

Modular Green Generation: An Untapped Green Market

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Introduction

It is widely recognized that consumers have a general interest in promoting the use of renewable sources of energy. This suggests that there is a large market for renewables. As a result, a variety of firms, both in regulated and deregulated markets, have attempted to enter this market.

The typical product that is offered to consumers is to charge them a premium price and then deliver electricity to them that is differentiated based on its environmental attributes. In essence, customers are buying the knowledge that they are promoting the use of renewable energy. These customers, however, have no opportunity for any financial return.

Another product that could be sold is to allow consumers to invest in the power generation equipment and then to receive a portion of the power for their own consumption.¹ An important advantage of this product is that, in addition to promoting the use of renewable energy, consumers have the opportunity to earn a financial return on their investment. The market for a product that will provide consumers with financial benefits may be substantially larger than a product that has no financial benefits.

Product Descriptions

The following three products illustrate how this might work. The products are called *Green Power*, *Green Generation*, and *Modular Green Generation*.²

¹ They could also sell the power if they were unable to use the power from the wind plant.

² The following assumptions are made in order to compare the three products:

- the customer uses 6,600 kWh per year
- wind plants have a current capital cost of \$1,000 per kW, costs are declining at a rate of 5 percent per year; they will stabilize at \$500 per kW in 14 years.
- wind plants have an O&M cost of 1.5¢/kWh, a transmission cost of 0.5¢/kWh, and a project management cost of 0.5¢/kWh
- wind plants operate at a 30 percent capacity factor
- consumers have a generation rate of 4¢/kWh and the wind plant output can be sold for 4¢/kWh
- no consideration is given to the effect of taxes

Status Quo

The consumer's current electricity generation bill is \$265 per year. This amount can vary over time as electricity prices change.

Product 1: Green Power

The *Green Power* product is to supply all of a customer's demand for electricity with energy that is generated from renewable resources. Based on experience in the California market, energy service providers charge customers a premium of \$135 per year (\$0.02/kWh more than the base electricity rate) for this product. This results in a total electricity generation bill of \$400 per year. This amount can change over time as system electricity prices vary. The customer has the flexibility to stop buying the product at any time.

Product 2: Green Generation

The *Green Generation* product is to sell customers a share in a wind plant that will supply all of the annual demand for electricity. A customer would need a 2.5 kW wind plant to accomplish this. They would incur an initial cost of \$2,500 and then save a net amount of \$135 per year for 20 years (they would pay \$130 per year to operate the plant, transmit the power, and pay the project manager, and then would save \$265 per year in electricity costs; the savings will vary depending upon the price of electricity). Customers have no flexibility once they purchase this product.

Product 3: Modular Green Generation

The *Modular Green Generation* is to sell consumers a share of a wind plant that will initially satisfy only a portion of their energy needs and then to continue selling more shares every year. Each consumer pays an extra \$200 per year for a total payment of \$465 per year for their electricity generation. The \$465 is paid every year for 15 years. The customer will have all of their energy needs satisfied with wind energy from that point on and will pay \$0 per year after 15 years. The total electricity bill will initially vary with the price of electricity and the variations will decrease in time as the size of the plant increases. There will be no variation after 15 years.

How is the *Modular Green Generation* different than the *Green Generation*? Rather than making the full investment immediately, the investment is made incrementally over time. This capitalizes on the modularity of wind farms and minimizes the financial exposure for consumers. Each year, the size of the plant is increased. By year 8, the plant will produce enough electricity to supply all of the customer's annual electricity needs. By year 15, the plant will be 8 kW and will be large enough to: (1) pay for the operation cost of the plant and the cost of transmission of the electricity (40% of the output); (2) satisfy all of the customer's demand (32% of the output); (3) invest in new wind plants to replace old units as they wear out (15% of the output); and (4) to pay the project manager \$100 per year (13% of the output). Even though the customer stops paying in 15 years, the plant will continue to grow in size to 12 kW by year 30.

Product Comparisons

This section compares the three products. Table 1 assigns a relative ranking to each of the three products for the product attributes listed below (1 is highest, 3 is lowest). As can be seen in the table, *Modular Green Generation* receives the best ranking for more than half of the attributes and is second for the other attributes. *Green Generation* receives the middle ranking for most of the attributes. *Green Power* receives half of the highest rankings and half of the lowest rankings. This suggests that the *Modular Green Generation* may be the most desirable product to consumers. The details of each of the rankings are described below.

