Low Carbon Ukraine

Policy advice on low-carbon policies for Ukraine

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

Policy Evaluation [PE/01/2023]

Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine" n° 9011-d:

Assessing the economics of prosumer provisions for residential rooftop PV

Rouven Stubbe
Dinara Saparova
Pavel Bilek
Robert Kirchner

Berlin/Kyiv, 2023

Implemented by

Berlin Economics

About Low Carbon Ukraine

Low Carbon Ukraine is a project that continuously supports the Ukrainian government with demand-driven analyses and policy proposals to promote the transition towards a low-carbon economy.

This project is part of the International Climate Initiative (IKI) and is funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK) on the basis of a decision adopted by the German Bundestag.

Low Carbon Ukraine
c/o BE Berlin Economics GmbH
Schillerstr. 59
D-10627 Berlin
Tel: +49 30 / 20 61 34 64 0
Fax: +49 30 / 20 61 34 64 9
info@berlin-economics.com
www.lowcarbonukraine.com

Date of submission: 1 August 2023

Executive summary

- Energy security is a top priority for Ukraine due to the Russian invasion, leading to the need for a transition to a decentralised and resilient energy system. In this context, the government is implementing **regulations to promote and compensate the sale of decentralised renewable electricity generated by consumers,** known as prosumers.
- Prosumer support schemes can be categorised into standard supply arrangements, net metering, and net billing. Ukraine currently has a feed-in tariff known as the 'Green Tariff' and has introduced net billing as an alternative.
- The **Law of Ukraine "On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine" (n°9011-d registered on 28.04.2023)** was adopted on 10 July 2023. It offers **two compensation options for prosumers: a feed-in tariff and net billing** based on hourly wholesale market prices.
- A cost analysis for a 5-kW rooftop solar PV installation in Kyiv shows that the **feed-in tariff** provides **a payback period of 7-8 years**. **The net billing scheme** has a **longer expected payback period of 15-16 years,** despite the addition of a net pay-out option.
- To promote prosumer investments, the **subsidy on household electricity tariffs** should be **phased out** through retail tariff reform. **Vulnerable consumers** should be **supported** through a **consumption-independent scheme,** such as a strengthened **housing and utility subsidy**.
- Alternatively, **extending the 'Green Tariff'** to **cover self-consumption** and combining it with a **time-dependent feed-in tariff** could incentivise self-consumption without inflating total prosumer revenues.
- **High capital costs** are a barrier to renewable energy investments, and **concessional loan schemes for prosumers** could help address this challenge.

1 Introduction

Energy security has been at the top of the political agenda in Ukraine since the unprovoked Russian invasion in February 2022. The ongoing Russian attacks on Ukraine's civilian energy infrastructure painfully underline the benefits of a gradual transition to a **more decentralised and resilient energy system**.

This transition has been highlighted by President Volodymyr Zelenskiy and Prime Minister Denys Shmygal as a key pillar to both reduce the vulnerability to attacks in the short and medium term, as well as to build a modern and green energy system in the medium to long run.[1] Notably, this intention matches well with Ukraine's overall future accession and integration path into the European Union.

Decentralised renewable electricity generation by consumers such as households, firms, schools, or hospitals could be a key steppingstone towards a more decentralised, resilient and future-oriented Ukrainian energy system.[2] As consumers turn into producers of electricity, partially covering their own needs and partially selling electricity back to the grid, this arrangement has frequently been termed **'prosumer'**. Throughout the last decades, policies supporting prosumers have been designed across the world, in particular for **rooftop solar PV**.

In this context, the policy evaluation **assesses the costs, revenues, and payback periods** for a 5-kW rooftop solar PV installation built in 2023 for two model households in Kyiv under adopted prosumer compensation schemes: **feed-in-tariff and net billing**. The evaluation is structured as follows: Chapter 2 provides an overview of production-based support schemes for prosumers and background information on legislative developments in Ukraine regarding prosumer support. Chapter 3 presents the main assumptions for rooftop solar PV. Chapter 4 discusses the results under feed-in tariff and net billing and implications for the prosumers. In conclusion, the evaluation highlights the key considerations for prosumer support and renewable energy investments in Ukraine.

