**4. Recruitment strategy**

The recruitment strategy is critical to project success and will be prioritised accordingly. While all beneficiaries have strong individual track records in terms of recruiting highly skilled researchers, network wide coordination will be used to enhance chances of success. In advance of the project start, the HR officer and project coordinator will prepare and distribute recruitment guidance, including templates for advertisements which emphasise the unique benefits of the programme (network connectivity, complementary skills training, industry exposure, etc.), and standardised guidelines for interviews. The preparation of these documents will be overseen by an experienced HR advisor from NTNU. The guidelines will specify how each recruitment should follow the EU *Code of Conduct for the Recruitment of Researcher*s, emphasising transparency and the equal treatment of applicants.

Candidates will be sought with relevant educational backgrounds, typically with Master’s degrees in Mechanical/Aeronautical Engineering, Physics, or Applied Mathematics, relevant skills in programming and other relevant skills in experimental, numerical or theoretical methods. Candidates prior access to research infrastructure will be considered to avoid institutional discrimination. Advertisements will be made locally and network wide through channels including: the *EURAXESS jobs and funding portal*, relevant engineering institutes such as *ERCOFTAC**[[1]](#footnote-2)* and *eFluids[[2]](#footnote-3)*, and to strive for gender balance the *Women in Science and Engineering27* and the *European Centre for Women and Technology28*sites targeting female applicants*.*

To assess applications international selection committees will be formed, involving as standard members from multiple institutions. Each committee will typically have 3 members, with adequate gender representation prioritised. Committees will be supported by local HR teams to ensure compliance with local employment law. All selected candidates will be offered fixed term contracts at each beneficiary of sufficient duration cases to qualify them for a doctoral degree. Each hiring committee will produce a ranking report for all eligible candidates, justifying the prioritisation. This will be reviewed by the gender officer and HR officer prior to recruitment, to help eliminate instances of unconscious bias.

Recruitment is planned between M3 to M8, with beneficiaries advised to prepare advertisements in advance of the project start date, but after receiving guidance documentation. A recruitment channel in MS Teams will be used to share information about strong candidates across the network, allowing the most suitable candidates to be appointed.

5. Network organisation

One of the initial tasks in WP5 is the establishment of a management structure, which will be formed according to figure 4. The supervisory board will be the main decision-making body, responsible for steering all network activities. Four dedicated committees will be formed by the supervisory board, to oversee: 1. Research; 2. Training; 3. Dissemination; and 4. the Doctoral Candidates. The committees will implement quality assurance measures and provide clear communication and management pathways. Each committee will convene once every 6 months as standard, with extraordinary meetings when required. A Gantt chart describes timing. Each committee will make annual reports to the supervisory board, which take actions. The supervisory board will also be supported by additional officers for: 1. Gender and Diversity; 2. Human Resources; and 3. Sustainable Research.

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| Figure 4. Management structure |

Overview of committees and their main functions

The research committee will evaluate research task progress via yearly reports, assessing critical deviations from the project specification or timeline, and any high-risk dependencies. The committee will provide a summary of these reports to the supervisory board, and recommend necessary corrective measures, to ensure the research goals are achieved. At the start of the project, the committee will produce guidance documents to identify procedures to follow in cases of scientific misconduct, which will be aligned with the *European Code of Conduct for Research Integrity*. The research committee will be formed by the scientific WP leaders (Professors Aimee Morgans, Kilian Oberleithner, and Matthew Juniper), and a representative from each industrial partner/beneficiary, to ensure the research is well connected with industrial needs.

The training committee will ensure Career Guidance Plans are completed on time, and assess training progress based on yearly reports, proposing amendments where necessary. The committee will also be responsible for workshop planning and execution, and for handling any issues connected to secondments. The training committee will be led by Professor Wolfgang Polifke, who leads the training activities in WP4. Three other representatives will be chosen from academia and industry, to ensure industry perspectives are included throughout the training programme.

The dissemination committee will be responsible for preparing the detailed dissemination, communication, and exploitation plan at the start of the project. During the project, the committee will: assess new opportunities for public engagement as they arise; act as the default contact for dissemination issues, including IPR and patent issues; and collate information from the consortium which will be published on the public website. The committee will include 2 members from academia, with one representative from each industrial partner, to ensure IPR issues are clearly and transparently communicated. The committee will also involve a communications officer from NTNU, who will help organise network outreach events.

Finally, a Doctoral Candidate committee will be formed to discuss issues affecting researchers and communicate these to the supervisory board. This committee will also arrange social and outreach functions for the DCs during workshop events, to strengthen informal interactions and group cohesion. This committee will be formed of three DCs, with positions rotated on a yearly basis to provide DCs with organisational experience.

Overview of officers and their main functions

The Gender and Diversity Officer will oversee the network operation, and ensure that gender, diversity, and equality issues are fully addressed. The Officer will be directly involved in: setting up the management structure, with the need for gender balance and diverse representation throughout all network management levels given high priority; drafting the recruitment protocols, and implementing extra measures aimed at increasing the number of women and researchers from diverse backgrounds in DC positions; communication with supervisory board to resolve any gender and diversity specific issues that affect the work environment, including those relating to mobility and training needs.

The Human Resource Officer will be given responsibility for drafting the recruitment protocols at the start of the network. During the network operation they will be the contact point for DCs to resolve personnel, mobility, and support issues, helping to ensure that researchers and employers act responsibly and professionally, following the guidelines set out in the *European Charter for Researchers*. They will also be closely involved with the training committee during the drafting and monitoring of Career Development Plans.

The Sustainable Research officer will be responsible for encouraging sustainable thinking in research management. They will be involved with the planning of network training and research activities and will be tasked with raising awareness throughout the lifetime of the network. They will report these activities to the supervisory board. These reports will be used to influence future research activities at each beneficiary both during and beyond the lifetime of the centre.

External advisory board

An external advisory board will be convened to provide oversight of the project. This board will involve senior researchers from international institutions, both academic and industrial, who are otherwise unconnected with the project. The network has made prior contact with the Aerospace Technology Institute, who coordinate a Hydrogen Capability Network, and will be invited to be members of the external advisory committee. The supervisory board will prepare annual summary reports of activities within the network, which will be reviewed by the advisory board. The external advisory board will also be contacted to help resolve discuss critical operational issues or conflicts.

Use of the Consortium Agreement to formalise network operation.

The network organisational structure will be formalised within the consortium agreement, which will be drawn up at project initiation, based on the *DESCA for Horizon Europe* model. The aim of this document is to provide a framework for successful project implementation, which in TITAN will include an extra focus on issues including budget management, data management/sharing and other IPR relevant areas. All beneficiaries and partners within TITAN have experience conducting European projects involving consortium agreements and are familiar with best practices. TITAN will adopt a standard approach to IP management, with ownership of all foreground IP assigned to the project partner carrying out the work. Work carried out jointly between partners will result in joint ownership of foreground IP. Lead scientists at each institution will be responsible for identifying potential new IP, and the dissemination committee will be involved in deciding next steps, such as how this should be protected.

Financial management strategy

The network will operate a transparent financial management strategy, with clear connections between financing and delivery of scientific and training objectives. Financial administrative officers at NTNU will assist with the preparation of overall budgets. Management costs for each DC will be partially redistributed within the network as part of the consortium agreement negotiation. Financial resources will be reallocated based on management and training responsibilities and costs, allowing beneficiary and partners to cover the costs of local activities, such as the organisation and running of workshops, and the employment of external educators. TU/e offers a 4-year PhD programme, and the extra year of funding has been agreed and will be supplied as in-kind by TU/e if the proposal is funded.

Internal network communication strategy

Dedicated channels will be created in MS Teams for the supervisory board, each of the committees, as well as a network wide channel to facilitate effective communication. The site will also be used to promote contact between network members, through regular online seminars and discussions. This will augment the face-to-face contact between network members during physical workshop and conference events. It will also allow DCs to pose questions to the entire network, encouraging engagement. The majority of committee meetings will be held online to avoid unnecessary travel.

**6.** Supervisory board

Professor Nicholas Worth will act as project coordinator and will chair the supervisory board, with responsibility for all administrative aspects and overall financial management. Administrative officers from NTNU will also be included to support the financial and project management. The board composition will ensure all beneficiaries and supervisors are represented, through the lead researcher/scientist from each organisation. A list of supervisors and co-supervisors is included in table 5. A board position will also be assigned to the DC who is head of the Doctoral Candidate Committee. This position will rotate yearly. All associated partners will also be represented, to ensure industry research and training needs are well represented. The Gender and Diversity officer will be involved in formation of the board, to help prioritise gender balance.

The board will convene every 6 months. Regular items of business will include: reviewing and approving reports from sub committees and officers; organisation and scheduling of network activities; financial management including monitoring of management and training costs; status and progress of training and research activities; assessment and modification of overall strategy, including research tasks and training elements, in order to remain on target to meet both research and training objectives.

All representatives on the board will have equal voting rights, and decisions will be made based on a simple majority principle. Given the strong existing relationships between beneficiaries and associated partners the *Interest-Based Relational Approach* will be used to deal with conflict resolution. This model ensures that good working relationships are prioritised, separates problems from people, and ensures each party is given space to set out interests and facts, with options to achieve common goals explored together. In cases where this approach fails, additional input and help will be sought from the external advisory board.

