

The volume of sold innovative industrial products (goods, services) outside Ukraine is 54.2% of the total volume of sold innovative industrial products (goods, services), i.e. more than half of innovative goods and services sold abroad.

The growing importance of digitalization in the processes of public administration and service provision is another factor of competitiveness in 2020. The number of public authorities and local governments that provide the opportunity to use the tools of digitalization (e-government) in Ukraine is quite high. Thus, digitalization processes in Ukrainian government can bring it closer to a competitive condition.

Today, the presence of specialists in the field of information and communication technologies, who are able to create modern economic systems of functioning in the digital environment, is of great importance. At the same time, only a quarter of Ukrainian enterprises have specialists in the field of ICT and only 6% of enterprises recruited them. The percentage of enterprises that conducted training in the field of ICT in Ukraine is also a limiting factor for the national economy.

Thus, according to the assessment of additional factors of the transformed system of competitiveness assessment of the country, outlined by the World Forum of Economists in 2020 and related to the impact of the COVID-19 pandemic, Ukraine cannot be considered ready for the change and resistant to the shocks of socio-economic life caused by the pandemic around the world. Accordingly, it is necessary to develop directions of the state policy to increase the competitiveness of the country under these conditions.

#### **Reference**

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## **METHODOLOGICAL APPROACH TO FORECASTING THE ENERGY INTENSITY OF UKRAINIAN INDUSTRY**

У роботі реалізовано сценарне прогнозування енергоємності промисловості за споживанням енергетичних ресурсів. Застосовано методи економіко-математичного прогнозування енергоємності ВВП України за рахунок структурних зрушень та енергоємності промисловості за споживанням енергетичних ресурсів у прогнозованому періоді, що дозволило встановити можливість досягнення цільових показників енергоємності України.

Forecasting the energy intensity of Ukraine and substantiation of measures on implementing the potential of energy saving should be the basis of improvement of the mechanism of development of the industry on the basis of the management of energy saving potential.

It is proposed to calculate the predicted reduction of energy intensity of industrial production by energy consumption as a result of the implementation of the technical potential of energy saving according to three scenarios:

the first scenario is based on the data on annual GDP growth provided in the Sustainable Development Strategy of Ukraine [1] (2021–2025 – 106.0; 2026–2030 – 107.0);

the second scenario assumes as light GDP growth during 2021-2025 – at 1% annually due to the state of economic recession and the lack of effective levers for economic recovery, after 2025 we predict annual GDP growth at 2%;

the third scenario (baseline) is based on annual GDP growth of 3% – in 2020-2024 and the resumption of economic growth of 4% during 2025-2030 annually.

According to the results of modeling via the tools of *Statistica 6*, a function is obtained that reflects the relationship of structural changes with the energy intensity of Ukraine's GDP:

$$EE=0,6445+0,0556*\ln(\mu(ДП))+0,1377*\ln(\mu(ПП))-0,0015*\ln(\mu(ПЕ)). \quad (1)$$

The multiple correlation coefficient of model (1) is  $R=0.71392393$ , and determination coefficient –  $R^2=0.50968738$ . That is, 51% of energy consumption is due to structural changes in industrial production.

The created model made it possible to forecast the energy intensity of GDP in 2025 and 2030 (Table 1).

Table 1

**The forecast of the change in energy intensity of Ukraine's GDP due to structural changes**

Year	The share of the mining industry in GDP, $\mu(MI)$ , UAH/UAH	The share of the processing industry in GDP, $\mu(PI)$ , UAH/UAH	The share of energy supply in GDP, $\mu(ES)$ , UAH/UAH	Energy intensity in GDP, TPES in oil eq. tons./thousand dol.GDP (PPP), EI
2007	0.042	0.184	0.028	0.234
2008	0.054	0.159	0.027	0.220
2009	0.042	0.143	0.031	0.220
2010	0.059	0.132	0.028	0.245
2011	0.065	0.119	0.031	0.222
2012	0.058	0.124	0.031	0.214
2013	0.055	0.113	0.029	0.203
2014	0.050	0.122	0.028	0.198
2015	0.048	0.119	0.027	0.187
2016	0.055	0.122	0.031	0.192
2017	0.059	0.121	0.029	0.177
2018	0.060	0.116	0.031	0.179
2019	0.056	0.108	0.031	0.165
2025 (forecast)	0.036	0.100	0.038	0.147
2030 (forecast)	0.034	0.091	0.040	0.131

Source: calculated by the author on the basis of data of the State Statistics Service of Ukraine [2]

The forecasted savings of energy resources according to the technical potential of the industry are given in Table. 2.

