

# 14. Economics & Marketing of Photovoltaic Systems

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## Learning Outcomes

After completing this chapter, the readers should be able to:

- Understand the different economic indicators relating to photovoltaic installations.
- Assess the economic viability of investments on various photovoltaic systems.
- Understand the basic marketing parameters of photovoltaics.
- Comprehend the required criteria for the composition of a proper marketing strategy.

## Introduction

Calculating the economics of a photovoltaic (PV) installation is key to understanding whether an investment is both feasible and reasonable. Aside from a study to assess whether the installation of a PV system is practical and realistic, an economic analysis is necessary to determine whether the financial investment on that system is economically sound as well.

Generally, PV systems are characterised by large initial capital investments by the energy user that require careful economic analysis and planning. The capital cost of a PV system declines every year, because not only the cost of the equipment drops but also due to the installers achieving superior installation methods and lower maintenance costs. For example, even though PV module prices remained steady from 2004 to 2008, the capital cost of PV installations declined due to the better racking systems and lower financing costs [1]. However, even though the capital cost of PV systems has been greatly reduced during the past decade, it remains considerable and is the primary detrimental factor of investments on PV systems. On the other hand, the operating and maintenance cost is usually small and often negligible compared to the cost of purchasing the energy from a provider.

Since the initial capital cost of PV installations is high, a correct economic analysis is of utmost importance. Stand-alone applications have to be accurately sized and the output of grid-connected systems properly estimated, otherwise there

would be significant monetary penalties to the owner. Simplistic economic evaluations based on present economic figures alone are inadequate and "rule of thumb" approaches are inaccurate and financially dangerous. Still, a proper economic evaluation of a PV system is not complex. The following sections describe the vital economic parameters of importance for the economic optimization of PV installations, an economic optimization method and system assessment examples.

### Economic analysis methods

The most common method of applying engineering economics to PV systems is to reduce all future income flows to their present value. The key idea is that money has a time value - a given amount of money will be worth less in the future than it does today. This is the basic of the two most widely applied economic analysis methods for photovoltaic systems, the life cycle cost (LCC) and the life cycle savings (LCS).

The LCC method is the sum of every cost associated with the photovoltaic installation over an analysis period, which usually is the expected lifetime of the installation. All costs are brought back to their present values (discounted), using an alternative discount rate and including inflation. All major cash flows should be assessed, including as many details as are significant.

The LCS method is defined simply as the difference between the LCC cost of a conventional fossil fuel fired energy source alone and the LCC cost of the photovoltaic installation that will replace it or assist it.

### Basic economic indicators

The basis of this analysis method is the discount rate ( $d$ ). The discount rate is the multiplier that converts the anticipated monetary income from a system to its current market value. Even though it is important to choose a realistic number for the discount rate, one can only make an educated guess. For PV systems, this may be the interest of bank savings accounts or the interest of the loan that financed the PV system.

The inflation ( $i$ ) is another economic parameter than needs to be assessed by the user and it should be based on both the current inflation rate and historic parameters. Note that the inflation rate of various products and services differs, therefore the use of the average national inflation rate can lead to misleading results. For a valid economic analysis, different inflation rates should be assessed for the cost of fuel, products and various services.

An estimated discount rate is necessary to assess the value of parts that may need replacement after a certain time, such as batteries, the future cost of services, as well as the value of the entire system after a certain period. This leads to the Present Value Coefficient ( $PVC$ ). Where  $n$  the time of periods (usually years), the PVC formula is:

$$PVC = \frac{1}{(1 + d)^n}$$

The PVC is used to convert the future value of a monetary sum, be it income or cost, to its present value. The formula displaying the Present Value ( $PV$ ) of a monetary sum if its Future Value ( $FV$ ) is known is:

$$PV = FV \times PVC = FV \times \frac{1}{(1 + d)^n}$$

This formula can also be used to convert currently known monetary flows to their future values.

