ESTIMATE OF THE ECONOMY IMPACT OF ELECTRICITY RATIONING TO THE ARGENTINE PRODUCTIVE SECTOR DURING 2007

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SUMMARY

In Argentina, within an electricity regulatory framework for the federal jurisdiction based on market mechanisms, the signs of prices and the economy decisions are based on values assigned to the Cost of Energy Not Supplied (CENS). However, within the regulation of the Argentine electricity market, these values have been fixed more than one decade ago and they do not present disintegrations for regions or system nodes.

Either under the conditions in the 90's when the decentralized solutions were favored, like in the new paradigm in which a State present is observed and with a certain planning vocation, the Reliability Value is the parameter of unavoidable reference to establish the CENS, and thus achieve the optimum adjustment in the subsystems of consumption and supply of an electricity system, in such way that it can reach the maximum net social benefit.

This paper has as its main objective to contribute to the discussion of this problem focusing mainly in the consequences of interruption of the service, originated under rationing conditions due to insufficient offer, in the productive sphere of the consumption subsystem of

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Argentina. For that the Input- Argentine Product (MIPAr-97) matrix technique is used, that offers an estimate of the CENS value, related to the external effects of the lack of supply in the productive sector of the economy. In particular the effects associated to the rationing, implemented by the Argentine government during 2007, have been quantified.

In the structure of the paper the following main parts can be identified: introduction of the problem, main outlines for the use of techniques of input product, results of their application, conclusion with comment on the consequences and implications for the Argentine electricity sector.

KEY WORDS: Energy Not Supplied, Input-product Matrix, Reliability Value, Rationing, Argentine Electricity Market.

1- INTRODUCTION

The implementation of a sectorial economy measure, e.g. the decision of applying an outline of energy rationing, needs a solid theoretical foundation, as well as an appropriate prospective analysis of the possible consequences in the economy system.

During 2007, the government has implemented an outline of electricity power rationing, limiting the consumption for productive uses, for a period of more than two months. In the paper, we have tried to carry out a first approach to estimate the impact that this electricity power rationing, has had on the Argentine GDP.

In the rest of the introduction some theoretical concepts are developed regarding the problem associated to energy rationing and of the importance of the appropriate estimate of its impact for the economy and in particular for the electricity sector. In section 2 the utilized methodology is described for the estimate of the economy impact, as well as the statistical information used in the model. In section 3 the results are summed up and in section 4 the conclusions are detailed.

1.1. Consumption and Supply Not Within the Optimum

Since Argentina reinserted itself within the growth path, one can observe between the media and the government a confrontation around an imminent energy crisis for the first ones, and the problems of quick growth for the latter.

Beyond the epithets, the characteristics of the electricity sector, where the investments take as a minimum two to three years in maturing, they determine the necessity to have tools to identify, in an early way, the maladjustments in two subsystems with independent dynamic characteristics: consumption and supply.

This independence of the subsystems implies that the growth speed of demand and offer can be different. In this sense, if the offer grows quicker than the demand, the costs are supported by the investors, in terms of smaller remunerations for the capital invested. However, in the other case, an increase of the vulnerability of the system takes place that can be represented as an increment of the electricity prices, and in the probability of having to ration a part of the demand; this rationing is known as Energy Not Supplied (ENS).

In the face of the eventuality of a maladjustment between offer and demand, in any market an adjustment of prices would take place to return to the equilibrium, specially if there were a surplus demand, the price would rise which would redound in a drop in demand, increase the offer, where the variations would depend fundamentally on the respective elasticity. Even when no market escapes this basic operation scheme, in the case of electricity there exist other restrictions, derived, on one hand, by the character imposed by the 1st Article of Law 24,065 that establishes the regulatory framework of the sector:

