# CONGREGATE

# ANALYSIS OF THE POSSIBILITIES FOR SUPPLYING 140th SECONDARY SCHOOL "IVAN BOGOROV", SOFIA WITH RENEWABLE ENERGY

**Developed by Center for Energy Efficiency EnEffect**

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**Legal disclaimer**

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# SUMMARY

This analysis discusses the possibilities of installing a photovoltaic plant on the roof of 140th Secondary School “Ivan Bogorov”, Sofia. The aim is to compare the different approaches for the implementation of the project, assessing the possibilities of building an installation to partially cover the needs of the building and selling the excess energy in the form of an Energy Cooperative. An alternative option has been considered by establishing a direct connection to the neighbouring kindergarten - kindergarten No 82 "Gianni Rodari", to which part of the electricity generated would be fed.

On the basis of the analyses, it is concluded that the structuring of an energy cooperative is feasible and would be beneficial for both the municipality and the participants in the cooperative. This allows for the distribution of the financial risk, providing an attractive return for investors compared to current levels of bank deposit rates.

Exemplary models for the participation of the attracted investors are developed, and a 10-year investment recovery period is considered. For this period, investors receive annually 1/10 of the value of the investment plus an annual dividend on its residual value. The expected return over the period, depending on the model chosen, is between 47% and 63% on the funds invested.

# 1. STUDY OF THE CURRENT SITUATION AND PLANNING

The widespread adoption of new technologies by energy consumers creates attractive opportunities, but these also come with the need to solve a number of site-specific applicability analysis tasks.

For decentralised electricity generation, photovoltaic installations are the most widespread due to their affordability. They can be supplied as individual elements or as a finished product for installation. Recently, proposals for combining PV installations with storage batteries for better utilisation of the produced electricity are also gaining ground.

It should be stressed that in order to achieve higher efficiency of decentralised energy production and consumption solutions, it is necessary to apply energy management software solutions, which are available on the market.

In connection with the task for the analysis of the possible models for the realization of a project for the deployment of a photovoltaic installation on the roof of the building of 140$^{th}$ Secondary School "Ivan Bogorov", the following sequence of steps was applied:

- Collecting data on electricity consumption in the building;
- Site visit and discussion on the availability of different end users;
- Based on the data obtained, a joint hourly load profile and PV power generation profile was prepared for use in the variant analyses;
- A financial model has been compiled including hourly prices on the Bulgarian Independent Electricity Exchange, Day Ahead platform, for the last 12 months.

On the basis of the prepared model, simulations were performed for the following variants:

- Sofia Municipality's stand-alone investment in photovoltaic installation and load utilisation options;
- Leveraged finance model.

To prepare the framework for the analysis, the project team consulted preliminary data provided by Sofia Municipality and a wide range of issues were discussed, including:

- the extent to which there is a change in the load profile for the building;
- the current approach to heating the building from the district heating system, but also involving air conditioning;
- swimming pool use (continuous or seasonal);
- whether there is another municipal site in the vicinity (and at what distance).

The following difficulties were identified for the specification of the estimates - the lack of an up-to-date energy audit of the building, which does not allow to estimate the contribution of the swimming pool as balancing volume, and the availability of hourly load data according to the Standardized Product Profile.

The roofs of the building's constituent units were found to be suitable for the placing of a PV installation, were not shaded and had an appropriate orientation. The roofs are flat, cold with varying air space and relatively new waterproofing.

The main data used in this model is the monthly consumption data in the building for the period 2014 - 2021. In view of the specificity of the task, a comparison is made with real consumption data from another site with a similar product profile.

The nearby kindergarten No. 82 "Gianni Rodari", which is a suitable site for connection to a common installation, was also visited. Although there are also suitable roofs, the option of locating a PV installation on the roof of the kindergarten was not considered due to its orientation and the lack of need to increase generation capacity at this stage.

As a result of the overall data and site review, in addition to additional energy efficiency measures (replacement of windows), soft measures such as the introduction of hourly metering and energy monitoring may also be recommended.

If a decision is made to implement any of the PV installation options, it will be necessary to appoint or train an energy efficiency officer to be directly responsible for monitoring of the performance.

For the purposes of this analysis and for model building, hourly data were used to build a PV generation profile and price parameters. Data from another site in Bulgaria were used and adapted to the solar radiation profile for the Sofia location using data from the European Commission's PVGIS-5 JRC[1]. The price parameters are based on prices achieved on the Day Ahead platform.

[1] https://re.jrc.ec.europa.eu/pvg_tools/en/

# 2. FORECAST LOAD PROFILE AND ENERGY BALANCE

For the purpose of the analysis and based on the assessment of the possibilities for deployment of photovoltaic panels on the roof of the building of 140th Secondary School in Sofia, a maximum capacity of the photovoltaic installation of 200 kWp was determined.

For the purposes of discussing the various options, the effects of the combination with the consumption load of the adjacent 82nd Kindergarten are analyzed below.

The results of the energy balance calculations combining the consumption load and PV generation are presented in Table 1.

