# Annual Report 2023-2024 Academic Year






## Sustainable Hydrogen

CENTRE FOR DOCTORAL TRAINING


**Email:** sushy@nottingham.ac.uk
**Website:** www.sustainablehydrogen-cdt.ac.uk







University of Nottingham UK | CHINA | MALAYSIA

Loughborough University

UNIVERSITY OF BIRMINGHAM

Ulster University

UKRI Engineering and Physical Sciences Research Council

## Sustainable Hydrogen Centre for Doctoral Training (SusHy CDT) established in 2019.

The Centre is the first UK hydrogen energy CDT, selected through the £446 million CDT call from the Engineering and Physical Sciences Research Council (EPSRC) aimed at tackling pressing global challenges. SusHy CDT has **four** partner universities – **Nottingham, Loughborough, Birmingham and Ulster** – and **four** overarching Centre objectives (see **Vision** below).

We recruited a total of 68 talented individuals to our CDT, which is providing high quality, multi-disciplinary training to achieve mass uptake of hydrogen technologies in the UK and beyond. As of October 2024, having recruited five cohorts of students, they work on hydrogen combustion, distribution, production, safety, storage, systems and upgrade. The CDT is supported by the EPSRC and over 50 Stakeholder partners.

# Our Vision

In-line with the UK's commitment to reduce emissions by **78% by 2035** and achieve **Net Zero by 2050**, we're developing hydrogen technologies facilitating deep-decarbonisation.

### Sustainable Hydrogen CDT's objectives:

- Deliver high quality trans-disciplinary training - covering fundamental science, applied engineering, and systems issues - and build an appreciation of societal barriers to innovation.
- Through innovation opportunities, build initiative and stimulate an entrepreneurial mindset.
- Deliver 'industry ready' doctorates, who have a comprehensive skill set and experiences.
- Co-create research ideas and undertake, in partnership with our stakeholders, cutting edge investigations of hydrogen-based solutions to deep decarbonisation of the energy system.

## Contents



# Executive Summary

SusHy CDT completed its recruitment last year. In total we recruited 68 students since the start of our programme in 2019. Our commitment to recruiting diverse cohorts was very successful. 43 % of recruited students identify as from ethnic minority communities. 32 % of all cohorts recruited identify as female and 16 % of recruited students identify as part of the LGBTQIA+ community. Examples of the SusHy CDT's efforts to create a supportive and inclusive environment for students can be found in the EDI section.

Our students have been researching into different aspects of sustainable hydrogen from production, upgrade and storage to distribution, combustion, systems and safety. As of October 2024, our students across the four partner Universities have published 29 scientific papers in total and presented their research at more than 34 events. Examples of publications and presentations can be found in this Report.

Our students have also participated in a number of public engagement activities throughout the year (examples on page 14) including running a hydrogen stall at Glastonbury Festival's Science Futures Field and Green Man Festival' Einstein Garden, bringing hydrogen education to the general public. SusHy students also contributed to the outreach activities as part of Pint of Science events at Nottingham and Loughborough.

This year, National Gas Transmission set a stakeholder challenge activity for our Cohort 4 and 5 students, in understanding the impact of variable hydrogen blends within the National Transmission System (NTS). The SusHy students visited the FutureGrid high-pressure test facility at DNV Spadeadam and worked in teams of 5 – 6, researching how natural gas with an increased hydrogen content of up to 20% will flow around the NTS. We also had two stakeholder workshops during the 2023/2024 academic year, including insightful talks from a wide range of hydrogen experts. More details can be found in the Stakeholder workshops section in page 10.

The annual SusHy CDT research conference was held in April 2024 at Ulster University where cohort 2 and 3 students gave a talk about their research activities and cohort 4 students presented their research posters. Cohort 5 students attended the Power Trader Workshop, working in teams to run an energy company in a simulated electricity market, where they were responsible for sourcing and delivering power to customers by running generation facilities and trading with other teams. SusHy CDT also organised a training course in Effective Presentations and Posters followed by cohort building activities at University of Nottingham.

We are proud to announce that our first students completed their PhD journey this year, including 7 students from Cohort 1 and 2 students from Cohort 2. Our alumni started their new roles in a range of different fields, from a research associate position at academia to working as a systems engineer, technology expert and analysist, scientist and project manager at industry. Employers included Energy Systems Catapult, University of Nottingham, Cambridge Display Technology, BeZero Carbon, WSS Energy Consulting and Ulster University. We wish all the best to our alumni with their new roles.

As we reflect on our achievements, we'd like to thank all of our students, stakeholders, and partners for a truly excellent year in the SusHy CDT. We look forward to another year of SusHy CDT events.

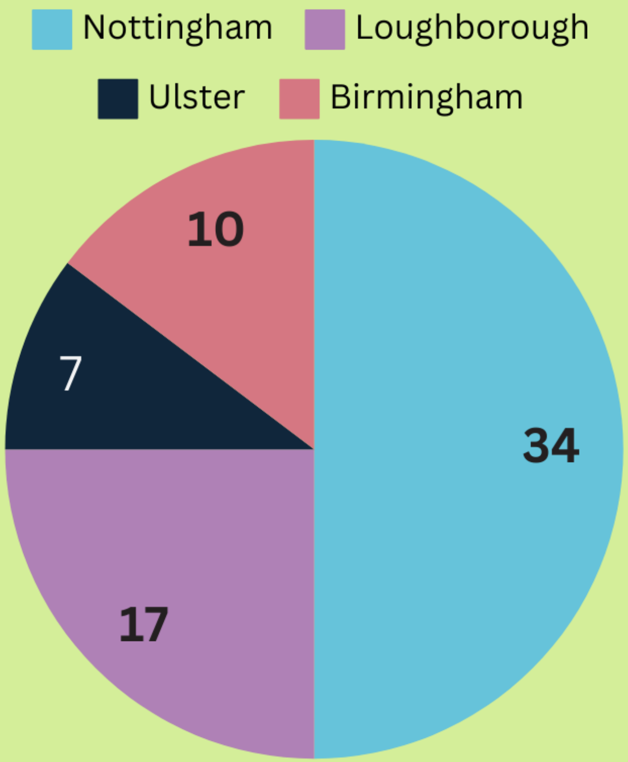
# Sustainable Hydrogen CDT Numbers
(as of October 2024)

Publications and presentations by CDT students

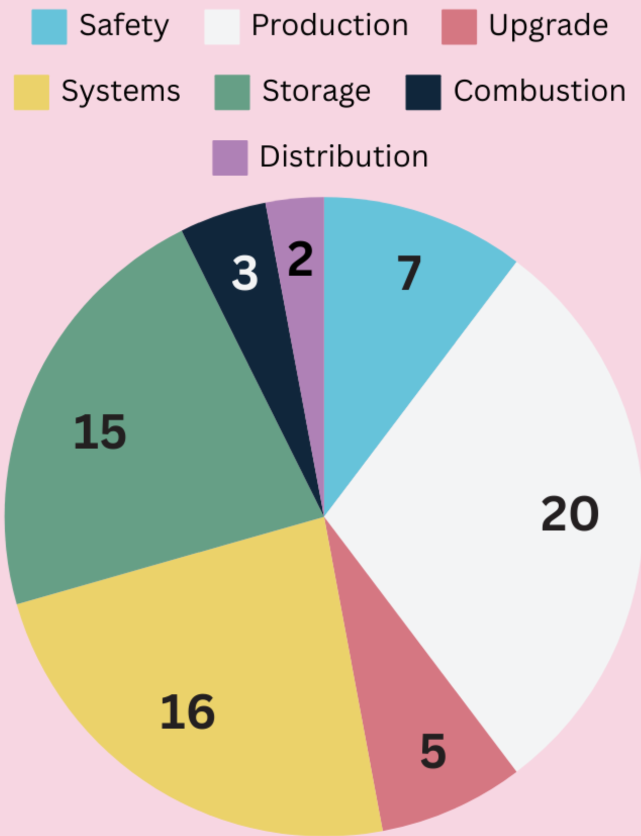
29

34

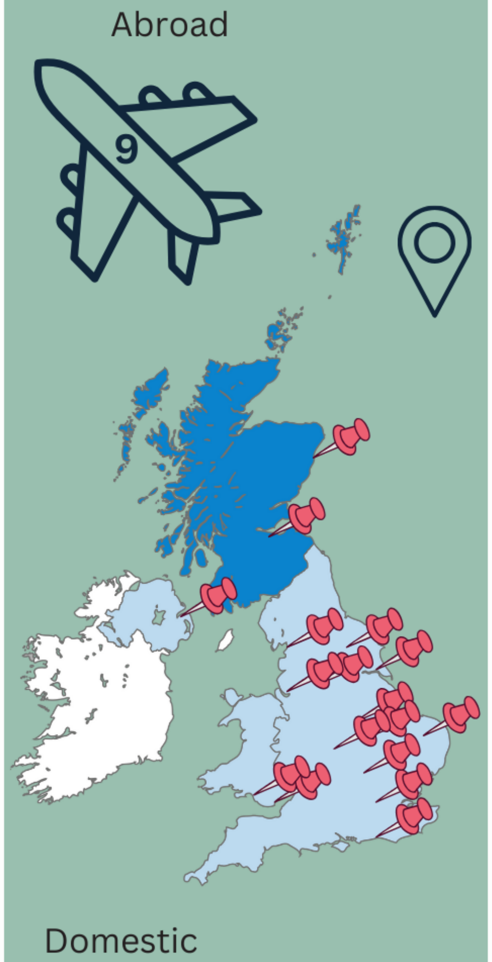
## Where our CDT students are based, as recruited:




## Research themes by number of students, as recruited:




## Where they previously studied:



# Equality, Diversity and Inclusivity (EDI)

women's engineering society

WISE

SusHy CDT aims to train the energy leaders we need to meet the Net Zero global challenge. We have put EDI at the heart of our operations and recruited amazing individuals from a diverse talent pool. We seek to provide and continuously improve our supportive environment, where everyone feels equally valued and able to achieve their full potential.

**EDI activities organised or supported by SusHy CDT during the 2023/24 academic year:**

- EDI induction training for the latest cohort
- Imposter phenomenon workshop
- Celebrating Women in STEM event
- Neurodiversity training session
- Men's Mental Health session
- Various cohort building activities

**16%** of recruited students identify as part of the LGBTQIA+ community

**43%** of recruited students identify as part of ethnic minority community.

**32%** of recruited students identify as female.

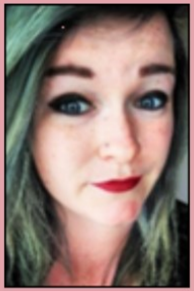
**We create a more inclusive environment with:**

- Our student EDI forum (monthly EDI catch ups with the CDT team) and the EDI student representatives at Management Board meetings, giving students influence on CDT EDI policy and opportunities to deal with issues.
- The 'Buddy Scheme', an idea from CDT student Mickella Dawkins, matches current with new intake students, to ease any stresses or concerns around beginning a PhD.
- The EDI Access Fund financially assists students if they have disability, mobility or domestic (childcare) needs, which might otherwise prevent participation in activities.
- Our newsletters and social media posts reflect CDT gender and cultural diversity, and back relevant advocacy dates, including but not limited to Black History Month in October, International Women Day in March and Pride Month in June.
- SusHy CDT is a proud partner of the Women's Engineering Society (WES) and Women Into Science and Engineering (WISE), and provides free membership for students.

# SusHy CDT Team

Sanliang Ling,
CDT Director

Gulcan Serdaroglu,
Programme Manager



Esther Little,
Administrative Officer

Ella Crowther,
Marketing Officer

**Contact details:**

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esther.little@nottingham.ac.uk

ella.crowther@nottingham.ac.uk

# SusHy CDT Management Board

## University of Nottingham
UK | CHINA | MALAYSIA

**Associate Professor Sanliang Ling**
Director

**Assistant Professor Annabel Lanterna**
Co-Director

**Professor Deborah Kays**
Co-Director (previously at Nottingham, now Cardiff)

## Loughborough University

**Professor Dani Strickland**
Co-Director

**Professor David Saal**
Co-Director

**Professor Wen-Feng Lin**
Co-Director

**Professor Upul Wijayantha**
Co-Director (previously at Loughborough, now Cranfield)

## University of Birmingham

**Professor David Book**
Co-Director

**Dr Daniel Reed**
Co-Director

**Professor Lynne Macaskie**
Co-Director

**Dr Rafael Orozco**
Co-Director

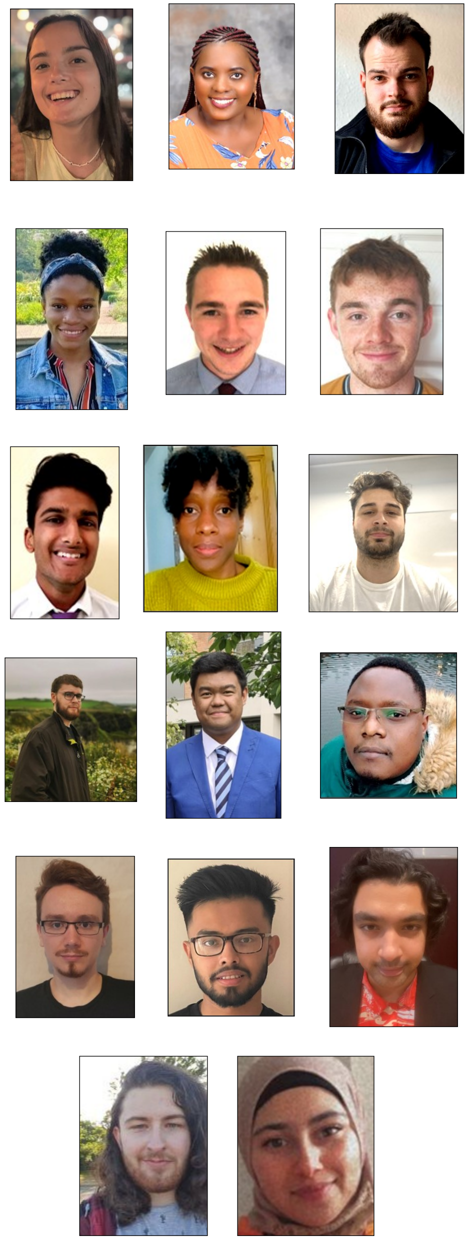
## Ulster University

**Professor Vladimir Molkov**
Co-Director

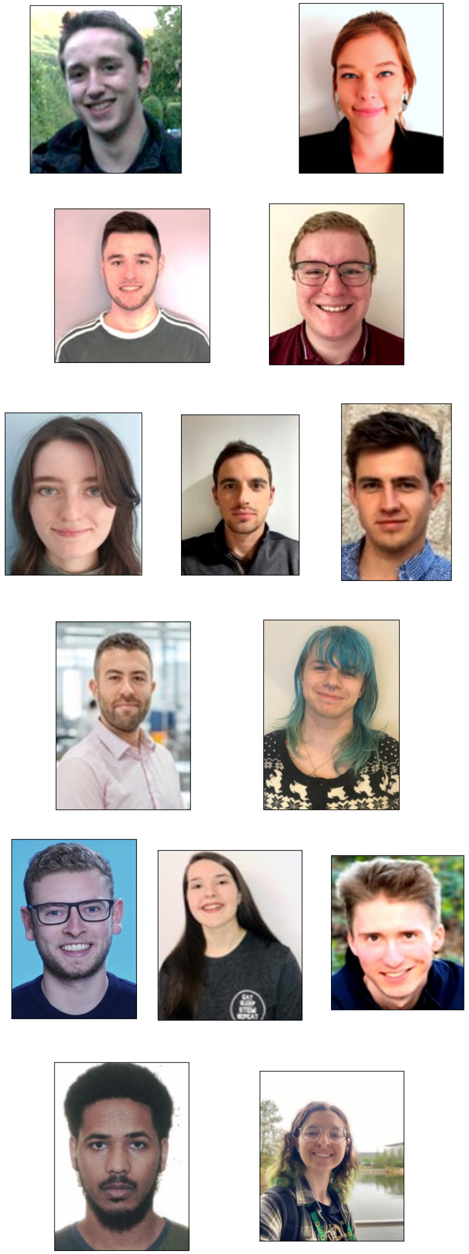
**Professor Dmitriy Makarov**
Co-Director

