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The EU's Digital and Green Twin Transition. Coupled up to Save Growth instead of Planetary Health

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This paper provides criticism on the underlying ideas of the European Union's green and digital twin transition from the perspective of ecological economics. It highlights five fundamental elements (presumptions) of the twin transition narrative and questions their credibility: (1) net zero is an adequate goal; (2) market-based solutions (e.g. carbon emission trading, biodiversity credits) are adequate means to lessen environmental harm; (3) the different elements of natural capital as well as natural and man-made capital are substitutes (the accumulation of one can compensate for the loss of the other); (4) economic value creation can be decoupled from environmental impact through technological change; (5) technologies and technological systems are neutral regarding the social relations and hierarchies.

The paper concludes that the EU's twin transition is actually an attempt to maintain the status quo (the growth-orientatation and the EU's role during a changing world order), instead of bringing about transformative change towards sustainability. It does not go beyond the eco-modernist approach: it attempts to fight the problems caused by modernisation with more of the same. Therefore, the twin transition, in its present form, is likely to contribute to the aggravation of the global environmental and social crises; and result in furthering (global) inequalities.

Keywords: twin transition narrative, ecological economics, degrowth

1. Introduction

Today, global environmental and social challenges and the need to tackle them, have become an integral part of public discourses and public policies. The debate in the literature is not about whether today's socio-economic processes are environmentally sustainable. There seems to be consensus about their unsustainability.

But there is little consensus on what the path towards a sustainability transition should be. The positions differ fundamentally (paradigmatically, one might say) (Hopwood et al. 2005). At one end of the scale is the view that environmental challenges can be effectively addressed within the current socio-economic operating logic, for example through greening of business operations or green innovations (status quo approach). In comparison, the reform approach argues for more significant changes, but still within the current institutional framework. This could be achieved by promoting less material-intensive sectors, the spread of natural resource-saving technological innovations and, ultimately, the decoupling of economic growth from environmental impact. At the other end of the scale is the view (transformative approach) that our socio-environmental problems stem from the very rationale of our current institutions (e.g. growth-oriented thinking). Thus, a transition to sustainability can only be envisaged if we rethink our fundamental social goals and entrenchments and revise our socio-economic institutional arrangements.

The need to tackle global environmental problems, even if not to the same extent as today, has been part of public policies for decades now. And the European Union clearly defines itself as a leader in this process. While public policy is (seemingly) getting more and more involved in slowing down climate change or preserving the integrity of the biosphere, the problems seem to be getting worse.

Global CO_2 emissions, energy or material use are growing uninterruptedly. Works that capture the Earth's major biophysical processes, the abundance of populations or the quality of ecosystem services, consistently show that the actual state of the environment has deteriorated significantly in the recent decades (IPBES 2019, WWF 2020). Based on Rockström et al. (2009), we identify nine planetary boundaries, transgressing any of those could have harmful or catastrophic consequences for the survival of human societies. Stepping outside the "safe operating space" has a high risk of severe degradation of the system. In these cases, humanity risks crossing a tipping point (the exact location of which is uncertain) that triggers sudden and irreversible processes. Attempts to measure planetary boundaries (e.g. Steffen et al. 2015, Richardson et al. 2023) show that for six out of the nine large Earth systems, we have already crossed the boundaries of the safe operating zone. Efforts to tackle global environmental problems have thus been largely ineffective at global level. Possible (partial) success could have been reached only in connection with a few partial problems on a smaller scale.

The *objective* of the present paper is to provide critical reflection on the European Union's twin transition. The twin transition (the combination of the green and digital transitions) serves as the main narrative framework for European policy making with regard to global "grand" challenges. We are basing our critical reflection on the arguments of ecological economics.

Ecological economics is a problem-driven and interdisciplinary (also transdisciplinary) research field. It does not consider the economy as a separate system, but as a subsystem of society and the natural environment. This has provided the basis for ecological economics to integrate ideas on the social embeddedness and moral foundations of the economy and to pay attention to the physical (material) basis of economic activities. Its approach to sustainability is *transformative*, i.e. it argues that the transition to sustainability requires a radical transformation of the currently dominant socio-economic institutions.

In chapter 2 the paper provides a brif overview of the twin transition narrative and highlight five fundamental presumptions, which privde the coherence of the narrative. Chapter 3 critically assesses these presumptions based on the arguments of ecological economics and highlights that none of them withstands reasoned scrutiny. We draw conclusions in chapter 4.

