TRENDS IN ENERGY-INTENSIVENESS:
AN INTERNATIONAL COMPARISON

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Prognostics on fuel and more specifically on power consumption by governmental bodies are usually based on the economic growth i.e. on the assumption that a unit increase in GDP will result in some computed amount of increase in fuel and power consumption.

1./ ONE-DIMENSIONAL COMPARISON

Table 1 shows power consumption per capita in 1985 as stated in the latest official long-term concept, comparing Hungary with some European countries and the States. Though the States and the Scandinavian countries are far ahead, the socialist countries fit quite well in the European average.

Table 1
POWER CONSUMPTION PER CAPITA
(sorted in decreasing order)

Country	Gross power consumption kWh per capita
Norway	24729
Sweden	16623
Finland	11367
USA	11176
Switzerland	7435
GDR	6851
FRG	6739
France	5817
Belgium	5791
Denmark	5778
Austria	5663
USSR	5467
CSSR	5430
Bulgaria	5148
Great Britain	5039
Holland	4466
Italy	3664
Poland	3645
Hungary	3531
Spain	3280
Yugoslavia	3263
Portugal	2083

Table 2
HOUSEHOLDS' POWER CONSUMPTION PER CAPITA
(sorted in decreasing order)

Country	Household consumption kWh per capita
Norway	7381
Sweden	3850
USA	3306
Finland	2478
Switzerland	1829
Belgium	1641
FRG	1592
France	1568
Great Britain	1568
Austria	1356
Denmark	1326
Holland	1110
Bulgaria	1066
GDR	921
Italy	779
Yugoslavia	771
CSSR	707
Hungary	694
Spain	620
Portugal	443
Poland	435
USSR	-

Table 3
HOUSEHOLDS AS AGAINST TOTAL POWER CONSUMPTION
(sorted in decreasing order)

Country	Household consumption per gross power consumption
Great Britain	0.311
Norway	0.298
USA	0.296
Belgium	0.283
France	0.269
Holland	0.248
Switzerland	0.246
Austria	0.239
Yugoslavia	0.236
FRG	0.236
Sweden	0.232
Denmark	0.229
Finland	0.218
Portugal	0.213
Italy	0.213
Bulgaria	0.207
Hungary	0.196
Spain	0.189
GDR	0.134
CSSR	0.130
Poland	0.119
USSR	--

Power consumption: an international comparison 1985

If we consider the share of households in absolute figures and as against the gross consumption then a polarization becomes obvious (*Tables 2 and 3*). *Table 3* shows only Yugoslavia to approach the European average while Spain has a share similar to those of the socialist countries (with the USSR values being unknown).

Such more or less one-dimensional comparisons tend to suggest that an increase in GDP goes hand in hand with an increase in power consumption, or even that the rise in GDP is based on a rising power consumption - which means on increasing the power supply capacities.

However, we may get a clearer picture if we look at the other factor, the GDP as well.

