Int J of Energy, Env and Economics ISSN: 1054-853X
Volume 17, Issue 4, pp.

TERTIARY NETWORK MODELING IN ITS BUILDING, ENERGETIC AND PRODUCTIVE DIMENSIONS. DETERMINATION AND COMPARISON OF BEHAUIOUR CARACTERISTIC PROFILES OF HEALTH AND EDUCATION SECTORS

Discoli Carlos* * *and San Juan Gustavo
Unidad de Investigación N°2, "Hábitat y Energía"
Instituto de Estudios del Hábitat (IDEHAB),
Facultad de Arquitectura y Urbanismo (FAU),
Universidad Nacional de La Plata (UNLP)
Calle 47 N° 162, CC 478. La Plata (CP: 1900), Argentina

ABSTRACT

Results showing suitable methods and mechanisms to know and model relevant variables in building tertiary networks are presented. Those data were used in Health and Education aspects. Due to complexity and diversity of the analysis, characterization indexes and profiles for each sub-sector were done in order to fully integrate all the information, and thus to know the real status of each network. In a second stage, the organization as a function of the equal distribution of all the involved resources will be inferred. Regarding energy, "early control" techniques will be designed to evaluate potential savings in each network.

1. INTRODUCTION

Our research group has been working for over a decade to elucidate and understand those processes dealing with urban and regional management which means "the assembly of different resources (human, financial, organizational, political) to control the production, regulation and maintenance of the city" (Pirez P., 1991) (Pirez et al., 2003). Several research projects as PIGUR, a "Computer program of urban-regional" management (Rosenfeld E. et al, 1997) and Methodologies for the control and early diagnosis applied to tertiary network"

* Investigador CONICET: Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina. E-mail: discoli@rocketmail.com

(Health, Education, commercial, Administration) have been developed (Discoli Carlos et.al., 1993-95). All of them allowed the study of their individual features on different scales (complexity of each netting node). Building networks were considered as a group of buildings in charge of functioning, management control, public services, materials within a geographical unit, giving rise to a spatial physical system.

This work shows graphical and numerical results that integrate and typify interactions of each sub-section. Also, they allow modeling and comparison of each network behavior at a global scale to the different variables related with construction aspects, energy and services. The framework in which this work and the projects have been developed, need to define some terms:

Management has been considered as a structural inter-relationship of significant variables such as supply and demand as well as dynamics of each activity, pointing out the habitat service production – energy relationship. Structural variables, in general, typify processes of each sub-section. Some of them have been considered as critical since they risk quality and efficiency of services. Particularly, we are referring to the ones related with territory, region, climate, energy, design and construction, social, services and economics. The analysis of those behavior patterns allowed us to devise new processes and modeling strategy.

Units of analysis that have been studied were the *service networks*, and we considered them as concept and not as object. This represents a new idea, referring to a new spatial organization. It shows quite clearly those relationships such as space – time –information – region; they are the main features of modern societies (Dupuy G., 1991). On the other hand, we are aware that either the existing information, or the statistical treatment techniques, do not account for certain changes in a region. This infinite ways and communication types, with a logic technique, economical or informative content, must take into account the different networks and circuits characteristics, associated to that territory, so as to achieve an efficient management.

Buildings have also been considered as units of analysis, working as netting nodes. They were also considered as models for each sub-section, or elements in a given system or physical spatial sub-system. Concerning some sub-sections of the State they were found to participate in a system involved in policies or programmatic lines, and they have common objectives (Katz, J. 1993).

The implementation of the developed methodologies and computer systems such as SALUD version "β_2" for the homonymous sub-section facilitated the transfer of experience to the sub-section of education for the development of EDUBA version "β_1" (San Juan G., 2001). Features of each experimental field were analyzed and incorporated; structural differences were observed in relation to:

(i) The continuous- discontinuous functioning (at phase with sun resource)
(ii) Building structure with high and low complexity
(iii) Requirement for high, medium and low energetic density
(iv) Provision of services in each network

The universe to be analyzed is numerically asymmetric. Regarding Health, there are a few buildings with intensive energetic features whereas in Education we have found a large number of buildings with medium and low energetic density.

