

Sustainability at DIFFER

Sustainable procurement, energy saving & sustainable innovation

Darío Cruz | ILO for fusion



DIFFER at a Glance

Dutch Institute for Fundamental Energy Research (DIFFER)

- **200** employees
 - 1/3 scientific
 - 1/3 technical
 - 1/3 support
- **€21 M** annual budget
 - 2/3 base funding
 - 1/3 project funding
- Founded in **1959**



To perform **leading fundamental research** on **materials, processes, and systems** for a global **sustainable energy** infrastructure, in close partnership with (inter)national **academia** and **industry**.



Mission

Departments

Fusion Energy

Chemical Energy

Facilities & Instrumentation

Support Facilities



DIFFER at a Glance

Sustainability across the institute

DIFFER performs fundamental research on clean energy conversion and storage, with fusion energy and chemical (solar fuel) energy as its two research pillars. Sustainability shapes not only what DIFFER researches, but also how the institute is built and run.

1

Sustainable Building

BREEAM-NL Excellent research facility, energy-efficient by design

2

Low-Impact Construction

Circular materials, vibration-free piling, biodiversity measures

3

Sustainable Innovation

Solar fuels and fusion research for a fossil-free energy system



Energy Saving

A building designed to perform

- Designed by Ector Hoogstrad Architecten with Peutz
- First research building in the Netherlands to achieve BREEAM-NL Excellent for both its offices and laboratories.
- Sawtooth east/west facade — daylight retained even with sun screens down
- Large south-facing overhangs limit solar heat gain
- Compact building form + triple glazing reduce heat loss
- 922 rooftop PV panels — $\approx 189,000$ kWh generated per year
- Connected to the TU/e campus underground heat/cold storage (KWO)



Sustainable Procurement & Construction

Environmental care in the 2015 new-build project

1

Materials & Waste

Sustainable materials used throughout; construction waste separated on site.

2

Vibration-Free Foundations

Piles were drilled rather than driven, producing far fewer tremors than traditional pile driving.

3

Water & Ecosystem

Special rainwater drainage reduces stress on the surrounding Dommel valley ecosystem.

4

Biodiversity

Displaced trees were replanted; nest boxes installed for local birds and bats.

Governance: a joint FOM/DIFFER steering group oversaw the project; BREEAM was a standing agenda item.



Sustainable Innovation: Solar Fuels

Chemical Energy research theme

The energy transition requires technology to store and transport sustainable energy efficiently. DIFFER researches splitting water into hydrogen and oxygen using renewable electricity, and reducing CO₂ into carbon monoxide as the starting point for CO₂-neutral synthetic fuels.

- **Autonomous Energy Materials Discovery**

Data-science-driven discovery of new energy conversion & storage materials

- **Catalytic & Electrochemical Processes**

Solid-state electrochemistry combined with (photo)catalysis

- **Electrochemical Materials & Interfaces**

Tuning materials/interfaces for high-performance sustainable energy systems

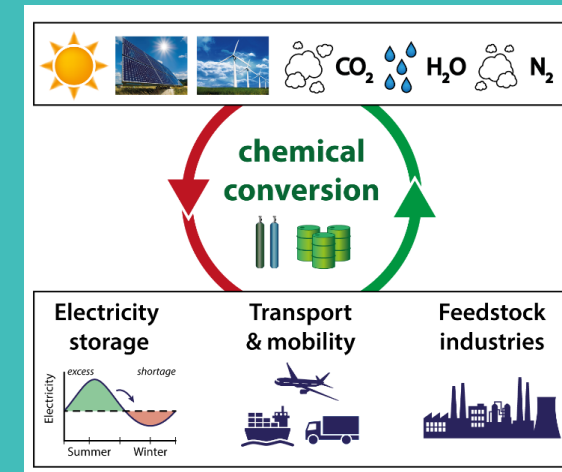
- **Plasma Solar Fuels Devices**

Plasma-assisted conversion to high-energy-density fuels (H₂, CO)



Solar-Driven Fuel Cycle

Renewable electricity → H₂O / CO₂ splitting → CO₂-neutral chemical fuels (H₂, CO)



Goal: scalable, efficient, cost-effective CO₂-neutral fuel production

Chemical Energy research at DIFFER

Scope

From theoretical model systems to laboratory scale and prototype-level reactor experimentation.