2./ TWO-DIMENSIONAL COMPARISON

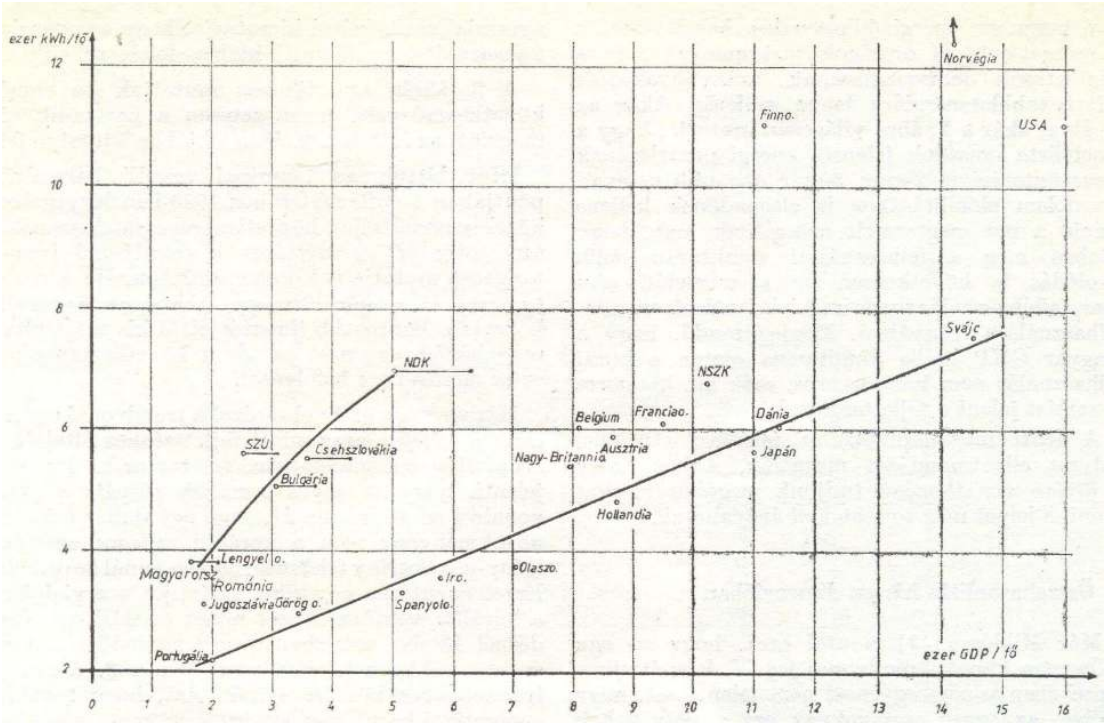

***Figure 1*. Gross electric power consumtion per capita against the GDP/capita**

Kerényi [2] considered a few countries more, and he lined them up by their GDP per capita (representing the respective degree of development), by their total power consumption per capita (kWh/head), and by their total fuel consumption per capita (GJ/head). We take now what he stated for 1985. Using his own corrected values for computing the heat equivalents he got some results that differ from what we have

shown before, but nevertheless the trend is clear so for the details we will just refer the reader to Kerényi's paper [2].

We used the separate diagrams by Kerényi [2] to devise a two-dimensional one with the method used by Miklóssy [3]. In *Fig.1* we represented the total power consumption (kWh/head), and in *Fig.2* the total fuel consumption (GJ/head) as against the GDP ($/head) in 1985. The two representations being of the same type we shall describe the analyses based on *Fig.2*.