**Table 1. Energy balance calculations and impact analysis**

| Month | RES Production (200 kWp) | School, base SLP, kWh | | | School, administration | | | School+Kinderg. adm. base, kWh | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Purchased energy from grid | Produced energy for sell | Saved energy from own production | Purchased energy from grid | Produced energy for sell | Saved energy from own production | Purchased energy from grid | Produced energy for sell | Saved energy from own production |
| January | 10 996 | 4 621 | 8 923 | 2 073 | 4 271 | 8 565 | 2 432 | 7 824 | 7 381 | 3 615 |
| February | 16 514 | 3 082 | 14 230 | 2 284 | 2 395 | 13 422 | 3 091 | 4 612 | 11 631 | 4 883 |
| March | 20 640 | 2 613 | 18 442 | 2 198 | 1 819 | 17 548 | 3 091 | 3 293 | 15 980 | 4 660 |
| April | 26 216 | 2 518 | 23 527 | 2 688 | 1 736 | 22 736 | 3 479 | 2 911 | 21 176 | 5 039 |
| May | 31 265 | 1 650 | 29 056 | 2 209 | 981 | 28 335 | 2 930 | 1 818 | 26 361 | 4 903 |
| June | 26 279 | 1 634 | 23 938 | 2 341 | 779 | 23 109 | 3 170 | 1 616 | 20 569 | 5 711 |
| July | 32 946 | 1 350 | 30 850 | 2 097 | 687 | 30 190 | 2 756 | 1 389 | 27 800 | 5 147 |
| August | 31 812 | 1 373 | 30 019 | 1 794 | 668 | 29 314 | 2 498 | 1 110 | 27 831 | 3 981 |
| September | 24 157 | 3 198 | 20 874 | 3 283 | 1 906 | 19 648 | 4 509 | 3 153 | 17 310 | 6 847 |
| October | 13 489 | 7 161 | 9 373 | 4 116 | 5 914 | 8 125 | 5 364 | 9 227 | 6 757 | 6 732 |
| November | 10 935 | 7 665 | 7 478 | 3 457 | 6 539 | 6 289 | 4 646 | 10 135 | 5 091 | 5 845 |
| December | 4 380 | 10 407 | 1 828 | 2 552 | 10 586 | 2 023 | 2 357 | 13 211 | 1 792 | 2 588 |
| **Total** | 249 629 | 47 272 | 218 538 | 31 092 | 38 282 | 209 306 | 40 323 | 60 299 | 189 678 | 59 951 |
| | | | | | | | | | | |
| **Analysis of effects** | | | | | | | | | | |
| **Saved energy from grid** | | | | 40% | | | 51% | | | 50% |
| **Efficiency of the PV for own needs** | | | | 12% | | | 16% | | | 24% |

Source: own model

Table 1 reflects the following specific features:

- analysis using the currently applied Standardized Load Profile (SLP) from the network company (Food_ Agriculture)[2];
- analysis using an adapted profile from an administrative building to the monthly loads of 140th Secondary School;
- analysis with the added load of 82nd Kindergarten.

[2] The reason for using this SLP could not be clarified; however, it is clear that is much different from the actual load profile.

At present, for customers connected at low voltage, the traders on the free market offer pricing of the supplied electricity on the basis of the SLP. These profiles are approved by the state Energy and Water Regulation Commission and are intended to facilitate the aggregation of a large number of profiles and the forecasting of the end-use consumption profile. The SLP is developed for one year and forms a chart that shows the indicative consumption pattern of a site for each hour of the day of the year.

In summary of the analysis of the effects of using different technological solutions, the following conclusions are drawn:

- the deployment of a photovoltaic installation with a capacity of 200 kWp, which is significantly higher than the maximum hourly consumption in the building (60 kW), leads to:
    - the possibility to reduce the power drawn from the grid by about 50%;
    - The efficiency of PV for own use is determined by the coincidence time between consumption in the building and production from RES and in this case reaches about 15%;
    - when connected to the 82nd Kindergarten for an additional load, the efficiency of the PV for own needs reaches 24%.

Deploying a rooftop PV system with a larger capacity relative to the building's maximum loads results in a significant reduction in electricity drawn from the grid, but the efficiency of the PV system is significantly lower. This is a prerequisite to analyse the efficiency of sales of the generated electricity in the next section.

It was reported that the SLP used does not reflect the actual hourly loads at a site and gives a distorted view when attempting to combine with the operation of a PV installation on an hourly basis, and this results in:

- Increasing estimates of electricity drawn from the grid;
- Underestimates the efficiency of PV for own needs.

Because of the latter, it is recommended to apply an adapted load profile for an administrative building for financial modelling purposes.

Figures 1 and 2 illustrate the different profiles obtained using the SLP and for an administrative building, in combination with a production load of a winter and summer mode PV installation.

It can be seen that the applied SLP, due to high weekend and night-time loads, distorts the model significantly.

