Heat Harvesting by Artificial Muscles, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

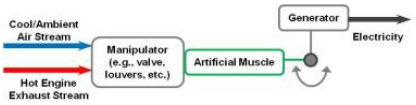
ABSTRACT

NASA emphasizes the need to implement energy harvesting in its future mission activities, as well as to conserve on energy and to enhance the sustainability of NASA's facilities. By harvesting energy from the ambient surroundings, there is less dependence on a primary power supply (e.g., combustion engines, fuel cells, batteries, solar cells, etc., and even AC electricity for ground applications), and a possibility for independent operation of assorted electronic and mechanical devices, including remote and wireless sensors. Differential heat sources are very abundant, both in ground and space scenarios. For this STTR application, Lynntech has teamed up with Dr. Ray Baughman (Director of NanoTech Institute, University of Texas at Dallas) to pioneer the use of artificial muscles (also known as coiled polymer actuators) as an advanced method for energy harvesting. The proposed innovative technology for efficient capture and conversion of thermal energy is very versatile: it can convert heat into mechanical and electrical energy, and it can heat harvest under typical ambient environments, under high intensity energy environments (as found in propulsion testing and launch facilities), and under cryogenic temperatures. Therefore, the proposed technology can be adapted for use in multiple space and ground applications for heat capture and conversion.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The expected outcome of the Phase II will allow applying this technology to NASA's roadmap in the area of Space Power and Energy Storage (SPES) (Energy Harvesting is listed under Power Generation) for Exploration Systems Mission Directorate, Space Operations Mission Directorate, and Aeronautics Mission Directorate. In addition, the National Research Council has identified "Increase Available Power" as a NASA Top Technical



Heat Harvesting by Artificial Muscles

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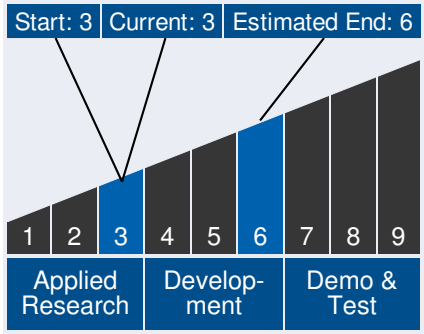
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

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Challenge. Also, a NASA Grand Challenge is "Affordable and Abundant Power" for NASA mission activities. As such, novel energy harvesting technologies are critical toward supporting future power generation systems to begin to meet these challenges. NASA has many unique needs for power that require special technology solutions due to extreme environmental conditions. These missions would benefit from the proposed versatile, advanced thermal energy harvesting technology. It will provide valuable mechanical and electrical energy from heat harvesting from diverse sources (both in space and terrestrial) to power multiple electronic devices and operate diverse mechanical devices. Additionally, the proposed technology will help enhancing the sustainability of NASA's facilities.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The proposed technology will provide a valuable supply of mechanical and electrical power obtained from harvesting waste heat from diverse sources such as jet engines, vehicle engines, rocket engines, exhaust pipes, microchips, solar cells, warm soils, power stations, boilers, cooling towers, power plants, oil refineries, steel manufacturing, glass and brick manufacturing, gas pipelines, compressors, furnaces, ovens, incinerators, refrigerators, electronic devices, etc. This in turn will reduce the net power consumption. Market sectors with attractiveness for waste heat recovery include oil and gas extraction, petroleum and coal products manufacturing, chemical plants, pulp and paper mills, steel, metal, glass, and brick manufacturing, etc. It can power multiple electronic devices (including wireless sensors) and operate diverse mechanical devices (including valves and thermal switches). Of special interest is heat waste harvested in remote locations, helping to provide independence from the electric grid.

Management Team *(cont.)*

Principal Investigator:
- Anuncia Gonzalez-Martin

Technology Areas

Secondary Technology Area:
Space Power and Energy Storage (TA 3)
└ Power Generation (TA 3.1)
  └ Energy Harvesting (TA 3.1.1)

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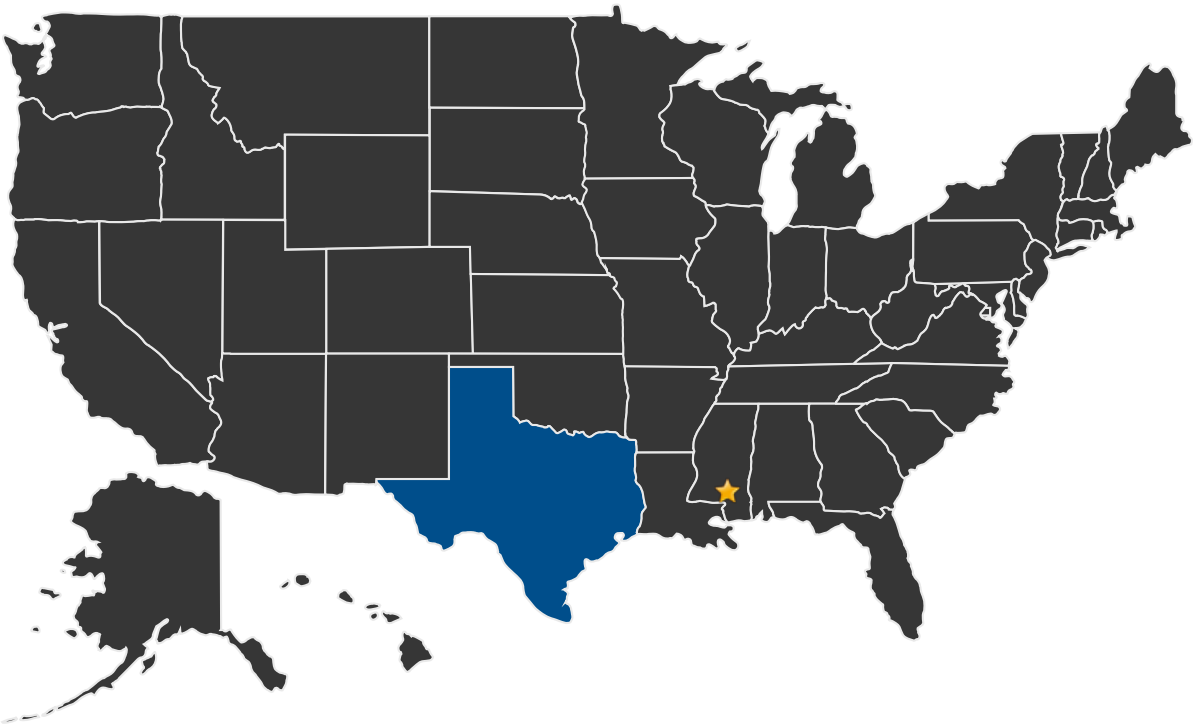
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Stennis Space Center

Other Organizations Performing Work:

- Lynntech, Inc. (College Station, TX)
- University of Texas Dallas (Richardson, TX)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/18072)

DETAILS FOR TECHNOLOGY 1

Technology Title

Heat Harvesting by Artificial Muscles