



Perspectives from 29 Years of Thermoelectric Power Generation

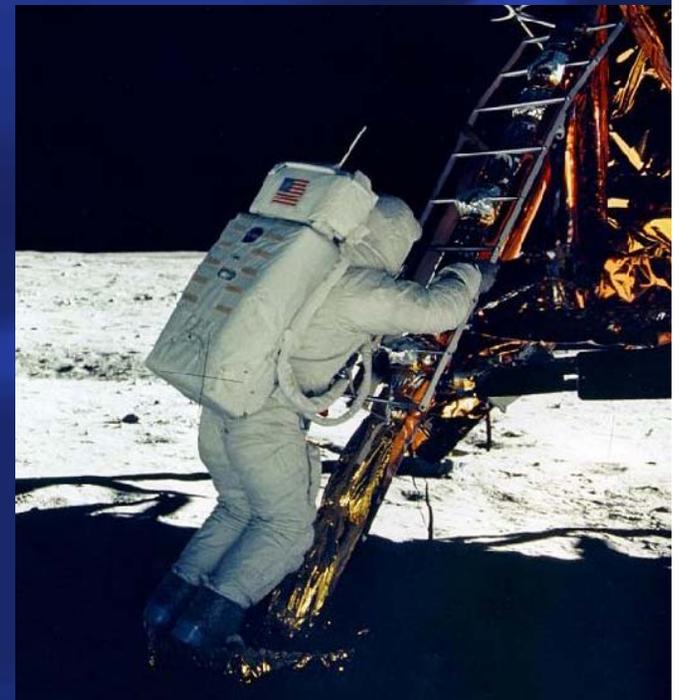
Global Thermoelectric Inc.
Calgary, Alberta, Canada

High Efficiency Thermoelectric Workshop
February 17-20, 2004
Loews Coronado Bay Resort
San Diego, California



A Colourful History

- Post WWII - 1957: Milwaukee Gas Specialty Company
 - Gas Control Valves
 - Baso valve still used today in TEGs





