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

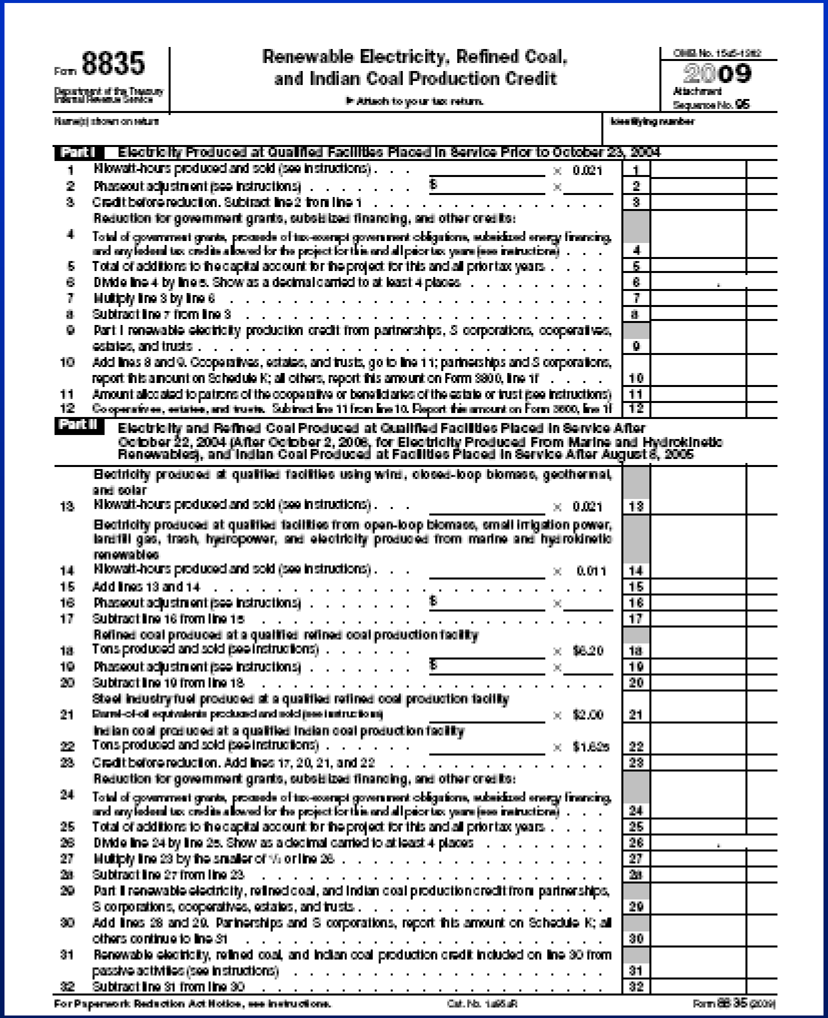
- **Application type:**
  - Residential or commercial; private or public ownership
  - Grid-connected or stand-alone
- **Financial details:**
  - One-time or recurring incentive payment
  - Financial records requirements
  - Incentive caps and limits
- **Installation requirements:**
  - Eligible contractors 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

Database of State Incentives for Renewable Energy (DSIRE)

Source: ww.dsireusa.org

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



Form **8835**
Department of the Treasury Internal Revenue Service

Renewable Electricity, Refined Coal, and Indian Coal Production Credit
▶ Attach to your tax return.