> 1ST ARTICLE: To characterize itself as a public service to transport and distribute electricity. The generation activity, in any of its modalities, totally or partially destinated to supply with energy a public service will be considered of general interest, affected to said service and framed within the legal and regulation norms that assure its normal functioning.
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> The public service character, has juridical type connotations, which impact on the economy operation, one can mention MATA (1995):

> "… for the doctrinal of the public service school, the activities dedicated to satisfy general interest are substantially different, due to their object, of private activities… The public services theory, on one hand was oriented to protect the citizens' rights"[2]

The author is clearer when he enunciates:

> From the economy perspective regulation presupposes a critical position facing the market, a prosecution in its form of working and of the voluntary actions of its operators, which gives place to a corrective policy of the so called market flaws"[3]

In this sense, one can mention for example, the stabilization System per quarter, of the prices foreseen for the Market Spot, dedicated to the purchase of the Distributors, which introduces delays in the transmission of price signal.

On the other hand, technical matters, as those mentioned in LASHERAS (1999):

> "The energy that can be taken from the transmission net for its consumption in a certain point and at a certain moment depends from the one being generated, transported and consumed in the different nodes of the net at that same moment. Any energy incorporation to the net, or any consumption, affects the whole system and can alter the capacity to inject generation or to satisfy the consumption of its different points."[4]

To the aforementioned complexity of coordinating offer with demand, one adds the impossibility of storing the electricity and its instantaneity character, all which forces to establish mechanisms to administer those situations in which the demand is superior to the capacity of system response, given by the available and prepared generating machines to enter into service[5], but also for the capacity of transport and distribution as mentioned by LASHERAS (1999), in cases of demand surplus the adjustment implies the interruption of the supply, that is to say rationing.

1.2. Dependability Value of the Supply

Independently of the origin of the non-adaptation of the system, rationing determines that

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[2] MATA, I. (1995), "Noción Actual del Servicio Público", Jornadas Jurídicas sobre Servicio Público de Electricidad, Buenos Aires, 8th and y 9th June 1995, Argentina. Ente Nacional Regulador de la Electricidad. Página 19.

[3] MATA (1995), Op. Cit., Page 23.

[4] LASHERAS, M. A., (1999), "La Regulación Económica de los Servicios Públicos", Ariel Economía, Barcelona, España. Página 254 y 255.

[5] On this matter, in Annex 35 of " Procedimientos para la Programación de la Operación el Despacho de Cargas y el Cálculo de Precios" it is specified that: "The perturbations due to an unexpected deficit or failures in the transmission net, cause a sudden non equilibrium between the offer and demand of electricity which causes a drop in frequency, and a risk in the loss of synchronism in the whole Argentine Interconnection System (SADI) or in a special area. To restore the equilibrium between offer and demand and avoid system collapse it is necessary to have an instantaneous reserve thru the automatic disconnection of loads, by means of overload relays."

a group of users cannot dispose of electric energy for which they would be willing to pay.

If in the common markets the signal that determines the adaptation of the offer and the demand is the price, in the case of the electricity sector, one needs a reference parameter to supplement the traditional signal.

This parameter is denominated Dependability Value, and it constitutes the corner stone to establish the Cost of the Not Supplied Energy (CENS). This is the value that is used to achieve the optimum adjustment in the consumption subsystems and the supply of an electricity system, and it affects the decisions of the agents in the three segments (generation, transport and distribution) in which the market was divided into by law 24,065, in the following way:

- Influencing in the cost assigned to the sending office of a machine fails in the market wholesaler,[6]
- Conditioning the Golden Rule to determine the public convenience of an amplification of transport, and,[7]
- Affecting the rebates that the distributors should reinstate to the final user by default of quality in the supply.[8]

In this economy sign, the interests and necessities of two generic types of users should be made compatible: the final consumption demands, for example a residential user, and the demands of the productive sphere, for example a aluminum producer company that needs a great amount of energy in its production process, and to which the inopportune halts mean to it, a significant profit loss.