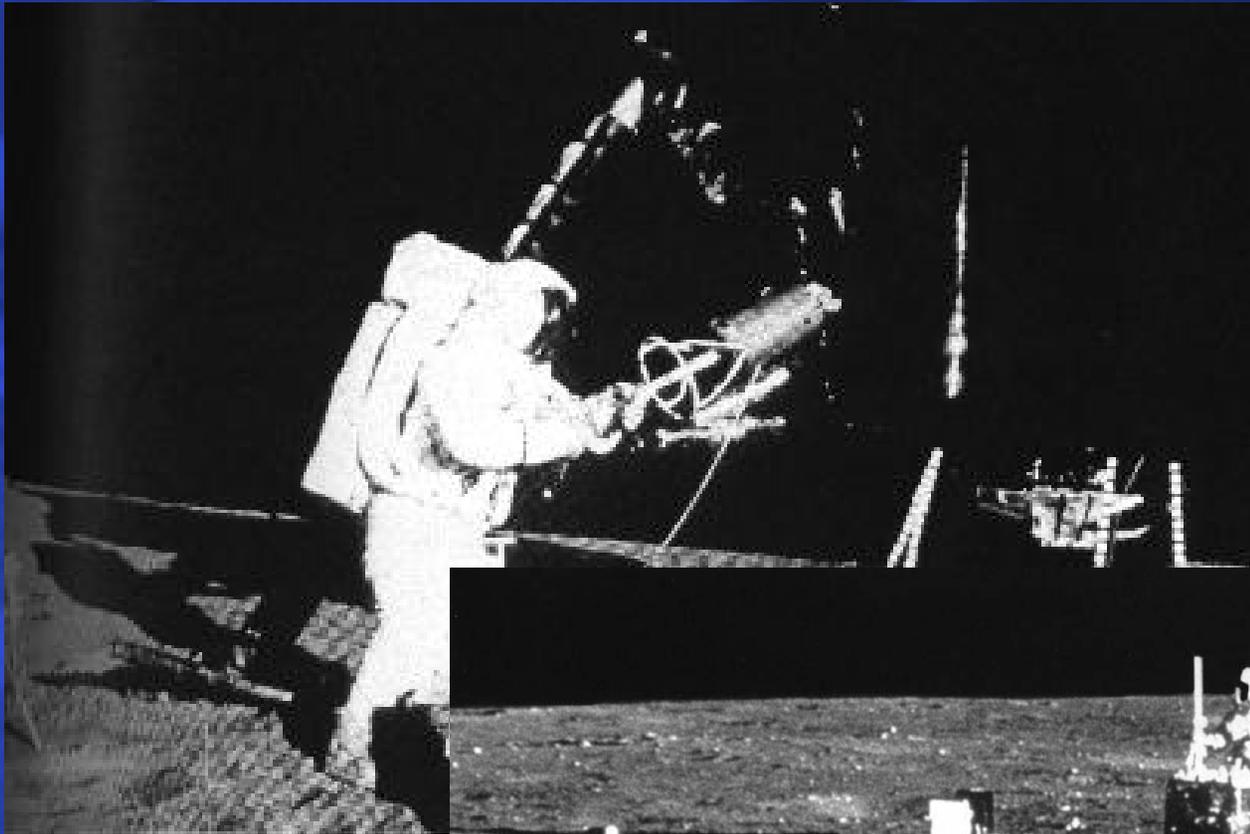
A Colourful History

- 1958 – 1974: 3M Electrical Products Group
 - Apollo Space Program – SNAP 27
 - Radioisotope 60W TEG
 - Remote power





