



# Small Thermoelectric Generators (TEGs)

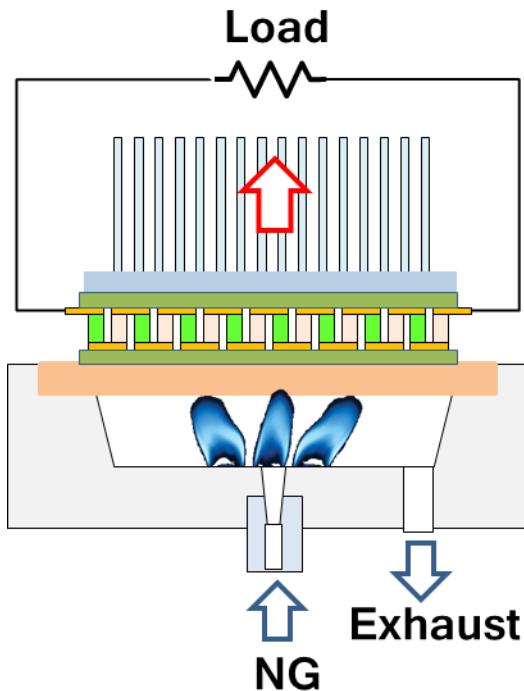
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**Natural Gas Workshop**

