The Vortex Engine:
Energy from Nature

Proponent: Don Cooper

Business Plan

Project purpose

To develop and market the technology for sustainable generation of electrical power by means of the atmospheric vortex engine.

The Problems

1. Renewable energy is critical to our environmental, economic, and national security. Demand for energy is on the rise, as is our national reliance on fossil fuel-based power plants for the bulk of our electricity generation.

2. Development of sustainable energy systems is mandatory in order to reduce and eventually reverse global climate change

3. Particulate discharge from fossil fuel combustion and burning of rainforests is responsible for the unprecedented and unsustainable ‘Asian Brown Cloud’ over much of India, southeast Asia and China

The Solution

- The vortex engine can generate power by using relatively ‘low grade’ heat, through tapping into the temperature differential between the top and bottom of the troposphere (~100C). Examples of this otherwise waste heat would be low grade geothermal (50 – 90^{o}C) or thermal power station flue gas and condenser cooling water
- Smog can be reduced and eventually eliminated by using a system such as the vortex engine which
  - Has no particulate emissions
  - Can help to ‘scrub’ the atmosphere through enhanced local precipitation
- The vortex engine will make it more attractive for third world nations in tropical regions to **retain** rainforests and utilise their natural features in synergistic partnership for power generation

Why now?

- We are in a race against time to prevent irreversible damage to our global environment

- We are in a race against other nations to develop this technology:
  - Canada - AVETec
  - The US - GATECH consortium
  - New Zealand - University of Auckland

Market size

1. **Meeting new renewable energy growth:** The market for renewable energy construction in 2015 was on the order of USD$200 billion. It is currently growing at a rate of 12% per annum. On this basis, the renewable energy construction market in 2020 will be USD$350B. Based on an achievable 20% share of this for the Vortex Engine, the potential market would be US$70 billion.
   However, these expenditures are nowhere near enough to mitigate global warming to the extent required to meet the objectives of the United Nations Paris Climate Conference. The Vortex Engine technology is therefore in an excellent position to attract investment away from conventional thermal power plant construction, which could easily double the available market.

2. **Replacement of existing technology:** In this connection, it has recently been reported that China is to halt the construction of more than 250 coal-fired power plants, with a combined output of 170GW, due to air pollution concerns. If the indicative capital cost of 1GW of generating capacity in China is USD$750M (a reasonable figure), there is more than $125B of power station construction to be replaced with one or more non-coal technologies. The Vortex Engine would be an excellent fit; based again on capturing a conservative 20% of that gap, there is another $25B market in China alone.

3. **Retrofitting existing legacy plant:** A third opportunity arises from the ease of retrofitting Vortex Engines to existing conventional power stations in place of cooling towers and conventional stacks. This substantially increases the generating capacity of such plants, while making them more sustainable, efficient and less polluting. The potential of this market is vast.

Competition

- AVETec in Canada

- The GATECH consortium led by Georgia Institute of Technology and including:
  - University of Illinois, Urbana Champaign
  - University of Texas, Austin
  - United Technologies Research Center
  - National Renewable Energy Laboratory

- The University of Auckland

Product

1. **Phase 1:** initially a research rig of around 20 metres diameter using waste heat from process plant for proof of concept. A desktop theoretical design assessment and computer modelling of the rig would be required before building began

2. **Phase 2:** doubling the geometric scale to 50 metres diameter, in order to generate usable power output (although still not final industrial scale). This rig could be designed to function as a retrofit for existing thermal power stations, with the primary objective of high altitude dispersal of waste gases.

3. **Phase 3:** a fully “industrial power” scale prototype.

Business model

1. Design of first phase research rig AUD$100K
   Funded one third each from venture capital, government and university “in kind”
2. Build and test first phase rig AUD$10M
   Funded one third each from venture capital, government and university “in kind”

The later stage costings are necessarily less meaningful due to the novelty of the technology:

3. Design second phase rig AUD$2M
4. Build and test second phase system AUD$50M
5. Design build and test third phase commercial rig AUD$500M

Research and development program

The plan offered here is for a phased, accelerated, research and development program designed to produce a commercial-scale power generating Vortex Engine in approximately 10 years. The reason for an accelerated program, in addition to the great need for this technology, is the lack of IP protection – the basic physics and engineering have been in the public domain for decades. Therefore a first-to-market position, and a commanding lead in development, are best obtained by an accelerated program. Opportunities will certainly arise to patent or otherwise protect improvements and ancillary inventions during the program.

Phase 1 of four years duration would develop and test a generic technology demonstrator, fully instrumented. This would be a small Vortex Engine to use as a test bed and proof of concept. For an example, see above under Scale. Phase 1 would begin with a discovery and due diligence process, plus detailed budgeting..

Preliminary budgeting for Phase 1 suggests a cost of USD$10M. Completion of Phase 1 would allow detailed cost modelling for Phases 2 and 3.

Phase 2 of three years would develop a waste gas Vortex Engine which would carry industrial waste gases toward the tropopause. This would contribute to overcoming Asia's smog problem, and would generate a return on the R&D investment.

Phase 3 of six years duration in *parallel with phase 2* would be to develop a larger scale Vortex Engine for power generation. This more expensive undertaking would be partly funded from the commercialisation of Phase 2.

It is not yet possible to meaningfully cost Phases 2 and 3, particularly given the commercialisation opportunities that can be expected once Phase 2 is demonstrated.

From there, as noted above, it should be possible to deliver 200MWe Vortex Engine power stations for around USD$500M in the USA, or $175M in China.

Proponent

Donald Cooper is a mechanical engineer and inventor strongly interested in alternative energy and the implications of climate change.

See LinkedIn profile at: https://au.linkedin.com/pub/donald-cooper/17/7ab/638