2. The Twin Transition Narrative

Both the green transition and the digital transition have been major topics of European policy making. The *green transition* is typically narrated as a necessity due to the severity of the global environmental challenges. A constraint, which the EU attempts to turn to its advantage through the "Green Deal". With regard to the green transition, the EU highlights fundamental objectives, such as net zero emission of greenhouse gases by 2050;

the decoupling of economics growth from resource use; and inclusivity – no person and place should be left behind.

> "The European Green Deal is Europe's new growth strategy, which will transform the Union into a modern, resource-efficient and competitive economy"[1]. Furthermore: "A change which will bring with it many benefits, from creating new opportunities for innovation, investment and green jobs, to improving our health and wellbeing"[2].

The *digital transition* is rather looked at an opportunity than a necessity. It is considered to be an external process (stemming from the course of technological advancement), which then brings fundamental changes to the societies and economies. "The digital transition is an ongoing process that continues to transform the way we live" (Muench et al. 2022, p. 3) and has the potential to boost economic growth.

These two transitions constitute the so called *twin transition* by reinforcing each other. Sustainable digital technologies are considered to enable the carbon neutrality of the EU, to support sustainable growth and to contribute to a fair and competitive future (Muench et al. 2022). In order to realize the twin transition, maximize their positive and minimize their negative impacts, the EU recommends to rely on a combination of well-known "ingredients":

- encourage innovations (e.g. related to renewable energy, electric vehicles, carbon capturing, green digital solutions);
- encourage new fast growing sectors (that can provide green growth and green jobs);
- enable markets (e.g. emissions trading, carbon or biodiversity offsetting);
- channel investment into the above innovations and sectors;
- apply corrective policies in case the transition would have adverse social or environmental "side effects".

These are not at all new tools, the difference is the addition of the word "green": green innovations, green sectors, green growth, green jobs. The tools are to a large extent market-based and they are directed to maintaining the EU's growth potential during the time of crises.This is in line with the stated objective, i.e. this is a growth (competitiveness) strategy – and not an environmental one.

The green transition in itself, but especially when combined with the digital transition forms a strong narrative, which is totally in line with the dominant *green growth (or eco-modernization)* discourse around sustainability transition.

The idea of green growth (or eco-modernisation) demonstrates that recognition of environmental constraints does not necessarily lead to a change in basic patterns of

[1] The website of the European Commission: https://reform-support.ec.europa.eu/what-we-do/green-transition_en Date of access: 4 February, 2024.
[2] The website of the European Commission: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_hu Date of access: 4 February, 2024.

thinking. In fact, the perceived problem (that growth has environmental limits) can lead to an even greater push for the usual forms of solution. Basically, the mainstream discourse is seeking answers to the question of how to solve today's environmental problems without radically rethinking our socio-economic institutions? In other words: how can economic growth be sustained while respecting the environmental constraints?

Our usual problem-solving schemes suggest technological solutions as the answer. The vision of green growth is that, just as in past decades (centuries), human ingenuity will overcome the problems we face. Technological innovations will result in more efficient use of our natural resources, help us replace scarce resources, reduce pollution, decontaminate air, soil and water, recycle materials, and place greater emphasis on less material-intensive (service-based or virtual) goods. In other words, we manage to *decouple (de-link)* economic growth (measured in value creation) from the physical size of the economy.

Green growth is more than just one of the ideas put forward to solve global environmental problems. It is a framework that has a decisive influence on the way problems are perceived, debates are conducted and solutions are proposed. The idea of green growth is reflected in most (policy) and industry objectives (Bajmócy–Málovics 2011). Eco-modernisation is also a dominant discourse among business actors (Pataki 2009, Köves–Bajmócy 2022). An important cornerstone of this approach is the emphasis on win-win measures; the assumption that corporate social responsibility and sustainability measures are beneficial for both the company and the biosphere and society. In many (policy) documents, a company that introduces "green innovations" has also become synonymous with a responsible company that promotes sustainability.

