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Cyria Emelianoff, Carole Wernert

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## **Metz ‚Stadtwerke‘ – a municipal strategy towards energy transition and its historical roots**

*C. Emelianoff<sup>1</sup>, C. Wernert<sup>2</sup>*  
*Université du Maine, ESO, UMR 6590 CNRS, Le Mans, France*

### Introduction

In France, the need for an energy transition arising from EU commitments collides with highly centralized structures of energy and electricity generation and distribution. Urban areas particularly active in the development of renewable energy often have pre-existing local cultures of energy. Their origin can be situated in mining, which led to the development of energy production centres, in the operation of hydropower from the late nineteenth century, and in the anti-nuclear protest movements, giving birth to an energy counterculture, focusing on solar power. In other geographical contexts, the pre-existence of local energy utilities also favoured the emergence of local energy and climate policies.<sup>3</sup> These legacies, when they add local energy production to energy counterculture, played a catalytic role in Germany in the low carbon transition, having the effect of differentiating geographic territories.

This case study concerns a *Stadtwerke* on French soil<sup>4</sup>, thus in hostile (towards municipal enterprises), centralized territory. The *Stadtwerke* gives rise to renewable energies, limited, however, by the prevailing context. We will evaluate three research hypotheses:

- (1) Low-carbon energy transitions could initially resonate with and become embedded in areas where energy, for many reasons, has remained an at least partially locally controlled and managed resource.
- (2) Certain geo-historical contexts lend themselves more easily to the development of renewable energies, notably (but not exclusively) the eastern fringes of France, whose territories have been subject to varying Germanic influences, which, in the end, gave more autonomy to local authorities. These regions have a concentration of municipal electricity and gas distribution companies (ELD), especially Alsace Moselle.
- (3) *Stadtwerke*, which in France have become local distribution companies of electricity and gas, could be turned into industrial tools promoting low carbon transition. Controlling electrical networks in clearly defined areas, they favour their own power generation as far as they can and, since 2007, can choose their energy suppliers to cover the needs of their territories. These local authorities which still control power distribution would therefore have more leeway to green their energy mix.

Beyond the historical factors favouring territories to engage an energy transition, we would ask, more prospectively, whether the instauration of energy as a territorial resource might be the key incentive for territories, in so far as it opens potential for local development (industry sectors, jobs, public income, territorial projects and actor synergies). This line of inquiry follows the work of some

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<sup>1</sup> Professor of land planning and urbanism at the Université du Maine.

<sup>2</sup> Ph.D. student in geography at the Université du Maine.

<sup>3</sup> Ute Collier, Ragnar E. Löfstedt, Think globally, act locally ? Local climate change and energy policies in Sweden and the UK, in: *Global Environmental Change*, 7:1, 1997, p. 25-40. And Harriett Bulkeley, Kristine Kern, Local Government and the Governing of Climate Change in Germany and the UK, in: *Urban Studies*, 43:12, 2006, p. 2237-2259.

<sup>4</sup> Metz inherited a *Stadtwerke* created during German occupation, which maintained its status as a municipal utility for generation and distribution of gas and electricity, a situation that is unique in France. Local actors continue to call it the "Stadtwerke".

historians of urban environment<sup>5</sup>

The *Stadtwerke* of Metz, a city in Lorraine of 120 000 inhabitants with an agglomeration of 290,000 inhabitants, was founded in 1901 under the German empire and became a public company in 1925 under French law. The Usine d'Electricité of Metz (UEM) is the largest independent local electricity distribution company in France, supplying 142 municipalities and a third of the Moselle department. Metz is the only French city to produce and distribute electricity and heat.<sup>6</sup> The "Stadtwerke", as the actors of the city still affectionately call it, began to diversify its energy sources from the 1950s, which has meanwhile led to the development of renewable energy. We will try to understand why.

A second line of inquiry focuses on the German influences that may have played a role in the choice of energy sources: the German past of the city and its municipal ownership board, and the neighbourhood with a country marked by energy decentralization and "Energiewende". To what extent does the historical background and the border effect encourage the development of renewable energy and do they weigh on energy and climate policy choices in Metz? The mining industry context of the north of Moselle region complicates the analysis: coal has been a local resource until the early 2000s, and local energy and renewable energy should not be confused.