# Our Students

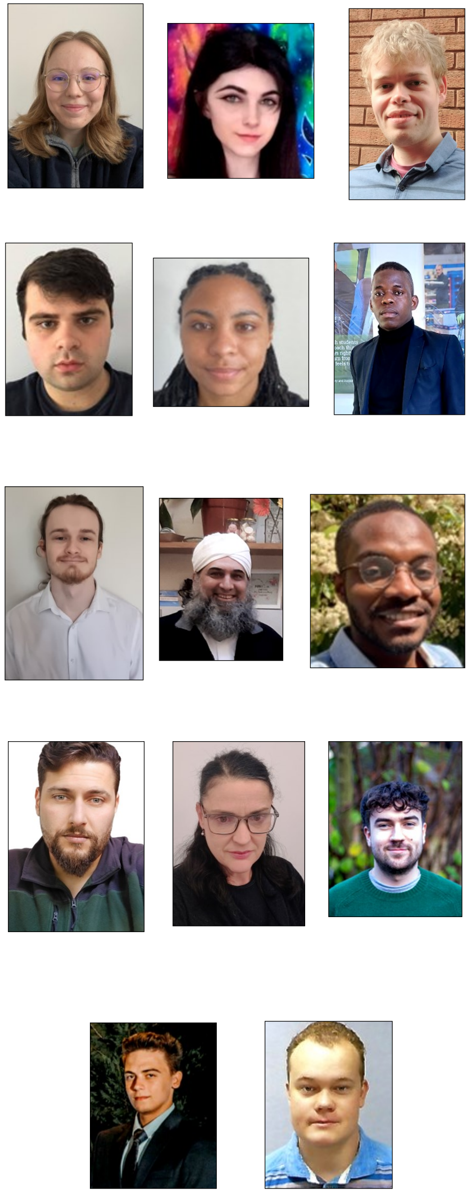
## Production



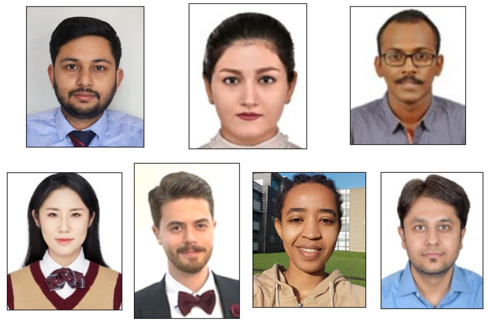
## Storage



## System



## Safety



## Distribution

## Combustion

## Upgrade

# Stakeholders

We work with 50-plus partners and stakeholders including energy providers, researchers, UK government and engineering consultancies. Such links are vital as the CDT pursues its four overarching objectives; particularly, delivering 'industry ready' doctorates and co-creating research ideas in collaboration with stakeholders. A Stakeholder list is at: www.sustainablehydrogen-cdt.ac.uk/stakeholders/stakeholders.aspx

## Stakeholders Supporting PhD Projects:

**Sustainable Hydrogen CDT** gratefully acknowledges those stakeholders collaborating on students' PhD projects, ensuring our research is answering those questions the hydrogen sector needs to further develop.

SusHy CDT students are supported to carry out secondments/placements with stakeholders to gain industry experience and understand the real sector requirements.

## Secondment at Saudi Aramco

Cheryl Duke (University of Nottingham) carried out an industrial placement with her PhD sponsor Saudi Aramco with their Aramco Fuel Research Center located in Rueil-Malmaison, Paris. The focus of this work was on conducting a combined lifecycle assessment (LCA) and lifecycle cost (LCC) model of hydrogen-fuelled SUV powertrains – including novel technologies such as hydrogen internal combustion engine (H-ICE) and fuel cell range extended (FCREx) vehicles. A technology-level LCA/LCC model was developed to quantify the environmental and cost impacts associated with each lifecycle stage. The developed model is currently being integrated into Saudi Aramco's fleet model to further enhance the analyses from a single-vehicle level to an entire fleet.

## Secondment at ARUP

Adedayo Dada (University of Nottingham) carried out an industrial placement with the Decarbonisation Team at ARUP Ltd from 3 June - 12 July 2024. This placement involved working as an energy consultant with the Sheffield, Manchester and Leeds sub-teams on several projects across the public and private sectors. Dayo also provided technical summaries on the chemistry behind hydrogen production technologies for senior consultants transferring to the Calgary office, which were essential in ensuring the team stayed well-informed about the latest advancements and innovations.

# Stakeholder activities 2023-2024 academic year

Regular CDT stakeholder events enable students to network, and in stakeholder challenges partners give students real sector issues to work on.

## Stakeholder workshop at University of Birmingham, October 2023

This event at University of Birmingham (UoB) featured interesting talks from a wide range of hydrogen expertise:

- Allan Walton, Professor in the School of Metallurgy and Materials at UoB and Founding Director of HyProMag Ltd, discussed hydrogen recycling of critical materials.
- Mayorkinos Papaelias, also a Professor in the School of Metallurgy and Materials at UoB, shared their research on an autonomous unmanned underwater vehicle powered by a H2 fuel cell.
- Dr Charles Calvert, Chief Engineer at Vanguard Sustainable Transport Solutions, talked about hydrogen-powered rail transport.
- Dr Shangfeng Du from the School of Chemical Engineering at UoB, discussed their research activities in 3D ordered catalyst electrode for low temperature fuel cells.
- Dr Rafael Orozco from the School of Biosciences, Chemical and Civil Engineering at UoB, gave a talk in Hydrogen Production via Biological Routes.
- We heard about PVD coatings in electrolysers and fuel cells from Dr Parnia Navabpour, Process Development/Research Team Leader at Teer Coatings Ltd.
- Our former SusHy CDT Programme Manager, Dr Kandavel Manickam, Principal R&D Engineer- Hydrogen Systems from Offshore Renewable Energy Catapult, talked about integration of offshore wind with hydrogen technologies.

## Stakeholder workshop at Ulster University, April 2024

The stakeholder event featured panel discussions, networking sessions and insightful talks from:

- Neil Hewitt and Vladimir Molkov (Ulster University)
- Katie Hart (EPSRC UKRI)
- Ryan Teggart (Artemis Technologies)
- Stuart Hawksworth (Health and Safety Executive)
- Gabriel Wild and Matthew Hammond (National Gas Transmission)
- Liam Nolan (Gas Networks Ireland)
- Kodjo Coudoro (Air Liquide)

## National Gas Transmission Stakeholder Challenge, September-October 2024

National Gas Transmission ran a stakeholder challenge activity for the Cohort 4 and 5 students in understanding the impact of variable hydrogen blends within the National Transmission System (NTS). The SusHy students visited the FutureGrid high-pressure test facility at DNV Spadeadam on 12 September, where a wide range of essential hydrogen tests are carried out to demonstrate that the pipelines and assets of the gas NTS could be used safely and reliably to transport hydrogen gas.

In teams of 5 – 6 the students worked on this research challenge and presented their findings to the National Gas Transmission team on 17 October 2024 during the workshop at University of Nottingham. There were very interesting and thought-provoking discussions around how to address the challenges during the transition from natural gas to hydrogen.


# Training activities 2023-2024 academic year

We organised a range of training activities for our students, also considering the student suggestions. During the 2023-2024 academic year:

### Induction week training sessions, 9-11 October 2023

The induction week activities for Cohort 5 students included soft-skill training sessions in Team dynamics, Communication skills and Creative thinking delivered by Rambutan. The SusHy CDT director Sanliang Ling also ran a training workshop in Responsible Innovation.

In collaboration with Sustainable Chemistry CDT we also ran a joint EDI training session during the induction week.

### Thesis writing and viva preparation session with alumni, 7 March 2024

This online session was organised for Cohort 1-3 students to give an opportunity to ask their questions to the CDT alumni.

### CDT annual research conference, 23 April 2024

This year's CDT conference was run at Ulster University, where Cohort 2 and 3 students gave a oral presentation about their research work and Cohort 4 students presented their research posters.

### Trusted research training, 9 May 2024

This hybrid session was delivered by the University of Nottingham Trusted Research team in collaboration with Sustainable Chemistry CDT.

### Power Trader Game Workshop, 1 July 2024

Cohort 5 students attended this workshop facilitated by Heuristic Games. They worked in teams of 2-3 to run an energy company in a simulated electricity market where they were responsible for sourcing and delivering power to customers by running generation facilities and trading with other teams.

### Masterclass: Stand and Deliver - Effective Presentations and Posters, 2 July 2024

This workshop was delivered by VOX Coaching to help student to gain confidence and speak compellingly in front of any audience and equip them with practical techniques for engaging, informing and influencing others.

### Writing retreat, 19-21 August 2024

In collaboration with Horizon CDT we organised a 3-day writing retreat for Cohort 2 students to provide a lightly time structured and focused event in a quiet environment, to focus specifically on doctoral writing projects, whether this be for the PhD thesis, research paper submission, analysis work or journals.

### CVs and Applications That Get Noticed, 5 September 2024

This webinar, run by UoN Careers and Employability Service, covered the basics of developing CVs, cover letters and application forms, including practical tips on structuring CV, tailoring applications to specific roles, and standing out in the competitive job market.

# News and events 2023-2024 academic year

October — November — December — January — February — March

19 new SusHy students joined our CDT and started their PhD studies on 1 October at our four partner universities. The induction week programme included the stakeholder event at University of Birmingham, and a soft skills workshops in team dynamics, communication skills, creative thinking and responsible innovation.

Mina Kazemi from Ulster University presented her research work in hydrogen flame stability limits at NI-HPC User Conference.

SusHy students visited Ulster University to attend the “Principles of Hydrogen Safety” training course, delivered by the academic staff members of the Hydrogen Safety Engineering and Research Centre (HySAFER).

Alexandra Brochoire from University of Birmingham presented a poster about her research during the World Fuel Cell Conference at Imperial College London.

Esther Mgbemeje from Loughborough University teamed up with 5 other PhD students from across the country, and won the best proposal prize during the Henry Royce Institute 2023 Sandpit.

SusHy students met in Nottingham for a CDT winter get-together. They first attended the cohort building activity in the University of Nottingham, and after a quiz, headed into the city centre to enjoy a meal.

Samir Soares from University of Nottingham attended and presented at the Energy Research Accelerator (ERA) conference. His research poster showcased some of his work in evaluating rural domestic heating systems to develop five archetypal user groups.

SusHy was one of the sponsors for 6th annual 'Celebrating Women in STEM Conference and Careers Event', hosted on 8 March in the Carbon Neutral Laboratory at University of Nottingham.

Joe Walton from University of Birmingham presented his poster, titled, ‘Up-to-date hydrogen production costs and their sensitivity to key parameter variations’ at the European Hydrogen Energy Conference.

# News and events 2023-2024 academic year

April — May — June — July — August — September

Kieran Heeley from University of Birmingham presented his research in algal biomass to hydrogen: a circular approach for green sustainable processing with enhanced efficiency and minimal waste, at the Hydrogen Days, 14th International Conference on Hydrogen Technologies.




The SusHy CDT stakeholder workshop and annual CDT research conference took place at Ulster University Belfast Campus.

The 18th International Symposium on Metal-Hydrogen Systems was well attended by the SusHy team, staff and students alike.

Mina Kazemi presented at the 5th International Symposium on Hazards, Prevention and Mitigation of Industrial Explosions

Samir Soares and Amelia-Rose Edgley presented their research at this year's official UK Energy Storage conference (UKES2024), which took place at University of Nottingham.

Cohort 5 students attended the Power Trader workshop facilitated by Heuristic Games. They worked in teams of 2 or 3 to run an energy company in a simulated electricity market where they were responsible for sourcing and delivering power to customers by running generation facilities and trading with other teams.

SusHy students received a training course in Effective Presentations and Posters followed by cohort building activities at University of Nottingham.

Amelia-Rose Edgley from University of Nottingham won the poster prize for Best Research Impact at Nottingham's Celebrating Engineering Research showcase.

Antonia Dase from University of Nottingham presented her research at the 45th International Conference of Coordination Chemistry (ICCC).

Niko Hilmi presented his research at the 7th UK Porous Materials (UKPorMat) Conference at the EuroMembrane 2024 Conference.

SusHy students visited the FutureGrid high-pressure test facility at DNV Spadeadam, where a wide range of essential hydrogen tests are carried out to demonstrate that the pipelines and assets of the gas National Transmission System could be used safely and reliably to transport hydrogen gas.

# SusHy CDT outreach activities 2023-2024 academic year

## SusHy students participated in STEM outreach event:

Amelia-Rose Edgley from University of Nottingham (UoN) and Alexandra Brochoire from University of Birmingham (UoB) participated in a STEM outreach event on the 10 January at UoB. The event was for girls in year 9, encouraging them to pursue STEM careers. It focused on the impact of climate change, and how hydrogen may play a role in transitioning future energy. Using kits, the challenge was to build toy cars that are run off of a hydrogen fuel cell, with the winning team having the longest run.

