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NEOLIBERAL ELECTRICITY: ECONOMICS AND THE PURIFICATIONOF ENERGY.

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Neoliberal electricity: Economics and the purification of energy.

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ABSTRACT:
I examine the formation of an electricity market in Chile and the constitutive effects of neoliberalism in the Chilean energy sector. But instead of resorting to conventional macro approaches, I describe how electricity was neoliberalized – that is, practically, technically and materially shaped into a neoliberal form. To this end I focus on the technical arguments mobilized by neoliberal economists to cancel a large nuclear project in the late 1970s. More specifically, I describe the work done by economists to purify electricity via the application of new economic evaluation techniques in which any factors, rationales and entities not conforming to neoclassical arrangements were isolated and erased. I identify three of these processes: the elimination of non-economic elements, the state and the engineering culture from electricity planning. The larger point of the paper is a call to assess neoliberalism in Chile – and the performative affordances of economics at large – as a process of technical articulation inseparable from the objects and entities being neoliberalized.

KEY WORDS:
- Neoliberalisation
- Evaluation techniques
- Electricity markets
- Economists
- Nuclear energy
- Chile

I. Introduction: economists, electricity and neoliberalism in the making

In 2011 electricity took over the Chilean political agenda. The approval of Hidroaysen – a hydroelectric megaproject to be built in the Chilean Patagonia – sparked one of the largest citizen mobilizations in the post-Pinochet era. The voids of the present energy regulation and the future challenges of electricity production became objects of wide public debate.
But in the midst of the controversy, *Le Monde Diplomatique* made a particular call. The search for solutions needed, the newspaper stated, to turn to the past, for the project was the end result of the violent reconfiguration of the energy sector into a liberalized market in the late 1970s. The newspaper also recalled that the formatting of an electric market played a critical demonstrational role for the larger Chilean neoliberal experiment:

> The Chilean energy sector reproduces and amplifies the free market model together with all its contradictions and distortions [and it is considered] as the cornerstone of the installation of the neoliberal model, pioneering the privatization process during the 1980s. (Walder, 2011).

This paper is also about electricity and neoliberalism in Chile. And it takes *Le Monde Diplomatique's* revisionist call as its starting point – but not for what it denounces but for what is not accounted by it. Much ink has been spilled describing how Chile's industrial (Meller, 1996), labour (Foxley, 1983), urban (Portes & Roberts, 2005; Sabatini, 2000) and environmental (Liverman & Vilas 2006) sectors and institutions were radically transformed by the neoliberal restructuring imposed in the country since the 1970s. In the case of electricity it has been described, for instance, how the application of the neoliberal programme translated into the constitution of a market-price system, the separation of the electricity chain into three operationally differentiated sub-markets (generation, transmission and distribution), and a massive privatisation process (Heller and McCubbins, 1996; Pollitt, 2004; Vignolo, 2000).

But in lieu of these macro approaches, this paper tries to answer a rather simple but not yet addressed question: how electricity was *neoliberalized* – that is, practically, technically and materially shaped into a neoliberal form. Thus neoliberalism won't be approached as an overarching force, but as a set of epistemological principles and material devices that had to be displayed in specific settings and controversies. This paper won't try to assess the outcomes of the market-based configuration of the electric sector in Chile, but to describe how – with which tools, arguments and practices – a group of economists and engineers managed to format electricity into a neoliberal form.

While usual accounts emphasize the violent incontestability of the neoliberal restructuring in Chile – enforced by the "unholy marriage" between neoliberal technocrats and the military – today we know that neoliberal ideas and techniques encountered several and stubborn obstacles within economic and political elites in the late 1970s. Even within the *Junta* (government body imposed after the coup and composed by the chief commanders of each military branch) neoliberal propositions were seen as too bold for the rather state-oriented ethos of the military (Valdivia, 2001). Neoliberalism, then, had to muddle its way through, and it should be therefore enquired not only as a relatively powerful ideology, but also as an ensemble of minute and concrete applications, mechanisms, programmes and instruments: for neoliberalism to triumph some objects and ideas had to be enforced – and some other discarded, minimized or reshuffled.

In this paper I identify some of the elements involved in this adaptative play of enforcements and removals in the formation of an electricity market in Chile. Based on interview data and archival research, I reconstruct the history of the *Proyecto de Energía Nucleoeléctrica* (the Chilean Nucleoelectric Energy Project, or PEN for its acronym in Spanish), the largest attempt to date to implement a nuclear energy in Chile. The focus, however, will not be on how this project was designed but on how it was cancelled in 1979 by the newly established *Comisión Nacional de Energía*, the National Energy Commission (CNE for its acronym in Spanish), a governmental office explicitly launched to convert the Chilean energy sector into an open, price-based market. As I will argue, the termination of the PEN in the hands of the CNE is a perfect site to explore how energy was neoliberalized via the assembling, organising and application of a new set of economic assumptions and techniques for the evaluation of energy projects – and how through these processes a new, neoliberal world was performed. More specifically, I will describe how CNE economists, in order to actualize a neoliberal world in which the PEN deemed as irrational and inefficient, attempted at *purifying* energy and energy evaluation: CNE economists assessed the PEN with new economic evaluation techniques in which political factors, rationales and entities had to be isolated and erased. A pure economic evaluation was performed.

From a broader perspective, this story illuminates an intermediate stage in the trajectory of neoliberal articulation that has been seldom accounted. The scholarship on the formation of neoliberal markets has mainly focused on the sociological histories of expert elites sustaining and advancing neoliberal ideas, or on the socio-technical entities (per)forming markets and the various governmentalities at play. But in between these to poles – between the economists promoting and articulating neoliberal markets, and the actual markets already in function – lays a mediating process of installation, adaptation and power allocation: economists (point of departure), in order to ensemble neoliberal markets and objects (point of arrival), engaged in a myriad of local and technical controversies through which their techno-political programmes were enacted (point of mediation). By identifying one of these mediating processes – the cleansing process by which some rationales, explications and objectives are excluded in order to produce a bare, unadulterated economic object – I aim in this paper at enhancing and expanding our understanding of neoliberalism in the making.