**Table 5. List of main and co-supervisors**

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| **Doctoral candidate** | **Main Supervisor** | **Gender** | **Co-supervisor** | **Gender** |
| DC1 | Jonas Moeck | Male | Nicholas Worth | Male |
| DC2 | Nicholas Worth | Male | James Dawson | Male |
| DC3 | Matthew Juniper | Male | Epaminondas Mastorakos | Male |
| DC4 | Matthew Juniper | Male | Simone Hochgreb | Female |
| DC5 | Wolfgang Polifke | Male | Grégoire Varillon | Male |
| DC6 | Wolfgang Polifke | Male | Camilo F. Silva | Male |
| DC7 | Aimee Morgans | Female | Salvador Navarro-Martinez | Male |
| DC8 | Salvador Navarro-Martinez | Male | Aimee Morgans | Female |
| DC9 | Thomas Ludwig Kaiser | Male | Kilian Oberleithner | Male |
| DC10 | Kilian Oberleithner | Male | Thomas Ludwig Kaiser | Male |
| DC11 | Laurent Selle | Male | Laurent Gicquel | Male |
| DC12 | Laurent Gicquel | Male | Laurent Selle | Male |
| DC13 | Guillaume Fournier | Male | Nicholas Treleaven | Male |
| DC14 | Vincent Moureau | Male | Guillaume Fournier | Male |
| DC15 | Claire Bourquard | Female | Danilo Beli | Male |
| DC16 | Mirko Bothien | Male | Kilian Oberleithner | Male |

**7.** Environmental aspects in light of the MSCA Green Charter

The TITAN network is committed to adopting the best practices outlined in the *MSCA Green Charter*, to ensure the sustainable implementation of research activities within the network, and accordance with the *European Green Deal* and the *United Nation’s 2030 Sustainable Development Goals*.

A variety of sustainable practices will be adopted from the outset of the project, with the joint aims of promoting awareness of sustainable research and making the implementation of the TITAN project carbon neutral overall. To achieve this dedicated training activities will be incorporated early in the programme, focusing specifically on CO2 calculations for research activities, complete life cycle assessment, and the circular economy. Based on this training, each DC will be able to make CO2 cost estimates for their local research activities (including the transport of goods, computational resources, office usage, etc), and travel. The Sustainability Officer will collate these estimates to calculate the total CO2 cost of the project. Total project CO2 emissions will be offset by a proportion of the travel budget being contributed to long term reforestation programmes, such as *One Tree Planted[[3]](#footnote-4)*.

Efforts will also be made to use low-emission forms of transport and reduce unnecessary transport emissions. One of the flagship activities for the TITAN network are the workshops and summer schools. By providing structured and unstructured opportunities for DCs to interact, these will allow DCs and researchers to strengthen their personnel networks. These will also provide DCs with international experience, of working and training in different environments and cultures. These wider training goals can only be achieved by holding physical events, which allow for face-to-face contact. To improve sustainability but maintain these crucial opportunities, fewer but longer events will be held. Combining multiple scientific and complementary training activities will reduce the overall amount of travel required and corresponding CO2 emissions. Furthermore, the Sustainability officer will release specific transport guidance. This will recommend modes of transport depending on travel duration. Rail travel will be prioritised for all short and medium journeys, with only long journeys recommended to take flights. Supervisory board, committee and supervisory meetings regarding research projects will be held online where possible to reduce transport costs and emissions.

At the local level all institutes will comply with sustainability best practices, including the reduction of project related materials (reducing unnecessary printing, papers), reuse (making use of existing computational resources such as screens, cables, accessories to reduce e-waste), and recycling of all possible materials following local guidelines. Online meetings will be held where possible to reduce unnecessary travel.

**8.** Participating Organisations

For **beneficiaries**:

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| **Beneficiary Legal Name:** Norges Teknisk-Naturvitenskapelige Universitet | |
| **General Description**  HR Excellence in Research Award — Vitae Website | NTNU is Norway’s leading university for engineering and science with over 20,000 undergraduate students situated in the city of Trondheim. The Department of Energy and Process Engineering has 42 faculty members with four specialist research groups: Thermo-fluids, Process and Power, Industrial Ecology, and Sustainable Energy Systems. NTNU endorses the *Code of Conduct for the Recruitment of Researchers.* Holds the *HR Excellence in Research Award.* |
| **Role and Commitment of key persons (including supervisors)** | **Nicholas Worth** (Male), is a Professor and Head of Research Group in the Department of Energy and Process Engineering at NTNU. He obtained a PhD from the University of Cambridge in experimental fluid dynamics and turbulence. His research areas include turbulent flows, gas turbine combustion, and the development of experimental methods. He was a recipient of an ERC starting grant in thermoacoustic instabilities in annular combustors. Role: Supervisor of DC, and project coordinator. 25% involvement.  **Jonas Moeck** (Male), is Associate Professor at the Department of Energy and Process engineering at NTNU. He received a PhD degree in combustion dynamics from the Technical University Berlin. His research comprises experimental and theoretical work related to thermo-fluid systems and their control. He has received 5 best paper awards for work on thermoacoustic oscillations. Role: Supervisor of DC, 10% involvement.  **James Dawson** (Male), is Professor in Fluid Mechanics in the Department of Energy and Process engineering at NTNU. He received his PhD at Cardiff University, and was an EPSRC Advanced Research fellow at the University of Cambridge. He is the current recipient and leader of an ERC synergy grant in the areas of hydrogen combustion at elevated pressure for stationary gas turbines. His research areas are in turbulent flows, gas turbine combustion, and experimental methods. Role: Co-supervisor of DC, 5% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | Diagram of a machine with text and words  Description automatically generatedA close-up of a machine  Description automatically generatedThese include approximately 2000 m2 of newly refurbished laboratories including a dedicated Turbulent Combustion Laboratory housing atmospheric and pressurised annular combustion facility (shown below).  A suite of laser diagnostics including high speed chemiluminescence imaging, high- and low speed PLIF and PIV systems, Laser Doppler Anemometer systems, FTIR emissions measurement system, |
| **Status of Research Premises** | All the research facilities are independent and fully owned by NTNU. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | The research team has been involved in several EU Research projects related to combustion, thermoacoustic instabilities, and training including: TAIAC (677931), an ERC starting grant on thermoacoustic instabilities in annular combustor; ANNULIGhT (765998), an Innovative Training Network (ITN) on instabilities, ignition and blow-off in annular gas turbine combustors. |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | HYROPE, an ERC synergy grant in the areas of hydrogen combustion at elevated pressure for stationary gas turbines. STA (299946) FRIPRO grant, Norwegian Research Council on H2 combustion. InsigH2T, Clean Aviation JU project to understand the fundamental effects of pressure on the turbulent burning rate, thermoacoustic response and emissions of flames under gas turbine operating conditions. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Indlekofer, T., Ahn, B., Kwah, Y. H., Wiseman, S., Mazur, M., Dawson, J. R., & Worth, N. A. (2021). The effect of hydrogen addition on the amplitude and harmonic response of azimuthal instabilities in a pressurized annular combustor. *Comb. and Flame*, *228*, 375-387.  [2] Worth, N. A. & Dawson, J. R. (2013). Modal dynamics of self-excited azimuthal instabilities in an annular combustion chamber. *Comb. and Flame*, *160*(11), 2476-2489.  [3] Æsøy, E., Aguilar, J. G., Wiseman, S., Bothien, M. R., Worth, N. A., & Dawson, J. R. (2020). Scaling and prediction of transfer functions in lean premixed H2/CH4-flames. *Combustion and Flame*, *215*, 269-282.  [4] Candel, S., Durox, D., Schuller, T., Bourgouin, J.-F., Moeck, J.P. (2014). Dynamics of swirling flames. *Annual Review of Fluid Mechanics*, 46, 147–173.  [5] Magri, L., Schmid, P., Moeck, J.P. (2023). Linear flow analysis inspired by mathematical methods from quantum mechanics. *Annual Review of Fluid Mechanics*, 55, 541–574. |