Table 1. Private and Public buildings were considered en La Plata, Berisso and Ensenada surroundings. 1995

	Building N°	Habitant/ building	m^2 / Bed / Desk	m^2/Institution	Built Area (m^2)	Comsuption ($kWh/m^2 year$)	Building Half Comsumption (kWh/year)	Energy Consumed in studied area (kWh/year)
Health (*)	70	9.499	79	5.205	364.350	231	1.205.508	84.385.620(38,6%)
Education (**)	503	1.321	2,3	763	383.789	70	53.452	26.886.160(12,3%)
Total Energy consumption, for both sectors.								111.271.780 (51%)
Total Energy consumption, for the Tertiary sector.								218.486.000 (100%)
(*) Acute; (**) Initial, Primary, Secundary. Se consideraroon establecimisntos estatales y privadops de La Plata, Beriso y Ensenada. 1995.								

If we study both sections, energy consumption is quite relevant. This means an important energy demand at a regional level of around 50% of tertiary section consumption. This study was carried out in an area covering the cities of La Plata, Berisso and Ensenada, Argentina, at 34° south latitude, 994 degrees, on day 18 (See Table 1). Consequently, the study of energy behavior with relation to building space and services in both sub-sections allowed us to infer that there is an important saving field based on the policy of the efficient used of energy (UEE).

2. Patterns and Comparison of Characteristic Profiles

Modeling of complex networks implies, on the one hand to know and determine the behavior of: structural variables that define the whole problem, and the critical ones which are essential to characterize a process, its interrelationships; design behavior patterns; detect and quantify distortions in order to obtain diagnoses (San Juan G., Discoli C., Tesler J., 1996), and on the other hand to facilitate new fields of action.

The use of different methods, including Statistics, allows the determination of correlation degrees and curves of behavior that play the role of standards for the system and its different scales. This is carried out in a delimited pilot area, Region I, covering the districts: La Plata, Berisso, Ensenada, of the Education sub-section, and XI Sanitary section of Health sub-section. The use of patterns have facilitated the development of alternative single-layer models, using diffused logic in order to obtain the energy demand, thus fulfilling the modeling of the systems (Discoli C., Romero F., 1996, 1997)

Figure 1 displays the interaction of two variables, correlation degree, the STD curve, and the involved dotted area (netting nodes –institutions). The distance from each node to the curve shows the distortion between it and its standards. This mechanism facilitates the detection, and graphical numerical quantification of the dispersion degree for the different network components in each variable analyzed.

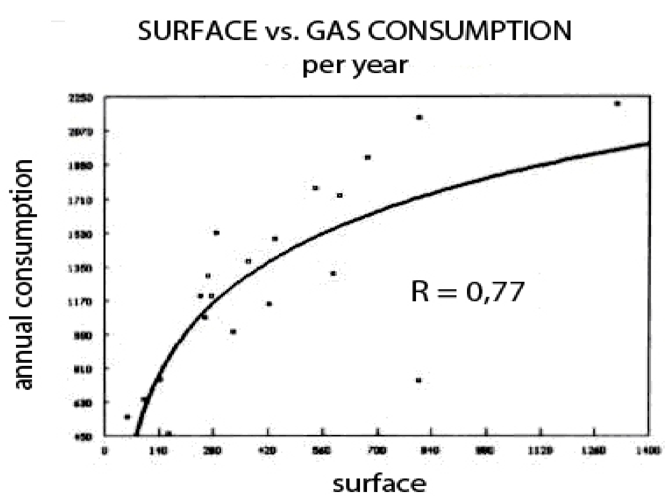

Figure 1. Logarithmic correlation. Surface versus gas consumption per year. Education sub-section. Level Pre-school.

