Lithuanian Photovoltaic Market between 2010 and 2020, European Background, Current State and Development Perspective

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Abstract

The usage of the Solar Photovoltaic Systems (PV) in Lithuania was commenced during the last decade of the 20th century. They were applied in buildings, yachts, vacation homes, and other facilities to satisfy minor demands of electric power.

The stagnation of the PV's development until 2010 was caused by well-developed electric power distribution infrastructure and relatively large conventional electricity production. The significant increase of installed power from the PV systems and energy they produced was monitored in 2010 when the Government has introduced high rates of purchase of PV produced energy; that lasted till 2013 when high rates were cut down. A two-sided electric power metering system was launched in Lithuania in 2015 and within the next years the cost of PV systems decreased significantly, also the financial support from the state became available. All this gave new impetus to the development of PV systems.

This study aims to review the PV market in Lithuania between 2010 and 2020, the current state and development perspectives.

Keywords: renewable energy, photovoltaic systems, energy prices.

1. Introduction

The renewable energy segment has continued to grow worldwide in recent years, alongside ever increasing global energy consumption and decreasing investment costs for many renewable energy sources. Furthermore, in a lot of countries, the fluctuating price of fossil fuels has had a serious impact on energy security. There are several alternative resources that can provide clean, continuous, and renewable energy, such as solar, wind, biomass, hydro, and geothermal.

In 2019 the solar PV market increased by 12% to around 115 GW. The last decade ended with strong demand in Europe, the United States, and emerging markets. The global total of 627 GW at the end of 2019, compares to a total of less than 23 GW in 2009. Demand for solar PV is spreading and expanding as it becomes the most competitive option for electricity generation for residential and commercial applications and increasingly for utility-scale projects – even without accounting for the external costs of fossil fuels [REN 21].

Lithuania is a Baltic country in the central Europe region, with an area of 65300 km^2 and a population of 2.8 million. The average global solar irradiation in Lithuania is around 1050 kWh/m^2 (2003-2018), similar to Germany, Austria, Denmark, and Poland.

PV systems have been installed in Lithuania for over 20 years, but only in the last decade, the market boomed. Within the recent years, prices of PV systems dropped significantly and a subsidy system was launched for renewable energy sources in single-family houses, public buildings, factories, etc. [Valancius et al. 2018]. Some studies and reports showed that 1 kWp of PV systems can produce around 1000 kWh/year [Valancius et al. 2018a; ENMIN 2020; LSEA 2020]. In 2018, the price of small (up to 10 kWp) PV systems in Lithuania has dropped below 1100 EUR/kWp. At the beginning of 2020, the price PV systems propped again, because of lower PV cells prices. That has increased the interest to PV systems. At the end of 2019 the amount of installed PV power in Lithuania increased to around 100 MW from around 0.018 MW in 2010.

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Competition in the Lithuanian PV market, as in the rest of the world, increased during the year due to the growing supply of equipment, emerging new manufacturers, and equipment installers. Currently, in 2020, there are three manufacturers in Lithuania producing solar modules from standard to integrated into building facades or roofs: JSC Via Solis Energia, JSC Solet and JSC Intelligent solar. There are also many companies designing and installing a solar power plant.

In 2015 a two-sided electricity accounting scheme was launched in Lithuania, which gave a great impetus to the development of PV systems. This energy accounting scheme works as follows: when a PV of an electricity-producing consumer produces more power than is consumed (for example, when the sun shines in the midday), the electricity produced but not consumed is supplied to the power grid. Later (for example, when you return from work in the evening), when the producing consumer does not have enough of his instantaneous power, the excess electricity accumulated during the day is recovered from the power grid. The bilateral accounting period is scheduled for the calendar year starting from April 1. This means that consumers can also use the excess power produced during the summer in autumn and winter months. In this case, the power grid acts as a battery - it receives electricity when there is a surplus of production and allows to pick up the stored power when an energy-producing consumer lacks it. Power grids charge a fee for storage. The aim is to create clear, transparent pricing that does not have a significant impact on other consumers.

