Institutional Challenges of the Ecological Transition

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1. Introduction

In October 2024, an IMF note warned that nature-related issues could have high and difficult to predict economic costs. "The economy is embedded in nature," state the authors (Gardes-Landolfini et al. 2024: 1), which means that "complex interactions occur between ecosystem services, and between ecosystem services and the economy" (*ibid.*: 6). As a consequence, the total economic and financial costs of environmental destruction are unknown and subject to great uncertainty.

Facing uncertainty can mean two things. First, it may reflect the lack of knowledge about how the economy may cope with increasing temperatures and the destruction of key ecosystems. Second, it may reflect the chaotic nature of interactions between the economy and its natural environment, explaining the impossibility of such calculation.

The IMF note does not choose between these two explanations, stating sometime that "efforts to estimate the impact of nature-related risks on GDP are still in their early stages" (*ibid.*: 6) – implicitly acknowledging that more research could eventually estimate the real costs of nature-related risk – and at the same time emphasizing the possibility of abrupt and irreversible ecosystems collapses that would destroy a natural capital that may not be substitutable with built or human capital (*ibid.*: 25). In this former case, it is hard to believe how the cost of nature destruction could be calculated.

To avoid irreversible damage to nature, humanity has settled numerous international agreements aiming at limiting climate change and protecting natural ecosystems. The Paris agreement, signed in 2015, aims to limit global warming to 1.5 – 2°C, and the Kunming-Montreal Global Biodiversity Framework (GBF) of 2022 wants to achieve the protection of 30 percent of Earth's terrestrial and aquatic area by 2030. Yet, the ways to achieve these nature protection policies are unclear and subject to divergent interpretations. For example, the Paris agreement does not mention the prominent role of fossil energies and the necessity to reduce their consumption. As for the GBS, it does not ensure that protected areas will be effectively enforced since it requires human and technological resources that many countries lack. In short, if the aims are clear, the ways to achieve them are not.

The question of how to achieve a goal is a matter of economics. From an economic point of view, two approaches can be defined. Mainstream economists tend to implement nature protection policies in line with traditional economic reasoning, based on a cost-benefit analysis. According to this approach, all we need is to improve our knowledge about the economic costs of nature destruction and compare them to the cost of nature protection (Nordhaus 2019: 2024). An alternative approach

rests on the idea that the costs of nature destruction cannot be calculated or are too high to use a cost-benefit analysis. Mainstream economic reasoning is then ineffective and should be replaced by nature protection policies without regard to their cost. But how exactly this could be done? Is it even compatible with a market economy and the functioning of capitalism?

This article aims to examine these two approaches in regard to their institutional consequences. If the cost of nature destruction can be estimated, radical uncertainties can be lifted, and market mechanisms can suffice to organize the green transition. However, if we believe that the consequences of environmental destruction are out the scope of any economic calculation, the way to organize institutional changes are still unclear. Indeed, heterodox approaches have raised important insights, highlighting the need for stricter state regulation and supervision, the use of heterodox monetary policies or the perspective to deeply change the economic system into a postgrowth economy. But how do these ideas integrate into a global institutional framework? How council them with an economy built around market institutions?

In the following pages, issues regarding the green transition and nature protection will be simplified and limited to the question of climate change, since similar reasonings can be used to study other natural resources destruction. The text is divided into two main sections. Section 2 analyses the green transition from the mainstream perspective. It discusses its institutional framework and shows its limits as to effectively achieve the transition. Section 3 is dedicated to heterodox approaches of the climate transition and discusses its institutional perspective. The last section concludes and questions the possibility of making the heterodox institutional framework compatible with a market economy.

2. The mainstream approach of the climate transition

2.1 Methodological foundations

The economic consequences of climate change have been thoroughly analyzed by Nobel Prize-winning economist William Nordhaus, who designed the Dynamic Integrated model of Climate and the Economy (DICE). Nordhaus wrote many books and articles that all follow the same methodological approach, which summarized in its 2019 AER paper (Nordhaus 2019).