Emily Blackett from UoN participated in a STEM outreach activity on 31 January, run by HyDEX programme at Loughborough University, helping year 10 students building the hydrogen model cars that are run off a hydrogen fuel cell.

## The Brilliant Club:

Bakhtawar Ahmed from UoB, is participating in The Brillant Club programme, which is mobilising the PhD community to support students who are less advantaged to access competitive universities and succeed when they get there.

Bakhtawar remarked: “It is useful for those who would want to consider academia in the future or who simply want to motivate pupils from disadvantaged backgrounds.”

## London science outreach session:

On Thursday 18 April, Samir Soares and Emily Blackett from UoN with two other PhD students went down to London to deliver a science outreach session with over 30 year 10 and 6th form students at Bacon’s College, Samir Soares’ former secondary school. They talked about the energy research carried out at UoN, how fuel cells work and engaging with students about being at university, as well as demonstrating hydrogen fuel cell toy cars.

## SusHy staff and students participated at Pint of Science:

Ella Crowther, SusHy's Marketing Officer, served as one of the event managers in Nottingham, and SusHy student, Cheryl Duke, volunteered on the planet earth theme at the Beeston Social. The events were successful and well engaged with almost 150 tickets sold across all 3 nights.

SusHy student, Esther Mgbemeje served as the lead coordinator for this year’s Loughborough Pint of Science festival. For the first time in the history of Pint of Science, Loughborough recorded the third largest festival in the UK with 21 events, 53 talks, 2 panel discussions, and 430 attendees.

## SusHy Glastonbury outreach:

Following last year’s successful public engagement event, the SusHy researchers’ team, Get With The H2ype, brought hydrogen education to the general public again at Glastonbury’s Science Futures field.

## SusHy Green Man outreach:

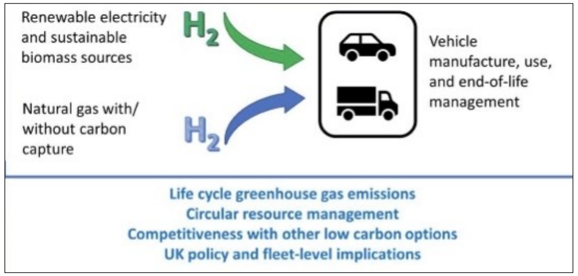
Building on the successful public engagement events at Glastonbury, the SusHy researchers’ team, Get With The H2ype also had a hydrogen stall at the Green Man Festival this year, interacting with 1,100 people at a festival of just 25,000.

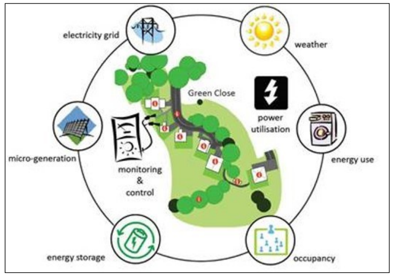


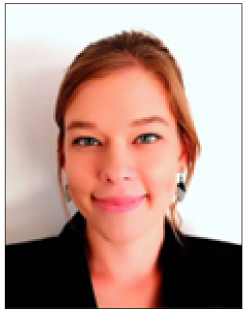

# Student Research Projects

Our **Sustainable Hydrogen CDT** PhD students, across all five Cohorts, are undertaking hydrogen research in a wide variety of areas.

In this section you will find research profiles for each CDT student researcher; working in areas such as Combustion, Distribution, Production, Safety, Storage, Systems, and Upgrade.



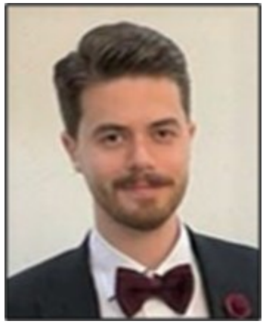
University of Nottingham
UK | CHINA | MALAYSIA

## Antonia Dase (Cohort 2)
## School of Chemistry

## Development of dehydrogenation catalysts for hydrogen storage materials

Antonia is working on the development of catalysts based upon earth abundant metals for application towards hydrogen storage materials including ammonia borane and metal borohydride ammoniates. Critical to the project is developing a fundamental understanding of the mechanisms involved the dehydrogenation of these materials in order to optimise catalytic performance.

**Supervisors**: Associate Professor Jesum Alves Fernandes, Professor Deborah Kays, Dr Saad Salman, Professor David Grant




Ulster University

**Hazhir Ebne-Abbasi (Cohort 2)**
**Belfast School of Architecture and the Built Environment (BSABE)**

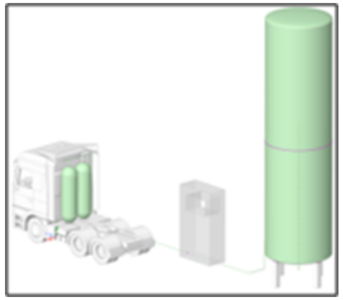



Figure 1. CFD modelling of a sub-cooled liquid hydrogen station

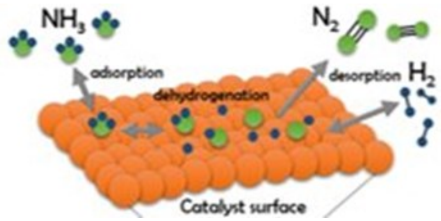
## CFD model of fuelling through the entire equipment of a hydrogen refuelling station

Since joining HySAFER (Hydrogen Safety Engineering and Research) at Ulster University Hazhir has contributed to a number of projects, including HyTunnel-CS, and SH2APED. He is now focusing on the development and validation of the first of its type CFD model for simulation of complex heat and mass transfer processes during refuelling; through the entire chain of equipment at HRS from a high-pressure tank through piping, pressure control valve, precooler, breakaway, hose, nozzle, etc. to onboard storage tanks. The research would be followed by focus on modelling sub-cooled liquid hydrogen stations.

**Supervisors**: Dr Dmitriy Makarov, Professor Vladimir Molkov.


University of Birmingham

**Bakhtawar Ahmed (Cohort 4)**
**School of Chemistry**


## Developing imide/amide catalysts for the ammonia decomposition process to produce hydrogen

Ammonia has the potential to provide itself as an effective medium for energy storage in the form of hydrogen. Implementing this idea of transforming existing hydrocarbon-based energy sources to renewable and essentially zero carbon energy in the form of hydrogen, requires overcoming limitations and working on research gaps.

The production of hydrogen from ammonia ($NH_3$) through catalytic decomposition has gained significant attention as a potential avenue for clean and efficient hydrogen production. Developing efficient catalysts for this process is crucial to enhance the kinetics and selectivity of ammonia decomposition, thereby enabling the large-scale utilization of ammonia as a hydrogen carrier. Bakhtawar's project will explore group 2 and transition metal imide/amide catalysts for ammonia decomposition, with an aim to operate the process at lower temperature and pressure. Bakhtawar will investigate sustainable catalysts, avoiding resource limited rare earth metals.

**Supervisor**: Associate Professor Joshua Makepeace

University of Nottingham
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## Ben Drake (Cohort 5)
## Faculty of Engineering

**Stakeholder collaboration**

ROLLS ROYCE

## Investigating the use of alternative fuel pump designs for cleaner aviation

Civil aviation needs to transition from kerosene to more sustainable fuels, liquid hydrogen (LH2) has emerged as a promising candidate. One key technological barrier to LH2 fuelled flight is reliably pumping the cryogen to the jet engines at sufficient rates for the duration of the pump's life cycle. LH2 turbopumps have existed for decades in the rocketry sector but with an active service life measured only in minutes and not the 10,000+ hours required for civil aviation. The lifespan of a LH2 turbopump is dictated by the failure of its bearing components, a consequence of traditional lubrication being unviable in cryogenic temperatures.

Ben will explore the operation of bearings in the harsh conditions by modelling various candidates, including foil, electromagnetic, and more conventional fluid bearing designs. The research will also explore the potential use of solid lubricants to further reduce wear.

**Supervisors**: Dr Benjamin Rothwell, Dr Mohammadreza Amoozgar, Professor Seamus Garvey, Dr Rajab Omar

University of Nottingham
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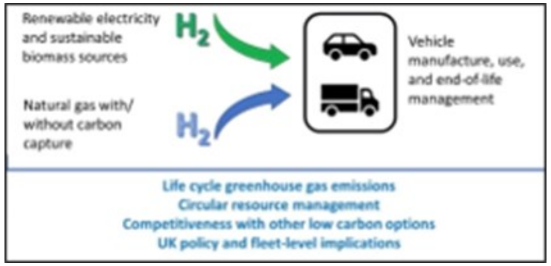
## Cheryl Duke (Cohort 3)
## Faculty of Engineering




**Stakeholder collaboration**

aramco

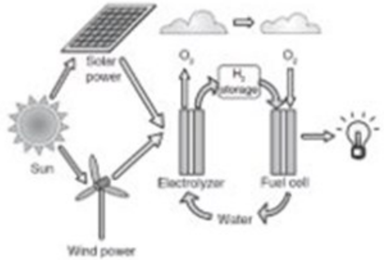
## Quantifying environmental and resource impacts of the future UK hydrogen-fuelled vehicle fleet

Cheryl's project is developing novel Life Cycle Assessment (LCA) models to assess the resource and environmental implications of deploying hydrogen-fuelled vehicles in the UK's light duty and heavy duty road fleets. Cheryl's comprehensive approach will consider the current and future mix of hydrogen production routes, vehicle manufacture and use, and end-of-life vehicle management (e.g. recycling).

Beyond more common LCA studies comparing technologies on a vehicular level, this project will consider the turnover of UK vehicle fleet and the uptake of hydrogen technologies, to quantify cumulative resource and environmental implications.

**Supervisor**: Professor Jon McKechnie

Esther Mgbemeje (Cohort 5)
School of Mechanical, Electrical and Manufacturing Engineering




## Green Hydrogen Production from Waste: A Techno-Economic and Social Analysis of Waste-to-Hydrogen Conversion Technologies

Esther's research aims to assess the techno-economic and social viability of waste-to-energy technologies, particularly waste-to-hydrogen, in developing countries. Through process simulations, sensitivity analysis, and laboratory experiments, the study will optimise energy integration, account for mass and energy flows and validate model accuracy. Laboratory experiments will clarify operational challenges, while a social impact assessment will address barriers to adoption, such as workforce skills and community readiness. The work seeks to advance sustainable waste management strategies that reduce landfill use and support economically viable, large-scale waste-to-energy solutions in resource-constrained settings, contributing to cleaner energy generation and resource recovery. Environmental performance will also be evaluated using life cycle assessment (LCA) to ensure the sustainability of optimized WtH processes.

**Supervisors**: Dr Richard Blanchard, Dr Simon Kondrat

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Amy Liscoe (Cohort 5)
School of Psychology

## Public values for a hydrogen energy system

Amy's project will investigate the public's view of novel sustainable technologies and their willingness to engage with a hydrogen fuelled future. Amy's project looks to broaden the current participant pool by speaking to experts in the field of hydrogen to gain an updated perspective on the UK's energy future and perceptions held by these experts about hydrogen and the public's views. With the aim of appreciating the trajectory of public values, Amy's project hopes to explore longitudinal perspectives held by the public and methods in which these can be measured. By appreciating the perspectives and views of individuals from all backgrounds, industries, and ways of life Amy aims to initiate an area of research which can progress the acceptance and application of hydrogen technologies in our society.

**Supervisors**: Professor Alexa Spence, Professor Begum Tokay

Loughborough University

**Faris Elasha (Cohort 5)**
**School of Mechanical, Electrical**

## Low pressure, low cost hydrogen storage technology

Currently green hydrogen production and storage is focused primarily around electrolyser technology with high pressure storage. However, there are many uses for hydrogen aside from the transportation industry that do not require compressing hydrogen to high pressures. For example, in the context of adding Hydrogen to the gas supply system of up to 20 %, pressures to domestic premises can be between 75 mbar and 2 bar, a big step down from the 350-700 bar of a high pressure system. It makes more sense from an energy perspective to store the hydrogen at low pressures and avoid the round trip energy cost and the financial cost of the compressors and tanks. There is no low-pressure low-cost, hydrogen storage products on the market. Faris' research aims to understand the fundamental science behind low pressure hydrogen storage and design low pressure hydrogen storage systems using sustainability principles. Faris will also validate the technology and analyse the suitability and durability of the system using a small-scale test rig.

**Supervisors**: Dr Jonathan Wilson

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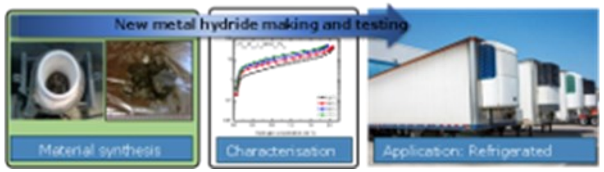
**Elizabeth Agathanggelou (Cohort 5)**
**Faculty of Engineering**




## H2COOL - dual energy store for refrigerated transportation

Elizabeth's project will be part of H2COOL, a project which aims to develop metal hydrides to take advantage of their endothermic dehydrogenation, to provide cooling for refrigeration, in addition to hydrogen storage. This dual-use store has the potential application for transporting perishable goods in heavy goods vehicles, as the hydrogen release can be used for powering a hydrogen fuel cell whilst the cooling effect refrigerates the cargo space inside.

**Supervisors**: Professor David Grant, Assistant Professor Alastair Stuart, Professor Martin Dornheim, Dr Jorge Montero Banuelos

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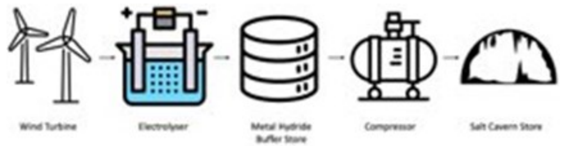
## Amelia-Rose Edgley (Cohort 4)
## Faculty of Engineering




# Nanostructured hydrogen storage materials for offshore green hydrogen

Metal hydrides are a more compact storage medium than compressed gas or liquid hydrogen. If a successful candidate can be found, metal hydrides can be used to simplify the equipment needed for an offshore hydrogen generation platform. Amelia is researching into higher capacity metal hydrides that are also resistant to the impurities found by generating hydrogen from seawater electrolysis.