The majority of power consumers in Lithuania are connected to the low voltage grid. Electricity prices in Lithuania currently vary from 0.095 to 0.149 EUR/kWh for households depending on the selected tariff [Ignitis 2020].

Tab. 1. Payment methods and prices (01.01.2020) for producing consumers [ESO 2020].

Payment method	Paid for	Price in low voltage, EUR (including VAT)	Price in medium voltage, EUR (including VAT)
Payment for recovered energy	For a kilowatt-hour of electricity supplied to the grid and subsequently recovered (kWh)	0.05203 Eur/kWh	0.02662 Eur/kWh
Payment for the installed capacity of the PV	For the installed kilowatt of power generated by the PV (kW)	2.6378 Eur/kW/month	1.3552 Eur/kW/month
Hybrid payment	Hybrid payment, i.e. for kilowatt-hours (kWh) of electricity supplied to and subsequently recovered from the power grid and for kilowatt-hours of installed power generated by the PV (kW)	0.02662 Eur/kWh 1.3189 Eur/kW/month	0.01331 Eur/kWh 0.6776 Eur/kW/month
Payment in kilowatt-hours	Payment in kilowatt-hours: a fixed percentage of the amount of energy supplied to the grid (kWh) is left to the operator for the use of network services, the customer will be able to recover free of charge a set percentage of the amount of his production supplied to the grid	36% (64% remains to producing consumer)	21% (79% remains to producing consumer)

For example: if PV produced and supplied 50 kWh to the ESO (company responsible for electrical energy and gas distribution in Lithuania) grid during the month, and the amount consumed was 150 kWh, then for the 50 kWh recovered from the ESO grid, the producing consumer pays according to the prices set for the producing consumers. For the remaining 100 kWh the producing consumer pays according to the tariffs of one-time zone. If during the month it was produced and supplied 50 kWh to the ESO grid, and the amount consumed was 20 kWh, the producing customer pays for 20 kWh recovered from the ESO grid according to the prices of the producing consumers. There is no deficiency (0 kWh) higher than consumed. The accumulated amount of 30 kWh, which is not taxable, is calculated. The accumulated quantity is forwarded to future months and this accumulated quantity can be recovered at any time before 31 March of the following year [ESO 2020].

In order to implement the EU Directive 2010/31/EU on the energy performance of buildings, it was required by the legislation of the Republic of Lithuania that all new buildings constructed after 1 November 2016 comply with energy efficiency class A. This class is granted to buildings that use renewable energy sources for electricity and heat production. It also provided an additional stimulus for the use of PV in urban environments.

2. Residential market

Until 2015 only sporadic PV systems were installed in single-family houses and mostly in the buildings that had no connection to the power grid. The two-sided electric power metering system was commenced in Lithuania in 2015. At the beginning, this system, because of complicated connection procedures and high initial investments, was not popular. After the installation procedures of the PV were simplified in 2017 and installation costs dropped, the number of installed PV started to grow rapidly. More than 1800 new clients were connected between May and November of 2019, in comparison between the years 2015 and 2018 only about 1100 new connections were made. From 2016 to 2020 the number of consumers who produced energy increased from 248 to more than 3000. This number is increasing every week by an average of 80 new producing consumers.

On purpose to promote between population the installation of PV systems in households, the conditions required to become producing consumer were simplified and facilitated in July of 2019. Therefore, presently there is no need to receive a permit for installation of systems with the capacity of less than 30 kW, the simplified connection procedure is applied, and it is enough to submit an application and to apply to an operator of energy distribution [ENMIN 2020a].

Tab. 2. The installation stages of PV with capacity to 30 kWp.