The twin transition clearly fits into the eco-modernization narrative. In terms of perceiving problems and seeking for solutions it clearly stays within this framework. I consider the following presumptions to be fundamental elements of the narrative:

- net zero emission is an adequate goal;
- market-based solutions are effective means to tackle environmental problems;
- different elements of natural capital as well as natural and man-made capital are substitutes (the accumulation of one can compensate for the loss of the other);
- technologies and technological systems are neutral regarding the social relations and hierarchies (in other words they are simple tools we can use to achieve our social goals such as 'decoupling of economics growth from resource use and inclusivity – no person and place should be left behind);
- as a result of all these economic value creation can and will be decoupled from environmental impact;

3. Dismantling the Key Presumptions of the Twin Transition Narrative

The idea of green growth (or eco-modernization) is widely criticised in the literature of ecological economics and degrowth (e.g. Daly 2019, Parrique et al. 2019, Liegey–Nelson 2020, Costanza 2023, Spash 2024). This paper does not attempt to provide an exhaustive

review of these critical thoughts. It focuses specifically on the twin transition narrative, and will use the abovementioned elements of the twin transition narrative to structure the critical reflection in this chapter.

The twin transition essentially proposes a continuation of the modernization agenda, only this time human ingenuity must be mobilized to "conquer" a new problem. Eco-modernisation allows growth to continue by decoupling economic activity from environmental impacts. In order to achieve this decoupling, the twin transition is essentially designed to mobilise market forces and the process of technological change.

3.1. Net Zero as an Insufficient Objective

Perhaps the most fundamental environmental goal of the European Union is to achieve carbon neutrality (net zero) by 2050. While, on the one hand, the ambition that greenhouse gas emissions should not exceed what the biosphere can absorb is certainly welcome. On the other hand, setting the target in this way is highly problematic.

Some of the criticisms receive relatively high attention, for example that net zero ignores the importance of past emissions and does not address the pathway to carbon neutrality. Ignoring *past emissions* is crucial because, on the one hand, achieving carbon neutrality does not reduce the concentration of greenhouse gases already emitted into the atmosphere, while current concentrations can already create a significant adaptation pressure. On the other hand, it does not take into account that the global North and South have not contributed equally to emissions. Historically, the Global North has accounted for a significant share of emissions. Per capita emissions are still significantly higher in high-income countries – nearly four times higher compared to low-income countries and cca 30 times higher compared to the lowest-income countries (Stoddard et al. 2021).

A key question is also the *route towards carbon neutrality*. If we expect an increasing rate of reduction towards the 2050 target date (as we currently do), this will result in a much larger increase in atmospheric concentrations by 2050 than decreasing emissions at a steady rate or faster at the beginning. This is a particularly important issue as half of all carbon dioxide ever emitted to the atmosphere has been emitted in the last 30 years (Stoddard et al. 2021).

In my view, two further aspects of the carbon neutrality target are even more problematic. On the one hand, the almost exclusive emphasis on carbon neutrality contributes significantly to the fact that public discourses and policies focus on only one of the global environmental problems. In other words, the net zero target distracts attention from the fact that climate change is *only one of the pressing problems* of our time. And there is currently no evidence to suggest that even if we were to solve the problem of atmospheric greenhouse gases in the current way (through the emergence of new technologies, eco-efficient production methods, the rise of new sectors, and carbon offsetting), it would also move us in the direction of a solution in terms of ocean acidification, freshwater use, risks associated with man-made substances, or the integrity of the biosphere.

The other major problem is that the net zero target is a *distraction from reducing emissions*, because it takes into account the possibility of carbon offsetting. In other words, a company or sector can maintain or even increase its emissions if other economic actors are able to implement projects that in turn reduce emissions. This is problematic because

growth and reduction can be spatially disconnected (thus potentially creating new social and global inequities). Furthermore, offsetting projects can be problematic in themselves, as we will discuss later.

The importance of all this should not be underestimated, as achieving net zero may rely to a large extent on this strategy. Köves and Bajmócy (2022), for example, point out that the global aviation industry's climate strategy, even in the most optimistic scenario, expects offsets to contribute more to achieving carbon neutrality than the combined contribution of increasing the eco-efficiency of aircrafts, operations and and infrastructure, and the shift to non-fossil fuels. In other words, under the concept of carbon neutrality, the aviation industry actually intends to increase the emissions.

In other words, net zero has become the primary environmental objective without actually being an indicator of the state of the environment; it does not target the actual reductions of emissions and it limits the public discourse on the global environmental crisis to a single issue.

