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ID 1693 | OILANDSCAPES. THE RECONVERSION OF FOSSIL FUELS MESHES AS "GREEN ENERGY BACKBONES" FOR THE TERRITORIAL RESTRUCTURING OF THE THIRD INDUSTRIAL REVOLUTION

Alberto Verde[1]; Alessandro Massarente[1]
[1]University of Ferrara, Department of Architecture
alberto.verde@unife.it ; alessandro.massarente@unife.it

ABSTRACT: Fossil fuels industry has always been carrier of huge spatial transformations: first of all, because the extraction of carbon-fossil resources requires the investment of huge amounts of funds to deploy a widespread infrastructural network, and secondly, because the associated industrialization process deeply contributed in the definition of new urban morphologies and settlements. We could affirm that fossil fuels and industrial revolutions represent two sides of the same coin. Since the end of XVIII century, the two industrial revolutions have been dominated by a fossil fuels' monopoly in terms of energetic production, firstly driven by coal-based activities and later by oil. As already known, hydrocarbon resources are not equally and democratically distributed in the subsoil, and this has created over the centuries some vertical dependences between fossil fuels suppliers and consumers, which completely redefined the geo-political equilibrium among countries. One of the most remarkable effects of this unbalanced distribution of fossil resources in the subsoil had been, especially during the first industrial revolution, the territorial attractiveness of hydrocarbon-rich territories for the settlement of huge heavy industry sites. The consequent high concentration of employment reshaped the territorial hierarchies among population, countryside, urban areas and infrastructures. The aim of the first part of the paper is to investigate about the role that fossil fuels industry played in the definition of territorial hierarchies during the first and the second industrial revolutions. The analysis will be led through a comparative study of some GIS cartographies of two renowned European territories: the "Ruhr region" and the "central Veneto region". In the second part of the paper, we will focus in a more proactive way on the "oil mesh of the North-Eastern Po valley" and wonder about how fossil fuels infrastructures could be "deengineered", albeit maintaining their energy production identity, and imagined as "green infrastructures", so becoming those landscape articulators which can foster the dialogue across territorial, urban and architectural scales thanks to their new socio-ecological role. The "scenario building" (Viganò, 2012 and Sijmons, 2014) will root its beliefs, assumptions and constraints around the vision of the "energetic transition towards the third industrial revolution" which, as advocated by the American economist J. Rifkin (2011), envisages a massive shift towards new renewable and territorially distributed forms of energy production.

1 A COMPARATIVE ANALYSIS OF TWO POLYCENTRIC MODELS: THE RUHR AND THE CENTRAL VENETO REGIONS

1.1 INDUSTRIALIZATION PROCESS

Not by chance one of the most important industrial development processes, tightly dependent on coal mining activities, settled up in Ruhr region. The reasons date back to Carboniferous era, something like 320 million years ago, when the equator passed right by this region. The process of petrification and coal formation of hermetically-sealed and compressed coastal forests in the marshy lowlands required million of years and was concentrated along an East- West area which went from the Ruhr region to Belgium, passing through southern Netherlands, perpendicularly to the river Rhine. At the beginning of the XIX century, the Ruhr region was still an agricultural area, characterized by small, handicrafts and semi-rural towns of about 8'000 inhabitants. Between 1840 and 1860, a revolutionary technical innovation in deep coal mining, which allowed digging up to 600 m deep and catching bituminous coal, kicked off a wide territorial industrialization process which lasted for almost a century (fig.1). The main industrialization trends can be summarized as follows (Reulecke, 1984 and Hötker, 1988):

- the first period (1840-1860) is characterised by the opening of new deep mining sites all over the "Hellweg strip", a sub-region comprised between the rivers Emscher and Ruhr which is crossed by the homonymous medieval trading route. New collieries and iron plants were settled up in rural contexts close to coal mining sites and to the existing small, semi-rural villages along the Hellweg trading route (Duisburg, Essen, Dortmund), contributing to their rapid urban growth;
- the second industrial development era (1860-1890) can be considered as the "golden age" of the productive Ruhr region because the enthralling power of industrialization moved North, towards the river Emscher, and led to the opening of several coal open pits in the middle of almost uninhabited territories (Oberhausen, Gelsenkirchen, Herne);
- only in the 1960s, after the end of the Second World War and the necessity to reconstruct the economy of a devastated country, the "Ruhrgebiet" witnessed another important industrial development era in its Northern part, towards the river Lippe. While coal industry was starting to collapse, the cooperation between petroleum and chemistry boosted the settlement of some huge petrochemical industrial complexes on the banks of the river Lippe. This industrialization stage never reached the envisioned amplitude because of the oil crisis at the beginning of the 1970s.