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| **Beneficiary Legal Name:** The Chancellor Masters and Scholars of the University of Cambridge (UCAM) | |
| **General Description** | UCAM is one of the leading scientific research institutions worldwide and is regularly ranked in the top 5 universities. The Engineering Department is the highest-ranking department of its type in the UK. It is an integrated department, with several cross-disciplinary collaborations. The department has 180 members of staff, 700 post-doctoral researchers and a similar number of graduate students. A sizable fraction of the activity, involving 70 staff in the university, revolves around fluid mechanics, aeroacoustics and combustion, with a correspondingly large number of PhD students. |
| **Role and Commitment of key persons (including supervisors)** | **Prof. Matthew Juniper** (Male) is Professor of Thermofluid Dynamics in the Engineering Department. He completed his PhD in Cryogenic Combustion from Ecole Central Paris in 2001 and was appointed Lecturer in Combustion at the Engineering Department in 2003. His research interests are in flow instability, adjoint-based sensitivity analysis, shape optimisation, physics-based Bayesian inference accelerated with adjoint methods, and programmable inference. He is Associate Editor of the Journal of Fluid Mechanics and has held visiting fellowships/professorships at Ecole Central Lyon, the Institute for Advanced Studies at TU Munich, KTH/Nordita Stokholm, IIT Madras, and the Center for Turbulence Research Summer Program at Stanford University. He was a recipient of an ERC Starter Grant, has participated on 5 Marie Curie ITNs, and has supervised or co-supervised 6 Marie Curie ECRs. He has graduated 20 PhD students and supervised another 4. Several previous members of his group are now full professors (Illingworth at Melbourne, Li at Hong Kong Inst. Sci. Tech, Magri and Rigas at Imperial College London, Tammisola at KTH Stockholm). Professor Juniper's role will be to supervise the fellows, to provide research direction, technical input, and to manage administrative matters. Professor Juniper's immediate research group contains around 6 researchers, whose skills will be invaluable to the additional support and training of the fellow. The Energy Group is also assisted by an experienced team of administrators familiar with Marie-Curie and other EU projects. Role: Supervisor of 2 DCs and WP3 leader, 20% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | The group has a fully automated highly instrumented laboratory scale thermoacoustic test rig. Diagnostics include 8 probe microphones, 4 free-standing microphones, a high-speed camera, and several dozen thermocouples, which allow the rig to be well characterised to within known measurement error. The group has significant software and computational facilities available to the project. The software includes a differentiable (to 1st and 2nd order) thermoacoustic network model that is used to assimilate data from the automated rig, a differentiable (to 1st order) thermoacoustic Helmholtz solver written in the Finite Element code DolfinX (previously known as FEniCS), and codes for calculation of local and global hydrodynamic instabilities in reacting flows. These codes run on individual high-performance workstations within the group and on the High-Performance Computing cluster at Cambridge University. |
| **Status of Research Premises** | All the research facilities are independent and fully owned by UCAM. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | ANADE (Marie Sklodowska-Curie grant agreement No 289428)  SSEMID (Marie Sklodowska-Curie grant agreement No 675008)  MAGISTER (Marie Sklodowska-Curie grant agreement No 766264)  ANNULIGhT (Marie Sklodowska-Curie grant agreement No 765998)  ALORS (ERC Starter Grant No 259620) |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | SSECOID (Marie Sklodowska-Curie grant agreement No 955923) |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] M. Juniper, Machine Learning for Thermoacoustics in *Machine Learning and its Application to Reacting Flows* Eds: Nedunchezhian Swaminathan and Alessandro Parente, Springer, ISBN 978-3-031-16250-3  [2] M. Juniper, R. I. Sujith, Sensitivity and nonlinearity in Thermoacoustics, *Annual Review of Fluid Mechanics*, **50**, 661–689  [3] M. Juniper, M. Yoko, Generating a physics-based quantitatively accurate model of an electrically heated Rijke tube with Bayesian inference, *Journal of Sound and Vibration* **535**, 117096  [4] A. Kontogiannis, S. V. Elgersma, A. J. Sederman, M. Juniper, Joint reconstruction and segmentation of noisy velocity images as an inverse Navier–Stokes problem, *Journal of Fluid Mechanics* **944**, A40  [5] S. Falco, M. P. Juniper, Shape Optimization of Thermoacoustic Systems Using a 2D Adjoint Helmholtz Solver, Journal of Engineering for Gas Turbines and Power 143 (7) 071025 (2021) |

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| **Beneficiary Legal Name:** Technische Universität München (TUM) | |
| **General Description** | TUM is one of the leading technical universities in Germany and one of the first “Universities of Excellence” with outstanding performances in research education and talent promotion. TUM educates 53,000 students in more than 180 study programs, organised across 7 schools. The Thermo-Fluid Dynamics group is a research unit in the Department of Engineering Physics and Computation with three postdocs and ten doctoral researchers. The research activities of the group cover the fields of thermo-fluid dynamics, e.g., transport processes, reacting flows, flow instabilities, aero- and thermo-acoustics, combustion instabilities and noise. |
| **Role and Commitment of key persons (including supervisors)** | **Prof. Wolfgang Polifke:** Professor of Thermo-Fluid Dynamics. PhD 1990 (CCNY). 30+ years research experience in thermoacoustic instabilities, (turbulent) premixed combustion, and multi-phase flows. 25+ years supervision experience with 40+ completed doctoral degrees. 300+ refereed, SCOPUS-listed publications. 10+ patents. Fellow of the Combustion Institute. 9 years industrial research (ABB Switzerland). Several previous members of his group are now full professors (Selimefendigil at Celal Bayar, Huber at U. Stuttgart, Ghani at TU Berlin, Doan at TU Delft, Surendran at IIT Madras, Karban at METU )  Role: supervisor of 2 DCs. WP Leader Training. Secondment host. 12.5% commitment.  **Dr. habil. Camilo Silva** Senior Researcher / Lecturer. Ph.D. in 2010 in Mathematics and Thermoacoustics from U. Montpellier, France. 10 years supervision. 65+ refereed publications listed in SCOPUS. Role: co-supervisor. 10% commitment.  **Dr. Grégoire Varillon:** Postdoctoral researcher, Ph.D. in 2019 in Plasma physics from U. Paris-Saclay, France. Expertise in linearised fields and associated numerical methods, thermoacoustic instabilities and fluid dynamics. 5 years of co-supervision experience. Role: co-supervisor of DC. 10% commitment. |
| **Key Research Facilities, Infrastructure and Equipment** | High performance computing facilities of the Leibniz Rechenzentrum (see [https://www.lrz.de](https://www.lrz.de/)). Software (AVBP, OpenFOAM, ANSYS Fluent, StarCCM+) for large eddy simulation of compressible (reactive) flows. Software packages "taX" (<https://gitlab.lrz.de/tfd/tax>) and “felicitaX” for frequency or time domain (stability) analysis of aero- and thermo-acoustic systems. Toolbox for reduced order model (acoustic scattering matrices or flame transfer functions, etc.) system identification from time series data. Toolbox for uncertainty quantification of thermoacoustic stability analysis. Each graduate student is enrolled in TUM Graduate School, which offers cross-disciplinary and soft-skill training (scientific writing, time & project management, etc.). |
| **Status of Research Premises** | Yes - all the research facilities are independent and fully owned by TUM. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | Several MSCA ITNs related to thermo- and aeroacoustics (**AETHER**, **FlowAirs**, **TANGO, ANNULIGhT**), high performance computing (**MyPlanet**), machine learning (**MAGISTER**), hydrogen combustion (**POLKA**). Numerous projects funded by DFG (German Research Council), e.g. priority programme **SFB TRR 40** and AG Turbo (research association for turbomachinery, co-funded by gas turbine industry and federal ministry of economics ). |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | **AG Turbo InnoTurbine** - Technological foundations for the development of gas turbine technology with increased operational flexibility (BMWK), **LuFo VI** (German federal research program in civil aviation) - two projects on thermoacoustic instabilities in low-emission combustion technology for reduced climate impact of aviation. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Caeiro F., Sovardi C., Förner .K, Polifke, W. Shape optimization of a Helmholtz resonator using an adjoint method. Int. J. Spray and Combustion Dynamics. 2017;9(4):394-408.  [2] Avdonin, A., Meindl, M., Polifke, W. Thermoacoustic analysis of a laminar premixed flame using a linearized reactive flow solver, Proc. Comb. Inst., 37 (4), 2019, p.5307-5314  [3] Meindl, M., Silva, C.F., Polifke, W., On the spurious entropy generation encountered in hybrid linear thermoacoustic models, Combustion and Flame, Volume 223, 2021, Pages 525-540  [4] Schaefer, F., Magri, L., and Polifke, W. A Hybrid Adjoint Network Model for Thermoacoustic Optimization. J. Eng.for Gas Turbines and Power, 144, No. 3, 2022, p. 031017.  [5] Varillon, G., Kaiser, T.-L., Brokof, P., Oberleithner, K., and Polifke, W., “Linear Analysis of a Swirling Jet with a Realistic Swirler Model,” Int. J. Spray Combustion Dynamics, 16, No. 3 2024. |