After a process of variable and dimension concentration as well as curve integration, diagrams of multiple inputs and outputs (characteristic profiles) are built up. They also show how to visualize the network dynamics according to standard patterns. Diagram construction for the different networks facilitates the definition of weight in the structural variables (Discoli C., 2009), (San Juan G., 2001). These typical global profiles may be separated into:

(i) Level of complexity (educational levels: starter (initial), EGB (primary), senior "polimodal" (secundary), etc; and levels of sanitary assistance according to the service: complexity I to X for patients (acute, chronic or both).
(ii) Construction technology (mainly considering education as the most predominant one).
(iii) Building production in relation with the representative types, this means in relation with the own actions of each company: offering services, personnel, demand and its dynamics.
(iv) Type of service use (continuous or discontinuous)
(v) Classification according to size proportion among the affected variables.

The generation of typical profiles based on the historical production of networks leads to the analysis of annual cycles and/or periods of institutional management; thus modifications related to variable behavior may be observed in accordance with the different scenarios.

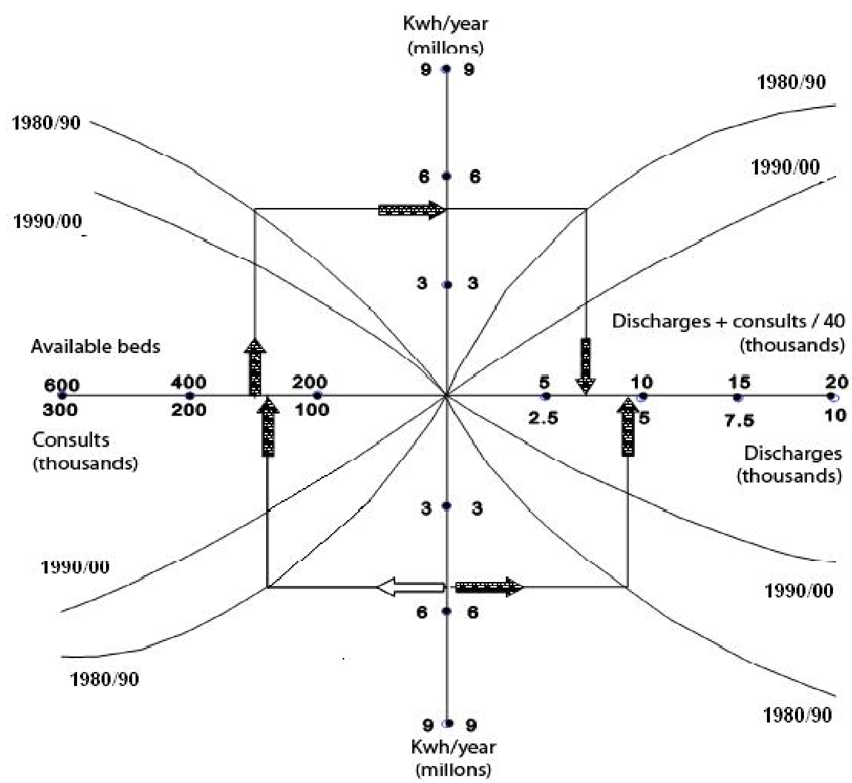

Figure 2. Annual energy versus production. Health section.

Figure 2 depicts changes in energy consumption versus production that are related to policies of privatization, carried out during the decade. At that time, public construction started being responsible for its expenses, evidencing a marked reduction which can be seen on these curves.

An appropriate combination of variables allowed us to build up theme diagrams and to compare them with national and international standards as well as between networks. For instance, profiles from both networks, relating equivalent and comparable variables such as surface, energy consumption, production and personnel, are shown.

Concerning Health network, Figure 3 shows, and refers to hospital for “acute“ patients. There complexity of the buildings were related to the number of beds, building area, consumption, quantity of medical services, hours of medical attention to ambulant patients, as well as those in the hospitals. In brief, this diagram depicts the “true” global pattern of structural variables within the hospital network. Concerning the design of future projects, this methodology allows us to measure the operative capacity of buildings, the necessary area and the energy demand that can be obtained as a function of needs (for example, number of beds, or energy).

Figure 4 shows in a global and separate way the relationship between nurses, number of available beds, production and expenses according with the different stages.

