

CLEAN POWER ESTIMATOR

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1 ABSTRACT

Clean Power Estimator is an economic evaluation software program for customer-owned clean energy systems. The internet-based program gives a personalized estimate of the costs and benefits of a system for a specific residential customer. The system can be composed of photovoltaics (PV), solar thermal, wind, and/or efficiency investments. The program takes into account the characteristics of the specific customer purchasing the system in order to provide the most relevant analysis. These characteristics include the system being purchased, the customer's location, the customer's rate structure, and other customer information. This paper describes how the analysis is performed.

2 BACKGROUND

The economic impact of owning a clean energy system is influenced by a variety of factors. Some of the major factors include: system cost, economic incentives, taxes on those incentives, utility bill savings, financing costs, and tax benefits associated with the financing costs. These major factors are, in turn, affected by a set of minor factors. For example, the utility bill savings are affected by how much electricity the system produces (or saves), the particular rate structure the customer is on, the customer's current consumption, and how the system output is metered. As another example, the after-tax economic incentives depend on the incentive structure, system cost, system size, and the consumer's marginal tax brackets.

The result is that it can be relatively complex to evaluate the costs and benefits of purchasing a clean energy

system. An indication of this complexity can be seen in references (1) through (8), research studies that were devoted solely to the analysis of PV systems (one part of a clean energy system). The complexity of the analysis increases with the number technologies in the system.

3 OBJECTIVE

One way to address this complexity is for every consumer that purchases a clean energy system to obtain the services of a qualified consultant to evaluate the economics of their situation. A second and more cost-effective alternative is to assist consumers with the analysis with the use of a consumer program.

This paper describes a computer program that has been designed to accomplish this purpose: Clean Power Estimator. The program is an internet-based economic analysis program that assists consumers in evaluating the economic impacts of purchasing a clean energy system. The program asks for a limited number of inputs that are specific to the consumer. These responses are combined with other more general information that applies to a broad category of consumers. The data are then processed and the result is a personalized estimate of the costs and benefits of a clean energy system for that particular customer.

Figure 1 and Table 1 give an overview of how the program combines customer inputs (**rectangles**) with pre-collected data (**circles**) and analytical methods (**ovals**) to provide a personalized estimate of the costs and benefits of a clean energy system for a specific residential customer.

Figure 1. Program flow.

