

Adaptive Ammonia–Biodiesel Dual-Fuel Compression-Ignition Engines for Net-Zero Heavy-Duty Transport

EPSRC funded PhD studentship with full fee waiver and £21,805 pa stipend (2026/27 rate)

Project Code: DLA_DTP_2026_19

Main Supervisor: [Dr Helen Miao](#)

Co-Supervisor: [Professor Wenxian Yang](#)

Project Introduction

Decarbonising heavy-duty transport requires low-carbon fuels for engines that are difficult to electrify. Ammonia is a carbon-free fuel with strong potential, but its low reactivity and slow flame speed challenge its use in compression-ignition engines. This project will develop an ammonia–biodiesel dual-fuel CI engine to enable stable, efficient, and low-emission operation. By integrating advanced in-cylinder diagnostics, reduced-order combustion modelling, and adaptive real-time control, the research will optimise fuel-flexible strategies across steady and transient conditions, providing practical pathways toward sustainable heavy-duty propulsion.

Project Details

1. Background and Knowledge Gap

Decarbonising heavy-duty transport is critical to meeting net-zero targets, particularly in sectors that are difficult to electrify such as long-haul freight and off-road machinery. Carbon-free fuels such as ammonia offer a promising pathway due to their high hydrogen content and compatibility with existing fuel infrastructure. However, ammonia's low flammability, high auto-ignition temperature, and slow laminar flame speed present significant challenges for compression-ignition (CI) engines, leading to unstable combustion, poor engine performance, and elevated unburned fuel. Recent advances at institutions such as University of Oxford and Oak Ridge National Laboratories have demonstrated ammonia–diesel dual-fuel concepts, yet fundamental gaps remain in understanding ignition control, transient response, and adaptive multi-fuel optimisation under real-world duty cycles. Especially, there is limited integration of in-cylinder diagnostics, predictive modelling, and real-time control to enable stable, fuel-flexible operation across full-load and transient conditions.

2. Research Questions

This PhD will address the following key questions:

- 1) How can renewable pilot fuels (e.g., biodiesel) be optimally used to initiate and stabilise ammonia combustion in CI engines?
- 2) What combustion strategies (e.g., split injection, in-cylinder flow motion, EGR optimisation) maximise efficiency while minimising NO_x and unburned ammonia emissions?
- 3) How can reduced-order combustion models be developed and embedded into adaptive control frameworks for real-time optimisation under transient operation?
- 4) What are the operational limits and fuel-flexibility trade-offs in ammonia–biodiesel dual-fuel systems?

3. Three-Year Research Plan

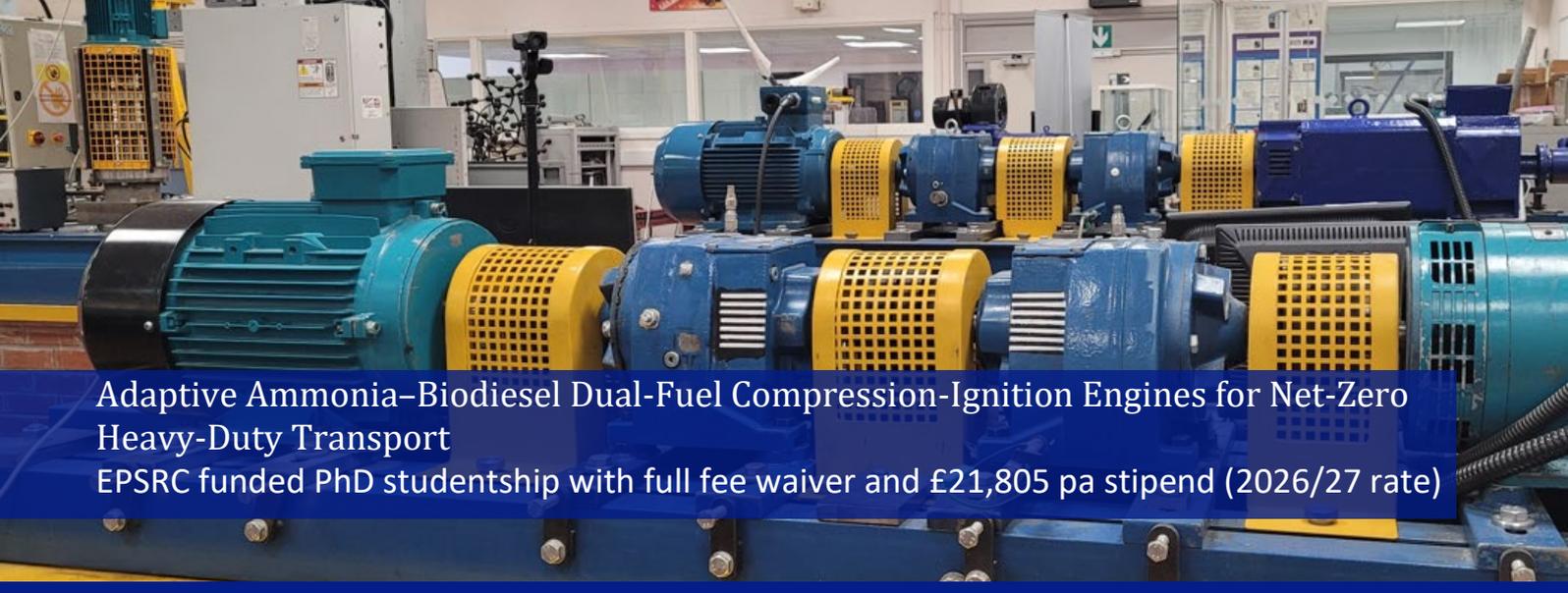
Year 1: Establish an ammonia–biodiesel dual-fuel CI engine platform. Benchmark baseline combustion strategies under steady-state conditions. Deploy in-cylinder diagnostics (pressure analysis, heat release, emissions measurement) to characterise ignition delay, burn duration, and emission formation pathways.