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| **Beneficiary Legal Name:** Imperial College of Science Technology and Medicine (Imperial College London) | |
| **General Description**  HR Excellence in Research Award — Vitae Website | Imperial College London is a science-based university with an international reputation for excellence in teaching and research. It is the only UK University to focus entirely on science, engineering, medicine and business. Consistently rated amongst the world's best universities and located in the heart of London, Imperial combines education, research and translation in order to harness science and innovation to tackle global challenges. Imperial College London endorses the *Code of Conduct for the Recruitment of Researchers.* Holds the *HR Excellence in Research Award.* |
| **Role and Commitment of key persons (including supervisors)** | **Aimee Morgans** (female) is Professor of Thermofluids in the Department of Mechanical Engineering at Imperial College London. Her research interests include thermoacoustics, aeroacoustics and flame simulations. She has a PhD on aeroacoustics from the University of Cambridge. She then held a Royal Academy of Engineering 5-year Research Fellowship, joining Imperial College as a Lecturer (Assistant Professor) in 2007. She has been at Imperial since, becoming full Professor in 2017. She formerly held a 5-year European Research Council (ERC) Starting Grant, and currently holds a 5-year ERC Consolidator Grant, both on thermoacoustic instability. She was elected a Fellow of the UK’s Royal Academy of Engineering in 2021 and the Menelaus Medal by the Learned Society of Wales in 2023. Role: Supervisor of DC and leader of WP1, 12.5% involvement.  **Salvador Navarro-Martinez** (Male) is Reader in the Department of Mechanical Engineering at Imperial College London. He completed his PhD in high-speed flows at the University of Southampton. His research focusses on the development of sub-models for reacting flows using Large Eddy Simulations, a topic on which he held a Royal Society University Fellowship (2009-16). His awards include the 2005 and 2007 Sugden for most important continuation to combustion Science in the UK and the 2010 Hinshelwood Prize, all from the British section of the Combustion Institute. He has graduated 9 PhD Students as main supervisor and currently supervised 4. Role: Supervisor of DC, 10% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | All DCs are provided with a desk equipped with a modern internet-connected workstation in their host department on campus. Computational, finance and wellbeing support is provided at department level and all PhD students have free access to a range of research skills and professional development courses through Imperial’s central [Graduate school](https://www.imperial.ac.uk/students/academic-support/graduate-school/professional-development/doctoral-students/)[[4]](#footnote-5). Computational projects benefit from access to Imperial’s high-performance computing facilities, allowing massively parallel simulations on several thousand cores, and supported by ICT and research software engineers. The open-source low order thermoacoustic network code, OSCILOS, has been developed over the last 10 years by the group of Aimee Morgans at Imperial College London and will be available to all DCs in this network. The high-order open-source compressible Large Eddy Simulation reactive solve CompReal has been developed over the last 8 years and can take advantage of modern GPU/OpenMP/MPI hybrid parallelisation strategies. |
| **Status of Research Premises** | All the research facilities are independent and fully owned by Imperial College London. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | Aimee Morgans has not been a beneficiary in previous ITNs. She was previously on the management and research committees for a UK Centre for Doctoral Training in Fluid Dynamics (2017-21) and previously held an ERC Starting Grant (ACOULOMODE 2013-18).  Salvador Navarro-Martinez was member of the ITN Holistic Approach of Spray Injection through a generalised multi-phase framework (HAOS 2015-19), MSCA grant agreement No 675676.  Imperial College London was fully involved in Horizon 2020 (2014-20). It was awarded 500 Horizon 2020 projects, including over 170 MSCA Individual Fellowships, and 54 MSCA ITNs. |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | The above key persons are not currently involved in any ITN Training Programmes. Aimee Morgans holds an ERC Consolidator Grant (AFIRMATIVE 2018-23).  For Horizon Europe (2021-2027), Imperial participates in over 164 projects including 18 Marie Skłodowska-Curie Doctoral Network projects (as an Associated Partner receiving funding from UKRI for its Doctoral Candidate recruitments); and 46 UKRI funded Postdoctoral Fellowships following successful MSCA Postdoctoral Fellowship proposals in 2021 and in 2022. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] J. Guzman-Inigo, D. Yang, H. Johnson, A. S. Morgans, Sensitivity of the acoustics of short circular holes with bias flow to inlet edge geometries, AIAA Journal, 57 (11), 4835-4844, 2019  [2] Y. Xia, D. Laera, W. P. Jones, A. S. Morgans, Numerical prediction of the Flame Describing Function and thermoacoustic limit cycle for a pressurised gas turbine combustor, Combustion Science & Technology, 191 (5-6), 979-1002, 2019  [3] X. Han, J. Li, A. S. Morgans, Prediction of combustion instability limit cycle oscillations by combining flame describing function simulations with a thermoacoustic network model, Combustion & Flame, 162, 3632-3647, 2015  [4] W.P. Jones, S. Navarro-Martinez, Large eddy simulation of autoignition with a subgrid probability density function method, Combustion and Flame, **150**, 3, 2007, 170-187, 2007  [5] D. Noh, E. Karlis, S. Navarro-Martinez, Y. Hardalupas, A.M.K.P. Taylor, D. Fredrich, W.P. Jones, Azimuthally-driven subharmonic thermoacoustic instabilities in a swirl-stabilised combustor, Proceedings of the Combustion Institute, 37, 5333-5341 2019 |

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| **Beneficiary Legal Name:** Technische Universität Berlin (TUB) | |
| **General Description**  HR Excellence in Research Award — Vitae Website | **TUB** is one of the largest technical universities in Germany, hosting more than 30’000 students, almost 20% being internationals. TUB also has a leading position in terms of gender aspects among German universities. The university’s seven faculties and its 40 institutes offer approx. 130 courses of study from the fields of engineering and natural sciences, economics and business, planning sciences, humanities, and the social sciences. The Institute of Fluid Dynamics and Technical Acoustics (ISTA) within the Department of Mechanical Engineering and Transport Systems performs teaching and research related to fluid dynamics, acoustics, and combustion. TUB endorses the *Code of Conduct for the Recruitment of Researchers.* Holds the *HR Excellence in Research* Award*.* |
| **Role and Commitment of key persons (including supervisors)** | **Prof. Kilian OBERLEITHNER** is heading the Laboratory for Flow Instabilities and Dynamics, ISTA, TU Berlin since 2018. PhD in 2012. Research focus: linear dynamic modelling of multiphysics complex turbulent flows, experimental and numerical methods, green hydrogen combustion, aeroacoustics, flow control and optimisation. More than 75 peer-reviewed journals articles. In the last 8 years he graduated 9 PhD students and currently supervises 9 PhD students. Holder of the Silver Medal of The Combustion Institute. Supervisor of one DC, co-supervisor of one DC. WP leader. Secondment Host. 12.5% commitment.  **Dr. Thomas Ludwig Kaiser** is group leader at the Laboratory for Flow Instabilities and Dynamics and chief developer of the linearise reactive flow solver FELiCS, PHD in 2018 (IMFT Toulouse), 10 years’ experience of combustion modelling with focus on linearised methods, author of more than 22 peer-reviewed journal articles and recipient of two ASME best paper awards. 5 years of co-supervision experience. Role: Supervisor of one DC, co-supervisor of one DC. 10% commitment. |
| **Key Research Facilities, Infrastructure and Equipment** | For linear modelling of turbulent flames, a world-unique, highly versatile multiphysics in-house developed linearised reactive flow solver is available. Moreover, an in-house cluster and national HPC resources are available for large scale computations and optimisation studies. |
| **Status of Research Premises** | All research facilities are independent and fully owned by TUB. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | Under FP 7, TUB was/is a partner in **9** Innovative Training Networks, of which one is coordinated by TUB, hosted **13** Marie Curie Individual Fellowships, and run a post-doc fellowship programme supported under the COFUND programme (IPODI). The university has won 10 ERC-Grants. As core partner of two EIT KICs (Climate and EIT Digital), TUB is responsible for a set of education and innovation activities within the consortia: **ANNULIGhT** (ITN, 765998), **Biorapid** (ITN, 643056), **SynCrop** (ITN, 764591), **ConCO2rde** (ITN EJD, 955740) , **C-PlaNeT** (ITN EJD, 859885), **FoodSci** (ITN EJD, 722166) , **FogGuru** (ITN EID, 765452) |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | Under Horizon 2020, the TUB is hosting **14** Individual Fellowships, and successfully applied for **20** Innovative Training Networks, one is coordinated by TUB: ITN-ETNs: **CBIM** (860555), **LIGHTCAP** (860613), **TEAMAero** (860909), **TOD-IS-RUR** (956030), **QUANTIMONY** (956548), **QUDOT-TECH** (861097), **INSPIRE** (956803), **VisIoN** (764461); ITN-EID **ROMSOC** (765374) (Coordination TUB); ITN EJD - **PLENOPTIMA** (956770); DN-2021 **AQTIVATE** (101072344),  The EU commission awarded the TUB **18** ERC Grants from 2014 to date. Under Horizon Europe, we have been granted **3** Postdoctoral Fellowships and **1** Doctoral Network:  **Prof. Oberleithner** currently holds six research grants from the German Research Foundation (>1.500 kEUR) and two industry related projects funded by the *Ministery of Economic Affairs and Climate Action* (>1.3 kEUR) and he participates in the EU grant: ACHIEVE: HORIZON-JTI-CLEANH2 (101137955) |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Kaiser, T. Varillon, G., Polifke, W. Zhang, F., Zirwes, T., Bockhorn, H., Oberleithner K. „ Modelling the response of a turbulent jet flame to acoustic forcing in a linearized framework using an active flame approach “ Comb. Flame 2023  [2] Casel, M. Oberleithner, K., Zhang, F., Zirwes, T., Bockhorn, H., Trimis, D., Kaiser, T.” Resolvent-based modelling of coherent structures in a turbulent jet flame using a passive flame approach” Comb. Flame 2022  [3] Kaiser, T., Oberleithner, K. “A global linearized framework for modelling shear dispersion and turbulent diffusion of passive scalar fluctuations” J. Fluid. Mech. 2021  [4] Jakob GR von Saldern, Johann Moritz Reumschüssel, Thomas L Kaiser, Moritz Sieber, Kilian Oberleithner,"Mean flow data assimilation based on physics-informed neural networks", Physics of Fluids 2022  [5] JS Müller, F Lückoff, P Paredes, V Theofilis, K Oberleithner,"Receptivity of the turbulent precessing vortex core: synchronization experiments and global adjoint linear stability analysis" J. Fluid Mech. 2020 |