OMB No. 1545-1362
2009
Attachment Sequence No. 95

Name(s) shown on return | Identifying number

Part I Electricity Produced at Qualified Facilities Placed in Service Prior to October 23, 2004

1 Kilowatt-hours produced and sold (see instructions) . . . × 0.021 | 1
2 Phaseout adjustment (see instructions) . . . . $ × | 2
3 Credit before reduction. Subtract line 2 from line 1 | 3
Reduction for government grants, subsidized financing, and other credits:
4 Total of government grants, proceeds of tax-exempt government obligations, subsidized energy financing, and any federal tax credits allowed for the project for this and all prior tax years (see instructions) | 4
5 Total of additions to the capital account for the project for this and all prior tax years | 5
6 Divide line 4 by line 5. Show as a decimal carried to at least 4 places | 6
7 Multiply line 3 by line 6 | 7
8 Subtract line 7 from line 3 | 8
9 Part I renewable electricity production credit from partnerships, S corporations, cooperatives, estates, and trusts | 9
10 Add lines 8 and 9. Cooperatives, estates, and trusts, go to line 11; partnerships and S corporations, report this amount on Schedule K; all others, report this amount on Form 3800, line 1f | 10
11 Amount allocated to patrons of the cooperative or beneficiaries of the estate or trust (see instructions) | 11
12 Cooperatives, estates, and trusts. Subtract line 11 from line 10. Report this amount on Form 3800, line 1f | 12

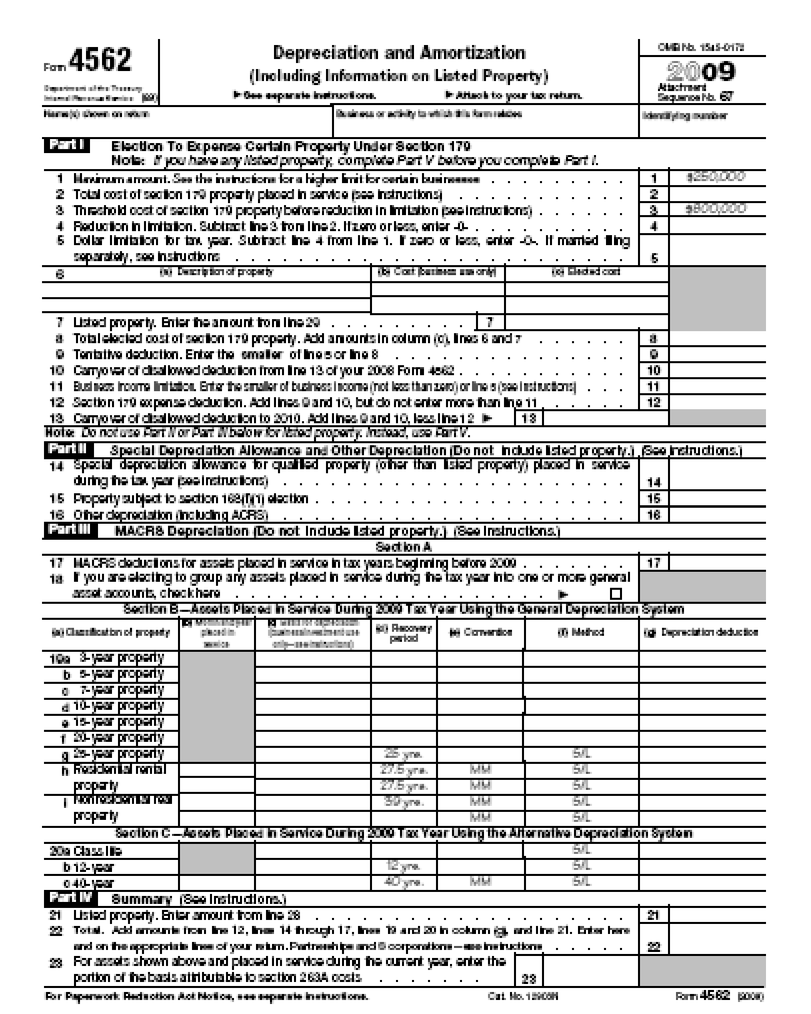
Part II Electricity and Refined Coal Produced at Qualified Facilities Placed in Service After October 22, 2004 (After October 2, 2008, for Electricity Produced From Marine and Hydrokinetic Renewables), and Indian Coal Produced at Facilities Placed in Service After August 8, 2005