Table 1. Relative Ranking of Three Green Products
(1 is highest, 3 is lowest)

Product Attribute	Product Name		
	<i>Modular Green Generation</i>	<i>Green Generation</i>	<i>Green Power</i>
Rate of Return	1	2	3
Annual Cost C	2	2	1
Short Term Price Stability	2	1	3
Long Term Price Stability	1	2	3
Short Term Environmental Benefits	2	1	1
Long Term Environmental Benefits	1	2	3
Product Flexibility	1	2	1
Product Lifetime	1	2	3

Rate of Return

Green Power has an undefined rate of return because the cash flow is not positive in any year. *Green Generation* has a 1 percent rate of return. *Modular Green Generation* has a 6 percent rate of return. Thus, *Modular Green Generation* has the highest rate of return.

Annual Cost

The purchase of system electricity costs \$265 per year. *Green Power* costs \$400 per year. The cash flow from *Green Generation* is not constant from year to year. It has an initial cost of \$2,500 and an annual cost of \$130; if the plant is financed at a 12 percent interest rate, the cost would be \$465 per year. *Modular Green Generation* has an annual cost of \$465 per year. *Modular Green Generation* costs only \$5 more per month than *Green Power*.

Price Stability

There is no price stability with *Green Power* because the product is based on a premium over the existing price of power. *Green Generation* has a very stable price over its 20-year life. *Modular Green Generation* has some price stability in the short-term. As the

size of the plant increases, the price stability increases. After 15 years, there is full price stability.

Environmental Benefits

One way to measure the environmental benefits is to examine the immediate amount of renewable energy generated. *Green Power* has an initial output of 6,600 kWh of renewable energy per year. *Green Generation* has an initial output of 6,600 kWh of renewable energy per year. *Modular Green Generation* has an initial output of 530 kWh of renewable energy per year. *Modular Green Generation* is the least desirable of the three products from this perspective.

Another way to measure the environmental benefits is to assess the wind plant's capacity after 15 years. While there is no need for any new wind plant capacity with *Green Power*, a product similar to the one described above that is offered in the California market guaranteed new capacity of at least 0.25 kW per customer. *Green Generation* results in a new capacity of 2.5 kW. *Modular Green Generation* results in a new capacity of 8.0 kW. Thus, *Modular Green Generation* will result in 32 times the new capacity as *Green Power* and more than three times the capacity as *Green Generation*.

Product Flexibility

Green Power gives consumers full flexibility because they can stop purchasing the product at any time. *Green Generation* is inflexible for consumers because they are fully committed once they pay the capital cost of the plant (or take out a loan to pay for the capital cost of the plant). *Modular Green Generation* gives consumers full flexibility because they can stop investing in new plants at any time and they will have no financial responsibility after that point. Thus, *Green Power* and *Modular Green Generation* provide consumers with equal flexibility.

Product Lifetime

Green Power will last as long as the consumer continues to buy the product. *Green Generation* has a 20-year lifetime. *Modular Green Generation* has an indefinite lifetime. Thus, *Modular Green Generation* is preferable in terms of the product life.

Frequently Asked Questions About Modular Green Generation

Q: What happens if I begin to purchase *Modular Green Generation* and then move?

A: You have two options: (1) sell your existing shares to another consumer; (2) continue to buy the product and, rather than receiving the energy output of the plant, you could sell your share of the output and receive the money.

Q: What happens if the firm selling the product goes bankrupt?

A: The project will be structured such that the wind farm is not owned by the firm in order to protect consumers from this event.

Q: What happens when I die?

A: Your share of the project will become the inheritance of whomever you choose.

Q: Why is *Modular Green Generation* so much better than *Green Generation*?

A: It is because *Modular Green Generation* capitalizes on the modular nature of wind plants.

Q: How can *Modular Green Generation* have an indefinite lifetime?

A: It is because you invest enough to make the plant self-sustaining (i.e., the plant's output will provide enough energy for the your electricity needs and then, with the remaining output, will pay for plant operation, new plant investment, and the project management).