# Technological sustainability

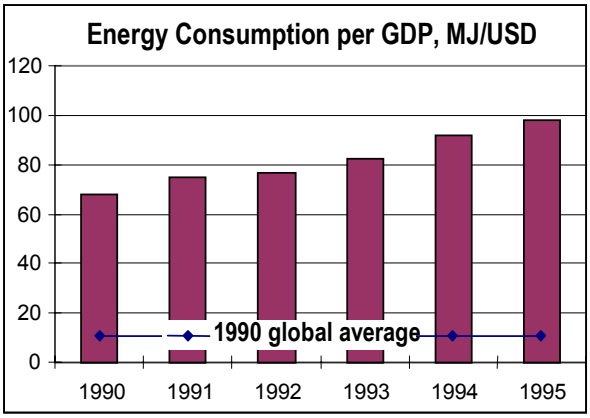
## ►Indicator 7: Energy Productivity

Vector Value Calculation:
Ukraine energy consumption per $GDP was 67.97 in 1990 and 97.95 in 1995.

Vector Value:
**1990** = (67.97-1.06)/9.58 = **6.98**
**1995** = (97.95-1.06)/9.58 = **10.12**

Ukraine is highly inefficient country in terms of energy use. The situation dates back to Soviet time. Planning economy of the USSR implied progress to be expressed in the number of products produced no matter what quality it is and whether it is needed. On another hand, there was no economic incentive to reduce production costs, use of raw materials and energy.

In nineties, production in Ukraine was falling down sharply. Energy use however did not go down as fast. In 1990 - 1995 GDP has reduced by 55%, final energy use dropped by 42% from 184 m toe in 1990 to 106 m toe in 1995. Thus energy intensity increased dramatically.




The main reasons identified are: (i) the economic structure, with its emphasis on energy-intensive heavy industry; (ii) use of older, inefficient technologies given low historic energy prices; (iii) the use of electricity in industry which is high compared with the OECD; (iv) poor insulation standards in most buildings; (v) low appliance efficiencies; and (vi) energy management practices, metering and recording systems which are non-existent or poor. Other than low energy prices until recently, perhaps the major reason for the higher energy intensity is the capital stock created under the era of central planning. The industrial capital stock was geared heavily to the production of heavy industrial outputs such as steel and basic chemicals, and military hardware. Both its structure, and the technology embodied within it, reflected then-contemporary prices, costs and investment criteria which were very different from those of the OECD economies.

Another explanation for increasing energy use per GDP is under-recording. A lot of business in Ukraine is not done officially to avoid taxes. Such activities are not reflected by GDP, while still consume energy accounted. If GDP data are corrected to reflect under-recording (perhaps of some 30-50 per cent), the energy intensity of the economy is lower, but still very much higher than in the OECD countries.

Ukrainian government has declared the improvement of Energy Efficiency to be a priority of the energy sector development. However, the energy saving program is hardly implemented. Instead, the President of Ukraine is pushing forward completion of the nuclear reactors. Completion of the new facilities looks ungrounded in a view of unused installed capacities.

**Table 7.1. Changes of energy use and economic development of Ukraine in 1990-1995** [26]

| | *1990* | *1991* | *1992* | *1993* | *1994* | *1995* |
|---|---|---|---|---|---|---|
| Total Consumption, m toe | 252.63 | 250.57 | 219.91 | 193.66 | 165.13 | 160.95 |
| Total Consumption, PJ | 10,577.62 | 10,491.37 | 9,207.63 | 8,108.54 | 6,913.99 | 6,738.98 |
| Population m | 51.9 | 52 | 52.1 | 52.1 | 52 | 51.9 |
| GDP bln USD | 155.62 | 140.03 | 120.44 | 98.18 | 75.6 | 68.8 |
| Energy Consumption per GDP, MJ/ USD | 67.97 | 74.92 | 76.45 | 82.59 | 91.45 | 97.95 |
| Total Consumption per capita, PJ per person | 203.81 | 201.76 | 176.73 | 155.63 | 132.96 | 129.85 |

To improve the energy efficiency in Ukraine few things have to be done:

- Privatisation of the energy facilities in a way that they can compete for customers.
- Development of the energy market. Only about 25% of energy (electricity and heat) delivered to final consumers is paid in cash. A lot of deliveries are paid with barter or not paid at all.
- Deregulate energy prices. Although, energy price was rising over last years it is still seen to be too low. Incentive to invest in energy saving is needed.
- There must be strong political commitment of the authorities at all levels to facilitate energy efficiency programs.

