PAYBACK AND ECONOMIC ASPECTS OF RESIDENTIAL SOLAR INVESTMENTS IN HUNGARY

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Abstract :
The regulatory changes of recent years have reshaped the conditions for the payback of residential solar investments in Hungary. This study aims to determine the extent to which the net billing system introduced in 2024 prolongs the payback period of household photovoltaic systems, and to present potential adaptation strategies to maintain the economic feasibility of these investments (eg, shifting consumption to peak solar production periods, installing home energy storage, or implementing smart control solutions). The research builds on the analysis of secondary data and a review of relevant literature, and includes a comparative scenario analysis under net metering versus net billing conditions (examining scenarios both with and without battery storage).

Keywords : residential solar systems ; payback period; net metering; net billing; renewable energy support

INTRODUCTION

In recent years, the number and installed capacity of household-sized solar systems in Hungary has increased dramatically. In 2022, the share of solar energy in the domestic gross electricity production was 13.2%, compared to an average of 7.4% in the European Union member states (Eurostat, 2024). According to 2024 data from the Hungarian Energy and Public Utilities Regulatory Office, by 2023, the total domestic solar capacity reached 5,649 MW, of which 2,329 MW belonged to small household power plants (HMKE) (MEKH, 2024). The most important question for residential investors is the return on investment: in how many years will the solar system return the invested amount through savings on the electricity bill, and what factors influence this payback period. This study examines this issue in detail, including recent developments in payback times, factors determining investment profitability, the role of additional investments to support the electric transition, the effects of net and gross settlement methods, the rationale for residential solar support programs, and an international outlook.

This paper it examines the key factors affecting solar payback – such as a household's electricity consumption profile, installation costs and available subsidies, site characteristics (orientation, shading, etc.), and the self-consumption ratio – and highlights which households benefit most from installing solar panels. Furthermore, the study discusses additional electrification investments that complement residential solar (including heat pumps, electric vehicles, and home battery systems) and explores their potential synergies. It compares the impacts of net metering versus net billing schemes on project profitability, analyzes the economic rationale behind government incentive programs for residential solar, and provides an international outlook on European solar energy trends. The conclusions indicate that despite regulatory challenges, residential solar investments in Hungary remain economically viable. In the new net billing environment, maximizing self-consumption and employing intelligent complementary technologies (such as battery storage and smart controls) are crucial for sustaining the profitability of solar investments. With appropriate adaptation measures, household PV systems will continue to deliver substantial long-term economic and environmental benefits, contributing to the broader adoption of renewable energy.

RETURN ON SOLAR INVESTMENTS IN HUNGARY

The payback period of household solar systems is the period during which the investment cost can be recovered from the savings achieved on the electricity bill. In Hungary, extremely favorable payback conditions were in force until 2022 due to the net settlement system. In this settlement form, the household could compare the amount of electricity fed into and taken from the grid on a net basis on an annual basis, so that the excess production in summer could fully offset the winter consumption. As an example, a household solar system with an output of approximately 5 kW in 2022, with an installation cost of approximately 2 million HUF and an annual production of 5–6 MWh, would pay back its price in approximately 8–10 years at the reduced electricity price (~36 HUF/kWh) (Szabó, 2023).

However, in the fall of 2022, a significant change occurred in the regulation: the government temporarily banned the grid feed-in of new solar systems, and then a decision was made to eliminate net settlement. Starting in 2024, newly commissioned PV systems can only operate on gross settlement. The essence of this is that the consumer must pay the full price for the electricity purchased from the grid, while the excess energy fed back into the grid is only charged at around HUF 5/kWh (MVM, 2024). As a result, the profitability of new systems has deteriorated drastically. According to expert estimates, the previously typical 8–10-year payback period for gross settlement systems may be extended to 15–20 years (Somogyiné, 2023). Households that installed their solar panels by the end of 2023 can still temporarily enjoy the benefits of the balance, but new entrants will have to calculate with a much longer payback period and will have to improve the economy of the system with additional investments (such as energy storage).

FOR WHOM AND UNDER WHAT CONDITIONS IS THE INVESTMENT WORTHY?

