THERMOPHOTOVOLTAICS: A NEW CONCEPT EVOLVING IN ENERGY CONVERSION

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Presentation Outline

1. BASIC COMPONENTS OF A THERMOPHOTOVOLTAIC (TPV) ENERGY CONVERSION SYSTEM

2. TRADE-OFFS: RADIATORS VERSUS RECEIVING CELL BAND GAP

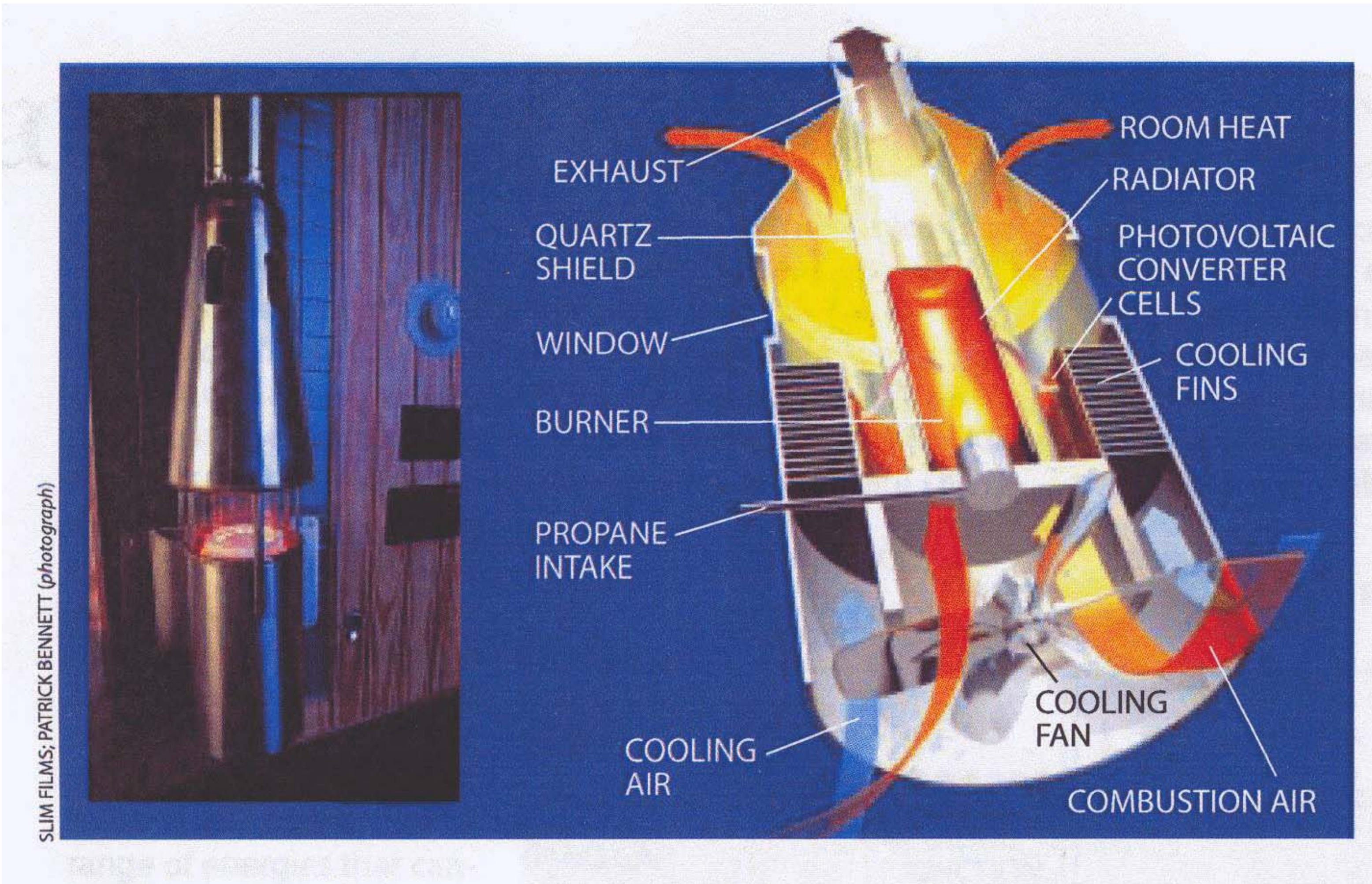
3. SUMMARY OF EXPERIENCE TO DATE WITH WIDE-GAP SYSTEMS

4. THE MICRON-GAP APPROACH: BASIC CONCEPTS

5. STATE OF PROGRESS IN MICRON-GAP SYSTEMS

6. CONCLUDING COMMENTS

BASIC TPV SYSTEM COMPONENTS



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TPV RADIATORS AND RECEIVING CELLS: AN OVERVIEW

- **TRADE-OFF ISSUES:** Operating temperatures, radiator materials and spectra, types of receiving PV cells
- **1,000 Degree C operation:** inexpensive radiator, costly cells
- **2,000 Degree C operation:** costly radiator, inexpensive cells
- **Role of continued R&D:** additional R&D efforts may result in new combinations of radiator and receiving cell materials, drawing in part on current research into advanced PV cell designs (CIGSe, CdTe, GaAlAs, etc)