3.2. Limitations of Market-based Solutions

The twin transition addresses environmental challenges largely within a market framework. The communication on the dual transition is full of elements that describe the management of the environmental crisis as an investment and growth opportunity, for example "by 2030, the net zero technology market will reach €600 billion per year "or"by 2050, a four-fold increase in the use of renewable energy sources and a 15-fold increase in the production of electric cars is expected"[3]. In essence, the EU is placing the whole phenomenon into an industrial competitiveness framework[4].

A striking example of the search for market solutions is the growing attention to carbon and biodiversity *offseting.* These offset markets essentially offer "credits" to projects that avoid, reduce or remove environmental impacts (e.g. emissions). These credits can then be traded on the markets. In this way, actors who engage in "harming" activities can compensate for their own environmental impacts. These markets are rapidly expanding and are expected to become increasingly important in the future (for example, if offsetting is made mandatory by the regulator). They are therefore of considerable interest to global financial players.

However, it is worth looking a little more closely at the rationale behind their operation. One crucial point is the projects that are considered to be environmentally beneficial activities and are thus given "credits" (which can then be traded). Such projects might be planting new forests, building solar or wind power plants, or preserving a corner of the rainforest (avoiding their extraction). There is a lot of criticism of these projects (e.g. zu Ermgassen et al. 2019, Hache 2019). On the one hand, some of them are not aimed at reducing emissions in the first place. On the other hand, due to problems with the

[3] The website of the European Commission: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan/net-zero-industry -act_hu Date of access: 1 July, 2025.

[4] Regulation (on net-zero industry) of the European Parliament and of the Council COM(2023) 161 final 2023/0081(COD)

certifying system, it is not clear whether they have a positive environmental impact at all. Thirdly, they may also create significant social problems.

Because of the complexity of ecosystems, even simple solutions can give rise to complex additional environmental risks. Large-scale reforestation schemes, nowadays a very popular carbon offsetting solution, are a case in point. However, the ecological impacts of reforestation depend on many factors. Hence, programmes that are implemented entail a number of risks (Holl–Brancalion 2020): destruction of traditional grassland ecosystems, spread of invasive species, loss of water supply. Particularly in the case of top-down programmes, there may be an increase in income inequalities due to the loss of agricultural land (some people lose their livelihoods); or even a reduction in the overall size of forest areas as operators (even illegally) make up for lost land by felling native forests.

In addition, the implementation of such projects requires a significant amount of land. In other words, while the Global North experiences these markets as opportunities for growth and investment, the Global South experiences them as social problems, land grabbing and further exploitation of their resources.

It is worth briefly looking at the operation of these markets in terms of basic economic concepts. In order for such markets to function, there is first of all a need for environmental damage (to make sense of the compensation), a need for projects that are considered beneficial and a need to see the two as comparable (equitable), so that trade and, accordingly, damaging operations can be sustained.

But it is worth noting that, if nature is marketised in this way, the conditions that economics envisages for markets to work are not met. In these markets, it is not real goods but, in the words of Polányi (1976), "fictitious goods" that are exchanged. The financialisation and marketisation of nature assumes, on the one hand, that the values that the market is able to transmit are the primary ones in making decisions concerning the biosphere (Spash 2015, Pascual et al. 2023). On the other hand, it assumes that nature is seen as a resource and, as such, as a subsystem of the economy. According to the arguments of ecological economics, however, this is an absurd assumption. All economic activities build on the "services" of ecosystems, and in physical terms they lead to inceased entropy and generate waste, i.e. they involve biosphere transformation.

The assumptions that the goods on which exchange is based are comparable, or that the market can signal scarcity of goods through prices, are also untenable. For example, it is difficult to believe that a newly created forest habitat or a new wind farm can compensate for the loss of a wetland or a coral reef on another continent. Given the absolute scarcity of resources, the fictitious nature of goods and the non-linear change of complex systems, the nature of public goods, and many other factors, it is not plausible that the market could reflect through prices all the aspects (including scarcity) that are key to nature-related decisions.

Finally, all economics claims about markets is that, under ideal circumstances, they produce (a so-called Pareto-) efficient allocation. This denotes a situation where no one's position can be improved further without someone else's being made worse off. Even if ideal conditions existed (which can never exist in reality), the economic argument does not claim that the resulting allocation would be fair or sustainable, nor even that it maximizes people's well-being, which includes elements other than material living

standards[5]. As Clive Spash (2010, p. 169). puts it: "the focus on [...] markets is creating a distraction from the need for changing human behaviour, institutions and infrastructure".