**Supervisors**: Professor David Grant, Dr Marcus Adams, Dr Timothy Cooper

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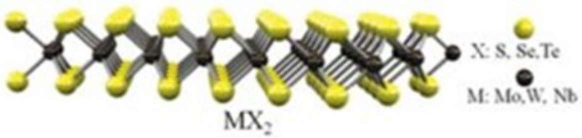
## Joseph Parkinson (Cohort 5)
## School of Chemical Engineering




# Novel materials and methods in electrocatalysis

Transition metal dichalcogenides (TMDs, e.g. MoS2, WS2) have been the subject of intense research in recent years as low-cost catalysts for the Hydrogen and Oxygen evolution reactions. The chemistry of the catalytically active sites is currently becoming more understood, and Joe's project seeks to build on these recent advances through:
(i) Maximising edge sites through controlled TMD electrodeposition forming porous structures,
(ii) Modifying the catalytic sites through metal doping,
(iii) Optimising the stability of active sites,
(iv) Elucidation of mechanistic detail

**Supervisors**: Dr Neil Rees, Dr Shangfeng Du

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**Una O'Hara (Cohort 2)**
**School of Chemistry**

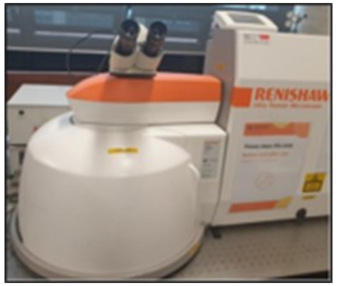

**Figure**: Raman equipment, University of Birmingham

## Development of high-performance complex hydrides

Una is investigating thermodynamic tuning of boron and nitrogen-based complex metal hydrides (CMHs), synthesized by chemical and mechano-chemical routes.

Nano-structuring by encapsulation in mesoporous-frameworks seeks to enhance cyclic stability, discharge and recharge rates whilst maintaining storage capacity. The materials will be characterised using a wide range of techniques to assess electrical, thermal and hydrogen storage properties.

**Supervisors**: Associate Professor Josh Makepeace, Professor David Book

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**Salim Ubale (Cohort 3)**
**Faculty of Engineering**

**Stakeholder collaboration**

ITM POWER
Energy Storage | Clean Fuel

## Optimisation of PEM electrolyser balance of plant operation and maintenance to maximise performance and re-silience of key infrastructure

Salim's project seeks to develop an asset management strategy for a hydrogen plant. Given the reliability issues faced by PEM electrolysers, the project aims to increase the reliability of the plant, thereby increasing its performance and to optimise the plant operation through the application of reliability and resilience engineering principles.

**Supervisors**: Dr Rasa Remenyte-Prescott, Professor David Grant, Assistant Professor Alastair Stuart

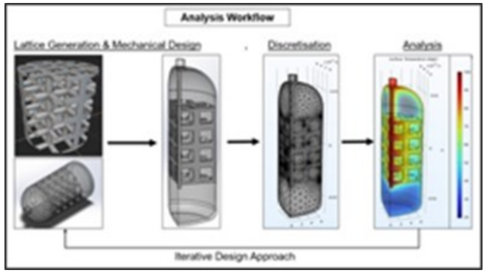
**Shiqi Cui (Cohort 5)**
**Belfast School of Architecture and the Built Environment (BSABE)**

## Safety of hydrogen and natural gas blends

Shiqi's research will focus on injecting hydrogen into natural gas pipelines and quickly mixing hydrogen and methane evenly. The homogeneous mixing of hydrogen and methane helps to prevent hydrogen embrittlement in the pipeline to prevent leakage from spreading. Safe handling of hydrogen and hydrogen-natural gas mixtures and understanding of the hazards and associated risks from leakage will also be included in future studies. These include (but are not limited to) hazard distances defined by the extent of the flammable cloud, and thermal effects from jet fire. Shiqi will focus on theoretical modelling and computational fluid dynamics (CFD) simulations. The research objective is to develop safety engineering tools related to hydrogen-methane mixtures. This will include consideration of theoretical modelling of unignited and ignited jets of hydrogen-methane mixtures and the effect of buoyancy on release.

**Supervisors**: Dr Sile Brennan, Dr Dmitriy Makarov, Professor Vladimir Molkov

**Yassin Ziar (Cohort 3)**
**Faculty of Engineering**




## Modular additive manufacturing for next-generation hydrogen storage

Compact hydrogen storage is a major challenge for hydrogen powered vehicles, with current state-of-the-art storage vessels being too large and operating at dangerously high pressures. Solid state Metal Hydrides (MH) can store large (relative to gaseous storage) quantities of hydrogen in much smaller volumes and at lower pressures, however current suitable candidate metals that reversibly store hydrogen are characterised by poor thermal conductivities which is detrimental to refuelling rates.

To improve heat transfer into the powdered metal, Yassin's PhD research aims to exploit the benefits and design freedom that Additive Manufacturing (AM) offers, by incorporating lattice structures into the vessel's internal architecture. This project will involve cell selection, lattice generation, mechanical design, numerical analysis, and experimental validation.

**Supervisors**: Dr Ian Maskery, Assistant Professor Alastair Stuart.

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## William Baker (Cohort 5)
## Faculty of Engineering

## Sustainable hydrogen for agriculture and rural environments

William's project identifies and analyses the key factors that determine how distributed sustainable hydrogen generation can help decarbonize agriculture and bring the rural environment into the hydrogen economy. The rapidly changing global environment means that the work seeks to understand the impact of different factors, so that specific scenarios can be analysed, making the understanding gained widely applicable. An important part of the work is direct engagement with stakeholders to understand their priorities and undertaking fieldwork within the UK and USA to gain understanding differences of industrial and small-scale farming, to present real-world case studies.

**Supervisors**: Associate Professor Katy Voisey, Professor Jon Mckechnie, Associate Professor Alexa Spence

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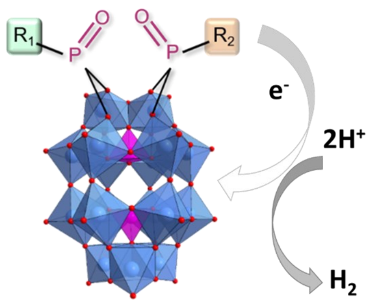
## Adedayo Dada (Cohort 4)
## School of Chemistry


## Highly efficient molecular hydrogen-evolution catalysts

Molecular hydrogen evolution electrocatalysts allow efficient hydrogen production from water under mild conditions.

Adedayo will research development of fully tailorable molecular clusters based on molybdenum/tungsten and sulfur/oxygen. Systems will be combined with conductive nanocarbon materials to develop highly efficient composite electrocatalysts for the water splitting reaction. The stability and efficiency of these systems will be explored during prolonged electrolysis.

We are looking to design a new generation of inexpensive electrocatalysts which could outperform state-of-the-art materials, while allowing atomic control of catalyst structure. The cheap and easy-to-prepare systems are particularly interesting from a commercialisation perspective, given the ease with which their preparation could be scaled-up.

**Supervisors**: Dr Graham Newton, Professor Lee Johnson, Dr Kieran Jones

Loughborough University

## Chisom Okeke (Cohort 5)
## School of Mechanical, Electrical and Manufacturing Engineering

# Low cost hydrogen technology for developing countries

Chisom's project aims to enable clean cooking and off-grid energy solutions in underserved rural areas in Africa by leveraging affordable green hydrogen. The project will explore the feasibility of using a flow battolyser—a device that stores electricity and produces green hydrogen—as a sustainable source of fuel for cooking. This work integrates green hydrogen production with a solar-panel-based microgrid, ensuring access to both clean cooking fuel and electricity.
To achieve this, the project will:

- Build knowledge of hydrogen-based cooking appliances and their applications in developing countries.
- Analyse the economics of using hydrogen for clean cooking and off-grid energy systems.
- Design and prototype low-cost hydrogen cooking appliances, such as cookstoves.
- Conduct testing and validation of hydrogen cooking appliances to ensure affordability, efficiency, and usability

**Supervisors**: Dr Richard Blanchard, Dr Jonathan Wilson, Professor Dani Strickland

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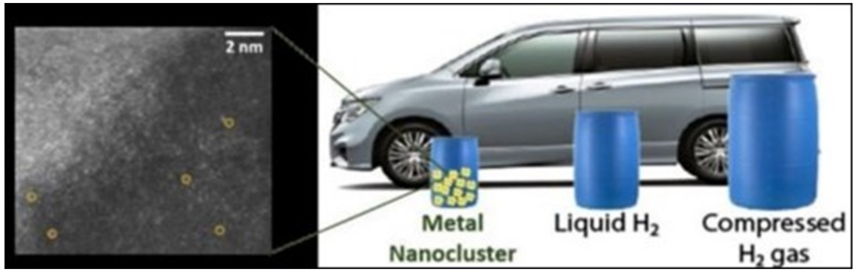
## Thomas Liddy (Cohort 4)
## School of Chemistry

Stakeholder collaboration

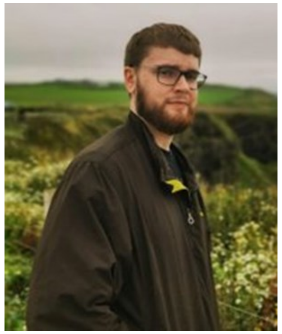
diamond




# Insights on metal nanoclusters (MNCs) (de)hydrogenation for on-board hydrogen storage application using electron microscopy and spectroscopy techniques

Ammonia is a rich source of hydrogen (17.8 wt%) and is suitable for room temperature and low-pressure storage. The use of catalysts addresses some of the challenges of ammonia decomposition, however the benchmark, ruthenium, poses scale up issues due to its cost. Thomas' project will explore bimetallic nanoclusters (diameters >2 nm), which are fundamentally different to metal nanoparticles where most metal atoms remain 'hidden' within the lattice, to present a potential solution, offering tuneable characteristics from more than one metal without the reliance on costly ruthenium. Advancing the viability of ammonia as a storage medium.

**Supervisors**: Associate Professor Jesum Alves Fernandes, Professor David Grant.



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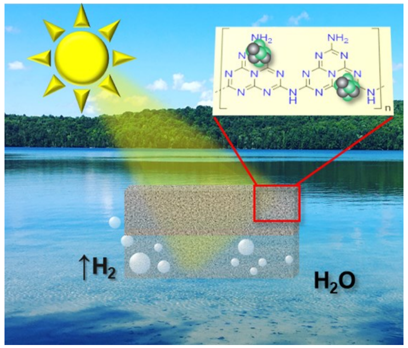
**Samuel Balmer (Cohort 5)**
**School of Chemistry**




## Supported nanoalloys for sustainable hydrogen production

Sam is researching supported nanoalloys for sustainable hydrogen production through photocatalysis. Sam's project aims to investigate the mechanisms that affect photocatalyst performance through pre- and post-reaction analysis using novel approaches to in-situ analysis.

**Supervisors**: Assistant Professor Anabel Lanterna, Associate Professor Jesum Alves Fernandes

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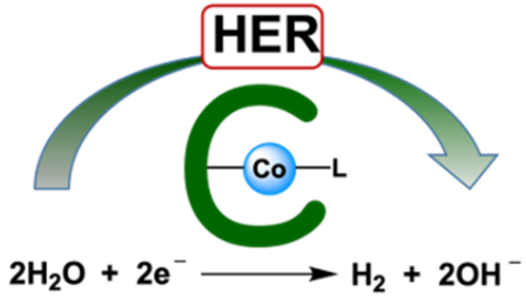
**Rafael Sanchez (Cohort 5)**
**School of Chemistry**




## Low-Coordinate 3d Metal Complexes as Alternatives to Platinum

Group Metals for Hydrogen Evolution Reaction

Rafael's project will develop a range of cobalt(I) organometallic complexes as single metal HER catalysts, where the metal centre is stabilised using highly sterically encumbering ligands. These unique complexes have never been investigated for HER chemistry, despite their favourable redox chemistry and substrate binding environment. The cobalt(I) compounds will be investigated for their redox chemistry and sensitivity to acid, along with their electrochemical response in the HER conditions.

**Supervisors**: Professor Graham Newton, Professor Jonathan McMaster, and Professor Deborah Kays

Loughborough University

**Redwan Atwiri (Cohort 5)**
**Department of Aeronautical and Automotive Engineering**

## Reliability modelling of equipment engaged in the production (electrolysers) and usage of hydrogen

Redwan's project aims to improve the reliability and reduce the wear and tear of hydrogen production and consumption equipment, notably electrolysers. It addresses the current research gap in system and cell-level reliability of green hydrogen technology equipment. By using advanced reliability analysis techniques, the project will develop comprehensive models for equipment reliability and degradation. The methodology combines deterministic physics-based models, stochastic coloured petri nets, and machine learning to predict equipment lifespan. Validation will occur through experimental testing and system-level analysis, using shared data and literature. Redwan also plans to develop new methods to accelerate equipment degradation for more accurate reliability assessments.

**Supervisors**: Professor Lisa Jackson, Dr Ashley Fly

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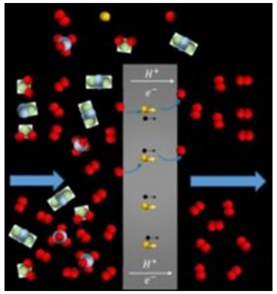
**Samir Soares (Cohort 2)**
**Faculty of Engineering**

## Hydrogen for a sustainable rural built environment

Samir is working to evaluate and model rural domestic energy systems and looking towards the opportunities and technologies to transition to low carbon energy consumption including technologies such as hydrogen fuel cells and boilers, with key considerations to energy accessibility challenges rural energy users face. Samir is also working on development of a green solid state hydrogen store with a digital twin.

Supervisors: Professor Mark Gillott, Assistant Professor Alastair Stuart

Luke Thompson (Cohort 4)
Faculty of Engineering

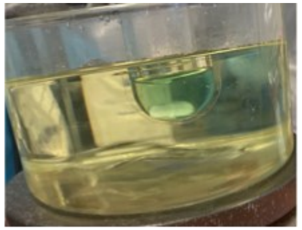


## Efficient hydrogen separation using proton-conducting ceramic membranes and electrochemical cells

Most hydrogen used today is produced from fossil fuels (e.g., through steam reforming of natural gas, coal gasification). Product gases consist mainly of H2 and CO2, and other impurity gases (CH4 and CO). Energy-efficient and low-cost hydrogen separation constitutes a crucial process to move towards a hydrogen economy.Luke's project aims to achieve energy-efficient and low-cost hydrogen separation using proton conducting ceramic membranes for hydrogen rich streams, generated through reforming of natural gas as well as onsite purification of hydrogen close to the point of end use for dilute hydrogen streams; distributed through natural gas pipelines using ceramic proton electrochemical cells (hydrogen pumps). Dense ceramic membranes made of mixed protonic-electronic conductors (MPECs) are capable of separating hydrogen from gas mixtures with 100 % selectivity, reduced energy penalty and cost compared to well-established techniques such as pressure swing adsorption technique.