Nordhaus perspective of climate transition follows a "standard neoclassical model of optimal economic growth known as the Ramsey model" (Barrage and Nordhaus 2024: 1) and rests on four main points.

1. The transition process should be based on a *social cost-benefit approach*. The climate is considered as a natural resource and climate change is viewed as a negative global externality. "The theory of public goods applies as well to climate change. Here, we are speaking of a negative externality or 'public bad' in the form of greenhouse-gas (GHG) emissions" (Nordhaus 2019: 1992). To make this calculation possible, Nordhaus presumes that the cost of global warming can be, if not calculated precisely, at least estimated, and integrated into the model as a decrease in the long-term global output (GDP).
2. The DICE model aims to calculate an optimal carbon emissions trajectory. To achieve this, it must determine a damage function that reveals the *Social Cost of Carbon* (SCC) which "represents the economic cost caused by an additional ton of carbon dioxide emissions (or more succinctly carbon) or its equivalent" at a global level (*ibid.*: 2004). The SCC varies and tends to increase over time as the global amount of CO_2 in the atmosphere accumulates.
3. The SCC can be seen as the *shadow price of carbon*. This price should fall on any agent that emits an extra ton of CO_2 as a price or a tax. If the carbon price may vary over time,

reflecting the growth of the SCC when global temperature rises, it should be geographically *uniform*, "that means that the carbon prices should be equalized in every sector and in every country" (*ibid.*: 2002).

4. Finally, even though the DICE-2016 model proposes an optimal carbon emission trajectory – which implies an "optimal" global temperature increase of +3.5°C by 2100 – it is possible to adjust the parameters of the model to find any other trajectory. One crucial parameter is the *discount rate* which reflects the preference for immediate consumption over future consumption. As the trajectory of carbon emissions is very long, from 2020 to 2100, this parameter considerably affects the calculation of the carbon price. The DICE-2016 model calculates that with the optimal trajectory, a discount rate of 1 percent means a carbon price of $515 per ton of CO_2 in 2020, whereas if the discount rate is set at 5 percent, the 2020 price of carbon should be $27 (prices are in 2018$). The optimal trajectory is calibrated with a non-constant discount rate between 3 and 5 percent that ends up with a carbon price of $43 in 2020, $105 in 2050 and $295 in 2100[1].

It is worth noting that the DICE model has been revised in 2023. This new version intends to incorporate new scientific evidence on the consequences of climate change, and uses an alternative damage function of quadratic form, meaning that economic damages are more than proportional to the rise in temperatures. It also uses a discount rate close to 4 percent. The DICE-2023 model ends up with an optimal increase of global temperature of 2.6°C, significantly lower than in the DICE-2016 model. The SCC is also slightly higher, calculated to be at $125 per ton in 2050 (in 2019$), compared to $105 (in 2018$) in the previous model (Barrage and Nordhaus 2024).

2.2 Institutional framework

The mainstream approach to climate transition mainly focuses on the neoliberal framework. According to this view, market prices should aggregate information about the relative scarcity of resources and ought to create an incentive system that coordinates efficiently decentralized individual behavior (Cayla 2023: 47-9). Interestingly, the neoliberal framework differentiates itself from classical liberalism in rejecting laissez-faire policies (Cayla 2021, Mirowski 2013). This is because contrary to classical liberalism, the neoliberal reasoning is founded on the idea that markets are not natural institutions, which means they need state institutions to operate. The state must organize the market well-functioning by implementing competition enforcement measure, anti-inflation monetary policies, interventions to guarantee social order, and free trade policies, while restraining itself from discretionary interventions within markets (Cayla 2021: 105-11).

In this approach, supervising the public good or reducing market externalities belongs to the state (Friedman 1962: 34). For that reason, there is nothing odd at imposing a carbon tax or implementing a carbon market. Overall, the neoliberal institutional framework works as follows: The state creates and supports market institutions, the markets generate prices, the prices impulse incentives, and the price incentives organize individual behaviors and social well-being. Nordhaus' institutional frameworks derive from this perspective. It is represented with figure 1 bellow.