In the next section I engage with the scholarship on the Chilean neoliberal experiment. Then I briefly describe the PEN to turn, in the forth section, to the cancellation of the PEN and the task of purification unfolded by CNE economists. The empirical material comes from interviews with officials working at CNE and the PEN in the late 1970s, and from two key documents – *Antecedentes y Propocisiones a las Autoridades de Gobierno para la toma de desiciones sobre la incorporación de centrales nucleoeléctricas al servicio del país and Factibilidad económica de una central nuclear en el sistema interconectado*[1], PEN's report and CNE's evaluation respectively. By paying special attention to the ways certain objects, practices and identities were enlivened as purely economic, I identify three distinct modes of purification: the concrete ways by which *politics*, the state and engineers were technically shaped by CNE economists. In the last section I return to the debates on market formation and neoliberalism and highlight some of the questions the case helps to rise.

[1] *Background and propositions to the governing authorities for a decision about the incorporation of nuclear plants to the service of the country" and "Economic feasibility of a nuclear plant within the interconnected system.*

II. Purification and processes of neoliberalization

The social sciences have usually approached the Chilean neoliberal experiment as a cultural object. Neoliberalism is viewed as a rather abstract sociological force, similar to Plehwe's definition of neoliberalism as a "thought collective", "a set of shared values and principled beliefs" (Plehwe, 2009, p. 35. See also Walpen et al., 2007). Indeed, the notion of the "underlying ideology" (Foxley, 1983, p. 41) seems to be the fundamental analytical resource in the description of the Chilean neoliberal experiment (cf. Foxley, 1981 and 1983; Ffrench-Davis, 2006; Vergara, 1985; Garretón, 2012). It's the heuristic allowing for a causal explanation of the economic and social adjustments experienced in Chile in the late 1970. The monetisation of the economy, the creation of new markets for the organization and delivery of social goods and services, the privatization processes, and the opening of markets are *effects* of broader ensembles of "ideas, beliefs and values that are used to cohere the dominant block and to justify its acts" (Vergara, 1985, p. 13).

Unlike this usual take, this paper attempts at understanding the process of neoliberalization experienced in Chile as a generative articulation of practices, devices and knowledges. My attempt therefore builds on – and engages with – three distinct although complementary literatures that have already rehearsed more epistemic-based, material-oriented and embodied approaches to the Chilean neoliberal experiment.

First, economic historians and sociologists have turned to the role played by economists – and their "irresistible ascendance" in power positions within the state (Markoff & Montecinos, 1993) – in the organization, shaping and unfolding of neoliberalism in Chile and Latin America (Centeno and Silva, 1998; Dezalay and Garth, 2002; Fourcade-Gourinchas and Babb, 2002; Gárate, 2012; Markoff and Montecinos, 1993; Valdés, 1995). This scholarship has emphasized the need to understand the articulation of neoliberalism under the light of the specific political and epistemic features of the raising economist-technocrat, therefore as the unfolding of a set of knowledge practices embodied in and mobilized by singular actors embedded in particular cultural circuits.

The analyses on the Chilean "Chicago Boys" are a primer example of this line of work. Coming from conservative Universidad Católica de Chile, these economists brought back from their postgraduate studies at University of Chicago's department of economics – a centripetal node for neoliberal thought (Van Horn & Mirowski, 2009) – not only a neoclassical and mathematicalized version of economics, but also a Hayekian conviction about the need of a reduced but highly technocratic state that would secure the free expansion of the market to all sectors of social life. In the late 1970s Pinochet granted this "uniquely powerful and ideologically coherent team of free-market technocrats, with a long-term vision for the Chilean economy" (Fourcade-Gourinchas and Babb, 2002: p. 545-6) with the responsibility of transforming Chile's economy into a liberalized, open, market-based economy (Fisher, 2009). And perhaps more importantly, Chicago Boys, through their various positions in thinks tanks, universities and the media (Fischer, 2009), installed the pervasive idea that markets are the most efficient solutions to public problems, and that hence (neoclassical) economists are the ultimate experts in the governance of social and political life (Ossandón, 2011).

A second scholarship, inspired by Foucauldian analyses on biopolitics and governmentality, has approached the expansion of neoliberalism in Chile as a project of political technology. This literature has emphasised the need to focus not only on how neoliberalism is transferred via cultural, professional and epistemic circuits, but also on how once in place it modulates

particular governmental rationalities: insofar subjects and subjectivities are done through and with a number of dispositifs (Foucault, 1980), the enlivenment of liberal subjects is inseparable from the "liberalisation" of diverse modes of knowing and ordering (Barry, 1996; Donzelot, 1979; Osborne, 1996; Rose, 2004). For example Paley (2001) has pinpointed how the use of surveys in political and community research in Chile as a way of quantifying social life has to be understood as a mechanism to produce subjects matching both the newly democratic ethos on the one hand, and the proliferation of consumer markets accompanying neoliberal economics under military rule on the other (2001, p. 137). Similarly, Schild (2000) argues that the construction of subjects – for instance within the participative exercises that proliferated in the early 1990s – as simultaneously citizens and consumers was instrumental for the formation in Chile of a capitalist democracy. The larger point made by these approaches is that neoliberalism in Chile is constituted by and executed through the devices, programmes and assumptions entangled in the making of specific subjectivities and political reasons (Paley, 2004).