Having the forecasted structural changes concerning the changes in the share of industry in GDP and the potential savings of energy resources as a result of technical measures, we obtain data on the forecasted energy intensity. To determine it, use the following formula:

$$EC_1^{nc} = \frac{Q_1}{BП_1} = \frac{Q_0 * \frac{BП_1}{BП_0} - E_1}{BП_1} = \frac{Q_0 * BП_1}{BП_1 * BП_0} - \frac{E_1}{BП_1} = \frac{Q_0}{BП_0} - \frac{E_1}{BП_1} = EC_0^{nc} - \frac{E_1}{BП_1},$$

where  $EC_1^{nc}$  - energy intensity of industry by consumption of energy resources in the forecast period, oil eq. ton/thousand dollars;  $Q_0$  and  $Q_1$  – the amount of energy resources consumed by industry in the base and forecast year, oil eq. ton.;  $BП_0$  and  $BП_1$  – the volume of gross industrial production at constant price in 2017 (PPP – purchasing power parity), thousand dollars;  $E_1$  – forecast saving of energy resources as are result of realization of technical potential, oil eq. ton.;  $EC_0^{nc}$  – energy intensity of industry by consumption of energy resources in the base period, oil eq. ton/thousand dollars.

Table 2

**Forecasted savings of energy resources according to the technical potential of the industry, thousand oil eq. ton**

Branch of industry	2025	2030
Electricity		
Mining industry	19.69	23.46
Processing industry	81.33	166.94
Supply of electricity, gas, steam and air conditioning	43.42	56.23
Total electricity	144.44	246.63
Coal		
Mining industry	180.86	272.36
Processing industry	145.86	157.71
Supply of electricity, gas, steam and air conditioning	2056.95	3018.54
Total coal	2383.67	3448.61
Natural gas		
Mining industry	44.1	76.59
Processing industry	812.7	1170.0
Supply of electricity, gas, steam and air conditioning	14.4	21.6
Total natural gas	871.2	1268.19
Total	3399.31	4963.43

Source: created and calculated according to data [3]

Table 3 contains the calculations of the forecasted energy intensity of the industry according to the consumption of energy resources.

Table 3

**Calculations of the forecasted energy intensity of the industry according to the consumption of energy resources**

Indicator	2019 (fact)	2025	2030
The share of industrial output in GDP, %	0.195	0.174	0.165
Technical potential of energy saving in industry, thousand oil eq. ton	-	3399.31	3448.61
Scenario I			
GDP at constant 2017 prices (PPP), mlrd. dol.	538.4	749.3	1051.0
The volume of gross industrial production at constant prices in 2017 (PPP), mlrd. dol.	105.2	130.38	173.41
Energy intensity of industrial production by energy consumption, oil eq. ton /thousand dol.	0.153	0.13	0.10
Scenario II			
GDP at constant 2017 prices (PPP), mlrd. dol.	538.4	577.18	637.25

The volume of gross industrial production at constant prices in 2017 (PPP), mlrd. dol.	105.2	100.43	105.15
Energy intensity of industrial production by energy consumption, oil eq. ton./ thousand dol.	0.153	0.12	0.07
Scenario III			
GDP at constant 2017 prices (PPP), млрд. дол.	538.4	649.12	789.75
The volume of gross industrial production at constant prices in 2017 (PPP), mlrd. dol.	105.2	112.95	130.31
Energy intensity of industrial production by energy consumption, oil eq. ton/ thousand dol.	0.153	0.12	0.09

Thus, in all scenarios there is a decrease in energy intensity of industrial production provided the technical potential is implemented.

### References

1. Strategy of sustainable development "Ukraine - 2020". URL: <http://zakon.rada.gov.ua/laws/show/5/2015>
2. State Statistics Service of Ukraine. URL: <http://www.ukrstat.gov.ua/>
3. Maliarenko O. E., Maistrenko N. Yu., Stanytsina V. V. Substantiation of forecast volumes of energy saving potential in the enlarged sectors of the economy taking into account technological and structural changes. *Problems of general power engineering*. 2016. Iss. 4. P. 58-67.

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