ALBERTA INNOVATES

CLEAN RESOURCES

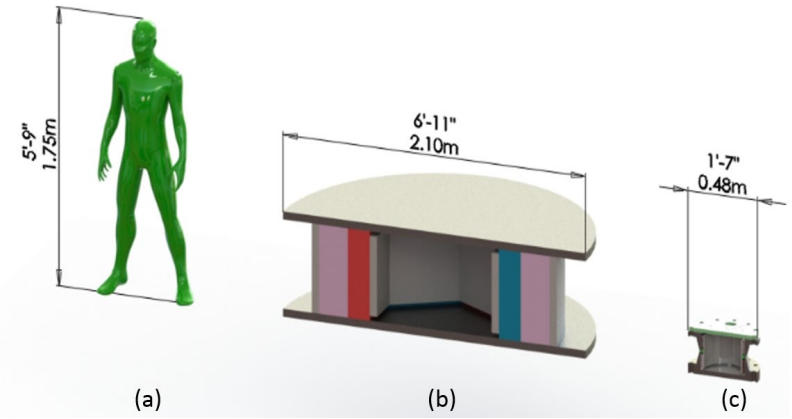
CLEAN TECHNOLOGY

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 lower temperature heat sources. 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 focused on developing a mathematical model to accurately predict the performance of Stirling engines with heat sources in the order of 180°C or less. The project was to construct a large-scale Stirling engine to provide important experimental data to validate the developed mathematical models. These models would 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



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

RECIPIENT:
Dr. David S. Nobes
University of Alberta

PARTNERS:
Future Energy Systems / University of Alberta

TOTAL BUDGET:
$728,000

AI FUNDING:
$200,000

PROJECT DATES:
JUL 2020 – DEC 2023

PROJECT TRL:
Start: 4
End: 6

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 provides 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.

38 Publications

34 Students Trained

Enabler of Future GHG Reductions

DEC 2023

The project is complete. The project achieved advancement towards a 100 kW Stirling engine for lower temperature operations (>180C), including successful construction, commissioning and operation of a unit with component modifications, which yielded reliable engine performance, predictive modelling matching engine data +/- 10%, and identification of scale up bottlenecks. Bottlenecks suggest further research and development including mechanical energy loss and heat transfer efficiency.