The third strand stems from the "performative turn" within economic sociology. This line of research has emphasized the role of market devices – including economic knowledge itself – in the actualization of economic objects and their collective calculability (Callon, 1998; Callon, 2007; Licoppe, 2010). One of the main claims is that economic activities are neither guided by intrinsic rationalities nor embedded in social relations but configured in and through complex ensembles in which objects, subjectivities, spaces, technologies, institutions and theories are productively entangled (Callon, 1998; Çaliskan & Callon, 2010). Thus the economy or any of its constituent entities (markets, goods, services, agents) are always elements that have to be constituted as. For modern market exchanges to act as such a number of elements have to perform them, including automated technologies (Muniesa, 2000), econometric models (Mackenzie, 2007), accounting techniques (Didier, 2007; Miller, 1998), tacit norms (Abolafia 1998) and trading rooms (Beunza and Stark 2004). Thus something becomes "economic" only insofar a matrix of connections pragmatically qualifies it as such. Çaliskan and Callon (2010) have called *processes of economization* the heterogeneous dynamics by which economic things and activities become economic – or the ways "through which behaviours, organizations, institutions and, more generally, objects are constituted as being 'economic'" (Çaliskan and Callon, 2010, p. 2). Taking these insights as his point of departure, Ossandón (2009, 2012) has analysed the birth of the private health insurance market in Chile. In his account, this market – among the flagship neoliberal projects designed and applied by the Chicago Boys – emerged from the neoclassical and Hayekian inspiration of conservative technocrats-economists, but also from the generative work of ad-hoc technical innovations, new regulatory frameworks, the work of think tanks and academic experts and a myriad of assessing and measuring technologies.

Taken together, these three approaches configure a robust story about neoliberalism in Chile – and one that doesn't resort to an overarching, abstract explanation. The preliminary conclusion is hence that an examination of neoliberalism in Chile should assess the specific processes by which certain techniques, epistemologies, devices and subjectivities, promoted by and organised in particular expert circuits, entwine to generatively produce specific types of economic arrangements and objects.

These three approaches, however, leave untouched a critical moment in the life of neoliberalism. They focus on the birth of neoliberalism or in the actual neoliberal markets

once in function, neglecting a crucial mediating phase. Indeed, these approaches are preoccupied either with the epistemic communities and expert cadres transferring neoliberal programmes and rationales to local state management and cultural circuits, or with the sociotechnical articulation of markets already in operation – and the performativities, epistemologies and governentalities inscribed and promoted in and by them. There is, however, a fundamental mediating instant: the inevitable moment in which neoliberal ideas, techniques and assumptions had to interact, and sometimes contentiously, with pre-existing modes of knowing and ordering. Somewhere and somehow, neoliberalism – as a set of theories and techniques – had to be installed in very specific technical situations and sites. Not the birth of neoliberalism nor the functioning of neoliberal markets and objects, but the in-between process of "making room" for a neoliberal world: for neoliberalism to operate, some ideas, technologies, practices and theories excluding had to be displaced, excluded and transmuted.

I call *purification* this process of displacement, exclusion and transmutation of old rationales for the subsequent installation of neoliberal arrangements. Hence purification does not only refer to the act of cleansing, purging and refining, but also to the inventive effect of these actions: through these processes of purification a realm, an object or a situation is modulated into being. The work of Timothy Mitchell (2007) is in this regard a relevant point of departure. In his analysis of the Peruvian housing voucher experiment, devised to enact a proper urban property market, he reflects on the performative affordances of economic thought. The case of Peru, following Mitchell, shows how economic experiments were not primarily conducted to retrieve relevant data about property titles and informality in Peru, but to confirm neoliberal theories and assumptions about what is – and what isn't – a proper market, a proper economic rationality and even a proper working ethos. Interestingly, for Mitchell this case indicates a particular form of performativity, one in which economics functions as a quasi-judicial devise demarcating between the economic and the non-economic (Ossandón 2012). In the words of Mitchell,

> To argue that the power of economics is performative is not to argue that its power necessarily lies in getting people to adopt its (mis)representations; rather, in helping to constitute the apparent border between the market and the nonmarket, economics contributes to the work of sociotechnical mechanisms that reorganize how people live, the political claims they can make, and the assets they can control. Its particular role, I argue, is in formatting a form of exclusion-inclusion (Mitchell, 2007, p. 248).

In Mitchell's account, economic experiments conducted in Peru, as sociotechnical devices acting upon the objects they observe, helped in purging what a housing and labour market were, and therefore in displacing some definitions and including others: it was a process of purification in which a neoliberal world was enact. And this process cannot be fully located at the "origins" of neoliberalism in Peru (since as Mitchell explains, there is an extended history of ideas travelling from US neoliberal think tanks to Lima), nor is a description of a neoliberal market already in operation, but it represents a mediating moment in which a neoliberal epistemology attempted to be installed.

In the remaining of the paper I will identify, as well, the processes of purification involved in the implementation of an electricity market in Chile. I'll try, in other words, to identify these precise and minute situations in which neoliberalism was pragmatically and technically set up by purging and cleansing critical definitions, principles and assumptions – and therefore by displacing those not attuned with the arriving ones. The cancellation of the PEN by a team of economists is, I argue, a privileged site to undergo this exploration. I thus follow how these economists mobilized models, presumptions, theories and evaluative techniques to purge, distil or clean decision-making in the electric sector and put forward a neoliberal world in which the PEN deemed as inefficient and irrational.

III. The Nucleoelectric Energy Plan: the history of a technological momentum.

By the late 1970s the PEN had become one of the most important and ambitious technological programmes in the country. Imbued by the ambience of fascination towards (nuclear) technology and propelled by the geopolitical competence against Argentina, in 1950 the Chilean government signed its first scientific agreement with the US Atomic Energy Commission to search uranium in Chilean territories.

