Principal Investigator
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PI Position Title
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Additional Co-PIs
N/A

Proposal Title
Hydrogen R&D Proposals with NTNU

Proposal Description
To impede the catastrophic climate change and sustain our civilization, the humanity must develop renewable energy systems with zero carbon footprint. Hydrogen fuel is an attractive clean energy carrier, as it can be generated by renewables and does not emit greenhouse gases with reacting with oxygen to produce usable energy. The Principal Investigator (PI) is actively working on liquid hydrogen (LH_2) systems as one of the primary members of the WSU HYPER Center, leading projects funded by the US agencies (NSF, DOE) and industry (Airbus, Microsoft, Plug Power). While our efforts are successful, they are limited in scope and methods. The PI is currently using traditional fluid mechanics framework to develop LH_2 storage/transfer models and build experimental setups. However, cryogenic hydrogen has unique properties, affected by quantum mechanics, which result in large uncertainties of predicted LH_2 processes.

The HYPER Center has initiated a collaboration with Prof. Wilhelmsen from Norwegian University of Science and Technology (commonly abbreviated as NTNU), who is also a senior scientist at SINTEF (one of the largest European research entities). He is an expert in non-equilibrium thermodynamics and cryogenic hydrogen and is involved in LH2 projects in Europe. Together with Prof. Wilhelmsen, we at HYPER are currently writing a textbook, which is highly anticipated by the LH2 industry (as well as our program managers at DOE). Our present collaboration with NTNU is rather narrow, while there is a huge potential to elevate our research by tapping into the expertise of leading European experts, combining it with our US-based experience, and initiating international R&D programs. Thanks to deeper collaboration with the world-leading group in non-equilibrium, cryogenic, and quantum phenomena and more intimate knowledge of overseas LH2 projects, we will be able to compete for large (~$10M) DOE and NSF grants, which will be a big step from our current ~$1M projects.

The PI is proposing a visit to NTNU, during which the PI will elevate the collaboration with Prof. Wilhelmsen and his colleagues by (1) discussing current/future projects of WSU and NTNU, (2) drafting collaborative WSU-NTNU proposals aiming at NSF, DOE, industry, and European funding agencies, (3) learning more about LH2 physics, experiments, and modeling that will help us develop more efficient LH2 systems and bring more external funding to WSU, (4) visiting SINTEF and clean energy companies, (5) getting familiar with NTNU educational innovations, outreach, and DEI efforts (which will strengthen our proposals on LH2 workforce training), and (6) recruiting UG students for graduate studies at WSU and NTNU grad students for postdoc positions at the HYPER Center. The PI will also give a seminar at NTNU and may contribute to a workshop or conference that are often held at NTNU. In addition, the PI will also visit the NTNU's Department of Marine Technology, which is within another expertise field of the PI (we had recent grants in that area from the Office of Naval Research and DARPA). The PI will hold discussions with the department head Prof. Steen and his colleagues on joint research work and proposals. Prof. Steen has inquired about the PI's availability to advise for their hydrogen-fueled ship R&D program, so this can result in an additional multi-disciplinary project.

The main outcome of this visit will be one or several proposals in collaboration with NTNU. The PI will also gain deeper knowledge in the LH2 field that will enhance our R&D competitiveness in the US.

Budget

The following funds are requested to cover the travel expenses:

1. Roundtrip airfare Spokane-Trondheim, $1,900. Estimated from Expedia website. Flying to Norway is essential to accomplish this trip.

2. Hotel lodging for 5 nights in Trondheim, $700. Modest-hotel rate estimated from Expedia website. The PI needs to stay several nights in Trondheim to achieve the goals of this trip. (1.5 day in NTNU with Prof. Wilhelmsen's group, 1 day to visit SINTEF and/or clean energy companies with Prof. Wilhelmsen, 0.5 day at Marine Technology Department with Prof. Steen, 1 day at Mechanical and Industrial Engineering Department with Prof. Wilhelmsen and/or participating in a technical workshop.)

3. Portion of per diem meals, $400. The US Department of state lists M & IE rate for Norway at $130 per day (food is expensive in Norway). The PI will cover the difference using his other grants/accounts or personal funds.

Total: $3,000

Certified Budget Administrator
Ian Leibbrandt

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