

A BROAD VIEW ON THE RELATIONSHIP BETWEEN ENERGY AND URBAN STRUCTURE

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1 INTRODUCTION

This article presents part of the results of a research developed at the Architecture and Urban Planning Graduate Program, Presbyterian University Mackenzie, research group Buildings and Sustainable Cities, coordinated by Ph.D. Prof. Gilda Collet Bruna. It was based on the content of the document: BRUNA, Gilda Collet. *Estruturas Urbanas e sua Mutação em Função das Formas de Utilização de Energia*. Sinopses, maio 1990, São Paulo, 13:PP. 46-53.

2 THE ENERGY AND THE TERRITORY OCCUPATION

The energy always has performed a fundamental role on the forms of organizing the territory. This is confirmed by the evaluation of the mutations the urban and regional structures had suffered as well as the ways of life through time.

Until the XVIII century the wood was practically the only way to generate energy, being rival only of the vivid and natural sources, as the animal traction and waterfalls. The strong dependency on these sources led to the structures of cities location straight linked to forest and water resources. There was also at this period especially around 1500 toward 1700, a serious worry with the preservation of forests. The metallurgic industry, strong consumer of the wood resources, became a motive for rivalry with the citizens, as they had to compete for the wood. The metallurgic plants should be located far away from the cities, within forested regions, so that it was possible to keep low the prices and avoid their scarcity. Once the situation became dangerous drastic measures had been adopted to guide the growth of cities and the territory occupation, in terms of energy utilization. Therefore in France, Francis I (crowned king in 1515; died in 1547) according to Drouet (1979) prohibited the construction of new plants that used the wood as combustible material¹.

Such strong measures highlight a vigorous discussion about the compatibility of land uses, like the residential versus the industrial use, and the existing energy.

The frail was a balance between the urban and regional demographic densities and the nearby forests used for the energetic consumption to allow heating, cooking food, lighting, and also the correct industrial production. Synthesizing the priority was assured for allocation of the indispensable resources: forests and water.

As a matter of fact, this relationship between energy and the territory organization had performed a detached role on the structuring of the waterways' transportation, railways and roads network.

3 THE ENERGY AND THE WATERWAY TERRITORIAL STRUCTURING

The possibility of the use of steam as a key force goes back to 1615, when Salomon of Caus discovered it, although it was only in 1785 that James Watt² applies it in a practical utilization, the steam machine, leading to an intense transformation on the shipping of products and people through sea or waterways, and thus being the propellant of the new economic relations among regions and nations.

Besides all, the invention of the sluice and the hydraulic lifts enabled to overcome the disparities and consequent obstacles at the beds of rivers, stimulating the construction of channels and river and fluvial navigation. Therefore yet in the XVI Century the European navigable rivers started to be interlinked by a system of channels. During the industrial revolution this fluvial system enabled the efficient transportation of raw material and manufactured products. These wide structures allowed also the regional links, like those of the Midlands' industrial areas toward London, as well as links from London to France, and toward the Atlantic and the Mediterranean Sea³. Such transformation leads to the disintegration of the traditional organization of the territory and cities. However, the resulting polarization generated such an economic vitality that only was surpassed by the railroads.

4 THE ENERGY AND THE RAILWAY TERRITORIAL STRUCTURING

Again the steam key force created a new transportation means, which impact on the territory was very strong. As a matter of fact, the railway had a large power over the territory, larger than the waterway system. Besides, it enabled higher velocities together with a bigger freight and passenger's transportation capacity⁴.

High population and industrial growth rates marked the regional and urban structures; and also the urban agglomerations and the main cities polarizations built urban areas stretching along the railways routes, mixed with hamlets and villages around the stations.

The regional differences became steeper, as there were created privileged relationships at the urban network and the areas of production. The railway restructured the economic back area of the harbors' system increasing their reach and diffusion. Also the urban networks became articulated with the external market, strongly matching the industrial geography, generating large and discontinued urban tissues, although they work out together.

Also at the intra urban structure the railway started huge transformations. Within the small cities the railway stations represented powerful urban activities concentration hubs, generating even new centralities. Within the larger cities the railway stations still got more importance, attracting hotels, shops, business and industries. Their role had been intense in urbanization, directing also the capital and infrastructure investments, like the viaduct over the railway, although representing also an inhibition factor as they created barriers as boundaries for the urban expansion, such as land strips of domain and land reservation needed to build courtyards of maneuvers, warehouses and others. At the XIX Century end there was a specialization process on the railway transport terminals, with the distinction of passengers, merchandising and industries terminals. Also there were more hierarchies on the urban road network, improving the main higher capacity axles for the circulation of people and vehicles.

