# Effects of electric power rationing on GDP in 2001

The following analysis is an attempt to estimate the impact of the energy crisis on GDP in the current year. Initially, the segments that will be most directly impacted by the shortage of this input and those that, for methodological reasons or their own specific characteristics, will not be significantly affected by the energy crises were identified within the structure of GDP. In the industrial sector, the subsectors of manufacturing, construction and public utility industrial services will be affected. The same thing will occur in the cases of the trade and transportation subsectors under the heading of services. The performance of crop/livestock farming and other subsectors of services will not be jeopardized, though they may suffer marginal impacts.

The results of the simulation described below indicate that the impacts of the energy crisis are situated in the interval between 1 and 2 negative points. However, one can observe preliminary signs evincing the possibility of a below the average estimate impact on GDP. Several factors will determine the magnitude of the impact of rationing on the activity level:

a) the independent generation of energy and the possibility of increasing generation at the moment;
b) the rechanneling of production to regions not affected by rationing;
c) the capability of substituting energy sources;
d) the rationalization of energy use;
e) the process of transfer of energy among sectors.

Among those factors, one should highlight the last one, which refers to the process of transfer of energy from segments in which the ratio between energy outlays and the value aggregated to product is high to other industrial segments. An IBGE recent study[1] indicates that the differences in this relation among industrial sectors is highly significant. One should also note that the sectors that have relatively higher levels of energy consumption and, therefore, are more sensitive to crises, have turned in more moderate growth levels in recent years. This factor could mean that the impact of the crisis on economic growth will be less intense. The following table summarizes this information.

One should note that the segments that have high intensity electric power expenditures consume 62% of electrical energy channeled to industry and participate with 26% of the value of product. At the other extreme, the segment with low intensity electrical energy outlays consume 13.4% of

1/ Presented by IBGE in a meeting sponsored by Fiesp on 6.7.2001.

**Industrial growth 1992-2001**

Percentage change

| Year | Level of expenditure on electric energy | | | Industry |
|---|---|---|---|---|
| | High | Medium | Low | |
| 1992 | -2.8 | -1.1 | -6.3 | -3.7 |
| 1993 | 6.0 | 7.4 | 6.7 | 7.5 |
| 1994 | 5.3 | 7.1 | 8.4 | 7.6 |
| 1995 | -0.3 | 0.1 | 6.9 | 1.8 |
| 1996 | 1.6 | 3.6 | 2.3 | 1.7 |
| 1997 | 3.4 | 3.4 | 4.3 | 3.9 |
| 1998 | -2.9 | 0.9 | -2.4 | -2.0 |
| 1999 | 0.6 | -0.7 | 0.0 | -0.7 |
| 2000 | 5.5 | 5.1 | 7.9 | 6.5 |
| 2001* | 1.9 | 6.5 | 10.6 | 6.8 |
| 1992-2000 | 17.1 | 28.5 | 30.1 | 8.2 |
| Participation on industrial aggregate value | 26.7 | 33.2 | 40.1 | 100.0 |
| Participation on electric energy expenditures | 62.0 | 24.6 | 13.4 | 100.0 |

Source: IBGE

* In 2001, up to April.

the electrical energy channeled to the industrial sector and account for 40.1% of product.Consequently, sufficient incentives exist for the wholesale energy market to come up with the best distribution for this scarce input, in such a way as to generate the smallest possible impact on overall product.

## Criteria utilized for the estimate

Considering the uncertainties involved in the functioning of the wholesale energy market, two scenarios were developed: in the first, no transfers of energy between sectors are taken into account and, therefore, the effective cutbacks by industrial segments are those defined in Resolution no. 8 of the Electrical Energy Crisis Management Council; in the second, electricity-intensive sectors undergo a greater reduction in energy consumption so that there is no need for other sectors to reduce energy consumption during the period of rationing in relation to the same period of the previous year.

The calculation of the impact on the product of the manufacturing industry considered the following model:

$$I = \sum_{j=1}^{n} [P_j . Ce_j . (1 - A_j) . (1 - ERS) . R_j . E_j]$$

in which:

I = impact on industry;

P = participation of sector j in industrial GDP;

Ce = the average cutback in effective energy consumption defined;
A = the percentage of independent generation of energy;
ERS = percentage of attenuation of the effects due to the process of restructuring, geographic rechanneling of production and substitution of energy sources;
R = the percentage of the production of sector j located in the region in which rationing exists;
E = the energy-product elasticity coefficient;
J = production sectors.

The average cutback in effective energy consumption (Ce) indicates the percentage of consumption of energy that each sector must achieve in the period from June to November of the current year, in relation to the same period of 2000, in order to comply with the target determined by the government.