With all the difficulties that this supposes, the appropriate determination of the value for

[6] Within the electricity Market, the maximum quantity, of Power that the system can offer, comes from the number of generators and from the transmission restrictions, factors which determine the Power price due to the marginal costs declared by the generators. The regulation establishes the concept of Machinery Failure, which allows to determine the Power price when the demand is higher than the offer; in the extreme case the value of the Power assigned to the last failure, is the Cost of the non Provided Power or Failure Cost.

[7] As Electricity Transport is a public service, so defined by Article 1 of Law 24065, investments should be approved by the "Ente Regulador de la Electricidad" (Electricity Regulating Entity). The general criteria used to determine the Convenience and Necessity of amplifying the transport, has as its objective to consider the social efficiency of the investment to be carried out, this mechanism is called the Golden Rule, which can be understood as the maximization of the net maximum aggregate benefit, of all costs (including those derived from non provided Power, as the amplification of transport capacity allows to diminish system Failure probability.

[8] In Argentine regulations, a Public Services Quality Norm scheme was adopted, which foresees sanctions on the Distributer in the cases in which the desired quality objective is not reached, i.e. a maximum number of cuts of more than 3 minutes. In such a case, the Distributer should reimburse an amount proportional to the time in which the service was interrupted, during the whole semester. When determining the values to be reimbursed to the affected users, the Failure Cost intervenes.

the CENS is fundamental for the operation of the Argentine electricity market. This work has as its main objective to contribute to the discussion of this problem, focusing mainly in the consequences that the interruption of the service, originated under rationing conditions due to offer inadequacy, has in the productive sphere of the Argentine consumption subsystem.

1.3. Rationing Administration

As was mentioned previously, rationing is reflected in an electricity power deficit. This is Energy Not Supplied (ENS) it is distributed in the system according to a series of procedures that come from the extended regulatory framework of the sector.

One of the alternatives, for an outline of administration rationing, consists on Programmed Cuts, which due to their character of Management Plan, exclude the situations of inopportune cuts. The forms of implementing the Programmed Cuts are the following ones:

- A geographical distribution of the rationing, in such a way that all the users, without discriminating their type, are affected by the supply interruption. This scheme was implemented in the Argentine energy crisis at the end of the 80's, as well as in the 1998 Chilean energy crisis.
- A distribution according to user type, in which certain types of users are mainly interrupted, for example productive uses, in order to protect residential uses.

Other alternatives are schemes for Demand Management or Energy Saving Plans. In situations in which dynamic non-adaptation takes place, in which the deficit is small regarding the total energy of the system, saving schemes can be implemented that are sustained in a combination of economy incentives (effectiveness of the price signal to attenuate the demand), and of moral incentives (commitment or social conscience regarding the necessity of the saving).

An example of the application of these measures based on the implementation of a penalties scheme due to higher consumptions, and of prizes for lower consumptions to a certain reference parameter, supplemented by a mediatic campaign to develop the Rational Use of Energy has been successful in Brazil at the end of the 90's, when the country had to

face a period of droughts that greatly reduced the capacity of response of its electricity system. However, in the case of present day Argentina, the implemented program is not giving the desired results, meanwhile residential consumption continues growing at a high rate.

1.4. Rationing Consequences

In the case of demand management, it is the users / consumers themselves, which carry out the election, adapting their behavior in function of the evaluation of the economy incentives to consume or to non-consume, we could not speak of ENS. However to whom the supply is interrupted, in inopportune form and due to the physical impossibility of maintaining the continuity of the supply, when in fact they would be willing to pay so that the service may not be interrupted, suffer a series of effects which could be interpreted as costs, direct and indirect, associated to the economy, social and organizational impacts.