2 Background

In general, production-based support schemes for prosumers fall into three broad categories:

1. **standard supply arrangements** (such as guaranteed feed-in tariffs)
2. **net metering**
3. **net billing**

[1] https://www.president.gov.ua/en/news/vistup-prezidenta-zi-shorichnim-poslannyam-do-verhovnoyi-rad-80113; https://www.kmu.gov.ua/en/news/pobudova-detsentralizovanoi-enerhosystemy-zrobyt-ii-mensh-vrazlyvoiu-do-vorozhykh-atak-premier-ministr

[2] See for example Low Carbon Ukraine (2023). https://www.lowcarbonukraine.com/wp-content/uploads/Keeping-the-lights-on-in-times-of-grid-outages.-Solar-PV-panels-battery-storage-systems-and-diesel-generators.pdf

In Ukraine, a **feed-in tariff** supporting renewable electricity producers (known as the 'Green Tariff') has been in place since 2009. The current support level for residential rooftop solar PV installations is set at **15.98 EUR-ct/kWh**.[3]

While classic feed-in tariffs are paid out independently from bills for electricity consumption, usually by a separate entity, under net metering and net billing schemes, a **net invoice for electricity production and consumption** is issued by the electricity supplier.

> *Under the **net metering** scheme, a net **difference of the withdrawn and injected energy is invoiced by the supplier**, and any remaining surplus of the injected energy during the billing period is **credited in kWh for the next billing period**. As a result, total excess energy is **valued at the retail electricity price**.*[4]
>
> *Under the **net billing scheme**, the invoice issued by the supplier is based on the value of the withdrawn energy decreased by the **value of injected energy**. In this case, any remaining surplus of the injected energy during the billing period is **credited in monetary units** for the next billing period.*[5]

Different approaches exist to value excess energy fed into the grid. Besides fixed feed-in tariffs, other approaches include time-varying compensation either based on predetermined dynamic tariffs or based on hourly wholesale spot market prices.[6]

In Ukraine, the discussions on these approaches started in February 2023, and the Ministry of Energy and members of the Verkhovna Rada have registered three draft laws n° 9011, 9011-1, and 9011-2 to reform the support for prosumers by adjusting feed-in-tariff levels and adding a net billing option as an alternative to the fixed feed-in-tariff. The hearings for these drafts were conducted in May 2023 and all draft laws were declined.

In May 2023, the Verkhovna Rada of Ukraine adopted in the first reading of another draft law, n° 9011-d: "On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine." As was noted by Andriy Gerus, the Chairman of the Committee of the Verkhovna Rada of Ukraine on Energy and Housing, this draft version is a revised committee version of the above drafts related to prosumers. The draft law n° 9011-d, in contrast to the other mentioned draft laws, proposes a comprehensive reform of policies that incentivise renewable energy. In addition to net billing, it regulates various policy aspects, including guarantees of origin, aggregator activities, and feed-in premiums. This draft was finally adopted and published on 10 July 2023.

[3] https://www.nerc.gov.ua/acts/pro-vstanovlennya-zelenih-tarifiv-na-elektrichnu-energiyu-viroblenu-generuyuchimi-ustanovkami-privatnih-domogospodarstv-5

[4] Energy Community (2018). https://www.energy-community.org/dam/jcr:5e6fd995-f753-4fe2-b180-95df8a1bf19d/PG_01_2018_ECS_RE_grid.pdf

[5] Energy Community (2018). https://www.energy-community.org/dam/jcr:5e6fd995-f753-4fe2-b180-95df8a1bf19d/PG_01_2018_ECS_RE_grid.pdf

[6] Please note that such time-dependent compensation schemes require advanced metering equipment.

3 Assessing effects for rooftop PV: main assumptions

The adopted law n°9011-d offers two compensation options for prosumers:

> **1) Feed-in-tariff in** which the 'green tariff' coefficients are reduced from 2024 by 10% compared to 2023. Subsequently, there will be two further reductions of 10% in 2025 and 2026. After 2026, the coefficient is fixed until the end of 2029.
> **2) Net billing,** based on the hourly wholesale 'day-ahead' market (DAM) prices with a provision allowing for the net pay-out for the monetary value exceeding the electricity bill amount.

