Electronic & Electrical Engineering

Information for Stage 1 Students

November 2025

UCD School of Electrical and Electronic Engineering

Scoil na hInnealtóireachta Leictrí agus Leictreonaí UCD

Outline

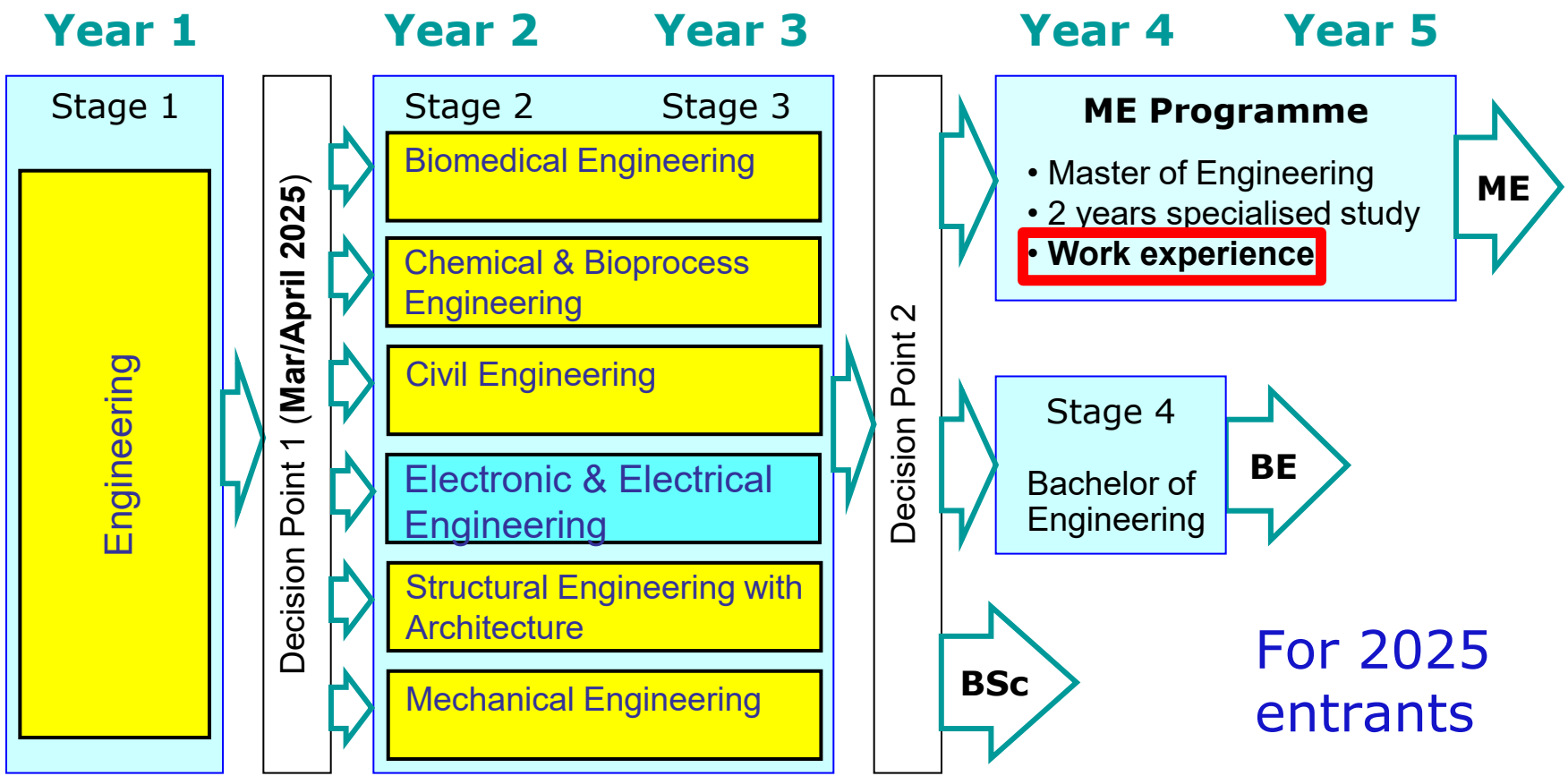
- Professor Peter Kennedy
  - Professor of Microelectronic Engineering

- Assoc. Prof Paul Cuffe
  - Associate Professor, Electrical Engineering

- Dr. Andrea Ortiz Cuadros
  - Chief Technical Officer – Electronic workshop

- Assoc. Prof Nam Tran
  - Programme Director, stage 2&3 BE E&E Engineering

UCD Engineering Pathways – DN150



What is Electrical and Electronic Engineering?

Professor Peter Kennedy
Professor of Microelectronic Engineering
University College Dublin

What is Engineering?

"…the application of *science* and *mathematics* by which the *properties of matter* and the *sources of energy* in nature are made *useful to people*…"

Merriam-Webster

What is Electrical and Electronic Engineering?

"…the application of *science* and *mathematics* by which the *electrical* *and* *electronic* *properties of matter* and the *sources of energy* in nature are made *useful to people*…"

Merriam-Webster

Electrical and Electronic Engineering

- Electrical Engineering: mainly processing energy in electrical form

- Electronic Engineering: mainly processing information in electrical form

Processing *Energy* Electrically

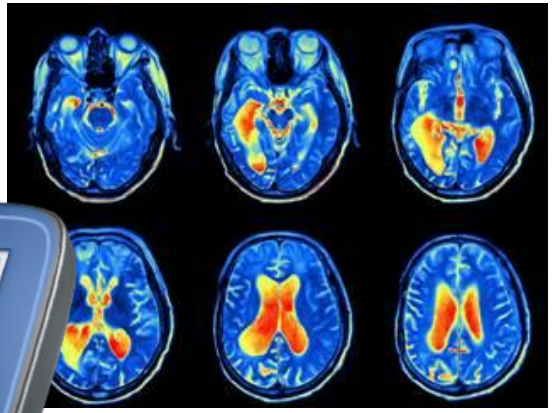
- Thermodynamics
- Machines
- Electromagnetics
- Communications
- Systems
- Control
- Energy

Processing *Information* Electronically

- Sensors
- Signal Processing
- Communications
- Data Analytics
- Computation
- Actuators
- Control

Processing (Biomedical) *Information* Electronically

- Sensors
- Signal Processing
- Imaging
- Communications
- Data Analytics
- Control
- Actuators



“Take Homes”

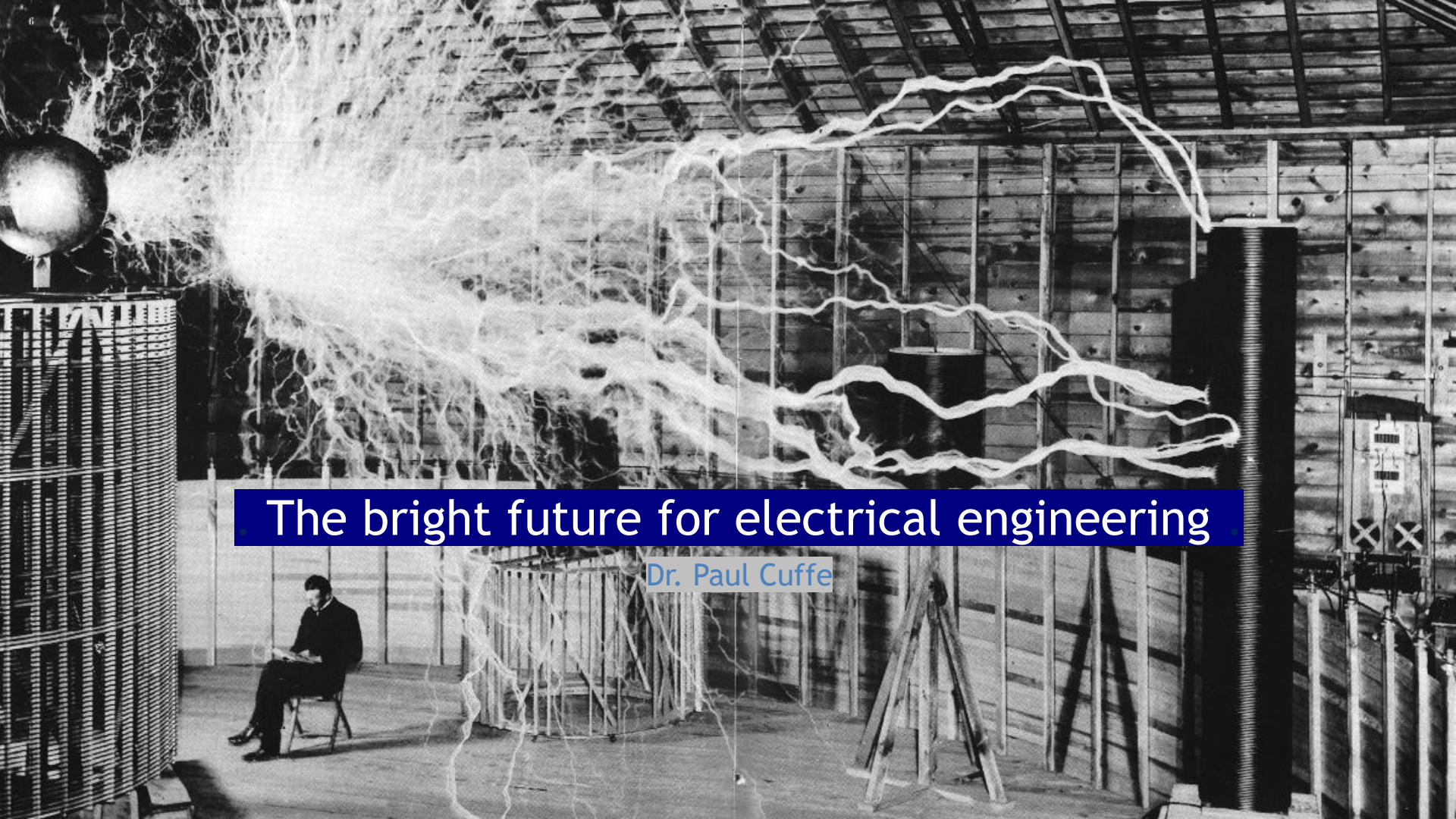
- Engineering is about solving problems using science, maths, and the properties of materials
- Electrical and Electronic Engineering use *electrical* properties of materials to process *energy* and *information*
- Electrical and Electronic Engineering have revolutionized society and will continue to transform our lives
- Every application domain needs more Electrical and Electronic Engineering
- The demand for core Electrical and Electronic Engineering skills is strong worldwide

“Designed by Engineers like me (in Ireland)”

- Analog Devices
- AMD
- Bosch
- Infineon
- Intel
- onsemi
- Qorvo
- Qualcomm
- Synopsys

“Designed by Engineers like me (in Ireland)”

- iPhone touchscreen
- Freestyle Libre glucose patch
- Bowers & Wilkins PX8
- Porsche Cayenne ABS & ESP
- Mercedes touchscreen
- Ericsson Cell Tower Radio
- Solar Panel Controller
- Smart Meters and Circuit Breakers
- YB Tracking Handheld Tracker (Satellite Phone)