**Supervisors**: Dr Ming Li, Professor Begum Tokay, Professor David Grant.

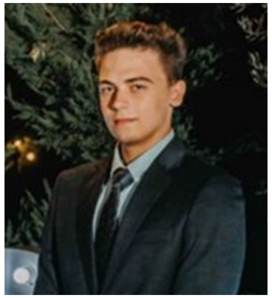
Isabelle Marriot (Cohort 4)
School of Chemistry



## Base metal catalysis of acceptorless alcohol dehydrogenation for hydrogen storage

Catalytic acceptorless alcohol dehydrogenation is an atom-economical approach for alcohol oxidation, without need for an oxidant. Reversible dehydrogenation/hydrogenation catalysis from this reaction provides a route to the use of organic molecules derived from biomass as liquid organic hydrogen carriers (LOHCs). Alcohols such as ethylene glycol, glycerol and the C4−C6 analogues erythritol, xylitol and sorbitol are considered to be potentially useful biomass-derived feedstocks; derived from agricultural or lumber resources, including waste streams and gravimetric hydrogen storage capacities, meeting targets set by the EU and the US Department of Energy. This chemistry has long been dominated by the platinum group metals (PGMs); however, low PGMs abundance means high economic and environmental cost, and their high toxicity means their removal from products can produce significant waste streams. Researchers are looking to other catalysts for industrial processes; with obvious candidates being base metals exhibiting low cost, high natural abundance, uniform global distribution and low toxicity. Isabelle's project will investigate a range of low coordinate and pincer complexes of the first-row transition metals in order to achieve the acceptorless dehydrogenation reactions and, with appropriate candidates, investigate the possibility of undertaking the reverse reaction with addition of H2.

**Supervisors**: Professor Deborah Kays, Professor Peter Licence.



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**Andreas Ioannides (Cohort 5)**
**Faculty of Engineering**

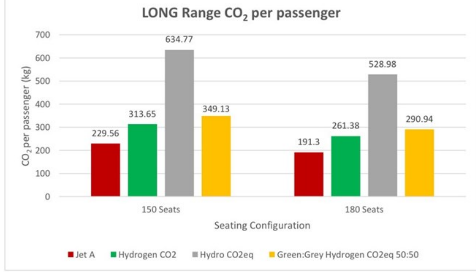


*Figure 16 CO2 emissions per passenger for hydrogen against jet A fuel using seating arrangemer from 150-180 seats.*

## Assessing the environmental and economic sustainability of hydrogen and sustainable fuels for aviation

To achieve significant climate change mitigation in aviation, transitioning to low life cycle greenhouse gas (GHG) emission fuels is crucial. Sustainable aviation fuels (SAF), specifically drop-in fuels, offer near-term solutions by displacing conventional fuels without requiring modifications to existing infrastructure or aircraft engines. Hydrogen, a vital input for SAF production, plays a key role in various pathways. In the long term, direct use of hydrogen as an aviation fuel shows promise due to its higher energy density than conventional fuels, potentially improving aircraft fuel efficiency. However, adopting hydrogen fuels necessitates substantial changes in both aircraft technologies and ground systems. Andreas' project aims to comprehensively assess the potential of SAF and hydrogen fuels for low carbon aviation, considering technology readiness, fuel availability, techno-economic performance, and life cycle GHG and environmental implications.

**Supervisors**: Dr Ioanna Demetriou, Dr Vilius Portapas, Professor Jon McKenchnie

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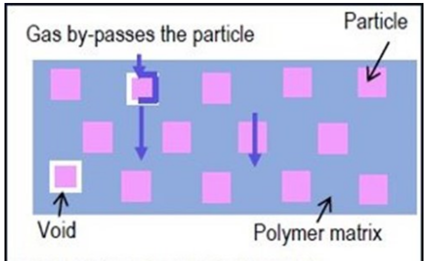
**Niko Hilmi (Cohort 4)**
**Faculty of Engineering**

**Stakeholder collaboration**
national gas transmission

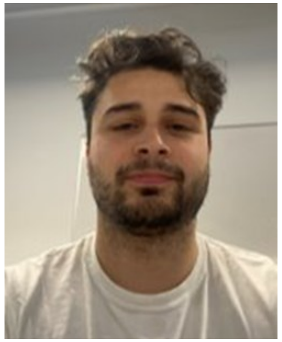



Mixed matrix membrane structure

## Composite membranes for H2 purification

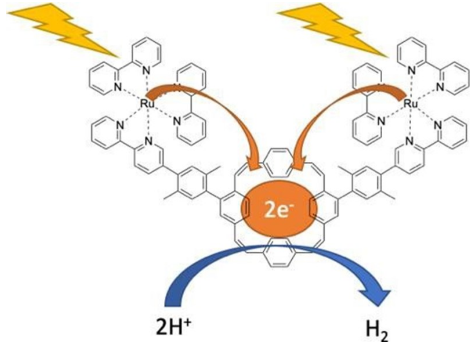
H2 is a high quality and clean energy carrier. Most hydrogen is produced by steam methane reforming, followed by water-gas shift reaction, with bio-hydrogen production increasing. Before hydrogen is used in fuel cell and other applications CO2 and CH4 resulting from production processes has to be removed. Membrane-based separation technologies are promising alternatives to conventional separation technologies, i.e. pressure swing adsorption, due to low energy consumption. Many inorganic membranes of zeolites, metal alloys and carbon molecular sieves have been developed but scaling-up difficulties limit applications. Polymer membranes are useful, whilst controlling permeability/selectivity in harsh conditions is challenging. Recently, mixed matrix membranes (MMMs) – where inorganic material is embedded into polymer matrix – have attracted attention; as they combine porous materials' functionality with polymer processability. In this context, metal–organic frameworks (MOFs), comprised of metal ions connected by organic linkers, are most promising; due to their diverse and flexible structure. In addition, MOFs' organic linker typically have greater affinity towards polymer chains; allowing control of the MOF/polymer interface. Void-free MMMs can be prepared without requirement for modification of filler or membrane surfaces. Niko's project will explore development of MOF/polymer MMMs with enhanced H2 selectivity, to enable membrane based H2 purification.

**Supervisors**: Professor Begum Tokay, Professor Edward Lester, Assistant Professor Andrea Laybourn



Loughborough University

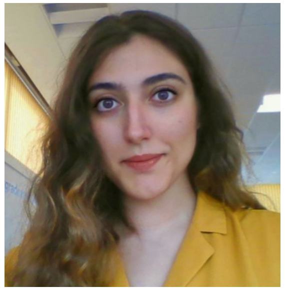
**James Turner (Cohort 5)**
**School of Chemistry**




## Modelling of photochemical water splitting based on charge accumulation in macrocycles

Photochemical water splitting using homogeneous catalysts provides a conceptually simple and promising route towards sustainable hydrogen production. At the heart of this processes lies a molecular photosensitizer along with a catalyst. Whereas such photoredox catalytic systems are well-established in other areas of synthetic chemistry, it is a particular challenge that photocatalytic water splitting requires a multielectron process where several electrons are accumulated in one molecular unit. These molecular systems that can accumulate several charges is provided by a class of recently developed macrocycles based on paracyclophanetetraene (PCT), where multiple charges can be stabilized with the occurrence of global aromaticity in the macrocycle. James will investigate prototype macrocyclic catalysts, contrast their properties with existing photoredox catalysts and suggest new candidates, through detailed computational studies.

**Supervisors**: Dr Felix Plasser, Dr Pooja Goddard



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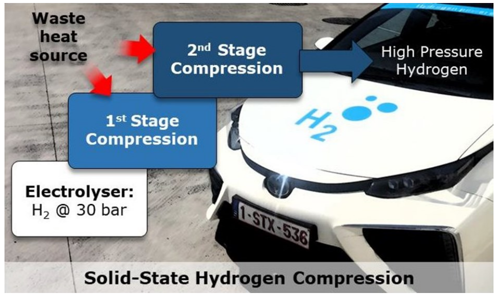
**Ramas Al Qudah (Cohort 5)**
**Faculty of Engineering**




## Innovative materials for thermal compression – Solving the challenge of hydrogen compression

Ramas’ project focuses on overcoming challenges currently present in the field of hydrogen compression. Through utilizing the thermodynamics of metal hydrides, solid–state compression circumvents some of the economic and safety concerns present in mechanical compression. MHHC utilize high-pressure alloys to absorb hydrogen and compress it by heating the metal hydride. Ramas’ project is centred around researching and developing suitable AB2 group alloys that will provide the desired isotherms with low hysteresis, flat pressure plateaus, and fast kinetics. Ramas aims to improve the efficiency of hydrogen compression through analysing hydrogen uptake, as well as thermodynamic and kinetic measurements for various alloy compositions. High-pressure alloy properties will be characterized by using analytical techniques such as XRD, SEM, and XPS. Moreover, Ramas’ project also aims to evaluate and modify the design of existing solid-state compressor prototypes to enable its successful deployment for hydrogen compression applications.

**Supervisors**: Professor David Grant, Assistant Professor Alastair Stuart, Dr Marcus Adams

UNIVERSITY OF BIRMINGHAM

**Mossen Randeree (Cohort 5)**
**Department of Marketing**

## Developing a roadmap for adoption of sustainable hydrogen: A Delphi study of business and industry

Mossen's research aims to identify the challenges, barriers and opportunities for businesses involved in the transition to a low-carbon and sustainable hydrogen economy. Utilising a mixed method forecasting approach, including Delphi, Mossen will survey practitioners in a sector or industry and through interviews with experts and practitioners, the Delphi method will produce a clear road map for the adoption of hydrogen technologies that can inform policy, design and use.

**Supervisors**: Associate Professor Robert Cluley, Professor William Green

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**Gagan Krishna Gopakumar Suja (Cohort 5)**
**Faculty of Engineering**

## Dual Fuel Ammonia Engines for Future Heavy Transport and Power Generation

The aim of Gagan's research involves the investigation of ammonia combustion on Compression Ignition (CI) Engines [Dual Fuel Operation]. Due to its potential advantages over traditional fossil fuel-powered systems in terms of performance, emissions reduction, and environmental sustainability, ammonia-fuelled dual fuel combustion engines have gained traction. Gagan's research will be conducted using a Volvo-Penta engine. This engine has the capability to operate on both ammonia and a conventional hydrocarbon fuel or hydrogen in dual-fuel mode.
Gagan is also a member of the MariNH3 research group. "MariNH3" is a five-year research program to develop new and disruptive engine technology that will significantly cut greenhouse gases and pollution emitted by diesel-powered marine vessels. Gagan's research is part of Theme 2 of the MariNH3 research programme – Combustion Mode Fundamental Studies.

**Supervisors**: Professor Alastair Cairns, Professor Antonino La Rocca

Loughborough University

**Harvey Monroe (Cohort 2)**
**Department of Chemistry**


## Development of odour additives for use in hydrogen technology

The remit of Harvey's project involves the design, synthesis and testing of novel compounds for use in hydrogen storage.
A number of potential odorants will be selected and compared with the novel compounds, as well as some odorants present in literature.

The tests will consist of hedonic tone and odour character tests, to ensure the suitability of an odorant's scent before fuel cell tests are performed to test which odorants don't poison the catalyst. So far, work on the novel compounds has been fully focused on the bicyclopentane framework, due to its volatility and broad substrate scope.

**Supervisors**: Dr Marc Kimber, Dr Gareth Pritchard.

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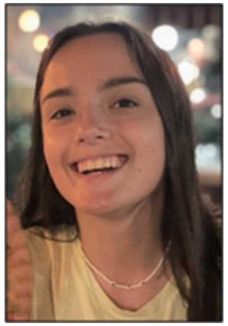
**Will Bowling (Cohort 1)**
**Faculty of Engineering**

## Experimental study of advanced ammonia-fuelled, heavy duty, internal combustion (IC) engines under low load operation

Will is carrying out an experimental research project looking to utilise advanced combustion techniques such as turbulent jet ignition and dual fuel operation to enable the use of ammonia as a fuel in heavy duty, internal combustion engines; with a specific focus on low load operation, during which the combustion is the most challenged.

The project will be formed of two main studies, a fundamental combustion study carried out using a bespoke optical constant volume combustion chamber to understand flame development in a laminar environment, as well as an applied engine study, converting a diesel heavy duty compression ignition engine to operate using ammonia and hydrogen.

**Supervisors**: Professor Alasdair Cairns, Professor Antonino La Rocca, Dr Richard Jefferson-Loveday.



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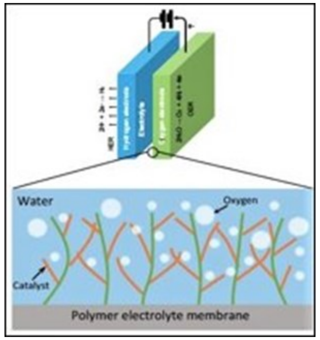
**Alexandra Brochoire (Cohort 4)**
**School of Chemical Engineering**




## Proton exchange membrane water electrolysers with thin film nanostructured electrodes

The biggest challenge with current proton exchange membrane water electrolysers (PEMWE) is their poor power performance and durability; which is mainly caused by large mass transfer losses and degradation of the electrode structure, from the random electrode structure from catalyst nanoparticles. Alexandra's PhD project will seek to develop a new generation of catalyst electrodes from aligned $IrO_2$- and metal oxide-based nanowires for PEMWE applications; taking advantage of the high stability of nanowires and the boosted mass transfer characteristics of the unique thin catalyst layers from nanowire arrays.

Project aims are substrate surface modification approach to increase surface activity, in-situ nanowire array growing process based on $IrO_2$ and metal oxide materials, surface deposition technique of $SrIrO_3$ on nanowire arrays, and electrode evaluation using half-cell and single cell test.

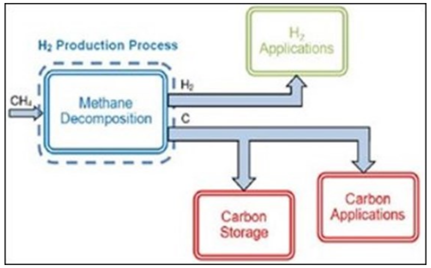
**Supervisors**: Dr Shanfeng Du, Dr Neil Rees.

Loughborough University

**Mickella Dawkins (Cohort 1)**
**Department of Chemistry**

**Stakeholder collaboration**

CATAPULT Offshore Renewable Energy




## Hydrogen enrichment of natural gas by thermo-catalytic decomposition of methane

The gas network currently supplies natural gas to consumers but could supply gases, such as hydrogen, in the future. Thermo-catalytic decomposition of methane allows enrichment of natural gas with hydrogen, a carbon-free fuel.