Conceptualization



Material development & characterization



Process characterization

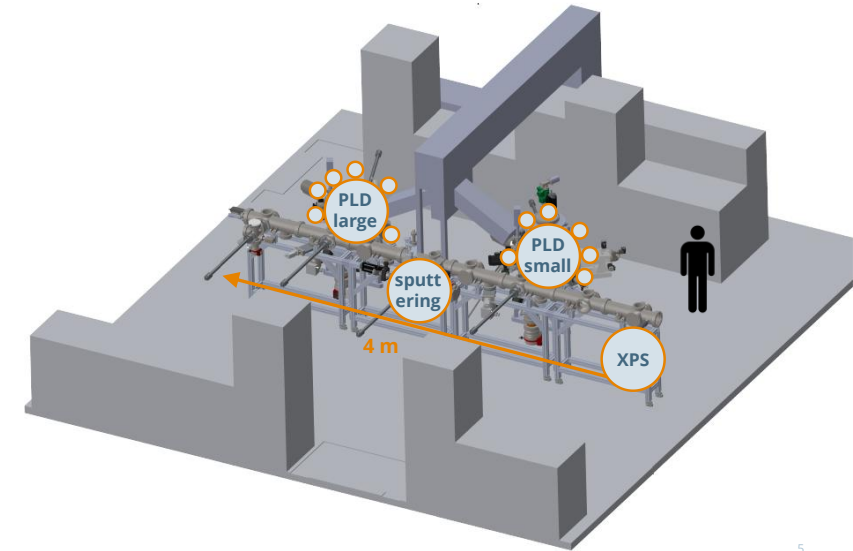
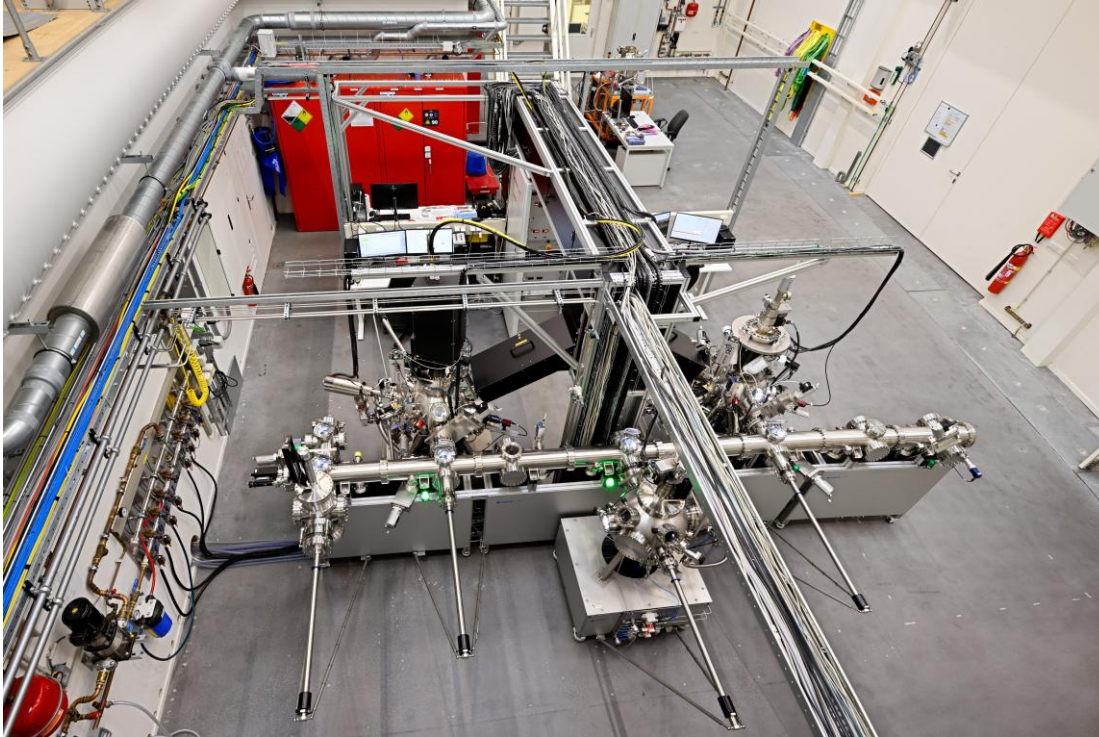


Reactor development



Pulsed Laser Deposition for Energy (PLD4Energy)

Example of co-development with industry



Co-development with industry:



TSST

Partners:



Sustainability at DIFFER
02 September 2026

Sustainable Innovation: Fusion Energy

Fusion Energy research theme

DIFFER's fusion research addresses the physics and materials science needed to make nuclear fusion a viable, virtually carbon-free source of baseload energy — complementing intermittent renewables and reducing long-term dependence on fossil fuels.