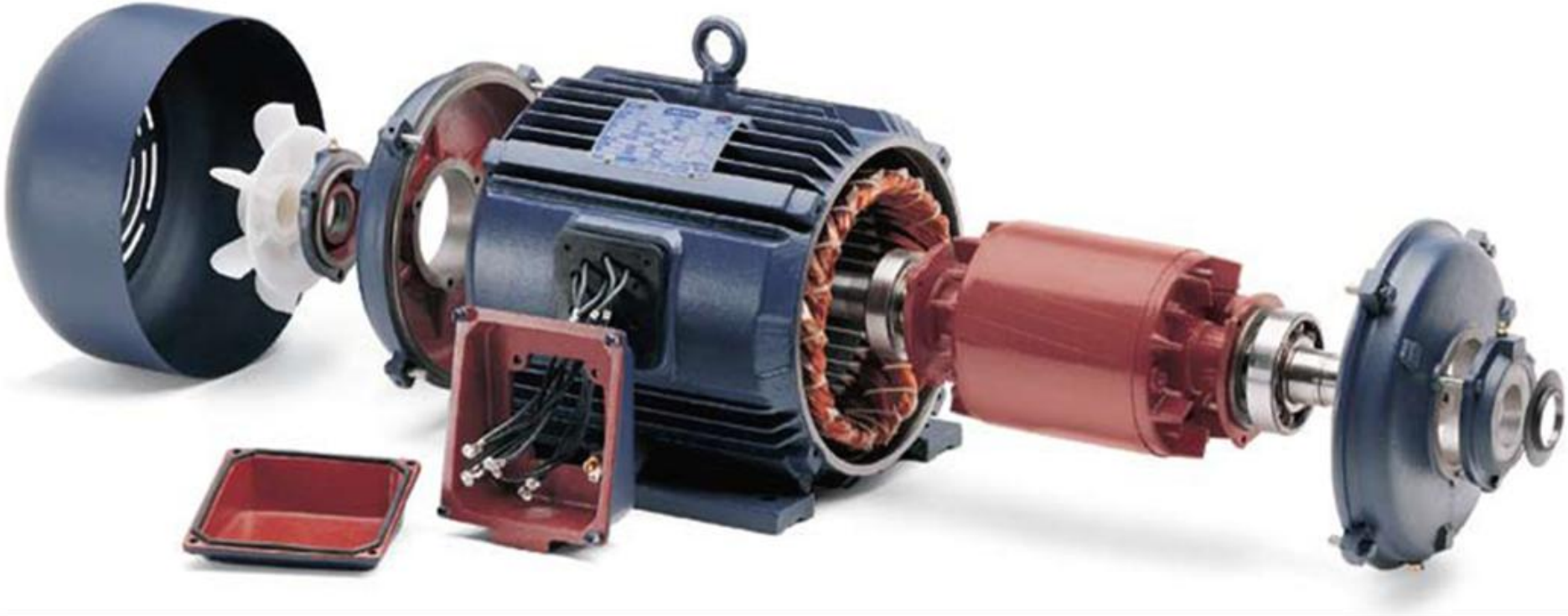
The bright future for electrical engineering

Dr. Paul Cuffe

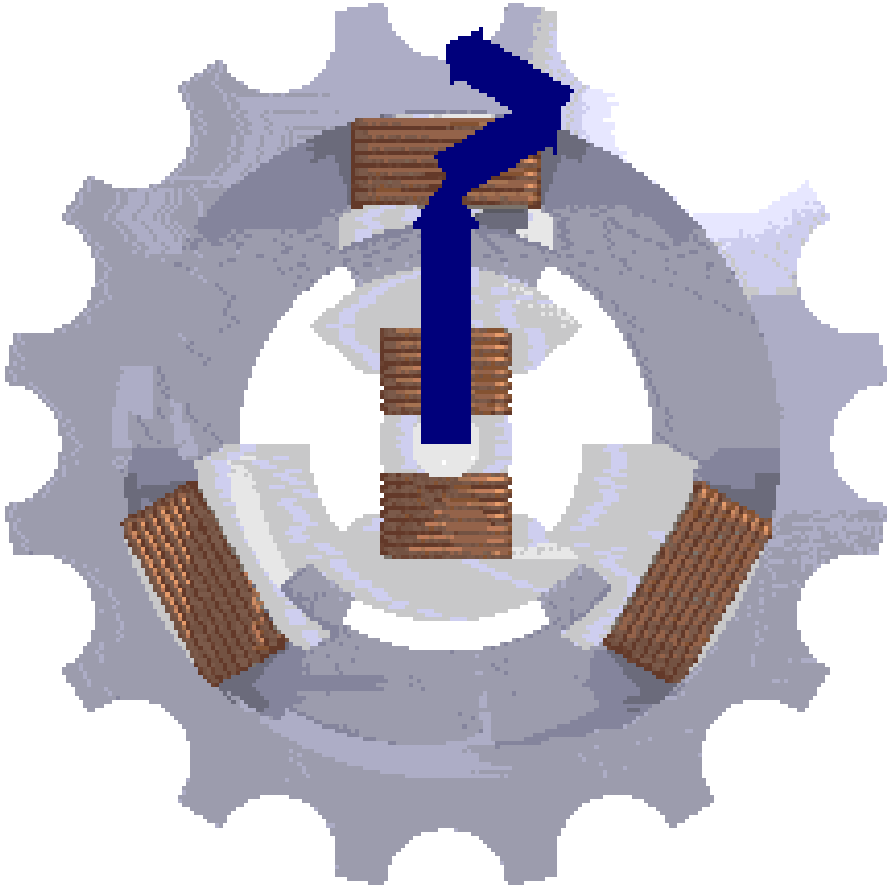
“Software is eating the world”

- Marc Andreessen of *a16z*

Thanks to cheap **batteries** and **renewable** energy, so is **electrical engineering**