**Figure 1. Illustrative sample of a PV operation, relative to the winter load profile of the building**

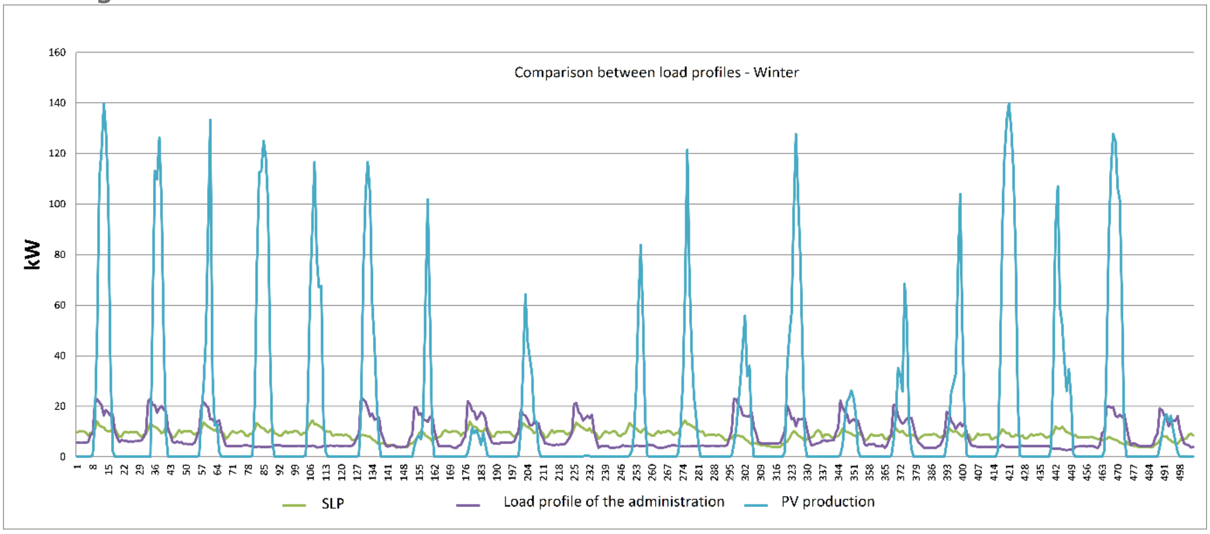
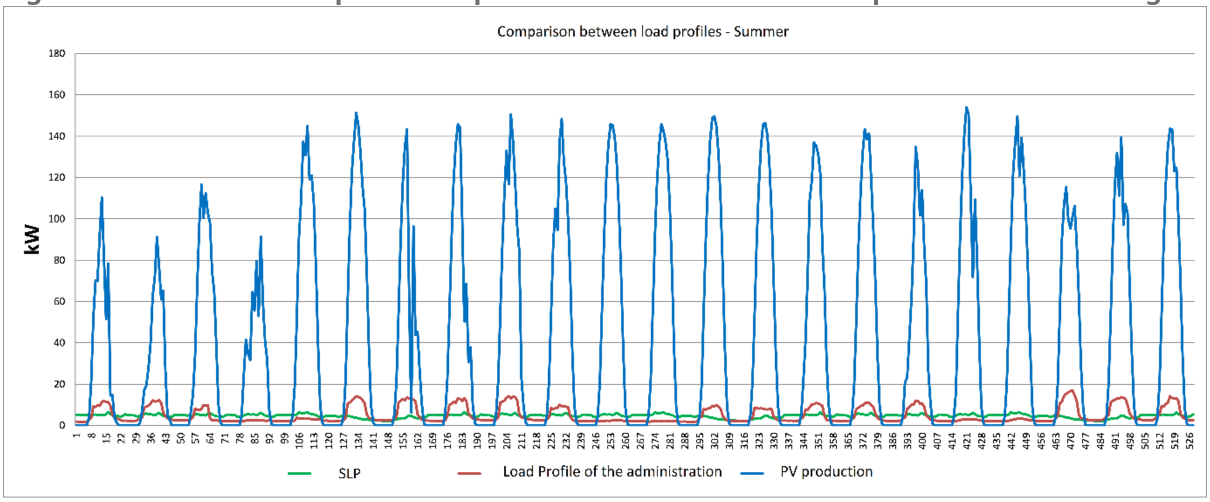



**Figure 2. Illustrative sample of PV operation versus summer load profile of the building**




Source: own model

# 3. DEVELOPING SCENARIOS FOR RENEWABLE ENERGY UTILIZATION IN A DECENTRALIZED SYSTEM

Meeting the needs of end users for electricity generated from renewable energy sources will increasingly be based on decentralised solutions. In this context, the following three categories of renewable electricity producers are now clearly emerging:

- those that build generating capacity in order to sell electricity from renewable energy on the market (utility installations),
- those that use the energy produced from renewable energy only for their own consumption, without selling it (a subset of this category are consumers who use only their own sources or "off-grid"),
- those whose aim is both to satisfy their own consumption and to sell the surplus energy produced (Prosumers).

These three categories differ in terms of the process of connection to the grid, their possible role as users of the grid, and their status as commercial participants in the electricity market. For example, for sites with self-consumption installations that operate in parallel with the grid and are not 'off grid', it is necessary to determine an optimal connection scheme and to investigate the supply voltage values of existing consumers, which is best done using specialised software.

In Bulgaria, combining consumers into a common group for electricity production and consumption is still an exception.

For the moment, the following examples can be offered:

- for pooling users to cover common costs - such as condominiums or users with space in commercial buildings like large shopping centres;
- pooling of consumers who have a common energy installation - such are available in condominiums, where the energy produced is sold and the amounts received are used to cover the common costs;
- pooling of a RES producer and a remote consumer through the grid - these are examples of targeted RES contracts.