More and more the central areas became concentrating the commerce and services structure, especially institutional and administrative, leading to the suppression of the public open spaces that became scarcer. This process was strongly stimulated by the market that privileged the cities center. Particularly the large cities had been structured on rigid radial systems of rails linking the center to the periphery, and thus stimulating land occupation at the surroundings of the rail stations, and a strong commercial specialization along the main traffic roads.

The technologic innovations had been very important to offer more efficient alternatives to the land use organization that unfortunately not always had been adequate used. There was new means of horizontal and vertical transportation, and the building technical revolution, with the control over cooling, heating, natural and artificial illumination of the environment.

But most important of all is that the second half of the XIX Century was marked by the experiments on new means of energy utilization⁵: The success of the steam traction on rails although it had failed on the urban roads. This process of changing technology resulted on concentration, centralization, interdependence, but also functional and social class segregation.

5 THE ENERGY AND THE ROAD TERRITORIAL STRUCTURING

The road transportation success was associated to the more portable oil motor. In 1886 K. Benz builds his first automobile, the Ford T model from 1908. Since this period the urbanization changed. There was a decrease on the urban concentration and an increase of an urban periphery. Thus the metropolitan regions in England, United States, France, Germany and Belgium transformed themselves. The new urban diffusion and capillarity had modified the model of cities as the productive activities deconcentration grew. The industry searched new locations and the labor force headquarters had been structured, as well as the residential bourgeois suburbs.

The urban policy continued to promote these decentralization made liable by the automobile. New cities had been built as a remedy for all urban troubles, especially in England, France, United States and other countries. The abundant and cheap oil energy supported this urban sprawling. The dislocation of population over the territory was followed by all the other urban functions. The traditional cities center lost population, and received low income people. Therefore the better urbanized and served areas became abandoned. Few initiatives tried to change this dynamic, at the center in many countries, but in general, their focus was limited to the urban renewal real estates bringing gentrification⁶. The suburban real state businesses involved the transformation of large peripheral land that before were built as rural areas. As a matter of fact the use of fertilizers and pesticides based on oil had transformed the rural activity into agro industry. The society paid a high price for this adventure, which only now the absurd they had done could be understood: the increase of food price.

The 1973 oil crises, more severe in 1979 had brought doubt about this model based on the waste of energy and the irresponsible use of the oil. Barry Commoner⁷ makes evident the real dimension of these crises: the decline of the automobile industry, the prices' inflation and the unemployment. He points that the North American coal and gas reservation is ten times bigger than the oil in energetic terms. Even though there are limits to the non-renewable sources and so to the use of coal transformed into synthetic liquid or gas fuel, which is an expensive operation. It is necessary then to find systems of energy production and consumption that could be self-sustainable. The oil crisis should be associated to the environmental one, as it pollutes the air with some harmful substances affecting the ecosystems, such as: dioxide and monoxide of carbon, dioxide of sulfur, oxide of nitrogen, among others, also responsible for the greenhouse effect.

6 CURRENT PERSPECTIVES

Brazil is today very dependent on the water resources for the generation of electric energy. This represents a favorable situation on one side, but on the other, this situation builds an energetic matrix very dependent on climatic imponderable factors, which are more serious in times of global warming. The adaptation of gas to the thermoelectric plants, industries and vehicles represent a possible alternative to the shortage of energy, although in Latin America it is still fragile in terms of political factors, being so an obstacle to the regular supply. The recent economic growth in the country demands a solution for this energetic impact. It is possible to grow in a more structured and responsible economy, without consuming such a large amount of energy, like says Serra: "The United States GDP grew about 35% since 1970, without any increase on the energy consumption"⁸. Another point that increases this preoccupation is the relation among the regional water resources, its dimension, location and nature of the cities to be supplied⁹. Many times the areas that offer water resources do not correspond to those that consume it, thus demanding public works, and technology to transport the energy adequately.

About the non conventional sources of energy, the researches and the gradual emergent use of the new technologies like the ones created by the biomass, wind and solar energy, geothermic and others is being slowly implemented. The 1970 decade Brazil has already begun a program to substitute the oil during the 1970 decade, the well-known Pro Alcohol that reached a relative success¹⁰. Today it has been modified and improved through the consolidation of the alcohol market and the use of flexible automobiles moved both on oil and alcohol. About the issue biomass, the growing increase of bio diesel resulted from the use of vegetable oils instead of the conventional diesel, brings improvements in the consumption and reduction of pollution. In the United States and Europe there is a return from the cleaner e simple technologies.