It is interesting to notice that while the Ruhr region faced the apex and the crisis of an economy based on a concentrated industrialization over a century, Veneto region was not touched by any massive industrial revolution (fig.2). Indeed, according to Roverato (2008) and Bagnasco (1977), a long, soft and dispersed industrialization process, opposite to the rapid industrial concentration occurred on the occasion of the "industrial triangle" (Milan-Turin-Genoa) and based on the consolidation of some SME industrial districts operating around smaller urban centres, began to take root in the region from the end of the XIX century. This phenomenon gave rise to what Bagnasco calls "the third Italy", so as to highlight an alternative territorial development model which differs from the usual dichotomy between the North-Western Italy's industrialization and the backwardness of the South. The richness of the spontaneous and diffuse SME industrial pattern around small urban centres was not perceived by the politics of the time to the point that Veneto, until the 1960s, was considered an agricultural and underdeveloped region, "the South of the North Italy" (Roverato, 2008), so as to enact special laws to boost the economic development of depressed areas.

Only two concentrated industrial episodes around the most important urban centres of the region had been experienced in Veneto, namely:

- Porto Marghera, where refining and petrochemical activities were settled from 1920s taking advantage of the logistic harbour which allowed to accommodate oil tankers coming from Italian colonies in North-Eastern Africa;
- the industrial platform in the South-eastern outskirts of Padua, where an inland port and a highly diversified industrial production settled up.

During the 1950s, these two big industrial poles deeply contributed in the consolidation of that fragile, dispersed and decentralized industrialization thanks to sectorial productive synergies and to the accumulation and sharing of experiences, knowledge and human capital. But it is with the crisis of big industrial productive sites from the middle of the 1970s that the decentralized industrialization model affirmed itself as the predominant model of the region and became visible to the most through a pervasive cohabitation of industrial landscapes with rural ones.

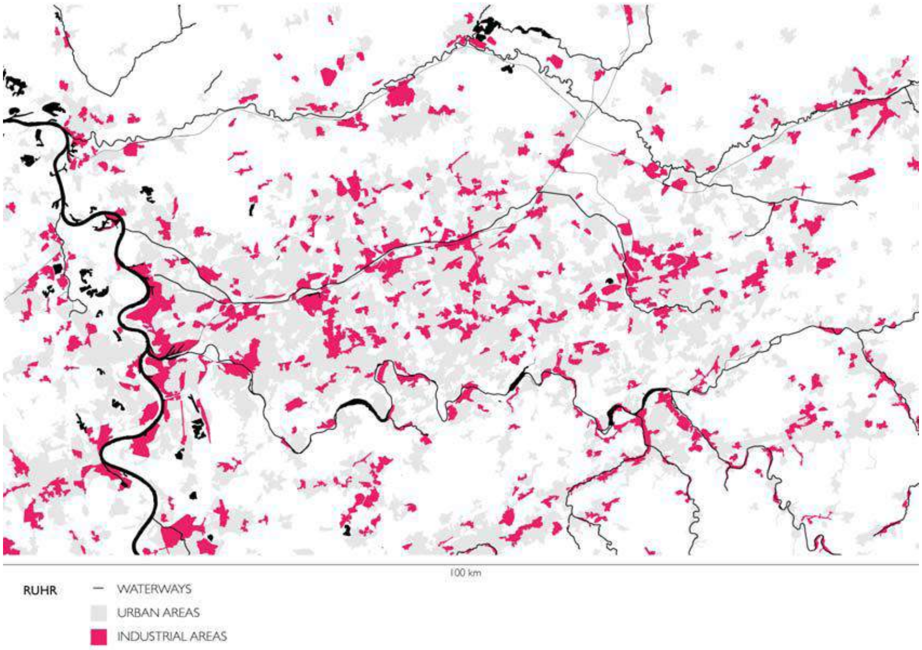

Figure 1 – The industrial pattern of the Ruhr region
(elaborated by the author, source: Corine Land Cover 2012 metadata)

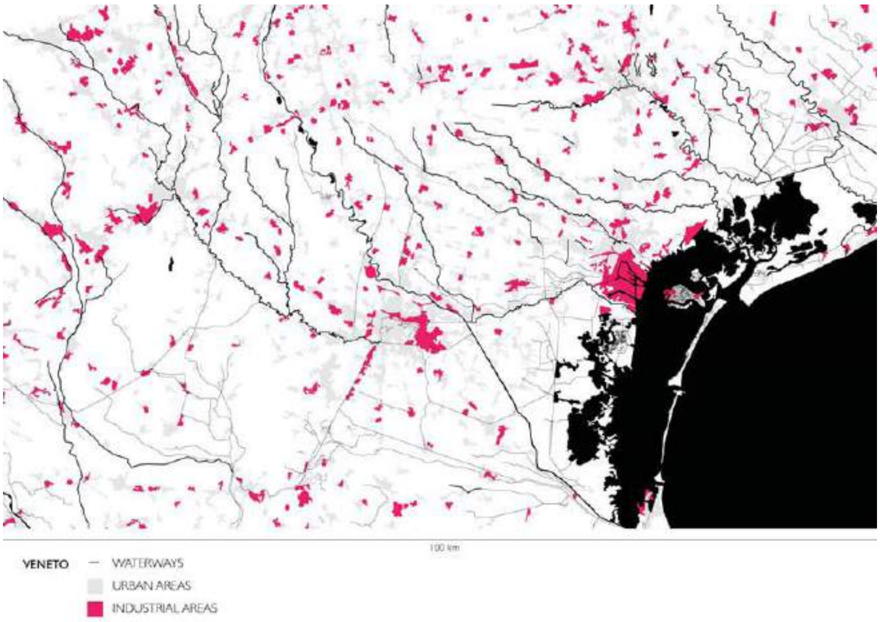

Figure 2 – The industrial pattern of the central Veneto region
(elaborated by the author, source: Corine Land Cover 2012 metadata)