April 24, 2013

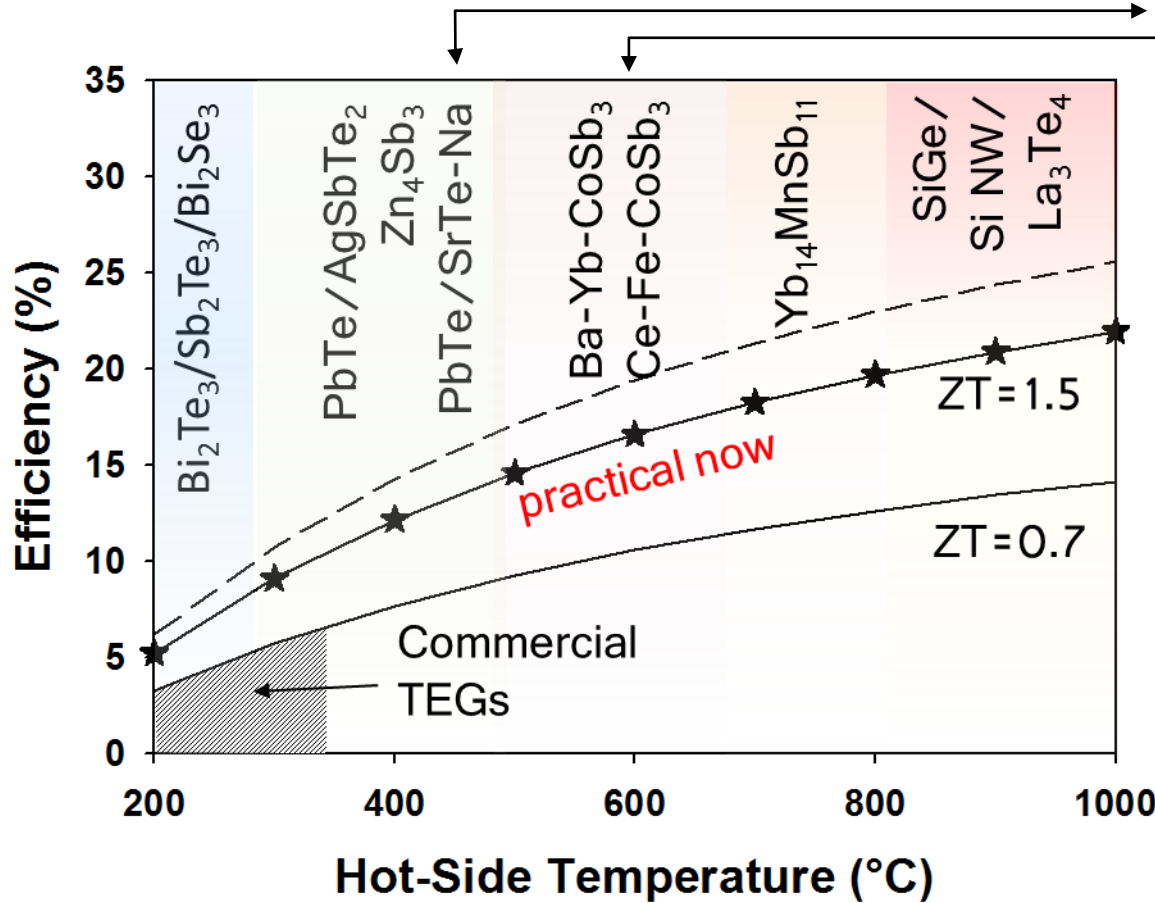
# Traditional TE Generators



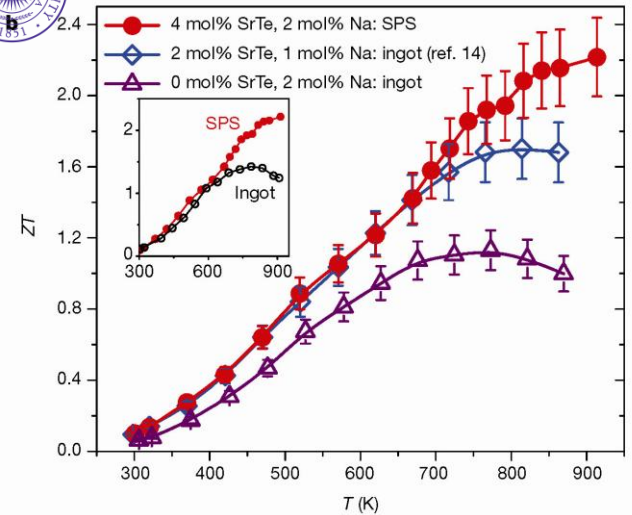
- NASA deep space missions from Pioneer, Voyager to Curiosity
- Generators for communications along gas pipelines and offshore platforms
- Automobile exhaust heat recovery

- **SOLID STATE**
- **15+ YEAR RELIABILITY**
- **FUEL FLEXIBLE /RAW GAS**
- **POLYCRYSTALLINE “BULK” TE**
- **LOW NOISE**
- **WIDE RANGE OF OPERATING TEMPERATURE**