The next decade was one of rapid and intense development. Prospective studies proliferated. The first one was commissioned in 1967. Two years later the Chilean government signed an assistance agreement with the International Atomic Energy Agency (IAEA) to develop a 5 MW research reactor. In 1970 ENDESA (National Electricity Company[2]) hired Pittsburgh-based NUS Corporation to evaluate the feasibility of installing a 75 MW commercial nuclear plant in Antofagasta, and in 1972 the *Comisión Chilena de Energía Nuclear* (Chilean Nuclear Energy Commission, CCHEN for its acronym in Spanish) conducted geological studies to determine the existence of underground water in the that area. That same year CCHEN conducted a pre-feasibility research to evaluate the possibility of retrieving uranium in Chuquicamata, 230 kilometres east from Antofagasta and the largest copper mine to date.

[2] *ENDESA was privatised in 1989.*

Insofar Chile was still behind Argentina and Brazil in the nuclear race, the construction of a research reactor turned into a priority. In 1968 three municipalities donated a site in La Reina (Santiago) for the construction of the first experimental plant. The next year the UK agreed to provide a 5 MW research reactor, and that same year enriched uranium was bought from the US. In 1972 the reactor of La Reina reached its first criticality and the construction of a second research reactor began in Lo Aguirre, in the western outskirts of Santiago.

In the face of these rapid developments, an aggressive training plan was established. In 1969 the Polytechnic Military Academy incorporated nuclear sciences into the engineering curriculum, and in 1971 the IAEA assisted CCHEN in the training of selected military officers and engineers. The Chilean government signed several training agreements, and by 1979 at least twenty-five engineers among the best graduates from the Polytechnic Military Academy had travelled to Spain, the UK, Argentina, the US and Germany to obtain their master degrees in nuclear engineering and nuclear sciences. Many others did professional internships in nuclear facilities in Brazil, Canada, Spain and the US.

In short, the military "put in twenty years a lot of dough, and not only in steel and construction, but in production, training of people, preparation" (interview with ex CCHEN official, 2012). As a result, in 1974 CCHEN, together with ENDESA and CHILECTRA[3], drafted the *Proyecto de Energía Nucleoeléctrica* (PEN), a detailed technical and economic project to fully introduce nuclear energy into the Chilean electricity matrix and with the short-term goal of having the first commercial nuclear plant by 1990. The PEN seemed not only necessary but also inevitable given the circumstances. The technological momentum and the socio-technical inertia of the PEN were too strong to stop the motion of events. The project was backed up by and initiated in the military world – always keen to technological innovations. Moreover, the PEN unfolded in the context of a military dictatorship in which dissident voices, co-natural to nuclear developments (Bauer, 1995) were non-existent. In addition, the project had established a solid network of political, technical and epistemic allies. The Plan was backed up and legitimized by the technical support of several countries, especially Spain, which served as the primary epistemic reference for the Plan. But more importantly, the Plan had enrolled ENDESA and CHILECTRA. Besides the strategic benefit of designing the project with monopolist agents – the two companies had total control over electricity generation (ENDESA) and distribution (CHILECTRA) – these two companies were nationalistic symbols of Chile's technological capabilities, imbuing the PEN with an epic narrative of technological and industrial development: nuclear energy was the means not only to secure clean and

[3] *Chilean Company of Electricity, privatized in 1987.*

abundant energy for troubled times, but also to propel Chile towards the developed world. "The principal element that I learned there [in Spain]", says an important military officer at CCHEN at the time, remembering the central question behind the PEN, "was the enormous impact that the construction of a nuclear plant has at the national level. [In Spain] between an 80% and 90% of the construction industry… had advanced due to the nuclear development".

The final PEN report was submitted in 1975 to the newly born *Comisión Nacional de Energía* (CNE), and it included site, legal and financial evaluations conducted by important international agencies, plus a thorough computational simulation to define the optimum energy matrix – including different energy sources – and its sequence of operational implementation. All the pieces were aligned and a lot of effort had been invested: the PEN had built an irrevocability that seemed impossible to revert. But it was.

IV. Neoliberalism and the purification of energy.

The CNE, established in 1978 as a direct order from the arriving economic team[4], had the explicit task of transforming the electric sector into an "efficient market." As one of the engineers that participated in the first CNE team remembers, "The Commission was created mostly by the economic team of the military regime, by people like Pablo Baraona and Sergio de Castro". It was indeed Sergio de Castro, perhaps the most influential figure behind the Chilean neoliberal experiment (Cavallo et al., 1998; Fisher, 2009)[5], which against the statist mind frame of the military – especially when it came to geomilitary-sensible issues – fervently promoted the launching of a new governmental office to reform the energy sector.

[4] *Bruno Philippi, CNE's first executive director, although trained at Stanford and not in Chicago, was part of the Chicago Boys clique and is usually pinpointed as a key figure behind the massive privatization of state companies in the late 1970s and early 1980s.*

[5] *Sergio de Castro, the "Pinochet of the economy" (Fisher 2008, p. 321), was Minister of Economy (1975-1976) and Minister of Finance (1976-1982). De Castro was a fundamental figure in the monetarist shock treatment implemented in Chile in the late 1970s and the crucial mediator between Pinochet and its economic team.*

The CNE kicked-off with an straightforward diagnosis: the energy sector had been co-opted by inefficient state companies – i.e. ENDESA and CHILECTRA – which had configured a monopolistic market whose operations were not guided by economic factors but by political incentives. Moreover, these companies had benefited from discretionary and crossed subsidies, and therefore had created a distorted price system (Rudnick et al. 2001). In the face of these facts, the treatment was quite forthright. As stated by one of the founding members of the CNE, under these circumstances the objectives of the CNE were "the issue of [establishing economic] prices, then to establish a framework in which the private sector could penetrate [into the energy market], and to decentralize the electricity sector [breaking the market monopoly]". This meant, in other words, the application of a new technical framing and a new way of understanding the notion of energy: one that was *purely economic.*

Only months after its establishment, the CNE run into the perfect occasion for an exemplary demonstration: the evaluation of the PEN, a state-based, military-run and national-oriented nuclear megaproject. If an efficient electricity market was to be created, then the CNE had to seclude decision-making from any contaminating factors, namely those that had dragged the energy sector into its actual irrational operations. The evaluation had to result from a strict and cleansed economic reasoning. The task of the economists was to *purify* decision-making, and with the PEN the CNE did so in three different ways.