[1] Nordhaus admits that the choice of the discount rate is a very controversial issue. In an unpublished paper, he contests the low discount rate of 1.7 percent chosen by the US Environmental Protection Agency (EPA) in an April 2023 circular (EPA 2023, Nordhaus 2023).

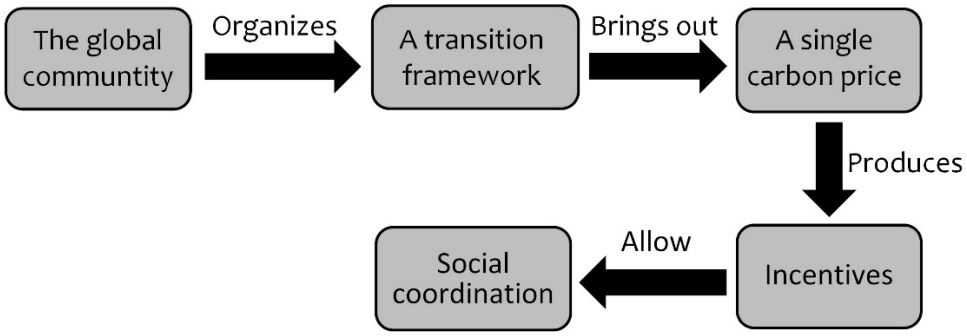

Figure 1: The neoliberal framework applied to climate transition

According to Nordhaus, the "transition framework" can either be a carbon tax or a cap-and-trade market. The main aspect of this system is that it does not require centralized planning. Every agent, producer or consumer, is free to behave and to trade as long as it pays the real price of its carbon emissions. Moreover, with a single carbon price, there should be no advantage to relocating or moving to another industry.

The difficulty with this framework is free riding. Since carbon emissions are mainly the result of energy consumption and low energy price is a major competitive advantage, it is hard to enforce the compliance of every country to that mechanism. To make that possible, Nordhaus proposes to institute a "climate club", "an agreement by participating countries to undertake harmonized emissions reductions [and where] nations would be penalized if they did not meet their obligations" (Nordhaus 2019: 2011). In addition, the club would penalize nonparticipants countries with measures such as tariffs on their imports.

The Nordhaus' institutional framework is simple, consistent with its theorization, and does not require any fundamental change in the economy. Not only it is compatible with a capitalist market economy, but it requires it, counting on private initiatives to effectively generate the climate transition. Yet, this framework may need other specific institutional adjustments to consider the real-world economy. Some state interventions may be necessary to accelerate the transition process. For instance, public banks or the emission of green bonds could help to finance green investments (OECD 2016). Moreover, as the IMF note explains, bad subsidies that push the demand for fossil energies should be ended, which may strongly affect households' welfare. Lastly, the green transition may need more public investment in transportation infrastructures, building insulation and low carbon energy production.

Overall, the climate transition will cost an increase in public and private investment efforts of more than 2 percent of GDP by 2030 in a country like France, even though carbon footprint is lower in that country than in most advanced economies (Pisani-Ferry and Mahfouz 2023). This increase in investment expenditure must be paid, in the short run, by a reduction of consumer welfare. The extra investment cost is due to two major elements. First, the climate transition often needs to replace well-functioning brown capital before maturity. Second, green investments are generally less profitable than brown investments, for electrification implies higher infrastructure costs, and electrified production goods are often more expensive. Similarly, building insulation is non-profitable and necessitates public expenditures to help firms and households to finance it.

2.3 The limits of the mainstream approach

Is the transition to green capitalism possible? Nordhaus's proposed theory and the institutional framework that derives from it, while internally coherent, rest on a series of fallacies and limitations that may contradict its ability to achieve its stated goal. Most of these limitations have already been discussed (see Boyce 2017, for example), so I will focus on only four points.