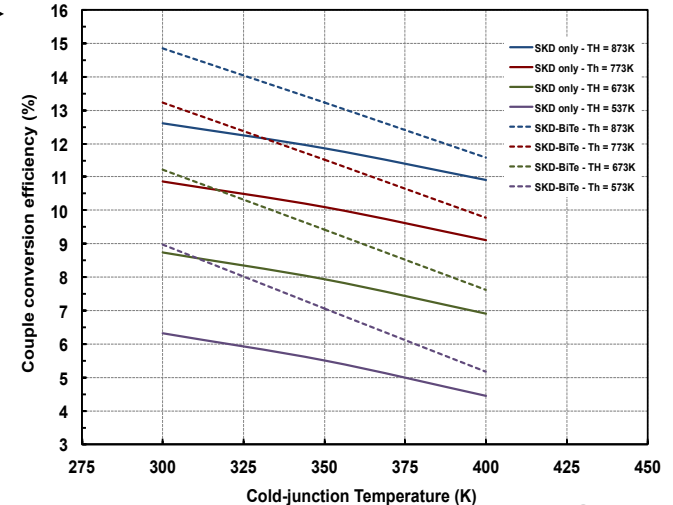
# Materials Advancements



NW Group, Nature, September 2012

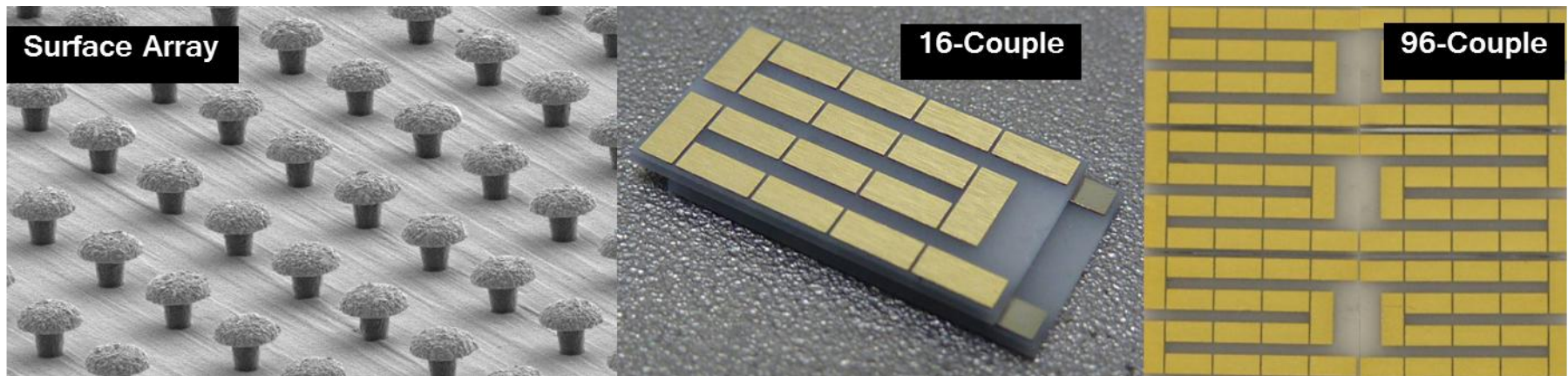


**JPL** JPL Skutterudites Couple Efficiency

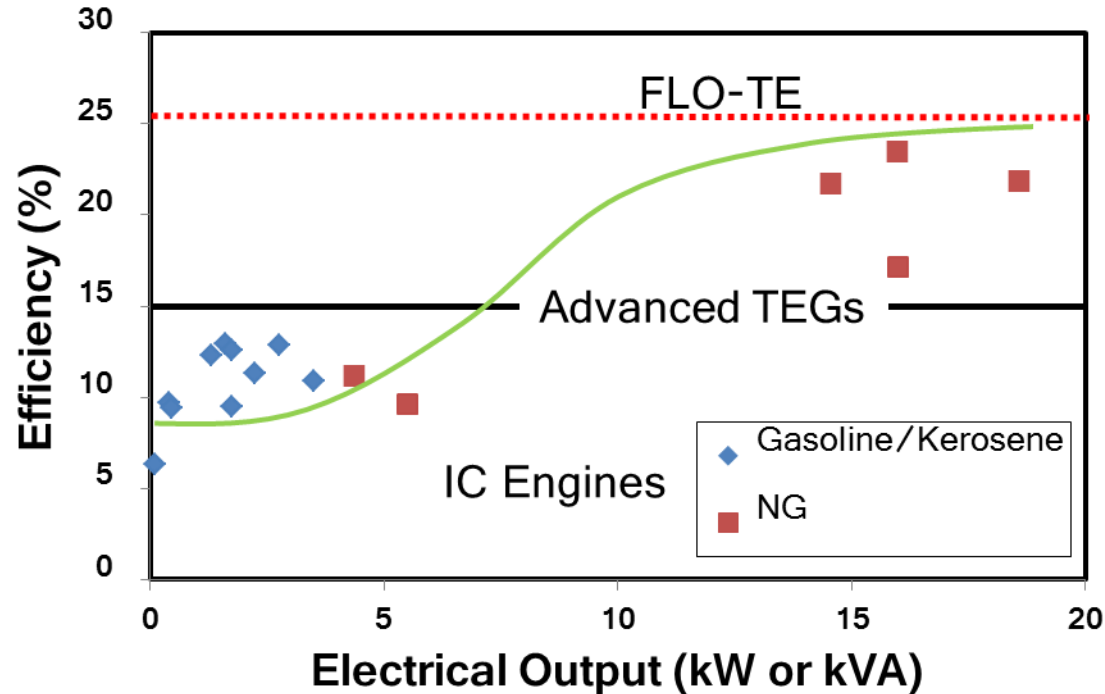


# Thin Film Generators

- Doubling of efficiency by managing heat flux and reducing interface losses
- 10-fold reduction in cost and 10,000 fold reduction in TE materials usage



# Small Generators



- Small (< 5 kW) IC engines have high maintenance & low reliability because they are used primarily as backup generators
- TE engines can be maintenance free with high reliability

Source: Efficiency data based on specification sheets of different manufacturers (Honda, All Purpose American Generator, Power House Portable Inverter Generator, Duromax, Brigg and Stratton, Generac)