The first section of the article shows the strength of resistance of the *Stadtwerke* against nationalization of the energy sector, its successive battles to survive and develop its energy capacity. The UEM tries to reduce its dependency on major national energy companies by developing its own energy resources. The second section explains the different logics that led to a diversification of these resources in the second half of the twentieth century. The third section discusses the assumptions and results of the study.

This work is based besides specialist literature, theses, municipal archives on fifteen open-ended interviews with local officials responsible for climate and energy policy, the UEM, and personalities with a long memory of local energy history.

## **Act 1. A Stadtwerke in French terrain: the struggle for independence**

Located at the confluence of the Moselle and Seille in Lorraine, Metz was a free city of the Holy Roman Empire until 1552. The Moselle ensured trade with the Rhineland, up until the three Franco-German conflicts, in which the city became a stronghold. Returned three times to France, Metz nevertheless retained its rights and idiosyncrasies, leading to a German-French double culture and a spirit of independence.

The period of German annexation (1871-1918) profoundly transformed the urban fabric. The urbanized area grew threefold; Metz acquired modern urban infrastructure and networks, and a *Stadtwerke*. The "imperial" quarter, a section of the city constructed during the German era in 'Belle-Epoque' style, is currently nominated as a World Heritage Site by the UNESCO. The municipality is very attached to its *Stadtwerke* because its profits improve local finances, and generate employment. That is why the UEM will resist the nationalization of the energy sector and the various restrictions that the French electricity giant, EDF, attempts to impose. With 580 employees today and more than 8 million euros annual municipal revenues, the company is locally regarded as an industrial gem, in a context of de-industrialization and demilitarisation.<sup>7</sup>

### **Early electrification**

Metz was one of the first French cities (under German annexation) to electrify street lighting. We find the pattern as then prevailed in Germany. Symbol of modernity, electricity was first reserved for sites

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<sup>5</sup> Dieter Schott, Bill Luckin, Geneviève Massard-Guibaud (eds), *Resources of the City. Contributions to an Environmental History of Modern Europe*, Aldershot 2005. Sabine Barles, *L'invention des déchets urbains : France 1790-1970*, Paris 2005.

<sup>6</sup> Geneviève Herberich-Marx, Freddy Raphael, *Enjeux et problèmes des régions des grandes villes de l'est de la France*, in: *Culture technique* 17/1987, p. 37-45.

<sup>7</sup> Demilitarisation impacted the economy of the city through loss of customers for local commerce.

of entertainment and prestige, before being deployed for the needs of urban transport (Schott, 2008).<sup>8</sup> In 1887, construction of Moulin-des-Thermes brought light to the Opéra Théâtre, previously lit by candles. This first public lighting network was expanded, despite the reservations of the German gas company, and powered by two hydraulic turbines on the Moselle through an agreement between the city and Siemens-Schuckert.

Fifteen years later, the project to electrify the tramway, powered by horses since 1876, allowed a change of scale in electricity generation. A plant was built in 1901 near the Moselle, which was ultimately to be supplied with Lorraine coal, the flow of the Moselle being too variable for reliable hydroelectricity generation. This marks the establishment of the Usine d'Electricité de Metz. The municipality initially owning the tram but not the energy that powered it, bought the power plant from the private company Allgemeine Elektrizitäts-Gesellschaft (AEG), turning it into a *Stadtwerke*.<sup>9</sup>

### **The refusal to nationalise (1946-1949)**

After the First World War, the status of energy utilities in France was uncertain. In 1938 the city finally managed to obtain a state concession to distribute electricity, the request dating from 1921. In the aftermath of the Second World War, the city council protested against power cuts in electricity supplies and the reduction of the state services. Relations with the central government were strained.<sup>10</sup>

In 1946, the municipality and local miners came to the rescue of the population by delivering free firewood and coal. In 1947, the City Council refused to adopt French municipal laws which were to replace local laws that gave more responsibility (in terms of social assistance in particular) and autonomy to local authorities. The nationalization of electricity was discussed in this context.

In 1946, energy systems producing more than 8 MW were nationalized within EDF and Gaz De France, ending the existence of private companies and imposing a single price (prices varied depending on the distance from the site of production). The UEM chose to not join EDF, as did twenty other public companies in Moselle, being supplied by the coalfields and steel producers. Gaz de France later bought the gas plant, but the power company remained in the hands of the city. EDF did not accept Metz's decision and more generally had a strong opposition to all municipal utilities, because they reduced EDF's economic potential.<sup>11</sup> A series of conflicts arise between the national electricity company and the *Stadtwerke* of Metz.