A Colourful History





A Colourful History





A Colourful History





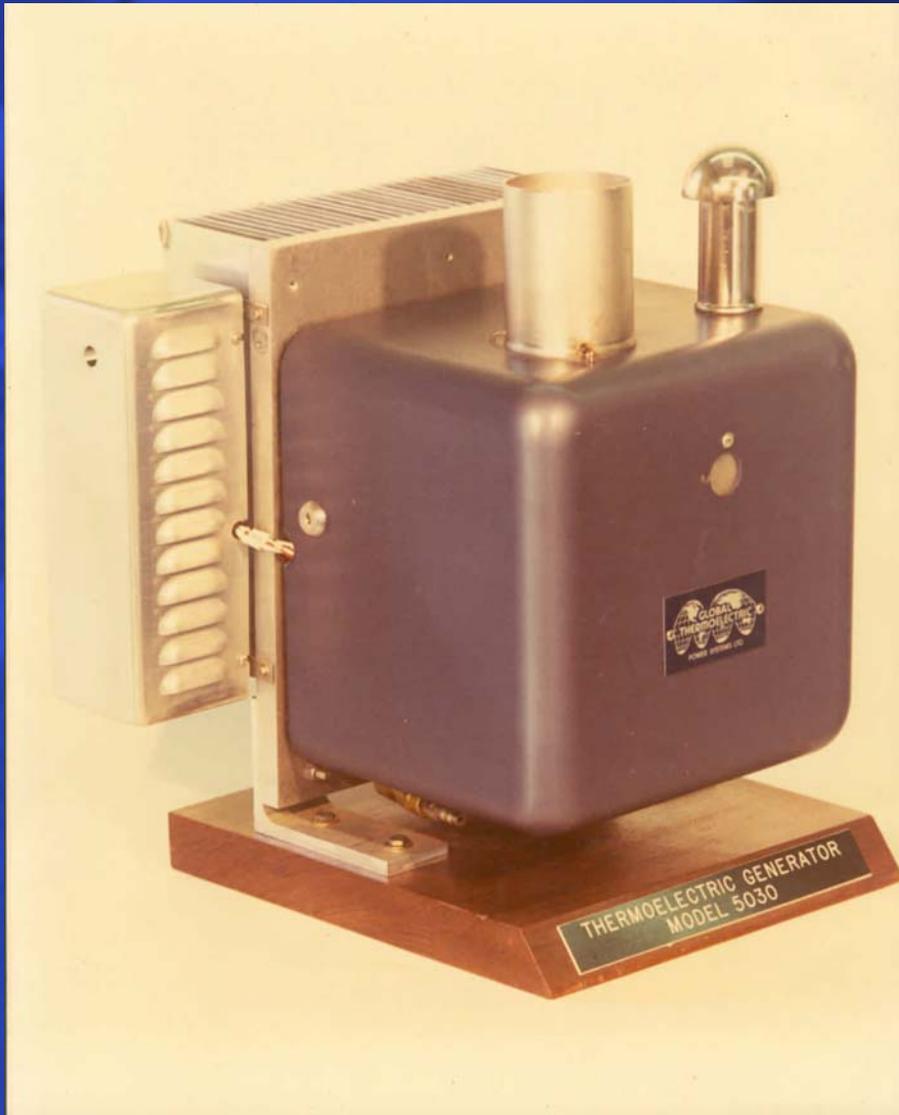
A Colourful History

- 1975 – Present: GLE
 - Local Investment
- Welcome to Bassano, Alberta, Canada
- About 500 miles west of Moose Jaw





Early Global TEGs





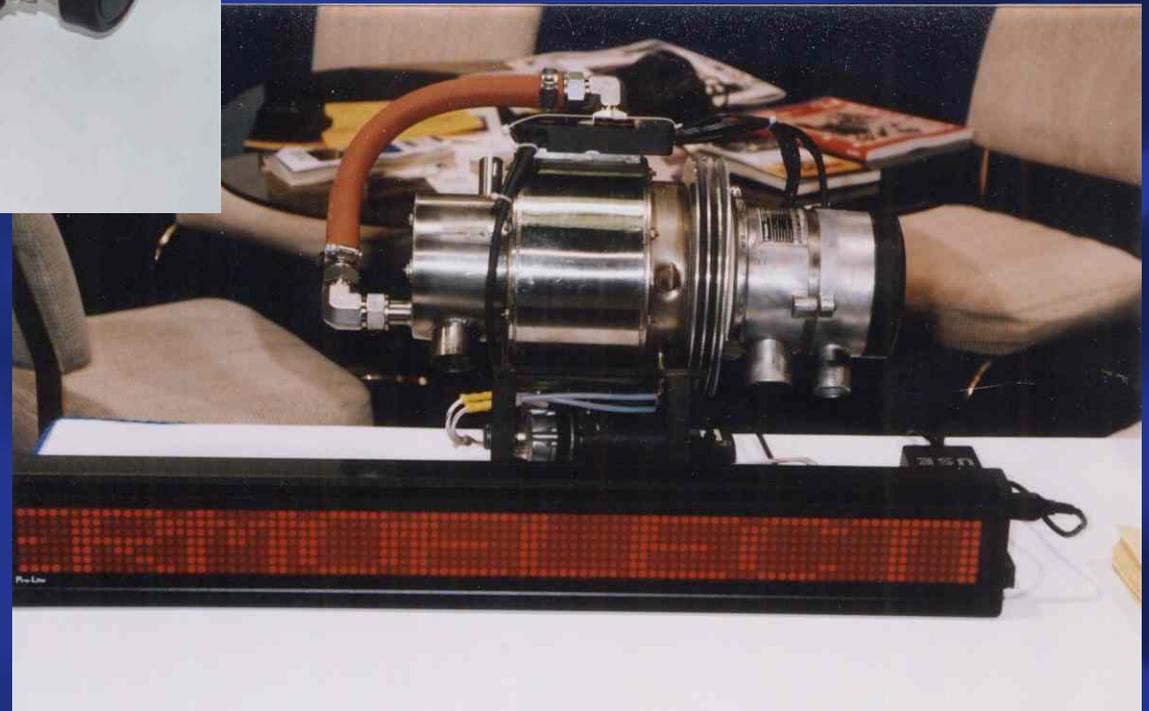
Product Experiences

- Liquid-fueled
- Gaseous-fueled
- Air cooled
- Liquid cooled
- Power generation
- Heating
- Portable
- Self-powered
- Military
- Planar, cylindrical
- Submersible