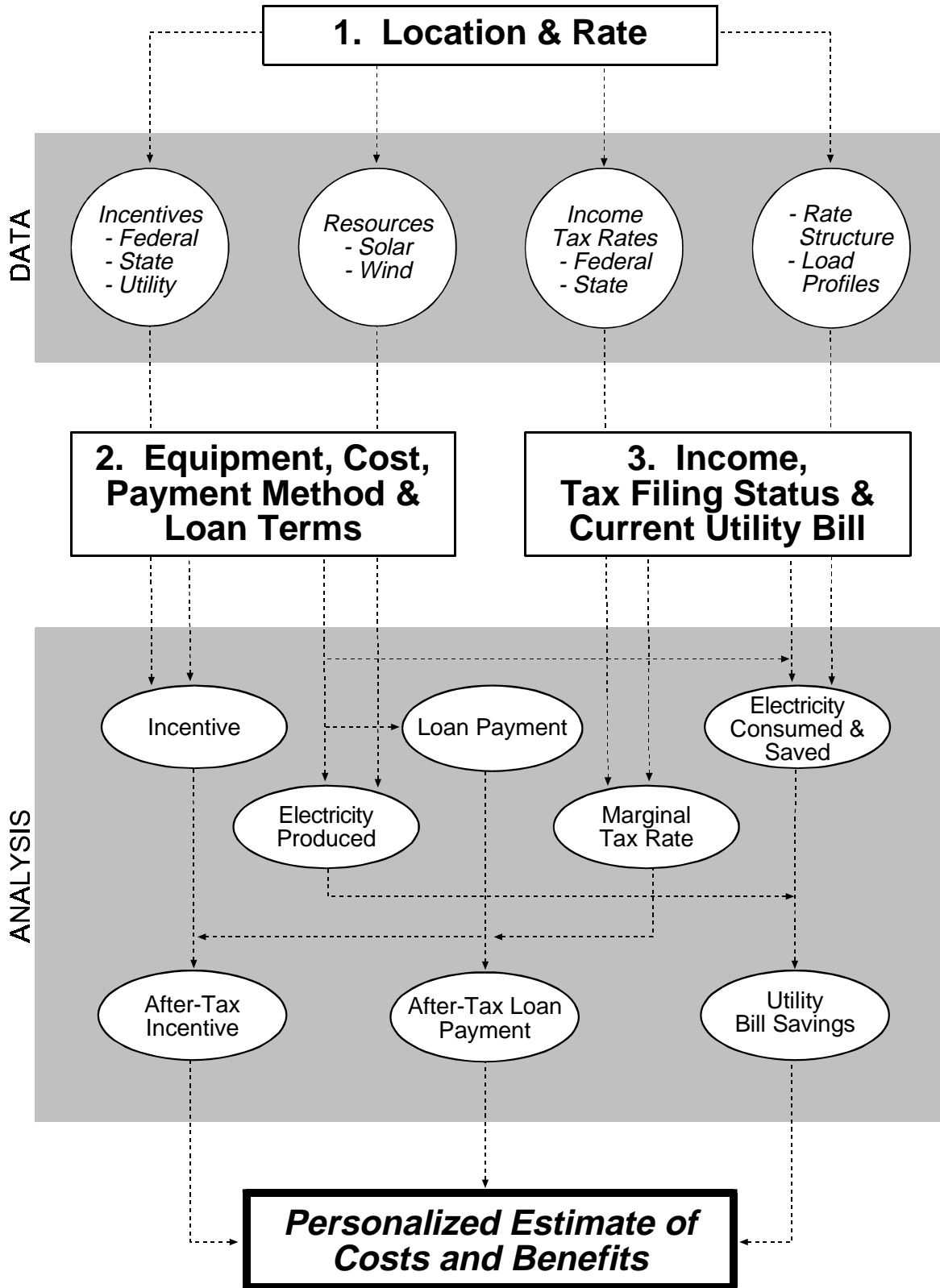


Table 1. Program flow.

1. Location and rate yield information for a set of potential customers

Location & Rate	⇒	Data for Potential Customers
<ul style="list-style-type: none">• Federal, state, and utility incentives• Solar and wind resource• Federal and state income tax rates• Rate structure and load profiles		

2. Equipment, cost, payment method, and loan terms yield results for purchasing customers

Equipment, Cost, Payment Method & Loan Terms	⇒	Results for Purchasing Customers
<ul style="list-style-type: none">• Incentive – based on incentives available, equipment purchased, and cost• Electricity produced – based on equipment selected and solar and wind resource• Loan payment – based on cost, incentives, payment method, and loan terms		

3. Income, tax filing status, and current utility bill yield the result for a particular customer

Income, Tax Filing Status & Current Utility Bill	⇒	Results for a Particular Customer
<ul style="list-style-type: none">• Marginal tax rate – based on tax structures, income, and tax filing status• Electricity consumed – based on current load profile, rate, and current utility bill• Electricity saved – based on equipment purchased, electricity consumed, and load profiles• After-tax incentive – based on incentive, marginal tax rate, and taxation of incentives• After-tax loan payment – based on loan payment, marginal tax rate, and payment method• Utility bill savings – based on current utility bill, new consumption, and rate		

4 DETAILED DESCRIPTION

Clean Power Estimator was designed with two competing goals in mind. The first goal was to include the complexities involved in an economic analysis of a consumer's purchase of a clean energy system. The second goal was to create a program that is quick and easy to use.

The first goal is satisfied by basing the program on several years of research (see References). A time consuming part of performing a rigorous economic analysis, however, is collecting the necessary data. This difficulty is mitigated by pre-collecting data from at least eight different data sets for a broad range of consumers. The consumer is then asked a few simple questions that indicate which data are relevant. This satisfies the second goal of having a quick and easy to use program.