3.3. The Different Elements of Capital are not Substitutes

As we have seen, the idea behind the market approach to environmental problems is that the different elements of natural capital can be brought to a common denominator and thus be equated. In addition, not only the different elements of natural capital, but also natural and man-made capital are assumed to be substitues (i.e. the construction of a solar or wind farm compensates for the degradation of an ecosystem or the additional emissions of greenhouse gases in the offseting markets).

The substitutability of natural and man-made capital is a debate that concerns the entire programme of modernisation, and the course of technological change since the industrial revolution. Indeed, if the two types of capital are substitutes, there is no obstacle to compensating for the increased human impact on nature by means of technological innovation. If, on the other hand, the relationship between the two types of capital is primarily complementary, then the disappearance of nature's "sevices" cannot be overcome by technological solutions alone. As Herman Daly (2019, p. 2) puts it: "decoupling generally requires substitution of capital for resources – that is claiming that complements are really substitutes – a bad error even in neoclassical terms."

> "Ecological economics sees [natural and man-made capital] as basically complements, substitutable only over a very limited margin. Neoclassical economics regards them as overwhelmingly substitutes. If complements, the one in short supply is limiting; if substitutes, then there is no limiting factor. The phenomenon of limiting factor greatly increases the force of scarcity. For example, if the natural capital of fish in the sea is the limiting factor then the complementary capital of additional fishing boats loses its value" (Daly 2019, p. 1).

The idea that economic value creation is separable from environmental impacts ultimately assumes that man-made capital can serve as a basis for production/consumption just as well as natural capital. Ecological economics is fundamentally sceptical about this, believing that no economic process can exist without material and energy flows and ecosystem services (i.e. the transformation of the biosphere). As Ward et al. (2016, p. 5) put it:

> "For non-substitutable resources such as land, water, raw materials and energy, […] whilst efficiency gains may be possible, there are minimum requirements […]that are ultimately governed by physical realities: for instance the photosynthetic limit to plant productivity and maximum trophic conversion efficiencies for animal production govern the minimumland required for agricultural output; physiological limits to crop water use efficiency govern

[5] Within the scope of this study, it is not possible to go into detail on the various concepts of efficiency in welfare economics. In any case, the statement made here remains true not only for the Pareto interpretation but also for the Kaldor-Hicks-Scitovszky interpretation.

> minimum agricultural water use, and the upper limits to energy and material efficiencies govern minimum resource throughput required for economic production."

The issue of substitutes versus compements is very often seen as a juxtaposition of techno-optimistic and techno-pessimistic ideas. And for the arguments listed above, ecological economics is seen as technopessimistic or technosceptical (Málovics 2020, Gébert 2023). But the technooptimist-technopessimist discourse is of limited help in elaborating arguments for a sustainability transition. Indeed, this framing fails to address the social embeddedness of technological change. The optimistic-pessimistic framing looks at technological change as an externally given phenomenon (which proceeds according to its own laws) and asks whether we are optimistic or pessimistic about its consequences. It ignores the obvious question of what kind of technological change we are talking about: how it is shaped, by what criteria, what technological solutions it creates, whom it helps to achieve what opportunities, etc.

Technological change is not a one-dimensional phenomenon. It can take many forms, it can maintain the current social order, but it can also play a role in changing it (Feenberg 1999). In this interpretation, it is not a process about whose consequences we are either optimistic or pessimistic, but one that can be shaped in the light of the current socio-economic order and visions of the future.

3.4. Technologies are Not Neutral

According to the eco-modernisation vision, technological change is not only a panacea for the economy (the main driver of growth), but also the main means of solving environmental and social problems. In this framework, the digital transition is boosts growth and makes the economy sustainable and inclusive at the same time. This idea is rooted in an image of technology that does not take into account the social and natural embeddedness of technological change. It fails to discuss in any meaningfull way the physical and social context that enables the operation of certain technologies.

For example, the spread of digitalisation or artificial intelligence is based on the precondition of meeting the demand for rare materials and the growing energy requirements of computing. These activities, in addition to projecting an increasing environmental pressure of digitalization, are being met in specific social contexts, such as those associated with significant North-South inequalities.