Taking into account the general trends, the two main scenarios for the realization of an investment plan for the deployment of a photovoltaic installation on the roof of the building of 140$^{th}$ Secondary School can be defined as:

- realization of own investment initiative with funds of Sofia Municipality, and
- implementation of a joint investment initiative between Sofia Municipality and small private investors.

It should be pointed out that Sofia Municipality has a programme to promote the use of energy from renewable energy sources and biofuels, and in particular a targeted measure to explore opportunities for attracting investment through public-private partnerships with the application of innovative organisational and financial schemes, such as energy cooperatives.

Therefore, an investment analysis for the second scenario has been prepared by developing a financial model that takes into account current prices for network and system services as well as prices for the supply of active electricity.

In order to clarify the general approach, it should be noted that for the purposes of the statistical coverage of price factors in final prices for consumers on the European market, the European Commission uses three main groups:

- Taxes and levies;
- Networks;
- Energy.

This approach is also used in this analysis under the following specific assumptions:

- the group "Taxes and levies" includes the general burdens, such as VAT and excise duty, but it is possible that an additional burden will arise, formed as a "Liability to society", as it was until 2021 in our country;
- The Networks group includes prices for the transmission of electricity through the electricity transmission and distribution network and access prices for non-household customers. The prices set in Decision No C-19 of 01.07.2022 were taken as the basis for the analysis. These prices are expected to increase;
- The Energy group includes market-determined prices for active electricity, which are most commonly associated with hourly prices on the Day-Ahead Market Platform, as well as the trading service, which includes load profile administration and supply balancing.

The assumed level for the commercial service price of BGN 25 per MWh is based on data from market supply in 2022, and an own forecast has been prepared for market prices for active electricity.

Typically, price level forecasts for energy supply and services are based on an analysis of historical data for 2 or more years. In the electricity market, the last 3 years have been marked by the strong influence of non-systemic factors, such as:

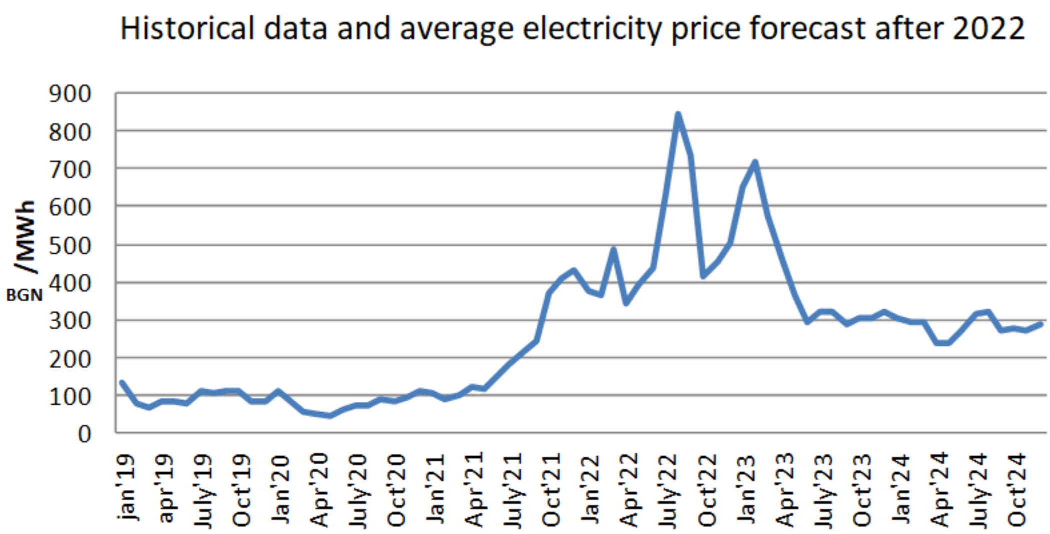
- Accelerated carbon price growth in 2019;
- Strong decline during the 2020 COVID pandemic and strong growth during the 2021 economic recovery;
- Overlay of gas supply crisis and war in Ukraine in 2022.

These factors make estimates of expected prices over the next 10 years conditional, but the expectation is that they will decline in 2023-2024 relative to current prices, but remain at higher levels than those achieved in 2019, taking into account:

- Continued dependence on gas supplies until at least 2030, and
- The need for high prices to maintain the interest of private investors to carry out the necessary renewable energy projects that underpin the energy transition.

As a result of the above, an own expert forecast is prepared, presented in Figure 3, which assumes an average annual wholesale electricity price of 140 € per MWh.

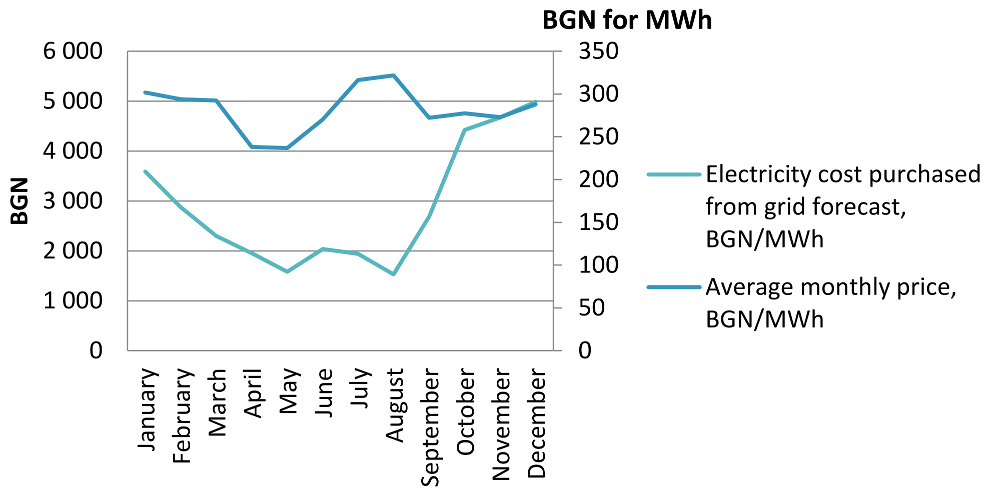
**Figure 3. Basis for determining the forecast electricity price**