In this sense, one can affirm that these costs, of re-organization, will be different in function of the characteristics of user's type, for example those derivates of supply interruption to residential users, regarding those that the industrial users could incur in. Literature identifies[9] the following characteristics of the impacts:

- The costs vary in function of the season of the year, and at the time of day when the cut takes place.[10]
- Differences exist on the impact if there is or there is not, prior notice.[11]
- The costs of the residential users tend to be lower than those of the commercial and industrial users, even when they are normalized to compensate the differences in the total consumptions.[12]
- The costs of the residential users tend to increase, more than proportionally, in the measure that they are considered as longer cuts, in other words the time average cost of an eight-hour interruption is superior to the average cost of a two-hour interruption.[13]

[9] To revise the International Literature one can consult: REVIS J., (2001), "Scoping Study on Trends in the Economic Value of Electricity Reliability to the U.S. Economy", LBNL-47911, Palo Alto C.A. (June 2001). EPRI. For a revision on Argentine literature one can consult: MUGUERZA, D.; KERSZBERG, E.; FERNÁNDEZ, R.; (2003), "Valor de la Confiabilidad en el Sistema Eléctrico – La Discusión Metodológica para su Determinación" (2003), CEARE – UBA.
[10] GILMER, R. W. & R. S. MACK. 1983. "The Cost of Residential Power Outages." The Power Journal. 4:55-74.
[11] SULLIVAN, M. J., B. N. SUDDETH, T. VARDELL & A. VOJDANI. 1996. "Interruption Costs, Customer Satisfaction and Expectations for Service Reliability." IEEE Transactions on Power Systems. 11(2):989.
[12] REVIS (2001).
[13] LEHTONEN, M. & B. LEMSTROM. 1995. "Comparison of the Methods for Assessing the Customers' Outage

- In contrast, the costs of the commercial and industrial users tend to drop, with the duration of the cut in a higher proportion than the lapse that the cut lasts, that is to say, the time average cost of a four-hour cut, is less than the cost of a one-hour cut.[14]

For the realization of the present paper one adopted a focus based on the identification of the consequences that the interruption of the service, originated under rationing conditions due to inadequacy offer, has in the subsystem productive sphere of consumption in Argentina, using a macro - economy methodology that allows to obtain average results for a given region or the domestic total, by means of the application of the Input-Product Model.

2. Input - Product Model

In the Input-Product Model it is necessary to clarify that in the writing of this point and in particular in the development of the calculation methodology one follows FERNÁNDEZ & MUGUERZA (2007)[15], it consists on the matrix representation of the economy of a country, and it constitutes an acknowledged instrument in economy planning. It is used to predict the effects which certain changes in the final demand of goods and services (family, government, and exports consumption), cause in the different sectors of the economy.

As enunciated by DI MARCO (1976), when this model is used for planning objectives it constitutes an open model, and the following procedure is applied:

> a) In function of the projected economy growth rate, the components of the final demand are determined, i.e., consumption, private and public investment, variation of inventories, government consumption, exports and investment for capital reinstatement.
> b) Once the "projected" final demand of the economy is determined, the production is obtained that each one of the sectors should reach.
> c) In a third stage the requirements of productive factors can be determined (manpower, benefits, etc.) per unit of final demand."[16]

This means that in the analysis, one considered that the Total Production of each sector of the economy is sold in the market, and that this production will be bought for its final

Costs." VTT Energy. TOLLEFSON, G., R. BILLINTON & G. WACKER. 1991. "Comprehensive Bibliography on Reliability Worth and Electrical Service Consumer Interruption Costs: 1980-1990." IEEE Transactions of Power Systems. 6(4):1508-1514.

[14] SULLIVAN, M. J., T. VARDELL & M. JOHNSON. (1997). "Power Interruption Costs to Industrial and Commercial Consumers of Electricity." IEEE Transactions on Industry Applications. 33(6):1448-1458.

[15] In said work, the methodology for the use of the Matrix Input Product is more precisely detailed, in matters related to the determination of Trustworthiness value.