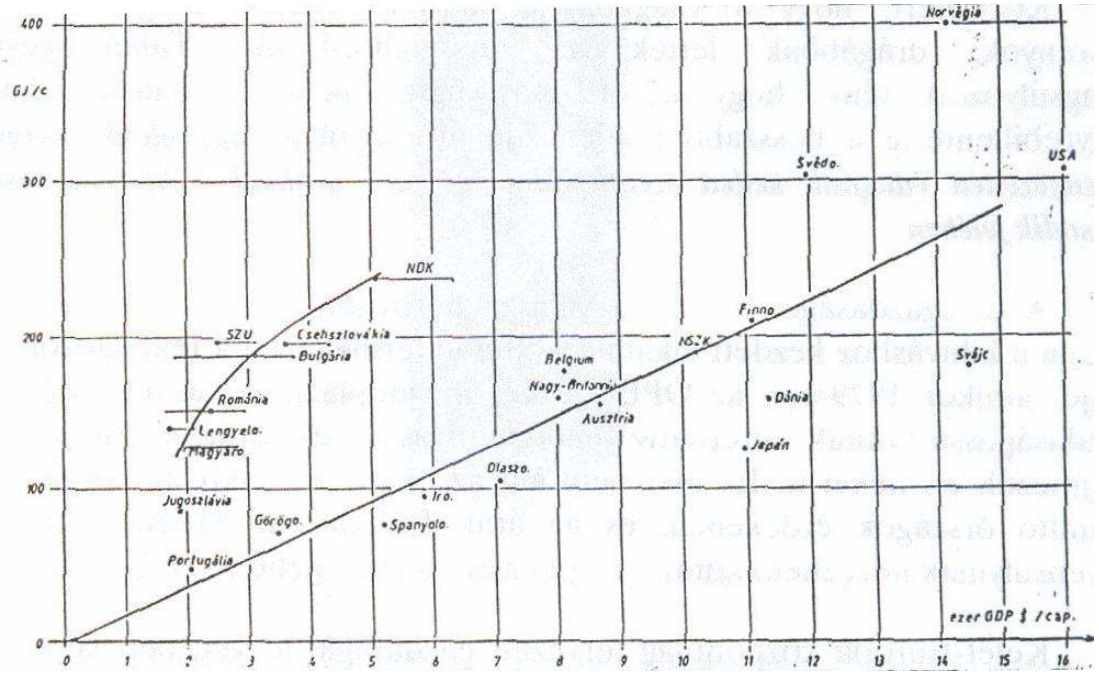

Figure 2. Direct total energy consumption per capita against the GDP/capita

Most European countries fit in a trend line starting at the origo and proceeding continuously up to GDP=12 000 $: from here the States also join the trend. Japan and Switzerland are falling behind, while Norway and Sweden are considerably above the average or trend line, which means less respectively far higher fuel consumption ratios. Fig.1 shows Finland and the States to have by far the highest total power consumption just as seen also in Table 1. This is obviously due to the abundance of cheap hydraulic energy - the others having less, or having less intensively developed their own fuel resources. When we say "cheap" hydraulic energy this is no generic but a specific term as we know hydraulic energy can be "expensive" or "cheap".

In *Fig.2* we see another group of countries showing a caracteristic deviation from the general trend, and these are particularly interesting to us as they are exactly the socialist countries. Their GDP levels are comparable to those of Portugal, Greece,

Spain and Ireland - and they even figure twice, because Kerényi had assessed their GDP on his own as there were no such data published, taking the actual Hungarian GDP as a datum line.

We can, however, clearly see that the socialist countries are using up twice or three times as much power as their European counterparts do for industrial purposes. This means that the one-dimensional representation is misleading when suggesting that our power consumption levels fit the European average and thus we should need more power if we are to see the household share increasing. Both *Fig.1* and *Fig.2* show clearly that if the socialist countries stopped their hugely power-wasting practices the today's power supply should be more than sufficient, in fact even if the GDP were doubled or trebled - leaving still room for a shift in structure to the benefit of household electrification. We might add that if the Hungarian GDP were correctly defined, then our own power- wasting would make up not the treble only the double of what we ought to consume at the actual stage of development.

Now this was only to show what contradictions there had been in 1985: to see what we ought to do next requires some more detailed analyses.

3./ THREE-DIMENSIONAL COMPARISON

Miklóssy [3] has already stated that a trend computed for a given period of time (which in his logarithmic scale is not linear) is not necessarily valid for each and every country: they may have different time scales or trend lines of their own.