1.2 INDUSTRIALIZATION AND RAILWAY INFRASTRUCTURES

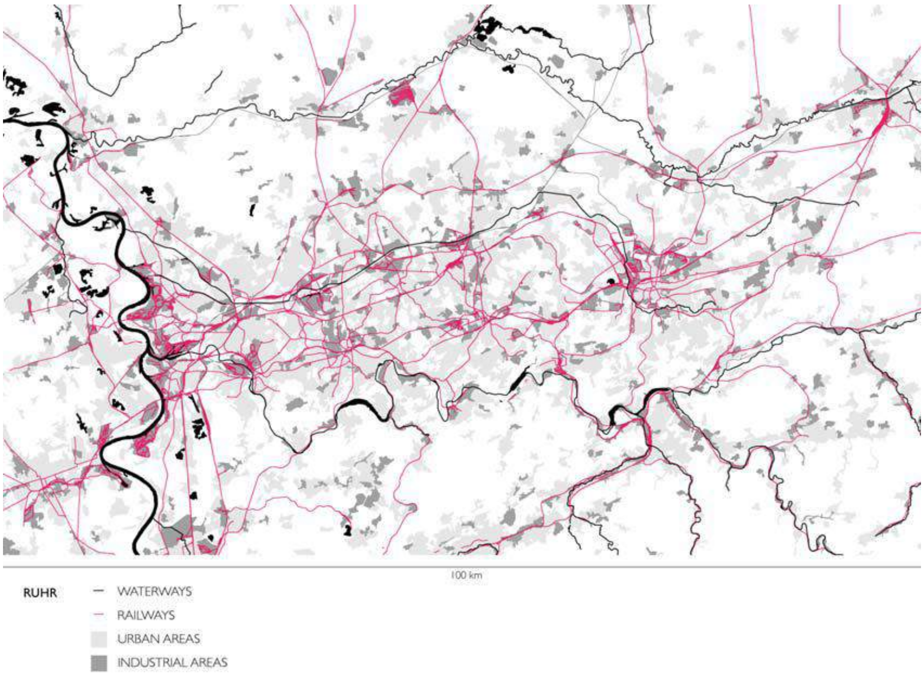

Figure 3 – The railway infrastructures of the Ruhr region
(elaborated by the author, source: DIVA-GIS metadata)

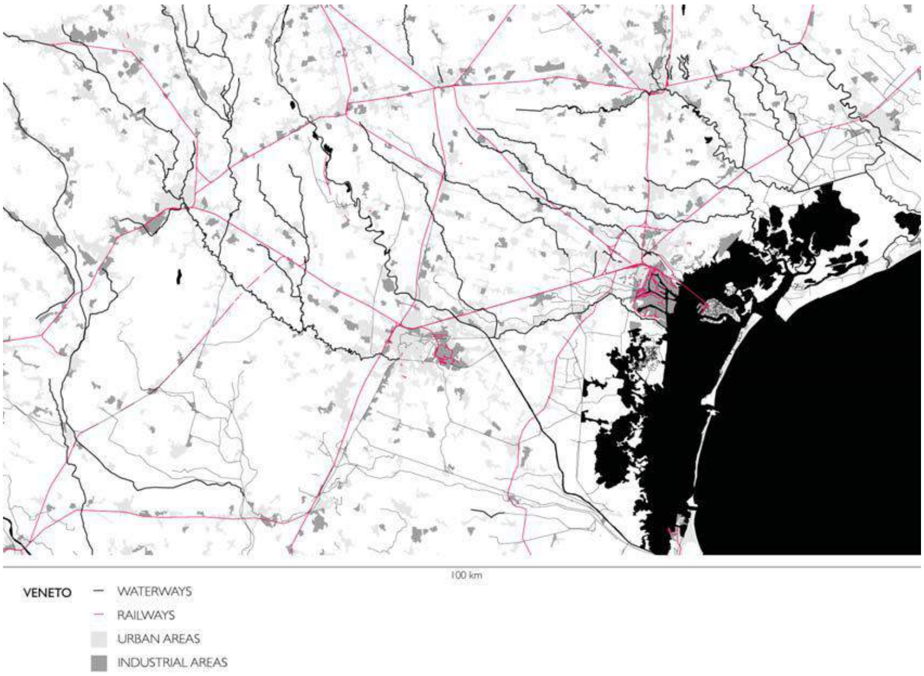

Figure 4 – The railway infrastructures of the central Veneto region
(elaborated by the author, source: DIVA-GIS metadata)