[16] DI MARCO (1976), Op. Cit., Página 80. The words in italics are the author's own words-

consumption (Final Demand), or to be used in the process of production of some sector[17] as an input (Intermediate Demand). The electricity power presents a clear example to understand the above-mentioned, on one hand a kWh can be consumed by a family in form of lighting during the night, or it can be used to drive a watering pump for the production of cereals, which will later enter as an input of another productive sector.

The interaction among all the economy sectors and the assignment of the production of each one to the categories of intermediate goods or final consumption goods is captured as from the monetary flows that represent the purchases of all the goods and services of the economy.

In this paper, the data will be taken from the INDEC's 1997 Input-Product Argentine Matrix, in which 124 activity sectors[18] are defined and macroeconomic simulations will be carried out by the Coefficients of Direct and Indirect Requirements of Production Matrix. It must be highlighted that the use of the MIPAr 97 supposes a disadvantage that conditions the results of this paper, since ten years have lapsed since the last estimate of the Argentine matrix.

In that period the country has suffered a recession that lasted 4 years, ending up in an economy crisis toward the end of 2001 which resulted in a fall of the 2002 GDP of more than 22% regarding its level in the previous year[19] in that year the total Fixed Gross Domestic Investment, represented only 51% of the average for the 1993-1998 period, and the investment in Durable Equipment of 40% of the average for the same period.

On the other hand, after getting out of the crisis, a new economy model has been implemented in Argentina, with a significant change in relative prices, which is producing a reassignment of resources (investment) towards the new dynamic sectors of the economy, and all these changes would imply modifications in the production coefficients which the focus assumes as fixed. Anyway, the results obtained by this method always constitute a good reference to compare the values obtained by other methods, and in this resides the main contribution of this paper.

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[17] This situation does not exclude the sales to an industrial sector, the same industrial sector (Own Consumption), for its use as an input.

[18] The activity sectors are the industries in the terminology used previously.

[19] The drop accumulated during the whole period, 1998-2002, considering the highest and lowest, within the GDP, was above the 27%.

2.1. Rationing in the model I-P

The analysis based on the Main Input - Product Matrix is frequently used in economy studies or of global planning. In the specific case of the Electricity Sector, the method can be apply to answer questions such as: How much electricity would be necessary if one wished to increase the aluminum production sector in 50%?, how much would the total electric power consumption increase if one motivates watering in the Agricultural Sector?

In the case of queries referred to interruptions in the supply of energy, the method presents a limit as long as it does not contemplate the re-calibration and restart costs of the production teams, reason why it cannot be applied to the brief interruptions, when the derivative costs of the discarded production, as those that originate in the restart process, are proportionally more significant than the lost production values. In this sense, the Main Input -Product Matrix, will only allow to estimate the impacts of long inopportune interruptions, or of those derived rationing programs.

On the other hand, as pointed out in CHIANG (1987), the Final Demand in the input - product model is considered exogenous and conditions the necessary production, that is to say the Total Demand[20]. In particular, to understand the functional relationship proposed in the model, it is convenient to remember that one is presupposing a production Leontief technology, or of fixed production coefficients, which means that to increase the production of an industrial sector, the use of all the necessary inputs will increase automatically in the proportions established by the matrix, that is to say, that they are not allowed neither considered processes of substitution of inputs[21].

In the case of application of rationing evaluation, the model allows to quantify the impact that an interruption which affects the Final Demand of the Electricity Sector, has in the whole economy, which one can obtain multiplying the inverse of Leontief's matrix, for a vectorial rationing: in mathematical terms, $\left(I^{(n*n)} - A^{(n*n)}\right)^{-1} d_{rac}^{(n*1)} = X^{(n*1)}$ [22] where $d_{rac}^{(n*1)}$ is the vectorial

[20] The functioning of the Input – Product Matrix, can be seen in CHIANG (1987), Page: 120 to 129.

