Welcome Remarks

Edward J. Wall, Program Manager
Office of FreedomCAR and Vehicle Technologies Program
U.S. Department of Energy

High Efficiency Thermoelectrics Workshop
San Diego, California
February 17-20, 2004

Milestones

- Discovered in 1821 by Thomas Johann Seebeck
- Use limited to
  - thermocouples (till 1940's)
  - niche applications (till 1990's)
- 1990's: DoD advances the Technology
- DOE interest in increasing transportation efficiency

Recent DoD TE Research

When	What	Who
1992	Bandgap engineering of BiSb	MIT-Lincoln Lab [ARO and ONR]
	Skutterudite studies	JPL [ONR]
1993	Theoretical prediction of enhanced TE properties via quantum enhancement effects in superlattice systems	MIT
1995-1996	Experimental Confirmation of Enhanced thermoelectric Effects	Superlattice: MIT-LL Skutterudites: JPL
1997	Thermoelectrics Initiative Launched	[DARPA]
	MURI Center in TE Quantum Structures	UCLA [ONR]
1999-2000	Efficacy of quantum-dot approach demonstrated	MIT-LL
	Efficacy of cross-plane superlattice approach demonstrated	RTI

Recent DOE TE Research

- Hi-Z/PNNL recently fabricated TE devices based on the Quantum Well Confinement concept, and demonstrated measured “ZT” values of up to 4!
- Currently the technology is at laboratory stage significant work remains to make it commercially viable.

DOE Interest

- More than 97 percent of the fuel consumed by the U.S. transportation sector is petroleum-based (two-thirds of the nation's total oil consumption).
- Although vehicle fuel efficiencies have improved steadily since the 1970's, increases in population and per capita miles caused consumption of petroleum for transportation to rise from 17.8 Quads in 1973 to 25.8 Quads in 2000.
- Defending oil supply sources from the Middle East can involve an economic/military cost.

DOE's charter includes conservation of energy.

What if We are Successful?

- Transportation
  - 50% and higher overall efficiency for trucks and personal automobiles?
  - Replace internal combustion engines with TE devices?
  - “More electric” vehicles and integrated motor/alternator starters?
  - Electric turbocompounding compatible with thermoelectrics?
- Non-transportation
  - Replace present day refrigerators/freezers?
  - Power stations/industrial plants?
  - Heating, ventilation, and air-conditioning (HVAC)?
- Environment
  - Improved engine efficiency can reduce emissions.
  - Global climate warming: Replacing the current refrigerant (R-134a), which produces approximately 1,800 times more greenhouse gas effect than CO_2, benefits the environment.

EERE Program Offices

- Solar
- Wind & Hydropower
- Geothermal
- Distributed Energy, Electricity Infrastructure and Reliability
- Biomass
- Industrial Technologies
- FreedomCAR & Vehicle Technologies
- Hydrogen, Fuel Cells & Infrastructure
- Building Technologies
- Weatherization & Intergovernmental Grants
- Federal Energy Management Program (FEMP)

TE benefits are of interest to multiple EERE programs.

Concluding Remarks

- DOE exploring various possible ways to stimulate the development of TE technology.
- DOE Energy Efficiency budget request is expected to stay level (same as last year, adjusted for inflation).
- Discretionary funding is available, but limited, for supporting R&D. DOE has to:
  - constantly re-evaluate the R&D portfolio,
  - consider where breakthroughs are likely, and R&D support could make the critical difference.
- RFP on waste heat utilization/thermoelectrics, coming from NETL, expected by February, 2004.