Step	Process	Approx. duration in days
1	Obtaining the connection conditions for PV from ESO	to 5
2	Signing of the connection agreement with ESO	1
3	Installation of PV, submission of the contractor‘s declaration	5-10
4	Signing of a producing consumer‘s contract for the purchase and sale of electricity	to 20
5	Installation of a double-sided metering unit	to 2
	Total:	~40 days

Moreover, starting from 2019 residents have the opportunity to produce and to consume the energy produced by the PV systems that are in different geographic locations. For example, a person that lives in an apartment can purchase a part of a system in the solar PV park managed by third parties. Also, residents are allowed to install a PV system on their sites, for example, in country homesteads and to consume the produced energy in apartments in towns.

The growing popularity of PV is also linked to the support for the installation of heat pumps in households. Although statistics are not collected, it is noticeable that quite often people who install or are installing a heat pump also install a solar power plant.

A natural person who owns a residential building (one or two flats) or a garden building, the construction of which has been completed and registered following the procedure established by legal acts for at least 5 years from the date of the invitation to submit registration forms, may apply for support for the installation of a heat pump. Natural persons are eligible for support if they replace old boilers with efficient renewable energy sources. Requirements for heat pumps: ground-to-water and water-to-water heat pumps with a seasonal efficiency factor (SCOP) of at least 3.5, air-to-water SCOP of heat pumps must be at least 3.0. A natural person is reimbursed with 50% of the amount that is calculated by multiplying the power of the purchased equipment in kilowatts (kW) by the fixed rates of one kilowatt of power, which depends on the type of heating equipment and set of equipment.

3. Large scale market

The significant increase of the installed power from PV systems and the energy they produced was monitored when in 2010 it was started to purchase the energy produced by the PV systems in high rates (0.30-0.52 EUR/kWh) for defined 12 years period, it lasted till 2013 when high rates were cut down. The amount of installed PV power: 0.018 MW in 2010, 0.37 MW – 2011, 7.1 MW - 2012 and 68.01 MW – 2013.

From 2015 legal entities also can become producing consumers. The capacity of PV is selected in such a way that the annual amount of electricity produced is close to the annual demand for energy consumed at the facility, as a company will not be paid for the excess electricity produced. Moreover, the installed capacity of the system has not to exceed permissible power consumption of the facility and has not to be larger than 500 kW.

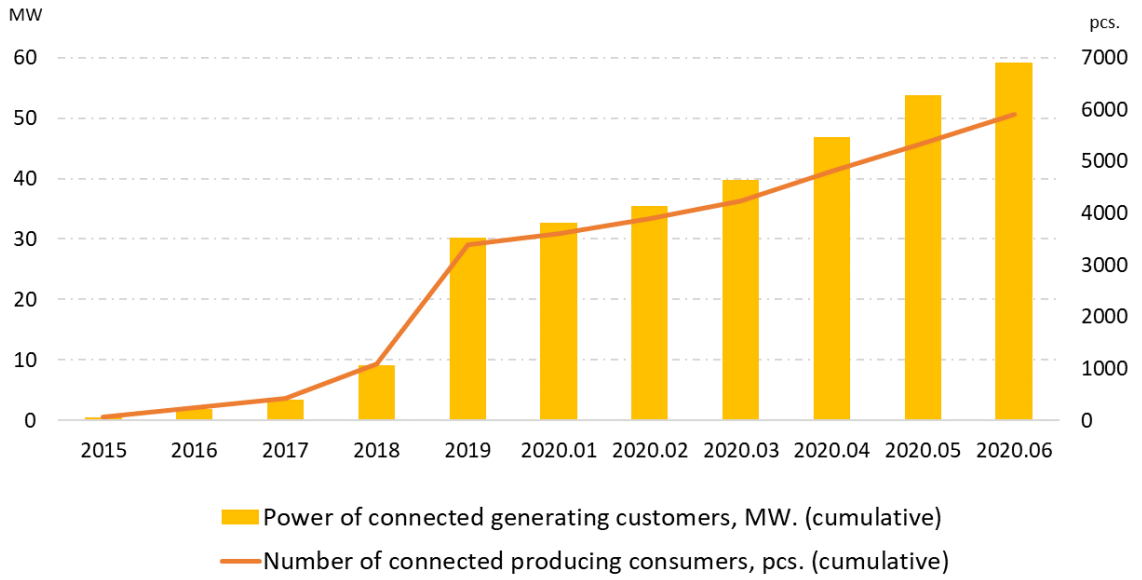

Fig. 1. The statistics concerning the connection of producing consumers [ENMIN 2020a].