Source: historical data from IBEX and own model

In addition to forecasting an average annual electricity price, the forecast model was also used to produce a forecast hourly price profile that follows the market price profile in 2019. The result is presented in Figure 4.

**Figure 4. Forecast profile for monthly wholesale prices and forecast costs when purchased from the grid**




Source: own model

It can be seen that in order to determine the baseline parameters for the construction of a forecast financial model and to discuss alternative investment options, a number of assumptions have to be made that are related to possible changes in different directions. In addition, their impacts differ depending on the capacity in which the investor is considered - producer, seller or consumer of own production. Table 2 provides a qualitative assessment of the impact of possible changes in baseline parameters on the business model of the Municipality as a consumer and the Municipality as a seller of electricity in the market. An assessment under the status quo without renewable energy investments is also included.

**Table 2. Analysis of the impacts of the underlying financial assumptions**

| Admission | Current state, without RES | Use of RES for own needs | Sale of electricity from RES |
|---|---|---|---|
| Imposing of surcharges | Increases costs | Increases savings from own needs | Does not affect sales revenue |
| Increased cost of network services | Increases costs | Increases savings from own needs | Does not affect sales revenue |
| Increase in commercial services | Increases costs | Increases savings from own needs | Reduces sales revenue |
| Increase in the wholesale price of electricity | Increases costs | Increases savings from own needs | Increases sales revenue |
| Wholesale electricity price reduction | Reduces costs | Reduces savings from own needs | Reduces sales revenue |
| Higher investments in renewable energy than planned | No relation | Reduces savings from own needs | Reduces sales revenue |
| Improved optimization in load management | Reduces costs | Increases savings from own needs | Increases sales revenue |
| The emergence of many identical RES capacities | Reduces costs | Reduces savings from own needs | Reduces sales revenue |

Source: own analysis

Despite the conditionality of the qualitative analyses, the following conclusions can be drawn from the table:

- In the position of a fully market-dependent consumer, the Municipality has very limited possibilities to counter negative market trends;
- The Municipality's position as a consumer of renewable energy for its own needs poses the least risks, which should encourage efforts to acquire this type of installation;
- The risks of the Municipality's position as a consumer and especially as a seller should be considered and steps taken to mitigate their impact.

In relation to the latter, conservative estimates of investment and market price growth have been assumed in modelling the scenarios below. On the other hand, the earlier a project comes to fruition, the less the impact of the latter factor will be.

The resulting financial estimate of the Municipality's electricity costs, cost savings, and estimated annual revenues from sales of free electricity are shown in Table 3.

**Table 3. Simulation model results for the PV contribution**

| | | School | School+Kinderg. | School | | | School+Kinderg. | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | Average monthly price, BGN/MWh | Electricity cost purchased from grid forecast, BGN/MWh | Electricity cost purchased from grid forecast, BGN/MWh | Purchased from grid electricity after PV | Electricity for sell | Saved electricity (produced by own PV) - School | Purchased from grid electricity after PV | Electricity for sell | Saved electricity (produced by own PV) - School+Kinderg. |
| January | 302 | 2,101 | 3,586 | 1,295 | 2,874 | 806 | 2,390 | 2,484 | 1,196 |
| February | 294 | 1,662 | 2,876 | 730 | 3,845 | 932 | 1,419 | 3,319 | 1,457 |
| March | 292 | 1,421 | 2,301 | 565 | 4,535 | 856 | 1,024 | 4,113 | 1,277 |
| April | 238 | 1,281 | 1,953 | 437 | 4,672 | 844 | 732 | 4,296 | 1,221 |
| May | 237 | 918 | 1,579 | 246 | 6,103 | 672 | 456 | 5,653 | 1,123 |
| June | 270 | 1,098 | 2,038 | 223 | 5,951 | 876 | 458 | 5,247 | 1,580 |
| July | 316 | 1,024 | 1,943 | 238 | 8,165 | 785 | 481 | 7,489 | 1,462 |
| August | 322 | 950 | 1,528 | 226 | 8,481 | 725 | 374 | 8,052 | 1,154 |
| September | 272 | 1,721 | 2,682 | 521 | 5,191 | 1,200 | 862 | 4,571 | 1,820 |
| October | 278 | 3,126 | 4,423 | 1,689 | 2,043 | 1,437 | 2,621 | 1,678 | 1,802 |
| November | 273 | 3,268 | 4,669 | 1,850 | 1,953 | 1,418 | 2,887 | 1,590 | 1,781 |
| December | 288 | 4,085 | 4,986 | 3,341 | 489 | 744 | 4,178 | 424 | 808 |
| Total | | 22,655 | 34,564 | 11,361 | 54,303 | 11,294 | 17,882 | 48,915 | 16,681 |
| Net services costs, BGN/MWh | 93.08 | | | | | | | | |
| Market services costs, BGN/MW | 25 | | | | | | | | |
| Total energy costs/ income BGN/y | | | 31,937 | 15,881 | 49,070 | 48,763 | 25,002 | 44,173 | |
| Saved energy costs | | | | 16,055 | | | 23,760 | | |