Magnetic fields in three phase synchronous or induction machine



Animation: kevmodeler

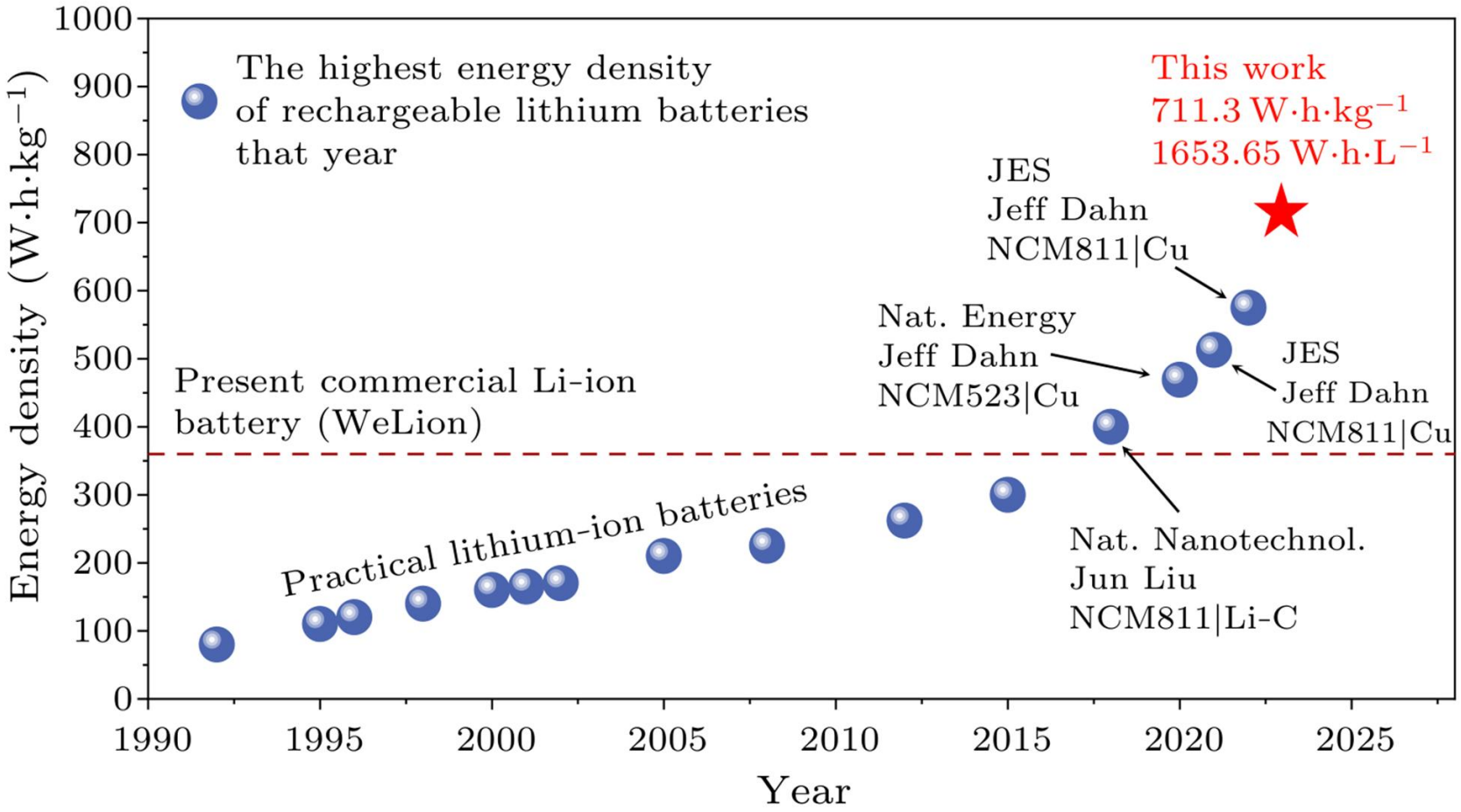


Chart: Quan Li *et al* 2023 *Chinese Phys. Lett.* **40** 048201

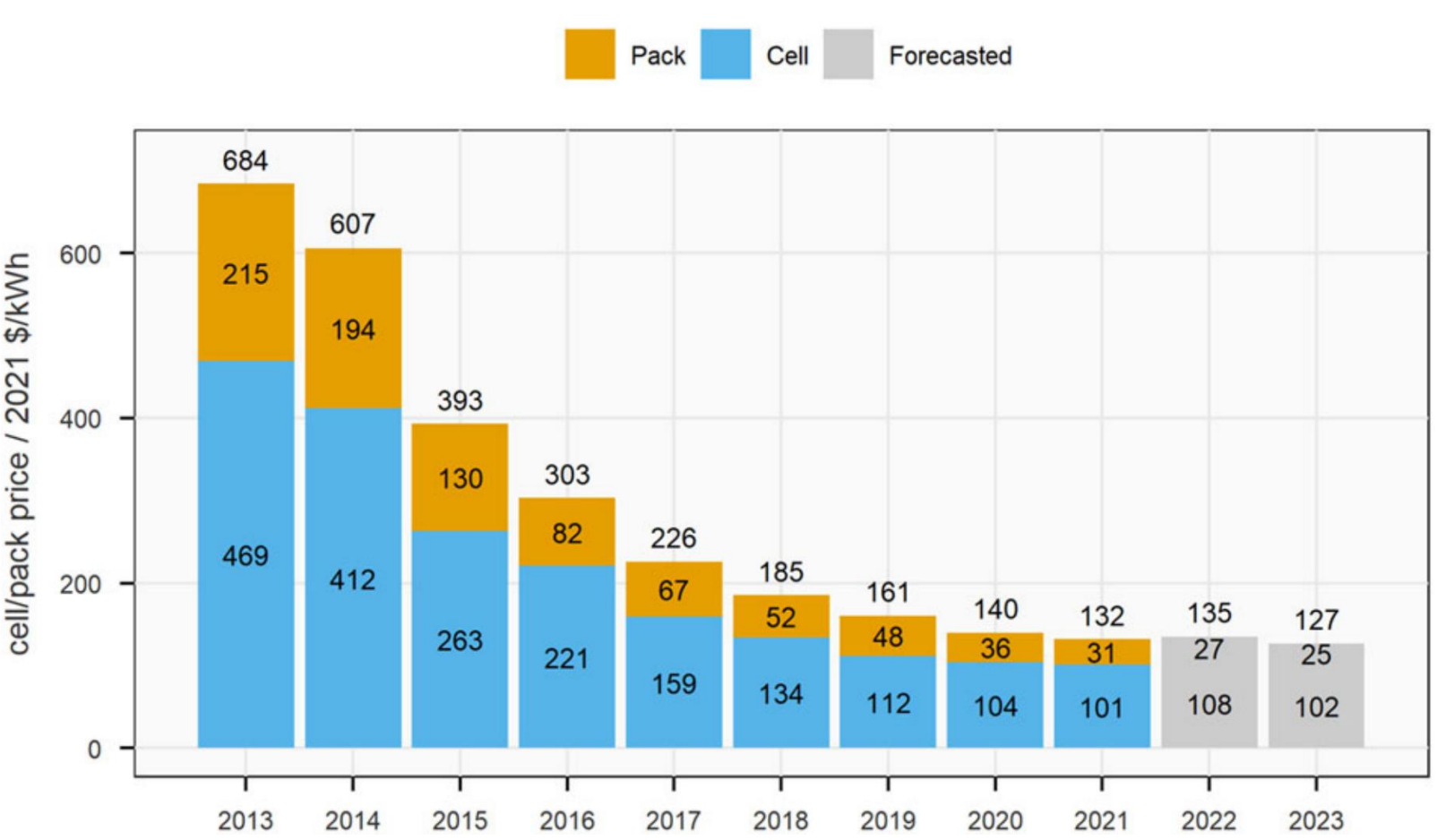
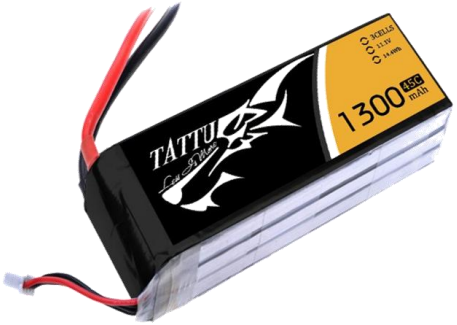


Chart: Frith, J.T., Lacey, M.J. & Ulissi, U Nat Commun 14, 420 (2023).

All transport will be **electric:**



Small, *powerful* three-phase motors

+

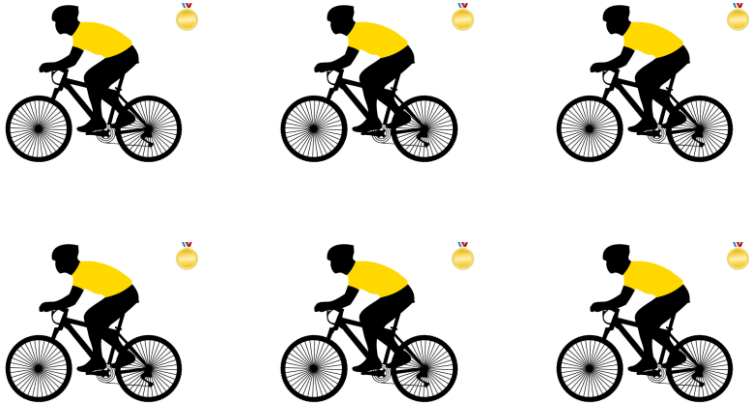
Cheap, *robust* power electronics to drive them

+

Acceptably light, affordable batteries to power them

Motors are **small**, **cheap** and **mighty**:

= 2.4 kW



= 2.4 kW

Legislation approved to allow e-scooters on Irish roads

Updated / Wednesday, 20 Oct 2021 08:31

The bill is due to go before the Oireachtas

By Dyane Connor

The Government has approved a new Road Traffic Bill which legislates, for the first time, the use of e-scooters and e-bikes on Irish roads.

© Raptor Direct Drive Skateboard

© InMotion Electric Unicycle

© Harley Davidson Livewire

© EHang 184 Human Carrying Drone

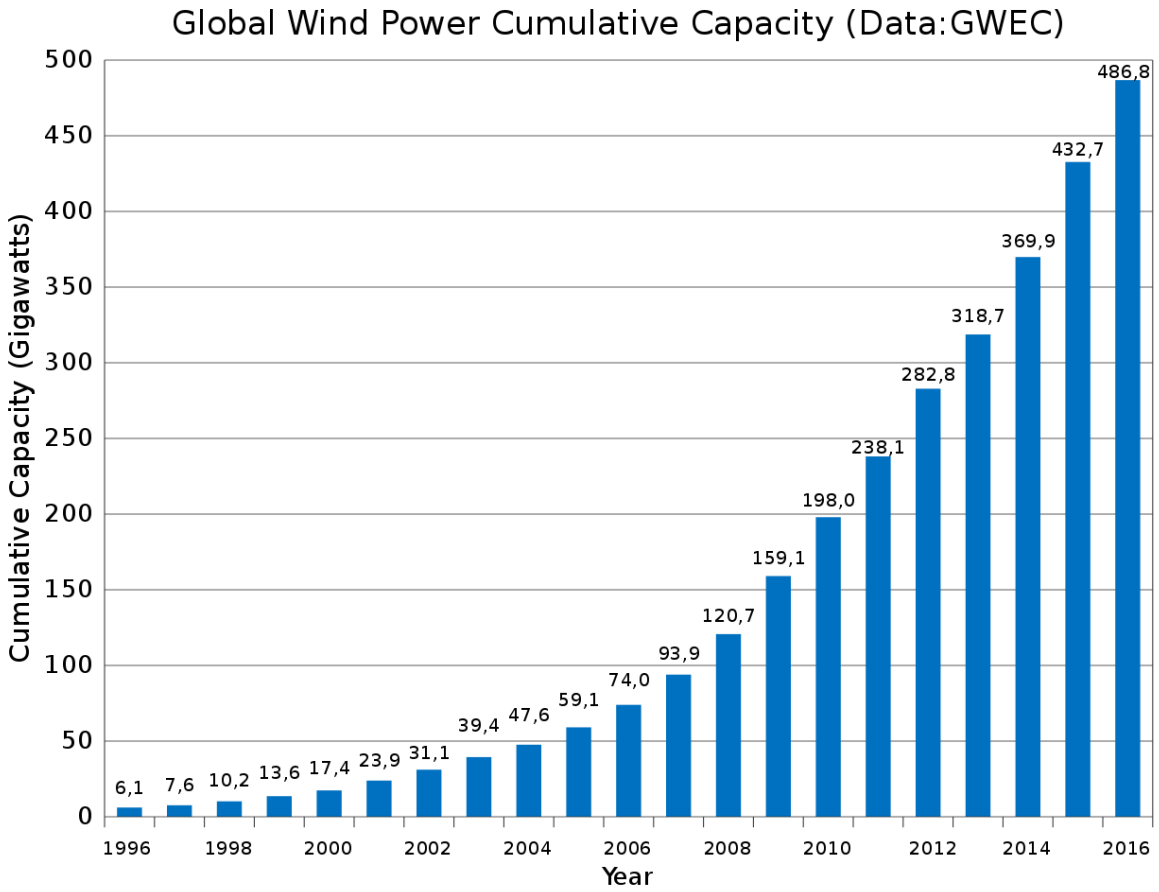

© KittyHawk Cora


© Tesla Model S

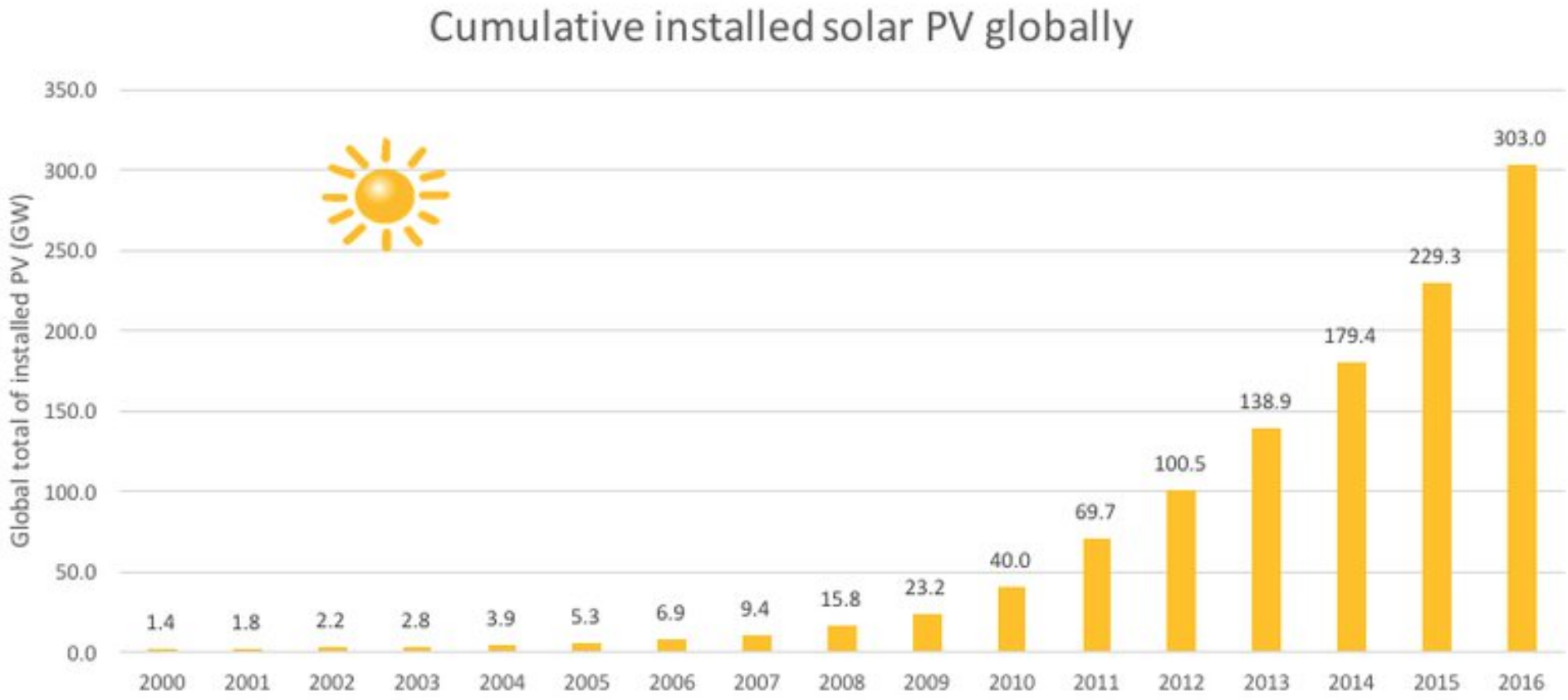
© Ampere battery electric ferry

Class 230 Vivarail D-Train
© Spsmiler

Will need a green grid to charge everything:



Will need a green grid to charge everything:



Source (years 2000-2013): Global Market Outlook for Photovoltaics 2014-2018 (EPIA, 2014), Source (year 2014): Global Market Outlook for Solar Power 2015-2019 (SSE, 2014), Renewables Global Status Report 2017 (REN21, 2017)


© Siemens

Batteries are **cheap** and renewables have **won**

We can’t get the **toothpaste back in the tube**


What future do you believe in?