[21] The characteristics mentioned, as the inputs fixed relation, are related to the simplifying hypothesis in which the mentioned model is based on, mentioned by CHIANG (1987), Page 121.

[22] The notation used, is conventional in the matrix models $I^{(n*n)}$ it is the matrix identity to the umpteenth value

rationing, in which the components are all zero except the ones corresponding to the electricity industry where it is completed with the equivalent monetary value to the physical interruption of the supply. In this way it is supposed that the final demands of the different sectors remain constant while the electricity demand decreases in a certain proportion. Additionally, the vector $d_{rac}^{(n*1)}$ can be interpreted as an energy saving vector, to estimate the convenience of promoting plans of energy saving in the residential uses, and the reassignment from those energy quotas to the productive sector.

2.2. 2007 rationing in Argentina

During the 2007 winter, as there were exceptional days of extreme cold, and starting off from a systematic growth of the electricity demand, the government decided to implement a rationing program focalized on the industrial users, preserving the supply of the residential users.

When this paper was edited, we did not have official figures on energy billing, or of energy not supplied during the validity of the rationing program. To approach the total energy supplied to the productive sector they considered as basic data the following elements, published in two widely read domestic newspapers:

- The rationing period was a total of 69 days[23]
- During the first 54 days the productive sector was required to reduce 1200 MW between the 4 PM and Midnight, then it was you flexibilized to a reduction of 800 MW between the 6:00 PM and 10:00 PM.[24]
- The existence of two rationing types is pointed out, one described in the previous point

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$A^{(n*n)}$ it is the matrix with the inputs coefficients, the difference between said matrixes is called technological matrix, which multiplied by $X^{(n*1)}$ which is the intermediate demand vector to satisfy the final demand $d^{(n*1)}$ Applying matrix algebra, one can clear the final demand vector, for which it is necessary to post-multiply the inverse of the technological matrix by the intermediate demand vector. For more details see CHIANG (1987). The specific application to this case can be seen in FERNÁNDEZ & MUGUERZA (2007) where the same notation is used, and the components of each matrix are detailed.

[23] "Terminaron los cortes de luz a empresas", (Enterprise Light cuts, are over.) Published in La Nación On Line, on 27th August 2007: Short Link:_http://www.lanacion.com.ar/938306 ".

[24] "Empezaron a reducirse los cortes diarios de electricidad a las empresas", (Enterprise Light cuts have begun to be reduced) Published in La Nación On Line, on 14th August 2007: Short Link: _http://www.lanacion.com.ar/934375_. Also in "A partir de hoy reducen los cortes de electricidad a las industrias", (as from today Enterprise Light cuts have been reduced) Published in Digital Clarín, on 13th August 2007: Short Link: http://www.clarin.com/diario/2007/08/13/elpais/p-01401.htm"

called the OFFICIAL one, and a NON OFFICIAL rationing that implied an additional reduction of 400 MW to those declared by the government's departments.[25]

- Starting off from the information of the previous data one can infer that the not supplied energy could have reached a theoretical maximum between 566 GWh and 763 GWh, for the official and not official rationing respectively. The calculation form is direct and it consists on multiplying the power interrupted by the total of hours that the outline of supply reduction would have lasted, with which the hypothesis of maximum is estimated of the aforementioned not supplied energy.

2.3. Parameters used in the calculation

The quantification of the impact of the 2007 rationing was carried out on the 2006 GDP values, and is established in terms of non produced added value.

The data corresponding to the input-product matrix correspond to the regrouping of the 124 activities of the MIPAr 97, in a more reduced group of only 11 activities or industries[26] the values used are shown in CHART N° 1. This simplification does not produce loss of generality, neither decrease in the precision of the estimate by the nature itself of the algebra matrix that underlies in the model, at the same time it allows to visualize the impact in a clearer way.

[25] "Terminaron los cortes de luz a empresas", (Enterprise Light cuts, are over.) La Nación On Line. Op. Cit.