For example, if the batteries of a stand-alone PV system have to be replaced after seven years, their present value can be assessed by estimating their current cost assuming a discount rate with  $n$  equal to seven. Assuming that the battery replacement would cost 10.000€ and a discount rate of 5%, then the value of their replacement after seven years is:

$$PV_b = 10.000\text{€} \times \frac{1}{(1 + 0,05)^7} = 7.106,81\text{€}$$

The total cost of system part replacements ( $C_R$ ) is simply the sum of the present value of the parts multiplied by their present value coefficients. Where  $z$  is the part that requires replacement and  $C_z$  the current cost of that part, the  $C_R$  is given by the following formula:

$$C_R = \sum_z PVC_z \times C_z$$

Aside from the cost of replacement parts, the engineer needs to assess the operation and maintenance cost as well. This cost is usually considered stable every year for the life of the PV installation but, like all monetary sums, its actual monetary value declines every year. For the calculation of the operation and maintenance cost ( $C_M$ ), it is necessary to assess the Capital Recovery Factor ( $CRF$ ). If the life of the PV installation is  $N$  years and  $i_M$  the inflation rate of the maintenance and operating cost, then the  $CRF$  of the maintenance and operating cost ( $CRF_M / CRF_O$ ) is given by the following formula:

$$CRF_M = \frac{i_M(1 + i_M)^N}{(1 + i_M)^N - 1}$$

$$CRF_O = \frac{i_O(1 + i_O)^N}{(1 + i_O)^N - 1}$$

Therefore, if the annual maintenance cost of a PV system is 500€ and the inflation rate of the maintenance services is 3%, its present value over a period of 25 years is:

$$CRF_M = \frac{0,03 \times (1 + 0,03)^{25}}{(1 + 0,03)^{25} - 1} = \frac{0,063}{1,094} = 0,0576/year$$

$$C_M = \frac{500\text{€}}{0,0576} = 8680.55\text{€}$$

The  $CRF$  is not limited to the assessment of maintenance and operation costs. It is especially useful for assessing any amortizing cost, such as annual bank payments. If the capital cost ( $CC$ ) of an entire PV system or performance/part upgrades (such as solar trackers) is covered by a bank loan with an interest rate  $i_b$  and a payback time  $N_b$ , then the yearly cost ( $Y$ ) becomes:

$$Y = CC \times CRF_b = CC \times \frac{i_b(1 + i_b)^{N_b}}{(1 + i_b)^{N_b} - 1}$$

For example, let us assume the installation of a tracker that would enhance the output of a PV system by 3.000kWh per year. The tracker costs 8.000€ and its purchased will be covered by an 8-year bank loan with an interest rate of 7%. So, we have that:

$$Y_{ex} = 8.000\text{€} \times \frac{0,07 \times (1 + 0,07)^8}{(1 + 0,07)^8 - 1} = 1339,74\text{€/year}$$

If the user wishes to cover this cost entirely by the energy production of the PV system throughout the loan period, then the price per kWh throughout this period should be greater than the electricity cost ( $EC$ ) of this example, which is:

$$EC_{ex} = \frac{1339,74\text{€/year}}{3000\text{kWh/year}} = 0,44658\text{€/kWh}$$

The Capital Cost of a PV system ( $CC_S$ ) consists of two parts - the cost dependent on the area of the collectors ( $C_A$ ) and the cost independent of the collector area ( $C_E$ ). The first includes all parts that depend on the collector area of the PV system (e.g. PV panels, wiring, racks, etc.) and the second the parts that do not depend on the size of the PV system (e.g. meters, batteries, grid connection cost, etc.). Where the PV panels area is  $A$ , the capital cost of a system is:

$$CC_S = A \times C_A + C_E$$

As a basic example, let us assume a grid-connected PV installation that will cover 150m<sup>2</sup>. The cost of the PV panels is 300€ for a two by one meters 300W<sub>p</sub> panel. The cost of the mounting racks is estimated at 50€ per square meter. Furthermore, the system requires a suitable inverter and the one-time connection cost to the grid is 2.000€.

To calculate the  $CC_S$ , we need to estimate the size of the installation first. Assuming that there is no installation tilt, i.e. the entire surface may be covered with PV panels, 75 panels can fit into our installation area. The cost of the panels will be

150€/m<sup>2</sup> and an inverter capable of withstanding 22.5kWp is necessary. Such an inverter is assumed to cost 6.000€. Therefore, the  $CC_S$  of this system is:

$$CC_S = A \times (150 + 50) + 6.000 + 2.000 = 38.000\text{€}$$

Finally, if the capital cost of the system is known, the total Life Cycle Cost ( $LCC$ ) of a PV system is:

$$LCC = CC_S + C_R + C_M - RV$$

Where  $RV$  is the remaining value of the system at the end of its lifetime. Frequently, this value is considered zero.

### Grid-Connected PV Installations

For the assessment of grid-connected installations, the LCC method is used to discount all cash flows into their present values.