UCD Energy Institute Real Time Display

Dr. Paul Cuffe
Associate Professor,
UCD School of Electrical & Electronic Engineering
13th November 2025

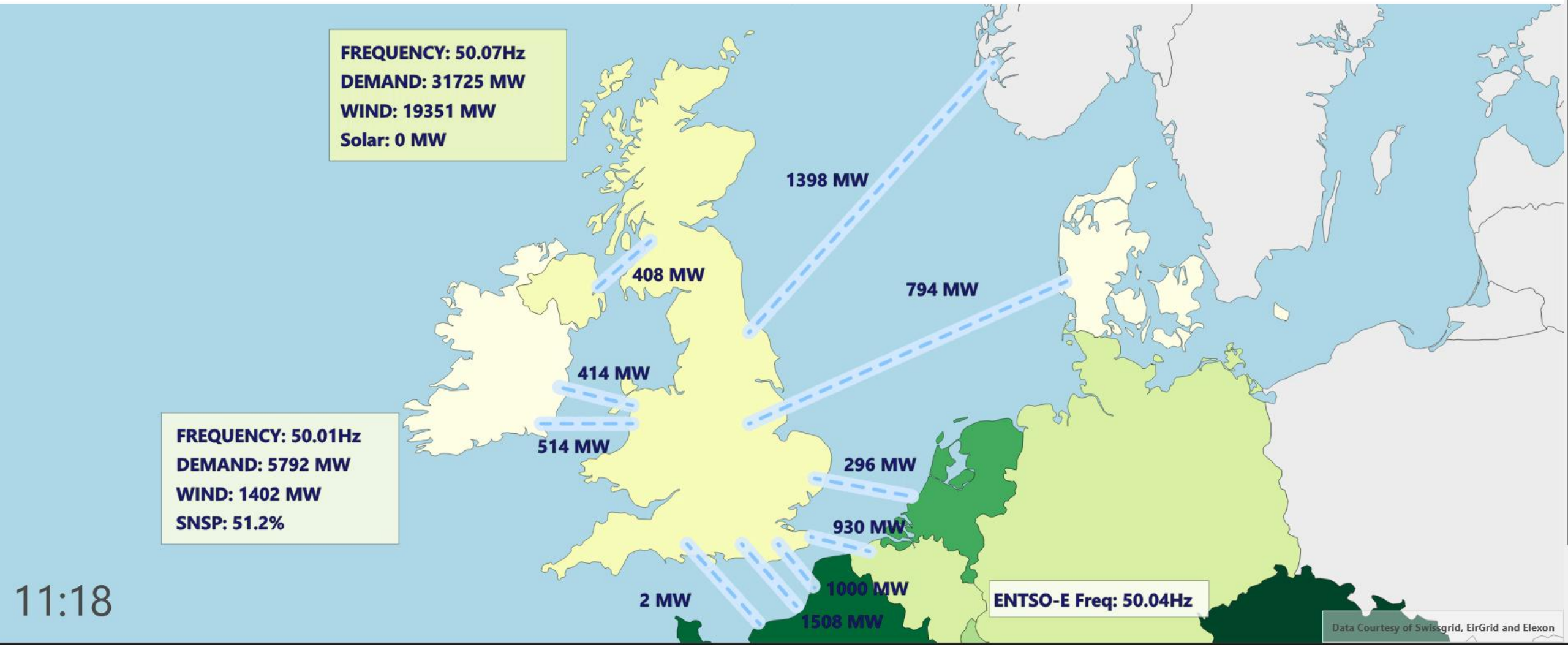
Continental flow monitoring

Cross-border ENTSO-E flows

UCD ENERGY INSTITUTE

UCD Energy Institute Real Time Display

NEXSYS



Continental flow monitoring

Calculate net power exchange vector for each country

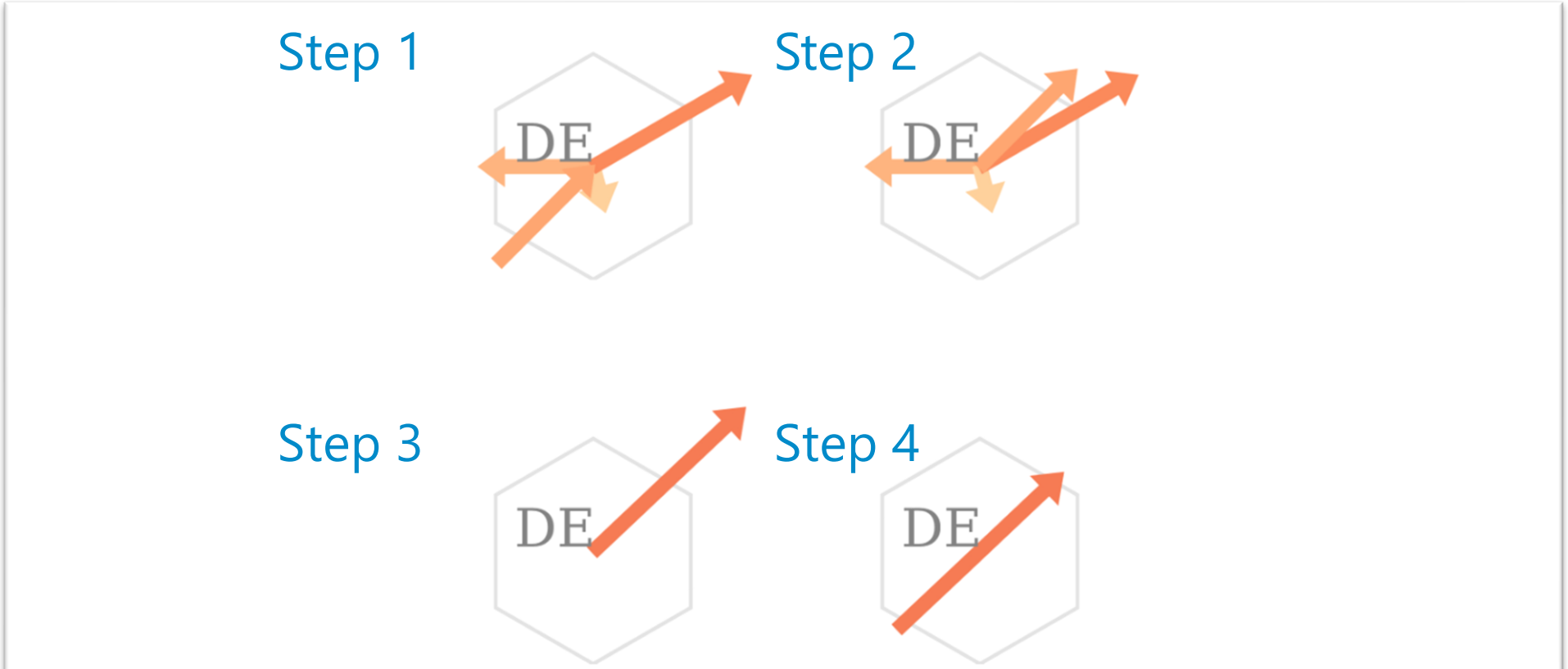
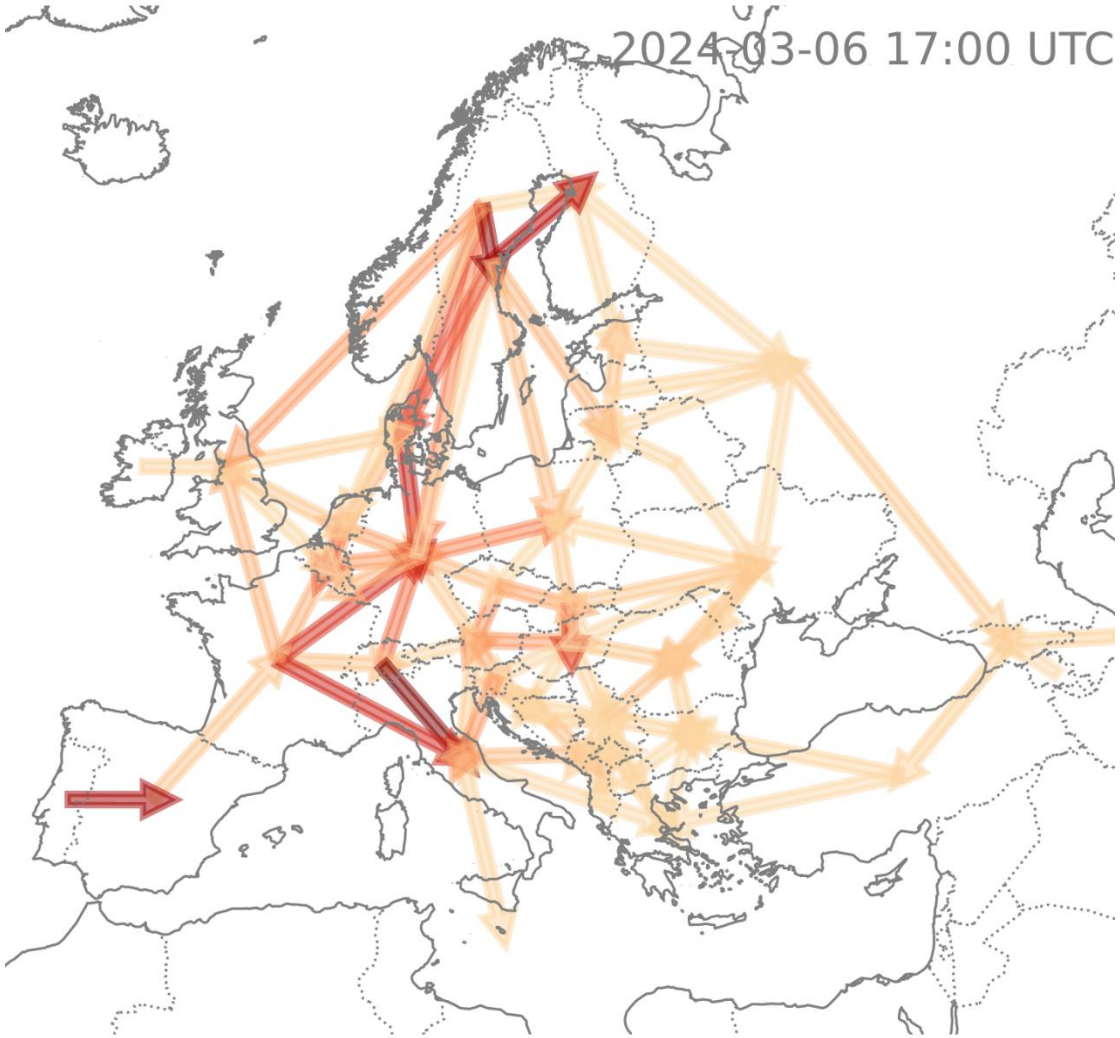