At first, the battle was parliamentary and judicial. The mayor of Metz, who was also a member of the National Assembly, managed, with a few allies, to change the 1946 law on the nationalization of energy. The Armengaud Law of 1949 amended several articles. It permitted local public energy companies to "remain as they are", securing their existence but prohibiting their territorial expansion and leading to other battles related to energy capacity. The UEM was obliged to sell electricity at the set national price. It sells its generated power to EDF, which supplies electricity in return for all their needs, at a lower price than that paid to UEM.

### **The battles for high voltage lines**

By the early 1920s, the freedom of supply of UEM was threatened. It needed to raise the voltage to 65.000 volts in order to meet the growing needs of the territory. The coal and steel industries, as well as the state network opposed this. The state network put in place a toll system to prevent new high

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<sup>8</sup> Dieter Schott, *Empowering Cities: The Incorporation of Gas and Electricity in the European Urban Environment*, in: Mikael Hård & Thomas J. Misa (eds.), *Urban Machinery. Inside Modern European Cities*, Cambridge 2008, p. 165-186.

<sup>9</sup> Gilbert Mayer, *L'Usine d'Electricité de Metz 1901-2001, cent ans en phase avec le développement local*, Metz 2001.

<sup>10</sup> Yves Le Moigne, *Histoire de Metz*, Toulouse 1986.

<sup>11</sup> 3,5 millions French consumers are currently being supplied by local energy companies. 17% of the profits of EDF are paid to the French state.

tension lines. The installation of new lines by the steel industry finally allowed UEM to achieve this voltage, in 1928, and thus to source its electricity where it wished.<sup>12</sup>

After the Second World War, following the construction of a hydroelectric plant on the Moselle canal in 1966, UEM requested authorisation for 63.000 volt lines, the network being insufficient to carry the energy produced. EDF opposed this, but the local company won its case in the Council of State. History repeated itself in 1987 when UEM strove to obtain 225.000 volt lines, eventually winning the case in 1991. The argument which convinced the State Council concerned the company's production capacity and the cogeneration process which UEM had chosen. The company thus became the first French local energy company to achieve 225 000 volts.

### **The liberalization of the energy market: new legal battles...**

The liberalization of the European energy market, in 2007, renewed the appetite of the major French energy companies. Liberalisation was under way as early as 2000 with the law of modernization of the public electricity service. The director of the UEM managed to secure the status of local electricity distribution companies and their transformation into SEM (*société d'économie mixte*, a company with one or more public owners), after obtaining concessions from each municipality involved, drafting a few of the paragraphs of the modernization law.

The UEM had to split its energy production and distribution activities: URM was created to manage electricity distribution. The mayor refused a takeover proposed by ERDF (Electricité Réseau Distribution France), which manages 95% of the network in metropolitan France, famously saying: "*the cathedral of Metz is not for sale*". Political control of the company (UEM-URM) was reinforced. Board members now include the mayor and his first deputy, where previously there were no politicians.

### **Act 2. The struggle for independence: the endogenous production**

Independence from the national French energy companies involved not only securing the status and rights of the company, but also to increase the share of power generation that was endogenous, without which the UEM would have no reason to exist. However, this fraction was quickly diminishing due to the strong growth of energy consumption. Currently, UEM buys 84% of the electricity it distributes from EDF. In 1933 the company was energy-independent and in 1966 it met 40% of its electrical needs. Aware of this growing dependency, the UEM is committed to developing local energy whenever it can, that is to say as soon as an opportunity arises and its resources allow.

To explain this attachment to local energy, local actors also invoke the fact that the inhabitants of Metz always had to rely on their own resources. Solidarity with Lorraine industry provided another reason to source locally. Attachment to "Lorraine" energy, not just "local", reflects a two-faceted regionalism: regional identity during a very turbulent period of history, and economic in the context of industrial struggle between the Ruhr and Lorraine.

### **Develop local resources: little geopolitical squabbles over hydropower and coal**

In Moselle, coal mining and hydropower were closely coupled. On the one hand, exploitation of hydroelectric power required canal works on the Moselle, calling for dams to allow the movement of large loads, the costs of which could be supported only through the needs of the mines and industry. On the other hand, until the 1960s, the Germans protected their steel industry in the Ruhr by opposing the canal work on the Moselle, exporting their coal by rail, which increased the costs and weakened the competitiveness of Lorraine industry.<sup>13</sup> The UEM therefore seized on the rare water development opportunities to implant hydropower.

