



A comparative assessment of net metering and net billing policies. Study cases for Spain



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ARTICLE INFO

Article history:

Received 22 November 2014
Received in revised form
25 February 2015
Accepted 10 March 2015
Available online 1 April 2015

Keywords:

Photovoltaic
Net metering
Net billing
Net present cost
Levelised cost of energy

ABSTRACT

Net metering and net billing are electricity policies that enable grid-connected customer-generators (homes or businesses that own a PV (photovoltaic) or other generation technology connected to the grid) to offset some or all their electricity consumption and get paid for excess energy injected into the grid.

There are many policies of net metering and net billing used by different countries. In this paper we propose a modified definition of some of the modalities that can be applicable to the two drafts of the royal decree for the Spanish regulation. Also we show, for the first time, the mathematical formulation of a comprehensive methodology for the assessment of the different modalities of net metering and net billing used in different countries.

We compare several cases, taking into account the actual two Spanish drafts, the two models proposed by the Spanish National Energy Commission in its reports about the drafts and other modalities used in other countries, concluding that the first Spanish draft would have been a superior regulation for PV net metering; however, the second draft impedes the profitability of the PV so no user will install a grid-connected PV system if this second draft is finally approved.

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1. Introduction

The development of grid-connected PV (photovoltaic) generators has been implemented in different countries by different programs: FiT (feed-in tariffs), feed-in premiums and quota system [1], with the FiT the most widely used program [2]. Economic analysis of grid-connected PV systems is shown in Refs. [3,4].

Net metering and net billing are policies that encourage the installation of grid-connected PV generators owned by the consumers of electricity. In the net metering modality, the electricity injected into the grid is preferably valued the same as that consumed from the grid (retail price); however, in net billing the electricity injected is valued at a lower price (wholesale or “avoided cost” price) than energy consumed from the grid. Net metering was first introduced in the United States in the 1980s, and now almost all the states include net metering policies: simple, with buy-back, with rolling credit or with buy-back and rolling credit [5,6]. Later many other countries included net metering (or net billing) policies [7].

In Spain, the PV generators have been encouraged since 2004 with FiT incentives. However, since the renewable cut-off of the

government in 2012 (the Spanish government slashed all subsidies for renewable energy and announced the cessation of all calls for the registration of new renewable energy projects), the PV sector has been stopped [2]. Net metering or net billing policies are under current consideration in the regulation of the electricity sector in Spain. Two RD (royal decree) drafts regulating on-site generation were issued but none was approved.

The Spanish National Energy Commission (“Comisión Nacional de la Energía”, CNE, the regulatory agency for energy in Spain) has proposed two alternatives to the RD drafts. The regulation has high significance in electricity markets and in general in the energy sector, as shown in Refs. [8–10].

This paper is structured as follows. Section 2 shows the methodology. Section 3 and 4 shows the results and the discussion of the application of the different net metering and net billing policies in Spain. Finally, section 5 shows the conclusions and policy implications.

2. Materials and methods

2.1. Definitions and state of the art

Different terms of net metering and net billing have been used by different authors [11–13], depending on the number of meters

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(one bi-directional or two), on the price at which the net electricity (or all electricity generated) should be paid (retail rate, or other rate), on the requirement for a utility to buy excess power from the PV system (buy-back), on the duration of the banking period (one billing period or more). The confusion about the terms “net metering” or “net billing” was clarified by Hughes and Bell [11] who defined the different modalities of net metering and net billing. Also, they defined the term “customer-generator” as “a typical grid-connected home or business which meets on-site loads using a combination of customer-generated electricity and electricity from the grid”. In net metering, “the grid is essentially treated as a battery, meeting all or part of the load whenever the customer-generator’s system is unable to do so” [14].

Yamamoto showed the difference between net metering and net purchase and sale in Ref. [15]. Mir-Artigues defined net metering and net billing in the following terms [16]: in net metering, there is only one bi-directional meter, which can run forward and backward, measuring imported minus exported energy in kWh; in net billing there are two meters so that exported and imported energy are measured separately, as they have different prices: energy exchanges are expressed in monetary terms. Figs. 1 and 2 show the differences in their schemes, where DE is demand of energy (electricity demanded by the load), GE is generation of energy (electricity produced by the PV generator), EE is exported energy (electricity injected to the grid), and IE is imported energy (electricity consumed from the utility).