Product Development

Liquid-fueled TEGs





Product Development

Self-powered Heaters





Product Development

Heat Recovery – Solid Waste Incineration





Product Development

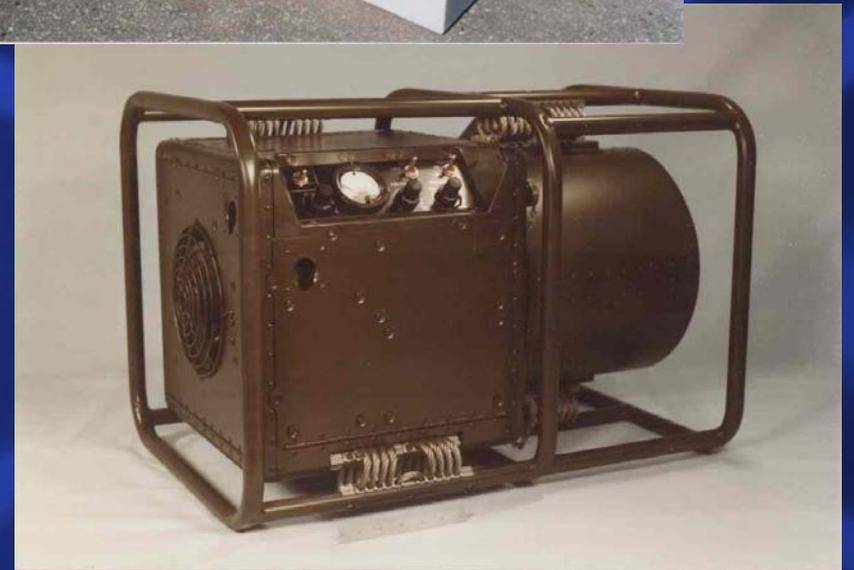
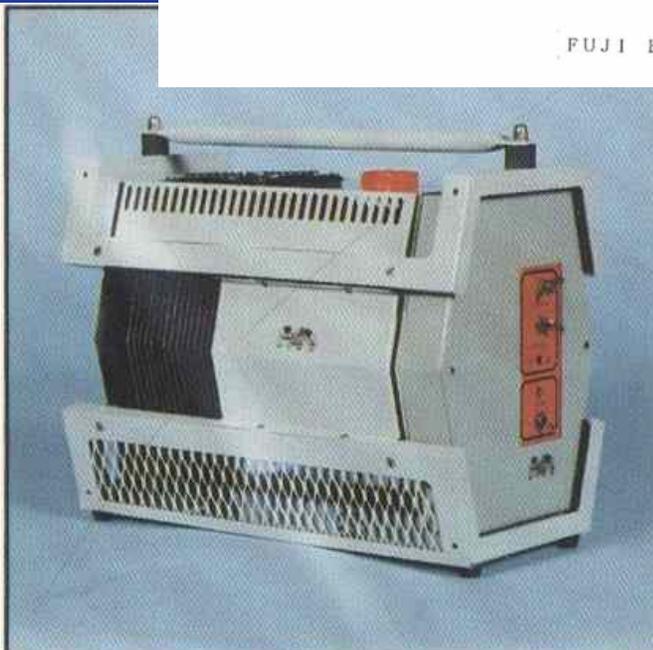
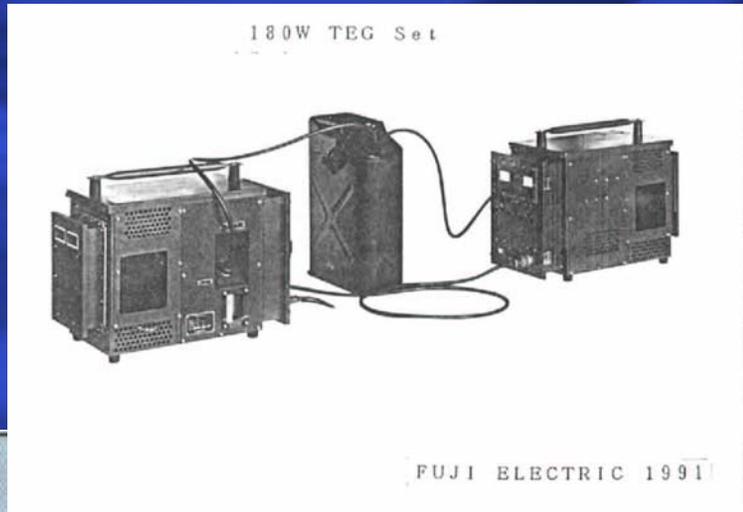
Heat Recovery – Automotive exhaust/alternator replacement