The annual economic benefit ( $AECB$ ) of a grid-connected PV system is the sum of the net cash flows (income minus expenses) over the economic analysis period. The net cash flow  $CF$  for year  $N$  is:

$$CF_N = [ES \times FIT \times (1 + i_{FIT})^{N-1}] - BPP - [C_{MN} \times (1 + i_{C_{MN}})^{N-1}]$$

Where  $ES$  is the energy sold to the grid during year  $N$ ,  $FIT$  is the feed-in-tariff price,  $i_{FIT}$  is the  $FIT$  annual inflation rate,  $BPP$  is the annual bank payment in the case of a loan,  $C_{MN}$  is the annual maintenance cost and  $i_{C_{MN}}$  is the  $C_{MN}$  annual inflation rate. More indicators, such as the operating cost or expected part replacements, may be added as well.

The annual bank payments  $BPP$  for a loan  $LS$ , for period of  $LNP$  years and assuming a loan interest rate of  $i_{bl}$  are calculated using the following formula:

$$BPP = LS \times \left( i_{bl} + \frac{i_{bl}}{(1 + i_{bl})^{LNP} - 1} \right)$$

Usually, the size of the loan equals the capital cost of the system and the length of the loan equals the estimate lifetime of the PV installation.

Finally, the Net Present Value ( $NPV$ ) of the PV system is:

$$NPV = \left[ \sum_1^N \frac{CF_N}{(1 + d)^N} \right] - ICC_S$$

Where  $ICC_S$  is the initial capital cost of the system not covered by a bank loan.

For example, let us calculate the  $NPV$  of a grid-connected system that consists of fifty 300W<sub>p</sub> panels. Each panel costs 300€. The racks for the panels are estimated to cost 100€ per panel, the inverter costs 3.800€ and the one-time

installation and connection cost is assumed to be 1.500€. The annual maintenance cost is 250€ and has an inflation rate of 2%. The FIT is 0.3€/kWh and has an inflation rate of 1%. Our entire initial capital cost is covered by a 25-year bank loan with an interest rate of 5.5%. Simulations displayed that the annual energy generation of the system would be 20.000kWh. Assuming a minimum rate of investment of 4% and a life cycle of 25 years, what is the *NPV* of the system?

The capital cost of the system is:

$$CC_s = 50 \times (300 + 100) + 3.800 + 1.500 = 25.300\text{€}$$

This cost will be entirely covered by a bank loan, the annual payments of which will be:

$$BPP = 25.300\text{€} \times \left( 0,055 + \frac{0,055}{(1 + 0,055)^{25} - 1} \right) = 1886,1\text{€/year}$$

The annual net cash flow *CF* per year *N* is:

$$CF_N = \left[ 20.000\text{kWh} \times \frac{0,3\text{€}}{\text{kWh}} \times (1 + 0,01)^{N-1} \right] - \frac{1886,1\text{€}}{\text{year}} - [250\text{€} \times (1 + 0,02)^{N-1}]$$

So, for example:

$$\begin{aligned} CF_8 &= \left[ 20.000\text{kWh} \times \frac{0,3\text{€}}{\text{kWh}} \times (1 + 0,01)^{8-1} \right] - \frac{1886,1\text{€}}{\text{year}} - [250\text{€} \times (1 + 0,02)^{8-1}] \\ &= 4259,5\text{€} \end{aligned}$$

The *ICC<sub>s</sub>* of the system is zero, therefore the discounted sum of the cash flows gives us the *NPV* of the system:

$$NPV = \sum_1^N \frac{CF_N}{(1 + d)^N} = \frac{114299,1\text{€}}{(1 + 0,04)^{25}} = 42876,1\text{€}$$

### Stand-alone or self-consuming PV installations

For stand-alone or self-consuming PV installations, the LCS method is usually the most appropriate, as the economic feasibility of investing in photovoltaic energy has to be compared against other energy sources. The LCS is virtually no different to the LCC method, with the exception that the LCC of every option has to be evaluated and the economic results are compared to each other.

The annual economic benefit of a PV system that will support or replace an existing grid-connected installation may also be split into two parts; the direct economic benefit (*DECB*) and the indirect economic benefit (*IECB*). The direct economic benefit is, as the name suggests, the monetary income per annum. For any year *N*, it can be expressed as:

$$DECB_N = H_N \times EC_N \times [EPC_N \times (1 + i_{EPC})^{N-1}]$$

Where  $H$  is the number of days per annum that the PV system will be functional,  $EC$  is the electric energy cost per kWh,  $EPC$  is the current electric energy per day that is covered by the PV system and  $i_{EPC}$  is the yearly inflation rate of the  $EPC$ .