With the lack of a regional railway infrastructure planning, private company owners built a profit-oriented railway network for goods and raw materials transport purposes, so as to connect coal mining sites to heavy industrial plants or to logistic harbours along the river Rhine (Reulecke, 1984). If during the first regional industrialization period railway infrastructures reinforced the role of the existing urban poles along the Hellweg trading route, during the second one a principal East- West oriented railway axis parallel to river Emscher became the principal backbone along which the sparsely inhabited territories settled up their urban and industrial growth (fig.3). Only at the beginning of the XX century, with the nationalization of the existing railway network, railways began to be used even for passenger transport (Hötker, 1988). This circumstance contributed in the diffusion of the “garden city” model as the principal miners’ dwellings model, so connecting residential areas with working sites, recreational areas and city centres by public transports. It is remarkable how the tardive industrial development along the river Lippe completely lacks of a dense railway network such as the one in the Southern Ruhr region.

If we look at the central Veneto region, the railway infrastructural development had a completely different course. In fact, the railway network in Northern Italy was implemented at the end of the XX century, and Veneto was far to be interested by any massive and concentrated industrialization process. Thus, the railway mesh that crosses the central Veneto region is completely independent from any industrial relationship, but it is rather the result of a general infrastructural planning for passenger accessibility, goods supplying and even military purposes (fig.4).

1.3 INDUSTRIALIZATION AND ROAD INFRASTRUCTURES

The motorway infrastructural network in the Ruhr region started to be developed since the 1920s, with the proposal of creating an East-West 3-lane motorway connecting Duisburg with Dortmund and with the implementation of the Reich Autobahn, parallel to river Emscher (Reulecke, 1984). Nevertheless, only the tardive industrial development occurred during the 1960s along the river Lippe had a direct relationship with the road network. In terms of regional accessibility, the dense Ruhr agglomeration is well served by 3 national East-West motorway axes, but, on the contrary, North-South connections are insufficient (fig.5).

What is outstanding from a first look at central Veneto region is, on one side, the scarcity in national motorway axis and, on the other one, the fine “isotropy” of the secondary road level, based on the Roman agricultural orthogonal grid (fig.6). The widespread capillarity of the local road network allows low dense territories to be used in an extensive way, being very well connected to decentralized production areas. This very peculiar type of road system, together with the decentralization of the industrial production on a vast territory, created the conditions for the settlement of some mixed commercial and industrial “agglutinations” (Savino, 1998) along important local road axis, the so called “strade mercato” (market roads).

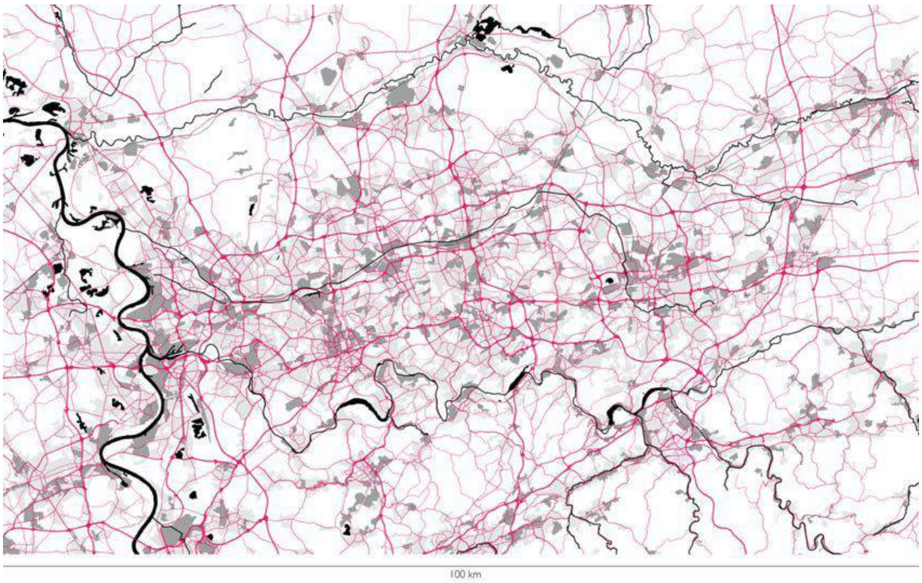

Figure 5 – The road infrastructures of the Ruhr region
(elaborated by the author, source: DIVA-GIS metadata)