1

Plasma Edge Physics & Diagnostics

Understanding the boundary plasma that controls reactor performance

2

Plasma Material Interactions

How fusion-relevant materials withstand extreme plasma exposure

3

Radiation Induced Defect Research

Radiation effects in materials for future fusion reactor components

4

Integrated Modelling

Predictive simulation of full fusion reactor scenarios



Sustainable Innovation: Fusion Energy

Fusion Energy research theme (continued)

Two further groups complete DIFFER's fusion energy research portfolio, spanning reactor control and the fundamental physics of plasma turbulence.

5

Energy Systems & Control

Developing system identification techniques and control algorithms for fusion reactors

6

Plasma Micro-Turbulence

Understanding the fundamental physics of plasma instability and turbulence



Fusion Energy Research at DIFFER

Divertor

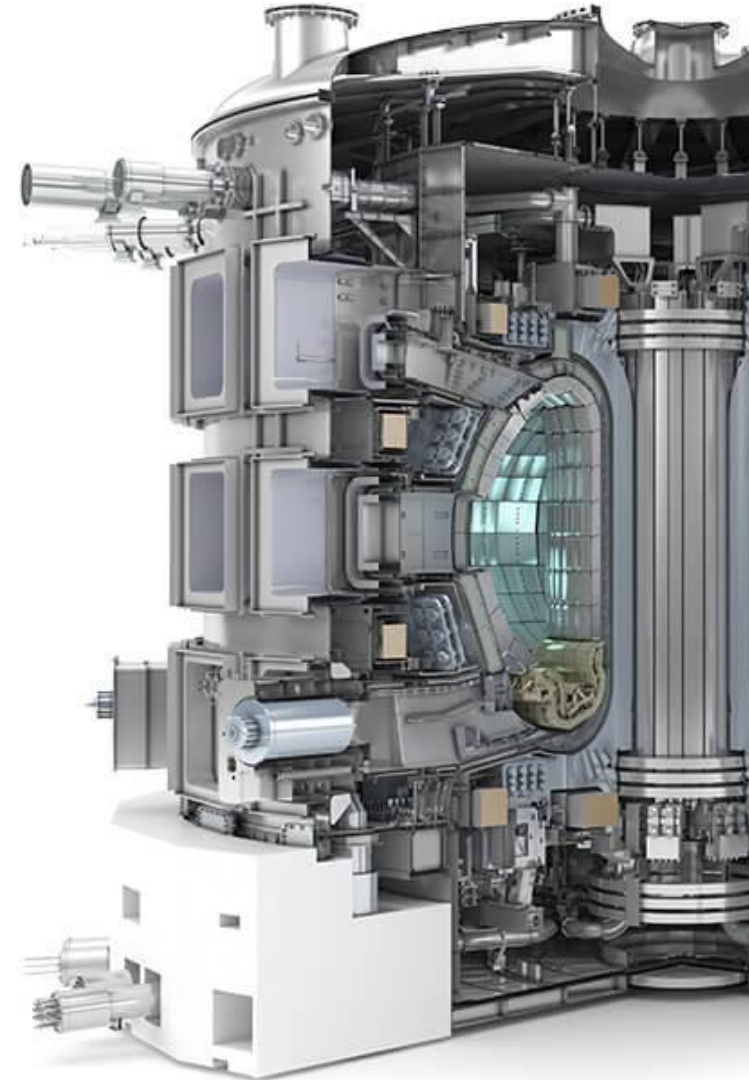
Which materials can withstand the heat and particle loads of a fusion reactor?