[26] The Electricity Sector belongs to Activity N° 93 in the matrix. According to the MIPAr-97 methodological annexes of this activity, it is the generation, reception, transport and distribution of electric energy. The separation of this sector is carried out due to the convenience of the time to carry out the rationing. <http://www.clarin.com/diario/2007/08/13/elpais/p-01401.htm>

CHART N° 1			
In millions of 1993 pesos	**INTERMEDIATE DEMAND**	**FINAL DEMAND**	**TOTAL DEMAND**
A. and B. AGRICULTURE, CATTLE RAISING, HUNTING, FORESTRY AND FISHING	19,261	17,761	37,227
C. MINING	6,703	5,219	11,981
D. MANUFACTURING INDUSTRIES 5	60,123	54,97	115,739
E. ELECTRICITY SUPPLY	6,401	4,187	10,634
E. GAS AND WATER SUPPLY	1,518	4,836	6,369
F. CONSTRUCTION	3,648	20,751	24,428
G. AND H TRADE WHOLESALERS AND RETAILERS - HOTELS AND RESTAURANTS	11,939	49,666	61,733
I. TRANSPORTS AND STORAGE MAIL AND TELECOMMUNICATIONS	18,121	33,049	51,342
J AND K. FINANCIAL INTERMEDIATION REAL ESTATE ACTIVITIES	36,708	55,299	92,352
L M N PUBLIC ADMINISTRATION AND DEFENSE – EDUCATION - HEALTH	4,074	41,310	45,411
O AND P OTHER COMMUNITY SERVICE ACTIVITIES	8,125	18,854	27,046
TOTAL	176,622	305,906	484,262
SOURCE: Own Elaboration with Data from MIPAr 97 – INDEC			

In the input - product matrix monetary values corresponding to each concept are used, so to establish the physical magnitude of the interruption, in energy units, Electricity Market specific information was used. In accordance with the 2005 Electricity Sector Report, the energy billing among all the users (Residential, Commercial, Industrial, etc.) totaled 81096 GWh in the year, of which 23577 GWh corresponded to Residential use, which represents 29% of the invoiced total, according to the INDEC the electricity supply demand grew a 9.1% in 2006, so that the total invoiced energy would have reached 88476 GWh, to which the same proportion will be applied between demand for Residential uses. On the other hand, the e 2006 electricity power offer of 104033 GWh (energy generated plus net imports which would be similar to the invoiced energy plus the losses)[27].

To discriminate the physical quantities corresponding to the Electricity Final Demand, to those attributable to Electricity Intermediate Demand to the first concept, the entirety of the energy corresponding to Residential use will be assigned, the rest of the uses identified in the Electricity Sector Report, will be assigned in block to the second concept. Finally, the losses

[27] In this paper we do not distinguish efficient losses, black losses due to energy robbery, and losses are considered as a whole, which constitutes a characteristic due to the electric system
<http://www.clarin.com/diario/2007/08/13/elpais/p-01401.htm>

are distributed proportionally between Final Demand and Intermediate Demand, according to the energy invoiced.

3. Alternative Rationing hypothesis

Even when it is clear that the government's objective of protecting the residential users from electric power supply interruptions, relapsed on the productive sector, one would need to establish which really were the sectors affected by the interruptions for calculating the economy impact on them.

For this the following alternatives were analyzed:

- Hypothesis 1 - Pondered Distribution of the interruption: This scenario presupposes that the impact affects the growth rate of each productive sector within the measure in which each sector contributes to the growth of the GDP.
- Hypothesis 2 - Interruption in the Manufacturing Sector: This scenario presupposes that the rationing is applied entirely to the Manufacturing Sector, and the rest of the sectors do not suffer rationing
- Hypothesis 3 - Interruption to the Residential Sector: In this scenario the impact of applying an equivalent rationing to the residential users, is established.