IV.1. Purification #1: *to eliminate non-economic elements from economic decisions.*

The PEN was a declared political project: it promulgated – and was based on – a very particular view on energy development. First, for PEN engineers the question about nuclear energy – and energy development at large – had to be framed as a *geopolitical issue*. The first paragraph of the PEN report submitted in 1975 reads:

> Today's energy crisis is still far from being solved, and it is producing profound changes in the economic and energy structures around the world; it is altering the force equilibrium in large political-economic influence zones and between States, and in fact it is generating new power forms that could lead to unsuspected international confrontations. Economic development and the survival of nations have a very important relation with their capacity to generate energy. Thus the importance of this vital world problem. (CCHEN/ENDESA 1975, p. 3).

Energy was not just an issue of pricing and efficiency, but one about political balances, international strategy and risk management. Economic reasoning was not enough to fully understand the political complexities and necessities involved in energy planning. Moreover, nuclear energy had to be assessed in the perspective of the country's *modernisation* process. The experience of Spain's development was a powerful inspiration. Nuclear energy had to be fostered because it would trigger an intense and far-reaching wave of industrial and technological development in the country. Or as the PEN report stated,

> The benefits derived from this project [PEN] will reach important aspects such as: formation and training of the human resources required by a nuclear development of this magnitude, and the following: enhancement of scientific-technical level and infrastructure, preparation of the industry and improvement of quality standards." (CCHEN/ENDESA 1975, 10).

But this geopolitical and modernising framing was at odds with how CNE experts understood the energy sector and the economy at large. The Chicago Boys were, via the teachings of Milton Friedman, close followers of Hayek's principles (Centeno, 1998). For the Austrian philosopher politics always unfolds as a biased competence in which interested stakeholders try to distort the rules for their own particular sake, therefore the political field is always inevitably captured by egoistic struggles from which the common good could never be restored (Centeno, 1998; Van Horn & Mirowski, 2009). The solution for Hayek is well known: to have a limited and restrictive government; to let the market – as an unbiased and emotionless mechanism – set the rules for social ordering; and to separate as much as possible political decisions from technical ones, leaving the command and control of state affairs on the hands of (market) experts.

Following these principles, the first task of the CNE economists was to demarcate economic elements from non-economic ones – and to eliminate the latter. "Political factors", as they called them – anything that wouldn't translate into economic factors within a neoclassical model – had to be erased. Indeed, the CNE established that the principal problem in the energy field was the entanglement between economics and politics. The most visible result of this unwanted mesh was that energy prices did not reflect economic value. Thus any trace of non-economic factors had to be excluded. And they did so in two stages.

First, the CNE had to limit and purify what was being understood by "social benefit". The CNE report stated clearly: "The basic objective of electricity planning is to determine the generation, transmission and distribution works that would serve the demand securing the *maximum benefit for the community*" (CNE 1979, p. 22. Emphasis added). But how to define "maximum benefit for the community"? Or better said, how to define it in pure economic terms? The report goes on developing a particular explication: the problem had to be *monetised* and framed as a neoclassical arrangement. The rationale of CNE was as follows:

(1) if two energy programmes seek maximum social benefit, then their costs have to be equal, and if moreover (2) an inelastic demand is assumed, then (3) demand should be also equal to both programmes. Thus against equal costs and demand, to maximize social benefit is to *minimize total actual costs*. "Social benefit" was not anymore about development goals or modernisation processes but about the *least expensive* project. "Social benefit" was purified to mean a measure of actual costs.

Once any possibility of infiltrating political elements into the definition of "social benefit" was secured, the second step was to frame those elements – modernisation, industrial advancement, techno-scientific development – *as technically unviable*. Or put differently: these elements were not only alien to a monetised form of "social benefit"; more profoundly, they were also at odds with any notion of rational (economic) optimization.

The CNE attacked the idea of *technological transfer,* crucial in PEN's argumentation. The CNE argued that any expectations about a national technological improvement were, due to the complexity involved in the construction of a nuclear plant, oversized by the PEN: "[T]he national participation in the construction of a first [nuclear] plant will be, in the best of cases, limited to the execution of public works, part of the assemblage and to the monitoring of the project", asserted CNE's evaluation. "It has to be acknowledged", the CNE's evaluation continues, "that not only the nuclear components of the project will be imported, but also the conventional ones such as turbine, generator, bombs, power transformer, etc." (CNE, 1979, p. 69).

But the claim of the CNE was also moral. Insofar social benefit was defined as a cost function, projects had the moral obligation of being as inexpensive as possible – to therefore free resources for other projects. The notion of *opportunity costs* became the metric with which to valuate morality and the common good. As stated by the CNE, if a programme of technological transfer *against* rational reasoning was anyhow executed, then "a programme of several plants would have to be planned… accepting important *over-costs*" (CNE, 1979, p. 69. Emphasis added). In the neoconservative model applied by CNE economists, over-costs are a synonym of unmet social benefits. Hence the moral dilemma: in the face of unjustified over-costs it would be "worthwhile asking whether there aren't other activities in the country that justify this allocation of resources" (CNE, 1979, p. 69).