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<sup>12</sup> Gilbert Mayer, *op. cit.*

<sup>13</sup> René Bour, *L'historique de la canalisation de la Moselle*, Académie nationale de Metz, Metz 1959.

This type of energy, we have seen, marked the beginnings of local power generation. In the inter-war years, Lorraine having rejoined France, the construction of the Mines-de-Fer canal for the Metz steel valley at Thionville was completed, making France one of the first iron-exporting countries. The following year, in 1933, UEM built a hydroelectric power station on a dam belonging to the Waterways of France agency, with a capacity of 16 MW. Increase in electricity consumption soon imposed the use of power from other sources, namely from the coal and steel industry, the Moselle canal project being blocked.

A second hydroelectric plant was finally built in 1957 in the heart of the town, on an old dike that needed strengthening to cope with floods. The completion of the Moselle canal, obtained in exchange for the return of the Saarland to Germany, allowed the installation of a third hydropower plant in 1966 on a dam bridge built by the state services. After this the deployment of hydropower met resistance from the prevailing centralizing logic.

A new project failed in the 1980s, after a sharp conflict with EDF, claiming that the local power companies were not authorised to build plants with a capacity of more than 8 MW. The Council of State, invoked by the Minister for energy, decided in favour of the UEM, but Waterways of France imposed prohibitively expensive work to strengthen banks and locks. The three operating hydroelectric plants now provide 48 MW, or 3% of company sales.

### **Profit from "the goose that lays the golden eggs"**

The search for economic profitability was acting contrary to the development of local energy sources on several occasions. Primarily, the municipality expects the UEM to supply financial benefits. Part of the city's means of action, or even its political legitimacy, are linked to the company's profits.<sup>14</sup> Thanks to the UEM, for example, local taxes were not increased from 1945 to 2008.

#### *Local economic performance: giving value to the lost energy*

Metz was one of the first French cities, in 1956, to be equipped with a district heating network. At that time, these facilities were common in Germany. The construction of a coal-fired cogeneration plant in Chambière in 1961 significantly improved returns. Furthermore, a new waste incinerator was built beside it by the intermunicipal authority for waste management in 1970. The two plants were technically linked by pipes which allowed to use process heat for the district heating. This second form of recovery of lost energy is atypical in the French context.

In 1989, the mayor wished to push the integration one step further. He returned from a trip to East Germany with the project to create a single SEM for energy, waste and the environment. This would have put an end to the unending arguments over the price of heat between the UEM and the incineration plant, and would have brought a financial windfall to the city. It did not count on the strong opposition of the waste management intermunicipal authority and the UEM itself, which was attached to its status as a Stadtwerke.

#### *Economic performance after the oil shocks: the yo-yo of fossil fuels*

After the oil shocks the economic profitability of energy supply choices was subject to the international situation. Investments were driven by fluctuations in energy prices. Price volatility caused constant changes in energy generation and strategy, in a yo-yo movement. Over a period of less than thirty years, the Chambière coal plant was fuelled by oil, coal, gas, coal once more, and wood in the late 2000s.

Conversion to oil in 1972 was short-lived. The oil shocks imposed a return to coal in 1976. The national watchword was energy conservation, something the company had always preferred in order to increase the share of its autonomous production while limiting investments. But the 1980s saw the collapse in energy prices in the context of the Cold War. Reagan asked Saudi Arabia to open oil valves to weaken the Russian currency. It is the decade of the "doldrums", marked by stagnation of

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<sup>14</sup> The municipal investment budget is around 50 million euros/ year.

investment and the heating network, and a massive electrification of heating, for fear of a shortage of oil and coal (drying up of Lorraine mines). A geothermal project was abandoned prematurely. The power supply was effectively secured by EDF's nuclear program.

The planned closure of the coal mines of Lorraine forced the UEM to question its existence in the late 1980s. Following the failure of the hydroelectric project, UEM decided to equip itself with German gas turbines, 50 MW, in cogeneration, such equipment not being available in France. Gas was more cost effective than buying electricity from EDF, especially at peak rate.<sup>15</sup> Energy yields reach 83%. The gas turbines proved their economic viability compared to electric heating.

However, gas prices increased in the early 2000s bringing a new comeback for coal, this time imported from South Africa. The Lorraine coal mines closed in 2004. The security of energy supply is fragile when resources are imported and subject to international price fluctuations: one more argument for a return to local energies...