First, it is necessary to recall the problem posed by the main assumption of neoclassical reasoning: that it is possible to quantify the economic cost of climate change. The problem is both technical and philosophical. A world in which everything is commensurable means that everything is fungible and replaceable. Nordhaus is perfectly award of this problem. Here is how he answers it:

> A deeper critique is that damage functions monetize all human and non-human activities, which is correct. People might not object to monetizing the losses of wheat that are replaced by soybeans, or houses damaged by hurricanes. But they have firmer grounds for moral objections when studies put a price on human health impairments or monetize the submergence of entire island cultures. The economists' response is usually that we attempt to put all costs and benefits in a common metric so that we can balance the losses in one area with losses in others. We should be attentive to imputing appropriate prices, but it is better to include some values on health damages than to omit them from the analysis. As Keynes may have said, it is better to be vaguely right than precisely wrong. (Nordhaus 2019: 2000)

Nordhaus's response admits the moral objection without resolving it in any way other than a pirouette recalling Keynes's own unquestionable morality. But the question exceeds the moral issue. Technically, economic services provided by natural capital may have no substitutes, such as plant pollination. Similarly, changes in the geography of rainfall could result in the disappearance of arable land and migrations, requiring the construction of new cities capable of accommodating hundreds of millions in just a few decades. How can such costs be calculated? In fact, the economic consequences of some effects of climate change are simply hard to imagine. For example, if New York City is partially submerged by sea level and frequently subject to tropical cyclones of category 3 or higher, how can insurance companies cope? The "island cultures" Nordhaus refers to are not all found in the Indian or Pacific Oceans.

A second question concerns the price elasticity of fossil fuels. Surprisingly, Nordhaus does not mention it. This is because this parameter cannot be incorporated into his model, since it is based on a single product that aims to represent the whole output. Yet, knowing the price elasticity of energy should be a central issue, since the reduction of carbon emissions is supposed to occur in response to price increases. If the target is to get rid of GHGs by the end of the century, will a price of \$125 per ton of CO_2 equivalent in 2050 be enough? A simple calculation casts doubt on this. Driving 100 km in a combustion-powered car consumes 6 liters of gasoline and emits 14 kg of CO2. With a tax of \$125, these 14 kg would cost less than \$2.2 in 2024\$[2]. This means that the carbon tax calculated by Nordhaus in his optimal scenario would increase the price of a 100 km trip by around 50 percent in the United States., and 20 percent in Europe[3]. Energy price elasticity is estimated at -0.221 in the short term and -0.584 in the long term (Labandeira et al. 2017). If the long-term figure is used, the \$125 carbon tax would have to generate a reduction of less than 30

[2] 0.125 x 14 = 1.75 2019\$, which is about 2.2 \$2024.

[3] With a gasoline price estimated at \$3 per gallon in the United States and €1.8 per liter in Europe. The euro/dollar exchange rate is set at \$1.1 for €1.

percent in gasoline consumption in the United States, and around 11 percent in Europe. How could such a low carbon tax lead to a gradual halt in GHG emissions?[4]

The third issue with the mainstream approach stems from the single price principle. This principle is fundamental to avoid any illicit transactions or the emergence of a black market in carbon emissions. However, it raises important equity and efficiency questions. As environmental economist James Boyce explains, "it is more likely that individual nations […] will continue to establish carbon pricing policies independently with prices that vary across systems." (Boyce 2018: 57). But the single price principle also raises political and ethical questions. As Boyce explains:

> In effect, a uniform international price would allocate the Earth's remaining carbon space on the basis of ability to pay: high-income countries would be able to afford more space than low-income countries. The low-income countries may regard such an allocation as inconsistent with the United Nations Framework Convention on Climate Change (UNFCCC) provision that countries will reduce emissions according to their 'common but differentiated responsibilities and respective capacities,' a formulation that implies that higher-income countries should do more, not less, to curb emissions. (Boyce 2018: 57-58)

Similar problems may arise within countries and between social classes. Even if a ton of GHG emissions has the same effect on the climate, whoever emits it and for whatever reason, it doesn't mean that the logic of "pay to pollute" will be accepted. In fact, paying the same carbon tax to offer space tourism to billionaires or to produce agricultural goods may not seem fair and is unlikely to be politically accepted in a time where the welfare of the middle class is at risk.