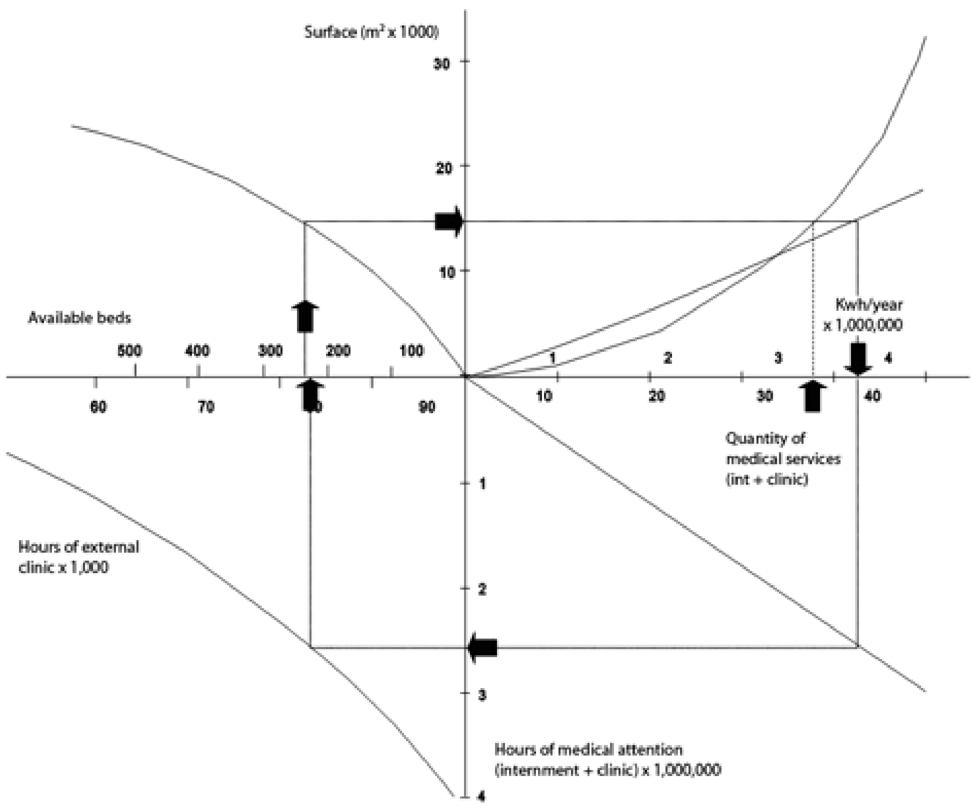

Figure 3. Global behavior of structural variables. Health sub-section.

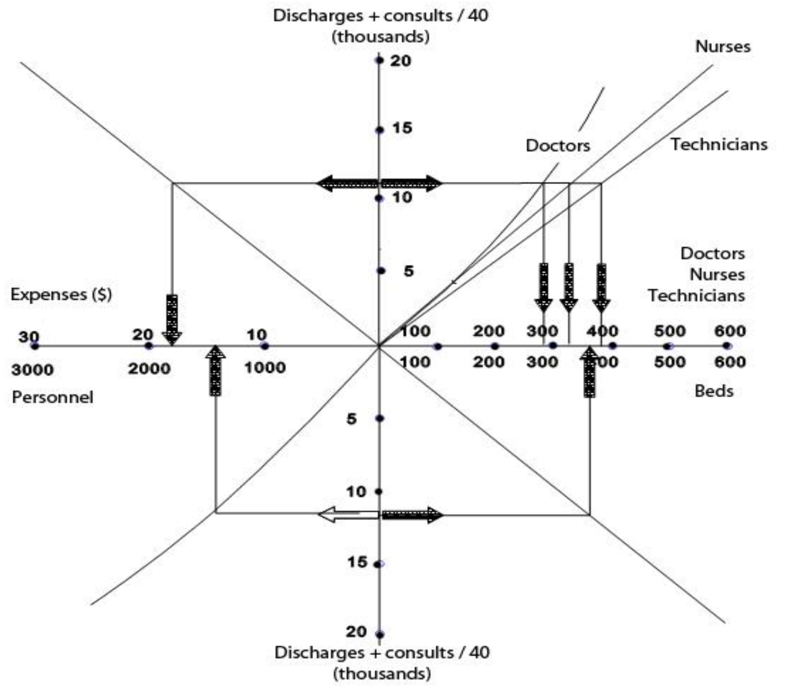

Figure 4. Personnel and expenses vs. production. Sub-section: Health.