For example, if a PV system operates 24/7 and generates 60kWh/day, if the electricity cost per kWh is 0.015€/kWh, then the  $DECB$  for this year is:

$$DECB = 365 \times 60 \times 0,015 = 328,5\text{€}$$

The  $IECB$  is an empirical value, representing the result of, for example:

- The reduction of adverse environmental impacts from the use of conventional energy sources.
- The increase of additional social services (e.g. health, security, etc.) that may occur from the reduction of fossil fuel imports.
- The decrease of unemployment.
- The reduction of the national energy dependence on imports.

Frequently, the  $IECB$  is considered to be half of the  $DECB$  [2]. Therefore, the  $AECB$  simply becomes  $1.5 \times DECB$ . However, for private economic investments, the  $IECB$  is usually not being considered and  $AECB = DECB$ .

*For example, let us compare the following three options over a period of ten calendar years. The load is assumed to be an average of 15800 kWh per annum.*

*4 kW Oil-fired generator - Capital Cost 5000€, energy cost 0.09€/kWh.*

*4 kW Gas-fired generator - Capital Cost 4000€, energy cost 0.11€/kWh.*

*12 kW<sub>p</sub> Stand-alone PV system - Capital Cost 40.000€, no energy cost.*

*We assume that no parts will require replacement and that the inflation of the energy cost is 6% per annum.*

For the oil-fired generator, we have an energy cost of:

$$\sum_{N=1}^{10} 15.800 \times 0,06 \times (1 - 0,06)^N = 20.825,66\text{€}$$

Including the capital cost, the LCC of the oil-fired system is:

$$LCC_o = 5.000 + 12.495,39 = 25.825,66\text{€}$$

Similarly, the gas-fired generator has an LCC of:

$$\sum_{N=1}^{10} 15.800 \times 0,11 \times (1 - 0,06)^N = 22.908,22\text{€}$$

$$LCC_G = 4.000 + 16.660,52 = 26.908,22\text{€}$$

Under these assumptions, the PV system is not a competitive investment, as its capital cost is significantly higher than the LCC of the fossil fuel generators. If however we assume that the PV system will be selling the excess energy to the grid at a fixed rate of 0.27€ for the next 10 years, a discount rate of 0.03% and the annual energy surplus is 4000 kWh, then we have:

$$DECB_{PV} = 6.500 \times 0,27 = 1.755\text{€/Year}$$

$$PV_{PV} = \left[ \sum_{N=1}^{10} FV \times \frac{1}{(1 + d)^N} \right] = 15.419,62\text{€}$$

Therefore, the LCC of the PV system is:

$$LCC_{PV} = 40.000 - 15.419,62 = 24.580,38\text{€}$$

Which now appears as a competitive investment compared to conventional energy generators.

## Marketing of photovoltaics

Marketing is defined as the totality of measures taken to attract customers on you and your products. It is a very wide topic but it can be divided into three main sections: basic marketing, systematic planning and sales talk. Basic marketing usually involves single, unorganized actions of direct or indirect reach. Sales talk is the most direct form of contact with the customers and is usually limited to face-to-face contact or telephone communication. Systematic planning is a programme or a series of strategic measures meant to fulfil a specific target. As systematic planning depends on time, it always is dynamic and usually focused on the following criteria:

- Economics (lower costs, higher income, greater economic value)
- Wider advantages (e.g. effect on environmental impact, unemployment)
- Improving technical performance
- Enhancing social acceptance

There have been numerous publications exploring various PV marketing strategies during the past two decades. Some propose marketing and financing

strategies [3], others study penetration strategies for specific/new markets [4-6]. Some study the impact of non-technical issues [7, 8], others analyze the behavior of consumers [9, 10]. A successful marketing programme requires the careful consideration of multiple parameters and the adaptation of multiple marketing strategies to the specific needs of the targeted customer group.

### Customer centered marketing

In order to achieve the expected results, the center of the marketing efforts needs to be the customer. Whether this involves a single, basic marketing action (e.g. an advert) or a major marketing programme, one seeks to understand the needs and the wants of the targeted customers and strives to satisfy them. Each group of customers may have different needs (e.g. financial, environmental) and thus they will respond differently to individual marketing actions. In order to select and perform marketing actions and strategies, four major parameters need to be considered.