Mickella's research is focused on the development of this technology and the incorporation of wind energy. Her research looks at the use of iron oxide from a natural source as the catalyst for the thermo-catalytic methane decomposition process.

**Supervisors**: Dr James Reynolds, Professor Sandie Dann and Professor David Saal.



## Atish Gawale (Cohort 4)
## Belfast School of Architecture and the Built Environment

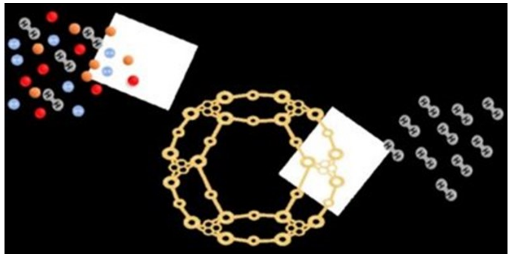

## Safety strategies and engineering solutions for hydrogen heavy-duty vehicles

Pursuit of a low carbon economy means practical implementation of zero-emission applications, including hydrogen-fuelled heavy-duty vehicles (HDV) such as buses and trucks. Hydrogen's use in public transport implies stringent bus design requirements. Industry and regulators' concerns over HDV design, considered critical for successful roll-out, include:

1. Development of HDV refuelling protocol comparable with modern fossil-fuel vehicles, without jeopardising onboard compressed hydrogen storage system (CHSS) safety.
2. Fire-resistance rating of current CHSS, which may lead to rupture in a fire with catastrophic consequences, i.e. blast wave, fireball and projectiles.

Atish's project will review 'old' and new HDV hazards of different designs and sectors (buses and trucks); identifying and analysing existing prevention and mitigation safety strategies, engineering solutions, knowledge gaps and technological bottlenecks in provision of HDV safety.

**Supervisors**: Dr Sergii Kashkarov, Dr Dmitriy Makarov, Professor Vladimir Molkov.




## Emily Dunkerley (Cohort 4)
## Faculty of Engineering

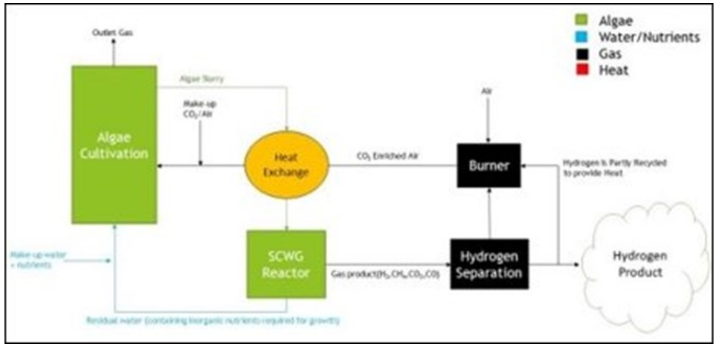

## Advanced hydrogen sensing platform based on functionalised metal-organic frameworks

Developing efficient sensor materials with superior performance for selective, fast and sensitive hydrogen detection is essential for environmental protection and human health. Metal–organic frameworks (MOFs) – crystalline and porous solid materials constructed from metal nodes (metal ions or clusters) and functional organic ligands – are of interest for gas sensing for their large surface area, adjustable pore size, tuneable functional sites and intriguing properties; such as electrical conductivity, magnetism, ferroelectricity, luminescence and chromism. However, selectivity, sensitivity and stability are still major challenges for MOFs–based sensors used in hydrogen detection.

Emily's project aims to fabricate novel multifunctional MOF composite materials with improved sensitivity and stability for hydrogen detection. The rational design of these robust, multifunctional MOFs composites will combine multiple post synthetic modification and deposition techniques to achieve selective sensing of hydrogen over multiple cycles.

**Supervisors**: Professor Begum Tokay, Professor David Grant, Dr Zakhar Kudrynskyi

**Kieran Heeley (Cohort 2)**
**Chemical Engineering**




## Algal biomass to hydrogen: A circular approach for green sustainable processing with enhanced efficiency and minimal waste

Kieran's project investigates hydrothermal conversion of algal biomass to hydrogen-rich gas, in a sustainable circular approach. It looks at optimising the catalyst, feedstock and operating conditions to increase the hydrogen yield; whilst maximising the nutrient recovery.

**Supervisors**: Professor Bushra Al-Duri, Dr Rafael Orozco, Professor Lynne Macaskie.

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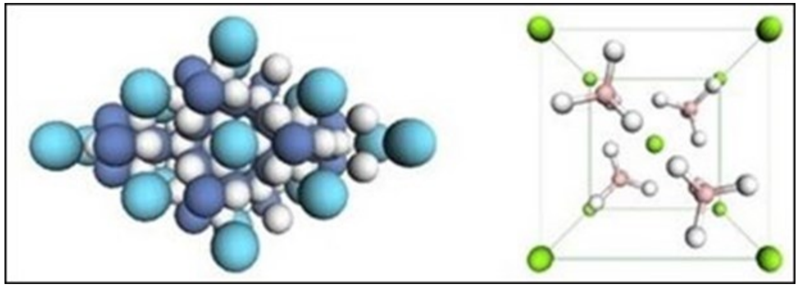
**Samuel Lines (Cohort 3)**
**Faculty of Engineering**



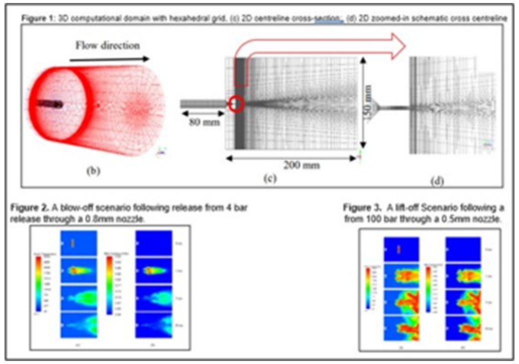
## Computational modelling of Solid-State Hydrogen Storage Materials

Sam’s project aims to understand the composition-structure-property correlations of solid-state hydrogen storage materials, through accurate density functional theory simulations of both existing and hypothetical materials.

The most promising candidate materials discovered from the computational simulations will be synthesised and characterised, and their hydrogen storage properties will be validated by experiments.

**Supervisors**: Associate Professor Sanliang Ling, Professor Martin Dornheim, Professor David Grant.

Mina Kazemi (Cohort 2)
Belfast School of Architecture and the Built Environment (BSABE)




## Prevention and mitigation of accidents with hydrogen-powered vehicles in confined spaces

The scope of Mina's doctoral study includes the identification and prioritisation of relevant knowledge gaps, to develop innovative safety strategies to mitigate and prevent hydrogen-fuelled vehicles accidents in confined spaces. The first step is performing analytical and numerical studies to increase hydrogen-powered vehicles' safety, through improving TRRDs design; to prevent pressure peaking phenomenon and blow-off phenomenon, which would both lead to hydrogen deflagration or detonation and catastrophe in confined spaces.

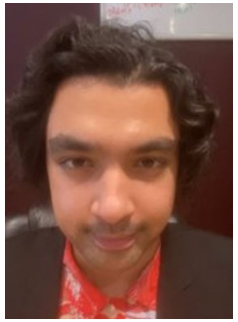
**Supervisors**: Dr Sile Brennan, Dr Dmitriy Makarov, Professor Vladimir Molkov.

John Taverner (Cohort 5)
Department of Chemical Engineering


## Understanding the lifecycle carbon footprint and costs of sustainable hydrogen energy systems

John's project delves into comprehensive research on current hydrogen production methods. Focussing on sustainability, this project involves developing analytical models to assess the carbon footprint associated with various hydrogen production techniques. By analysing the entire lifecycle of hydrogen energy systems, from production to utilisation, John's project aims to provide invaluable insights into environmental impact and cost-effectiveness.

**Supervisors**: Professor Wen-Feng Lin, Professor Jin Xuan.



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## Vinay Patel (Cohort 5)
## School of Chemical Engineering

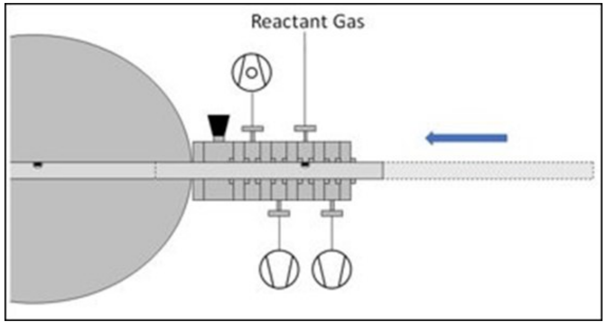
## Production of Hydrogen from Termites

Vinay is studying and quantifying the chemical activity of Termites, in order to fully incorporate them into process engineering and Hydrogen production. This will primarily include quantifying the chemical reaction stoichiometry, and the chemical kinetics as a function of gas partial pressures and the temperature. The secondary objective will be to quantify the Termite reproduction rate as a function of temperature, gas partial pressures, and space.

**Supervisors**: Dr Taghi Miri, and Dr Scott Hayward

University of Nottingham
UK | CHINA | MALAYSIA

## Chris Ryder (Cohort 1)
## School of Physics and Astronomy




## High-throughput cycling coupled X-ray photoelectron spectroscopy (XPS) of hydrogen storage materials

Chris's research looks into the application of X-ray photoelectron spectroscopy (XPS) to samples after reactions at elevated pressures.

Chris is designing a sample transfer device that enables rapid X-ray photoelectron spectroscopy (XPS) analysis of samples after reactions at elevated pressures. The device will soon be used to investigate various solid-state hydrogen storage materials, with a particular focus on their change in performance with increasing hydrogen cycles.

**Supervisors**: Associate Professor James O'Shea, Professor David Grant.

Stephen Marr (Cohort 2)
Department of Chemistry

Stakeholder collaboration

## Development of techniques and methods for sampling, calibration and testing of hydrogen purity for fuel cell vehicles

Measurement challenges for hydrogen fuel cells are preventing the overall sector from growing. Stephen's project is looking at ways of developing a cylinder passivation technology, which would provide temporal stability data for the 14 trace contaminants outlined in ISO (International Organization for Standardization) 14687-2.

**Supervisors**: Dr Ben Buckley, Professor Upul Wijayantha, Dr Paul Holland.

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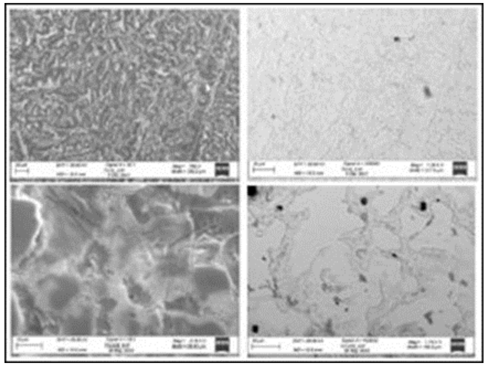
Alex McGrath (Cohort 2)
Faculty of Engineering

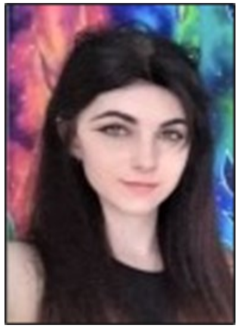
Stakeholder collaboration



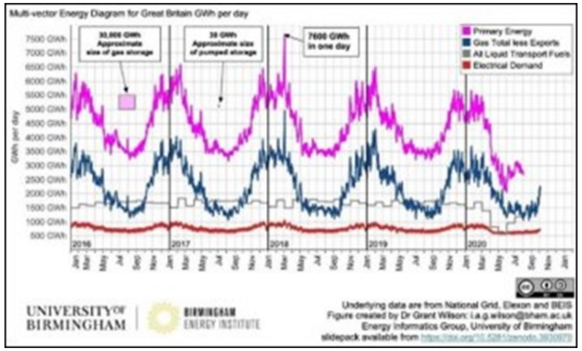
## Synthesis and characterisation of metal alloys for hydrogen storage and related applications

Alex's project aims to experimentally synthesise new metal alloys shortlisted by computational screening; and characterise their physical, chemical and structural nature along with their thermodynamic and kinetic properties, during hydrogenation and de-hydrogenation. Alex is investigating synthesising new metal alloy compositions which will have improved hydrogen storage properties, forming their hydrides and characterising their microstructures.

**Supervisors**: Professor David Grant, Associate Professor Sanliang Ling



**Katarina Pegg (Cohort 3)**
**School of Chemical Engineering**




## The role of green hydrogen in the West Midlands Combined Authority local energy system

Green hydrogen production from weather dependent low carbon generation is an area of growth signposted in the UK Committee on Climate Change's 6th Carbon Budget (published December 2020); which provides UK Government Ministers with advice on the volume of greenhouse gases the UK can emit during the period 2033-2037.

Katarina's research will focus on the advantages and disadvantages of green hydrogen generation at a local level, specifically within the West Midlands Combined Authority area.

**Supervisors**: Dr Grant Wilson, Professor Bushra Al-Duri.

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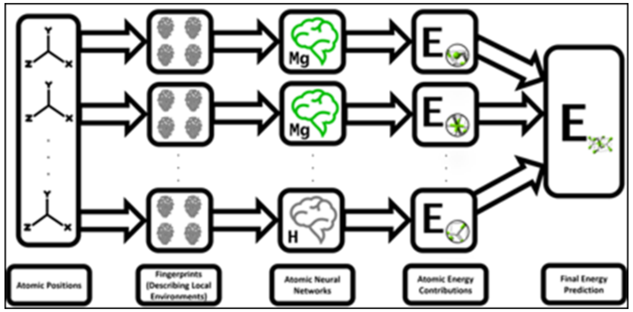
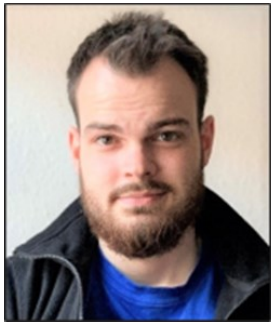
**Oliver Morrison (Cohort 1)**
**Faculty of Engineering**



## Hydrogenation of storage materials

Oliver is undertaking research into the use of Machine Learning Potentials (MLPs), models that use machine learning to approximate the potential energy surface; with particular focus on High-Definition Neural Networks (HDNNs). With sufficient training data, MLPs enable large-size and long time-scale, accurate molecular dynamics simulations, which are unattainable via conventional methods.
Oliver has used MLPs to simulate a variety of Magnesium-Hydrogen systems, including hydrogenation of magnesium clusters. Future simulations, with larger atom counts and time scales, will be used to gain insight into the process of hydrogenation and may inform the selection of improved hydrogen storage materials.

