

## VIALE AREAS FOR IMPROVING INCENTIVES TO INTRODUCE RENEWABLE ELECTRICITY GENERATION SOURCES IN UKRAINE

*This article discusses the issue of introducing renewable electricity generation sources in Ukraine's integrated power system after imposing feed-in tariff with a view to promoting their development. It points out that their further uncontrolled development may have serious negative repercussions on reliable supply of electric power to local consumers, bringing about dramatic growth in tariffs. This makes necessary further improvement of incentives to promote the development of renewable electricity generation sources, the viable ones being presented in this article.*

*Key words:* electric power, renewable energy sources, wind farm, photovoltaic power station, state policy.

The rapid pace of the introduction of renewable electricity generation sources (REGS) in Ukraine's Integrated Power System (IPS) has brought about a number of problems, which could be solved by substantially improving the incentives for REGS development.

This work aims to study these problems and identify viable areas for improving incentives for REGS development in Ukraine taking into consideration the specific conditions of the development and functioning of the national economy and energy sector.

A stable development of Ukraine's economy is impossible without the efficient operation of its IPS, with key criteria of efficient operation being defined as the ability to ensure:

1. Acceptable prices for electric power both for the utilities and the consumers.
2. Normalized power quality and reliable operation of the IPS.

These objectives will be much more difficult to achieve if REGS, primarily wind farms (WFS) and photovoltaic power stations (PVPSs) are integrated to the IPS. The key factors responsible for this situation are presented below.

In general, REGS are uncompetitive compared to conventional power plants, and with their intro-

duction electricity price for consumers will rise. This price increase -  $\Delta C_p$ , could be deduced from the following formula:

$$\Delta C_i = C_i^r - C_i^b,$$

where  $C_i^b$  and  $C_i^r$  correspond in equal conditions to the electricity price under the base case optimal IPS development scenario, which excludes the introduction of uncompetitive REGS technologies, and the price under the base case optimal IPS development scenario when REGS are introduced to a certain amount.

The increase in the production cost of electricity is not only caused by the higher cost of REGS-generated electricity, but also by the rising cost of electric power generated by conventional power plants as a result of decreased electricity production and the badly needed investment in the power grid development, automation and management systems, raising thus transmission cost. On the other hand, integrating WFs and PVPSs in the power grid has virtually no impact on the required capacity levels of the IPS's conventional power plants, providing only some extra capacity to the IPS.

Another problem is to compensate for WFs and PVPSs capacity fluctuations caused by objective instability of the primary energy source, which they

utilise (for instance, changes in wind velocity and solar radiation intensity), while maintaining normalized power quality (frequency, voltage, etc.). This problem could be solved by using regulating capacities provided by conventional power plants and/or special controlled load consumers.

It is common knowledge that if REGS capacities exceed IPS capability to compensate for such capacities fluctuations, the IPS in the best case scenario will not be able to maintain normalized power quality. In the worst case scenario, this will bring about system blackouts with serious negative and possibly catastrophic socio-economic and environmental consequences.

Presently, these problems have aggravated in the countries that had the highest introduction rates and the share of REGS in the structure of generating capacities. This concerns, in the first place, the EU countries, where REGS introduction rates have been substantially cut down, and even a moratorium is being imposed on their tapping into the IPS. This is the case with Spain, where enormous subsidies required for the development of solar and wind energy have put the country in dire economic straits. [1].

In Ukraine, a somewhat paradoxical situation came to exist with regard to REGS development. Ukraine's Energy Strategy until 2030, which was approved in 2006 [2] (the 2006 Strategy) and effective until 2013, was silent about any incentives for or any substantial development of REGS. As appears from the studies carried out in the process of the Strategy development, the following factors were behind that:

1. Ukraine's IPS has low manoeuvrability and the problems related to the power quality and security of supply are largely resolved by its parallel operation with Russia's electric power system. Should some technical, economic or other factors make the parallel operation with Russia impossible, Ukraine will face problems ensuring a reliable power supply and quality even without introducing REGS. Increasing WFs and PVPSs capacities may dramatically aggravate this problem and cause permanent emergency situations in Ukraine's power system.

2. Given Ukraine's energy-intensive economy, the impossibility of curtailing energy consumption within a short term and the low paying capacity of the consumers, a significant growth in cost of elec-

tric power provoked by REGS introduction will have an extremely negative socio-economic impact, bringing down local manufacturers' competitiveness and standard of living for households.

3. The high rate of obsolescence of plants and equipment calls for heavy investments in the conventional power engineering sector and existing networks to ensure reliable power supply. Shorter payback periods and lower investment risks in case some preferences are provided for renewable electricity-generation technologies will increase investments in their development, limiting the possibility of addressing much more acute problems in the national power industry than REGS introduction.