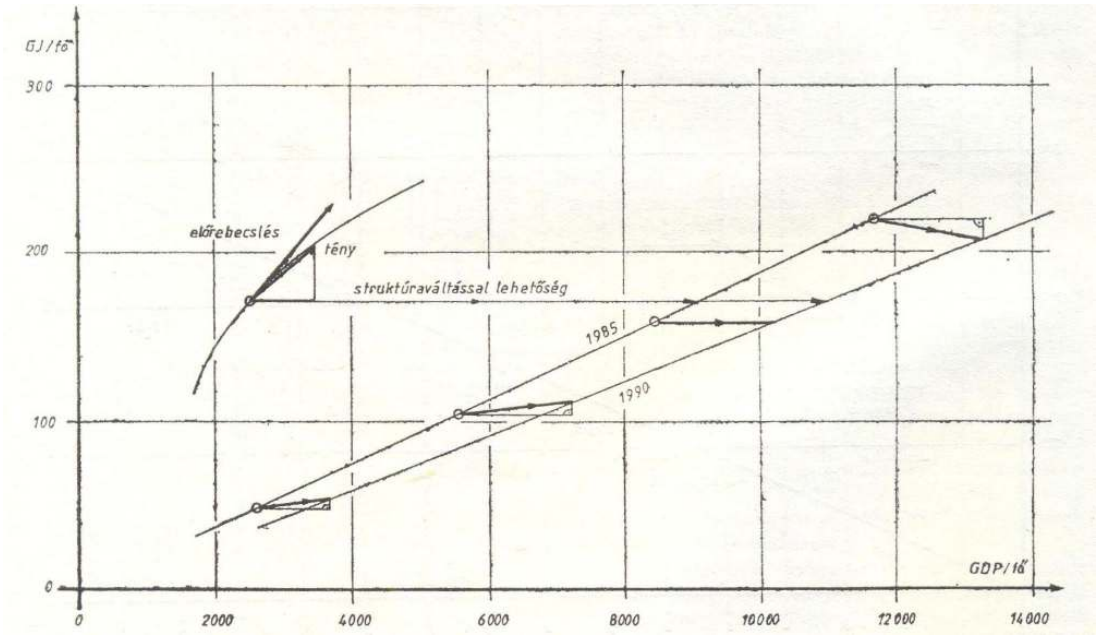

Figure 3. Development paths calculating with the time dimension

Éva Ehrlich [4] computed trends for 1970, 1975 and 1980 by the same method as used for *Fig.2* and these show a decline.

In *Fig.3* we show the consequences of this decline, with the time dimension on the same level as in *Fig.2*.

At any point in the "European trend" of 1985 we see an almost identical fuel consumption per 1 $ GDP: in actual fact this is represented in the direction tangent of the trend line expressed as GJ/$. If the straight section of the trend passes through the origo then GJ/$ is a constant value. A more accurate adaptation results in a slightly steeper trend line which has, however, no bearing on the conclusions.

After three, or five, years the trend line as such slips down to a lower level that is the same level of development goes with a lower average of fuel consumption. This means that after a while the individual trends of each country step down from the upper limit to the lower limit line: the specific economic growth ratio (GDP) implies a lesser increase of fuel consumption - while the gross power consumption per capita may slightly increase (less than the GDP does), or it may stagnate, or it may even decrease! This is what the arrows between the trend lines show in Fig.3. Now the question whether new capacities are needed or not will obviously depend on whether the total consumption does grow or not (replacements are not deemed to be "new" capacities...)

Trend line curvatures suggest that there is at least an approach to be expected between socialist and non-socialist countries: trends might become at least parallel to one another. However, power supply is a strategic, a "pushing" industry and new projects are greatly affected by plans that happen to aim not even at the socialist trend but rather at the tangent of it.

4./ WHERE ARE WE NOW?

Hungary ought to switch over to the European trend, this has already been expressed in *Fig.2*. However, these last years there was almost no move toward that target: fuel price increase did not lead to decreasing the specific consumption as expected but rather to a decrease in GDP [2] This decrease in GDP has been at the root of the fact that since 1970 our power consumption growth has eventually dropped from 8 or 9 to 2 or 3 %.

The official prognostics [1] reckon with 1.5% power consumption growth by 1995 and with a constant 2.5% after that, expecting a total consumption of 64 460 GWh for the year 2010. *(Figure 4.)* Now if instead of taking these figures we extrapolate what happened between 1970 and 1985 and assume that power consumption growth rate decreases by one percent point instead of two in every five years, than we come to 33 900 GWh, roughly half of what is officially expected for 2010 (with

an increase of +0.5% by 1995, of -0.5% by 2000, of -1.5% by 2005, and of -2.5% by 2010). What this means is that the total power consumption in 2010 will not be higher than what it was in 1983.

