MASSACHUSETTS INSTITUTE OF TECHNOLOGY

EVCO: Providing Hot Water in Lesotho

MIT IDEAS Competition

Background

- Economy: Least Developed Country
- Geography: 80% lies above 1800m
- Climate: between -7ºC and -18ºC in winter
- Demography: 80% in rural highlands

Need

- Rural schools: 1-2 classrooms; no electricity, hot water, or heating
- In winter, attendance is low because of -5ºC classroom temperatures
- ASHRAE recommends a classroom temperature of 22ºC
- Some schools have electric generators

Edinger, Gunzburg, Jiricek, Lee, Samouhos, Wong

Our team

Sarah Edinger: First year masters student in Mechanical Engineering at MIT

Tamira Gunzburg: Senior in Development Studies at Wellesley College

Joshua Jiricek: Senior in Mechanical Engineering at MIT

Jessica Lee: Junior in Biological Engineering at MIT

Stephen Samouhos: 1st year PhD student in Mechanical Engineering at MIT

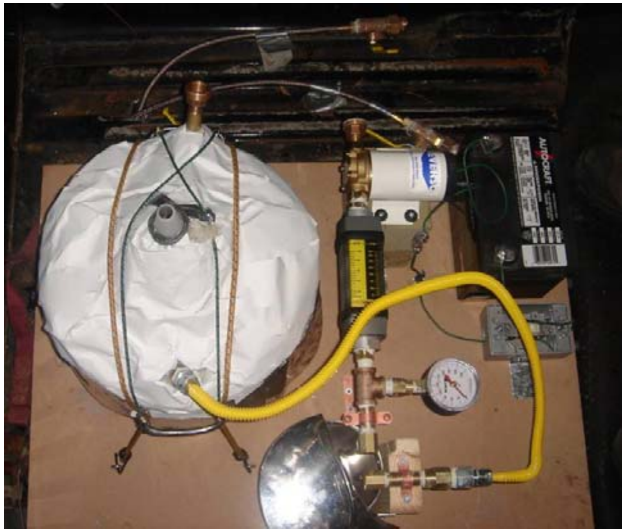
Katherine Wong: First year in Mechanical Engineering at MIT

Entering: MIT IDEAS Competition 2007

Our innovation

A technology that captures otherwise wasted heat from a generator and uses it to heat water, e.g. for space heating.

- None of the generator’s electricity is used
- No additional running cost
- Almost all materials locally available
- Only 12-20 l of water necessary for space heating



EVCO: Providing Hot Water in Lesotho

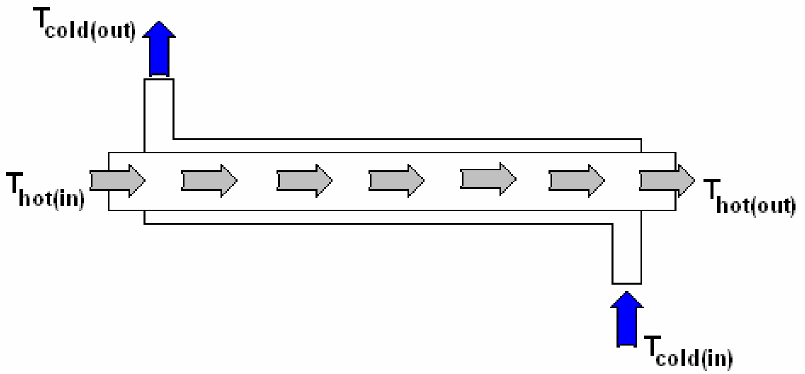
History

Initial quest: to increase the energy efficiency of distributed electric power generators

First prototype: a device that utilized the waste heat from the exhaust of a civilian pick up truck in order to distil and purify water while the vehicle was idling or in use

- Second model: installed on an electric generator
- Search for applications in developing countries:
  - as an autoclave in rural clinics
  - to boil and purify water in slums or on rural buses
  - to heat water for space heating

Design



- Pumps heat transfer oil through a 0.61 m, cross flow, annulus-type heat exchanger installed over a section of exhaust pipe where the oil experiences a ΔT of 7ºC.
- The hot heat transfer oil is then piped to a hot water tank where it releases its heat to the water and returns to the exhaust heat exchanger to be reheated.
- In steady state, the system removes and transfers heat from the exhaust at a rate of 4600 Watts.
- At this rate, a regular 230 l hot water tank would completely transition from 15°C to 50°C in about two and a half hours.
- For space heating, requirements are highly dependent on electrical equipment present in the space, occupancy limits, and building envelope design

Community Partners

Main partner:

MIT spin out company "Solar Turbine Group" (STG). STG is working on using solar energy to provide electricity and hot water.

Their problem: they can't produce hot water.
Our problem: not all schools already have generators.

Together: Provide a combined package of electricity and hot water based on environmentally friendly and free renewable energy.

Other partners: U.S. Peace Corps Lesotho, UNICEF, UNESCO, Friends of Lesotho, Lesotho Evangelical Church, Christian Council Lesotho, United Society for the Propagation of the Gospel

Implementation Plan

- Several stages.

  The experiences of each stage leads to the design of the next.

- First stage: pilot - two week trip to Lesotho for 2 engineers.

  (1) Deploy:

  install our prototype in STG's partner high school, which already has an electric generator

  (2) Train:

  train one or more locals on how to maintain and repair the system

  (3) Fuse:

  lend our expertise to STG, install prototype on solar turbine

  (4) Network:

  meet with other community partners, the ministry of education, forge alliances, plan next stage

Impact

- Access to hot water and space heating is an enormous improvement, especially during the winter months.
- At no cost to the villagers:
  ~ Free by-product of electricity being used anyway
  ~ With STG, even this electricity is free and renewable
  ~ Reduces burden of relying on fuel and firewood
- Can bridge inequality:
  With STG we can provide a combined package to any school, not just those that already have generators
- Our technology is simple, and could be used in other developing countries as well.

Budget

Airfare (2 people, to Maseru)	USD 4400
Materials purchased ahead of time by STG: Based on U.S. price estimates of common plumbing supplies, for the construction of the heat exchanger, and back up parts for on-spot repairs or design changes	USD 500
Heat exchanger (imported from U.S.) *Sunk cost (the heat exchanger is already in our possession)*	USD 250 *USD -250*
Stay in Maseru (2 people, 4-5 days)	USD 200
Stay in Bethel (2 people, 9-10 days) Based on stay in a homestead-type arrangement	USD 500
Administrative costs Intra-Lesotho travel, communications during the stay, possible translator fee (ca. 3 USD per hour), follow-up communications (calling cards)	USD 200
Subtotal Contingencies (10%) **Total**	USD 5800 USD 580 **USD 6380**

Future directions

- We did not get IDEAS money
- We will probably send the heat exchanger + blueprint to STG in Lesotho
- We will maintain contact with Lesotho community partners in case future funding opportunities become available