Chapter 15

Economic Analysis

Incentives ● Value Assessment ● Life Cycle Costs Analysis ● Financial Tools
Overview

- Identifying and the various types of financial incentives applicable to PV systems and sources for additional information.

- Explaining the concepts of discount rate, present value and time value of money.

- Describing the components of a life-cycle cost analysis, including initial costs, maintenance and replacement costs, energy costs and salvage value.

- Calculating the life cycle cost for competing utility and PV power supply options.

- Identifying software tools and other resources for conducting financial analysis for PV systems.
Financial Incentives

- Federal tax credits and deductions
- Rebate programs
- Production incentives
- Grants and loans
- Sales and property tax exemptions
Incentive Program Factors

- **Application type:**
  - Residential or commercial; private or public ownership
  - Grid-connected or stand-alone

- **Financial details:**
  - One-time or recurring incentive payment
  - Financial records requirements
  - Incentive caps and limits

- **Installation requirements:**
  - Eligible contractors and equipment
  - Code compliance and interconnection approval
  - Special metering requirements

- **PV system design:**
  - Site survey and system design requirements
  - Limits on size of PV system, peak AC power or energy production
  - Warranties
Federal Tax Credits

- A tax credit is a direct reduction in the tax owed by a taxpayer.

- Qualifying PV installations may be eligible for a 30% federal tax credit.

- Corporate tax incentives:
  - Renewable Electricity Production Tax Credit (PTC)
  - Business Energy Investment Tax Credit (ITC)

- Personal tax incentive:
  - Residential Renewable Energy Tax Credit

© 2012 Jim Dunlop Solar
Certain commercial PV systems may qualify for accelerated depreciation under the Federal Modified Accelerated Cost-Recovery System (MACRS).
Several states and municipalities offer sales and property tax incentives for renewable energy installations.

Sales taxes may be exempted or refunded for the purchase of solar energy or energy efficient equipment on a temporary or permanent basis.

Property tax incentives exclude the value of renewable energy systems for tax purposes.
Rebate Programs

- Rebate programs are one-time initial payments to encourage the installation of PV and other renewable energy systems.

- Offered by states, local government and utilities.

- Rebate amounts and program requirements vary widely, typically based on $/watt of PV capacity installed.

- Rebate programs usually have limits on the types and sizes of systems installed, and many require qualified contractor participation.
Grants and Loans

- Grants are competitive financial awards. Some grants are available to fund solar energy installations for certain end-users.

- Loans may also be used to finance solar energy installations. Loan rates and terms vary widely, and may be available from utilities or financial institutions.

- Property-Assessed Clean Energy (PACE) programs are a type of loan authorized by states, allowing local governments to finance PV installations through a special property tax assessment.
Performance-based incentives provide cash payments based on the energy produced by a renewable energy system over time.

Feed-in tariffs are a type of performance incentive that obligate utilities to purchase renewable energy at above market rates.

- Long-term payments are made to renewable generators based on energy production, and costs are distributed among all utility rate payers.
A Power Purchase Agreement (PPA) is a legal contract between an electricity generator and a purchaser of energy.

Commonly used by owners of power generation assets to raise capital and to create revenue streams.

A high percentage of non-residential photovoltaic installations are financed by a PPA.
A Renewable Portfolio Standard (RPS) is a goal or regulatory policy that obligates electricity suppliers to obtain a certain percentage of their electricity from renewable energy sources over a specific time period.

For compliance, electricity suppliers may own and operate renewable generation, or purchase credits from certified renewable energy generators.

Over 30 states have RPS policies.
A Renewable Energy Certificate (REC) is a tradable commodity representing 1000 kWh of renewable energy production.

Electric utilities purchase credits from certified renewable energy generators to comply with their Renewable Portfolio Standard.

Voluntary markets are driven by green customers choosing to buy electricity produced by renewable energy sources.
Public Benefit Funds are state-level programs developed through electric industry restructuring to support renewable energy development.

