Utility Oil Conservation

A Near-Term PV Central-Station Market

CONCLUSION

If baseline technology commercial readiness goals are reached, it will be cost-effective by the late 1980s in the primary market areas to construct photovoltaic plants solely to reduce oil consumption. Even if the real (uninflation-adjusted) price of oil does not increase over 1980 values, the economic advantages of photovoltaics will be substantial in the primary market areas.

PRIMARY MARKET AREAS
- California
- Florida
- Hawaii
- Puerto Rico
- Nevada
- Oregon
- Idaho
- Montana
- Wyoming
- Washington
- Alaska
- Louisiana
- Texas
- Oklahoma
- Utah
- Nevada
- New Mexico
- Arizona
- Colorado
- New York
- Pennsylvania
- Maryland
- Virginia
- West Virginia
- North Carolina
- South Carolina
- Georgia
- Florida
- Alabama
- Mississippi
- Louisiana
- Arkansas
- Missouri
- Illinois
- Wisconsin
- Minnesota
- Iowa
- South Dakota
- North Dakota
- Nebraska
- Kansas
- Oklahoma
- Texas
- New Mexico
- Arizona
- California
- Oregon
- Washington
- Idaho
- Nevada
- Utah
- Colorado
- Montana
- Wyoming
- Alaska
- Hawaii

SECONDARY MARKET AREAS
- Louisiana
- Texas
- Oklahoma
- Utah
- Nevada
- New Mexico
- Arizona
- California
- Oregon
- Washington
- Idaho
- Montana
- Wyoming
- Alaska
- Hawaii

PRESENT (1973) OIL USE:
- 85,000 BBL/DY (OIL EQUIVALENT)

PRESENT (1973) NATURAL GAS USE:
- 18,000 BB/DY

CONCLUSIONS

If commercial readiness goals are reached, by the late 1980s, the economic advantages of photovoltaics will be significant in the primary market areas. Even if the real (uninflation-adjusted) price of oil does not increase over 1980 values, photovoltaics will still be cost-effective.
Issues

• QUESTION: IS THIS APPARENT OPPORTUNITY REAL, OR IS THE ANALYTICAL APPROACH TOO SIMPLIFIED?
  • RESPONSE: DETAILED ANALYSES OF VALUE OF PHOTOVOLTAIC GENERATION IN SPECIFIC OIL-DEPENDENT SUNBELT UTILITIES

• QUESTION: ARE THESE RESULTS CREDIBLE TO THE INDUSTRIES THAT WOULD BE INVOLVED?
  • RESPONSE: EXTENSIVE IN-DEPTH DISCUSSIONS WITH REPRESENTATIVE ORGANIZATIONS IN THE UTILITY, PHOTOVOLTAIC MANUFACTURING, AND CONSTRUCTION INDUSTRIES

• QUESTION: HOW CAN TECHNICAL AND ECONOMIC RISKS BE REDUCED TO THE POINT THAT THE PRIVATE SECTOR WILL TAKE ADVANTAGE OF THIS OPPORTUNITY?
  • RESPONSE: ANALYSES OF INNOVATIVE FINANCING ARRANGEMENTS THAT COULD LEAD TO HAND-OFF TO THE PRIVATE SECTOR AT CURRENTLY ACHIEVABLE SYSTEM COSTS, ONCE TECHNICAL FEASIBILITY HAS BEEN DEMONSTRATED

SUPPORT OF FEDERAL PARTICIPATION IN INITIAL UTILITY-SCALE PROJECTS THAT DEMONSTRATE TECHNICAL FEASIBILITY OF LARGE PHOTOVOLTAIC SYSTEMS FOR UTILITY APPLICATIONS

Value Analysis Methodology
Value of PV Power Plants in the Southern California Edison System

ASSUMPTIONS

- ALL COSTS IN 1980 DOLLARS
- GENERAL INFLATION RATE
  - 1981 - 1987: ~8.4%/YR
  - 1988 - : 5%/YR
- REAL FUEL PRICE ESCALATION
  - 1981 - 1984: ~2.7%/YR
  - 1985 - : 2%/YR
- PHOTOVOLTAIC SYSTEM LIFE: 30 YR
- PHOTOVOLTAIC PENETRATION
  - ENERGY: 5%
  - CAPACITY: 11%
Value of PV Power Plants in the Los Angeles Department of Water and Power System

ASSUMPTIONS

- ALL COSTS IN 1981 DOLLARS
- GENERAL INFLATION RATE
  - 1981 - 85: 9.12% / YEAR
  - 1986 - 90: 8.30% / YEAR
  - 1991 - : 5.95% / YEAR
- REAL FUEL PRICE ESCALATION
  - 1981 - 85: 0.88% / YEAR
  - 1986 - 90: 1.70% / YEAR
  - 1991 - : 2.05% / YEAR
- PHOTOVOLTAIC SYSTEM LIFE: 30 YEARS
- PHOTOVOLTAIC PENETRATION
  - 1981: 2.1% OF ELECTRIC ENERGY FROM THERMAL UNITS
  - 1994: 1.5% OF ELECTRIC ENERGY FROM THERMAL UNITS
Third-Party Ownership Option

CONCEPT:
INVESTOR GROUP FINANCES CONSTRUCTION OF PHOTOVOLTAIC POWER PLANT, SELLS ELECTRICITY TO UTILITY, TAKES ADVANTAGE OF TAX INCENTIVES NOT AVAILABLE TO UTILITY.