Although the return on investment in solar panels may vary from household to household, several technical and financial factors generally determine who is most likely to benefit from installing a solar panel system and under what conditions. The household's electricity consumption profile and current electricity bill are primarily important considerations. Families that pay high electricity bills – for example, use electric heating or operate many power-intensive appliances – can achieve greater savings with solar panels. The reason for this is that electricity consumption above the reduced average consumption is currently billed at market price (~70 HUF/kWh); thus, each kilowatt-hour of solar energy generated in this way results in a significant cost reduction. In contrast, in the case of a low-consumption, small-sized apartment – where the monthly electricity bill is already low – the investment pays off much more slowly. It is therefore essential that as much of the energy produced by the solar panel as possible is actually needed in the given household.

Investment costs and available subsidies also play a key role. Over the past decade, the specific installation cost of solar systems has decreased dramatically, which in itself has significantly improved return on investment indicators. While previously installing 1 kW of capacity meant an expense of up to millions, today a system can be implemented for a fraction of that. In addition, state and EU support programs further improve the economics of the investment. For example, the RRF-funded residential solar panel tender launched in 2021 provided many households with 100% support, so that they practically immediately paid for the investment; in addition, the 50% Home Renovation subsidy halved the costs for many families, shortening the payback time. In the absence of support, raising the initial cost can be a serious obstacle – especially for lower-income households. That is why there are targeted programs, such as preferential green loans or special tenders, that provide assistance to these families.

The location and method of installation also significantly affect the system's yield, and thus the return on investment. A roof surface with an optimal slope facing south, not shaded by trees or other buildings, ensures maximum energy production. Conversely, an unfavorable orientation or partial shading reduces the amount of electricity produced, so the savings that can be realized will be smaller. However, the individual characteristics of each building are critical. Certain modern solutions can reduce losses due to shading or unfavorable orientation. It is also important to consider the expected life of the system and plan in advance, for example, with the cost of periodic replacement of the inverter.

Under the conditions of gross billing valid from 2024, a key question has become what proportion of the solar energy produced can be used directly by the household at the time of production. Since there is only a very low fee for the surplus fed back into the grid, the investment pays off all the faster the larger part of the generated electricity can be used within the house, replacing the electricity purchased from the grid, which is payable at a price of 36–70 HUF/kWh. The proportion of self-consumption can be increased, for example, by consciously reallocating consumption over time (whenever possible, devices with higher electrical power – such as washing machines and electric cars – can be scheduled for sunny daytime hours), and by using energy storage devices – primarily household batteries. Anyone who consciously pays attention to the timing of consumption and optimizes energy use with smart home systems can significantly improve the economics of the solar panel investment.

ADDITIONAL INVESTMENT OPPORTUNITIES IN THE ELECTRIC TRANSITION

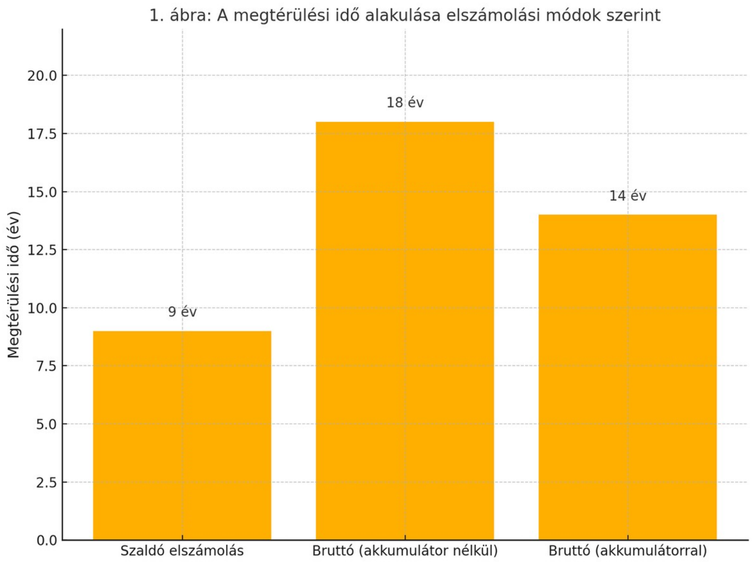
The benefits of a solar system can be further enhanced if the household also switches to electricity in other areas of energy use. Three key areas are worth mentioning, which are synergistically linked to the use of solar energy.

The household can further increase the benefits of the solar system by electrifying other consumption areas, for example by using a heat pump or using an electric vehicle. The heat pump works with electricity and replaces gas heating, so when combined with solar panels, a significant part of the heating energy can be produced in the household, which drastically reduces the heating bill. By charging the electric car at home, the extra energy produced during the day results in fuel savings. Every area electrified in this way increases the utilization of the solar system and improves the return on investment.