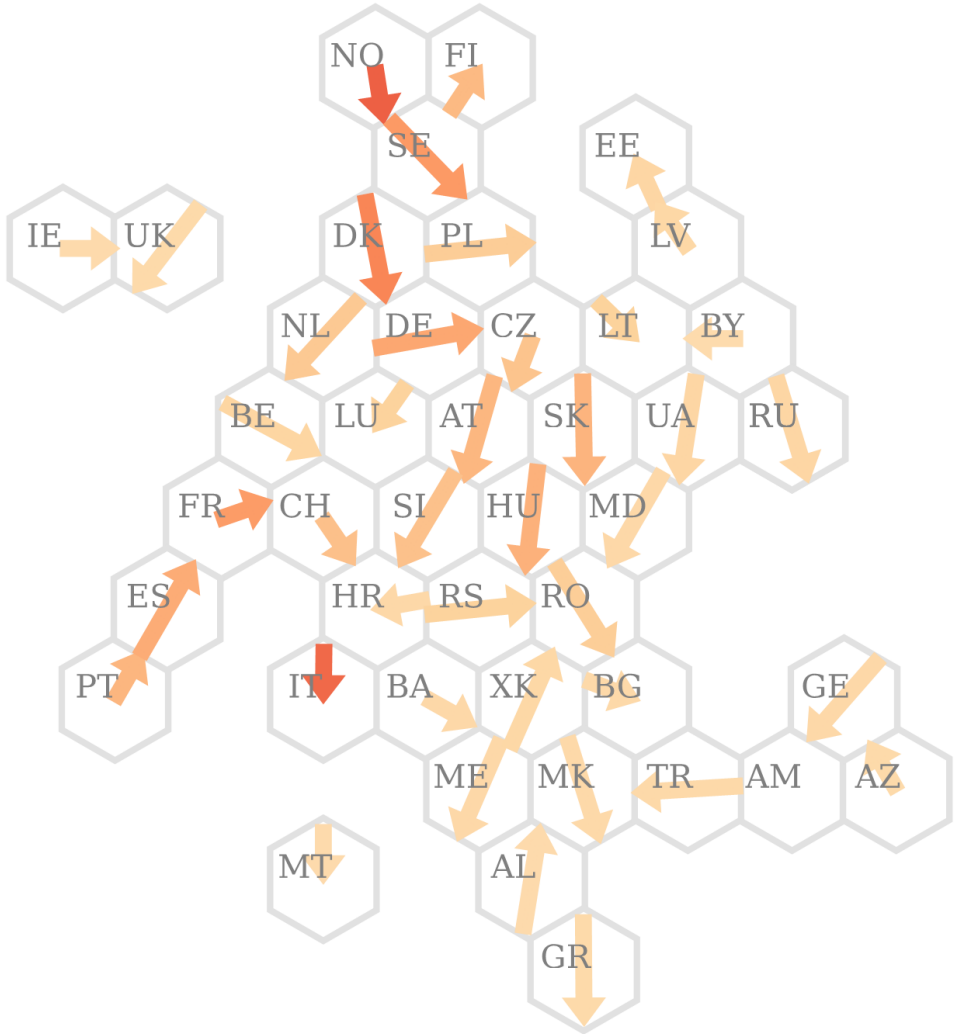
Fig. 3.1. Illustrative breakdown of net vector computation for Germany (DE) using synthetic vector data. The diagram shows (1) raw directional vectors, (2) reoriented import vectors, (3) net vector formed by summation, and (4) its rendered position on the hex map.

C. Kelly and P. Cuffe, "Vector Field Approaches for Summary Visualization of Cross-Border Power Exchanges: Comparing Streamlines and Tessellated Hexagonal Diagrams", IEEE UPEC 2025, (in press)

Continental flow monitoring

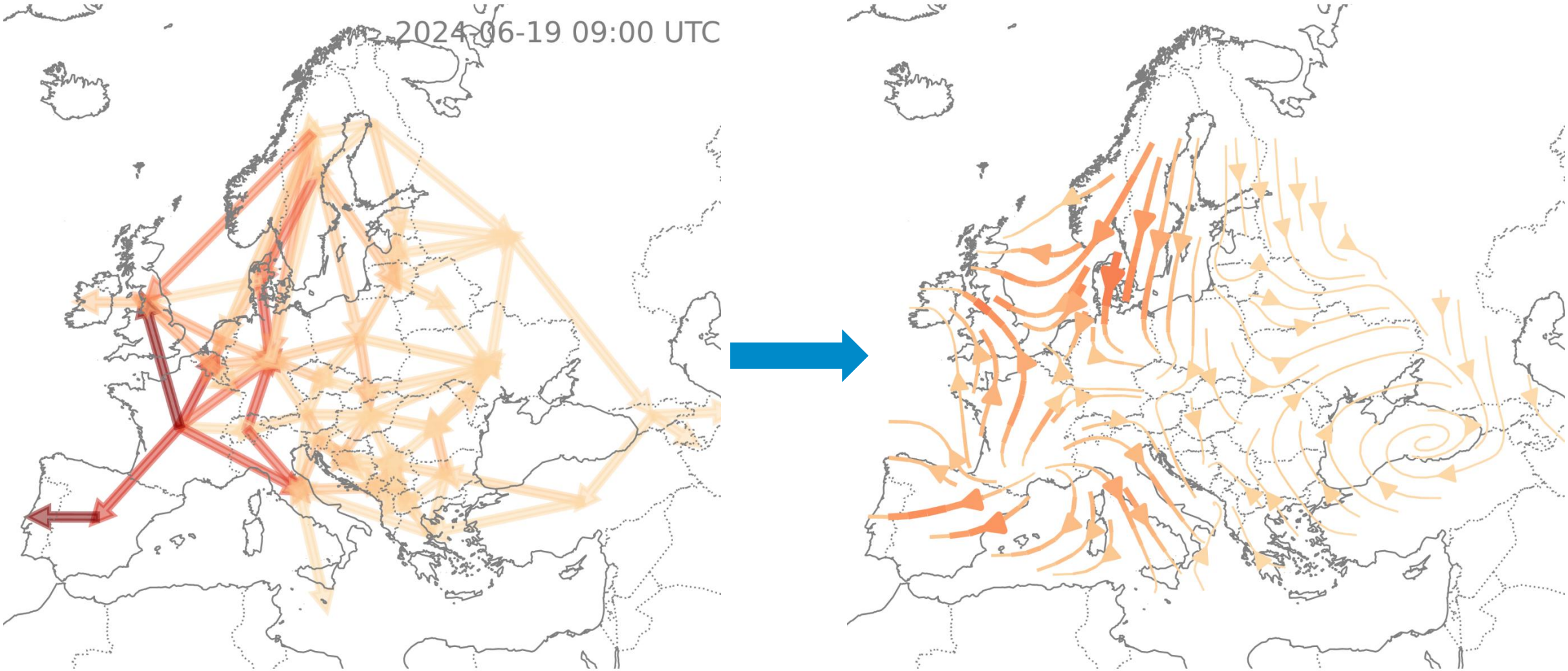
Draw country net vectors within hex tiles