We calculate **costs, revenues, and payback periods** for a **5-kW rooftop solar PV** installation built **in 2023** for **two model households** in Kyiv with a south-facing roof. The first household represents a household with average Ukrainian electricity consumption (2,120 kWh per year); the second represents a wealthier household with higher-than-average electricity consumption (6,000 kWh per year). The residential retail electricity price is set at a subsidised price of 6.56 EUR-ct/kWh (264 kop/kWh) as of 1 June 2023.

Hourly solar radiation for Kyiv is derived with Atlite[7] and based on Copernicus climate data.[8] Hourly household electricity demand is based on the quarter-hourly standard load profile for a German representative household from VDEW[9] and adjusted to match Ukrainian holidays and annual demand. CAPEX for the rooftop solar PV installation is based on market research and expert assessment and assumed at 1,000 EUR/kW_p. **Total CAPEX** for the 5-kW rooftop solar installation amounts to about **EUR 5,000**. Annual electricity generation equals **6,173 kWh** with a utilisation rate of 14%.

[7] Hofmann, F., Hampp, J., Neumann, F., Brown, T., & Hörsch, J. (2021). Atlite: a lightweight Python package for calculating renewable power potentials and time series. *Journal of Open Source Software*, *6*(62), 3294.

[8] Hersbach, H. et al. (2018). ERA5 hourly data on single levels from 1959 to present. *Copernicus climate change service (c3s) climate data store (cds)*, *10*(10.24381).

[9] Fünfgeld, C., & Tiedemann, R. (2000). *Anwendung der repräsentativen VDEW-Lastprofile: step-by-step*. VDEW.

4 Discussion of results and implications

4.1 Results: Revenues, savings and payback periods

Out of the electricity produced, the average household self-consumes 1,043 kWh and feeds 5,130 kWh into the grid. The wealthier household with higher electricity consumption self-consumes 2,550 kWh and feeds-in 3,624 kWh to the grid, which affects revenues, savings, and total benefits as shown in the table below.[10]

Table 1: Annual revenues, savings, total benefits (EUR) and payback periods (years)

	Support scheme	*Household consumption*	*Feed-in revenues (after taxes)*	*Savings (lower electricity bill due to self-consumption)*	*Total annual benefits*	*Simple payback period*
Law 9011-d	**Feed-in tariff**	Average	660	68	728	6.86
		High	469	167	637	7.85
	Net billing	Average	250	68	318	15.72
		High	175	167	342	14.60

Source: Own calculations

4.2 Implications

The **feed-in-tariff** proposed by the law provides **sufficient remuneration level for residential prosumers with a simple payback period of 7-8 years**. A time-dependent feed-in-tariff could incentivise installation of southwest or westward facing solar panels and produce more electricity during the evening peak hours. Such a provision would favour system-friendly renewable generation with better temporal alignment of electricity generation with peak demand.

Despite the recent two-fold increase in the household electricity retail tariff, the **net billing scheme cannot significantly stimulate prosumer investments** under the current tariff (expected payback periods of 15 to 16 years). However, the availability of the net pay-out option markedly improved the payback periods compared to the earlier draft versions of the Law.

Some **distortionary incentives** remain under both schemes, most importantly due to low **subsidised household electricity tariffs**. The consumer subsidy for household electricity consumption effectively turns into a **'prosumer penalty' for self-consumption**. This could lead to unwanted side effects where prosumers shift consumption away from sunny midday hours and towards peak morning and evening hours to maximise revenues, increasing system costs and subsidy needs.

Moreover, while not modelled in this analysis, **current rules are not favourable for the installation of distributed storage assets**. Due to the low opportunity cost of subsidised household electricity tariffs, energy storage for self-consumption is not attractive. Additionally,

[10] These calculations assume no demand response to the monetary incentive that arises from the difference between feed-in tariffs and subsidised grid electricity prices. In practice, prosumers might try to shift consumption to increase feed-in volumes in scenarios where feed-in tariffs are substantially higher than grid electricity prices (see discussion in section 4).

due to a provision in the Law which caps revenues under net billing at the subsidised household tariff (in case storage is installed), energy storage for system-friendly grid feed-in (during high price / scarcity hours) is similarly disincentivised.