Electricity produced at qualified facilities using wind, closed-loop biomass, geothermal, and solar
13 Kilowatt-hours produced and sold (see instructions) . . . × 0.021 | 13
Electricity produced at qualified facilities from open-loop biomass, small irrigation power, landfill gas, trash, hydropower, and electricity produced from marine and hydrokinetic renewables
14 Kilowatt-hours produced and sold (see instructions) . . . × 0.011 | 14
15 Add lines 13 and 14 | 15
16 Phaseout adjustment (see instructions) . . . . $ × | 16
17 Subtract line 16 from line 15 | 17
Refined coal produced at a qualified refined coal production facility
18 Tons produced and sold (see instructions) . . . . . . × $6.20 | 18
19 Phaseout adjustment (see instructions) . . . . $ × | 19
20 Subtract line 19 from line 18 | 20
Steel industry fuel produced at a qualified refined coal production facility
21 Barrel-of-oil equivalents produced and sold (see instructions) × $2.00 | 21
Indian coal produced at a qualified Indian coal production facility
22 Tons produced and sold (see instructions) . . . . . . × $1.625 | 22
23 Credit before reduction. Add lines 17, 20, 21, and 22 | 23
Reduction for government grants, subsidized financing, and other credits:
24 Total of government grants, proceeds of tax-exempt government obligations, subsidized energy financing, and any federal tax credits allowed for the project for this and all prior tax years (see instructions) | 24
25 Total of additions to the capital account for the project for this and all prior tax years | 25
26 Divide line 24 by line 25. Show as a decimal carried to at least 4 places | 26
27 Multiply line 23 by the smaller of ½ or line 26 | 27
28 Subtract line 27 from line 23 | 28
29 Part II renewable electricity, refined coal, and Indian coal production credit from partnerships, S corporations, cooperatives, estates, and trusts | 29
30 Add lines 28 and 29. Partnerships and S corporations, report this amount on Schedule K; all others continue to line 31 | 30
31 Renewable electricity, refined coal, and Indian coal production credit included on line 30 from passive activities (see instructions) | 31
32 Subtract line 31 from line 30 | 32

For Paperwork Reduction Act Notice, see instructions. Cat. No. 14954R Form 8835 (2009)

Depreciation

- **Certain commercial PV systems may qualify for accelerated depreciation under the Federal Modified Accelerated Cost-Recovery System (MACRS).**



Form **4562** — Department of the Treasury, Internal Revenue Service (99)

Depreciation and Amortization
(Including Information on Listed Property)
▶ See separate instructions. ▶ Attach to your tax return.

OMB No. 1545-0172 — **2009** — Attachment Sequence No. 67

Name(s) shown on return | Business or activity to which this form relates | Identifying number

Part I — Election To Expense Certain Property Under Section 179
Note: *If you have any listed property, complete Part V before you complete Part I.*

1	Maximum amount. See the instructions for a higher limit for certain businesses	1	$250,000
2	Total cost of section 179 property placed in service (see instructions)	2	
3	Threshold cost of section 179 property before reduction in limitation (see instructions)	3	$800,000
4	Reduction in limitation. Subtract line 3 from line 2. If zero or less, enter -0-	4	
5	Dollar limitation for tax year. Subtract line 4 from line 1. If zero or less, enter -0-. If married filing separately, see instructions	5	

6 (a) Description of property	(b) Cost (business use only)	(c) Elected cost

7	Listed property. Enter the amount from line 29	7	
8	Total elected cost of section 179 property. Add amounts in column (c), lines 6 and 7	8	
9	Tentative deduction. Enter the smaller of line 5 or line 8	9	
10	Carryover of disallowed deduction from line 13 of your 2008 Form 4562	10	
11	Business income limitation. Enter the smaller of business income (not less than zero) or line 5 (see instructions)	11	
12	Section 179 expense deduction. Add lines 9 and 10, but do not enter more than line 11	12	
13	Carryover of disallowed deduction to 2010. Add lines 9 and 10, less line 12 ▶	13	

Note: *Do not use Part II or Part III below for listed property. Instead, use Part V.*

Part II — Special Depreciation Allowance and Other Depreciation (Do not include listed property.) (See instructions.)

