

CLEAN RESOURCES

CLEAN TECHNOLOGY

RENEWABLE AND ALTERNATIVE ENERGY - ELECTRICITY GENERATION

FUNDING DETAILS

Development of Low Temperature Stirling Engine Technology for Power Generation

Alberta has vast, untapped geothermal and industrial waste heat energy resources that are currently underutilized due to the lack of technology to produce electricity from heat sources <100°C. Stirling engine technology could potentially fill this gap because it allows a wide variety of heat sources to be used, compared to other types of engines. At the University of Alberta, Dr. Nobes' team is focusing on developing a mathematical model to accurately predict the performance of Stirling engines with heat sources under 100°C. This project will construct a large-scale Stirling engine to provide important experimental data to validate the developed mathematical models. These models will then be used to predict engine performance under unique conditions and be used to optimize engine design and size allowing an economic analysis to determine if the technology is economically and technologically viable.



RECIPIENT:

**Dr. David S. Nobes
University of Alberta**



PARTNERS:

**CES Power and Control
Eavor Technologies**



TOTAL BUDGET:

\$728,000



AI FUNDING:

\$200,000



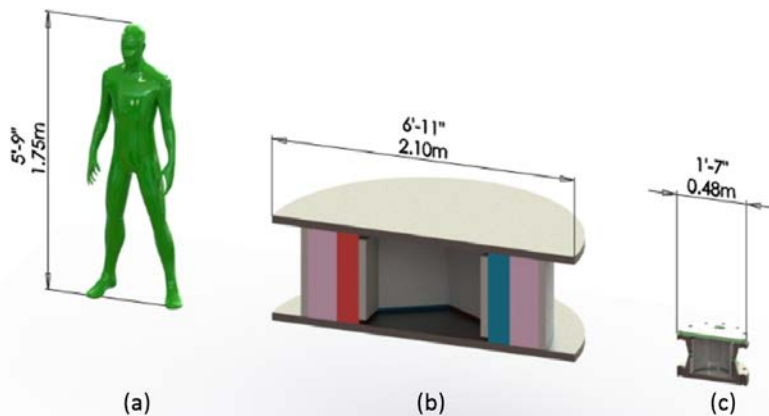
PROJECT DATES:

**JUL 2020 –
JUN 2023**



PROJECT TRL:

**Start: 4
End: 7**



The (a) human scale compared to the (b) proposed engine scale compared to the (c) current engine scale

APPLICATION

This technology is targeted at the geothermal industry and any industry with a substantial waste heat stream. In both cases, where the heat source is low-grade (90-150°C), advanced technology is required to convert the heat into a useful form like electricity. The knowledge generated in this project will provide experimental data that can be used to validate models primarily for the design of large-scale Stirling engine technology.

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PROJECT GOALS

- Design a large-scale, low temperature Stirling engine for experimental testing.
- Build, instrument and commission the Stirling engine.
- Run a wide range of test cases to collect experimental data.
- Validate low temperature mathematical models using the experimental results obtained from the testing of the Stirling engine.
- Use the models to predict engine performance for larger size engine design and industrial deployment.
- Complete an economic analysis to predict the economic potential of this technology for industrial deployment.

BENEFITS TO ALBERTA

- Advancement in applied research for low temperature engine design and development.
- Collaboration and training of mechanical engineering and business students to support the establishment of new technology development companies.
- If the Stirling engine is commercialized and deployed in Alberta, it could:
 - Increase lower carbon electricity generation from geothermal and industrial waste heat resources,
 - Help to reduce Alberta's large carbon footprint, and
 - Develop a new industry with associated jobs, technology and knowledge.



10 Publications



7 Students
Trained



17 Project Jobs



1 New
Product/Service



1 Spinoff
Company



Enabler of Future
GHG Reductions

CURRENT STATUS

DEC 2022

Raphael engine baseline tests, when evaluated against modelling and simulations, revealed an energy/heat transfer bottleneck in the heat exchangers. Further analysis led to a modified design and fabrication of two optimized heat exchangers. An experimental set up is being built to test the units. Modelling and simulation tools have been enhanced to enable heat exchanger performance analysis. Progress continues towards building and testing a large-scale engine.