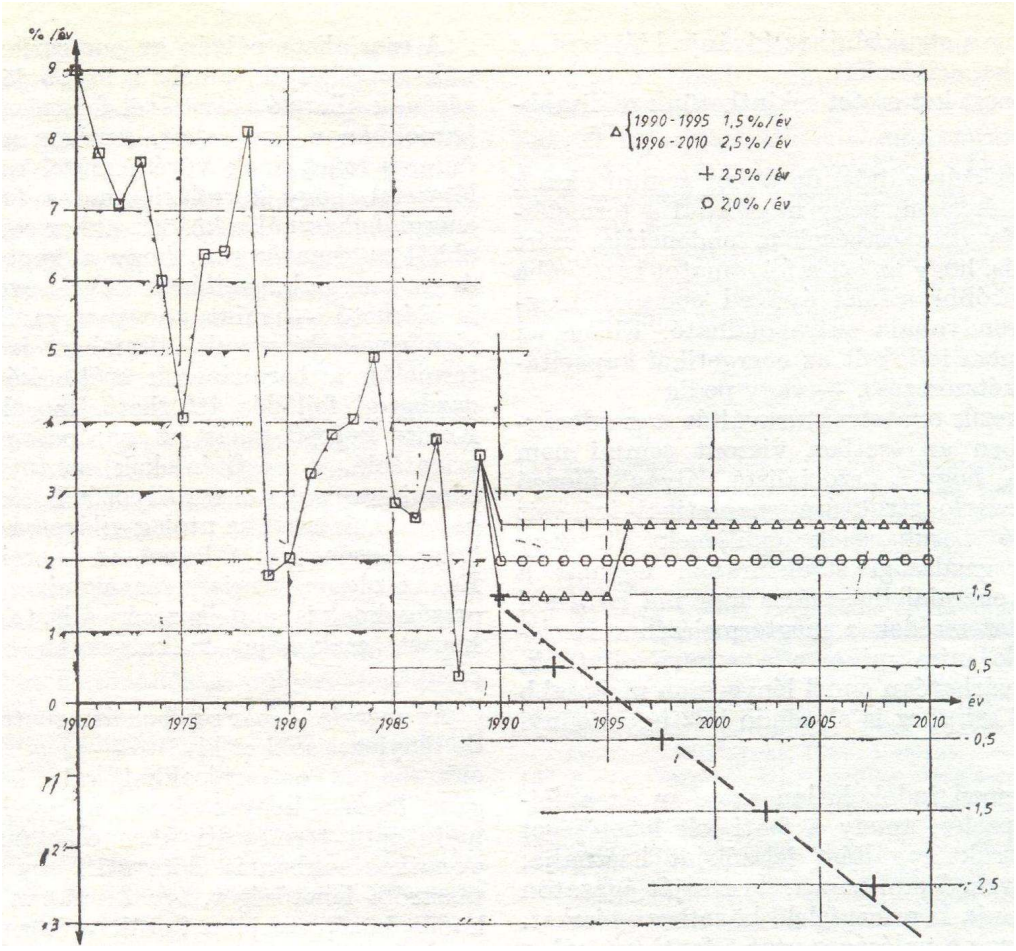

Figure 4 The yearly increase of the elecricity consumption

To those who would object that this is not serious, a mere juggling with figures based on the past decrease which was due to a decline in GDP, we should like to point out that the official prognostics based on economic growth (GDP) are in no way more serious. On the contrary, the official prognostics reckon with an economic growth due to a structural turnover while planning to provide for power supply capacities needed and measured only by those old structures.

Therefore what we need is to consider two alternatives:

- there will be no structural turnover: then there is no reason for us to expect that the GDP will stop to decrease. Therefore extrapolating the facts of the last

15 years is correct, and doubling the power supply capacities is not justifiable, or

- there will be a structural turnover: then there is nothing to justify our planning for capacities calculated by wasteful practices of structures moving along the "socialist trend" - what we have today would be more than enough if our production structures were updated, in fact it would suffice for a GDP twice the amount we have now and by the time we reach that level the same amount of power supply might be enough for an even higher level of production.