Thirdly, the use of household energy storage (battery) has become an almost indispensable supplement in terms of return on investment in the new billing environment. Its task is to store energy generated during peak hours during the day but not used immediately for later (in the evening or at night), so that the household has to take less from the grid. Installing the battery significantly increases the investment cost, but it drastically increases the self-consumption rate. According to expert calculations, a household battery with a capacity of approximately 5 kWh, connected to a 5 kW solar panel system, can reduce the payback period of the gross billing system from ~20 years for purely grid-generated electricity to approximately 13–15 years (Szabó, 2023). The lifespan of batteries is limited (approx. 10–15 years), so their replacement must be expected later, but at the same time, technological developments and the expected decrease in prices will improve the return on investment. In addition, a properly designed solar-battery system can supply essential consumers for a few hours even in the event of a power outage.

BALANCE VS. GROSS ACCOUNTING AND THEIR IMPACT ON RETURN

The difference between the gross settlement introduced in 2024 and the previous net settlement system fundamentally changes the return on solar investments. In the case of net settlement, the electricity network practically functions as a virtual battery: the excess energy fed into the network in summer is completely deducted from the amount taken in winter, so the household can replace 1 kWh of consumption with every 1 kWh of energy produced. In contrast, in the case of gross settlement, the service provider receives the fed-in energy at a price of only approximately 5 HUF/kWh (MVM, 2024), while the household has to pay a price that is approximately ten times higher for the electricity taken from the network – 36 HUF/kWh (up to average consumption) or even ~70 HUF/kWh (for above-average consumption). As a result, if the household does not use the energy for its own purposes, the savings potential is almost lost. Quantified: the payback period for a typical household system was approximately 7–10 years, while in the case of gross settlement (without a battery) it was 15–20 years; by installing a battery with a capacity of ~5 kWh, the payback period can be reduced to approximately 13–15 years (Szabó, 2023; Somogyiné, 2023).



1Evolution of the payback period according to accounting methods
Source: *own editing*

The estimated payback period of an average (~5 kW) household solar system is shown in three different cases: with net settlement, with gross settlement without a battery, and with gross settlement with the installation of a household battery with a capacity of ~5 kWh. It is clear that the gross settlement, which will be mandatory from 2024, will extend the payback period from the previous ~8–10 years (net settlement) to ~15–20 years, if the customer does not use some self-consumption increasing technique. This almost doubles the time required for the return on investment, which causes a significant decline in the attractiveness of the investment. The third column of the graph shows that by integrating a household energy storage of approximately 5 kWh, the payback period can be reduced to ~13–15 years in gross settlement. The battery therefore mitigates the adverse impact of the gross system by ensuring that the household uses a larger part of the energy produced itself, so less needs to be fed back into the grid at a price of HUF 5/kWh. As a result, more kWh of solar energy is taken from the grid (the price of which is currently HUF 36–70/kWh, depending on the level of average consumption), which improves the annual savings of the investment and thus shortens the payback period compared to the gross mode of purely feeding into the grid. At the same time, the battery represents a significant additional cost, and even with this technology, the payback period is longer (by around 5 years) than in the previous net system. Overall, the comparison shows that the introduction of gross billing has drastically worsened the financial return on new residential solar investments: in the absence of appropriate interventions (e.g. storage, consumption shifting), investors can only realize the return on their investment over a much longer period than before. This change explains why the pace of new installations dropped significantly in 2023: with gross settlement, the return on solar investment is much less attractive for new entrants unless they improve their self-consumption rate with additional investments (for example, by installing batteries).

Due to the above differences, the introduction of the gross system in 2023 significantly reduced the willingness of new residential installations, as the significantly extended payback period deterred many interested parties. However, the regulatory intention is still to ensure that solar investments remain attractive - only in a more efficient way than before and in a way that places less strain on the network. To this end, some supporting measures are expected to come into effect: for example, state support for household energy storage systems is planned, as well as the introduction of the institution of energy communities. The latter would allow prosumers (producer-consumers) to utilize the excess energy they produce at a community level or even sell it at market price. The implementation of such new mechanisms could also improve the payback prospects of gross settlement systems. In the current transitional period, the focus is increasingly on maximizing household use and applying complementary technologies (batteries, smart controls, etc.) to ensure that solar investments remain economically viable in the new billing environment.

