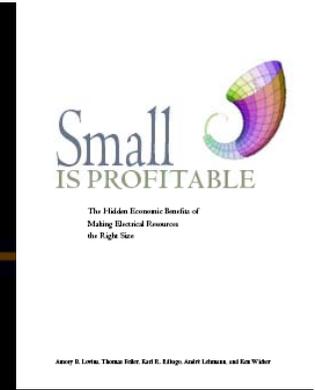
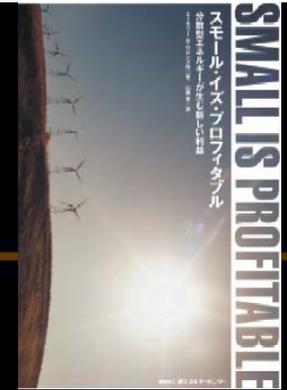




"Distributed benefits" change the game



- ◇ Size matters!
- ◇ *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size* (Rocky Mountain Institute, 2002; Japan Energy Conservation Center, 2005)
 - www.smallisprofitable.org; an *Economist* book of the year
- ◇ Codifies and quantifies 207 "distributed benefits" that collectively increase the economic value of decentralized generation by typically ~10× (but site-specific)
- ◇ Four kinds: financial economics, electrical engineering, miscellaneous, externalities
- ◇ "Cleaner Energy, Greener Profits" (www.rmi.org, 2001) shows how this approach can make fuel cells profitable even at handicraft prices (\$3,000–5,000/kW_e)
- ◇ As markets start to recognize distributed benefits, the decentralized-electricity revolution will accelerate



Negawatts/renewables synergy: Bundling photovoltaics with end-use efficiency

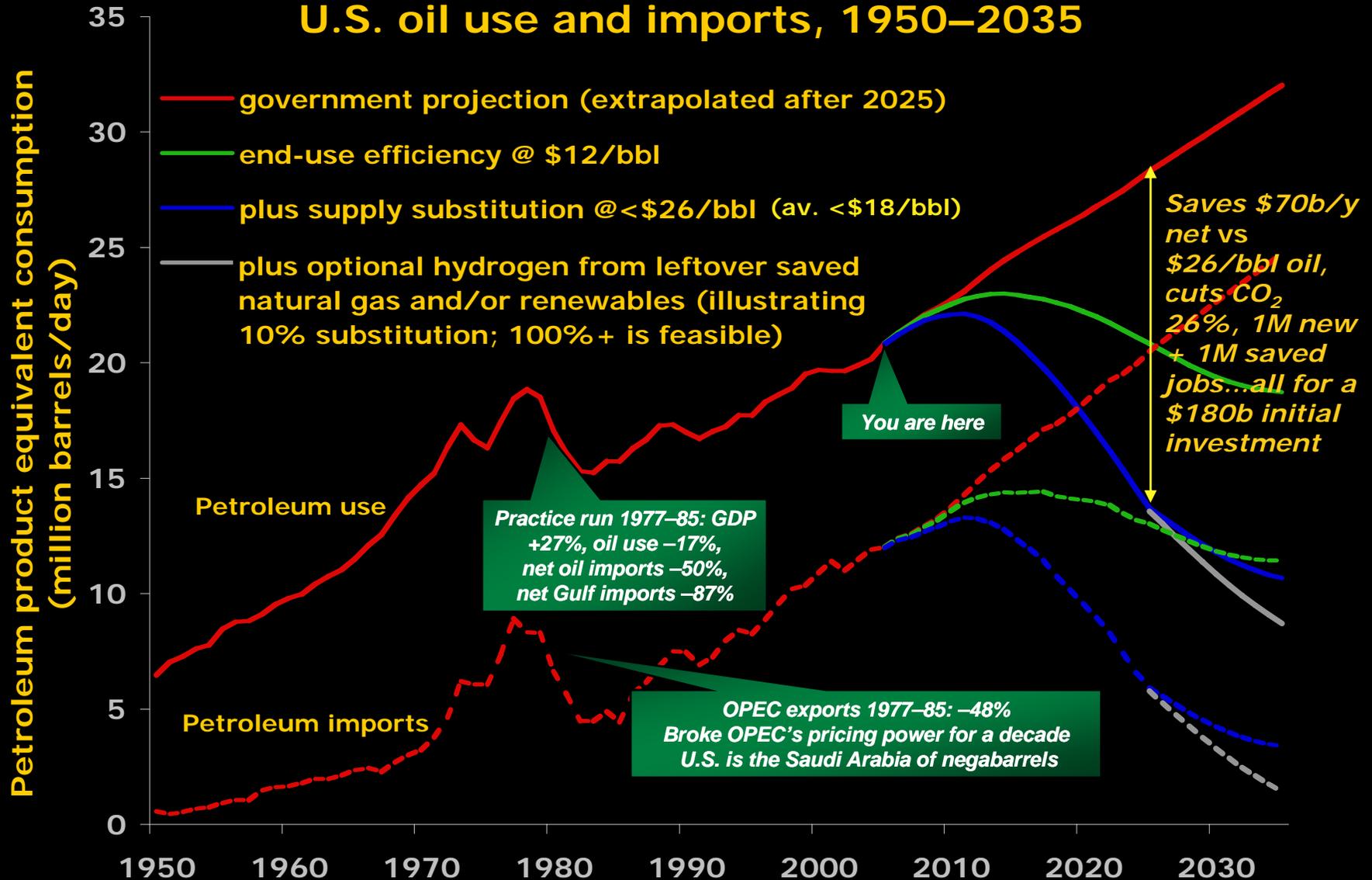


- ◇ Santa Rita Jail, Alameda County, California
- ◇ PowerLight 1.18 MW_p project, 1.46 GWh/y, ~1.25 ha of PVs
- ◇ Integrated with Cool Roof and ESCO efficiency retrofit (lighting, HVAC, controls, 1 GWh/y)
- ◇ Energy management optimizes use of PV output
- ◇ Dramatic (~0.7 MW_p) load cut
- ◇ Gross project cost \$9 million
- ◇ State incentives \$5 million
- ◇ Gross savings \$15 million/25 y
- ◇ IRR >10%/y (Cty. hurdle rate)
- ◇ Works for PVs, so should work better for anything cheaper



A profitable U.S. transition beyond oil

U.S. oil use and imports, 1950–2035





Vehicles use 70% of US oil, but integrating low mass & drag with advanced propulsion saves ~2/3 very cheaply

CARS: save 69% at \$0.15/L

PLANES: save 20% free, 45–65% @ ≤\$0.12/L

Surprise: ultralighting is *free* — offset by simpler automaking and the 2x smaller powertrain



250 km/h, 40 km/L

TRUCKS: save 25% free, 65% @ \$0.07/L



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

BLDGS/IND: big, cheap savings; often *lower capex*



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.



Technology is improving faster for efficient end-use than for energy supply