ADVANTAGE:
INCLUSION OF TAX BENEFITS MAKES INVESTMENT ATTRACTIVE WHEN COST OF PLANT IS STILL TOO HIGH FOR UTILITY PURCHASE.
Investment Evaluation: Third-Party Financing Arrangement

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<tr>
<th>ECONOMIC ASSUMPTIONS</th>
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<tr>
<td>SYSTEM COST ($/Wp)</td>
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<td>DEBT CAPITAL (% of system cost)</td>
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<td>EQUITY RESERVE (% of system cost)</td>
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<td>REQUIRED AFTER-TAX RETURN ON EQUITY</td>
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<th>BENEFIT/COST BREAKDOWN (After-Tax Net Present Value as Percentage of Equity)</th>
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Before-Tax Cash Flow

- NET ELECTRIC POWER REVENUE
- NET CASH FLOW
- LOAN COSTS
- RESERVE RELEASE

YEARS: 0, 2, 6, 10, 14, 18, 22, 26, 30
FRACTION OF INVESTMENT EQUITY: 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6

Before-Tax Cash Flow
**ECONOMIC ASSUMPTIONS**

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<tr>
<th>Economic Assumption</th>
<th>Value 1</th>
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<td>System Service Life (years)</td>
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<td>Real Escalation of Electricity Price (%)</td>
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<td>3%/yr</td>
<td>3%/yr</td>
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<td>Equity Capital (percent of system cost)</td>
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<td>Debt Capital (percent of system cost)</td>
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<td>Equity Reserve (percent of system cost)</td>
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<td>Required After-Tax Return on Equity (%)</td>
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<td>16%</td>
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<td>Benefit/Cost Breakdown (after-tax net present value as percentage of equity)</td>
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<td>Federal Investment Tax Credit</td>
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<td>6.2</td>
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<td>Net Loan Cost (less interest shelter)</td>
<td>(48.1)</td>
<td>(31.2)</td>
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<td>Net Electric Power Revenue (net of O&amp;M)</td>
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<td>22.7</td>
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<td>Reserve Release</td>
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<td>Total</td>
<td>101.0</td>
<td>99.9</td>
<td>100.8</td>
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Current Large-System Projects

- SACRAMENTO MUNICIPAL UTILITY DISTRICT PROJECT
  - PLANNED CAPACITY: 1 MW\(_p\) (AC)
  - SITE: RANCHO SECO NUCLEAR POWER PLANT, 30 MILES SOUTH OF SACRAMENTO, CALIFORNIA
  - FUNDING ALLOCATION: $12 MILLION -- $6.8 MILLION FROM DOE, $2 MILLION FROM STATE OF CALIFORNIA, $3.2 MILLION FROM SMUD
  - PROJECTED IOC DATE: JUNE 1984
  - FIRST STAGE OF PLANNED 100 MW\(_p\) PHOTOVOLTAIC POWER PLANT

- ARCO SOLAR/SOUTHERN CALIFORNIA EDISON COMPANY PROJECT
  - PLANNED CAPACITY: 1 MW\(_p\) (DC)
  - SITE: LUGO SUBSTATION NEAR VICTORVILLE, CALIFORNIA
  - ARCO SOLAR TO BE BUILDER, OWNER, AND OPERATOR
  - SOUTHERN CALIFORNIA EDISON TO PURCHASE AND DISTRIBUTE OUTPUT POWER
  - PROJECTED IOC DATE: DECEMBER 1982
  - PRIVATE VENTURE MADE POSSIBLE BY STATE AND FEDERAL TAX INCENTIVES
Conclusions

- Detailed analyses of the value of photovoltaic generation to specific utilities confirm the results of simplified analysis:
  - Photovoltaic plants costing $1.50 - 2.00/Wp would be cost-effective in an oil-dependent southwestern investor-owned utility.
  - The breakeven cost in a similar municipal utility would be even larger: $3.00 - 4.00/Wp.

- The progressive elements of the utility industry are keenly interested in photovoltaic technology but require assistance to proceed with large commercial (i.e., non-R&D) projects:
  - Risks arising from uncertainties in system cost and performance are too large to be justified under allowed rates of return.
  - Utilities are, however, willing to enter into agreements with third-party financed projects.

- Under a properly-structured third-party arrangement, constructing a photovoltaic plant at currently achievable costs can be an attractive investment:
  - Current solar tax credits contribute heavily to effective rate of return on investment.
  - Leveraged financing at reasonable rates significantly increases returns.