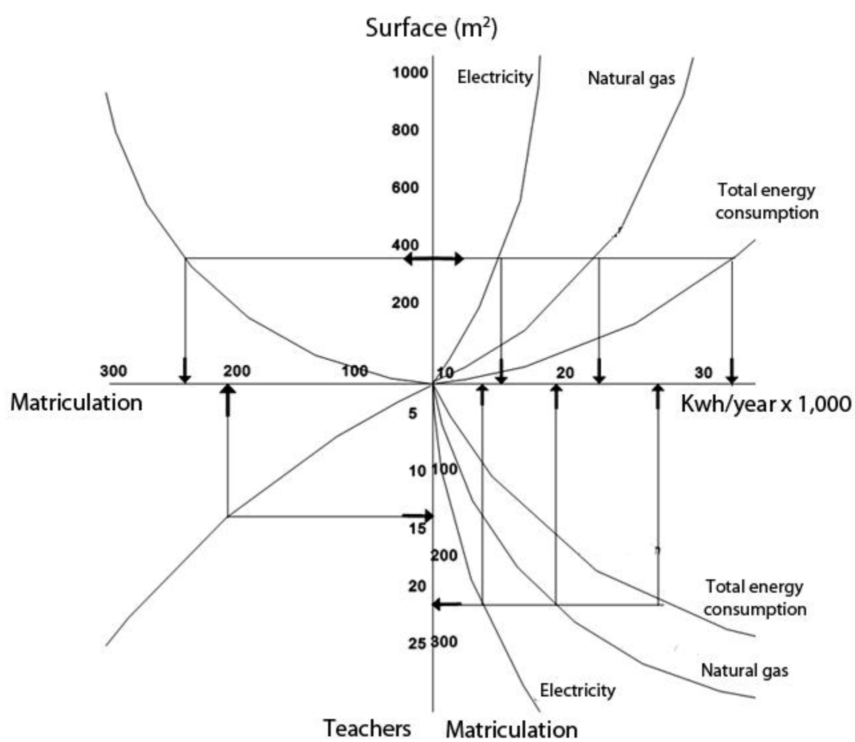

Figure 5. Global behavior of structural variables. Education sub-section.

Figure 5 displays a global view of the structural variables at pre-school education level: matriculation, covered area, teachers and energy in agreement with the consumption of electric energy and natural gas network. Data may be contrasted with the present situation after the implementation of the Law of Federal Education (approved in 1993) as well as concerning the improvement of qualitative and quantitative conditions derived from new buildings. This law led to a re-distribution of matriculation at each level as well as capacity changes in the network, affecting energy consumption.

Figure 6 links indicators of current use such as the relationship between surfaces: free land, total covered area and rooms, giving rise to the availability degree of each buildings based on the surface and the proportion of rooms and other parts. Thus, the relationship between these two variables was determined according to different degrees of proportionality (free surface, covered surface= 1:1; 1:2; 1:3 and free surface + covered surface = 1:2; 1:4) in order to arrange different facts. We must bear in mind that this variable depends on the real estate market, urban land availability and the demand of new construction as well as enlargement.

Figure 7 shows in detail the energy variable of heating related with matriculation and surface. The estimated consumption was modeled taking into account real buildings. Regarding the covered/matriculation ratio, compared with acceptable standards (current law of the Ministry of Culture and Education) for pre-school level, the covered area is 216,00 m^2 = 3,00 m^2/student. For the analyzed network, the average is 431,00 m^2, the value is 1,3 m^2/student; it means 56% under the acceptable value.