The main differences between net metering and net billing can be summarised as:

- Net metering: the energy exported to the grid has the exact same value as the energy imported from the grid. In other words, the cost relation between the imported and exported energy is 1:1.
- Net billing: all the energy exported to the grid is sold to the utility at a price (usually wholesale or “avoided cost” prices) and all the energy imported from the grid is bought at retail rate.

2.2. Previous definitions of different modalities of net metering and net billing and proposal of changes in the definitions

Hughes and Bell defined the different modalities of net metering and net billing, showing the classification that follows [14]. We have added definition # 5 (it was not defined in Ref. [14]) and we have modified definition #7.

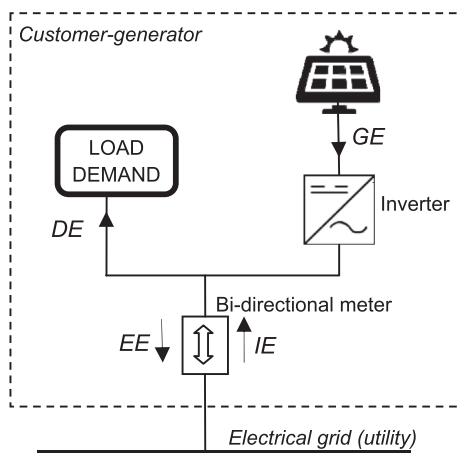


Fig. 1. Net metering scheme.

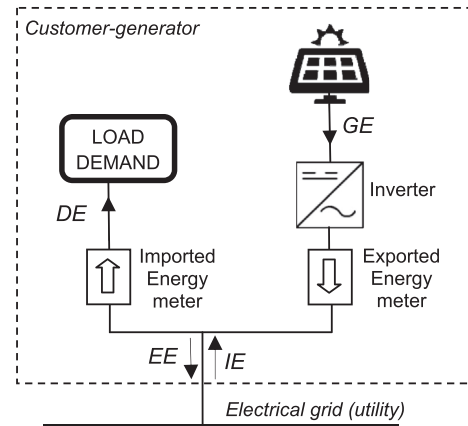


Fig. 2. Net billing scheme (also applied in some cases of net metering).

- 1) Net metering (simple): there is a bi-directional meter to measure the difference between IE and EE during the billing period (usually one or two months).
 - If $IE - EE > 0$: the customer-generator must pay the utility for the difference.
 - If $IE - EE \leq 0$: the customer-generator receives no compensation.
- 2) Net metering with buy-back: if $IE - EE < 0$ the customer-generator is paid for the excess energy ($EE - IE$) generated during the billing period, which can be valued below retail rate (typically avoided cost of generation, i.e., wholesale rate or cost to the utility), retail rate, or above retail rate.
- 3) Net metering with rolling credit: the banking period extends over a billing period (typically one year). If during a billing period there is excess energy ($IE - EE < 0$), this value ($EE - IE$) is used as a credit to reduce the bill in future billing periods.
- 4) Net metering with rolling credit and buy-back: combination of 2) and 3).

In net metering modalities, the balance ($IE - EE$) is done in energy terms (kWh); however, in net billing the balance should be done in monetary terms.

Some cases can be considered net metering (the balance is done in energy terms) but they must use two meters because for all the energy imported from the grid some charges are applied, and in these cases the cost relation is not strictly 1:1. They must be defined into net metering modalities as the balance (exports minus imports) is quantified in physical terms (kWh) and not in monetary terms. This is the case proposed in the first Spanish RD draft of 2011 [17], which ultimately was not approved.

A simple net billing modality has been added in this paper (next definition # 5) as it was not included in the classification shown in Ref. [17] but this is one of the alternatives proposed by the CNE in 2012 [18].

- 5) Net billing (simple): At the end of the billing period, if the cost of all the energy imported from the grid (at a certain price, at which the customer-generator purchases electricity for the utility) is higher than cost of all exported electricity (at a certain price, at which utility purchases electricity for the consumer-generator), the customer-generator must pay the utility for the difference between the two terms. If the cost of all the energy imported is higher than cost of all energy exported, the customer-generator receives no compensation.
- 6) Net billing with buy-back: At the end of each billing period, the customer-generator pays the utility for all the energy imported

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