The process of installing PV systems larger than 30kWp is much longer [ENMIN 2020a] compared to lower capacity ones and can sometimes take up to half a year or even longer. The steps are described in Table 3.

Tab. 3. The installation stages of PV with a capacity above 30 kWp.

Step	**Process**	**Approx. duration in days**
1	Obtaining pre-connection conditions for a PV system from ESO	to 15
2	Obtaining a permit to develop electric power capacity	to 30
3	Obtaining PV connection conditions from ESO	to 3
4	Design activities	30-60
5	Signing of the connection agreement with ESO	to 5
6	Installation of PV system	5-60
7	Inspection of an installed PV system by the National Energy Regulatory Council	to 30
8	Permit to produce electricity issued by the National Energy Regulatory Council	to 30
9	Signing of a producing consumer‘s contract for the purchase and sale of electricity	to 5
10	Installation of a two-sided metering unit	2
	Total:	~7 months depending on a project

The following solar PV systems were the largest ones in Lithuania till the end of 2019: Sitkunai Solar Park – 2.56 MW, Brizgai Solar Park – 1.99 MW, Dausiskiai Solar Park – 1.96 MW. Over the next years, it is planned to build several 3-5 MW solar parks exclusively for residents that want to become producing consumers. The plan is until 2021 to install the first in Baltic region water floating solar plant at Kruonis pumped storage plant. Its capacity at the first stage will be 60 kW. Later, it is planned to increase the capacity to 200-250 kW.

4. Subsidies and prices of photovoltaic systems

The record amount of 9 MM EUR is planned in the 2020s for the subsidies to PV systems. The record subsidies in the amount of 4.5 MM EUR are planned for the installation of remote solar PV or the purchase of the part in solar PV parks. Also, 4.5 MM EUR will be allocated to solar PV in single-family houses. The compensation for 1 kW of installed solar PV capacity is 323 EUR [APVA 2020]. Requirements applied to the equipment:

- it must be new (unused), comply with EU standards and eco-labels normally required for such equipment;

- the product warranty period for solar modules must be 10 years and 80% performance guarantee must be for 25 years, it must have adequate protection against dust and moisture (at least IP 65);
- product warranty period for inverters must be 10 years, it must have adequate protection against dust and moisture (at least IP 65).

Also, the compensation in the amount of 100% of installation cost can be received for schools, hospitals, and other public buildings. Only a feasibility study and a design for the building of a solar PV system have to be prepared on their own expenses. According to the promotional measures for industrial facilities, there is a possibility to receive the support from 30 to 80% of investments to the sustainable resources equipment.

The support in the amount up to 80% is available to state or municipal institutions and bodies, traditional religious communities, religious associations or centres, public institutions owned or partnered by the state, municipality. Not only PV systems but also solar collectors, wind turbines, heat pumps, and other energy-saving measures are supported. The maximum amount of the grant for one applicant who is not engaged in economic and commercial activities is EUR 1,450,000, and for those who are engaged in economic and commercial activities - EUR 200,000. It is considered as an ineligible applicant (beneficiary) if the building where the heat generating installation is to be replaced is connected to the district heating system [APVA 2020].

The support in the amount up to 40% is available to heat supply companies and independent heat producers. The installation of not only PV systems, but also solar collectors, heat storage, heat pumps, absorption heat pumps, and other energy-saving measures is supported. The funding rate per applicant is 30% of the eligible costs (for large enterprises) and 40% of the eligible costs (for small or medium-sized enterprises) may be increased by 10% for investments in specific assisted areas. The maximum grant per applicant is EUR 1 450 000 [APVA 2020].