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| **Beneficiary Legal Name:** Centre national de la recherche scientifique (CNRS-CORIA) | |
| **General Description**  HR Excellence in Research Award — Vitae Website | CNRS-CORIA is a joint laboratory organised between CNRS, the University of Rouen, and INSA of Rouen. CNRS-CORIA is a Mechanical Engineering Lab (185 people) fully devoted to fundamental and applied studies of reactive and non-reactive flows: combustion, two-phase flows, heat transfer, plasmas, ... The reduction of pollutant emissions in propulsion systems is one of the key challenges that CNRS-CORIA is focused on. CNRS-CORIA has a strong experience in the development of high-performance CFD solvers that can tackle large-scale combustion simulations. The participating team leads the development of the YALES2 code since 2009. More than 500 researchers and engineers in academia and in the industry have been trained to the use of this high-performance computing code and more than 120 people have contributed to the code base consisting of 920 000 Fortran2008 lines. CNRS-CORIA endorses the *Code of Conduct for the Recruitment of Researchers.* Holds the *HR Excellence in Research* Award*.* |
| **Role and Commitment of key persons (including supervisors)** | **Vincent Moureau (Senior Researcher – Male):** Dr. Vincent Moureau is a CNRS researcher at CNRS- CORIA in the combustion modelling group. He obtained his PhD from IFP-EN and “Ecole Centrale Paris” in 2004. After a two-year postdoctoral fellowship at Stanford University in the Centre for Turbulence Research, he joined SAFRAN Helicopter Engines as a combustion engineer from 2006 to 2008 working among others on thermo-acoustic instabilities. Since 2009, his research is focused on turbulent combustion and spray modelling, and on the development of the YALES2 solver for Large-Eddy Simulation and Direct Numerical Simulation of turbulent flows in complex geometries using massively parallel computers. He received the aeronautical and aerospace science award of the French Academy of Science in 2018. He has co-authored more than 60 publications with an impact factor of 22 (ISI web of science). Role: Supervisor of DC, 10% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | High-performance computers: CNRS-CORIA has access to all the French High Performance Computing facilities and YALES2 is included in the national and regional benchmarks for evaluating new super-computers.  Code: CNRS-CORIA leads the development of YALES2, which solve the 3D incompressible/compressible Navier-Stokes equations on unstructured meshes, but also features many other solvers (heat transfer, spray, time-domain acoustics, …) |
| **Status of Research Premises** | All the research facilities are independent. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | STREAM (Horizon 2020 grant agreement No 865378) |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | Center of Excellence in Combustion (Horizon 2020 grant agreement No 952181)  OASIS (french ANR project on hydrogen combustion)  H2TECH (french project on hydrogen combustion)    YALES2 training sessions: 2 to 4 per year with 15 to 25 participants each. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Janodet, R., Guillamón, C., Moureau, V., Mercier, R., Lartigue, G., Bénard, P., Ménard, T., Berlemont, A., 2022. A massively parallel accurate conservative level set algorithm for simulating turbulent atomization on adaptive unstructured grids. Journal of Computational Physics 458, 111075.  [2] Domingo-Alvarez, P., Bénard, P., Moureau, V., Lartigue, G. & Grisch, F. (2020) Impact of spray droplet distribution on the performances of a kerosene lean/premixed injector. Flow, Turbulence and Combustion, 104, 421-440.  [3] Mercier, R., Mehl, C., Fiorina, B. & Moureau, V. (2019) Filtered wrinkled flamelets model for large-eddy simulation of turbulent premixed combustion. Combustion and Flame, 205, 93-108.  [4] Benard, P., Lartigue, G., Moureau, V. & Mercier, R. (2019) Large-Eddy Simulation of the lean-premixed PRECCINSTA burner with wall heat loss. Proceedings of the Combustion Institute, 1-11.  [5] Benard, P., Balarac, G., Moureau, V., Dobrzynski, C., Lartigue, G. & D'Angelo, Y. (2016) Mesh adaptation for large-eddy simulations in complex geometries. International Journal for Numerical Methods in Fluids, 81 (12), 719-740, fld.4204  *YALES2 software:*  9 software deposits at French software protection agency |

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| **Beneficiary Legal Name:** Institut National Polytechnique de Toulouse (INPT) | |
| **General Description**  HR Excellence in Research Award — Vitae Website | INPT (National Polytechnic Institute of Toulouse) is a group of 7 engineering schools with more than 7000 students, tightly integrated with 18 research laboratories with more than 450 professors and researchers. It is one of the leading universities for engineering in France and well recognised in Europe. INPT endorses the *Code of Conduct for the Recruitment of Researchers.* Holds the *HR Excellence in Research* Award*.* |
| **Role and Commitment of key persons (including supervisors)** | Dr. Laurent Selle is Research Director at CNRS and has been working at the Institute of Fluid Mechanics of Toulouse (one of INPT laboratories) since 2006. He was the head of the reacting flows group from 2018 to 2022 and he currently is the Chair of the European Sections of the Combustion Institute. He received the Distinguished Paper Award in the Spray, Droplet, and Supercritical Combustion colloquium for the 36th International Symposium on Combustion and two Best Paper Awards from ASME (2016 and 2019). He is the recipient of the 2020 Research Excellence Award of the Combustion Institute and has co-authored more than 60 publications (h-index 25 in Scopus).  Role: Supervisor of DC, 10% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | INPT is equipped with 7 combustion test benches dedicated to hydrogen and SAF. Specifically, a swirl burner called TALISMAN was designed and built during the PhD work of T. Morinière (2020-23), which is dedicated to the study of spray / combustion / acoustics interactions.  TALISMAN is instrumented with acoustic actuators, microphones and a photomultiplier for the characterisation of flame responses (FTF and FDF). High-speed cameras are also available for direct flame visualisation and several laser diagnostics can be implemented to characterise the flow (PIV) flame (OH-PLIF) and spray (PDPA).  Altogether, the combustion bench and diagnostics represent an investment of more than 600k€ in the past 3 years, which directly benefit the present project. |
| **Status of Research Premises** | All research facilities are independent and fully owned by INPT. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | Laurent Selle was co-PI in the ERC Advanced Grant INTECOCIS (2013-18) and project leader of a national ANR research program called MACOPA. He was also WP leader of multiple French ANR programs. |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | Laurent Selle is currently participating to two ERC Advanced Grants (SCIROCCO and SELECT-H) and PI of a Synergy grant called HYROPE to start in Sept. 2024.  He is also the PI of multiple projects with industrial partners (Airbus, Bulane) or governmental research organisations (CEA) |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] T. Morinière, L. Selle, T. Poinsot and T. Schuller: A Thermoacoustic Instability Precursor Based on the Acoustic Flux at the Combustion Chamber Inlet. *Comb. Sc. Tech.*, 195 (14), pp. 3357-3371, 2023. (<https://doi.org/10.1080/00102202.2023.2261673>)  [2] A. Aniello, D. Laera, S. Marragou, T. Poinsot, T. Schuller and L. Selle: Influence of pilot H2 injection on methane-air swirled flame stabilization and acoustic response. Combust. Flame, 253, 2023. (<https://doi.org/10.1016/j.combustflame.2023.112749>)  [3] A. Cellier, C.J. Lapeyre, G. Oztarlik, T. Poinsot, T. Schuller, L. Selle:3 Detection of Precursors of Combustion Instability using Convolutional Recurrent Neural Networks. *Combust. Flame*, 233, 2021. (<https://doi.org/10.1016/j.combustflame.2021.111558>)  [4] T. Kaiser, K. Oberleithner, L. Selle and T. Poinsot: Examining the Effect of Geometry Changes in Industrial Fuel Injection Systems on Hydrodynamic Structures with BiGlobal Linear Stability Analysis, *Journal of Engineering for Gas Turbines and Power*, 142(1), pp. 1-8, 2020. (https://www.doi.org/10.1115/1.4045018) |