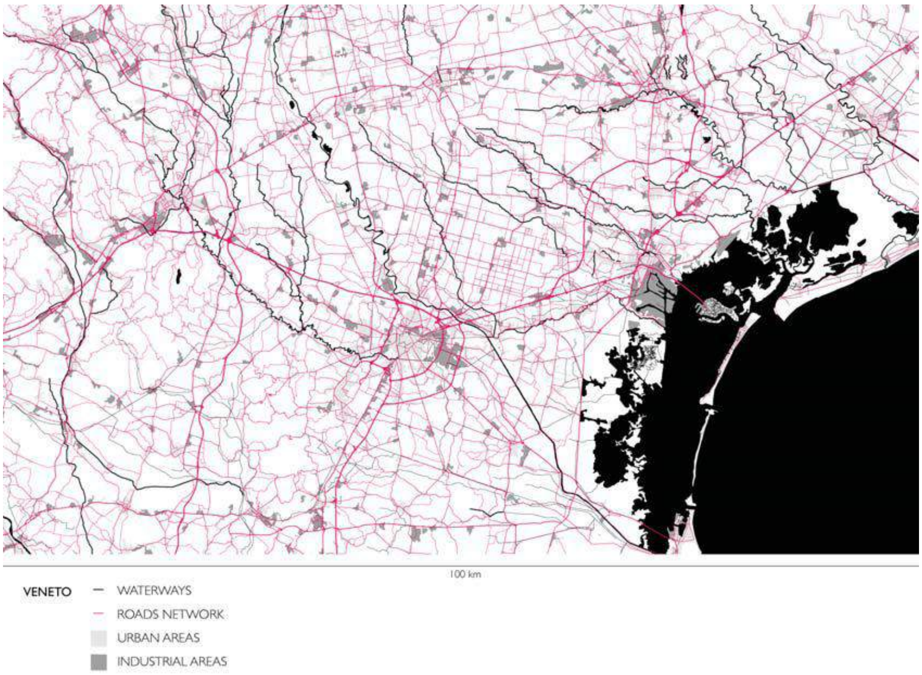

Figure 6 – The road infrastructures of the central Veneto region
(elaborated by the author, source: DIVA-GIS metadata)

1.4 POLYCENTRISM

The comparative analysis of the two case studies under the lens of their polycentric territorial structure reveals how the two models work in a completely different way. The massive industrialization of the Ruhr area led to a significant wave of migration from rural areas. Two main trends characterized urban areas' expansion according to their geographical situation:

- along the Hellweg trading route, the already existing urban centres (Essen, Bochum, Dortmund) had a remarkable radial expansion until industrial boundaries in the outskirts;
- moving North, towards the river Emscher, the lack of former consolidated semi-rural settlements encouraged a linear development of urban areas parallel (Oberhausen) or perpendicular (Gelsenkirchen) to railway infrastructures.

At the beginning of the XX century, the political and territorial fragmentation began to raise the issue about how to manage a regional growth which lacked of a unitary structure and development strategy. The "polycentric" model prevailed over the "metropolitan" one because of the presence of several medium cities presenting similar growth rates, high urban densities and no hierarchical dependences towards only one major urban centre (Reulecke, 1984).

In the following decades up to 1980s, the continuous urban growth of the polycentric urban system made the administrative boundaries no more recognizable. Urban areas merged in a densely builtup area, which enclosed industrial, commercial and administrative clusters together with some fragments of agricultural and natural landscapes (fig.7).

The polycentric territorial development of the central Veneto region is based on completely different assumptions. According to Indovina (1990), at the very beginning of the light and diffuse industrialization process at the end of the XIX century, central Vento was affected by an internal relocation process of local people in the same region thanks to some economic improvements, but no massive migratory phenomenon was registered. This consequent rural settlement model is called "campagna costruita" (built countryside) by Indovina (1990) and is based on the social role of the "family" as the minimal organisational unit, which compensates the lack of public facilities. During the 1970s, in parallel with the crisis of the major productive sites and the affirmation of the industrial decentralization, a process of social substitution in the rural context took place. In fact, the urban middle class started to move towards small rural villages to get closer to the decentralized workplaces and to search for better living conditions which best corresponded with their imaginary lifestyle. The consistency of population who sought for living in decentralized territories was elevated, so that Indovina (1990) defines this stage as "urbanizzazione diffusa" (diffuse urbanization), a preliminary step towards the "città diffusa" (diffuse city), which is characterized, during the 1990s, by the decentralization of urban, commercial and public facilities.