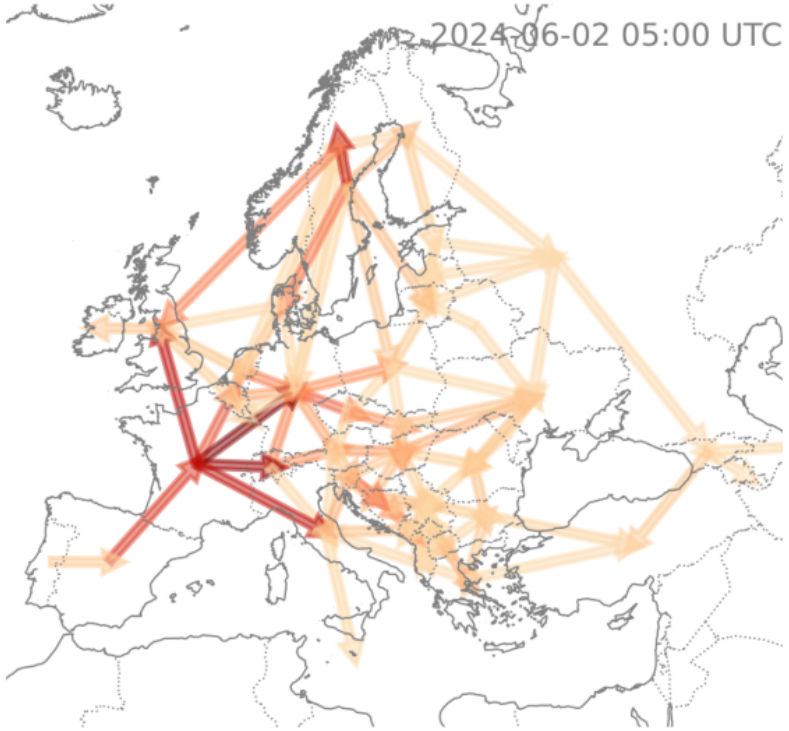
Continental flow monitoring

Use streamlines to interpolate net vectors

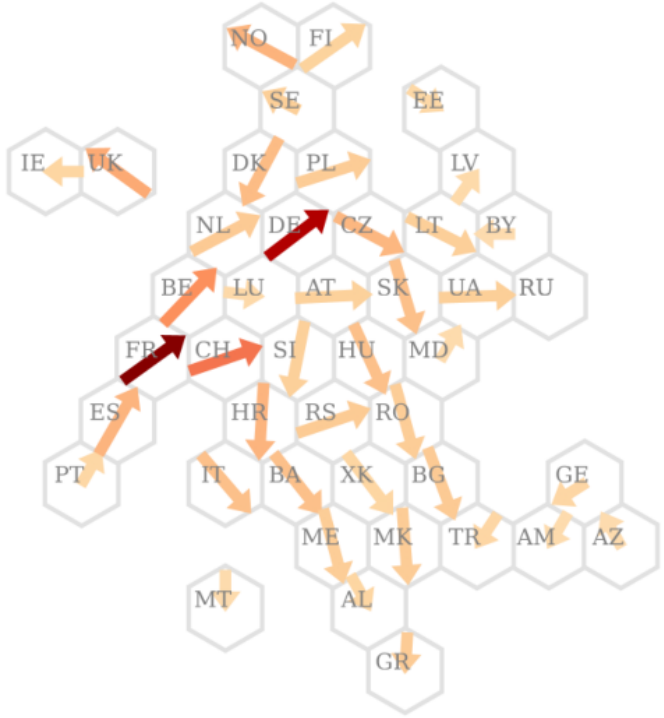


Continental flow monitoring

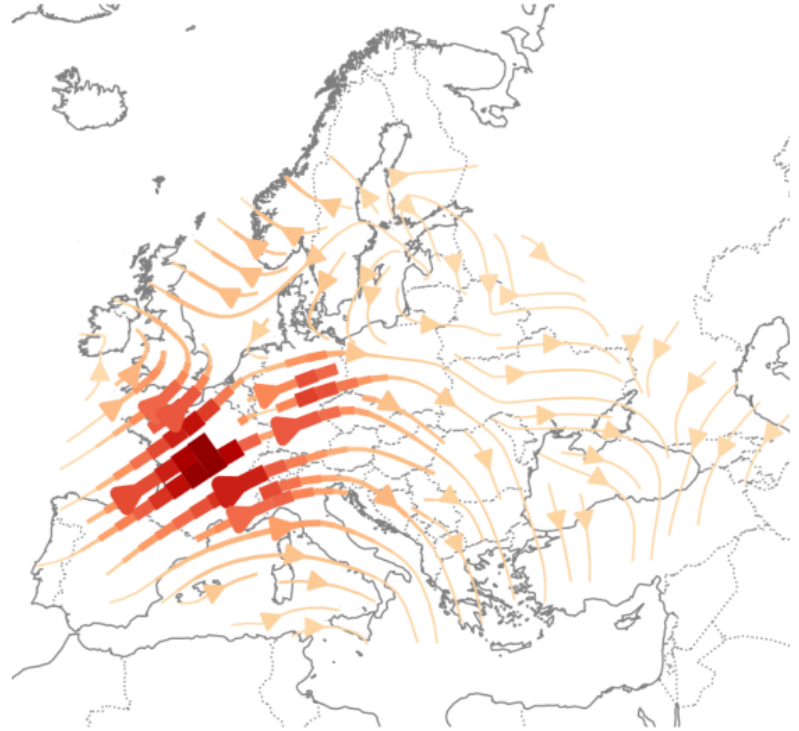
Reference Diagram



HexMap



Streamline



Continental flow monitoring

Finding recirculating flows

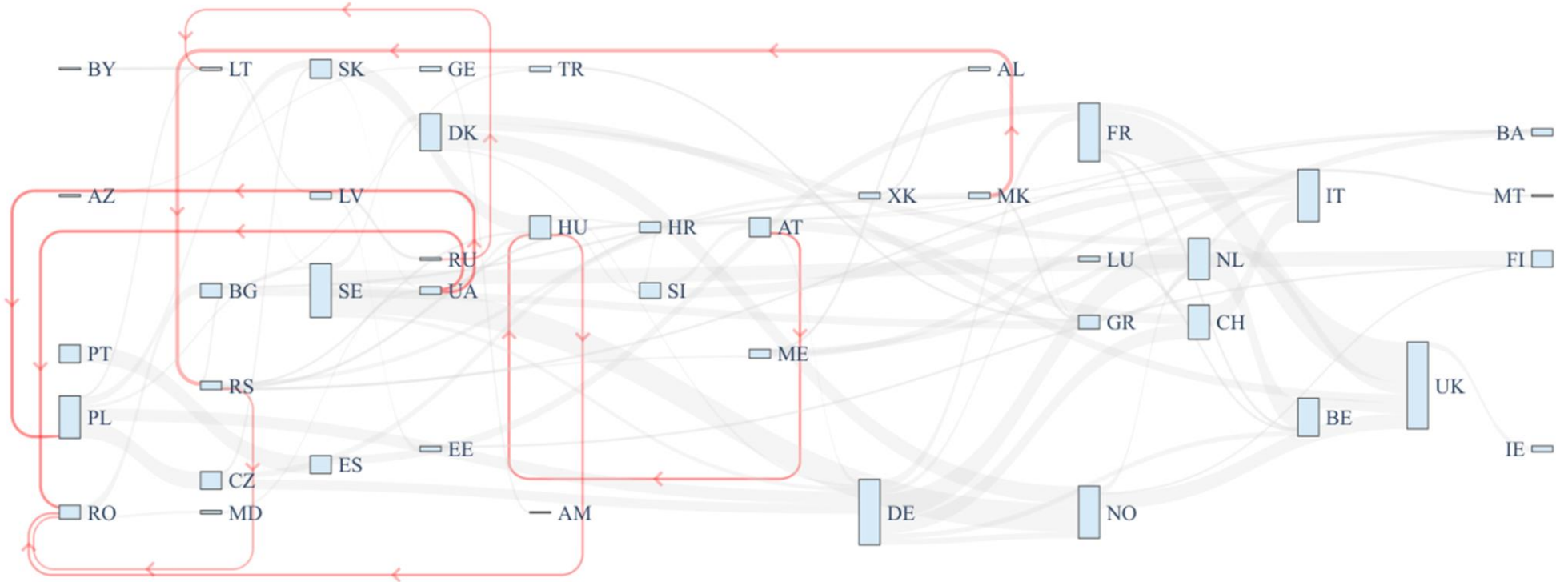
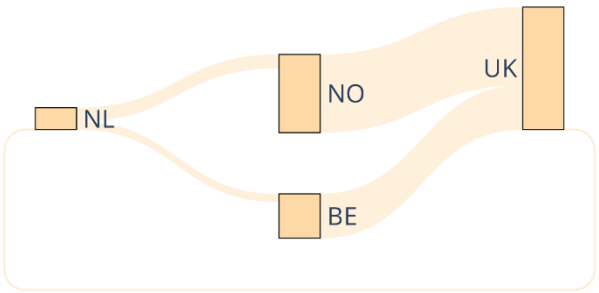
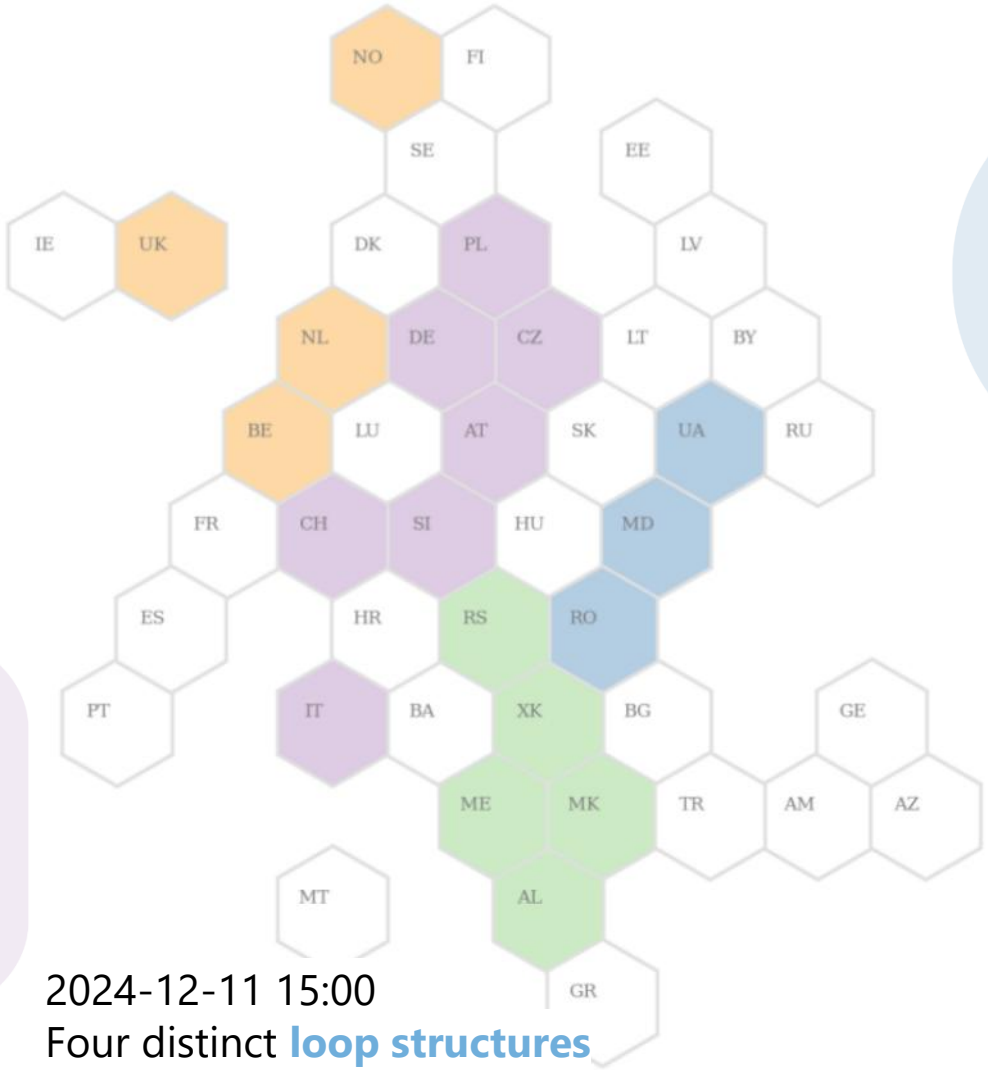


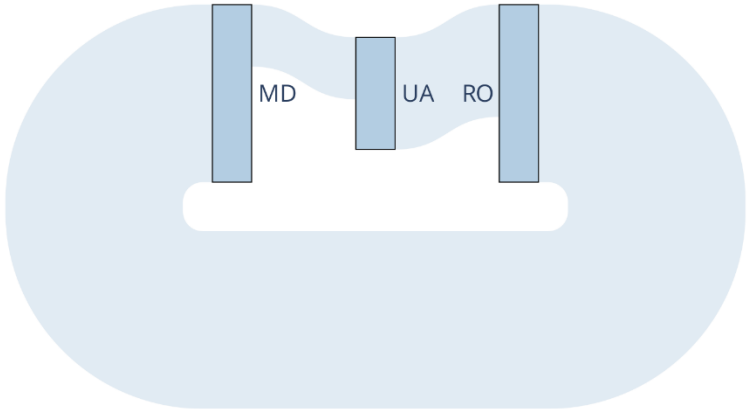
Fig. 4.3. Sankey diagram of cross-border energy-exchanges happening in Europe for one hour; `2024-03-11 00:00:00`. There were 43 countries trading energy, 26 of which can loop back to themself. Highlighted in red is the feedback arc set. If these edges are removed, the graph will become acyclic, and there will be no self-reaching nodes. Power flows from left to right, apart from the feedback arc set, which have an opposite flow.