Now what is most certainly ***not to do***is to mix the elements of these two alternatives: economic growth is not to be used as a slogan - its premisses and consequences have fully to be considered, in every branch of the economy.

What we must know is this: ***we cannot afford*** to move along either of the two paths - we have to move off the past trend line which was and is the result of an extensive, self consuming, wasteful and pauperizing economy, and we have to try to approach the "European trend" as fast as we can. Now this cannot be achieved if we go on thinking wasteful - we simply cannot afford to implement capacities which are overrated today and will be overrated when we have achieved the turnover. We must see that even if there is some need for more power supply this will only be temporary: we are not to build new capacities to satisfy a merely temporary need - such needs should be covered by imports.

5./ ENVIRONMENT-ORIENTED STRATEGIES

International comparison shows that there exists apart from the socialist model a more effective strategy - though it does not show what this strategy is.

We must, however, see that even though the actual difference is huge the European countries never ceased to try to force their energy consumption down even more: they believe they need a structural turnover to achieve this goal...

In the social economy power supply is deemed to be a pushing industry - it has always been the promise for a better future and as such it has consumed the sources in a continued battle of distribution. Never, not even in the fourties when a correlation between more electric power and a higher degree of development was true, has it automatically been true that the two are in a causal relation with one another, just as it has never been proved that forcing new industrial capacities might lead to jumping several steps in economic development. Non-socialist countries with their market and profit oriented economies had an inbuilt regulator which forced them to produce energy with the less possible cost - this was an advantage. What we have to see now

is that this advantage was available also to all the socialist countries if they had chosen to see it: so the advantage is fictitious not real.

That a cost-conscious power supply has advantages has only appeared after the shock of the oil price explosion - and at the same time it became clear that we are to think of the future and of natural conservancy. Now we now that an ecological catastrophy is perfectly possible: it becomes evident that we must see how we can best prevent it.

This is what we mean by environment-oriented strategies: a complex consideration of the possible correlations, a balance of natural resources, the reckoning with the limits of the natural resources, the recycling of waste (enthropy). As a first step we need to identify the ecological bases, the philosophy - and only then can we proceed to find ways of how to cope with the problems.

Today, we believe, philosophy has a major importance: we need to know about and to identify ourselves with natural conservancy: it won't do merely to know what official regulations we are to satisfy. Official regulations should be considered a minimum requirement - to stop health impairing technologies, sooth, gas, steam, dust, radiation, noise immission should be a common-sense general requirement. Environment-oriented energy strategies are more than that: they should not be concerned with official regulations but with a complex consideration of the natural cycles involved.

We all only try to identify the main pillars of environment-oriented strategies - but what we can see now is that the European trends are nearer to such targets than we are. Therefore we should think there is nothing to lose in trying to approach what they do.

And what they do is to promote development by waste-free technologies, material and energy saving methods, and by an ambundance of information. In contrast, the socialist model is very strict on information while being wasteful in material and energy. This is a pattern contrary to modern technology, to natural conservancy, to the general rules of evolution and thus there can be no doubt that the decrease in GDP is no temporary phenomenon: it is the sign of a final dead end.

A free flow of information and a readiness to support any local enterprise is what suits natural conservancy. This is also in line with the general wish of individuals for an appropriate role in society which is unimaginable without sufficient information (self-employment, self-management, local autonomy). Those methods which were based on concentrating information have led to wasting material, resources, and energy, and those "economic" solutions based on limiting knowledge and responsibility by reserving the decisions to "central bodies" have proved to be wrong ("optimum-

size" companies, concentration of local government powers, of schools, of people which led to the depopulation of villages and smallholders's cottages).

Return on capital, loans, and projects ought to be seen in a wide context - and this applies to energy management as well. They ought to be seen in terms of their long-term effects on every aspect they might influence: this will be consistent with economic and ecologic considerations. Market oriented, profit oriented mechanisms are necessary and well- proven regulators to be built in, but they cannot be seen as the main values: today we all are badly in need of a new scale of values to pursue.

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6./ LIST OF REFERENCES

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