### **Energy transition and penny counting**

To the many expectations that weigh on the UEM, a recent environmental demand has been added, following the local and national debates on energy transition, and incentive schemes that are being set up. Gas price increases drives the company towards biomass combined heat and power generation (45 MW), which has the advantage of being a local energy and increasing the share of renewable energy in the heating network to more than 50%, thereby lowering VAT from 19.6% to 5.5%. Metz thus has the first large district heating network in France (44 000 household equivalents) fed with such a high proportion of renewable energy (60%). However biomass does not have unanimous support among the political class as the wood waste consumed no longer feeds the soil. There are no plans to deploy more wood energy.

Other renewables are facing a shortage of land, which will lead the UEM to delocalise its production of renewable energy. An attempt by the UEM to acquire land at the air base, to rent to a German investor who would place 380 acres of solar panels, remained unsuccessful. District mayors opposed the acquisition of land by the UEM. The UEM turned to the Mediterranean region, more profitable in the light of declining feed-in tariffs since 2009 in France for photovoltaic power. In 2013, a wasteland of 8 hectares near Marseille was outfitted, which receives 40% more sunshine than the Moselle, producing 4.5 MW. For wind power, externalisation does not exceed the scope of the department (46 MW installed).

If the share of renewable energy is still modest in the company's total energy mix, it is significant on the scale of the city of Metz (30% in 2013 excluding transport), covered by the district heating network. In 2008, renewable energy accounted for 10% in the city. The evolution is thus rapid. However, only the city of Metz, a shareholder of the UEM, is concerned. The UEM is considering establishing a subsidiary regrouping the energy producers, which could produce and buy the energy then sold to local power distribution companies, which would allow it to produce and sell outside its territory. The UEM intends to work in partnership with other SEM, such as Grenoble, to invest in new production tools, notably to deploy hydropower, by building or buying power plants on the Rhine and the Rhone.

### **III. Discussion**

The first objective of this research was to understand the reasons that led the city of Metz to develop local and renewable energy. Three phases can be distinguished in the UEM's supply policy.

From the beginnings of electrification to the oil shocks, priority was given to hydropower and Lorraine coal for their local and inexpensive nature, but the availability of these resources was limited. The use of local energy first determines the independence and development of the company, its endogenous production capacity justifying the capacity gain of its electricity distribution network. Local energy then determines its financial benefits, the electricity produced being sold to EDF at a higher price than that purchased from the national supplier. But it requires increasing investments as consumption soars.

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<sup>15</sup> Gilbert Mayer, *op. cit.*

The UEM thus turned to the sale and distribution of heat by installing a district heating network. Lorraine coal was the main fuel, but left room for energy recovery from waste incineration after 1970. The company favoured cogeneration, circular economy and energy saving to avoid oversizing its equipment.

After the oil shocks, a second phase starts, more turbulent, characterized by both the yo-yo effect international energy prices had on supply, and the fear of shortage of fossil fuels. Supply lines had to be secured while simultaneously responding to high demand for energy. The fall in energy prices in the context of the Cold War blocked the UEM investment capacity and therefore its autonomous production. It further encouraged the electrification of heating and increased its energy dependence on the national supplier. The approaching scarcity of Lorraine coal forced it to start looking for other sources of supply. The UEM turned towards gas, but soaring prices undermined this choice a few years later.

The end of the era of Lorraine coal opened the way for a third period, of renewable energies, in a favourable international and national context. Opportunities are acted on for biomass cogeneration (subsidies, fiscal incentives), but the further development of this local resource is not on the agenda for environmental reasons. Coal from South Africa continues to be used, the result of coal path dependency, as well as gas, which becomes a backup energy source to cover peaks in demand. In the field of electricity, options become reduced under the EDF monopoly. In view of the feed-in tariffs and unavailability of land linked to poor governance of the agglomeration, the UEM relocated its photovoltaic and wind power plants. It thus bypassed some local and national obstacles (poor fiscal conditions outside areas with high potential). Non-local production of renewable energy could allow a greening of the enterprise's energy mix in the future.