The first-best solution to the distortionary effects described above, of course, would be to **phase out the subsidy to household electricity tariffs** via liberalising residential electricity retail tariffs. Retail tariff reform would have to be part of a larger, comprehensive package of reforms. When phasing out price subsidies, vulnerable consumers would have to be adequately supported by a consumption-independent support scheme, such as via a strengthened housing and utility subsidy (HUS).

A second-best solution, before cost-covering retail tariffs are established, could be to **extend the 'Green Tariff' to cover self-consumption**. The level of this 'self-consumption incentive' could be set at the feed-in tariff minus the (subsidised) electricity retail tariff. In order not to inflate total prosumer revenues (and support costs), the level of the feed-in tariff could be adjusted downward. Such a monetary incentive for self-consumption is not unprecedented. Germany, for example, is paying a self-consumption incentive for rooftop solar PV systems installed between 2009 and 2012.[11] A self-consumption incentive could also be combined with a time-dependent feed-in tariff.

Furthermore, **rules for net billing** should be improved. In general, passing on wholesale market price signals to distributed producers is a desirable approach. Similar to a fixed time-dependent feed-in tariff, this incentivises production in those hours where it is most valuable. However, the current regulatory and market environment in Ukraine might induce high investor uncertainties under such a net billing option. Future wholesale market prices are hard to predict, particularly under uncertainties about further electricity market reforms and closer EU market integration. Potentially, an annually revised factor[12] could be applied to hourly wholesale market prices which ensures reasonable aggregate net-billing revenues, thus reducing investor uncertainties while maintaining hourly price incentives.

Finally, it should be mentioned that **one central barrier** to renewable energy investments in Ukraine, including but not limited to rooftop solar PV projects, are **high capital costs**. As simple payback periods do not include the cost of capital, real-life amortisation periods might be considerably longer. The Law suggests adopting a 'state targeted economic programme' to stimulate small-scale generation by households under the net billing scheme. The proposed measures for the programme are full or partial reimbursement of the loan interest related to generation unit and/or energy storage installation. If implemented, such a concessional loan scheme for prosumers could significantly reduce financing costs for households.

A full assessment of **economic and fiscal benefits and costs** of prosumer subsidies goes beyond the scope of this analysis. However, it is clear that support costs for small-scale renewables are higher than for larger renewable projects. Furthermore, while distributed generation increases resilience of the individual prosumer, effects are less clear on the system level.[13] Considering

[11] https://www.clearingstelle-eeg-kwkg.de/haeufige-rechtsfrage/91

[12] based on a transparent and impartial formula and published reasonably in advance of billing periods

[13] Without cost-covering and well calibrated time-of-use tariffs, prosumer behaviour can also reduce system-level resilience as the need for balancing capacities and distribution grid upgrades increases with increasing penetration of distributed renewable generation. This is especially true if distributed storage capacities are not dispatched according to wholesale market price signals.

Ukraine's wartime economic and fiscal situation and **budget constraint,** costs and benefits of decentralisation and prosumer support should be assessed holistically. The need to reduce support costs underlines the **importance of ambitious electricity tariff reform**.

5 Conclusion

The analysis highlights several key considerations for prosumer support and renewable energy investments in Ukraine. The **feed-in-tariff** demonstrates a **favourable remuneration level for residential prosumers,** while the implementation of a time-dependent feed-in-tariff could further incentivise renewable generation during peak hours. However, the **net billing scheme falls short in stimulating prosumer investments** due to **significantly longer expected payback periods**. To address these challenges, comprehensive reforms are necessary, including the **phasing out of subsidies** along with the required **social support measures** and the introduction of **liberalised residential electricity retail tariffs**. Additionally, the extension of a 'Green Tariff' to **cover self-consumption** and the improvement of net billing rules are potential ways forward. **High capital costs** can be mitigated through **concessional loan schemes for prosumers** as being suggested by the Law. Ultimately, **a holistic assessment of economic and fiscal costs and benefits** is essential.