Source: own analysis

For the preliminary profitability analysis for the two options considered – for 140th Secondary School load only and combined with 82nd Kindergarten added load, the following assumptions are made about the investment required, which are derived from a review of commercial proposals for similar capacity plants[3] :

- 200 kWp installation - 320 000 BGN, delivery and installation;
- Included upfront costs of BGN 20,000, for survey, design work, organisational costs and pre-equipment (hourly meter).

The investment in a PV installation includes panels, support frames, inverters, wiring, a panel with protections and a power meter.

As indicated, the own consumption-only PV scenario was excluded from consideration due to the possibility of deploying a large capacity PV installation, resulting in low efficiency for entirely own consumption operation, hence a longer payback period. The scenario of shared investment is therefore considered.

The following analysis describes the scenarios involving Sofia Municipality and other stakeholders for the implementation of a rooftop PV project, as well as the results of the financial assessments for each of them.

Possible options for "sharing" the building's rooftop PV plant include extending the range of users by connecting neighbouring sites using the possibility of a direct cable feed, or involving small investors in financing the project and then sharing the profits.

The practice of combining consumers into a common group for electricity production and consumption is already developing in the "after the meter" model, where the management of production and consumption in the group is carried out by intelligent systems. This is a variant of the Energy Cooperative, which manages the project independently, and for which it is necessary:

- Developing a financial-technological model of production and distributed consumption;
- Development of a project for the distribution of the generated electricity to each consumer in the cooperative, including the provision of metering facilities;
- Developing rules for the operation and control of energy flows.

After a review of the nearby municipal users of the building of 140$^{th}$ Secondary School, it was concluded that it is possible to join the building of 82$^{nd}$ Kindergarten. Due to the

[3] Example: https://pvsolars.net/product/50-kw-%d1%84%d0%be%d1%82%d0%be%d0%b2%d0%be%d0%bb%d1%82%d0%b0%d0%b8%d1%87%d0%bd%d0%b0-%d1%81%d0%be%d0%bb%d0%b0%d1%80%d0%bd%d0%b0-%d1%81%d0%b8%d1%81%d1%82%d0%b5%d0%bc%d0%b0-%d0%b7%d0%b0-%d0%b1%d0%b8/

high capacity of the PV installation and although the additional load has a similar profile to the base load, the overall efficiency in this case increases.

In the model for the participation of small investors in financing through a cooperative with cash contributions, the guiding principle is the existence of a commercial interest - investors in new renewable energy installations should be able to share the revenues generated by the production of electricity from these installations in accordance with the share of investments made.

In this model, the generated electricity is sold to the grid through a trader who is licensed under the Energy Act.

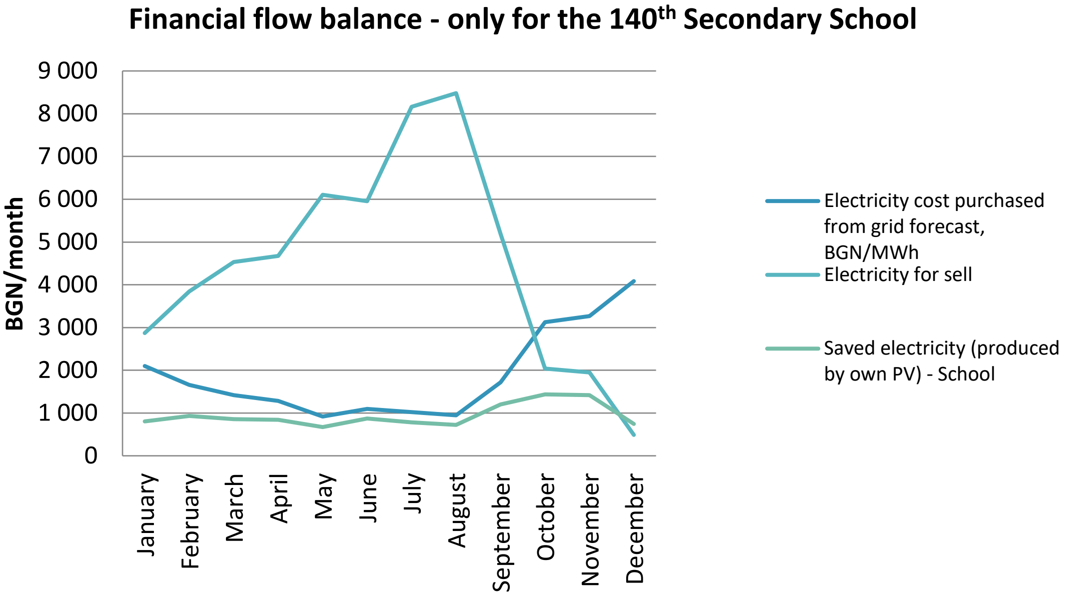
The essential component in this model is that Sofia Municipality is the initiating party, engaging in the overall organization of the investment process, the implementation of the project, raising capital and organizing the payment of principal and dividends.