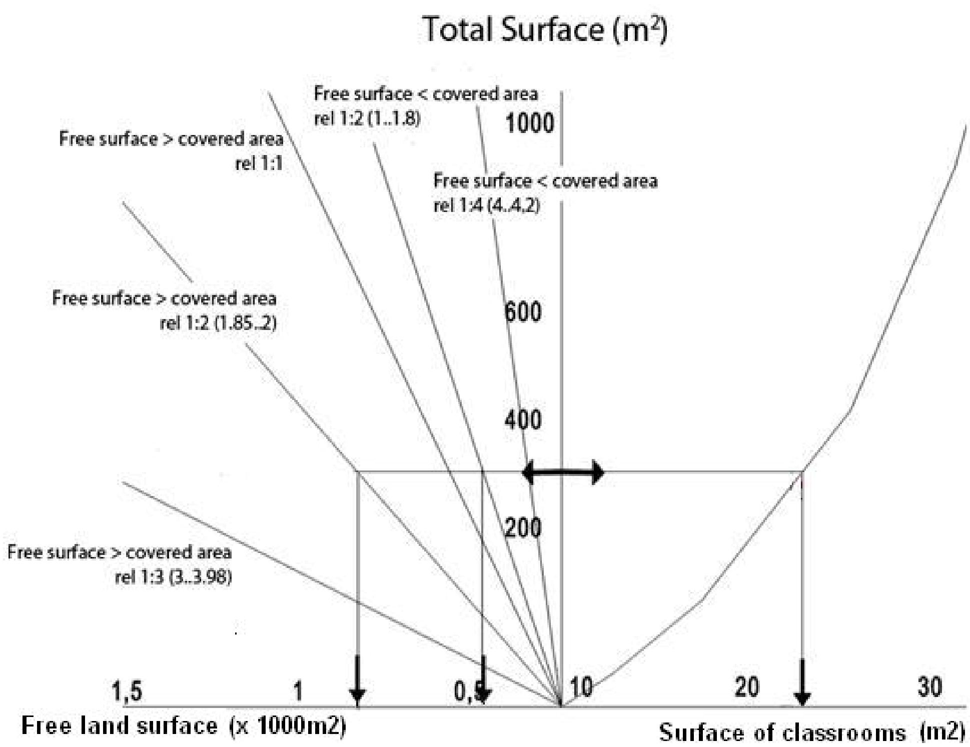

Figure 6. Area indicators. Education sub-section.

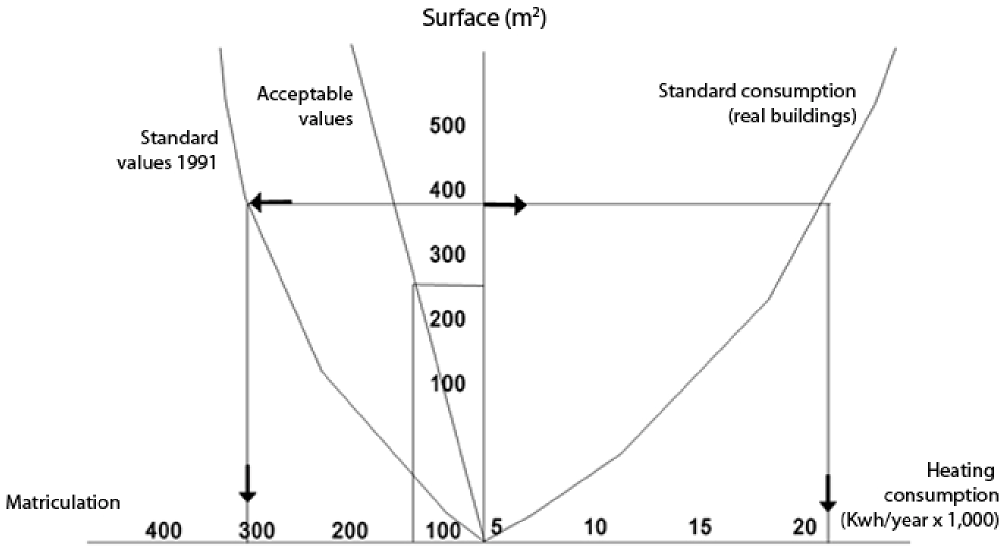

Figure 7. Special features. Matriculation, surface, heating consumption. Education sub-section.