Control

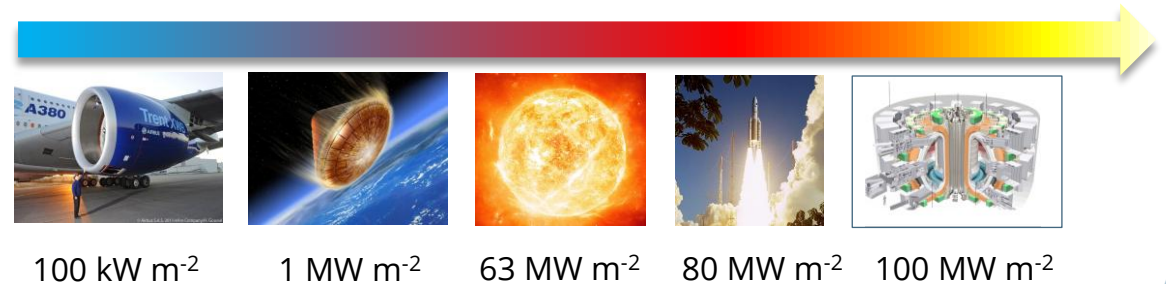
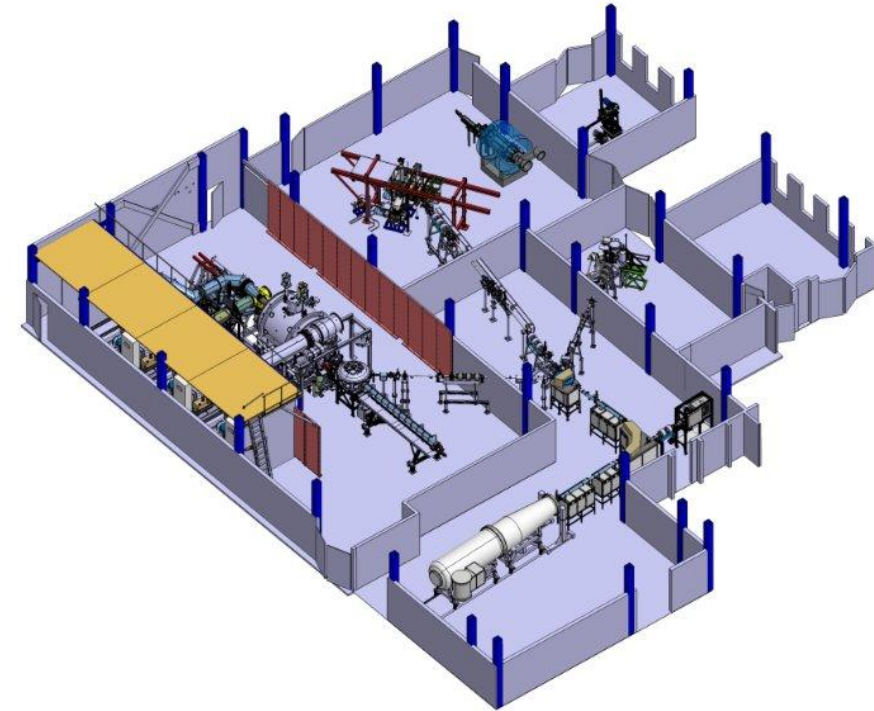
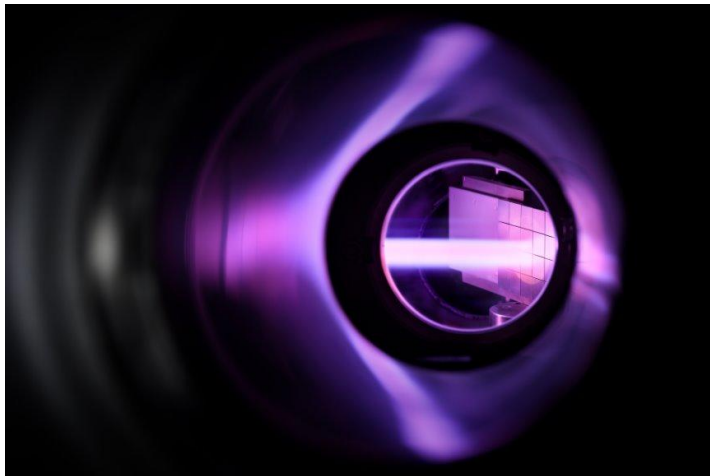
How to keep the fusion plasma burning without destroying the divertor?