Product Development

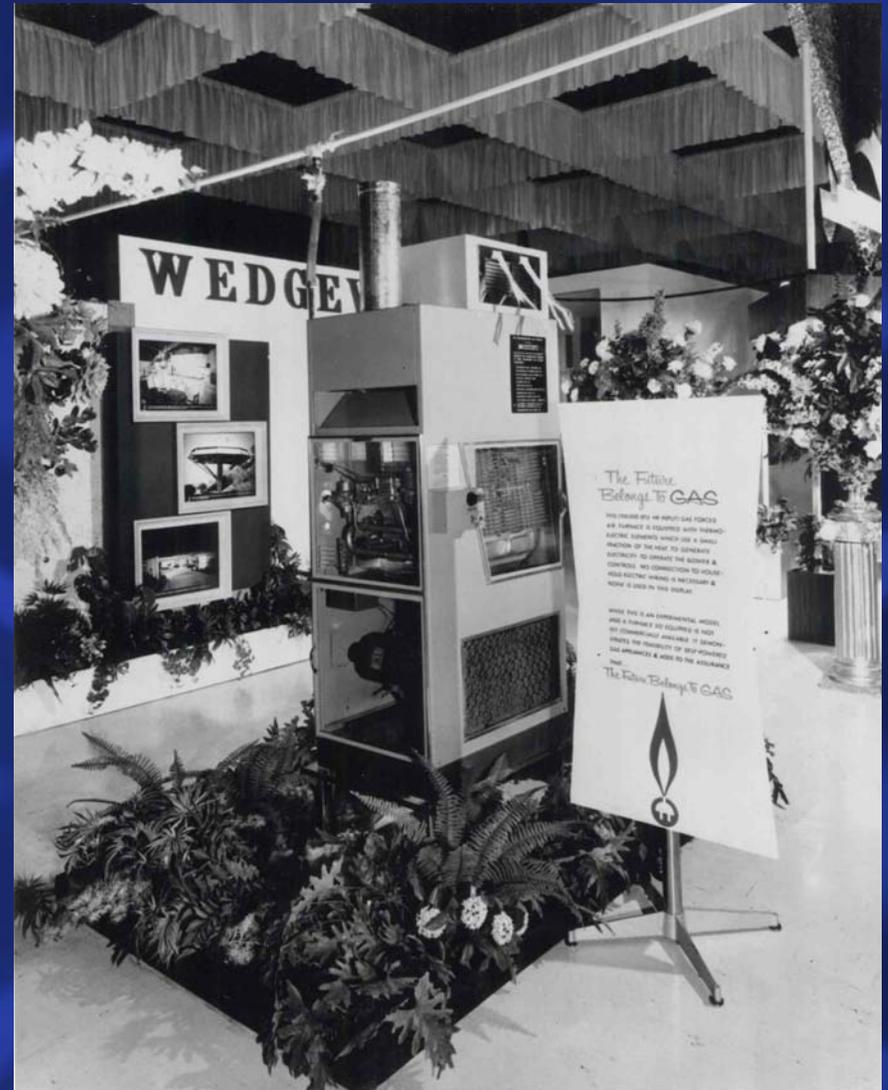
Mobile Power Supplies





Product Development

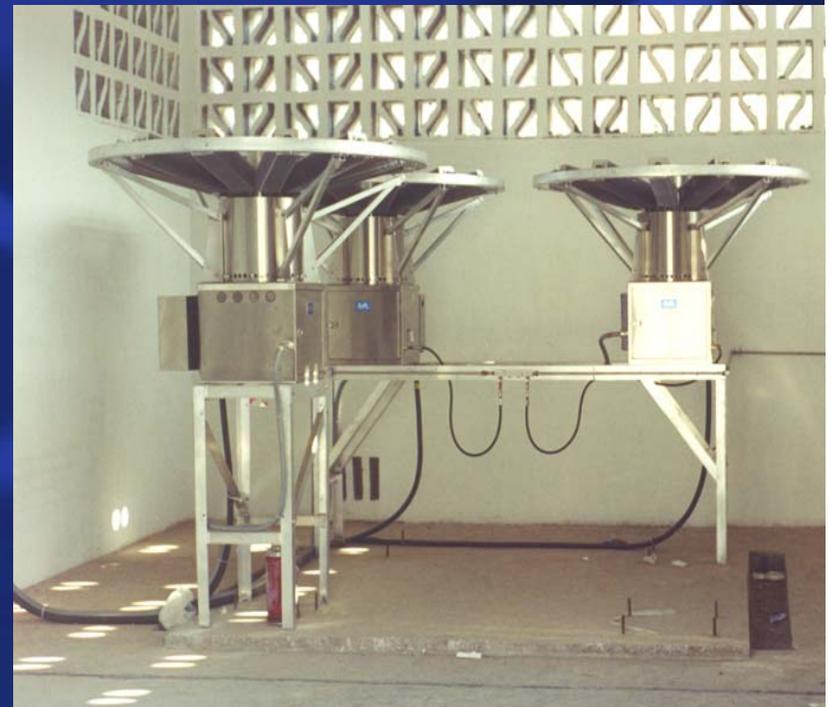
- Special Configurations





Today's Global TEGs

- Reliability
- 20 year design life
- Almost 20,000 installed worldwide
- Some in service for 30 years