4. Most parts of REGS equipment are not manufactured in Ukraine and their imports will make worse the country's already negative trade balance and pressure on national currency.

However, contrary to the 2006 Strategy, the Law of Ukraine "On the Power Industry" [3] incorporated changes [4] creating most favourable conditions for investing in local REGS. Except for some reference to world trends, no in-depth feasibility study substantiating such decision was presented, no consideration was given to the above problems concerning REGS introduction, to Ukraine's specifics and possible consequences for the economy and reliable operation of the IPS.

These changes imposed an encouraging, very high basic feed-in tariff, whereas the State guaranteed purchasing feed-in electricity that was not sold under contracts with consumers or electric utilities. This minimum tariff was set as a retail price for the second class voltage consumers in January 2009 multiplied by the feed-in tariff ratio for the electricity produced by each type of REGS. In case of PVPSs, the derived value is additionally increased by the tariff rate applied for the peak hours (for three-zone tariff classification). At the same time, it guaranteed no-charge connection of REGS to electricity mains and, which may have no precedents in the world, minimization of currency risks by pegging the minimum feed-in tariff to the current euro exchange rate set by the National Bank of Ukraine for the respective period of time. If the euro rate is higher than it was in January 2009, the feed-in tariff is increased proportionally. The National Electricity Regulatory Commission (NERC) reviews it therefore on a monthly basis.

In this context, the fast growth of the REGS capacity in this country was only a matter of time,

while some possible negative consequences of introducing the above incentives were pointed at virtually immediately after these changes took effect. [5-6].

This also enabled using the Joint implementation mechanism under the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which made renewable power generation even more attractive.

Against this background, an investment boom started in Ukraine's REGS sector as experts had predicted. The declared capacity of projected REGS reached around 17 GW as soon as in 2010-2011, where wind and solar energy projects had the lion's share. The projects were launched rather fast, and the installed capacity of the renewable energy

facilities operating under the feed-in tariff totalled 1.216 GW as of 1 January 2014, growing more than 12-fold against 2009. In 2013 alone, PVPSs operating under the feed-in tariff doubled their capacity, increasing it from 371.6 MW to 746.9 MW, wind power capacity rose from 275.7 MW to 370.7 MW or by almost 34.5%, small hydropower plants showed a modest growth from 73.5 MW to 75.3 MW, and electricity produced from biomass jumped more than 4-fold, from 4.2 MW to 17.2 MW. Power output rose from 638.6 million kWh in 2012 to 1,247 million kWh in 2013, showing a nearly double increase. However, fast growth of REGS capacity and electricity output are rapidly building up their pressure on the price of electricity to consumers (Table).

**REGS share in power supply to Wholesale Electricity Market and in total cost of electricity, in %\***

Type of power plants	2012 share in:		2013 share in:	
	power supply	total cost	power supply	total cost
biomass	0.01	0.03	0.02	0.06
small hydro	0.1	0.19	0.16	0.41
photovoltaic	0.18	2.15	0.32	3.48
wind	0.14	0.4	0.36	0.96
Total	0.43	2.77	0.86	4.91

\* according to the data supplied by Energorynok State Enterprise.

As appears from the above Table, while not reaching 1% of the output, cost of electricity produced by REGS accounted for almost 5% of the total cost of power supplied to the market. It is clear that further growth in REGS output and declining hryvnia/euro exchange rate, providing a substantial compensation for lowering feed-in tariffs over the long term as foreseen in legislation, will result in further increase in REGS influence on the price of electricity to ultimate consumers that are actually subsidizing REGS development. In this context, the price will be growing uncontrollably and fast. The studies carried out by the National Academy of Sciences of Ukraine Institute of General Energy [5-7] show that subject to specific conditions of the development of the national power engineering sector, the  $C_i^r$  value will be 1.5 to 2 times higher than  $C_i^e$  by around 2030. On the other hand, even with the existing wind and solar capacities and the paral-

lel operation with Russia's electric power system, serious problems have already occurred in ensuring reliable operation of Ukraine's IPS.

In view of the customary cross-subsidization this burden falls chiefly on economic entities, above all industry, thus exacerbating its already poor ability to compete.

It was not until possible catastrophic consequences of any further uncontrolled growth of wind and solar energy in Ukraine became clear to almost everyone, not only to experts, that efforts were made to restrict the development of renewables by substantially increasing the so-called "local" component (a certain share in the equipment/construction and installation services manufactured/provided by companies operating in Ukraine) in REGS construction projects [8]. Starting from 1 July 2014 this component is supposed to make up at least 50%.

However, the capability of this mechanism to substantially restrict the introduction of wind and solar energy capacities is raising serious doubts for the following reasons:

1. Our Energy Community and European Union partners, international financing institutions consider such measures as discrimination against foreign investors, and make strenuous efforts to remove the "local" component; its virtual elimination is one of the requirements for Ukraine in the framework of its Association Agreement with and membership in the EU.