**Supervisors**: Associate Professor Sanliang Ling, Professor David Grant.



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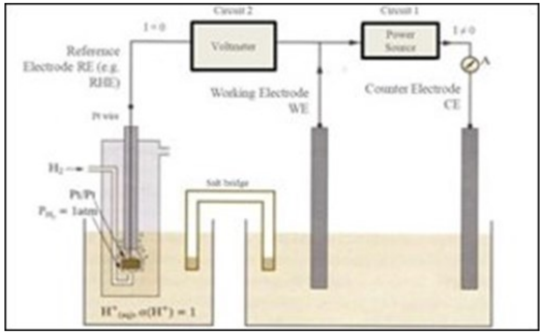
Adam McKinley (Cohort 1)
Department of Chemical Engineering



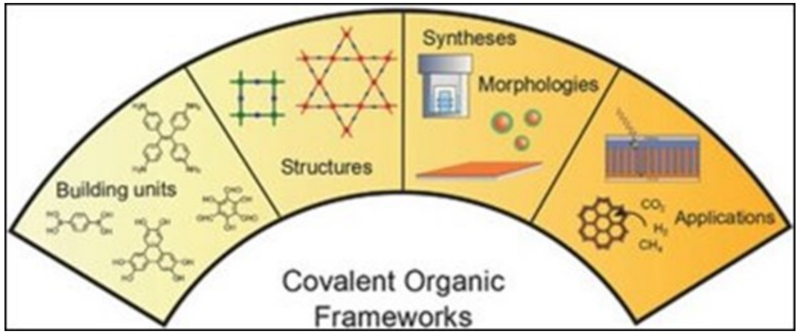

## Catalyst development for low-cost, large-scale sustainable hydrogen production from water and seawater using renewable energy sources

Adam is looking at the oxygen evolution and hydrogen production, via water and seawater splitting, driven by renewable energy. He is interested in the production and utilisation of low-cost, highly efficient and highly selective catalysts for the process. Adam is currently investigating the performance of Ruthenium and Palladium (Ru and Pd) nanoparticle-based electrodes for the hydrogen evolution reaction at varying temperatures. He aims to explore the prospect of a bifunctional catalyst capable of efficient and consistent performance in both the hydrogen evolution reaction and oxygen evolution reaction (HER and OER).

**Supervisors**: Professor Wen-Feng Lin, Professor Jin Xuan, Dr Darren Walsh.

Loughborough University

Jai-Ram Mistry (Cohort 1)
Department of Chemistry




## Photocatalytic covalent organic frameworks for hydrogen production and storage

Jai undertakes research into the use of covalent organic frameworks (COFs) for hydrogen production and storage, as opposed to the popular metal organic frameworks (MOF) alternative.

His project involves the synthesis of new molecules which can be functionalised onto the surface of COFs; creating photocatalytic and size-specific channels which will permit hydrogen production from water and selective ingress, storage and egress.

**Supervisors**: Dr Iain Wright, Dr Simon Kondrat.

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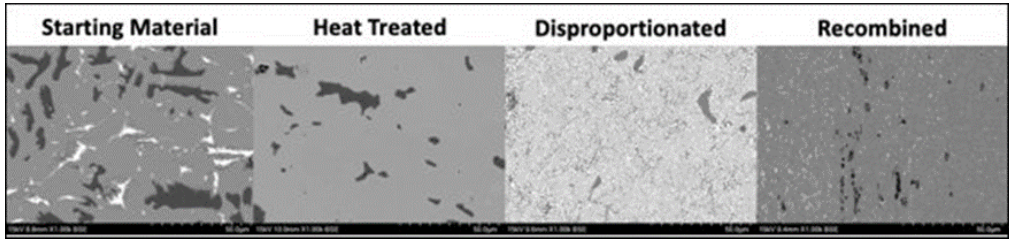
**Patrick Powell (Cohort 3)**
**School of Metallurgy and Materials**




## The use of hydrogen as a processing gas to produce rare earth magnets

Hydrogen is used in the conventional production of sintered (rare earth) neodymium-iron-boron magnets and in the recycling of these materials. In recent years new methods to manufacture rare earth magnets based on a process called the Hydrogen Ductilisation Process have been found.

This process reduces the number of processing steps, reduces waste and could give a significant economic advantage to magnet manufacture. However, the process is far from optimised and the aim of Patrick's project will be to develop this process.

**Supervisors**: Professor Allan Walton, Dr Richard Sheridan, Professor David Book.

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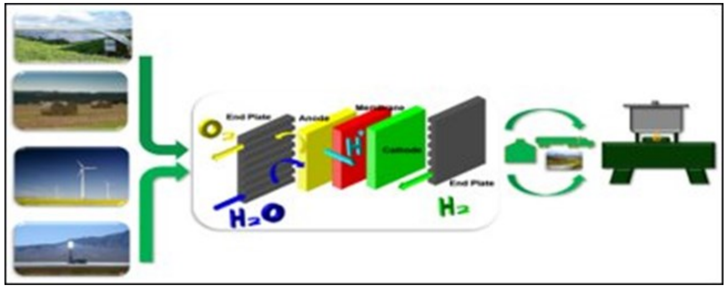
Loughborough University

**Mulako Mukelabai (Cohort 3)**
**Centre for Renewable Energy Systems Technology**
**Wolfson School of Mechanical, Electrical, and Manufacturing Engineering**



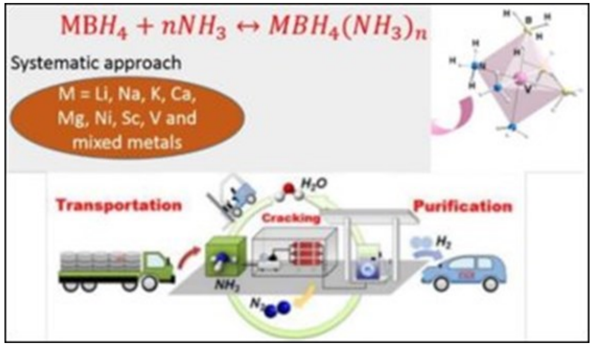

## Renewable hydrogen production to transition to clean cooking

Mulako's project aims to develop technical and business models, and processes which will enable hydrogen produced from renewable energy to be utilised for cooking.

Though this process is understood, the system needs not just the right technology but also development of the right business model, human capacity and social acceptance to bring about the transformation of traditional cooking practices.

**Supervisors**: Dr Richard Blanchard, Professor Upul Wijayantha, Dr Alastair Livesey

**Jacob Prosser (Cohort 1)**
**Faculty of Engineering**



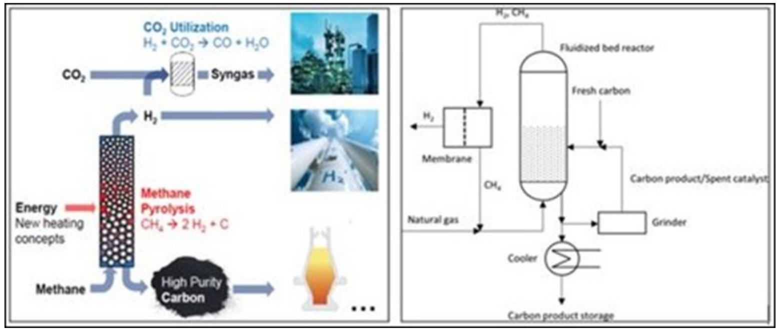

## High capacity single and mixed metal borohydrides ammoniates for hydrogen energy storage applications

Jacob is researching the synthesis and characterisation of single and mixed metal borohydrides ammoniates (MBA/MMBAs), to increase the hydrogen storage performance of these materials and elucidate the reaction mechanisms of the decomposition process.

He is assessing the influence of metal charge density, electronegativity, additional metal cations and the number of ammonia ligands on the hydrogen storage performance.

**Supervisors**: Professor David Grant.

**Aryamman Sanyal (Cohort 3)**
**Department of Engineering**




## Reactor design and performance optimisation for catalytic hydrogen production from methane

Aryamman's project aims to design, develop and test a hydrogen generation reactor suitable for advanced catalyst; demonstrating high H2 yield and efficient carbon separation.

Natural gas into hydrogen and graphite has the potential to be highly disruptive and could be of substantial value if the process can be scaled up to commercial quantities.

**Supervisors**: Professor Weeratunge Malalasekera, Professor Upul Wijayantha

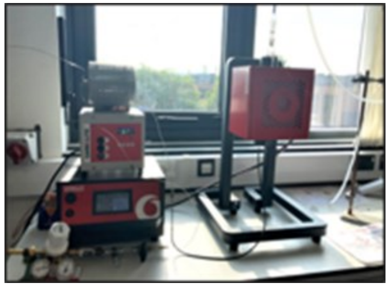
**Srinivas Sivaraman (Cohort 3)**
**Belfast School of Architecture and the Built Environment (BSABE)**


## Safety of Using Ammonia in the Hydrogen Economy

Owing to characteristics such as high energy density and the experience of the use of ammonia in industries; its transportation around the globe offers practical, cost-effective means of storing and transporting large quantities of hydrogen. Using ammonia as a hydrogen carrier and in fuel applications calls for a reassessment of hazards and risks. Srinivas's project aims to develop safety strategies and engineering solutions for the handling of large quantities of ammonia, used as a hydrogen carrier during transport and storage onboard, and the use of relevant infrastructure. His project will analyse the hazards – including toxicity effects, existing prevention and mitigation safety strategies – and perform comprehensive quantitative risk assessment for safe utilisation of ammonia as hydrogen carrier.

**Supervisors**: Dr Dmitriy Makarov, Prof Vladimir Molkov, Dr Volodymyr Shentsov.

**Jack Shacklock (Cohort 2)**
**Department of Chemistry**



## Lowering the H2 cost in methane cracking technology by using solid carbon as an energy storage material

Jack's research is designed to investigate the systematic alteration of process conditions to obtain value-added solid carbon, specifically for energy storage whilst still maintaining a high yield of hydrogen. Initial studies have been conducted to improve the methane cracking process to increase yield and longevity. By-product carbon has separated in batch processes and been studied in electrochemical supercapacitors, demonstrating a high rate of performance compared to commercial carbon used for supercapacitor manufacturing. These results suggest lowering the cost of turquoise hydrogen, by finding applications for by-product carbon, is promising. Further studies are currently underway to separate by-product carbon in real-time operation (as opposed to batch process) and evaluate their performance in applications.

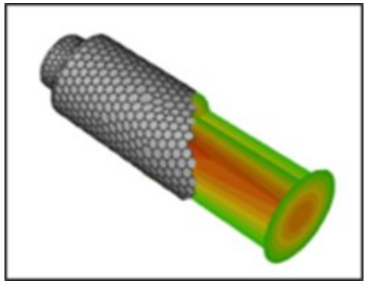
**Supervisors**: Dr Simon Kondrat, Prof Upul Wijayantha

University of Nottingham
UK | CHINA | MALAYSIA

**Zak Waite (Cohort 2)**
**Faculty of Engineering**

Stakeholder collaboration

Beckett THERMAL SOLUTIONS



## To a 100% hydrogen domestic boiler

Zak's project seeks to redesign the domestic boiler so that hydrogen can be used as a network fuel. At the moment because methane, which is currently used, burns quite differently from hydrogen our existing domestic boilers cannot utilise hydrogen gas.

**Supervisors**: Dr Donald Giddings, Professor David Grant, Professor Robin Irons

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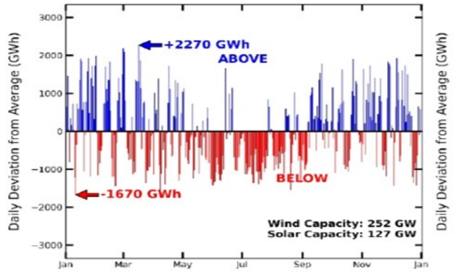
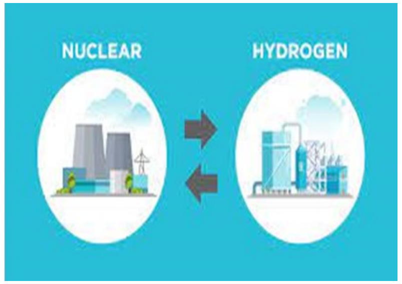
Loughborough University

**Kate O'Neill (Cohort 5)**
**Business School**

Stakeholder collaboration

NATIONAL NUCLEAR LABORATORY




## Investigating the economic value of nuclear-hydrogen

As the generation mix in energy systems is characterised by an increasing penetration of generation from renewable energy sources (RES) energy imbalances are becoming more prevalent and potentially more costly to mitigate in the absence of flexible and cost-effective forms of storage. Kate's project will consider nuclear power as a potential source of both power and flexibility and explore the role, costs and potential value of nuclear to the wider energy system in its transition to net-zero and beyond.

Kate will investigate how conversion of nuclear based electricity into hydrogen not only provides storage and balancing opportunities but may also increase the return to and value of nuclear investments, by providing alternative vectors for storing and consuming energy derived from nuclear power. Kate's research aims to develop a tool for assessing economic costs and benefits of nuclear power with hydrogen to the GB energy system.

**Supervisors**: Professor David Saal, Associate Professor Grant Wilson, Professor Monica Giulietti

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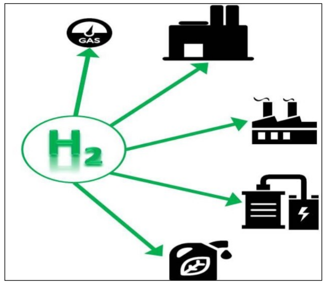


**Joseph Walton (Cohort 4)**
**School of Chemical Engineering**

## Business cases for green hydrogen

It is generally agreed that hydrogen employed in sustainable and emission-reducing projects needs to be sourced from ‘green’ feedstock and energy. Nevertheless, the vast majority of hydrogen sold today is ‘grey’ and produced by steam reforming of natural gas. Obviously, there are cost issues. Joseph’s work will look into how green hydrogen can be costed, so that it is more compatible with today’s energy system. This will include several areas of analysis: hydrogen production costs; externalities and effects on energy poverty; and business cases, high-value applications, and options to sell ‘greened’ products based on green hydrogen application. Joseph’s research aims to deliver a fully established cost model including environmental pricing, conclude business model development, dialogue with industry and validation of models and approaches.