Year 2: Develop and validate reduced-order combustion and emissions models informed by experimental data. Investigate fuel-flexible operation across varying ammonia substitution ratios and transient load cycles. Optimise injection timing, pilot quantity, and EGR strategies for efficiency–emission trade-offs.

Year 3: Design and implement adaptive real-time control algorithms integrating model-based predictions and sensor feedback. Validate performance under dynamic drive cycles representative of heavy-duty applications. Conduct system-level efficiency and lifecycle emission assessments.

4. Expected Outcomes

The project will deliver: (1) a validated dual-fuel ammonia CI combustion strategy, (2) experimentally verified reduced-order models suitable for real-time implementation, (3) adaptive control methodologies enabling stable, efficient, and low-emission operation, and (4) design guidelines for scalable multi-fuel heavy-duty engines. These outcomes will provide a robust technical pathway for sustainable, fuel-flexible propulsion in hard-to-electrify transport sectors.



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Project-specific entry requirements

Applicants should hold (or be expected to obtain) a first-class or high upper second-class (2:1) BEng/MEng degree, or a Master's degree with distinction/merit, in Mechanical Engineering, Automotive Engineering, Aerospace Engineering, Energy Engineering, Chemical Engineering, or a closely related discipline.

A strong academic background in thermodynamics, fluid mechanics, combustion, and heat transfer is essential, including:

- Fundamental understanding of internal combustion engines and combustion processes.
- Knowledge of alternative fuels (e.g., hydrogen, ammonia, biofuels) and emissions formation mechanisms (NO_x , unburned fuel, particulates).
- Understanding of engine calibration or real-time control systems is beneficial.

Essential skills:

- Experience with experimental methods, data acquisition systems, and signal analysis.
- Familiarity with modelling tools (e.g., MATLAB/Simulink, Python, GT-Power, or similar) and basic control theory.
- Ability to work both independently and collaboratively within a multidisciplinary research team.
- Excellent communication skills (written & verbal) in English to effectively convey research findings, collaborate with team members, & present results to diverse audiences.

Desired Skills/Experience:

- Experience in experimental design, data interpretation, and technical report writing.
- Experience with data processing, modelling, or control algorithm development is advantageous.
- Industrial experience in engine development, alternative fuels, or control systems is beneficial but not essential.

Further Information

This call is open to **UK Applicants only**.

Applicants should be of outstanding quality and exceptionally motivated.

The studentships are funded for 3 years (subject to satisfactory annual performance progression review) and will provide tuition fees and tax-free stipend paid monthly.

Please note that there are more projects than funded studentships available and therefore this is a competitive application process which will include an interview. Shortlisted candidates will be contacted for an interview in person or via Teams. After interview the most outstanding applicants will be offered a studentship.

Queries about the application process are welcome and should be emailed to pgrscholarships@hud.ac.uk.

Informal enquiries should be directed to [Dr Helen Miao](#).

Type of Award: Doctor of Philosophy (PhD).

Eligibility: UK applicants only. First Class or Upper Second-Class Honours degree or equivalent in a relevant subject area, please refer to the entry requirements on the specific projects being advertised.

Location: Huddersfield.

Funding: 3 years full time research covering tuition fees and tax-free bursary (stipend) starting at £21,805 for 2026/27 and increasing in line with EPSRC guidelines for subsequent years. Funded via the Engineering and Physical Sciences Research Council Doctoral Training Programme.

Duration: 3 years full-time plus 12 months writing up (please note no funding is available for writing up period).

Closing date: 28th April 2026

Start date: 1st October 2026

Application details

- Go to the EPSRC webpage and download the [Expression of Interest Form 2026](#).
- Provide copies of transcripts & certificates of all relevant academic and/or professional qualifications.
- Provide references from two individuals – please contact your referees and ask them to send them directly to pgrscholarships@hud.ac.uk from their email address.
- Proof of eligibility – e.g. scan of passport photo page.
- Completed forms, including all relevant documents should be submitted via-email to pgrscholarships@hud.ac.uk.
- **Please note:** if you do not attach all the relevant documentation prior to the closing date your application will not be considered.