Thus the CNE, via the application of very specific evaluative techniques and theories, modulated the energy production in a very particular way. Using optimization modelling, elasticity theory, opportunity-cost principles and monetising social benefit, they enacted a version of electricity in which the meeting of social welfare was subjected to actual costs. Any additional consideration that could potentially increment costs was immoral, since it would hamper the allocation of resources in other sectors.

IV.2. Purification #2: *to eliminate the state from energy management.*

Once a pure economic evaluative metrology was designed and imposed, it was necessary to eradicate a more ubiquitous entity from the epistemic scheme mobilized by the PEN: the state.

The state was a key element in PEN's architecture. As in most countries (Hughes, 1983), electricity planning, generation and distribution in Chile have traditionally been state-led functions. Already Hernecker et al.'s *Política Eléctrica Chilena* (1936) – considered the foundation of modern electricity planning in Chile – assessed that as a "service of extreme public utility [electricity] has to be exploited directly by the State, or by particulars subject to a strict reglamentation and fiscalisation". Being an intense-investment industry, the electricity sector "can only economically survive in monopolistic regimes". Moreover, insofar

"the dominion over electric energy permits the dominion over the country" (Hernecker et al., 1936, n/p, cited in Ibáñez, 1983, p. 60-61), electricity had to be seen as a strategic geopolitical asset planned and controlled by the state.

The PEN proudly continued this state-led tradition in energy planning. Indeed, the PEN readily declared that "a country's energy is a national asset and a power factor. It constitutes one of the fundamental infrastructures for National Security. Thence its use, conservation and development, must constitute a fundamental State preoccupation" (PEN, 1975, p. 3). Enrolling ENDESA – which fully represented this national, technical and strategic ethos – as the technological partner of the PEN was a powerful sign. As one public servant from CCHEN remembers, "we thought it was appropriate that state enterprises were the ones in charge of this [PEN], for example ENDESA, that had the support of [being national leaders in] energy production" (I4, 2012).

Indeed, the PEN report visibly marks the importance of ENDESA within the project. As with any technological project, the PEN had to install and heighten its relevance, necessity and technical robustness (cf. Callon, 1991; Hughes, 1989), and ENDESA was the perfect ally for that endeavour. The basic technical requirement to justify the PEN – the "need to incorporate the First Nuclear Central of approximately 500 MW by 1986" (PEN, 1975, p. 5) – was endorsed by ENDESA. ENDESA also participated in the feasibility study and facilitated the "mathematical models… to define the most economic-efficient sequence of installation" (PEN, 1975, p. 7). Moreover, the operational responsibility of programming the nuclear plants and integrating them to the *Plan de Electrificación Nacional* (National Electrification Plan) rested on ENDESA, together with the design an "Action Plan" for future developments (PEN, 1975, p. 11). In brief, with the national company involved, the PEN could construe itself as a state entity, thus securing its relevance, feasibility and irrevocability.

The CNE, however, had a radically different perspective. The state, far from being an enabling element was a *distorting* factor – and thus had to be eliminated from any electricity evaluation. This meant to destabilize the position of ENDESA within the PEN and, more amply, within the Chilean technopolitical regimen at large.

With military elites still longing for a strong state, the CNE had to redefine the imaginary around of "state-owned firms." And they did so by defining them as *corrupt*. ENDESA, one of the largest state companies, was a perfect target. As one important official from CNE of the time remembers, one immediate objective of the CNE was to gain control over the evaluation of ENDESA projects: "we did not know if their [on-going energy projects] were good or bad, because that [evaluative] function had been ran by [state] companies *too autonomously*" (I5 2012. Emphasis added). Here "too autonomously" doesn't refer to the lack of external audit procedures or counterfactual information but to a formal decisional incapability of state-firms. Indeed, at the heart of this diagnosis – the inability of state-owned firms to evaluate their own performance – laid a very particular assumption: that to manage a firm in which the agent has not invested is an incentive for the agent to maximize agentic – and not social – gains.

Developing an idiosyncratic theory of the firm, CNE economists extended to it the figure of the *homo economicus*: not only individuals are more efficient if their egoistic interests are at stake; the firm as well is more efficient when managing their own investments. A state company, since it does not administer its own resources, is "anthropologically" unable to evaluate the fitness of its endeavours.

The new criteria pointed expressly to ENDESA, the epitome of this deviated economic configuration. "Let's talk things clearly", an important former CNE officer remembers saying to a room crowded with ENDESA engineers when announcing its privatisation, "you have never felt that this company belongs to the state, nor to Chile, you feel this firm belongs to you, with the difference you have *never* put a dime on it" (I3 2012). ENDESA, as a state company, was structurally impeded to evaluate, design and implement energy projects. In

the view of the CNE, ENDESA was run by bureaucrats that had transformed the company into a gigantic political, inefficient and corrupted machine. "When you looked at ENDESA, which was the best among state-owned firms," recalls a former official from CNE, "[you could see that] it was run by administrators who accommodated themselves according to where they could have more game".

IV.3. Purification #3: *to eliminate the engineering expertise.*

CNE Economists understood that for the constitution of a new object, namely a new a form of electricity that would conform to a neoliberal formatting, the elimination of non-economic factors and the eradication of the state from electricity planning were not enough. A controversy over the technical reasoning utilized to evaluate energy projects and the role of the state would result in an endless brawl of one expert argument against the other. It was necessary to destabilize the more profound collective worldviews at play. And this meant to attack the engineering culture backing the PEN.