In the year 2000 Ukraine consumed 122849.1 GWh of electricity, 60.367 m ton of coal, 8.4889 m ton of oil and 73.4 bln cubic meters of natural gas. This figures lead to 4894,53 PJ. Same year GDP stands for UAH 175 bln USD 28 bln. Thus, energy intensity stands at 175 MJ/USD. This figure is not reliable since it double count coal use (as coal and as electricity produced out of it). However, it demonstrates trend for decreasing energy productivity. Vector value for 2000 would be about 18.

[26] Energy Policy of Ukraine.OECD.1996. Based on World Bank Data

# ►Indicator 8: Renewable Energy Deployment

Vector Value Calculation:

Seeing that in 1990 a share of "renewables" within the capital investments in Ukraine's fuel and energy sector was equal to zero (see table 4.1), we can assume that the use of renewable energy was equal to zero as well. Therefore, in 1990 the renewable energy fraction was simply 0. (0.95 -0)/0.8636=1,10004

As it follows from table 8.1, in 1999 the situation with renewables was slightly better: 0.08%. Target value is 95% of energy consumed to be renewable. So, we can assume that Ukraine's vector value for 1999 equals (0.95 – 0.0008)/0.8636 = 1.0407

Vector Value:
**1990 ~ 1,100**
**1999 = 1,099**

Of the renewable energy sources, only hydro power makes a significant contribution to Ukraine's electricity supply at present. About 8.7% of total installed capacity is accounted for by hydro plants, but this generates 14.3 bln kWh or about 8% of the country' electricity, table 8.1. Part of the reason for this low utilisation factor is the fact that most of the major hydro stations are located on the Dnipro River, on which the flow is highly seasonable. However, some of the hydro plant is used at least partly to provide much-needed peaking capacity, to maintain system stability.

In accordance with the National Energy Programme of Ukraine [27], in 2000 the share of renewables in Ukraine's net generation of electricity had to be 0.8% or 2.1 bln kWh. Because of severe budget constrains during the previous five years, this programme has not been fulfilled. Actually, less than 10% of needed funds have been assigned for renewable energy in 1996-2000. Therefore, we can consider that in 1999 the real share of renewables was around 0.08% [28].

**Table 8.1. Ukraine's net generation of electricity in 1999** [29]

| | bln kWh | % |
|---|---|---|
| Fossil fuel | 86 | 49.9 |
| Nuclear electric | 72.1 | 41.8 |
| Hydro electric | 14.27 | 8.22 |
| Renewable electric | 0.13 | 0.08 |
| Total | 172.5 | 100 |

Besides that Ukraine possesses significant resources of wind, solar, small hydro, biomass and geothermal energy. Although none of these are currently exploited in significant quantities for electricity generation, their potential future contribution to the energy balance is being explored [30].

[27] National Energy Programme of Ukraine. Adopted by the Rada (Parliament) in May 1996.

[28] Borys Korobko, Director of the State Research Institute of Non-Traditional Energy Sources. Personal Communication, January 2001.

[29] Ukraine Power Industry. Ministry of Fuel and Energy of Ukraine. Kyiv, 2000.

[30] Comprehensive State Energy Conservation Programme of Ukraine. Kyiv, 1996.

First Ukrainian wind mills were installed in 1993. Since that time existing wind mills (table 8.2) produced around 17.5 m kWh of electricity [31]. It should be mentioned that the larger half of installed turbines are outdated USW 56 -100 type.

**Table 8.2 Installed wind mills (1999).**

| No: | Location / Name | Number of wind turbines |
|---|---|---|
| 1. | Donuzlav | 53 |
| 2. | Novo-Azovsk | 27 |
| 3. | Saki | 21 |
| 4. | Truskavets | 7 |
| 5. | Askania-Nova | 3 |

[31] Borys Korobko, Director of the State Research Institute of Non-Traditional Energy Sources. Personal Communication, January 2001.