The support in the amount up to 65% for the installation of renewable energy sources is available to small, medium, and large industrial enterprises. Renewable energy sources are non-fossil energy sources: wind, solar, aerothermal, geothermal and hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogas. Investment costs necessary to ensure better environmental protection. If the share of environmental investment costs in the total investment costs can be identified as a separate investment, this part of the environmental costs is an eligible cost. In all other cases, the costs of the environmental investment are determined in comparison with similar less environmentally beneficial investments that would be likely to be made without the aid. The difference refers to the costs related to environmental protection and constitutes eligible costs. The maximum grant per applicant is EUR 868 860 [APVA 2020].

It is obvious that the cost of PV installation has a major impact on its payback period. Prices vary over a wide range depending on the equipment selected, the installation location, and the contractor. The analysis assessed at least 5 proposals that met the minimum requirements for support. Systems larger than 50 kW were not analysed because not enough data was collected. Analysis results is presented in Table 4.

Price composition of the analyzed PV systems is presented in Figure 2. The price of PV panels and inverters systems comprises 67% of the total system price. In recent years there has been a decrease in the prices of PV modules in other hand prices of inverters did not changed. Evidence that the price composition can vary in a wide range, depending on selected equipment, installation place etc.

Tab. 4. Prices analysis of PV systems depending on a size (2020 June).

PV system size	Average price including design and installation cost, EUR (including VAT)	Average price of 1 kWp, EUR (including VAT)	Notes
5 kWp	4979	996	Design and inspection activities are not mandatory
10 kWp	9366	936	
30 kWp	25802	860	Design, permissions and inspection activities are mandatory
50 kWp	40644	813	

Some studies, calculations showed that the payback period of a solar PV in a single-family house varies from 4 to 7 years, if the state support has been received. The payback period for larger facilities is from 3 to 6 years. The payback period depends deeply on the proper selection of the system, the cost of installation and equipment chosen [Valancius et al. 2018a; LSEA 2020].

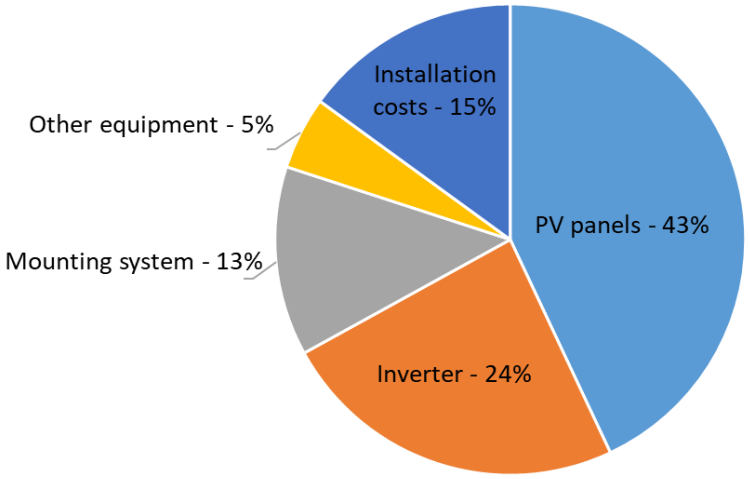

Fig. 2. Price composition of equipment in PV systems from 5 to 10 kWp (2020 June).

5. Discussions and conclusions

Analysis showed that average 1 kWp of small and medium size (5-50 kW) PV system in Lithuania was from 813 to 996 EUR in 2020 EUR. Within the recent years, prices of PV systems dropped significantly and it's expected to decrease slightly in the future.

The goal set by the Ministry of Energy to have 34 000 producing consumers in 2020 is practically unachievable. Although residents, public facilities, and businesses are quite willing to use the support provided for the installation of solar PV systems or to install them without support but a purchase of these systems in solar parks did not receive huge interest from the population.

Obviously simple and clear conditions for connection to a power grid, reduced investments to the equipment, as well as the support of the state to the installation of systems, make a huge impact on the development of the solar PV systems.

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