4.1 Data Selection

The consumer begins by selecting the state and city in which they live. These selections yield: the structure of federal, state, and utility economic incentive programs for all types of equipment (three data sets); solar and wind resource data (two data sets); federal and state income tax rate structures (two data sets); and the electric rates available at that location. The consumer then selects their rate structure. This yields specific rate information as well as load profiles for customers on the schedule (two data sets). These data are needed for all *potential* customers in that particular location.

Next, the consumer selects the equipment to be purchased, cost, payment method, and loan terms. This narrows the data to a set that applies only to *purchasing* customers.

Finally, the consumer enters their after-tax income, tax filing status, and current utility bill. This narrows the data to information that applies to the *particular* customer making the purchase.

4.2 Determine Current Electricity Consumption

Once the data are selected, the analysis is performed. The analysis is performed without any more inputs from the consumer.

The first step of the analysis is to determine the consumer's current electric consumption (the program uses average daily loads (24 hours/day) that vary monthly). An iterative search process is used to find the level of annual electricity consumption such that the average load profile (which is based on the electric rate schedule that was selected) scaled to this total

consumption level and then processed through the given electric rate structure equals the consumer's current annual electric bill.

4.3 Estimate New Electricity Consumption

The second step is to calculate the new load after the investments are made. This calculation depends upon the type of investments being made. The three types of investments that affect the load are: 1) energy efficiency investments (they reduce the load with no possibility of overproduction); 2) solar thermal investments (they reduce the heating load but can overproduce without any benefit to the consumer); and 3) PV or wind systems, (they produce electricity that reduces the load or is sold if it exceeds the load).

The new load equals the old load reduced using efficiency, solar thermal, and PV or wind systems, with the calculation being performed in that order. Net production equals the excess electricity from the PV and/or wind systems.

4.4 Calculate New Utility Bill

The third step is to calculate the new utility bill using the new load and the electric rate schedule. The program can accommodate a wide range of electric rate schedules, including tiered rates, multiple seasons, time-of-use rates, several types of net billing, fixed monthly costs, minimum bills, and sell-back rates.

4.5 Find Marginal Tax Rates

The fourth step is to find the consumer's marginal tax rate. This is found by combining the consumer's taxable income with the federal and state tax rate schedules. The two marginal rates are then combined into a single marginal tax rate (see Appendix in Ref. 3).

4.6 Calculate After-Tax Incentives

The fifth step is to determine the after-tax economic incentives available at the federal, state, and utility levels. The incentives are calculated based on the type of equipment purchased, cost, and incentive rules (i.e., how the incentive is calculated). The calculation takes into account interactions between multiple technologies. The taxability of the incentives is then determined and the tax is calculated based on the marginal tax rate from the previous step.

4.7 Calculate After-Tax Loan Payment

The fifth step is to calculate the after-tax loan payment. It is assumed that the amount of the loan equals the capital cost reduced by the available incentives and then increased by the taxes on those incentives (e.g., the loan amount is \$7,500 for a system that cost \$10,000, has

\$4,000 in incentives, and \$1,500 in taxes on the incentives). The loan payment is calculated, divided into the principle and interest portions, and then combined with the marginal tax rate to calculate the after-tax loan payment.

4.8 Final Result

The final result is determined by combining the utility bill savings (old utility bill minus new utility bill) with the after-tax loan payment.

5 CONCLUSIONS

The economic impact of owning a renewable energy system is influenced by a variety of factors. The result is that it can be relatively complex to evaluate the costs and benefits of purchasing a renewable energy system.

This paper described a computer program that has been designed to accomplish this purpose: Clean Power Estimator. The program is an internet-based economic analysis program that assists consumers in evaluating the economic impacts of purchasing a clean energy system. The program asks for a limited number of inputs that are specific to the consumer. These responses are combined with other more general information that applies to a broad category of consumers. The data are then processed and the result is a personalized estimate of the costs and benefits of a clean energy system for a particular customer.

6 REFERENCES

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