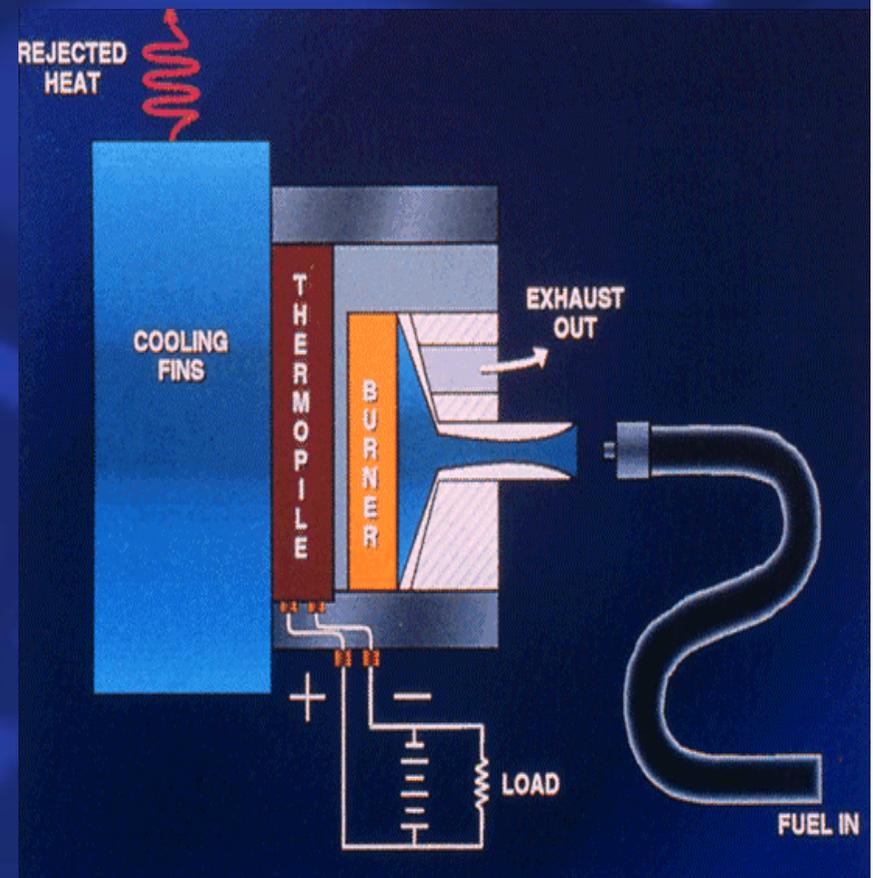


Thermoelectric Generators

Solid State Devices

Key components

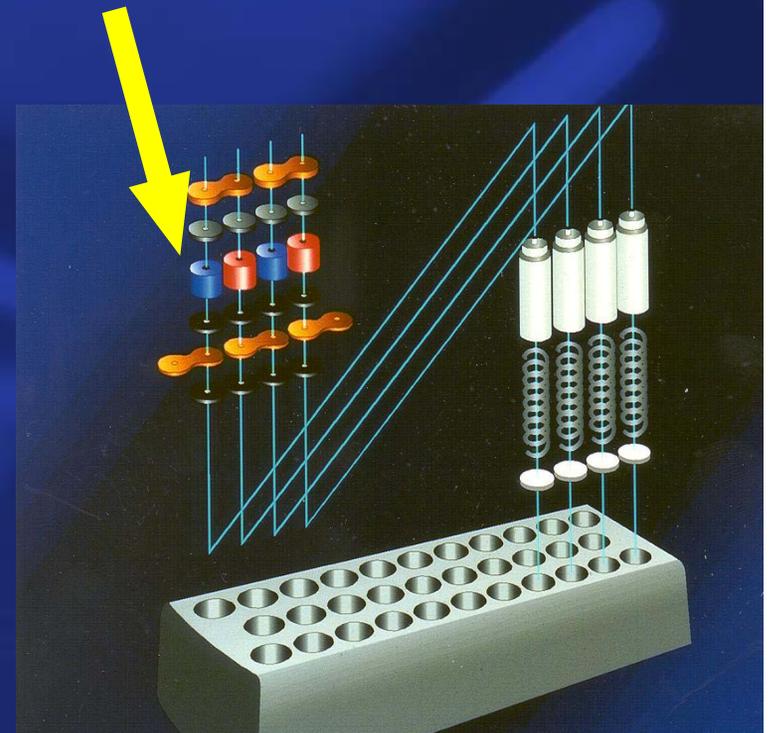
- **Burner** – the heat source
- **Sealed Thermopile** – the energy conversion device
- **Heat sink** – cooling fins or heat pipes





Thermopile

- Energy conversion takes place in hermetically-sealed thermopile
- Lead-tin-telluride elements
- ΔT across thermopile creates DC current





Technology to Product

- Burner system
- Heat dissipation
- Gas flow control
- Fuel conditioning
- Power conditioning
- Electronic ignition
- Auto shut-off
- Enclosure
- Class 1 Div1/2





Common Applications

- Gas Wells & Pipelines
 - Cathodic protection & SCADA
- Offshore Platforms
 - Communications, monitoring and emergency systems
- Homeland Security
 - Military/security monitoring & communications
 - Emergency services
- Telecom
 - Remote sites





TEG Products

- 15W to 550W
 - Model 5015 – 15W @12/24V
 - Model 5030 – 21W @12/24V
 - Model 5060 – 54W @12/24V
 - Model 1120 – 100W @12/24V Class 1 Div1/2
 - Model 5120 – 108W @12/24V
 - Model 5220 – 220W @12V/176W @24V
 - Model 1500 – 500W @24V Class 1 Div1/2
 - Model 8550 – 550W @24V





A Funny Thing Happened...

- Extensive experience in thermoelectrics
- More extensive experience in systems
- Broad experience in applications
- Success in one niche market
 - Differentiation, Distribution, Quality