The last problem concerns the discount rate used in the DICE model. It is true that, from an individual's point of view, the trade-off between immediate consumption and long-term consumption implies a discount rate. But the problem is that the climate constraint cannot be seen as a trade-off between two periods in the life of the same person, but between two different lives belonging to two different generations. The person who will be living in degraded conditions in the year 2100 is not the same as the person who will enjoy a greater consumption in the year 2020. So how can we compare the well-being of an individual in 2020 with that of his or her grandson or granddaughter, who may have very different preferences from the former?

3. Heterodox approaches of the green transition

3.1 Methodological foundations

Climate change viewed from a heterodox economic perspective implies that the implementation of a transition process cannot be the result of a cost-benefit calculation for several reasons. Firstly, because the cost of global warming in excess of 2°C may have very uncertain consequences that may fall beyond any calculable economic cost. Therefore, the only acceptable transition process must be the one that aims to limit ecological damage and comply with the Paris Agreement. Secondly, this approach takes seriously the idea of the non-substitutability of natural capital, which means that above a certain temperature, a certain number of natural ecosystems could be permanently destroyed, resulting in a definitive loss of irreplaceable natural capital (Neumayer 2007). The third reason for not using a cost-benefit calculation is that a profound transformation of the

[4] A similar calculation can be made by studying the impact of the European gas crisis on German industrial gas demand. According to Eurostat, the German gas price for industrial usage (tax included) in 2022-2023 increased by 97 percent compared to the 2018-2021 reference period, whereas German industrial gas consumption evolved from 595,569 Gwh in 2021 to 477,373 Gwh in 2023, showing a reduction of 19.8 percent (source: https://www.smard.de). The calculated short-term price elasticity is therefore -0.20, which is in line with Labandeira et al. 2017 estimate.

economy would change the metric of evaluation itself. According to Keynes, costs and valuations are the product of a social convention that is considered to be true as long as the economy evolves within a specific framework (Keynes 1936: ch.12). But both climate change and the transition to climate neutrality should result in a shift in the framework of the economy, transforming the conventions on the basis of which costs are calculated.

The refusal of the cost-benefit calculation does not mean the refusal of any economic logic but implies that the only satisfactory trajectory of carbon emissions is the one that sticks to the Paris Accord, implying a minimization of carbon emissions.

While this approach does not reject the idea of a carbon price (Boyce 2018), it does not rely on prices alone to organize the climate transition. This is because individual economic behaviors are not seen as driven solely by prices. Moreover, responses to price changes may not be as clear-cut as in the neoclassical framework. Consumption involving high carbon emissions, such as long-distance travel, could be transformed into Veblen goods whose consumption logics include an ostentatious dimension. Finally, heterodox approaches emphasize the role of social beliefs and expectations in behavior, praising the need for new institutional arrangements to change the economy. For this reason, these approaches tend to consider that spontaneous coordination via the price mechanism is far from sufficient to achieve climate transition. The role of the state and democratic coordination are therefore essential, and imply stricter mandatory regulations and much higher public spending than in the traditional approach.

3.2 Two heterodox proposals

The main issue with heterodox approaches of the climate transition is that they appear more costly and difficult to implement than the mainstream proposal, especially in a capitalist economy. Institutional changes imagined by heterodox economists are numerous and a survey of all of them exceeds the scope of this paper. Two heterodox proposals can however be studied. The first one aims to use alternative monetary policies to achieve the transition; the second concerns the possibility to implement a post-growth economy.