14	Special depreciation allowance for qualified property (other than listed property) placed in service during the tax year (see instructions)	14	
15	Property subject to section 168(f)(1) election	15	
16	Other depreciation (including ACRS)	16	

Part III — MACRS Depreciation (Do not include listed property.) (See instructions.)

Section A

17	MACRS deductions for assets placed in service in tax years beginning before 2009	17	
18	If you are electing to group any assets placed in service during the tax year into one or more general asset accounts, check here ▶ ☐		

Section B—Assets Placed in Service During 2009 Tax Year Using the General Depreciation System

(a) Classification of property	(b) Month and year placed in service	(c) Basis for depreciation (business/investment use only—see instructions)	(d) Recovery period	(e) Convention	(f) Method	(g) Depreciation deduction
19a 3-year property						
b 5-year property						
c 7-year property						
d 10-year property						
e 15-year property						
f 20-year property						
g 25-year property			25 yrs.		S/L	
h Residential rental property			27.5 yrs.	MM	S/L	
			27.5 yrs.	MM	S/L	
i Nonresidential real property			39 yrs.	MM	S/L	
				MM	S/L	

Section C—Assets Placed in Service During 2009 Tax Year Using the Alternative Depreciation System

(a)	(b)	(c)	(d)	(e)	(f)	(g)
20a Class life					S/L	
b 12-year			12 yrs.		S/L	
c 40-year			40 yrs.	MM	S/L	

Part IV — Summary (See instructions.)

21	Listed property. Enter amount from line 28	21	
22	Total. Add amounts from line 12, lines 14 through 17, lines 19 and 20 in column (g), and line 21. Enter here and on the appropriate lines of your return. Partnerships and S corporations—see instructions	22	
23	For assets shown above and placed in service during the current year, enter the portion of the basis attributable to section 263A costs	23	

For Paperwork Reduction Act Notice, see separate instructions. Cat. No. 12906N Form **4562** (2009)

Sales and Property Tax Incentives

- 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

- **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.

Power Purchase Agreements

- 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.

Renewable Portfolio Standards

- 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.

Renewable Energy Certificates

- 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

- 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.

Economic Analysis

- **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

Time Value of Money

- 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 Cost Analysis

- **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
L_{CC} = 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 ($)
S_{PV} = present value of salvage value ($)

The Cost of Energy: Utility Example

- **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:**

$$LCC = E_{PV}$$

The Cost of Energy: Utility Example (cont.)

- 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.

$$LCC = E_{PV} = \$28,540$$

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

The Cost of Energy: PV Example

- **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 pervious example.**

The Cost of Energy: PV Example (cont.)

- **The initial cost is the installed cost less the rebate and tax credit:**
  - The rebate is worth \$2/W x 10,000 W = \$20,000.
  - The tax credit is worth 30% x \$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 x 0.676 = \$4,732
- **The present value of annual maintenance is determined by a recurring present value factor:**
  - M_{PV} = \$50 x 13.59 = \$680
- **The salvage value at twenty years is 20% of the installed cost:**
  - \$80,000 x 20% = \$16,000
  - The present value for salvage is \$16,000 x 0.456 = \$7,296

The Cost of Energy: PV Example (cont.)