The participation of the energy generated by the companies themselves (A) in relation to total energy consumption has increased in recent years from 10.16% in 1990 to 16.19% in 1999, according to data released by the National Energy Balance (BEN). The largest share of this generation is concentrated in energy-intensive sectors, particularly paper and pulp and steel.

In terms of geographic location, the southeast, central-west and northeast regions possessed 75% of the output of the manufacturing sector in 1998, according to Regional Accounts of Brazil, a component of the publication entitled National Accounts. This was the percentage used for the major share of the industrial segments, with the exception of electricity-intensive industries. For these, data on the regional location of the production of the five hundred largest electrical energy consumption companies in the country were utilized.

For purposes of analysis, it was admitted that energy rationalization processes, substitution of energy sources, as well as shifts in production to states located outside the area subjected to rationing will tend to minimize the impact by 50%. Recent information on capacity for reducing electric power consumption without affecting production flows, particularly in industries that are not electricity-intensive, as well as on increased imports and production of generators and energy generation equipment, indicates that the percentage used above may be underestimated.

The estimate of elasticity coefficients is based on the growth of industrial production and electricity consumption in the past two decades. For the manufacturing industry, monthly data on regional consumption drawn from Eletrobrás studies and regional industrial production figures calculated by IBGE were utilized and were put into logarithmic form for 1980 to 2000. The coefficient obtained was based on the weighting of the coefficients calculated for the northeast, southeast and central-west regions according to consumption in those regions and came to 0.58 (the same estimate,

using data at the national level, closes at 0.48). The elasticity of 0.58 was utilized in most industrial segments. For those itemized by Resolution no. 8, specific coefficients were calculated when available data made that possible.

The impact of the energy crisis on the public utility industrial services product was obtained directly by using a weighting factor of -20%, which corresponds to the government determined consumption average cutback, and the participation of the subsector in GDP (3.01%), since this segment refers almost entirely to the supply of electrical energy.

The calculation for the construction industry followed the model used for industry. Elasticity (0.59) was obtained by utilizing BEN annual data on the sector's energy consumption and output in the period from 1982 to 1999.

For the most part, growth in the trade subsector was a consequence of changes registered under crop/livestock and manufacturing industry product, weighted by the respective marketing margins. Therefore, the calculation for the sector considered the impact on these sectors and the effect of rationing on the trade segment itself.

Finally, in the item of transportation, the direct impact of energy restrictions is not particularly strong. However, the repercussions generated by the falloff in the activity level are expected to be significant. The calculation of the change was based on this second factor, considering its relation with GDP in recent years.

**Results**

The following table presents initial estimates for performance in 2001 in the sectors analyzed together with GDP before the energy crisis and in the two scenarios considered.

The impacts of the energy crisis on GDP growth are situated in the interval between 1 and 2 negative p.p.

| Itemization | Weight | Sectoral change (estimation) | | | Impact on GDP | |
|---|---|---|---|---|---|---|
| | | Initial | Scenario 1 | Scenario 2 | Scenario 1 | Scenario 2 |
| Manufacturing | 22.5 | 5.2 | 0.4 | 2.8 | -1.1 | -0.5 |
| Construction | 9.0 | 3.0 | -0.5 | 2.1 | -0.3 | -0.1 |
| Public utility industrial services | 3.0 | 4.0 | -2.3 | -2.3 | -0.2 | -0.2 |
| Transportation | 3.3 | 3.7 | 2.3 | 2.6 | 0.0 | 0.0 |
| Commerce | 7.5 | 4.5 | 0.0 | 2.4 | -0.3 | -0.2 |
| Financial institutions | 5.4 | 4.1 | 2.4 | 3.4 | -0.1 | 0.0 |
| GDP at market price | | 4.4 | 2.4 | 3.4 | -2.0 | -1.0 |

The results point to the importance of the process of transfer, rationalization and saving of energy. Particularly relevant is the process of transferring energy among productive sectors, in view of the magnitude of the gains for the economy as a whole, as evinced by the difference between GDP estimates in both scenarios. One should note the fact that the reduction in the energy consumption of electricity-intensive sectors considered in scenario 2[2] was determined in such a way that the other segments of the industrial sector would maintain the same level of consumption during the period of rationing as registered in the equivalent period of 2000. Simulations carried out by the Secretariat of Economic Policy (SPE) of the Ministry of Finance, in which optimum energy transfer among sectors is supposed, have indicated that the negative impact on output would reach 0.8 p.p.

2/ Based on Aneel data, it was calculated that the consumption reduction among electricity-intensive sectors needed to make scenario 2 feasible would be 39%, in a linear calculation. Should independent energy consumption be taken into account, this figure would be lower.