The rationing impact, for each considered hypothesis, measure in terms of the 2006 GDP are shown in CHART N° 2 and corresponds to the scenario of OFFICIAL rationing.

CHART N° 2			
In millions of 1993 pesos	Hypothesis 1	Hypothesis 2	Hypothesis 3
A. and B. AGRICULTURE, CATTLE RAISING, HUNTING, FORESTRY AND FISHING	-40	0	0
C. MINING	-1	0	0
D. MANUFACTURING INDUSTRIES 5	-836	-2053	0
E. ELECTRICITY SUPPLY	-3	0	-79
E. GAS AND WATER SUPPLY	-4	0	0
F. CONSTRUCTION	-229	0	0
G AND H TRADE WHOLESALERS AND RETAILERS - HOTELS AND RESTAURANTS	-642	0	0
I. TRANSPORTS AND STORAGE MAIL AND TELECOMMUNICATIONS	-322	0	0
J. AND K. FINANCIAL INTERMEDIATION REAL ESTATE ACTIVITIES	-416	0	0
L. M. N. PUBLIC ADMINISTRATION AND DEFENSE – EDUCATION - HEALTH	-153	0	0
O. AND P. OTHER COMMUNITY SERVICE ACTIVITIES	-71	0	0
TOTAL	-2717	-2053	-79
Impact on the GDP Growth	-.89%	-.68%	-.03%
SOURCE: Own Elaboration with Data from MIPAr 97 - INDEC			

If to the OFFICIAL rationing the so called NON OFFICIAL rationing had been added, the impact in terms of not generated GDP would have been of -1.20%,

-0.90% and -03% for Hypothesis 1, Hypothesis 2 and Hypothesis 3 respectively.

4. SUMMATIONS

4.1. On Rationing Impact

In this paper different hypothesis have been proposed to quantify the impact, that the energy rationing implemented by the Argentine government has had on the 2007 GDP, characterized by centering itself on the productive sector. Of the obtained values it is clear that to ration the productive sector, that is to say to limit the intermediate demand of energy, leads to reductions of the GDP much higher to the possible impact of a rationing on the final demand. However, the strategy followed by the government, of concentrating the rationing on the manufacturing sector, is shown as a better strategy than its distribution in the whole spectrum of productive sectors.

When this paper was edited there was no information regarding the evolution of the GDP for 2007's third quarter, with which to contrast the prediction of the model. However, the Industrial Monthly Estimator (IME) that is used to measure the performance of the manufacturing sector showed a deceleration in the annual growth rate that from averages superior to 8% for 2005 and 2006, fell in July 2007 from 3.6% regarding July 2006. Even when the methodologies of the IME and the estimate of the GDP are not comparable, the annual growth of the GDP manufacturers showed consistent figures with those of the IME in the previous years.

If one considers that the GDP manufacturer grew to average values of 8% annually and that the model estimates a drop of between 3.7% and 5% as an impact of the denominated OFFICIAL and NON OFFICIAL rationings, the values shown by the IME would be consistent with the prediction of the impact carried out by the model.

4.2. Elements for future discussions

It fit to highlight that during the months of August and September 2007, the IME has shown a very quick recovery, with high monthly growth rates that placed the industrial development in the habitual annual growth averages in 2005 and 2006. A possible explanation for this situation would be the process of inter-temporary substitution that means to diminish the production in the rationing months and to recover the lost ground in the subsequent months.

To conclude, and independent of the general consistency between the estimates and the evolution of the statistical series, it is convenient to point out that the economy would have begun the recovery during the month of August, during which rationing plan was still effective.

This apparent discrepancy would reflect the defensive behavior of the manufacturing companies, starting off from the substitution process among electricity power networks, for other provisioning outlines (for example self-production), phenomenon which is not contemplated by the methodology of the input product matrix which presupposes the substitution impossibility when considering an outline of fixed coefficients.

BIBLIOGRAPHY

Pleace refer to article`s spanish bibliography.