EXPERIENCE TO DATE WITH WIDE-GAP TPV SYSTEMS

- **The concept has been proven:** various operating temperatures, radiator and cell materials have been explored, with planar and cylindrical configurations
- **Products have been marketed:** boat APU, “E-stove”
- **Costs are high and performance is marginal**
- **Low-level R,D&D continuing for wide-gap systems**

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COMPARISON OF BROADBAND AND SELECTIVE RADIATORS

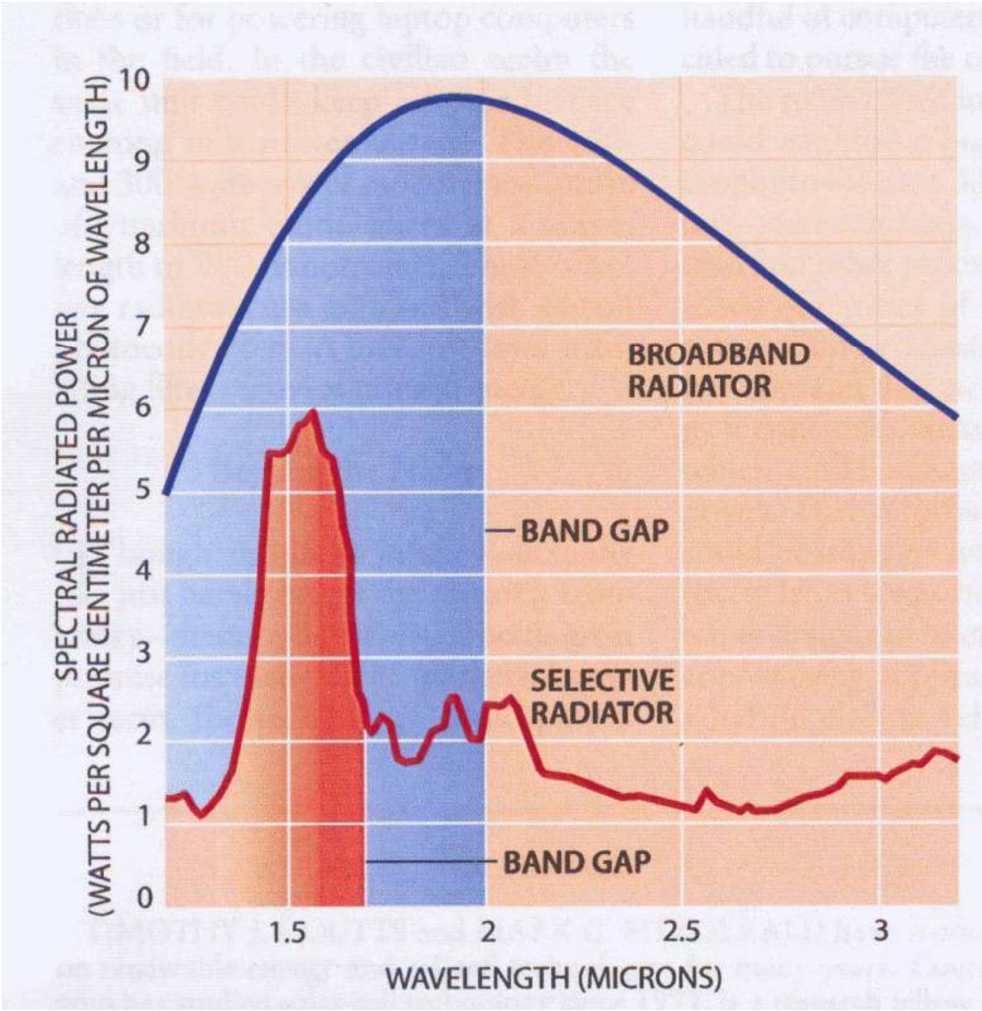

Illustration credit: Scientific American, September 1998

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Potential Markets

- **Home outage but gas available: furnace power, some lighting**
- **Quiet and clean source of power required: boats in a remote anchorage**
- **Military applications: more power, longer run time compared to fuel-cell systems**
- **Home emergency power: less hazardous than gasoline-fueled generators, quieter, less emissions**

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STOVE & POWER SOURCE FOR CABINS

Midnight Sun® Stove
100 W of electricity
25,000 BTU/hour of heat

Image from JX Crystals web site, jxcrystals.com, 6/2007

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THEORETICAL BASIS FOR MTPV CONCEPT