It is very difficult for mainstream economics to take account of ideas about the social and environmental embeddedness of technology[6]. In mainstream economics, technological change is the way of unfolding efficiency (transforming the relationship between inputs and outputs of production). From this perspective, it is irrelevant what the technical object is (a screen reader app for blind people, a social media app based on the privatised big data, or an autonomous lethal weapon). If our attention is focused solely on productivity change, it is irrelevant what social arrangement is involved in the creation and operation of this technical object, or whether the innovation is merely an attempt to

[6] This essentially emerges with regard to a singe issue: accounting of the economic and institutional factors that influence the pace of technological change.

correct an earlier "unintended consuquence". All this is irrelevant to growth and is unmanageable at the level of abstraction of economic models.

For ecological economics, social and environmental embeddedness is the point of departure. Within this framework, it is possible to build on the decades of knowledge of the academic schools (science and technology studies; actor-network theory, critical philosophy of technology) that argue that technological change carries the characteristics of the social context in which it occured and is a distinctive shaper of social relations by creating new realities (Latour 1993, Feenberg 1999). The recognition and acknowledgement of embeddedness has a number of implications.

On the one hand, technologies never exist in isolation: they are interconnected and embedded in systems (Kleine 2003). This means that a technological solution is not functional on its own, but only in combination with other technologies, with a certain infrastructure, with a set of rules. Thus, technologies always carry with them a vision of the environment in which they will operate (the systems of production and use). In other words, the technology and the social context in which it is embedded cannot be separated. For example, it only makes sense to produce batteries for electric cars if other actors are mining the raw materials and producing the other components of the car, if we think that electric cars will gain a significant place within vehicles, and that individual, motorised transport will continue to be the dominant social vision.

Another aspect of embeddedness is the technological mediation of social relations. In today's societies, the relations between people (and between people and other living beings) are mediated to a large extent by technologies and technological systems. Our artefacts, our built environment, our health care system, etc. are all created along certain social visions. They are more suited to the values and interests of some groups than others. For example, the design of cities mediates reflects the relative political importance of cars versus bicycles in transportation. Or if our playgrounds do not have accessible toys, this reflects the social attitudes towards equality for disabled children (and their families).

It is important to see that it is the technical design of the artefact itself that mediates these social relations. It is therefore inseparable from the essence of the technology. It is not a question of whether a neutral technical object is used by people for "good or bad". Our technologies and technological systems are not neutral, they shape aspects of social reality such as how equal we are compared to others, how centralised power should be, how we make social decisions, etc. (Feenberg 1999).

For example, the physical design of our public spaces and buildings tells us a lot about the extent to which people with disabilities are equal members of society. A nuclear power plant necessarily says something about the importance of easy centralised control over energy supply in a country, or, on the other hand, the autonomy of citizens in their energy supply. A nuclear power plant necessarily entails a large-scale, highly centralised power supply, where substantive decisions are necessarily concentrated in the hands of a few (i.e. it provides a significant opportunity for control/exclusion). The time and energy required for the eventual decommissioning of the plant, and the timeframe for the storage of the waste generated, encodes the "importance" of the future generations. Today, social media (arguably) creates the potential for greater control over citizens than ever before, by collecting and organising a wealth of personal data, and putting it into corporate ownership. Social media does not technically require that big data be created or owned by

a single company[7]. The specific designs that are now being put in place are precisely to create and maintain this relationship.

A third very important consequence of embeddedness is that technologies carry the characteristics of the context in which they are created. If the process of technological innovation does not reflect on how the existing context shapes the innovations (e.g. which relevant groups have influence, in which space important decisions are made, what is the basis of legitimacy there), than there is a good chance that the innovations will reproduce or reinforce the status quo, the existing institutions and social hierarchies (Feenberg 1999). Today, for example, there is little reflection on the social relations that are re-produced, the aspects that are taken into account (and ignored) by placing technological decisions in the hands of market actors. While the EU innovation policy aims to improve how technological innovations respond to environmental and social challenges, this kind of reflection is completely missing from the policy documents (e.g. Mazzucato 2018).

Eco-modernisation does not differ substantially from the modernisation agenda in terms of the role of technologies. Modernisation is essentially a programme of controlling nature (the challenges that nature poses to humans). Accordingly, modernisation has created the separate categories of human and nature and has built the major institutions of society on the basis of this separation.