The estimate of the investment payback period is made on a linear basis, without taking into account maintenance and control costs. For each PV capacity option there is a specific model for the participation of the investors involved, and a 10-year payback period for their investment is considered. In this period, investors receive annually 1/10 of the investment value, plus an annual dividend on the residual value of the investment:

- 200 kWp installation, supplying only 140th Secondary School: participation of the investors with 300 000 BGN and Municipality's self-participation with 20 000 BGN.
  - Investors receive annual principal and dividend payments over 10 years, totalling 14%;
  - The payback period for the Municipality's share is 1.2 years on account of cost savings and can be reduced below 1 year with active management of available loads and energy buffers;
  - During the investment recovery period, investors receive a total return of 63% on their investment.

The projected revenues profile on a monthly basis in this case are presented in Figure 5.

**Figure 5. Estimated financial flow profiles for own consumption only of 140th Secondary School**

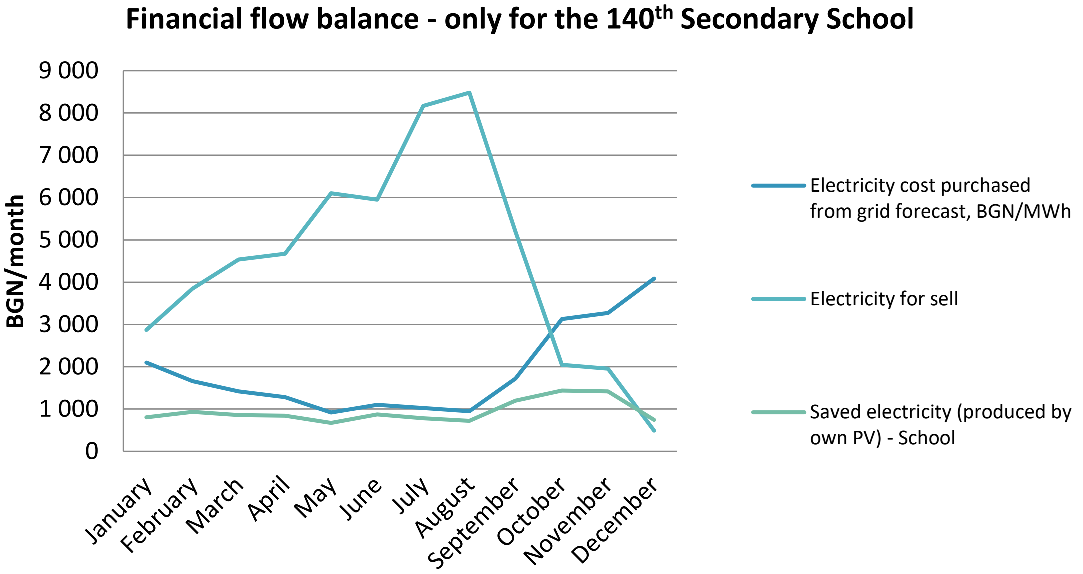



Source: own model

- 200 kWp plant, supplying 140th Secondary School and 82nd Kindergarten: participation of the investors with BGN 300 000 and self-participation of the Municipality with BGN 20 000.
  - Investors receive annual principal and dividend payments over 10 years, as the dividend totals 10%,
  - the payback period for the Municipality's share is 0.8 years on account of cost savings and can be further reduced with active management of available loads and energy buffers;
  - during the investment recovery period, investors receive a total return of 47% on their investment.

The projected profile of receipts on a monthly basis in this case is presented in Figure 6.

**Figure 6. Estimated financial flow profiles for own consumption of 140th Secondary School and 82nd Kindergarten**




Source: own model

Table 4 shows the annual investment recovery and dividend payments to small investors.

**Table 4. Investment recovery by year**

| Year | Investment 300 000 BGN, only 140th secondary school is supplied | | Investment 300 000 BGN, supplied Secondary school and Kindergarten | |
|---|---|---|---|---|
| | Principal, BGN | Dividend, BGN | Principal, BGN | Dividend, BGN |
| 1 | 30 000 | 19 070 | 30 000 | 14 173 |
| 2 | 30 000 | 19 070 | 30 000 | 14 173 |
| 3 | 30 000 | 19 070 | 30 000 | 14 173 |
| 4 | 30 000 | 19 070 | 30 000 | 14 173 |
| 5 | 30 000 | 19 070 | 30 000 | 14 173 |
| 6 | 30 000 | 19 070 | 30 000 | 14 173 |
| 7 | 30 000 | 19 070 | 30 000 | 14 173 |
| 8 | 30 000 | 19 070 | 30 000 | 14 173 |
| 9 | 30 000 | 19 070 | 30 000 | 14 173 |
| 10 | 30 000 | 19 070 | 30 000 | 14 173 |

Source: own analysis

It can be seen that participation of small individual investors is more attractive in the case of lower own-consumption load as higher sales provide higher dividend for investors.

The model is advantageous for the Municipality, as after the return of investment in less than a year, the reduced electricity bills will have an effect for at least 2 more decades.