- Funds are created by a surcharge to all utility customers based on consumption.
- May be used to fund education, research and development, or incentivize PV installations or other energy conservation and renewable energy systems.
The economic value of PV systems depends on many factors:

- Costs of competing energy supplies
- Cost and lifetime of PV equipment
- Costs for maintenance and equipment replacement
- Financial factors and incentives
- Value of energy produced
The discount rate is an economic factor that relates the future value of money to present day terms.

Present value represents the value of future investments or expenditures in present day dollars:

\[ PV = \frac{FV}{(1+r)^t} \]
Life-cycle costs represent the total costs of owning and maintaining an asset over its lifetime, and can be used to compare the costs of PV systems and alternate energy sources.

\[ LCC = I + M_{PV} + E_{PV} + R_{PV} - S_{PV} \]

where
- \( LCC \) = life-cycle cost ($)
- \( I \) = initial cost ($)
- \( M_{PV} \) = present value of maintenance costs ($)
- \( E_{PV} \) = present value of energy costs ($)
- \( R_{PV} \) = present value of repair and replacements ($)
- \( S_{PV} \) = present value of salvage value ($)
Consider a typical residence with the following assumptions:

- Energy consumption is 15,000 kWh/year
- Current retail rate is $0.14/kWh

What is the life-cycle cost to the consumer assuming a discount rate of 4% over a period of 20 years?

Since the retail electric consumer incurs no initial, maintenance, replacement or salvage costs, the life-cycle costs are simply equal to the present value of energy costs over time:

\[ LCC = E_{PV} \]
First year energy costs are 15,000 kWh/yr x $0.14/kWh = $2,100/yr.

Using the recurring present value factor for 20 years at a 4% discount rate gives $2,100 x 13.59 = $28,540.

Therefore, the cost of utility energy over 20 years is worth $28,540 in present dollars.

\[ LCC = E_{PV} = $28,540 \]
Consider a 10 kW PV system with the following assumptions:
- System produces 15,000 kWh/yr
- Installation cost is $65,000
- Rebate is $2 per DC watt
- Tax credit is 30%
- Discount rate is 4%
- Maintenance costs are $50/yr
- Inverter replacement at 10 years will cost $7,000
- Salvage value is 20% of installed cost
- System is net metered

What is the estimated LCC over 20 years for the PV power supply option? Compare to the cost of utility service in the previous example.
The initial cost is the installed cost less the rebate and tax credit:
- The rebate is worth $2/W \times 10,000 \text{ W} = $20,000.
- The tax credit is worth 30\% \times $65,000 = $19,500.
- I = $65,000 - $20,000 - $19,500 = $25,500.

The present value of the inverter replacement at 10 years is determined by a single present value factor:
- \( R_{PV} = $7,000 \times 0.676 = $4,732 \)

The present value of annual maintenance is determined by a recurring present value factor:
- \( M_{PV} = $50 \times 13.59 = $680 \)

The salvage value at twenty years is 20\% of the installed cost:
- $80,000 \times 20\% = $16,000
- The present value for salvage is $16,000 \times 0.456 = $7,296
Since there are no energy or fuel costs associated with operating the PV system, $E_{pv} = 0$:

\[
LCC = I + M_{PV} + E_{PV} + R_{PV} - S_{PV}
\]

\[
LCC = $25,500 + $680 + $4,732 - $7,296
\]

\[
LCC = $23,616
\]

Therefore, the present value of energy from a PV system is about $5,000 less than the cost of utility energy over a 20 year period.
In My Backyard (IMBY)
The economic value of PV systems depends on many factors, including the cost of the PV system and competing energy supply options, incentives, and financial factors.

The time value of money considers the discount rate and present value of future investments.

A life-cycle cost analysis considers initial costs, maintenance and replacement costs, energy costs and salvage value to determining and compare the life operating costs of competing power sources.

Under certain scenarios, PV systems can be cost-competitive with utility power.
Questions and Discussion