For a long time, technological change has fed the illusion of this dividevand has been the main proof of the success of the modernisation agenda. But, as Latour (1993) puts it, in fact "we have never been modern". This separation is an illusion, since it can never happen in reality. We act on a system which we are part of; we cannot control the system from within. As Feenberg (2010, p. 14) puts it so eloquently "the things we as a society do to nature are also things we do to ourselves" [...] "when humanity conquers nature, it merely arms some humans with more effective means to exploit and oppress other humans who, as natural beings, are among the conquered subjects."

3.5. The Limits to Decoupling

The twin transition essentially seeks to decouple economic values creation from environmental impact. As we have shown, this objective is primarily indicated by the net zero target, and seeks to mobilise market forces and the process of technological innovation to achieve it. The critical comments made so far already make it clear that the basic idea behind the twin transition, that decoupling is possible and will happen quickly enough, seems to be questionable.

The available empirical evidence suggests as much. Even if decoupling does occur, it is partial (for one or a few indicators; in a few, typically high-income countries); and it is much more common to observe relative than absolute decoupling (e.g. Haberl et al. 2020, Vadén et al. 2020). Vogel and Hickel (2023) show in the context of CO_2 emissions that absolute decoupling does occur in high-income countries, but at a pace significantly below that required by the Paris Climate Targets. Szigeti et al. (2017) use the example of the ecological footprint to show that it remains highly correlated with GDP, with a relative decoupling between ecological footprint and GDP for a subset of countries and an absolute decoupling for a much smaller subset. But there is no absolute decoupling

[7] Other configurations are possible and exist (e.g. Diaspora Social Network).

at the global scale. At the global scale, Ward et al. (2016) found a relative decoupling between GDP and material and energy use. Hickel and Kallis (2020) find no decoupling in the relationship between GDP and material use at the global scale – the latter captured by the material footprint indicator.

Moreover, indicators measuring material and energy use or emissions do not directly measure the state of the environment. And indicators of the state of the environment, as indicated above, show a steady deterioration.

In fact, the operating logic of our current socio-economic institutions makes it very difficult (or impossible) to reduce the environmental impact of economic activities in absolute terms. A number of mechanisms can be identified that clearly work against decoupling, such as the emergence of new problems; rebound effects and problem shifting. This also implies that the link between decoupling at the level of economic agents (micro level) and decoupling at the level of the entire economy (macro level) is far from clear. Even if economic actors introduce innovations that increase eco-efficiency, it is not certain that this will lead to a reduction of environmental impacts at the level of the entire economy. As Antal and van den Bergh (2016, p. 165) put it, "decoupling as a main or single strategy to combine economic and environmental aims should be judged as taking a very large risk with our common future. To minimize this risk we need to seriously consider reducing our dependence on growth."

As technological innovation seeks to control a system of which we are a part, it will affect us in new ways, in the form of new (often unforeseen) challenges, which Beck (1992) called the risks of modernisation. Our current global socio-environmental problems are such man-made challenges. Eco-modernisation seeks to overcome these "risks of modernization" by additional technological fixes. But by the same logic, this is likely to lead to new problems. It is not just that digitalisation can create new problems, but that technological innovations intended to address environmental problems can themselves create new kinds of environmental problems.

There are well documented cases of additional risks arising from the large-scale use of renewable energy sources. Such new impacts include the shading effects of solar and wind power plants or the threat they pose to migrating birds. (Large-scale) hydroelectric power plants also have a significant impact on ecosystems. But the potential negative impacts associated with reforestation schemes have also been mentioned earlier.

The next important issue that arises from decoupling is the so-called rebound effect, which refers to the fact that an increase in the productivity of a natural resource usually does not lead to a reduction in its use as much as would be expected from the rate of efficiency gains. In fact, in many cases, efficiency gains are associated with increased absolute use of the resource. In essence, the rate of increase in production or consumption is greater than the rate of increase in eco-efficiency.

Since under current institutional conditions economic agents are fundamentally motivated to increase production/consumption, it is generally expected that a rebound effect will occur. In addition, it is precisely increased efficiency that is the main driver of growth, so innovations that increase eco-efficiency can essentially provide a growth stimulus to the economy, thus negating the eco-efficiency efforts. For example, the aviation industry has reduced CO_2 emissions per passenger-kilometre by 50% in three decades. But over the same period, the number of passenger-kilometres travelled has

increased so much (partly due to cheaper airfares resulting from greater efficiency) that the industry's actual CO_2 emissions have doubled.