2. The production localisation process got off to a flying start, in particular, the Wind Farms of Ukraine Group has already been licensed to manufacture 2.05 MW, 2.5 MW and 3 MW wind power turbines, and representatives of the company have published its capacity to produce up to 100 turbines a year.

The "local" component may therefore only slightly slow down the REGS development in Ukraine and decrease imports of technologies for REGS introduction. Ukrainian economy and power engineering sector will, however, have to cope with uncontrolled development of WFs and PVPSs in the longer term.

In view of this, it is necessary to refashion the incentive system for REGS development, which in the first place concerns WFs and PVPSs.

It would be reasonable to continue stimulating the development of small hydro power plants and biomass-fuelled thermal power facilities, especially, if the issues related to flood protection and disposal of agricultural, forestry and solid household waste are resolved at the same time, taking into consideration the general scarcity of the feasible potential of such sources. The existing potential should also be preserved for low-capacity (up to 5 kW) WFs and PVPSs; however, tight control should be exercised over feed-in volumes.

With regard to WFS and PVPSs, the new stimulation system should primarily limit bringing into operation of new capacities at such REGS according adjusting them to Ukraine's IPS capability to provide a reliable supply of electric power to its consumers when REGS operate parallel with the national power grid. On the other hand, the new system must not lead to a dramatic price increase for Ukrainian consumers.

It is reasonable that these two prerequisites, as shown in analysis [9-10], should be met by introducing a mechanism stimulating the development of high-power wind farms and photovoltaic power

stations using the combination of advantages offered by investment grants and competitive selection of construction projects.

This mechanism will provide investment grants to wind and solar construction project owners on competitive basis when their electricity is purchased at average conventional sector prices formed at the Wholesale Electricity Market, or at such market prices one day in advance when a new electricity market model is introduced based on bilateral agreements and a balancing market. The funding source is provided by the investment surcharge to tariff for generated electricity at the rate of 1%.

New capacities are introduced at WFs and PVPSs according to the following algorithm:

1. A State Fund for Support of Wind and Solar Energy Development (WSEF) is set up.

2. The system operator, whose functions are presently performed by Ukrenergo, determines on an annual basis the possible scope of introduction of wind and solar capacities ensuring stability of the national IPS, taking into account conventional generating capacities and REGS development plans, as well as electricity mains, power system manoeuvrability, expected electric power use levels and conditions, etc., as well as risks related to incomplete performance of the planned activities.

3. The WSEF invites tenders and selects proposals for the construction of WFs and PVPSs within the scope determined in step 2. A list of projects potentially eligible for investment support from the WSEF is prepared and the amount of funds required for their implementation is identified taking into account connections.

4. NERC identifies financial capacities to support WF and PVPS development with a 1% investment surcharge to tariffs (prices) for electricity for the next year and relays them to the WSEF.

5. The WSEF, taking into consideration financial restrictions, prepares the final list of WFs and PVPSs that will receive investment grants, and makes contracts with the owners of such projects.

Such mechanism would minimize risks associated with price shocks and system blackouts, which will be steadily increasing if the uncontrolled development of WFs and PVPSs continues.

Of course, the investors that have already managed to register their WFs and PVPSs construction projects, our Energy Community and EU partners, international financing institutions will hardly be in raptures over the introduction of such system, but Ukraine has virtually no other way out considering



its current financial situation, paying capacity of the consumers, which may drop dramatically given extremely complicated relations with Russia, and the technical condition of Ukraine's ISP.

#### Conclusions

1. The established system for subsidizing the development of high-power WFS and PVPSs is posing grave threats as their unpredictable development supported by substantial preferences, which provide gradual growth of their capacities, may stir up a new non-payment crisis, reduce home manufacturers' ability to compete and trigger system blackouts in Ukraine's IPS. We have already had such experiences.

2. It is reasonable to encourage the development of high-power WFs and PVPSs based on integrating investment grants with competitive selection of projects. Such mechanism could be implemented by establishing a State Fund for Support of Wind and Solar Energy Development (WSEF). Based on proposals put forward by Ukrenergo and NERC, the WSEF will make a list of investment projects which will not cause any problems for the country while ensuring reliable operation of Ukraine's IPS and not placing crushing burden on power consumers.

3. It is necessary for the government to come up with a clear public explanation for such steps as the response of all stakeholders will be extremely negative if the existing situation continues.

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*Надійшла до редколегії 28.03.2014*

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*Зав. відділу прогнозування розвитку та управління функціонуванням електроенергетики ІЗЕ НАН України, д-р техн. наук, ст. наук. співр. С.В. Дубовський*