The possible energetic combinations should be linked to the use of the regional resources, the accessibility to energetic sources and to the establishment of complexes energetic systems well adapted to lack reality. It is urgent to define a national urban policy that must clearly focus the energy issue. The first option to be done is related to the nature of the system to be adopted. In a simplified way, it is possible to have a system more centralized, dimensioned for each region; or a centralized system organized according to the national network of energy supply; and finally a hybrid one aggregating the advantages of both the first ones. The comparison between advantages and disadvantages related to the urban agglomeration, their density, infrastructure among others. Today in Europe there

is a very positive effort toward a more decentralized energetic policy that should be evaluated¹¹.

In the developed countries of cold climate, there is a huge difficulty, which is the urban consumption of energy for climatization that reaches about 60% of the total demand if associated to the accessibility¹². For this reality the rationalized motor transportation and the correct organization of the energy in the urban structure are essentials. The issue involves urban policies of wide scope focusing since the architectonic conceptions and building techniques, until the control of size, density, spatial distribution of the urban activities. Dominique Drouet points out the need to reduce the costs of distribution through the maximization of the location advantages, with the minimum utilization of energy. For this author there is a spatial inertia in the location of the activities; however, there are advantages for the urban municipalities heating and use the energy efficient bus service. In counterbalance the author shows the disadvantages of living in the periphery, where the low densities don't allow the supply of urbanization needs, leading to a harmful addiction onto the automobile and individualized solutions of the infrastructure, taking to an increase of about 50% in the consumption of energy.

Nevertheless Pierre Laconte¹³ advises about the adequate measure to the economy of energy adopting of higher densities in the city, however without using higher-rise buildings. Also the architecture should be adequate, increasing its performance in the climate scenery in transformation, as for instance shows the study realized in eight European countries by the CEC¹⁴: Being horizontally dense allows the automobile traffic reduction, as they are substituted by the public transportation; also it reduces the use of lifts. Thus this confirms the thesis that the economy of energy is straightly related with the urban form.

Under the energy viewpoint, surely the more economic urban structure involves the reduction of energy the automobile uses; it facilitates, the proliferation of the communication systems and the offer of mass transportation. Together with these, come the optimization of the urban tissue and its existing buildings, and the stimulus to multiple or mix (combined) uses, and the promotion of centers of commerce and services, and also businesses and social facilities of health and education corridors. The change of the urbanism toward the multifunctional scope is fundamental. The abandonment of the elementary functional modern urbanism in pro of the contemporary urbanism brings again the complexity and variety of the urban practices enhancing the multi sensorial quality of the public and private spaces¹⁵. All this new urban reality need to count on high indicators of synergy in all its systems so that it should be possible to form a true and complex symbiosis.

Despite of the need to face the eventual lack of energy like a component very important in the regional and urban agenda, there is today an ideological rehabilitation of the nuclear energy, as a result of the improvement on safety now very far from the disasters that happened in the past. Theoretically this would mean an inexhaustible source of energy, and therefore it is important to be careful. It is a complex and protected technology, not trustful, dangerous often polluter and has high capital costs. Claude Derian¹⁶ believes that in the XXI Century the nuclear energy can become dominant, however he points that the reactor can only be located in determined places, where there is water for cooling and where there is a certain safety, and where environmental conditions could be satisfied. Besides, the high-tension lines would represent a problem, as this energy model is highly indivisible, demanding large units and very centralized systems. Its presence would induce a strong concentration in parks of industrial activities. The competition of uses in the coastal areas would be established and would represent a serious danger. The industrial activities and leisure would dispute the infrastructures of urbanization and use the natural spaces that need to be protected; generally these natural areas are very delicate and fundamental to the maintenance of the terrestrial biome. Surely, in the future there will be a new generation of reactors, more safe and amicable, however still they aren't available.

The current dilemma is expressed by the question: what should be the urban development model and the energy option adopted? Surely this discussion involves the notion of progress and the development model to be adopted. The change of paradigm should be target. The planet shows signs of crisis. The change of the life style should be conceived as avoiding the unbridled consumerism and hedonism. The use of the automobile should be rationalized and limited to the essential social activities. The Australian researchers Peter Newman and Jeff Kenworthy show the absurd of the dependence on the automobile, which generates a huge waste of energy and of material and human resources¹⁷. It is inevitable the use of more light building and transportation techniques, with less impact. The informational technique also represents the great hope in this sense¹⁸, together with the adoption of more adequate regional and urban models. The patterns of location should be appropriated to a future of low energy. This seems still a controversy, although it could be similar to the diversified and more traditional integrated city that existed before the industrial revolution¹⁹. Nevertheless it is already possible to have energy balance on the territorial organization proposals, simulating and comparing the consequences of alternative hypothesis. Besides, the growing fusion of data that will produce a benchmark thus is enabling the society

awareness and the community participation in the policy decisions, avoiding manipulation and populist act

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