#### Parameter 1 : Geographic location

Obviously, photovoltaic panels are usable only in unshaded areas. However, many other parameters need to be considered as well, such as the local climatic data (sunshine hours, solar irradiation per square meter, wind speeds, etc.). It is imperative that at least the basic climatic parameters have been considered and techno-economic simulations have been performed prior to the suggestion of installing a PV system, assessing whether the investment is viable both economically and technically to begin with. The panels also need to be facing towards the sun's path over the celestial dome (south for countries at the northern hemisphere, north for countries at the southern hemisphere).

#### Parameter 2 : Demographics

There are three major categories of investors: residential, commercial and industrial. Each of them has different needs, budget and goals. For example, residential investors will most likely be attracted to small, low cost installations and may be swayed by the environmental benefits of a PV installation, even though the economic benefits may be small. Commercial investors may be convinced to perform a significant investment in order to improve their corporate social responsibility indexes, attracting more customers to their cause. Industrial investors are likely to be attracted only to monetary and reliability gains.

If a marketing programme is to be aimed towards multiple demographic groups, it is imperative that its resources are allocated according to the expected willingness of each group. For example, the largest portion of marketing resources should be devoted towards the group with the greatest monetary wealth while considering their investing willingness.

#### Parameter 3 : Psychographics

Psychographics allow the segmentation of the potential customers into groups based on their social class, lifestyle and personality characteristics. Frequently, those groups willing to invest on photovoltaics share common values and needs. Either they are after a low-risk economic investment or their motives are environmental. Cultural/Regional behavioral characteristics are also very important. Adapting marketing strategies to the social class, values, opinions and interests of the target group is vital for the marketing action to have a significant impact.

#### Parameter 4 : Behavioral

Studying, identifying and segmenting the customers into groups based on how they respond to a product is important for both basic and complex marketing strategies. Photovoltaic marketing strategies have to be adapted according to the technical and environmental awareness of the target group, taking into account their intentions and expectations. For example, high-income residential users may entertain an investment on a PV system but they frequently dismiss it for aesthetic purposes; therefore, the marketing of panels/systems that may be more expensive but less visually intrusive will be more effective. In areas where the environmental awareness of the potential customers is very low, effective marketing is usually based on economic figures.

### The creation of a marketing strategy

A simple definition of a marketing strategy is "the effort to put the right product, in the right place, at the right price, at the right time". This is also known as the "four P's" of marketing - Product, Place, Price and Promotion [11]. James Culliton described the role of the marketing manager as a "mixer of ingredients" - one who sometimes follows recipes prepared by others, sometimes prepares his own recipe as he goes along, sometimes adapts a recipe from immediately available ingredients, and at other times invents new ingredients no one else has tried [12].

#### Parameter 1 : Product

For photovoltaics, "products" can be separated into two major groups: tangible goods and intangible services. Goods are the panels, mounts, inverters and any other physical equipment. Services are the sales, after sales service, maintenance, warranty terms and more.

An effective marketing plan should consider the goods and services according to the needs and wants of the customers. For example, specialized mounts and panels need to be marketed towards potential customers where hailstorms are frequent and intense, while advanced after-sales service is important to commercial users. The expected life cycle of each product should be clear to the customer and the marketer needs to assess the challenges that may arise during the life cycle of the PV installation as a whole or concerning its individual parts.

## Parameter 2 : Price

Price is the total cost that a customer pays for a specific product or service. It is not only a monetary aspect but it also includes other parameters, such as time and conscience. For the marketer, the correct assessment of this parameter is of utmost importance, as it affects both the competitiveness of the marketing strategy and the survivability of the seller.

For photovoltaics, it is important to provide a detailed accounting of every monetary cost along the life cycle of the installation, not just the capital cost. Currently, this cost usually is high and most investors will see it as a huge expense. Effective marketing should depict the long-term financial gains, alongside other gains, such as ethical gains.

## Parameter 3 : Place

An effective marketing strategy requires knowledge of where and towards to whom the marketing is taking place. This leads to the selection of a proper distribution method, which may be intensive, selective or even exclusive (peer-to-peer sales). Selective distribution is often selected by marketers that want to attract specific groups of users, while exclusive distribution is mostly performed at a business-to-business level. Intensive distribution rarely is effective with the marketing of photovoltaics, unless there is a large-scale subsidization programme in effect.