The municipality can therefore make an additional commitment to investors to guarantee a minimum amount on an annual basis after the second year.

Finally, it should be noted again that the analysis is based on a conservative estimate of annual wholesale prices of 140 € per MWh. If current market prices are applied, the dividends to investors exceed 20% and the cost recovery period for the Municipality is within a few months.

# 4. STRUCTURING AN ENERGY COOPERATIVE WITH SMALL INVESTORS

Electricity supply development concepts have evolved in recent years and, in addition to a centralized generation-transmission-distribution-consumption system, various close-to-consumption generation options, or decentralized system concepts, are increasingly applied.

The availability of grid infrastructure and the still low share of renewables limit and hinder the application of decentralised system concepts, but they are becoming increasingly relevant in view of unpredictable free market prices, but also in view of low-emission economy policies that are accompanied by incentives.

The widespread development of decentralised system concepts is associated with the implementation of Energy Cooperative or Renewable Energy Community models, with European legislation already in place and national legislation under discussion.

A renewable energy community, according to an EU directive[4] , is a legal entity that owns and develops renewable energy projects, is based on open and voluntary participation, and is independently and effectively controlled by its members who are located in the vicinity of renewable energy projects owned and developed by that community.

The Renewable Energy Community does at least one of the following - generates, consumes, stores or sells electricity, heat and cooling energy from renewable sources and/or shares within that community renewable energy produced by community-owned projects, including through virtual net metering.

A "prosumer" can be defined as an end-user of electricity operating on its own premises or on other premises located within the same district who generates renewable electricity for its own consumption and who may store or sell the renewable electricity it generates. There may be co-operating prosumers – these should be at least two co-operating producer-consumers located in the same building or in a multi-family residential building.

It is the sale of electricity that involves serious regulatory issues that need to be further developed in national legislation to take into account the specificities of renewables and to account more fairly for the energy produced and consumed by energy communities and prosumers.

[4] EU Renewable Energy Directive 2018/2001 https://bit.ly/2FHtr6o

Three new concepts are now being worked with - the renewable energy community, the user of own renewable electricity (prosumer) and net (virtual) metering.

The establishment of commercial communities can also be implemented under the current legislation, as the specifics of RES generation and consumption should be further developed for specific cases with changes to the Energy from Renewable Sources Act and the Energy Act, including by refining the interaction with grid operators and the metering of commercial electricity generation.

A new aspect is net (virtual) metering, which is evolving in parallel with the development of smart grids and digitalisation in consumers.

Net metering is the ongoing reconciliation of electricity produced and consumed by a producer-consumer at the same renewable energy generation site, owned by the producer who is at the same time a consumer.

Virtual net metering is net metering where at least one of the sites where the energy is consumed is different from the site where the energy is produced.

In this way, consumers who do not have the necessary roof space for solar power generation, for example, may still be part of a renewable energy project that is implemented through an installation at another connection point. In this case, the energy produced can be offset against their consumption as if it had been produced at their site, but with the appropriate grid access charges.

Through virtual net metering, energy flows can be managed and surplus electricity can be used more efficiently, including at times and places other than generation.

In the Bulgarian legal framework the forms of association are fully permissible and used for the needs of Energy Communities, for example there are such under the Condominium Act, but the most common are tripartite contracts with the participation of a consumer, a producer (or investor) and a trader.

It should be recognised that there is still a lack of ready-to-use contractual models for cooperation. Due to the still nascent model of energy cooperation, the analyses within the research projects point out that at this stage, the leading role of a Cooperative Initiator around which the individual actors join, is crucial.

Often the Initiator is driven by broader goals than commercial gain and includes in its strategy support for new renewable energy projects, support for the application of innovative technologies, addressing social issues, etc. This is the reason why in most cases of cited energy cooperatives local municipalities play a leading role. In these cases, the specific role of municipalities covers:

- Funding or guarantees for new projects;

- Creating an enabling environment, including requiring investors to set targets for citizen participation in projects;
- Provision of information;
- Procurement of community-generated energy;
- Cooperative membership;
- Providing administrative assistance and other non-financial resources to citizens.

The main source of funding for Energy Cooperatives is the investments made by their founders.

# 5. CONCLUSIONS AND RECOMMENDATIONS

1) The implementation of stand-alone measures for the deployment of RES installations for own consumption has a limited effect and is linked to the sale of electricity through the grid. The efficiency of the investment depends on the possibilities to manage the load profile on-site. In this case a contract with a third party electricity trader is needed.
2) Scenarios operating in the form of an "Energy Cooperative" allow for the distribution of the financial risk, providing attractive returns for investors in comparison to current levels of bank deposit rates.
3) If steps are taken to implement such a project in conditions of still too high wholesale electricity prices, the profitability of the project will be significantly higher and the Municipality can offer better conditions to investors.
4) It is recommended that the Municipality offer a guaranteed level of dividend on the investment after the period of recovery of its deductible.
5) It is recommended that investors be given assurances that at higher market prices, their dividends will also be increased.
6) It is recommended that when planning an investment in renewable energy and attracting small investors, the municipality establishes its own unit to control and manage energy flows in the target buildings and to communicate with traders and investors.
7) It is recommended that the Municipality organize targeted measurements of solar radiation on its territory and form hourly production and load profiles based on real data.