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| **Beneficiary Legal Name:** Centre Européen de recherche et de formation avancée en calcul scientifique (CERFACS) | |
| **General Description** | **CERFACS** is a center for fundamental and applied research, specialised in modelling and numerical simulation. By its means and know-how in high performance computing, CERFACS deals with the major scientific and technical problems of public and industrial research. Around 120 people work at CERFACS, including more than 95 researchers and engineers from 10 different countries. Involved in national and international projects, Cerfacs works in close interaction with its seven partners: Airbus Group, Cnes, EDF, Météo France, Onera, Safran and Total. It has also established partnerships with the CNRS (Associated Research Unit), Irit (joint laboratory), CEA and Inria (cooperation agreements). The CERFACS CFD team includes more than 50 scientists, including 30 doctoral students. It develops solvers for partial differential equations (PDE) adapted to massively parallel computation, dealing with various physics such as fluid mechanics and combustion. The codes developed are intended for research but also for industry, allowing a very fast transfer of knowledge. |
| **Role and Commitment of key persons (including supervisors)** | **Laurent Giquel** (Male), obtained his PhD in 2001 his HdR in 2007, and continued research in turbulent combustion at CERFACS. His research interests are in the simulation of industrial burners as well as GTs. He has authored over 50 journal papers and several book chapters. He has considerable experience participating and coordinating several Marie Curie projects (LIMOUSINE, ECCOMET and COPA-GT). Role: Supervisor of DC, 10% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | These are specific infrastructures that will play a key role in the project  (a) (b) Computer nemo_lenovo(c)  Figure : CERFACS High-Performance Computing (HPC) facility (in house systems) (a) Kraken and (b) Nemo offering a total of 1,300 peak Pflop/s) used to produce advance engine simulations as shown in (c).  The main research facilities offer an aggregated peak capacity of approximately 860 Tflop / s, thanks in particular to 2 different massively parallel machines: a Lenovo cluster (490 Tflops / s) and a cluster HP (276 Tflops / s). In addition, CERFACS has access to the main high-performance computing centers: **CEA TGCC** (Bull Tera-10), CINES and **IDRIS** in France, other European centers via the PRACE program and even US centers via the INCITE program. Among the innovation products resulting from the project, all codes developed and used within the project and originating from CERFACS will benefit to the community either research institutions or industrial partners. Among the codes, one can list: **AVBP, AVSP, ARCANE, STORM**. Complementarily to the codes, obtained **CFD** data bases within the project will remain available for code validation or developments. Likewise, modelling could access the data basis. |
| **Status of Research Premises** | All the research facilities are independent and fully owned by CERFACS. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | The research team has been involved in several EU Research projects related to: ITN grants on combustion and instabilities: ANNULIGhT, MAGISTER; EU projects: LOOPS, JETSCREEN (alternative fuels) |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | H2 combustion: ERC grant INTECOCIS & SIROCCO & SELECT-H (in collaboration with INPT), EU Clean H2 grant FLEX4H2 & HyPowerGT, EU Clean Aviation grant HESTIA. HPC: COEC |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] P.W. Agostinelli, D. Laera, D. Chterev, I. Boxx, L. Gicquel and T. Poinsot ”Large eddy simulations of mean pressure and H2 addition effects on the stabilization and dynamics of a partially premixed swirled-stabilized methane flame”, Comb. & Flame, 249, pp. 112592, 2023  [2] P.W. Agostinelli, D. Laera, D. Chterev, I. Boxx, L. Gicquel and T. Poinsot ”On the impact of H2-enrichment on flame structure and combustion dynamics of a lean partially-premixed turbulent swirling flame,” Combustion & Flame, 241, pp. 112120, 2022  [3] V. Shastry, E. Riber, L.Y.M. Gicquel, B. Cuenot and V. Bodoc, ”Large Eddy Simulations of complex multicomponent swirling spray flames in a realistic gas turbine combustor”, Proceedings of the Combustion Institute, Vol. 39, 2022  [4] C. Pérez Arroyo, J. Dombard, F. Duchaine, L. Gicquel, B. Martin, N. Odier and G. Staffelbach ”Towards the Large-Eddy Simulation of full engine: Integration of a 360 azimuthal degrees fan, compressor and combustion chamber. Part II: Comparison against stand-alone simulations”, in GPPS Journal, Data-driven modelling and high-fidelity simulations Special Issue, pp. 17-33, May, 2021.  [5] L.Y.M. Gicquel, G. Staffelbach and T. Poinsot, ”Large Eddy Simulation of Gaseous Flames in Gas Turbine Combustion Chambers,” Prog. in Energy and Comb. Science, 38, 782-817, 2012. |

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| **Beneficiary Legal Name:** Technische Universiteit Eindhoven (TU/e) | |
| **General Description** | TU/e has around 3000 employees, 240 professors, 7200 students, 250 PDEng students and 760 PhD students. TU/e is a research-driven, design-oriented university of technology, with the primary objective of providing young people with an academic education within the engineering science & technology domain. TU/e forms part of the European University EuroTeQ, and CLUSTER and EuroTech university networks and has partnerships with universities around the world. **The Dynamics and Control Group** within the Department of Mechanical Engineering will participate in the proposed project and it comprises 3 full-professors, 2 part-time professors, 3 associate professors, 3 assistant professors, 2 post-docs and 23 PhD students. |
| **Role and Commitment of key persons (including supervisors)** | **Claire Bourquard (female):** Assistant professor of Acoustics for Complex Engineering at TU/e. She has experience in aero-acoustics, acoustic damper modelling, low-order modelling of thermo- and aero-acoustic coupled systems. Role: Supervisor of DC. 10% involvement.  **Ines Lopez Arteaga (female):** Professor of Acoustics and Noise Control at TU/e and Professor of Engineering Acoustics at KTH Royal Institute of Technology, Stockholm (Sweden). PhD in 1999 from University of Navarra, Spain. 20 years' research experience in near-field acoustic holography, modelling of thermo-acoustic instabilities and applications of Machine Learning to vibro-acoustic problems. 20 years' supervision experience. 100+ publications. 4 patents. Role: Co-supervisor of DC. 5% involvement.  **Danilo Beli (male):** Lecturer at the Dynamics & Control group of the Mechanical Engineering Department at Eindhoven University of Technology (TU/e). He has experience on dynamics, vibrations and waves, working more specifically on the following topics: wave propagation, smart materials (piezoeletric) and elastic/acoustic metamaterials. Periodic structures Role: Co-supervisor of DC. 5% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | Acoustics and thermos-acoustic laboratories with reactive and non-reactive impedance tubes, allowing for measurement of acoustic absorption and acoustic transfer matrices at low flow velocities, electro-acoustic instability setup to assess dampers and liners stabilization performance. Library. ICI Web of Knowledge (large database of scientific publications). Workspace with desk, PC/laptop for each individual researcher. Access to postgraduate courses through the School of Engineering Mechanics. Purpose-built nursery for the children of students and staff. Counselling service for staff and students. Student Sport Centre offering sports, recreation, health and relaxation to all students and employees. |
| **Status of Research Premises** | All the facilities are owned by the beneficiary, and they are wholly independent from other beneficiaries and partner organisations in the consortium. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | Prof. I. Lopez Arteaga was a full partner of the Initial Training Network TANGO. She was supervisor of 1 ESR in this network and organiser of a workshop. FP7-People-2012-ITN-316654  Initial Training Network POLKA, where she was WP Leader for the Training Program and supervisor of 2 ESR. 813367-POLKA-H2020-MSCA-ITN-2018. |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | None. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Ganji, H. F., Kornilov, V., van Oijen, J., Lopez-Arteaga, I., & de Goey, P. (2024). Thermoacoustic stability analysis and robust design of burner-deck-anchored flames using flame transfer function composition. *Combustion and Flame*, *269*, 113631.  [2] de Priester, J., Aulitto, A., & Lopez Arteaga, I. (2022). Frequency stop-band optimization in micro-slit resonant metamaterials. Applied Acoustics, 188, 108552.  [3] Thomes, R. L., Beli, D., & Junior, C. D. M. (2022). Space–time wave localization in electromechanical metamaterial beams with programmable defects. Mechanical Systems and Signal Processing, 167.  [4] Bourquard, C., & Noiray, N. (2019). Stabilization of acoustic modes using Helmholtz and Quarter-Wave resonators tuned at exceptional points. Journal of Sound and Vibration, 445, 288-307  [5] Miniero, L., Mensah, G. A., Bourquard, C., & Noiray, N. (2023). Failure of thermoacoustic instability control due to periodic hot gas ingestion in Helmholtz dampers. *Journal of Sound and Vibration*, *548*, 117544. |