Modelling

How to develop a "flight simulator" for fast and accurate reactor modelling?



Plasma Surface Interaction (PSI) Laboratory



Events



BSBF 2026
27-30 October 2026
Maastricht (NL)
Register today!



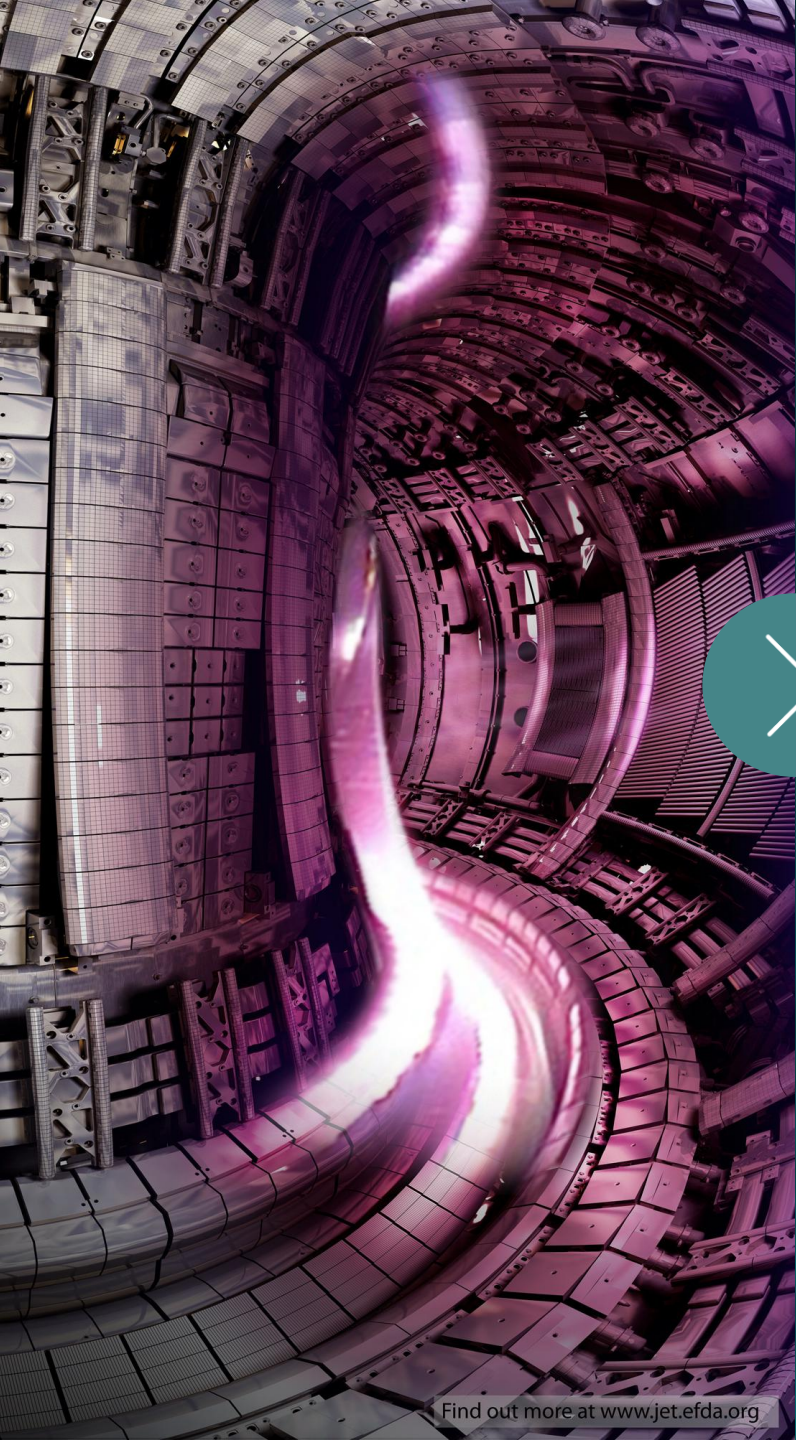
Dutch Fusion Day
8 May 2026
Eindhoven (NL)



F4E Roundtable
Spring 2027
Barcelona (ES)

Mail to ilo@diffier.nl for more information





Thank you!



DIFFER

Find out more at www.jet.efda.org