At the heart of the PEN and its developmental expectations laid a strong vision of engineers as carriers and promoters of Chile's grandeur. In this vision, as explained by Ibáñez (1983), engineers were called upon the construction of a "progressive and modern nation… involving material development together with the search of social well-being" (1983, 58). Engineers not only endow the country with national technology, but they are integral parts of the Chilean state and its modernisation process. In fact ENDESA and CHILECTRA, proud carriers of state interests in national development, were home for the best engineers and the icons of the "Chilean technology" (Medina, 2011). Reflecting retrospectively, an officer from CCHEN remembers how the PEN was sustained on the unique mixture between the technical prowess and the nationalistic ethos of ENDESA's engineering culture:

> I also think that engineering, but not so much from the point of view of knowledge but from that of the attitude and the concept of doing engineering that we had in the seventies, and whose maximum expression was ENDESA, would have transformed the nuclear [programme] into a veritable school. (I4, 2012).

So like the 19-century French engineers, Chilean engineers "did not so much derive legitimacy from their technological achievements as the other way around. That is, their position within the state *conferred* legitimacy on their technologies." (Hecht, 2009, p. 26. Emphasis in the original). This mixture between technical expertise and a "progressive and nationalising mission" (Ibáñez 1983, p. 58) made engineers the only certified authority in electricity matters. As it has been already noted, electricity in Chile has been traditionally framed as a state matter (Ibáñez, 1983). Thus engineers – trained in state universities and public servants in state-owned companies – were the only valid spokespersons when it came to electricity planning – and this sentiment remained strong by the late 1970s. Indeed, the landing of economists into the electricity field and the engineering turf was seen with extreme scepticism. A military officer occupying a high-rank position within the CCHEN remembers their reaction when the CNE was established with Bruno Phillipi, not an electric engineer, as its executive director:

> we had an unpleasant time… he [CNE's director] was angry with me for a while, because he was a system analyst looking forward to apply his [economic] scheme, but he himself manifested when we met "I don't know a thing about energy, nothing", and I responded "how can it be possible to put someone that doesn't know a thing as executive director [of the CNE]?" (I1, 2012).

The newly established CNE clashed with this engineering epistemology, and made every effort to delegitimize it. First, and following the assumption that economic agents cannot be rational if they have not invested in the firm they manage, the CNE stigmatised engineers as individuals with the propensity to fall into technological fantasies: engineers, freed from every economic boundaries, create technological monstrosities. One of the founders of the CNE puts it this way:

> The PEN had gathered a group of engineers, among the best in ENDESA and CHILECTRA, but the thing was very confusing. While the PEN was run by ENDESA it was basically a rather technical project and something typical of technicians and engineers… they always like to build new and different things, especially if they are not framed within a rational economic system… the temptation of technicians is to build something different, but whether it was worthwhile or if somebody else paid for it, that's another story [irrelevant for engineers]. (I4 2012)

This unbounded irrationality was accompanied by a second, perhaps more insidious stigma. Indeed, the CNE economists not only viewed engineers as out-of-control technicians; they also catalogued them as *incompetent*: they were not even *good* engineers. "I think that the main explanation to the programme [PEN]'s disorder… was where it was anchored, and it was anchored in the Chilean Commission of Nuclear Energy, which was honestly managed by military polytechnicians extremely incompetent", explains a former officer from CNE. The main claim of the CNE was that military polytechnic engineers were not professionally and academically prepared for duties outside combat-related activities. As a former CNE officer explains,

> Actually, if you think about it, military polytechnic schools come from the French, and [military polytechnic engineers] are really sappers, guys that what they really should do is to study how to rapidly assemble a bridge, how to pass a river. But in that time [1970s] they generated a kind of school, a military polytechnic school in which in four years they supposedly earned a title of engineer.[6] But in those four years these guys also had to follow the military career, then it was far less than four years.

The attack was not aimed at engineers in general, but particularly to military polytechnic engineers. Thus the epistemic clash between economists and engineers could not be demarcated from a class conflict between traditional universities and the Polytechnic Academy. It has to be remembered that the neoliberal experiment is closely linked to Universidad Católica de Chile (UC), the most affluent, elite-oriented and conservative university at the time (Fischer, 2009; Valdés, 1995)[7]. The Chilean military, on the contrary, has always been linked to the emergence of state-sustained middle-classes (Valdivia, 2001). The CNE, headed by a UC professor and populated by UC engineers, was in stark contrast with the military world embodied in CCHEN, ENDESA and the PEN. And the clash was both evident and painful:

> I think it was a hard process for the military, very hard... the army has always represented very well the different social classes of the country. In contrast, these people [CNE economists and Chicago-boys] didn't [represent all social classes], they belonged to the upper groups. (Interview, CCHEN official, 2012).

Thus PEN engineers were underprepared, at least compared with their peers graduated from Universidad Católica or Universidad de Chile. Moreover, these military quasi-engineers had Spain as their epistemic reference in nuclear matters. The nuclear engineering master and doctoral program at Madrid Polytechnic University had been the preferred destiny for PEN engineers. However, for CNE experts the United States was the only valid source of knowledge. With the ascendance of the economist as the expert per excellence and the latter displacement of Keynesian economics by the more mathematicalised and monetarist economics taught at Mid-West US universities, to hold a PhD from a North American university became an obligation – in lieu of the classic law doctorate in a European university (Domínguez, 1997; Markoff & Montecinos, 1993). Anything different from a US doctorate was dimmed as inferior or, as a former CNE official with a PhD from a prestigious US university puts it, *indecent*. He remembers how he obstinately struggled, after the PEN's cancellation, to change the training programme by sending military officers to obtain their master degrees in the US. "Once you had a couple of guys really understanding the [nuclear] issue, the fight is over", he remembers explaining his rationale. "If you send an intelligent officer to study in a *decent university* he would realize that this is not just to follow the Spaniards" (I3 2012).