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| **Beneficiary Legal Name:** Safran SA (SAFRAN) | |
| **General Description** | The Safran Group is a leading supplier of systems and equipment for the Aerospace, Defence and Security markets Safran boasts very robust fundamentals: sustained R&D investments (2.1 billion euros in 2015/21% of the 70 000 employees work in R&D) and a dynamic innovation policy. In this strategy, Safran inaugurated on January 2015, Safran's new Research & Technology Center, Safran Tech. The Safran Tech Center houses a research workforce of around 300 scientists and engineers. The Safran Tech Center underlines the Group’s resolve to intensify and mutualize research and technology endeavours on major technological disruptions. The activities of the Energy & Propulsion department are distributed along three complementary axes:   * Investigation of the architectures of the aircraft energetic systems, propulsive or non-propulsive, to orientate technology and innovation, * Elaboration of technologies contributing to the design of high-pressure ensembles for the next turbo engine generations, * Development of advanced technologies for innovative or breakthrough propulsion designs. |
| **Role and Commitment of key persons (including supervisors)** | **Dr. Nicholas C. W. Treleaven** (male) is an expert in combustion, thermoacoustics and numerical methods for aircraft combustion chambers at Safran Tech. He has spent the last 8 years working with Rolls-Royce, Loughborough University, TU Darmstadt and CERFACS developing the codes AVBP and PRECISE-UNS. He has assisted in the supervision of a number of Master’s and PhD students. He is currently coordinating the European project HESTIA. Role: Supervisor of DC, 10% involvement.  **Dr. Guillaume J. J. Fournier** (male) is an expert in thermoacoustics at Safran Tech. He has spent the last 10 years working in turbomachinery with Safran Helicopter Engines, ArianeGroup, TU Munich and Safran Tech, covering a broad range of fields of application, e.g. fluid design of turbopumps for rocket engines, thermoacoustics of aero and land-based gas turbines, among others. From 2018 to 2022, he participated in the MSCA ITN ANNULIGhT as an ESR. He is currently co-supervising 4 Ph.D. students. Role: Co supervisor of DC, 10% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | Clusters: Safran Tech is equipped of several advanced computer clusters and can access to the High-Performance Computing facilities of CCRT (Centre de Calcul Recherche et Technologie)  LES codes: Safran Tech has access to AVBP and YALES2, which solve the 3D compressible and incompressible Navier-Stokes equations on unstructured and hybrid meshes, respectively. |
| **Status of Research Premises** | All the research facilities are independent and fully owned by SAFRAN. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | SAGE (Clean Sky grant agreement No 999902)  SOPRANO (Horizon 2020 grant agreement No 690724)  JETSCREEN (Horizon 2020 grant agreement No 723525)  MAGISTER (Marie Sklodowska-Curie Actions grant agreement No 766264)  ANNULIGhT (Marie Sklodowska-Curie Actions grant agreement No 765998)  ENABLEH2 (Horizon 2020 grant agreement No 769241)  ALTERNATE (Horizon 2020 grant agreement No 875538)  INSPIRE (Marie Sklodowska-Curie Actions grant agreement No 956803) |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | H2POWRD (Marie Sklodowska-Curie Actions grant agreement No 101169009)  HESTIA (Horizon Europe Grant agreement No 101056865)  NEXTAIR (Horizon Europe Grant agreement No 101056732) |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Leparoux, J., Mercier, R., Puggelli, S., Cailler, M., Moureau, V., 2023. Numerical Investigation of a Hydrogen-Air Flame for NOx Prediction, in: Proceedings of ASME Turbo Expo 2023: Turbomachinery Technical Conference and Exposition. American Society of Mechanical Engineers, p. V03BT04A025.  [2] Treleaven, N.C.W., Puggelli, S., Mercier, R., Leparoux, J., Sun, X., Sethi, B., 2023. High Altitude Relight Performance of Hydrogen-Air Micromix Combustion Systems, in: Proceedings of ASME Turbo Expo 2023: Turbomachinery Technical Conference and Exposition. American Society of Mechanical Engineers, p. V03BT04A063.  [3] Dillon, S., Mercier, R., Fiorina, B., 2023. Large-Eddy-Simulation of Turbulent Non-Premixed Hydrogen Combustion Using the Filtered Tabulated Chemistry Approach, in: Proceedings of ASME Turbo Expo 2023: Turbomachinery Technical Conference and Exposition. American Society of Mechanical Engineers, p. V03AT04A010.  [4] Puggelli, S., Leparoux, J., Brunet, C., Mercier, R., Liberatori, L., Zurbach, S., Cabot, G., Grisch, F., 2023. Application of an Automatic Mesh Convergence Procedure for the Large Eddy Simulation of a Multipoint Injection System. Journal of Engineering for Gas Turbines and Power 145, 61019.  [5] Urbano, A., Douasbin, Q., Selle, L., Staffelbach, G., Cuenot, B., Schmitt, T., Ducruix, S., Candel, S., 2017. Study of flame response to transverse acoustic modes from the LES of a 42-injector rocket engine. Proceedings of the Combustion Institute 36, 2633–2639. |

For **associated partners:**

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| **Associated Partner Legal Name:** Rolls-Royce Deutschland Ltd & Co KG (RRD) | |
| **General description** | Rolls-Royce Deutschland Ltd & Co KG (RRD) is part of the Rolls-Royce Aerospace Group and is responsible for the design, development, certification, manufacture, service and overhaul of aeroengines with the particular focus on large business jet applications. RRD is a leading partner in major European and national research projects supporting the development of future clean and quiet aero engines. With the recent certification of the new Pearl propulsion system family significant improvements have been achieved to lower the emissions and noise footprint of a business jet engine. Within its combustion section of the Hot End department, RRD develops and optimises advanced combustion concepts based on conventional RQL and lean burn concept, for kerosene and alternative fuels (SAF and Hydrogen) for the next generation aeroengines. In this context, the Rolls-Royce group supports the so-called University Technology Centres, in which RRD strongly interacts with universities and research institutes worldwide. |
| **Key Persons and Expertise** | **Dr. Claus Lahiri** (M) is leading the global thermoacoustics team within the Rolls-Royce Group. He brings along more than 16 years of experience in thermoacoustics covering aero-engine development and academic research.  **Dr. Ruud Eggels** (M) is the manager of the combustion method section within the ES-2 Combustion and Turbine Subsystem department at RRD. The section is responsible for research, numerical combustion, experimental investigations, and combustor technology development. He is well-known in the combustion community and coordinates the so-called Universities Technology Center, in which RRD strongly interacts with universities and research institutes worldwide. He has already co-supervised a lot of doctoral works. |
| **Key Research Facilities, Infrastructure and Equipment** | HPC facilities, experimental facilities (low TRL up to full engine testing) |
| **Previous and Current Involvement in Research and Training Programmes** | The research team has been involved in several EU Research projects related to thermoacoustics, hydrogen combustion and low emission combustion: HESTIA, RECORD, IMPACT-AE, SOPRANO, ESTIMATE |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | *[1] Reinhardt, H., Alanyalıoğlu, Ç., Fischer, A., Lahiri, C., and Hasse, C. "A Hybrid, Runtime Coupled Incompressible CFD-CAA Method for Analysis of Thermoacoustic Instabilities." ASME. J. Eng. Gas Turbines Power. March 2023; 145(3): 031003.*  *[2] Fischer, A, & Lahiri, C. "Ranking of Aircraft Fuel-Injectors Regarding Low Frequency Thermoacoustics Based on an Energy Balance Method." ASME Turbo Expo 2021, GT2021-59561.*  *[3] C. Lahiri, F. Bake, “A review of bias flow liners for acoustic damping in gas turbine combustors” Journal of Sound and Vibration, Volume 400, 2017, Pages 564-605.* |

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| **Associated Partner Legal Name:**  General Electric Deutschland Holding GMBH (GEDE) | |
| **General description** | GE Aerospace is a world-leading provider of aircraft engines, components, and integrated systems for commercial and military aircraft. With more than 52,000 employees around the globe, it builds on its unrivaled legacy to advance the future of flight towards sustainable aviation. The GE Aviation Advanced Technology (GEDE) team located in Munich, Germany, develops technology for commercial and next-generation aircraft engines, from large turbofans to small turboprops, and their derivatives for ground-based applications. The team is involved in GE product development programs as well as in joint research and technology programs; covering compressor, turbine, fan, and propeller aerodynamics and aeroacoustics as well as thermal systems and combustor design for state-of-the-art and next-generation aircraft engines such as LEAP, GE9X, Catalyst and RISE. GEDE will bring to the consortium decades of expertise in aero engine design with key competencies in experimental and numerical simulation methods applied to develop thermoacoustically stable aero-engine combustion systems. |
| **Key Persons and Expertise** | **Dr.-Ing Gerrit Heilmann** (male) is an expert in the field of thermoacoustics and responsible for computational tool development at GEDE. Being involved in the combustion design and particularly the prediction and mitigation of thermoacoustic instabilities for aero and land-based turbomachines at SIEMENS Energy, TUM and GE Aerospace, he has accumulated 9 years of industrial experience.  **Dr.-Ing. Maximilian Zahn** (male) supports and leads different combustor technology maturation projects at GEDE. He dedicated the last 10 years of his career to the design of combustion systems with a focus on thermo- and aeroacoustics in aero-engines gaining a broad expertise in both modeling and experimental procedures. |
| **Key Research Facilities, Infrastructure and Equipment** | HPC capacities. |
| **Previous and Current Involvement in Research and Training Programmes** | GEDE’s combustion team has been involved in a broad range of national as well as EU research projects such as  H2020 – SOPRANO  LuFo VI-2 WAKOS  LuFo VI-3 H2-LoNOCS  Clean Sky 2 – iCore & MAESTRO  Clean Aviation – HYDEA  ITN – MAGISTER  Horizon-Europe – HESTIA. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Faure-Beaulieu, A. et al., 2024, “Measuring acoustic transfer matrices of high-pressure hydrogen/air flames for aircraft propulsion”, Combustion and Flame, 270.  [2] Lourier, J.-M. et al., 2014, “Numerical analysis of indirect combustion noise generation within a subsonic nozzle” AIAA Journal, 52(10)  [3] Lourier, J.-M. et al., 2014, “Large Eddy Simulation of a Thermoacoustic Instability Within a Swirl-Stabilized Burner Using Impedance Boundary Conditions” in ASME Turbo Expo 2014.  [4] Innovation product: GE TAPS combustor, which is the first lean premixed combustor certified for commercial aircraft engines and empowers a large fleet of aircrafts already today. It allows currently reducing emissions such as NOx by around 75% in comparison to conventional combustors. GEDE is strongly involved in GEs TAPS development for next generation engines, e.g. GE9X. |