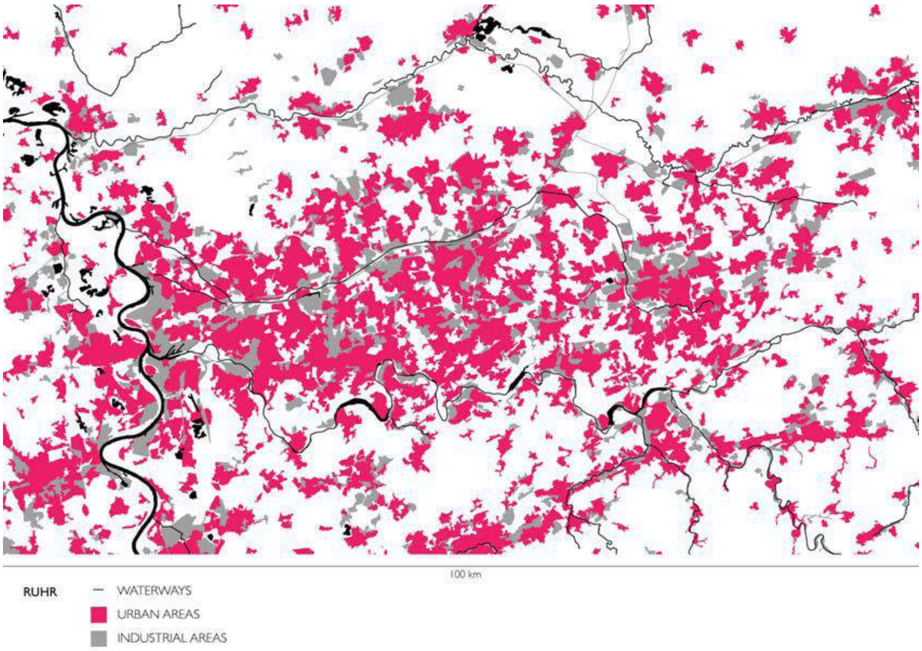

Figure 7 – The polycentric structure of the Ruhr region
(elaborated by the author, according to Corine Land Cover 2012 metadata)

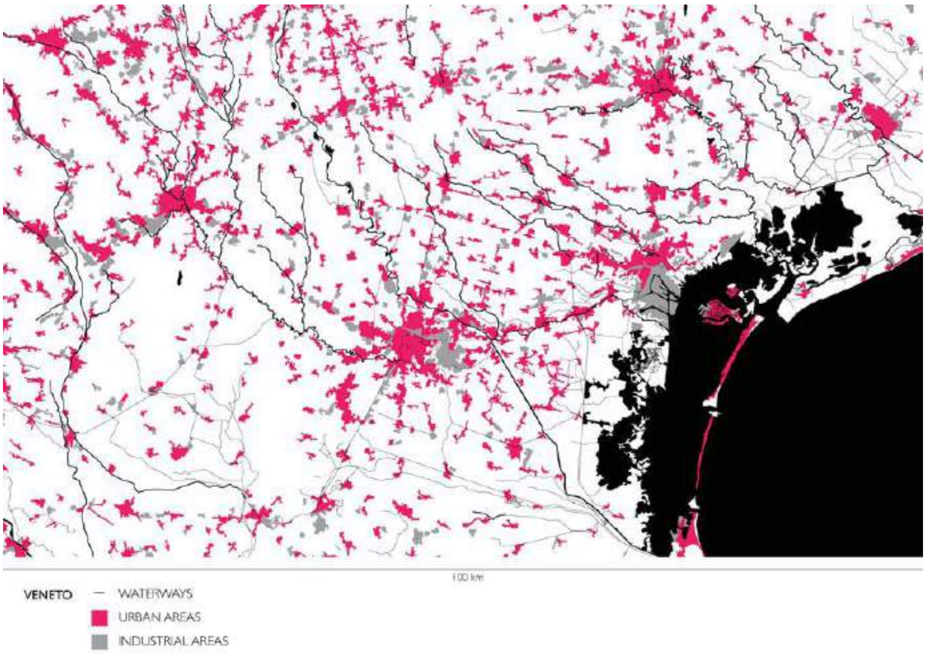

Figure 8 – The polycentric structure of the central Veneto region
(elaborated by the author, according to Corine Land Cover 2012 metadata)

The "città diffusa" looks like a territory constituted by a diffuse polycentric structure of medium and small urban centres immersed in an agricultural continuum where few major cities punctuate the territory, but don't play the strongly hierarchical role of "metropolitan centres" (fig.8). In other words, spatial interconnections among the distributed urban functions play a key role in the "città diffusa", because they allow an extensive use of the territory as if it was a "wide mesh" city. In this sense Indovina (1990) introduces the use of the term “città-territorio” (city-territory) while describing the functioning of the central Veneto polycentrism.

1.5 A WEAK URBANIZATION: THE INSPIRING MODEL OF ANDREA BRANZI FOR THE THIRD INDUSTRIAL REVOLUTION

Between provocation and utopia, since the mid-90s Branzi (2006) prefigures to seek for an ideal urbanization model which loses its tight bond with the historical debate about the correspondence between urban form and function, but which instead lies on the evolving relational flows among society, economy and land uses. Branzi builds its personal “weak urbanization” model around the concept of “uncertainty” which characterizes contemporary dynamics, and substitutes the “rigid certainties” on which classic modernity rooted its philosophical thinking and can be easily exemplified by the dichotomies between city and countryside, industry and nature. According to Branzi (2006) “we have gone from the age of functionalism to the age of functionoids, instruments that do not possess a single function, but as many functions as the operator’s needs”. In this sense, architecture has to lose the figurative code of its “cathedrals of the modernity”, and acts more like a “personal computer”, being adaptive to evolving societal needs, and like “agriculture”, integrating time as a design element. A weak urbanization model should even include agricultural and energetic production as necessary design challenges. It is interesting to notice that if Branzi takes as reference the resilient “favelas” model as an adaptive aggregative process to respond to contemporary liquid society’s needs, some decades before him even Yona Friedman (1978) speculated on the survival architecture of “bidonvillages” as a possible response to industrialization simulacra, focusing on their self-sufficient and synergic organisational model to provide water, food and weather protection to their inhabitants.