[6] *The engineering curriculum in a traditional university (like Universidad Católica and Universidad de Chile) takes six years.*

[7] *The Chicago Boys were born from an agreement between University of Chicago and Universidad Católica, and most of the economists in charge of the neoliberal restructuring were academics at Universidad Católica's department of economics – which operated as a de facto think tank for the experiment (Fischer, 2009; Valdés 1995).*

In other words, military engineers were not only irrational and underclassed. They also mobilized illegitimate knowledge. This epistemic conviction was so strongly imprinted in the government that even Pinochet, an "astute hillbilly" taught by Sergio de Castro, as defined by a CNE officer, would deem a Spanish degree as insufficient. The same former CNE officer recalls a conversation that Pinochet had with PEN engineers when the plan was cancelled:

> 'Wait a bit, who among you has studies, who has a doctorate, who knows what you're talking about [nuclear energy],' Pinochet asked PEN engineers, 'well, we had courses in Spain' they said. 'Don't tell me that, it is not the same. When you can really show me that you have *titles* we'll talk about what can and what cannot be done [with nuclear energy]' (I3 2012).

V. Concluding remarks

The CNE, devised to transform the electricity sector into a neoliberal market, designed, mobilized and imposed a new technical regime – one in which the evaluation of energy projects had to be performed in *purely* economic terms. Under this regime "social benefit" became a measure of cost-opportunity and non-market elements were relegated from energy evaluations; the state – as an entity hampering the unfolding of market efficiency – was segregated from any economic venture; and the engineering culture was degraded as irrational and military engineers were dismissed as incompetent. The PEN, assembled by military engineers, based in state-owned firms, and framed in a national and geostrategic discourse, was cancelled in 1979.

Several conclusions may be derived from this story. In the remaining of this paper I would like to highlight three of them. Firstly, the story here presented sheds light on the notion of performativity as discussed by economic sociologists. I have called purification the process by which economists purged the evaluation of energy projects of any elements distorting or polluting a strict neoclassical economic model. And this cleansing created a world: by defining what is accepted as optimal, efficient, effective and good in energy planning, these processes of purification enacted a particular type of electricity: one which realizes and confirms the parameters of a neoliberal world. Through a myriad of metrologies, calculative devices, policy instruments and technical tools, electricity was neoliberalised. Theories of elasticity were mobilized to define the social good as a purely monetized function; the optimization models based on cost-benefit analyses close down the entry of any geopolitical and developmental consideration in energy evaluation; and the definition of firms as rational entities mimicking the egoistic behaviour of the *homo economicus* expelled the participation of the state in energy-related issues. So while Mitchell has identified how neoliberal ideas are mobilized by think tanks and academic research to demark between the market and the nonmarket, in this paper I have attempted to show how very specific technical evaluative apparatuses establish boundaries between the rational and the irrational, the fair and the unfair, the collective and the agentic, the effective and the ineffective, the economic and the political.

Secondly, the world enacted by CNE economists had long-lasting effects. This is as well a story about policy lock-ins. For example, by determining that any long-term investment elevating present costs was a form of social inefficiency, CNE economists brutally hampered the possibilities of renewable energy-based electricity matrix. Energy systems, and especially sustainable energy projects, have heavy up-front costs (Walker, 2008). Indeed, a basic principle in power system economics is that efficient energy systems have to operate in the long run: while in the short run the costs associated with some production factors are fixed, "in the long run we can minimize the production cost for any level of output because we can adjust all the factors of production" (Kirschen and Strbac, 2004, p. 30). Moreover, environmental and social externalities, critical for properly estimating the costs of energy production and distribution (Bromley, 1991), have to be always estimated in the long run. These nuances, however, didn't comply to the neoclassical definition of social benefit, and were therefore discarded.

The innovative extension of the theory of the *homo economicus* to the firm had also weighty effects. Although even Chicago economists had rejected the assimilation of the firm to the figure of the entrepreneur (Fama, 1980), CNE economists stubbornly assumed that rationality, and thus efficiency, would naturally spring if firms' own resources are at stake. This particular interpretation, articulated to deem state companies as irrational, became one of the main arguments justifying the violent privatisation process experienced in Chile in the early 1980s. Finally, I've attempted to show that the story told in this paper is not about the naissance of neoliberalism in the Chilean energy sector, nor about its functioning via the operation of a proper electricity market. The former would require a more detailed account on how neoclassical principles were incorporated by Chilean economists and energy engineers; the later a leap to the 1980s, when the DFL 1, the Electricity Law sanctioning the formation of an electricity market was passed and electricity companies were privatised. Rather, this is a story about that in-between moment in which neoclassical techniques and theories had to struggle their way through. This is thus a story about embodied queries unfolding in situated arenas; about encounters, clashes and tensions *in the field*: the multiple collisions between the arriving programmes, devices and assumptions, and the existent architecture that had to be dismantled.

Thus this paper, by identifying this mediating stage, also contributes to the larger discussion on neoliberalism. Indeed, this mediating moment not only enriches our understanding of the political life of neoliberalism, but also helps knitting together the Foucauldian interest on neoliberalism as a political technology with the focus of science and technology studies on the performative affordances of material devices and techniques. For the collisions found in the ground, while percolated by particular political visions and ideologies, cannot be grasped just as abstract discourses or governmentalities shaping subjects and objects in certain ways. They do involve certain political rationalities, but these unfold and have to be seized as extremely technical and minute controversies related to how to define social profit; what tool utilise for calculating costs and benefits; how to incite and secure the optimum performance of firms; and what type of experts and knowledges are better fitted to evaluate energy projects. Thus the moment identified in this paper doesn't only mediate between to chronological stage of neoliberalism, it also mediates between the broader political rationalities of neoliberalism and its grounded material deployment. Further analyses on neoliberalism, in Chile and elsewhere, could benefit from identifying this mediating moment of force manoeuvres, recognising that neoliberalism is usually installed with guns and blood, but also with the contentious instating of new elasticity models, optimization theories and organizational principles. It is through these knowledges and techniques that a world is materially neoliberalised.

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