CONCLUSIONS

Both sub-sections here described show a marked discrepancy between energy demand and density. Despite the fact that the covered area is similar, the number of schools in this area under study, is seven times higher than that of hospitals, and the energy consumed in the second sub-section is tree time higher. This picture denotes a greater distribution in the first section and a large concentration in the second one. If all the sections are considered, an energy density pattern could be made in order to estimate differences. On the other hand, this network could be evaluated according to acceptable and optimized standards (see Figure 7).

This mechanism is a useful aid to work under the present conditions and to produce new scenarios. Proper information, modeling and diagnosis lead us to the application of a sustainable pattern in order to efficiently improve habitability conditions as well as to reduce public expenses.

Modeling of these complex experimental fields – Tertiary networks allowed us:

- To obtain and select information in order to qualify and quantify features of each network, mainly macro values (Table 1).
- To identity those interactions between structural and /or critical variables which characterize their functioning at different scales.
- To integrate of curves (characteristic profiles) depicting the dynamics of the network.
- To feedback procedure of input and output of data.
- To make early diagnosis known as “early control”.
- To device new scenarios to study the proper behavior and re-distribution of critical resources, leading to an efficient use of energy and detection of significant potential resources.

REFERENCES

Discoli Carlos, Romero Fernando. (1996). "*Desarrollo metodológico aplicando control borroso a las bases de datos del sector terciario, subsector Salud*". Actas de la 19º Reunión de ASADES, Asociación Argentina de Energías Renovables y Ambiente Universidad Nacional de Mar del Plata. Tomo I, 621-624.

Discoli Carlos, Romero Fernando. (1997). "*Control borroso aplicado a las bases de datos del sector terciario. Primer modelo simple capa para el subsector Salud*". Revista Avances en Energías Renovables y Medio Ambiente. Vol. 1 nº 2, 12.

Discoli Carlos. (2009). "*Metodología para el diagnóstico urbano-energético-ambiental en aglomeraciones intermedias. El caso del Gran La Plata*". ISBN 978-978-595-066-5. Pag.492. Editorial universitaria de La Plata. La Plata, Argentina.

Discoli Carlos. (1993-95). "*Diagnóstico temprano y control de la gestión energético-productiva del hábitat en las redes del sector terciario*". Proyecto CONICET, Consejo Nacional de Investigaciones Científicas y Técnicas de la Argentina.

Dupuy Gabriel. (1991). "*L'Urbanisme des réseaux. Théories et méthodes*". Armand Colin, Editor. París.

Katz Jorge. (1993). "*El sector salud en la república argentina: Su estructura y comportamiento*". Fondo de Cultura Económica/Serie de Economía, Buenos Aires.

Pirez Pedro. (1991). "*Municipio, necesidades sociales, y política local*". Grupo Editor Latinoamericano / IIED-AL.

Pirez Pedro, Rosenfeld Elías, Karol Jorge, San Juan Gustavo. (2003). "*El sistema urbano-regional de redes de servicios e infraestructuras. Materiales para su estudio*". Editorial de la Universidad Nacional de La Plata, UNLP, Colección Sociales, ISBN: N° 950-34-0268-9.

Rosenfeld Elías, et al. (1997). "*PIGUR, Programa Informatizado de Gestión Urbana y Regional*". Programa de Investigación y Desarrollo. PID-BID, N°1102, CONICET, Consejo Nacional de Investigaciones Científicas y Técnicas, de la Argentina.

San Juan Gustavo (2001). "*Evaluación de redes edilicias de educación. Variables energo-productivas y de habitabilidad, en el hábitat bonaerense*". Proyecto CONICET.

San Juan Gustavo, Discoli Carlos, Tesler Julio. (1996). "*Diagnóstico temprano de redes complejas de servicios: el caso educación*". 19 Reunión de ASADES, Asociación Argentina de Energías Renovables y Ambiente. Universidad Nacional de Mar del Plata. Tomo I. 605-608.