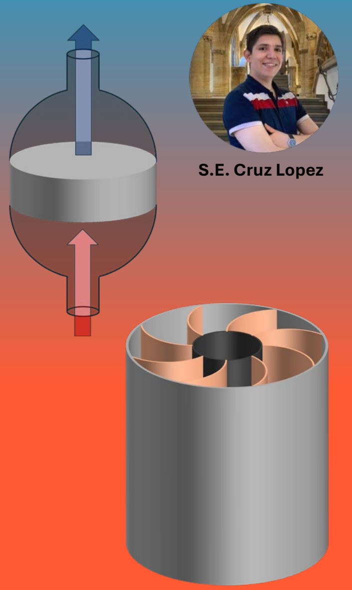
Agglomeration

Methodology



Hydrogel reduces deliquescence





NWO NOBIAN IamFluidics ARES systems

TCS FMFM Fluid Mechanics for Functional Materials

UNIVERSITY OF TWENTE.

Malte Vogt

Circularity of Photovoltaics

Malte R. Vogt

PVMD
Delft University of Technology

3rd of April 2025

4TU Energy Community Day, Amersfoort

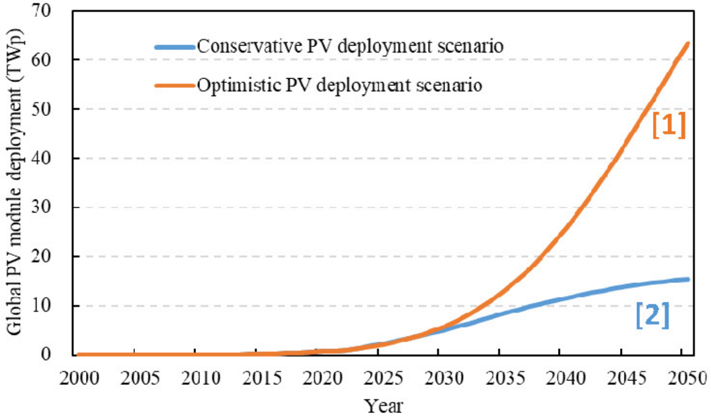
Contact: m.r.vogt@tudelft.nl

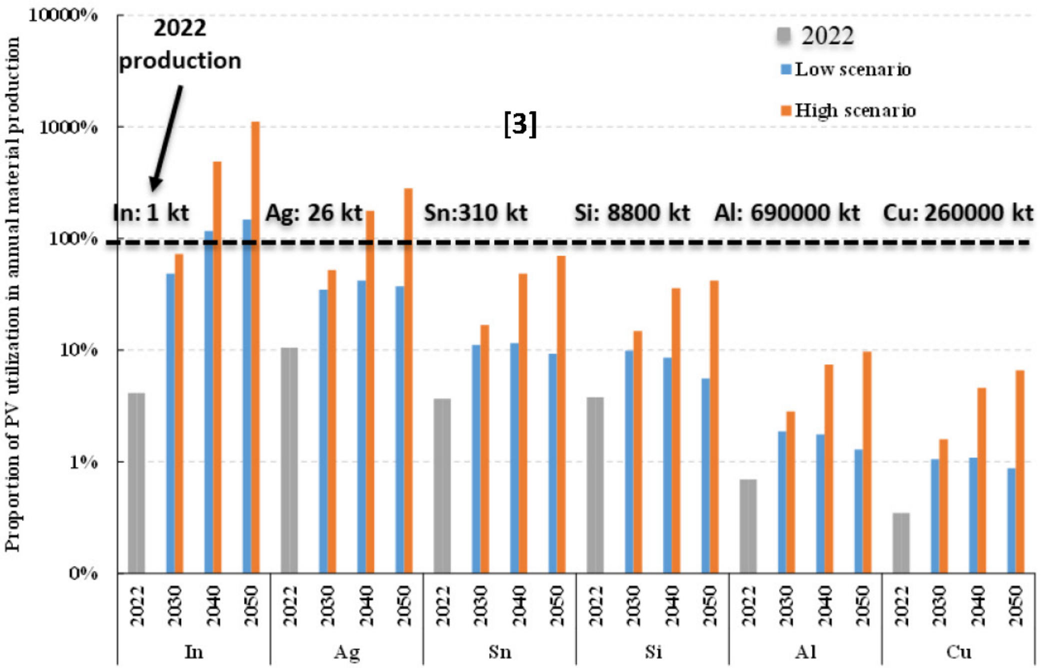
TU Delft

Research Vision – 1) Sustainability analysis of PV

- Life cycle analysis of PV
- Projections for PV EoL
- Material flow analysis based:

  PV material demand projections



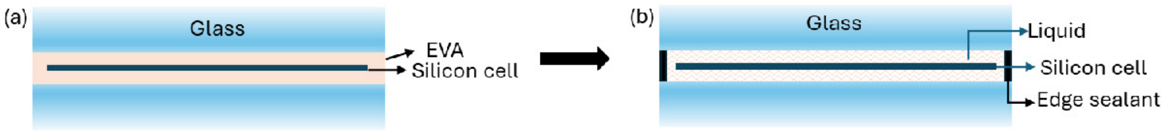


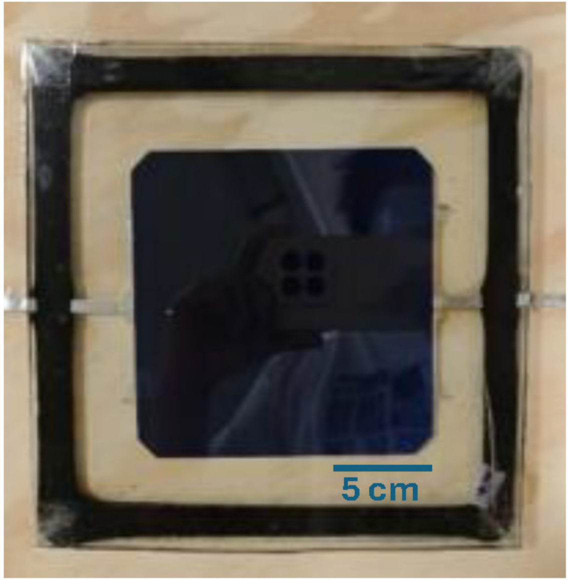
[1] D. Bogdanov et al., Energy 227, 120467 (2021)
[2] IEA, World energy outlook(WEO), (2021)
[3] Chengjian Xu et al., *RCR Advances* **210**, 107824 (2024)

Research Vision – 2) Engineering PV Circularity

- **Material separation key challenge in recycling**
- **Design for Circularity**

  → Liquid-encapsulated photovoltaic module





- **FAIR-PV project: Future Repairable, Transparent and Sustainable Solar-PV**

BIOSPHERE SOLAR

Circularity of Photovoltaics Team

Youri Blom

PhD Candidate

Dr. Chengjian Xu

Postdoc

Dr. Urvashi Bothra

Postdoc

Dr. Mohammad Abdelbaky

Postdoc

Nithin Perunthottathil

PhD Candidate

(Starts in July)

Thank you for your attention!

TU Delft Institutes

Urban Energy

e-Refinery

AgTech

TU Delft Climate Action Programme

Funded by the European Union

PVMD funding

Rijksdienst voor Ondernemend Nederland

URBAN EUROPE

HORIZON 2020

cet Partnership

Horizon Europe

NWO

HyET Solar
Flexible light weight solar modules

Contact

m.r.vogt@tudelft.nl

Hiring now!
Open PhD and Postdoc positions!

CHUNG YU YEH

Power-free thermal upgrading system for low-temp. residual heat via Thermochemical material