The post-2008 shift in monetary policies and the recent development of the Modern Monetary Theory (MMT), popularized by the publication of Stephanie Kelton's book (Kelton 2020) have pushed many heterodox economists to believe that alternative monetary policies could be implemented to ease the financing of the climate transition. This approach is important since it is acknowledged that traditional finance and the development of green bonds or green banks may not suffice to achieve the transition. As explained by Alain Granjean and Julien Lefournier, the main issue with green finance is that it wants to achieve two contradictory objectives: insure an acceptable financial return, since institutional investors need to adjust their portfolio in accordance with their client's interests, and help to finance ecologically beneficial investments. This poses two problems. On the one hand, the ecological nature of green bonds is never clearly defined and can vary from one certification body to another; on the other hand, as long as green bonds have to be as profitable as brown bonds, they have no trouble finding financing... whereas less profitable but ecologically necessary green investments have no chance of finding financing through green finance (Granjean and Lefournier 2021).

In fact, unprofitable investments such as building insulation must fall within the remit of public spending. The problem is that the increasing competition due to globalization, and the implementation of neoliberal institutions have restrained the ability for states to develop their expenditures. To solve that issue, some economists propose to use the central bank and monetary policies to

help finance these investments, organizing the monetization of public debt and involving "the permanent or sustainable creation of money" (Scialom 2023: 400).

Another question pushed forward by heterodox economists is the idea that the green transition is by nature incompatible with economic growth. For that reason, the only way to achieve a real transition would be to change radically the economy in order to implement a global economic degrowth. The degrowth perspective aims to council a minimum social welfare for the population with the respect of Earth's ecological limitations (Raworth 2017). Degrowth approaches imply a deep reorganization of the economy to allow its re-embeddedness in the social matrix. They recommend a social and political reorganization that would limit market and profit-oriented behaviors in favor of the development of convivialist communities pushed by the objective of improving social interactions instead of wealth accumulation (see Parrique 2019 for an extended review of degrowth theories).

To some extent, it is possible to combine the degrowth framework with alternative monetary policies. Olk et al. (2023) propose a stimulating effort in that direction, pointing out the "significant overlap" of the policies proposed by MMT and degrowth. According to the authors, both theories aim to contest two sorts of construct scarcities. The MMT proposes a way to escape the "artificial scarcity of money," whereas the degrowth framework aims to fight against the "artificial scarcity of essential goods" created by capitalism.

3.3 Institutional limitations of heterodox approaches

As seen in section 2, the mainstream approach of climate transition proposes a consistent institutional framework that does not need any fundamental change of the current capitalist framework. This is obviously not the case of the two heterodox approaches presented above. Implementing new monetary policies and organizing a radical shift in the financial system would contradict years of financial neoliberalism and would require revising in depth many laws and international agreements. The degrowth approach is even more radical, since it implies a profound break with the social habits built up over two centuries of capitalism. Organizing a reduction in GDP per capita to save the climate would contradict the wealth expectations of most households and could in fact lead to electoral uprisings of the kind we saw after the inflationary surge of 2021-2023.

But the real problem with these two approaches is that they do not really solve the problems they set out to address.

Contradictory with the claim of the monetary approach, *the cost of the climate transition is not a financial matter*. Creating more money or monetizing the public dept will not reduce the cost of the climate transition. As mentioned above, the fundamental issue behind the climate transition is to increase the overall amount of investment to replace well-functioning fossil fuel machines with more expensive machines that use low-carbon electricity, and to insulate buildings. But considering the limitation of resources at our disposal, the only way to achieve that is by shifting resources from the production of goods and services dedicated to consumption to the production of capital goods used for investment. This cannot be done without an important reduction in households' welfare. The transition implies therefore a cost in the real economy that cannot be solved with new monetary policies or with the implementation of deep financial reforms.