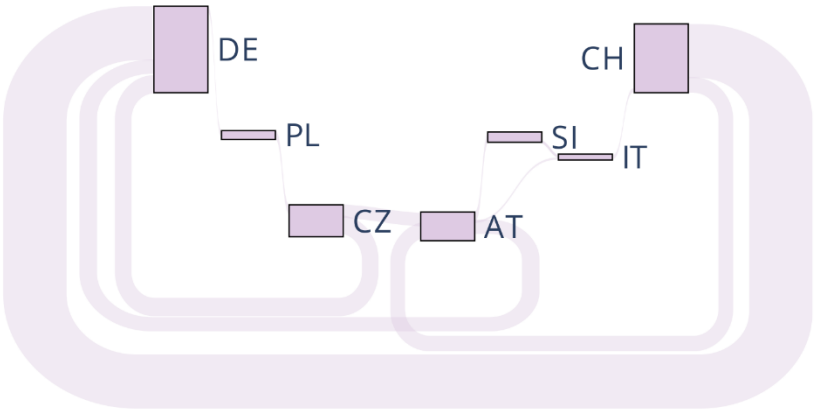
Continental flow monitoring

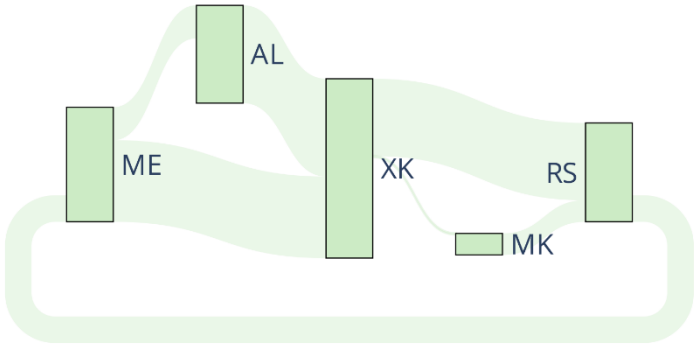
Finding recirculating flows











2024-12-11 15:00

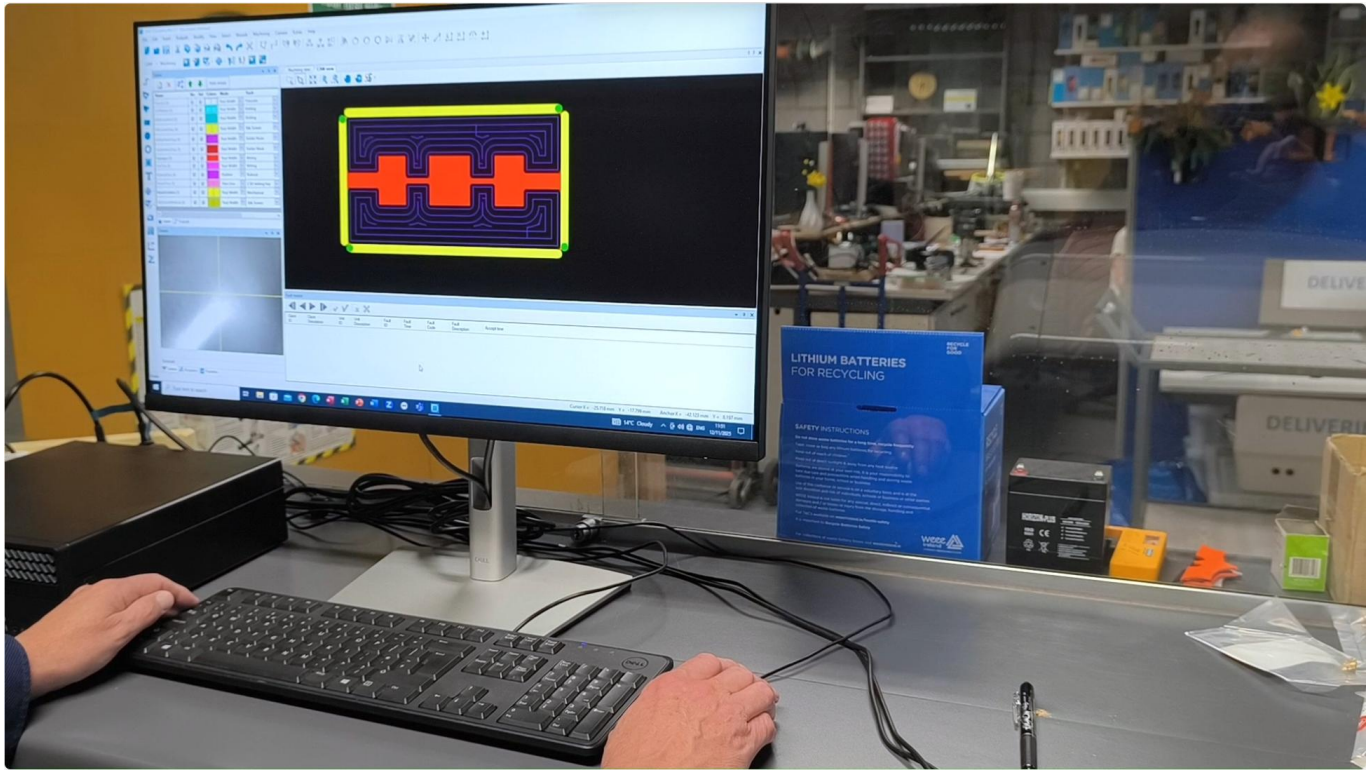
Four distinct **loop structures**

Many thanks!

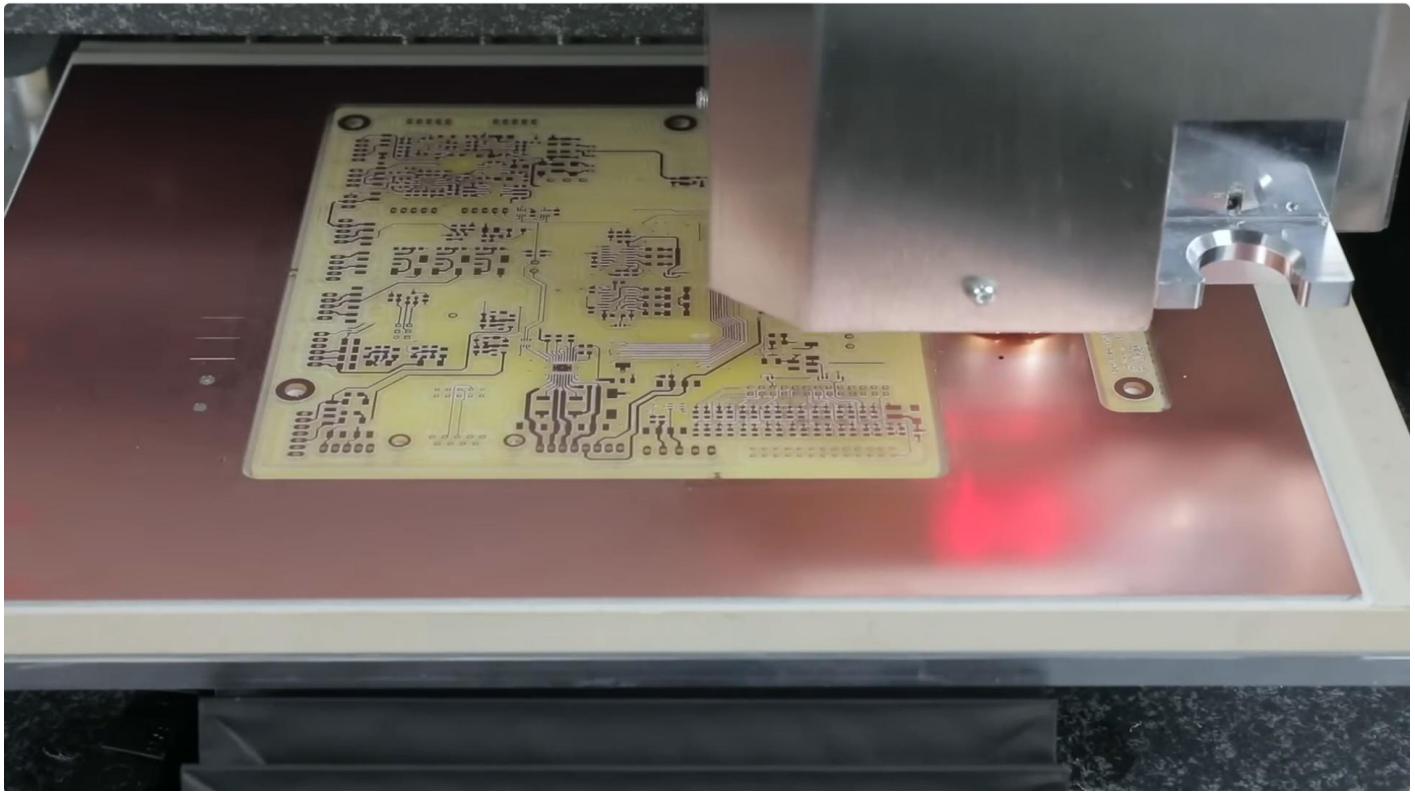
paul.cuffe@ucd.ie

Dr. Paul Cuffe, Associate Professor, UCD School of Electrical & Electronic Engineering