4TU.Energy

Chung-Yu Yeh
c.yeh@utwente.nl

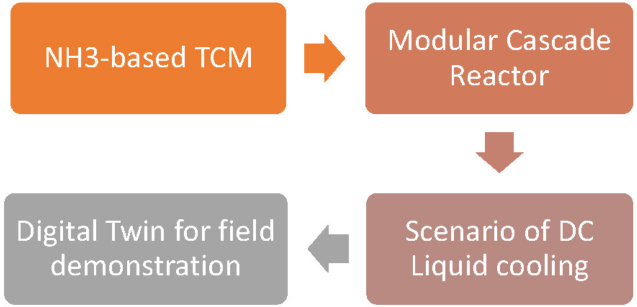
Motivation And Aim

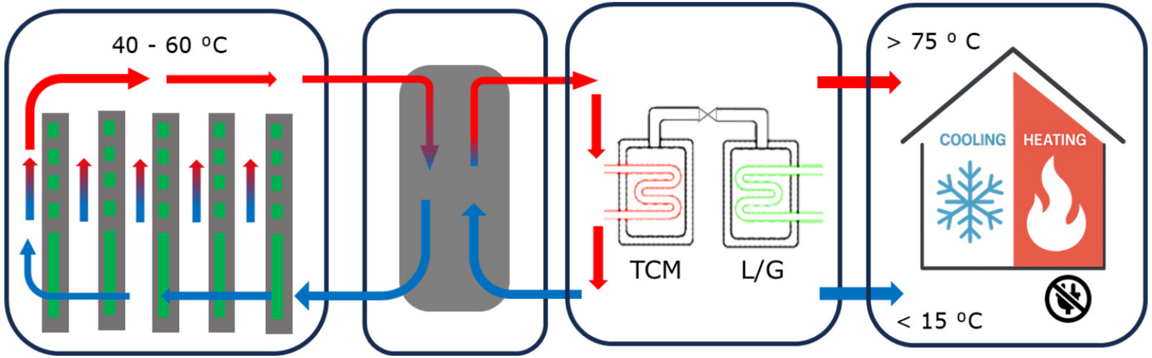
- Rapid rise in data center (DC) power demand
- High potential for DC waste heat recovery
- Power-free heat upgrading for heating needs
- Thermally driven self-sufficient DC cooling

MISD Project

- €34 million in Dutch government funding
- Partnership of seven key organizations
- Five-year, large-scale initiative (2024–2029)
- Targeting over 50% CO_2 reduction

Methods and Techniques





Server Racks in Immersion cooling tank | Coolant Distribution Unit (CDU) | Heat Recovery via TCMs | Thermal upgrading and cooling

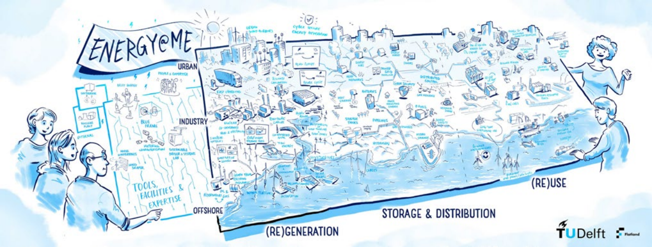
MISD PROJECT | University of Twente | Asperitas Immersed Computing | Deerns | Better Be | TNO innovation for life | NBIP nationale beheersorganisatie internet providers

Marta Zagorowska

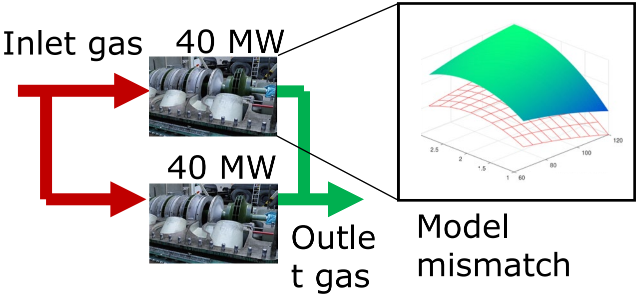
Marta Zagorowska | Control and Optimization

DCSC, TU Delft

Energy Systems



Methods and Techniques



Energy infrastructure:

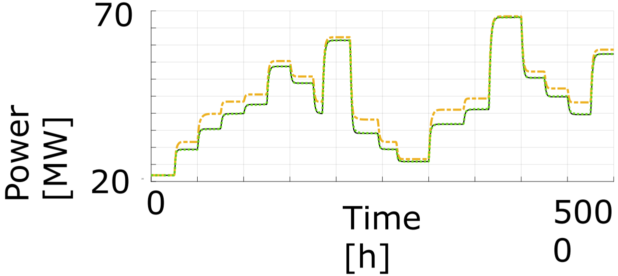
- **Efficient** operation over **entire lifetime**
- **Safe** operation of **interacting** subsystems
- **Limited information** available

Research:

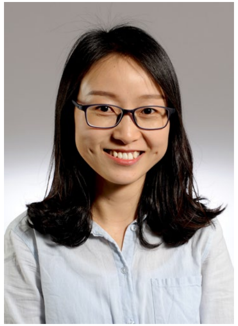
- **Optimization** algorithm as **controllers** to reach the **optimum** and **satisfy constraints**

Outcomes:

- **Optimization** with **learning** overcoming **model mismatch**
- Reduction of power consumption up to **0.8%**



Tingting Zhu



Goals / Research topics

- Thermodynamics of Mixture Refrigerants
- Heat Transfer and Frost Formation
- Advanced Heating and Cooling Technologies