In this sense, the non-figurative architecture of a diffuse energy production model should blur the rigid limits between industry and nature. Those “energetic territories” which could produce renewable energies valorising the hidden energetic potential coming from the metropolisation of territories’ process will power the boundless and adaptive “weak urbanization”.

The physical interrelationship of “fossil fuels meshes” becomes a suitable territorial feature to propose their conversion as “energy backbones” for a diffuse energetic production.

The original interdependence of fossil fuels infrastructures turns out to be the main criterion to define the boundaries of our 150x150 km territorial case study in the North-Eastern Po Valley that we are going to analyse in the second part of the paper.

2 THE SCENARIO BUILDING OF THE “ENERGETIC TERRITORIES” OF THE NORTH-EASTERN PO VALLEY

The case study of the North-eastern Po valley is one of the richest in terms of presence of fossil fuels infrastructures in the whole Italian territory. Indeed, the three processing sectors of the fossil fuels industry are present at the same time on the territory, that is to say upstream (extraction), midstream (transport) and downstream (processing) activities. Some of the fossil fuels infrastructures are also interrelated by underground oil pipelines: storage oil tanks in Ravenna industrial harbour fed the power plant in Polesine Camerini (70 km) and the refinery in Porto Marghera is connected via underground pipelines with the one in Mantua (120 km). In addition, some underground gas pipelines connect some depleted gas fields in Emilia-Romagna to the national gas grid.

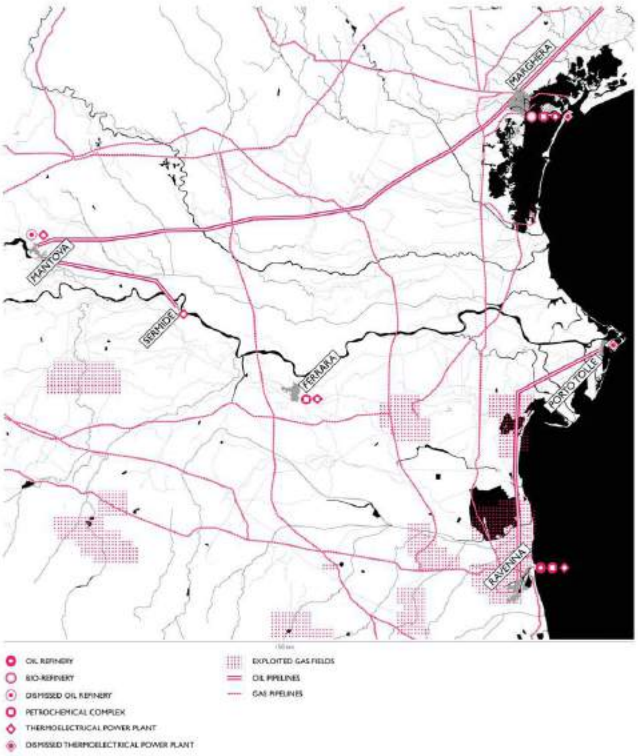

Figure 9 – The fossil fuels mesh of the North-Eastern Po valley
(elaborated by the author)

The potential of fossil fuels meshes for a territorial restructuring of the Third Industrial Revolution resides in their physical and functional connections, which run through far and different territories. In this sense they could be imagined to be converted into “green energy backbones” for CO2 recovery and H2 storage, to which other diffuse energy production networks could hook up. In particular, CO2 recovery network could use the existing oil infrastructures, while the intermittent electric energy storage under the form of hydrogen could principally function around the existing gas infrastructures.

The recovery of CO2 needs to be boosted by activities that produce a huge amount of CO2 emissions, as refineries, petrochemical sites and heavy industries are. Considering our territorial case study, the state of use of downstream sites is very diversified and this condition suggests a further step in the construction of our scenario: the still functioning refineries and petrochemical sites could temporarily keep the role of “CO2 feeders”, while the dismissed oil infrastructures could be reconverted in “CO2 eaters”. As even mentioned by landscape architect Dirk Sijmons in his interesting research about the dimensional relation between landscape and energy (2014), the necessary technological improvement consists of the application of the “Carbon Capture and Storage” (CCS) technology so as to intercept CO2 from exhausted fumes. Carbon dioxide will be stabilized in a liquid state and then conveyed through the former oil pipelines. In this way, it will be necessary to set up an activity capable to absorb and digest huge quantities of CO2 on the receiving site. Plants are the best devourers of carbon dioxide through the chlorophylline photosynthesis process, and in particular are algae.