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| **Associated Partner Legal Name:** Zürcher Hochschule für Angewandte Wissenschaften  (ZHAW) | |
| **General Description** | **ZHAW** is located in the city of Winterthur, Zurich, Switzerland. The university was established in 1874 and specializes in applied research. It consists of 8 schools with a total turnover of €600 million, a total staff of about 3700 and some 14500 students. **Prof. M.R. Bothien** leading the Renewable Energy Focus at the Institute of Energy Systems and Fluid Engineering (IEFE) of the School of Engineering will participate in the proposed project. The IEFE combines applied research with industrial development and is partner in many international cooperation projects and has a lot of industry collaborations. The 9 research groups of IEFE cover many relevant aspects of the future energy system spanning both thermal and electrical topics. |
| **Role and Commitment of key persons (including supervisors)** | **Prof. M. R. Bothien** is the Head of Renewable Energy at the IEFE, ZHAW, and an Adjunct Professor at the Department of Energy and Process Engineering, Norwegian University of Science and Technology. His research concerns the utilisation of alternative fuels for the decarbonisation of the energy system, with a particular emphasis on combustion dynamics. In collaboration with his team, he has developed numerous combustion dynamics tools and approaches that have set new standards and are highly regarded within the research community, both in academic and industrial contexts. He has worked in industrial research and development for over 15 years at Ansaldo Energia, Alstom Power and Siemens Energy, acting as an expert in thermoacoustics and occupying various managerial roles. He has co-authored over 100 technical publications and 52 invention disclosures in the field of combustion dynamics and alternative fuels. **Role:** Supervisor of DC. Secondment host. 10% involvement. |
| **Key Research Facilities, Infrastructure and Equipment** | The lab comprises the infrastructure for atmospheric combustion test rigs with a thermal power of up to 200kW. Hydrogen and methane as well as mixtures thereof are available as fuel (4+1 lines). Compressed air can be preheated up to 600°C (4 air lines). The test rig used in the proposed project is water-cooled and equipped with loudspeakers and microphones up- and downstream of the flame, optical access for chemiluminescence and planar flame imaging. This allows for full acoustic characterization of novel burners. Currently, a second atmospheric test rig is procured, which allows testing of RQL as well as sequential combustor architectures. In addition, an isothermal acoustic test rig allows for the development of mitigation devices for instabilities. The in-house cluster with 1184 nodes enables to run high-fidelity transient combustion simulations.  A machine in a room  Description automatically generated |
| **Status of Research Premises** | All the research facilities are independent and fully owned by ZHAW. |
| **Previous Involvement in Research and Training Programmes, including H2020 ITN** | **Prof. Bothien** was a full partner in the Innovative Training Networks **ANNULIGhT** (GA 765998, supervisor of 1 ESR, secondment host) and associated partner **INSPIRE** (GA 956803, secondment host). |
| **Current Involvement in Research and Training Programmes, including H2020 ITN** | Prof. Bothien currently is involved in three Horizon Europe projects (**FLEX4H2**, 101101427; **HyPowerGT**, 101136656; **InsigH2t**, 101192349), in which he supervises 3 PhD students and 2 postdoctoral researchers working on hydrogen combustion and thermoacoustics. In addition to this he has nationally funded research projects. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | [1] Gant, F., Ghirardo, G., **Bothien**, M. R., On the importance of time delay and noise in thermoacoustic modeling, Journal of Sound and Vibration, 501:116067, 2021.  [2] Gant, F., Ghirardo, G., Cuquel, A., **Bothien**, M. R., Delay Identification in Thermoacoustics, Journal of Engineering for Gas Turbines and Power, 144(2), pp. 021005-1-10, 2021.  [3] Æsøy, E., Aguilar, J. G., Wiseman, S., **Bothien**, M. R., Worth, N. A., Dawson, J. R., Scaling and Prediction of Transfer Functions in Lean Premixed H2/CH4-Flames, Combustion and Flame, 215:269-282, 2020.  [4] **Bothien**, M. R., Ciani, A., Wood, J. P., Fruechtel, G., Toward Decarbonized Power Generation With Gas Turbines by Using Sequential Combustion for Burning Hydrogen, Journal of Engineering for Gas Turbines and Power, 141(12):121013-1-10, 2019.  [5] **Bothien**, M. R. and Wassmer, D., Impact of Density Discontinuities on the Resonance Frequency of Helmholtz Resonators. AIAA Journal, 53(4):877-887, 2015. |

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| **Associated Partner Legal Name:** MTU Aero Engines AG (MTU) | |
| **General description** | MTU Aero Engines AG (MTU, http://www.mtu.de) is a DAX-listed company and Germany’s leading engine manufacturer. The established global player in the industry engages in the design, development, manufacture, marketing, and support of commercial and military aircraft engines in all thrust and power categories and stationary gas turbines. Operating affiliates all over the world, MTU has a local presence in major regions and markets. MTU’s portfolio of technologies for the future includes some 100 projects that are firmly focused on the company’s objectives and pursued in accordance with strict product development rules. |
| **Key Persons and Expertise** | Thomas Komarek (male), combustion expert at MTU with background in thermoacoustic combustion instabilities. He has participated in various research projects before. |
| **Key Research Facilities, Infrastructure and Equipment** | High performance computation capacity with high backup redundancy |
| **Previous and Current Involvement in Research and Training Programmes** | HESTIA (Horizon Europe grant agreement No 101056865)  SOPRANO (Horizon 2020 grant agreement No 690724)  JETSCREEN (Horizon 2020 grant agreement No 723525)  IMPACT-AE (EU FP7 grant agreement No 265586) |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | *[1] Konle et al. “Multiphysics Simulations with Openfoam in the Re-Design of a Commercial Combustor”, Proceedings of ASME Turbo Expo, 2018*  *[2] Konle et al. “Numerical Analysis of Thermal Load Variation in a Commercial Engine during Dual Fuel Operation”, Proceedings of Montreal 2018, Global Power and Propulsion Forum (GPPS-NA-2018-0086)* |

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| **Associated Partner linked to a beneficiary Legal Name:** The Universite de Rouen Normandie (UR) | |
| **General description and link to the concerned beneficiary**  HR Excellence in Research Award — Vitae Website | The Universite de Rouen Normandie is a public institution of higher education and research founded in 1966. However, the first medical school was established in 1605. The Universite de Rouen Normandie is also a member of Normandie Université, the Normandy community of universities and institutions of higher education. UR is one of the largest multidisciplinary universities settled on six campuses in the Rouen metropolis (30.000 students / 490.000 inhabitants). Our aim is to form innovative, analytical students that are ready to enter the professional world and contribute something meaningful and useful to society. The UR has a joint Research Unit with CNRS named CORIA (JRU 6614) |
| **Key Persons and Expertise** | Doctoral School PSIME brings together research centres in Physics, Engineering, Materials and Energy. **About 310 PhD students are enrolled in DS-PSIME.** Thesis are prepared under the supervision of 220 professors, or associate professors (HDR) within 14 Research Units. |
| **Key Research Facilities, Infrastructure and Equipment** | UR has focus on transdisciplinary projects linked with environmental and climatic impacts in which the international approach is identified as a key factor of success (e.g. partner of NASA-CNES programs, regional IPCC coordination). For risk analysis of Rouen metropole firms’ activities, UR developed specific governance structure to facilitate interdisciplinary expertise and communication between different stakeholders. |
| **Previous and Current Involvement in Research and Training Programmes** | UR participates in scientific projects co-financed by the European Union through various funding programmes. These projects are generally collaborative and involve regional, national, or international partners. The main funding programs are as follows: FEDER, INTERREG, H2020. |
| **Relevant Publications/datasets/ softwares/ Innovation Products/ other achievements** | *https://ed-psime.normandie-univ.fr/wp-content/uploads/sites/80/2021/02/reglement-interieur-ed-psime.pdf* |

**END PAGE**

MARIE Skłodowska-CURIE ACTIONS

**Doctoral Networks (DN)**

**Call:** **HORIZON-MSCA-2024-DN-01-01**

PART B

“**TITAN**”

**T**hermoacoustic **I**nstability **T**ools for future **A**eroengi**N**es

**This proposal is to be evaluated as:**

**DN**

1. https://www.ercoftac.org/ [↑](#footnote-ref-2)
2. http://www.efluids.com/index.htm [↑](#footnote-ref-3)
3. https://onetreeplanted.org/ [↑](#footnote-ref-4)
4. <https://www.imperial.ac.uk/students/academic-support/graduate-school/professional-development/doctoral-students/> [↑](#footnote-ref-5)