ECONOMIC REASONS FOR SUPPORT SYSTEMS FROM A STATE AND UNION PERSPECTIVE

In recent years, numerous domestic and EU support programs have supported residential solar investments (such as the 100% subsidized, RRF-financed solar application, the Home Renovation Program, or green loan structures with preferential interest rates). The question arises as to why it is worthwhile for the state or the European Union to provide such subsidies. There are reasons at several levels that explain this.

The first obvious reason is to achieve climate and energy security goals. Encouraging the spread of solar energy is essential to meet climate protection commitments and reduce energy dependence. Every new solar system contributes to reducing carbon dioxide emissions by replacing electricity production from fossil sources. In addition, expanding our own electricity production increases security of supply: it reduces import dependence and exposure to external (e.g. Russian) energy carriers. The 2022 energy crisis also showed that the development of domestic renewable capacities is a strategic interest. This is also why the European Union finances the green programs of the member states, since the achievement of common climate goals and the stability of the single energy market are in everyone's common interest.

Another consideration is budgetary and economic stimulus. Although at first glance subsidies represent an expense for the state budget, in the long run they may even pay off at the macroeconomic level. On the one hand, they reduce the cost of reducing utility bills: if households produce part of their own energy, less state compensation is needed to keep residential energy prices artificially low. On the other hand, subsidies stimulate the economy: the installation of solar panels creates jobs for domestic businesses and can trigger the development of new industries (such as energy efficiency services). The expansion of the solar energy sector creates jobs and generates tax revenues. Moreover, a well-designed subsidy program is less of a burden on the budget in the long run than a continuous subsidy for utility bills: a one-time investment subsidy results in significant savings in the long run.

Thirdly, social impacts also play a role. Through subsidies, the state and the EU also try to ensure that access to the use of renewable energy is widely ensured, and not just the privilege of the wealthier classes. For example, the 100% solar panel application applied an income limit, guaranteeing that primarily low- and middle-income households can benefit from the subsidy – those who would have difficulty financing the investment on their own. In this way, the subsidy policy also serves social justice and contributes to the reduction of energy poverty: the bills of needy families are permanently reduced by solar panels. In addition, these programs cannot be neglected in terms of shaping public attitudes: many applicants have implemented further energy modernizations in their homes as a condition of the subsidy and have become more informed about energy matters, which in the long term contributes to the development of a more energy-conscious society.

INTERNATIONAL OUTLOOK: THE ROLE OF SOLAR ENERGY IN EUROPE

The European Union is also witnessing a surge in solar energy. In 2022, solar energy accounted for 7.4% of electricity generation in the EU on average (Eurostat, 2024), but some Member States are well ahead of this. In 2023, around 50 GW of new solar capacity was installed in the EU (~40% annual growth), and many countries have set ambitious targets for the coming years. Policy support is also in place (e.g. the 2022 REPowerEU plan with fast-track permits and mandatory solar installations).

Hungary is also keeping pace: domestic solar capacity has grown rapidly, so that in 2023 the sun provided more than 10% of electricity production, which is above the EU average. Meanwhile, in several member states, the previous balance settlement is gradually being replaced by market-based net-billing settlement: this may slow down residential installations in the short term, but in the long term it will ensure more sustainable integration of the electricity grid. In 2023, almost 45% of the EU's electricity production came from clean sources, and the share of fossil fuels fell to a historic low. In Europe, solar energy has become a key pillar of the green transition, and our country is also part of this process. International examples show that with appropriate political support and innovative solutions, solar energy can carve out an even larger slice of the energy production mix in the future.

CONCLUSION

The economic outlook for residential solar investments has remained fundamentally positive despite the regulatory changes of recent years, although the conditions have changed significantly. The elimination of net accounting has extended the payback period for investments, but with appropriate adaptations – for example, by increasing self-consumption, installing a household battery or using smart control systems – solar panels can still prove to be a profitable investment. Support programs and discounts have already contributed greatly to making this technology widely available to households and will continue to be key in maintaining the willingness to install in the future. Moreover, the use of solar energy not only brings environmental benefits (by reducing greenhouse gas emissions), but also, over time, relieves the burden on the family budget and reduces the country's energy dependence.

The development of the domestic residential solar sector is in line with European trends: first there was dynamic growth, then regulatory adjustments in the interests of sustainability. Meanwhile, technology is developing rapidly, prices are falling, and more and more integrated solutions (such as energy storage, smart grid solutions) are helping to efficiently use renewable energy. If the regulatory environment remains stable and supportive, residential solar energy investments will remain economically attractive in the future. In summary, under the right conditions, solar systems are profitable and long-term investments for households and the national economy.

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