The degrowth approach poses the same type of problem. By being techno-critical and focusing on reducing the production of wealth, this approach aims to achieve the climate transition by reducing production rather than by producing more capital goods. But it is an illusion to believe that cutting fossil fuel consumption by reducing GDP will be enough to save the climate. In fact, the climate

transition needs more machinery, not less. Of course, the degrowth approach is right to highlight the limits of accumulation from a moral and social point of view. But, for example, dismantling the automotive industry will only mean leaving cars in circulation to be used for an extended period, thereby consuming more petrol and emitting more CO_2.

How can we organize the climate transition in the real world? The only way is to fully recognize the constraints it implies. Indeed, the vast majority of our GHG emissions come from our fossil fuel needs. It is therefore easy to calculate the relationship between our consumption of fossil energies and the rise in temperature. In this case, if we want to respect the Paris Agreement, we can calculate precisely how much CO2 we can still tolerate. From there, it is possible to control the use of fossil energy resources and allocate them on a priority basis to certain sectors or countries, with these uses being democratically discussed. At the same time, this constraint on the allocation of fossil fuels could be accompanied by state support for the transformation of the production system. Finally, as this transition could jeopardize the well-being of households, it must be accompanied by strong government intervention to ensure the supply of vital goods and to guarantee a minimum level of well-being for households during the transition process. This type of public intervention will require a thorough reshaping and reorganization of democratic institutions to ensure that efforts are equitably shared.

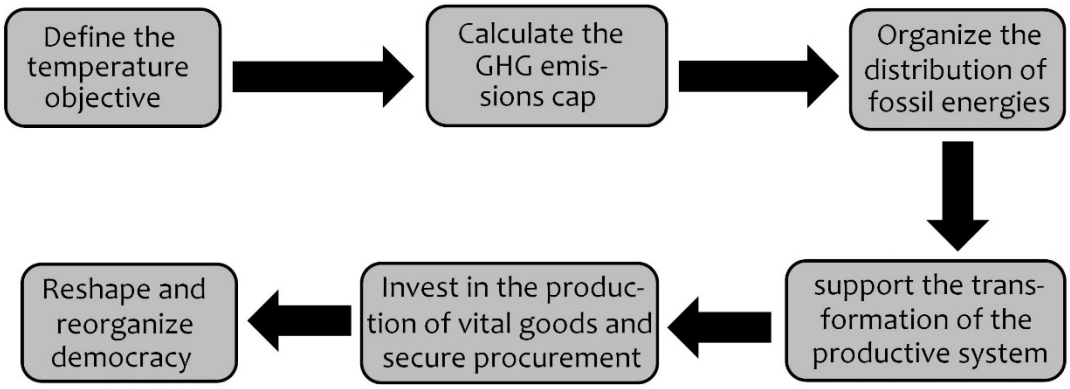

Figure 2: An alternative institutional framework for climate transition

Figure 2 synthetizes the institutional framework described above. It may seem to be very far from any current proposal by either mainstream or heterodox economists, but in fact it is not totally innovative. It some ways, it is the same kind of framework that was implemented by Franklin Roosevelt to prepare the US economy to World War II. At the time, the question was also to transform rapidly the economy in order to provide the army the resources it needed by reducing the resources allocated to households' welfare.

4. As a conclusion, should we get rid of the market economy to achieve the green transition?

The compatibility of climate constraint with a market society could itself be the subject of an article – or a book. I have already partially addressed this subject in another book (Cayla 2023: 152-65), so I will limit myself here to a brief commentary.

As mentioned above, organizing the climate transition in just a few decades could be compared to entering a war economy. This imposes serious constraints on the economy's capacity to produce consumer goods and services. However, in the United States in 1944, in London during the Battle

of Britain or in Kiev during the war with Russia, the ability to undertake free economic activity never disappeared. The constraints of war are important, of course, but the market can function under constraining conditions.

Of course, it is always possible to imagine another economic system; however, even if achieving the ecological transition imposes enormous constraints on the economy, this does not mean that it is in itself, or by nature, incompatible with the market economy.

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