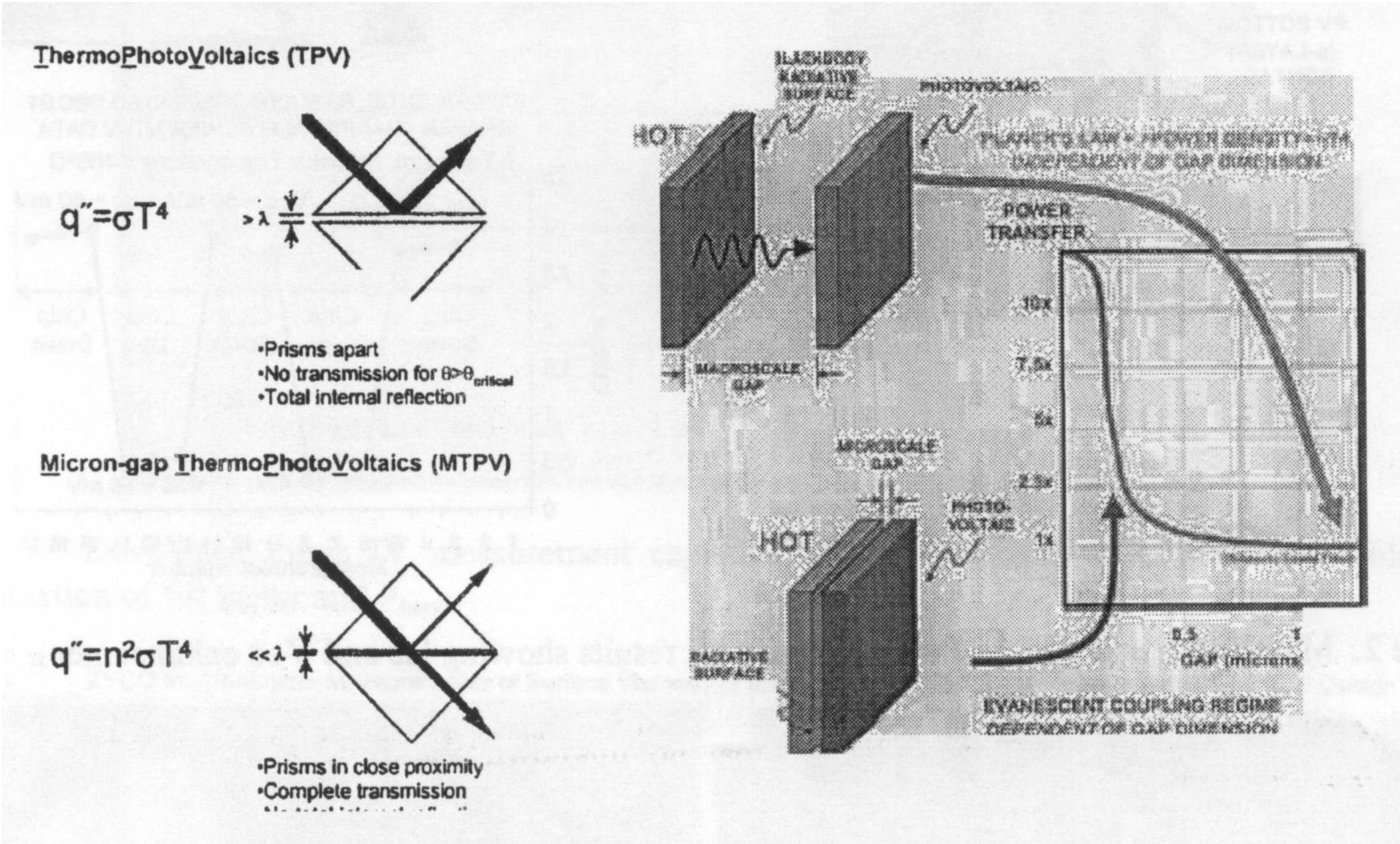

Illustration credit: Reference 2, Figure 1

Conclusions

- **TPV remains an interesting concept, but more economical options exist now for quiet, clean power than 15 years ago.**
- **Micron-gap TPV is receiving the most attention now, with promise of greater efficiency than the wide-gap approach.**
- **Progress in development of materials for radiators and PV cells could enable commercial feasibility of TPV systems.**

References & General TPV Information

[1] ***Thermophotovoltaics*,** by Timothy J. Coutts and Mark C. Fitzgerald, Scientific American, September, 1998, pp 90-95

[2] ***Micron-gap ThermoPhotoVoltaics (MTPV)*,** Research Report LM-04K064, R. DiMatteo et al., Charles Stark Draper Laboratory, Inc., Cambridge, Ma; Lockheed Martin, Schenectady, NY, and Bechtel Bettis, Inc., West Mifflin, PA

[3] JX Crystals web site, jxcrystals.com

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