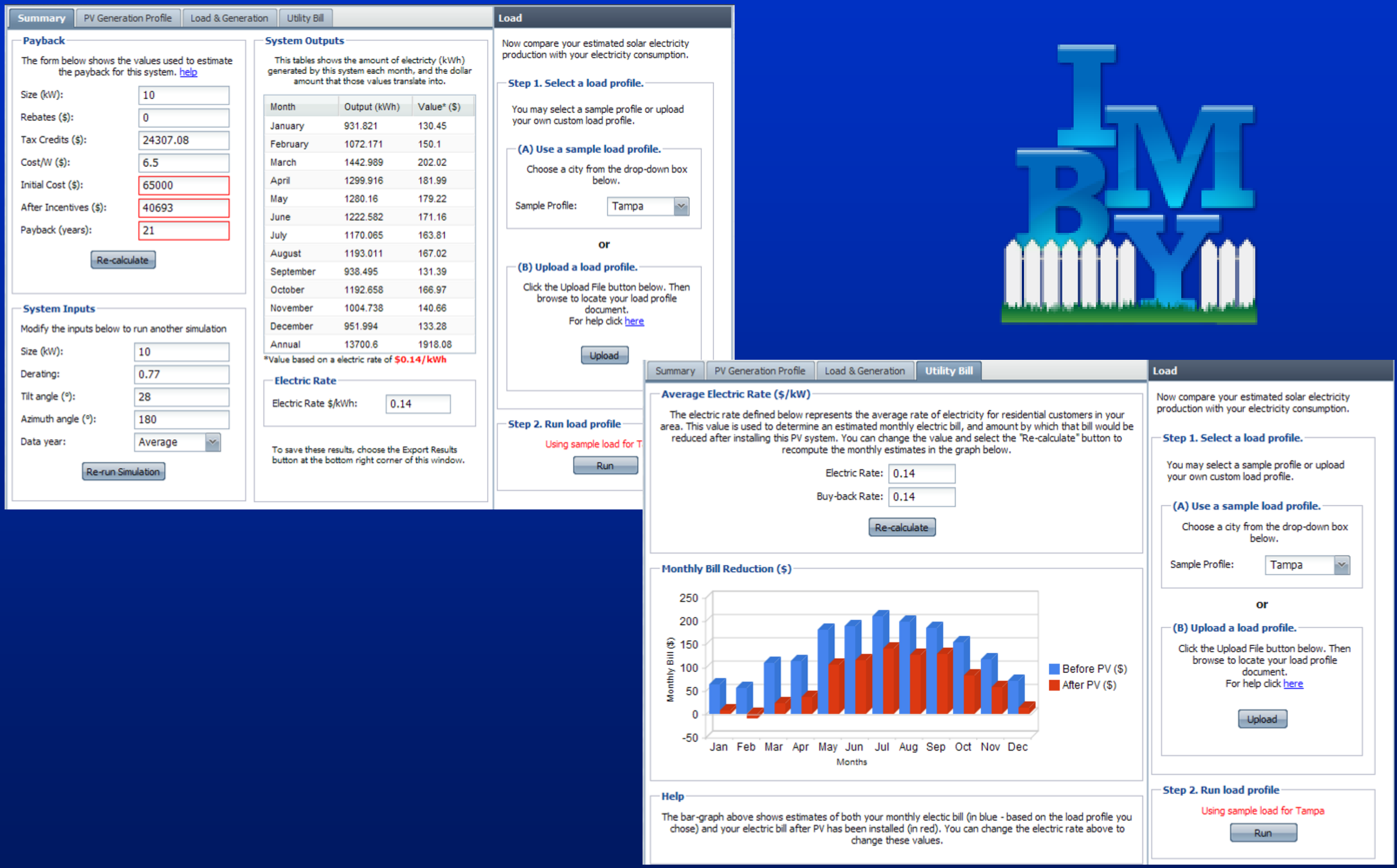
- Since there are no energy or fuel costs associated with operating the PV system, $E_{pv} = 0$:

$$LCC = I + M_{PV} + E_{PV} + R_{PV} - S_{PV}$$

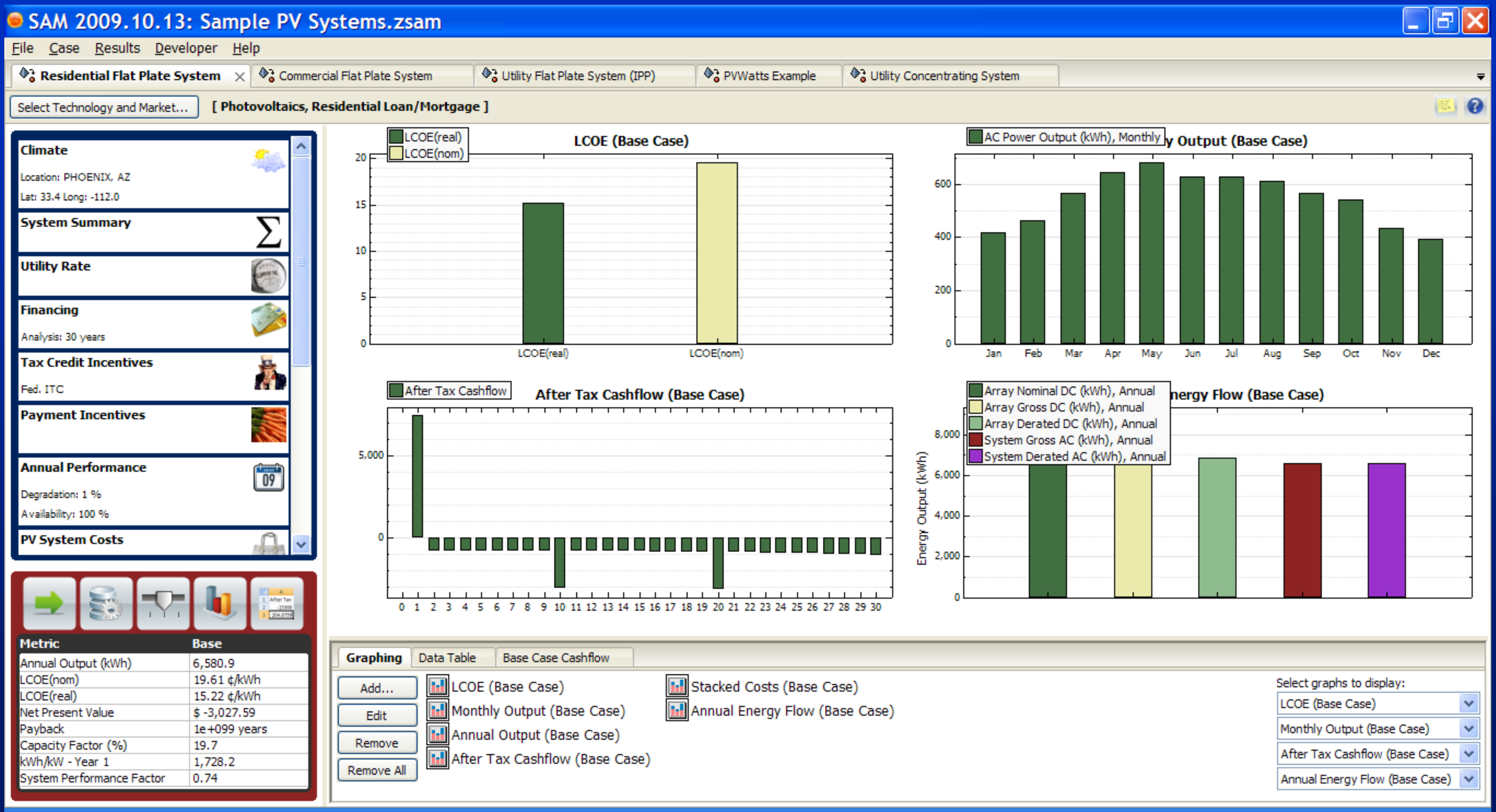
LCC = \$25,500 + \$680 + \$4,732 - \$7,296
LCC = \$23,616

- 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)



Solar Advisor Model



Summary

- 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