Hydrogen economy is considered a necessary step to implement a massive renewable energetic transition (Rifkin, 2011). In fact, one of the critical problems concerning renewable energies is that electricity is produced intermittently and it is difficult to stock peaks of production. Hydrogen technology could solve the electric energy storage problem because, through hydrolysis process, electricity can be transformed in oxygen and hydrogen. Nevertheless, hydrogen is unstable and explosive and has to be stored in safe places. Some EU funded researches deepened these matters and one in particular, NaturalHY project (European Union, 2009), focused on the feasibility to transfer hydrogen through the existing gas pipelines network, mixing a hydrogen quota with the natural gas. The separation of hydrogen from natural gas will be made in apposite processing units, which will convey hydrogen to the storage place. Other researches were conducted to demonstrate that depleted gas fields are suitable storage sites for hydrogen (Mignard et al., 2016 and Basniev et al., 2010). Thus, the depleted natural gas reservoirs in Emilia-Romagna could become underground hydrogen storage sites and, when needed, processing units will demand for hydrogen through gas pipelines and they will transform it in electricity to be distributed through the national grid.

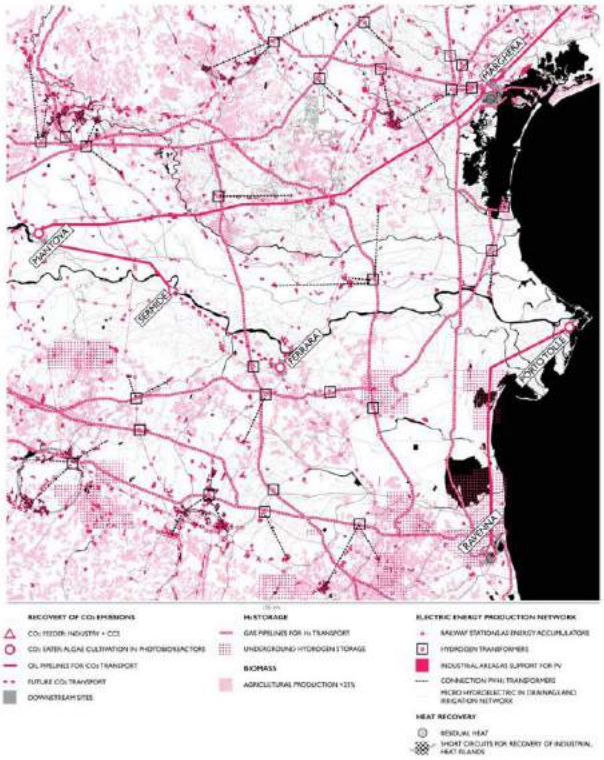

Figure 10 – A possible “energetic territories” scenario
(elaborated by the author)

3 CONCLUSION: GREEN ENERGY BACKBONES AS ARTICULATORS AMONG DIFFERENT SCALES

The renewed role of our former fossil fuels infrastructures as “green energy backbones” does not stop at a supporting responsibility for the supply of territorial distributed renewable energies. As mentioned in the previous paragraphs, new urban and architectural scenarios of reconversion of the “cathedrals of the modernity” are tightly related to the socio-ecological re-signification of existing fossil fuels meshes, thus making our “green energy backbones” as the articulators among different design scales (territorial, urban and architectural one), taking advantage of landscape design tools as the multi-scalar and evolving minimum common denominator.

If we take into consideration the dismissed thermal power plant in Polesine Camerini, in the very middle of the fragile eco-system of the Po Delta, we envisage that its reconversion scenario should probably start from the maintaining of its original productive identity, but converting its previous fossil fuels-based energy production process in a bio-based one. Taking advantage of the CO2 recovery backbone, it is possible to imagine that the site could be converted in a “CO2 digester”, setting up an efficient algae cultivation system in closed translucent photobioreactors to produce biofuels and biomass, pumped with CO2 emissions coming from still functioning downstream oil sites in Ravenna. In this way, we could wonder that the whole site could be transformed in an “Agro-energy park” because the ecological-sensitive energy production would allow to couple social inclusive activities, such as R&D activities in the agro-energetic, agro-food and phytoreclamation domains, so boosting the creation of new green jobs in an economic depressed area. The synergies between the existing agro-food territorial excellences and the agro-energetic industry will arouse a renewed vigour to ecological tourism, thus contributing in the development of new widespread ecologic corridors, which will merge with the Natura2000 protected areas network. Thus, the boundaries between nature, intended as untouchable areas only suitable for recreational purposes and as biodiversity reservoirs, and industry, intended as impenetrable and polluting activities, will fade, so as those between "oil" and "landscape", allowing to experience OILANDSCAPES as supportive backbones for a multi-scalar energetic and socio-ecological territorial restructuring.

Figure 11 – Agro-energy park as a reconversion scenario for Polesine Camerini power plant (elaborated by the author)

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