## Parameter 4 : Promotion

Promotion includes every communication method available to the marketer that may be used to approach various user groups. It is often mistaken as the only part of marketing, but this could not be further from the truth. The four most basic elements of promotion are:

- Advertising, which covers any paid for communication, such as commercials and printed media.

- Public relations, which covers communication not directly paid for, such as trade fairs, seminars and press releases.

- Sales organization, which identifies and approaches each group of potential customers. Frequently, the marketing of photovoltaics requires personal selling, meaning that the salesperson will often have to meet with and understand the potential customers and their needs.

- Sales promotion, which may involve the informing of customers regarding available local or national subsidies, rebates or taxation credits, or any action that may provide a short-term sales boost (e.g. coupons or temporary discounts).

It should be noted that large companies and complex marketing strategies require the assessment of at least two more sets, the consumers and the circumstances. The factors related to each of these sets can be remembered by the four cardinal directions, which is why this extension is called the "compass model". These factors are:

Consumers	Circumstances
N - Needs	N - National/International
W - Wants	W - Weather
S - Security	S - Social/cultural
E - Education	E - Economic

Unlike the four P's, these elements of the marketing strategy are targets, not tactics. Regardless, their consideration is vital for long-term and large scope marketing strategies, where failures will lead to a momentous waste of resources.

The marketer also needs to assess forces that are outside of control of marketing decisions. These may be:

Environmental: Strong climatic shifts, chance of extreme weather phenomena.

Competition: The appearance of other entities offering similar services.

Technological: Advancement that may affect the availability and price of any part related to photovoltaic installations.

Social: Any change to the awareness and willingness of the public regarding photovoltaics and renewable energy sources.

Economic: Recessions, financial crises and emerging markets.

Legislative: Licenses, permits, safety regulations, subsidies and any government-related policy that may affect the use of photovoltaics.

## References

- [1] M. Bazilian, I. Onyeji, M. Liebreich, I. MacGill, J. Chase, J. Shah, *et al.*, "Re-considering the economics of photovoltaic power," *Renewable Energy*, vol. 53, pp. 329-338, May 2013.
- [2] I. Fragkiadakis, "Photovoltaic systems," *Professor of TEI of Crete, Zito press, Copyright*, 2004.
- [3] T. Nordmann, "Successful Solar Marketing and Financing in Europe: How to get from here to there in Photovoltaics?," *Proc. EUROSUN'96 Freiburg*, 1996.
- [4] B. Sigrin and E. Drury, "Diffusion into New Markets: Economic Returns Required by Households to Adopt Rooftop Photovoltaics," in *2014 AAAI Fall Symposium Series*, 2014.

- [5] N. Bach, P. Calais, and M. Calais, "Marketing residential grid-connected PV systems using a Balanced Scorecard as a marketing tool," *Renewable Energy*, vol. 22, pp. 211-216, 2001.
- [6] M. Muntasser, M. Bara, H. Quadri, R. El-Tarabelsi, and I. La-Azebi, "Photovoltaic marketing in developing countries," *Applied energy*, vol. 65, pp. 67-72, 2000.
- [7] R. Haas, "RESIDENTIAL PHOTOVOLTAICS APPLICATIONS: THE RELEVANCE OF NON-TECHNICAL ISSUES," *International Journal of Solar Energy*, vol. 20, pp. 37-55, 1998/01/01 1998.
- [8] B. Groenendaal, T. De Lange, P. Lako, J. Van Roosmalen, C. Tool, and D. Wild-Scholten, "Critical Success Factors for the Large-Scale Introduction of Grid-Connected Photovoltaic Systems. A survey focusing on the non-technical aspects," Netherlands Energy Research Foundation ECN, Petten (Netherlands)2000.
- [9] A. Faiers and C. Neame, "Consumer attitudes towards domestic solar power systems," *Energy Policy*, vol. 34, pp. 1797-1806, 2006.
- [10] W. Jager, "Stimulating the diffusion of photovoltaic systems: A behavioural perspective," *Energy Policy*, vol. 34, pp. 1935-1943, 2006.
- [11] N. H. Borden, "The concept of the marketing mix," *Journal of advertising research*, vol. 4, pp. 2-7, 1964.
- [12] J. W. Culliton, *The management of marketing costs*: Division of Research, Graduate School of Business Administration, Harvard Univ., 1948.