- Compromises for focus and profitability
 - Stability – Long Life – Reliability
 - Limited materials research





A Colourful Future!

- A resurgence in interest
- Market demand in new areas
- Time for new technologies to break through to markets







Market Focus (Global View)





Peripheral Products

- Fuel Conditioning Systems
- Stands
- Custom power supplies
- Electrical Distribution Panels
- Integrated batteries
- Solar hybrids
- Heat Recovery Systems





Project – Jamnagar-Loni Pipeline (India)

- 1,100 km LPG pipeline
 - 312 TEGs for CP, Telecom and SCADA
 - 2, 3, and 4 kW systems with 24/48 Vdc output
 - Global scope also included GPRS, fuel vaporizers, system control panels, batteries, installation and commissioning





Project – Total Indonesia

- Unmanned offshore platform
 - Scope of supply included hazardous approved distribution panels, isolation switch boxes, and batteries
 - TEGs for SCADA
 - 10+ platforms





Features

- Standard 12 VDC, 24 VDC
 - Other Voltages (DC or AC) available upon request
- Generators can be connected in parallel or series for larger loads
- Systems can be designed for load requirements from 10 W to 5000 Watts
- Gaseous fuels – natural gas, propane
- Cathodic protection interface panel





Turnkey Power Solutions

- Gas pressure reduction systems
- Electrical distribution panels
- Multi-TEG system control
- Installation
- Commissioning
- Customer support