**Supervisor**: Professor Robert Steinberger-Wilckens, Dr Rosie Day

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University of Nottingham
UK | CHINA | MALAYSIA

**Lukas Paulsson-Habegger (Cohort 5)**
**Business School**

## Manufacturing conductive oxides as catalyst support for energy efficient production of hydrogen and ammonia

Lukas will investigate a variety of solid oxides such as alumina and yttrium-stabilised zirconia and with the aim of characterising a number of properties such as their composition, crystal structures and conductivity, the end goal being to improve their performance in a number of roles such as catalyst supports, solid oxide electrolyser/fuel cell electrolytes, and membranes. This will involve creating and understanding new compositions of materials through doping and defect chemistry, in order to enhance processes such as hydrogen and ammonia production through increased efficiency and performance.

**Supervisors**: Dr Ming Li, Professor David Grant, Associate Professor Sanliang Ling

**Alemtsehay N Negash (Cohort 5)**
**Belfast School of Architecture and the Built Environment (BSABE)**

## Safety of compressed hydrogen storage systems for maritime applications

As the maritime industry moves towards greener fuels, hydrogen is emerging as a promising alternative due to its potential for zero-emission propulsion. However, ensuring the safety of compressed hydrogen storage systems in transport and other hydrogen-powered applications within the decarbonised maritime sector is critical for widespread adoption. Alemtsehay's project addresses the safety challenges, including those identified in IGF/IGC Codes, through rigorous research and focuses on identifying potential hazards and associated risks, including hydrogen leakage, overpressure scenarios, and fire hazards. These efforts aim to set new standards for safe hydrogen adoption and to close knowledge gaps by means of beyond state-of-the-art numerical models, and developing safety engineering solutions and strategies to ensures hydrogen-powered applications can operate inherently safer.

**Supervisor**: Dr Segii Kasharov, Professor Dmitriy Makarov, Professor Vladimir Molkov

**Mayank Kamboj (Cohort 5)**
**Belfast School of Architecture and the Built Environment (BSABE)**

## Modelling heat and mass transfer during liquid hydrogen refuelling

Liquified hydrogen (LH2) is considered as the most practical storage method onboard heavy-duty vehicles (HDV), trains, ships and planes in case of long distances. Currently there are no fuelling protocols for hydrogen inventory in excess of 10 kg when refuelling gaseous hydrogen. Modelling of fuelling of cryogenic hydrogen and LH2 transfer will pose even more challenges due to significantly lower temperatures and presence of two-phase flows with evaporation and condensation.

LH2 refuelling will require development of innovative safety strategies and engineering solutions for storage and transfer infrastructure, understanding of underlying physical phenomena, development and validation of contemporary Computational Fluid Dynamics (CFD) and reduced engineering models and tools for safety design. The developed and validated LH2 model will allow to run "numerical experiments" to get insight into underlying physical phenomena avoiding high costs, hazards and associated risks typical for large-scale experimental studies, and, on practical side, develop LH2 refuelling protocols.

**Supervisors**: Professor Dmitriy Makarov, Professor Vladimir Molkov, Dr Donatella Cirrone

# Student publications as of October 2024

| Publication |
|---|
| **Dada, A.O.**, Jones, K.D., Walsh, D.A. and Newton, G.N., 2024. Design and Strategies to Enhance the Electrochemical Properties of POM Nanomaterials for Electrocatalysis. Applied Polyoxometalate-based Electrocatalysis, pp.27-58. |
| **Sanyal, A.**, Malalasekera, W., Bandulasena, H. and Wijayantha, K.G.U., 2024. Review of the production of turquoise hydrogen from methane catalytic decomposition: Optimising reactors for Sustainable Hydrogen production. International Journal of Hydrogen Energy, 72, pp.694-715. |
| **Heeley, K.**, Orozco, R.L., Shah, Z., Macaskie, L.E., Love, J. and Al-Duri, B., 2024. Supercritical water gasification of microalgae: The impact of the algal growth water. The Journal of Supercritical Fluids, 205, p.106143. |
| **McGrath, A.J.**, Wadge, M.D., Adams, M., Manickam, K., Ling, S., Walker, G.S. and Grant, D.M., 2024. Stoichiometry and annealing condition on hydrogen capacity of TiCr2-x AB2 alloys. International Journal of Hydrogen Energy, 53, pp.582-591. |
| **Kazemi, M.**, Brennan, S. and Molkov, V., 2024. Hydrogen Safety by Design: Exclusion of Flame Blow-Out from a TPRD. Hydrogen, 5(2), pp.280-292. |
| **Heeley, K.**, Orozco, R.L., Macaskie, L.E., Love, J. and Al-Duri, B., 2024. Supercritical water gasification of microalgal biomass for hydrogen production-A review. international journal of hydrogen energy, 49, pp.310-336. |
| **Kazemi, M.**, Brennan, S. and Molkov, V., 2024. Numerical simulations of the critical diameter and flame stability for hydrogen flames. International Journal of Hydrogen Energy, 59, pp.591-603. |
| **Ebne-Abbasi, H.**, Makarov, D. and Molkov, V., 2024. CFD model of refuelling through the entire equipment of a hydrogen refuelling station. International Journal of Hydrogen Energy, 53, pp.200-207. |
| **Sivaraman, S.**, Makarov, D. and Molkov, V., 2024. Flash boiling and pressure recovery phenomenon during venting from liquid ammonia tank ullage. Process Safety and Environmental Protection, 182, pp.880-893. |
| **Mistry, J.R.**, McQueen, E., Nudelman, F., Sprick, R.S. and Wright, I.A., 2024. Non-conventional bulk heterojunction nanoparticle photocatalysts for sacrificial hydrogen evolution from water. Journal of Materials Chemistry A, 12(35), pp.23411-23415. |
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# Student publications as of October 2024 continued

| Publication |
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| Molkov, V., **Ebne-Abbasi, H**. and Makarov, D., 2023. CFD Model of Refuelling through the Entire HRS Equipment: The Start-Up Phase Simulations. Hydrogen, 4(3), pp.585-598. |
| Baptista, J., **Shacklock, J.**, Shaban, M., Alkayal, A., Lobato, K. and Wijayantha, U., 2023. Superior Rate Capability of High Mass Loading Supercapacitors Fabricated with Carbon Recovered from Methane Cracking. Inorganics, 11(8), p.316. |
| Molkov, V., Kashkarov, S., **Sivaraman, S.** and Makarov, D., 2023. Hazards and Associated Risks of Hydrogen Vehicles in Underground Traffic Infrastructure. Chemical Engineering Transactions, 105, pp.43-48. |
| **Mukelabai, M.D.**, Wijayantha, K.G.U. and Blanchard, R.E., 2023. Using machine learning to expound energy poverty in the global south: Understanding and predicting access to cooking with clean energy. Energy and AI, 14, p.100290. |
| Grantham, H.F., Lee, R.J., Wardas, G.M., **Mistry, J.R.**, Elsegood, M.R., Wright, I.A., Pritchard, G.J. and Kimber, M.C., 2023. Transition-Metal-Free Continuous-Flow Synthesis of 2, 5-Diaryl Furans: Access to Medicinal Building Blocks and Optoelectronic Materials. The Journal of Organic Chemistry, 89(1), pp.484-497. |
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| **Ebne-Abbasi, H.**, Makarov, D. and Molkov, V., 2022, May. CFD modelling of the entire fuelling process at a hydrogen refuelling station. In Proceedings of the International Seminar on Fire and Explosion Hazards (ISFEH10), Oslo, Norway (pp. 258-268). |
| Montanaro, S., Pander, P., **Mistry, J.R.**, Elsegood, M.R., Teat, S.J., Bond, A.D., Wright, I.A., Congrave, D.G. and Etherington, M.K., 2022. Simultaneous enhancement of thermally activated delayed fluorescence and photoluminescence quantum yield via homoconjugation. Journal of Materials Chemistry C, 10(16), pp.6306-6313. |
| Kashkarov, S., Dadashzadeh, M., **Sivaraman, S**. and Molkov, V., 2022. Quantitative risk assessment methodology for hydrogen tank rupture in a tunnel fire. Hydrogen, 3(4), pp.512-530. |
| **Mukelabai, M.D.**, Wijayantha, K.G.U. and Blanchard, R.E., 2022. Hydrogen for cooking: a review of cooking technologies, renewable hydrogen systems and techno-economics. Sustainability, 14(24), p.16964. |
| Kashkarov, S., Dadashzadeh, M., **Sivaraman, S**. and Molkov, V., 2022, May. QRA methodology of hydrogen tank rupture in a fire in a tunnel. In Proceedings of the International Seminar on Fire and Explosion Hazards (ISFEH10), Oslo, Norway (pp. 150-159). |

# Student publications as of October 2024 continued

| Publication |
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| **Mukelabai, M.D.**, Wijayantha, K.G.U. and Blanchard, R.E., 2022. Hydrogen technology adoption analysis in Africa using a Doughnut-PESTLE hydrogen model (DPHM). international journal of hydrogen energy, 47(74), pp.31521-31540. |
| **Mukelabai, M.D.**, Wijayantha, U.K. and Blanchard, R.E., 2022. Renewable hydrogen economy outlook in Africa. Renewable and Sustainable Energy Reviews, 167, p.112705. |
| **Kazemi, M.**, Brennan, S., & Molkov, V. (2022). Numerical modelling of sustained hydrogen combustion and flame blow-off from a TPRD. In Proceedings of the 10th International Seminar on Fire and Explosion Hazards (ISFEH10) Oslo, Norway (pp. 160-170). |
| Montanaro, S., Pander, **P., Mistry, J.R.**, Elsegood, M.R., Teat, S.J., Bond, A.D., Wright, I.A., Congrave, D.G. and Etherington, M.K., 2022. Simultaneous enhancement of thermally activated delayed fluorescence and photoluminescence quantum yield via homoconjugation. Journal of Materials Chemistry C, 10(16), pp.6306-6313. |
| **Jones, E.**, Inns, D.R., Dann, S.E., Silverwood, I.P. and Kondrat, S.A., 2022. Characterisation of ethylene adsorption on model skeletal cobalt catalysts by inelastic and quasi-elastic neutron scattering. Catalysis Communications, 163, p.106409. |
| Zhou, D., Li, P., Lin, X., **McKinley, A.**, Kuang, Y., Liu, W., Lin, W.F., Sun, X. and Duan, X., 2021. Layered double hydroxide-based electrocatalysts for the oxygen evolution reaction: identification and tailoring of active sites, and superaerophobic nanoarray electrode assembly. Chemical Society Reviews, 50(15), pp.8790-8817. |

# Selected student presentations (Sep 2023-Oct 2024)

| SusHy student | Presented at | Presentation title/topic |
|---|---|---|
| Samir Soares | Net Zero Futures Conference, 18 September 2024 | The challenges of decarbonising rural remote domestic heating in the UK (poster presentation) |
| Niko Hilmi | EuroMembrane 2024 Conference, 8-12 Sept 2024 | Metal-organic framework mixed matrix membranes for hydrogen purification (poster presentation) |
| Samir Soares | STFC Early Career Researchers Conference, 3-4 Sept 2024 | The challenges of decarbonising rural remote domestic heating in the UK (oral presentation)<br>Digital twin of a lab metal hydrogen system simulated in a rural UK home (poster presentation) |
| Antonia Dase | Dalton Northern Regional Meeting, 14 August 2024 | Ligand synthesis and transition metal complexes (poster presentation) |
| Antonia Dase | 45th International Conference of Coordination Chemistry (ICCC), 28 Jul - 3 Aug 2024 | Design and Synthesis of the Bulky [(SiiPr3)2P]− Ligand Precursor and its Low-Coordinate Group 12 and Transition Metal Complexes (oral presentation) |
| Mina Kazemi | 5th International Symposium on Hazards, Prevention and Mitigation of Industrial Explosions, 10-14 June 2024. | Stability of non-premixed methane flames: dependence on storage pressure and leak diameter (oral presentation) |
| Amelia-Rose Edgley | Celebrating Engineering Research showcase at University of Nottingham, 12 Jun 2024 | Nanostructured hydrogen storage materials for offshore green hydrogen (poster presentation) |
| Niko Hilmi | 7th Annual UK Porous Materials (UKPorMat) Conference, 4 - 5 Jun 2024 | Metal-organic Framework Mixed Matrix Membranes for Hydrogen Purification (poster presentation) |
| Alex McGrath | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Stoichiometry and annealing condition on hydrogen capacity of TiCr2-x AB2 alloys (poster presentation) |
| Samir Soares | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Developing a combined electrolyser and metal hydride storage system to evaluate metal hydride (poster presentation) |
| Yassin Ziar | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Thermal Conductivity Improvement for Hydrogen Storage via Additive Manufacturing (oral presentation) |

# Selected student presentations (Sept 2023-Oct 2024) continued

| SusHy student | Presented at | Presentation title/topic |
|---|---|---|
| Una O'Hara | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Identifying hydrogen release and diborane mitigation reaction mechanisms in sodium zinc borohydride - calcium hydride composites (oral presentation) |
| Salim Ubale | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Reliability Analysis of PEM Electrolyser Plant (poster presentation) |
| Ramas Al Qudah | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Innovative Materials for thermal Compression- Solving the Challenge of Hy-drogen Compression (poster presentation) |
| Amelia-Rose Edgley | 18th International Symposium on Metal-Hydrogen Systems, 26-31 May 2024 | Feasibility Study into Metal Hydride Buffer Stores for Use in Offshore Wind Scenarios (poster presentation) |
| Mossen Randeree | Birmingham Business School Research Conference, 8 May 2024 | Towards Understanding Sociotechnical Aspects of Regional Hydrogen Econ-omies (oral presentation) |
| Samir Soares | Energy Research Accelerator (ERA): A race against time – energy innovation for Net-Zero Conference, 25 Jan 2024 | Evaluating rural energy accessibility by the UK (poster presentation) |
| Samir Soares | UK Energy Storage conference (UKES2024), 10-12 Apr 2024 | Using hydrogen for a sustainable built environment (oral presentation) |
| Amelia-Rose Edgley | UK Energy Storage conference (UKES2024), 10-12 Apr 2024 | Nanostructured hydrogen storage materials for offshore green hydrogen (poster presentation) |
| Kieran Heeley | Hydrogen Days, 14th International Conference on Hydrogen Technologies, 20-22 Mar 2024 | Algal biomass to hydrogen: a circular approach for green sustainable pro-cessing with enhanced efficiency and minimal waste (oral presentation) |
| Joseph Walton | European Hydrogen Energy Conference (EHEC), 6-8 Mar 2024 | Up-to-date hydrogen production costs and their sensitivity to key parameter variations (poster presentation) |
| Alexandra Bro-choire | World Fuel Cell Conference at Imperial College Lon-don, 11-13 Dec 2023 | Proton exchange membrane water electrolysers with thin film nanostructured electrodes (poster presentation) |






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