This simple overview clarifies the multi-scalar nature of the choices for "local" energy supply and the low-carbon transition.<sup>16</sup> The UEM is held within a web of national and international decisions, and its strategies must be adapted to the international situation. The geopolitics of energy prevented the deployment of local resources three times: before the oil shocks, when the exploitation of the hydro potential was constrained by the interests of German industry; after the oil crisis, which led to development of gas, exploitation of hydropower being hampered this time by the French authorities; finally, in the era of Reagan, the energy price collapse putting a stop to investments. When energy prices are too high, the UEM is forced to juggle energy sources. When they are too low, the fraction of endogenous production decreases and it falls back on nuclear power (by encouraging the electrification of heating). Ultimately, it is the increase in gas prices that triggered the transition to renewable energy, thus a financial opportunity, in a context having become more favourable to renewable energy.

The UEM's room to manoeuvre is also constrained by the energy centralism of France. Barriers to renewable energy development are numerous and tariff policy provides little incentive, especially for solar energy. The instability of fiscal and financial incentives (subsidies, loans) is another obstacle. The local context also conditions the choices of energy supply. The lack of governance between the municipalities of the urban area limits the range of the UEM.

The second aim of this work was to highlight and identify the German influence on the policy of the *Stadtwerke* and the city of Metz. Does the proximity to Germany provide a comparative advantage in the context of a low carbon transition? Without restating all the influences that we have identified, we can point out that this proximity played a central role in all choices of energy production, making Metz an atypical case in France.<sup>17</sup> These influences do not stem from cooperation between local authorities, rather through technical professional circles, meetings and visits, investors, and more generally by a culture of *Stadtwerke*.

The final objective was to understand the added value of a local energy company for low carbon transition in a territory. We have shown that the survival of such a company in the French context requires a certain degree of auto-production, which promotes the use of local resources, energy efficiency and renewable energy, once the Lorraine coal mines dried up. The UEM underwent a

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<sup>16</sup> Cyria Emelianoff, Local energy transition and multilevel climate governance. Lessons from two pioneer cities (Hanover, Germany, and Växjö, Sweden), in: *Urban Studies*, 51:7, 2014, p. 1376-1391.

<sup>17</sup> The other large local companies in the east of France have opened their capital to private investors or EDF.

measured but effective green shift. Nevertheless, dependence on nuclear energy remains strong. The investments necessary to green the energy mix at the level of the 142 communes would deprive the city of Metz of a financial cash cow. Given the situation, the most promising prospect for transition appears to be via a change of scale, allowing the UEM (through subsidiaries) to produce and sell renewable energy in other territories, in partnership with local energy distribution companies, becoming a macro-regional player in the energy market.

## Conclusion

The Metz case study shows that the instauration of energy as a territorial resource facilitates transition but is not in itself a triggering element. Explicitly renewable energy arrived in Metz due to the high price of gas and a favourable national context. With the *Stadtwerke* and its new subsidiaries, Metz has more leeway to carry out this transition than most French cities. However, political support for the low-carbon transition, rooted in a sensitized or motivated electorate, is lacking. The city has not benefited from the anti-nuclear movements that have shaken some European cities, leading to an early engagement in energy policies.<sup>18</sup> The Green electorate and environmental associations occupy a small place on the political chessboard and in public opinion. Climate friendly policy was slow to take off, and then oriented towards the thermal retrofitting of the most wasteful facilities and housing, and to the extension of the heating network, serving the interests of the UEM. Cross-border cooperation on the theme of energy transition also appears very shy.

The low carbon transition is inextricably a matter of technical and political change, to spur new actor interactions, new socio-technical systems. However, this transition is depoliticized in Metz, in that it is not rooted in a process of democratic debate. Product of an industrial tool, the transition emanates from the technical structure of the city and a model that remains paternalistic. Other political mediations are required for a change of scale in production and distribution of renewable energy.

We see that historical research holds interest for territorial studies on low-carbon energy transition in two ways, on a scientific and an operational level. Understanding the conditions for the emergence at a local level of an energy transition project leads us to ponder the historical relationship to local energy, renewable or not, the role of environmental actors, transnational networking, cross-border... The analysis of the processes leading to territories becoming interested in energy transition can subsequently identify what are the operational levers acting for an energy transition at the local level. Local authorities that reflect upon their legacies can build a new territoriality of resources and energy control. It is thus possible to show that the historical dimension is directly relevant to the issue of governance of the low-carbon energy transition.

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<sup>18</sup> Cyria Emelianoff, Pioneer cities for Climate Protection (Freiburg im Breisgau, Grenoble): the 1960-70s inheritance, in: IMS 2/2010, p. 34-44.