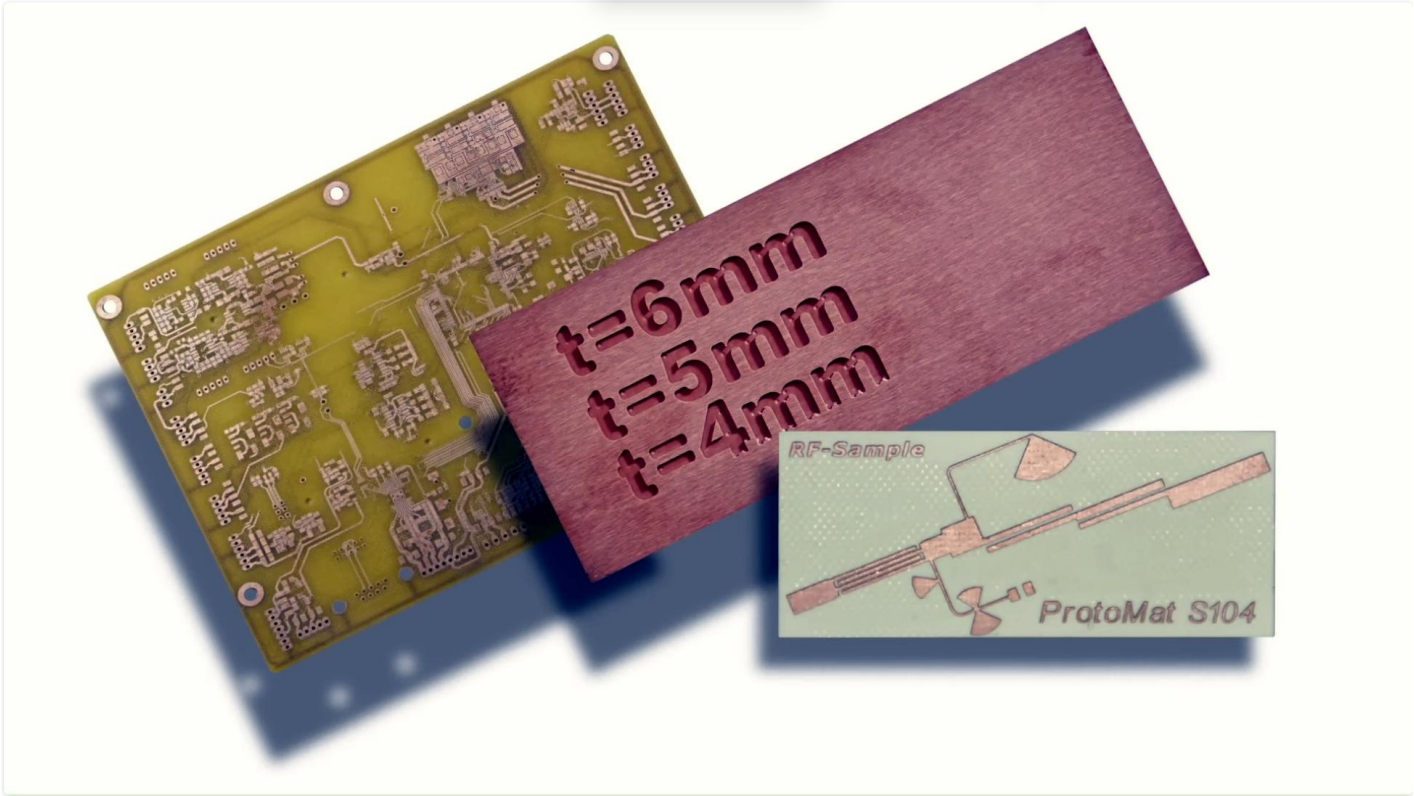
Electrical and Electronic Workshop



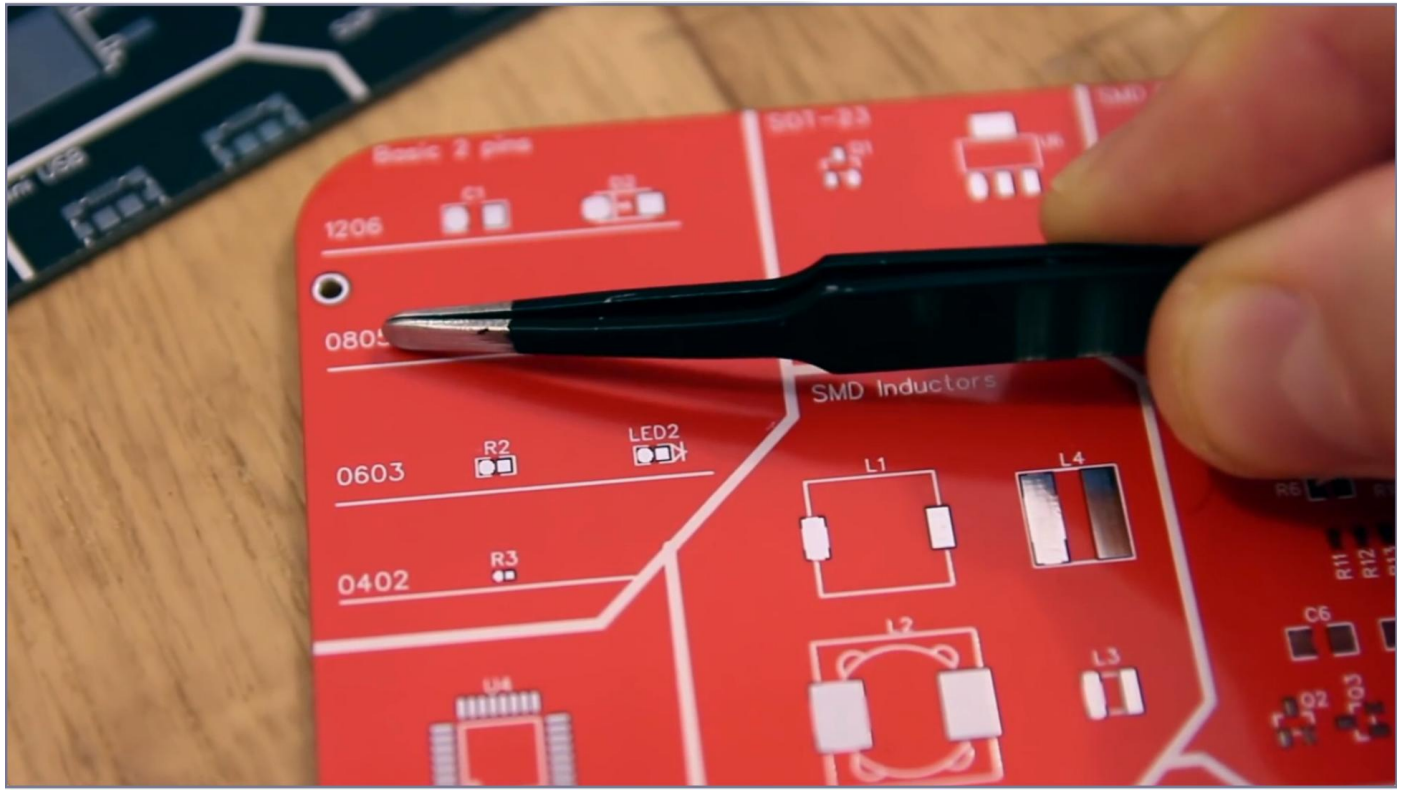
Electrical and Electronic Workshop



Electrical and Electronic Workshop

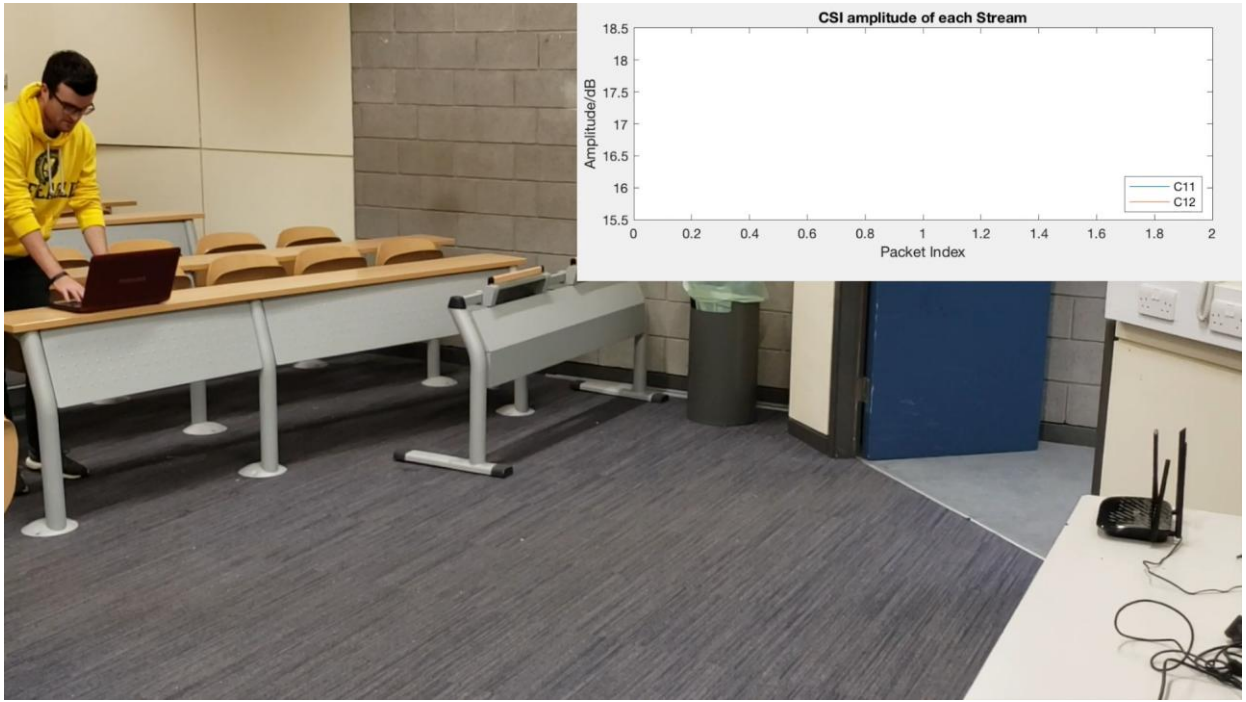


Electrical and Electronic Workshop



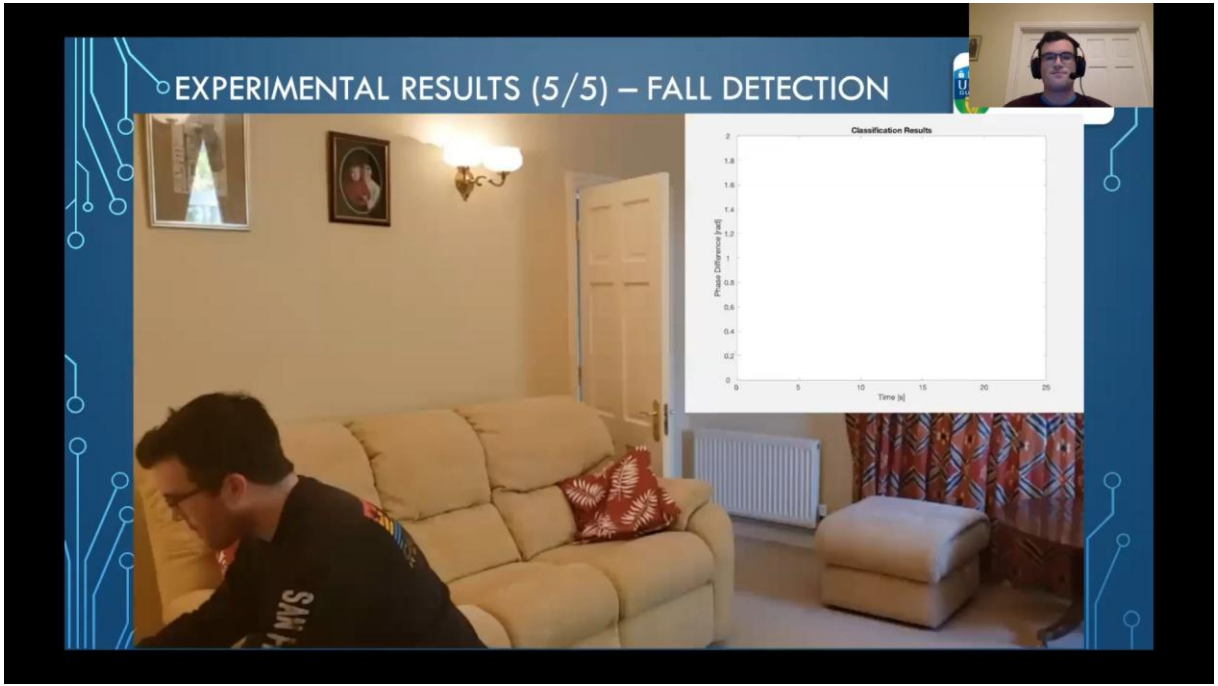
A Selected Demonstration of an ME project

- Uses Wi-Fi systems for fall detection.



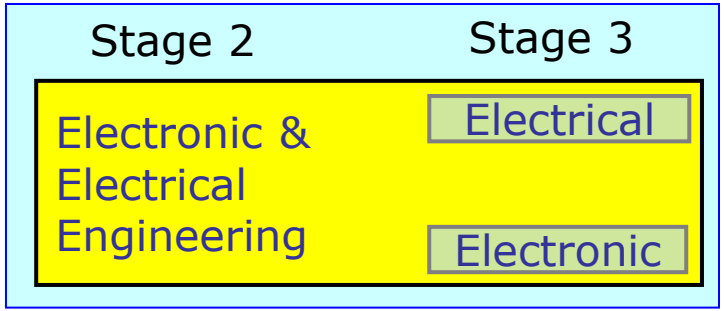
A Selected Demonstration of an ME project

- won the **Best Student Experimental Paper Award** at IEEE PIMRC 2020, London, UK.



EE Programme Overview

- Stage 2 is common
  - Fundamentals of Electronic & Electrical Engineering
- Specialisation in Stage 3
  - choose options for electrical engineering or for electronic engineering
- At the end of Stage 3
  - Continue towards BE (bachelor of engineering)
  - Enter ME (master of engineering) programme
  - graduate with BSc (Engineering Science)



ME Programmes

- Two years of study in your chosen field
  - making five years in total
  - includes a major project at Master level (20-25 credit)
  - includes a work placement (usually 7 months, 30 credit)
- Entry requirement
  - based on stages 2 and 3, weighting factors 3 and 7
  - minimum GPA 2.8 (equivalent to C grade)

Highlights

- Tackle real-world problems that shape the future
- Develop both technical and soft skills
  - Carrer development classes are integrated across all stages
- Opportunity to study abroad in Stage 3
- Gain industry experience with leading companies (for ME programmes)
- Continuous assessment kept minimal and synchronised across all modules
- Access dedicated support from the Workshop
- Wide range of scholarships available
- Huge job opportunities with high pay for EEE graduates nationally and globally