The third fundamental mechanism that hinders decoupling is the so-called problem shifting. Problem solving based on technological innovation very often focuses on a narrowly defined problem. The innovation process does not address the whole sustainability problem, but necessarily only some of its components (e.g. climate change; waste recycling, switching to renewables, pollutant removal, etc.). For example, a car company is much more likely to focus on fuel efficiency or vehicle emissions than on habitat loss or biodiversity loss. In other words, technological innovations typically seek to address one (or at most a few) of the global environmental problems at a time.

Timothée Parrique uses an ingenious metaphor to capture the phenomenon of problem shifting[8]. Imagine that each side of a Rubik's cube represents a different environmental or social problem (planetary boundary). One side of the cube is not particularly difficult to solve. But after that, the task becomes much more difficult. Everyone is probably familiar with the phenomenon that, when one is trying to solve a new side, it is easy to spoil the side(s). This is essentially what problem shifting is all about. To stay in the safe zone, we need to pay attention to all sides of the Rubik's cube at the same time.

Problem shifting is a cardinal issue because of the central role of economic growth. If we can overcome an environmental problem through technological solutions, for example by geo-engineering or climate engineering, or if we can exploit fusion energy on a large scale and profitably, then the obstacles to further economic growth seem to be removed. But if there is even a single planetary boundary from which we cannot decouple economic growth, then additional growth on that side will create additional problems. A possible solution to climate change or the energy crisis would presumably fuel further economic growth, which in turn would most likely lead to further habitat loss, further loss of biosphere diversity, increased material use, additional emissions of new (man-made) materials, etc. In other words, while solving one side of the imaginary Rubik's cube, we would permanently mess up the other sides.

4. Conclusion

This paper has used the arguments of ecological economics to provide a critical reflection on the underlying assumptions of the twin transition. We have shown that the digital and green dual transition is an eco-modernisation vision that seeks to capture its success primarily by the net zero objective and to achieve this objective predominantly through market instruments and technological innovation.

We have argued that this objective is far from being satisfactory, that market solutions are fundamentally inadequate to address global environmental (and social) problems, and that technological solutions also have a very limited potential under the

[8] Why will technology not save our souls? Timothée Parrique and Alexandra Köves In Economics for Rebels. The Podcast series of the European Society for Ecological Economics (ESEE). https://open.spotify.com/episode/51nudbQzbNJM ggpw0DDBlT?si=310dde7b220c4922&nd=1 Date of access: 4 February, 2024.

current institutional set-up. In essence, eco-modernisation seeks to address the problems in the same way that created them, by applying the more of the same principle.

Thus, based on the arguments of ecological economics, the likelihood that the twin transition can make a meaningful contribution to addressing environmental and social challenges is very low. Rather, it seems that the strategy of the twin transition is aimed at maintaining the status quo (and growth-oriented thinking as part of it). As such, we expect it to lead to an intensification of global environmental and social problems and (global) inequalities.

The European strategy for the twin transition (and the green transition as part of it) does not in any way call into question the primary objective of economic growth. In essence, it is an attempt to maintain the EU's capacity to grow in a new era of environmental and social challenges. However, according to ecological economics, growth-centred thinking is the very problem; growth cannot be globally decoupled from environmental impact (with regard to all of the planetary boundaries simultaneously); nor is it evident that it is a socially desirable goal under all circumstances. Thus, if our goal is to address global environmental and social challenges (a transformative sustainability transition), a substantially different approach is needed.

The success of such a transformative transition could usefully be captured by indicators of the state of the environment (and society). In the context of climate change, for example, the change in average temperature, the frequency or severity of extreme weather events, or at least the atmospheric concentration of greenhouse gases, could be such target indicators. And instead of focusing on "net zero", a real debate should be opened on the actual reduction of emissions.

A transformative approach must address the issue of reimagining technological change in a meaningful way. The spaces in which innovations emerge (i.e. what is the context of production and use encoded into the technological design); and the process through which innovations are shaped (since our technologies are not neutral) are of fundamental importance. Technological change can serve to recreate existing social relations or to challenge and alter them.

Technological innovations (unless there is deliberate social intervention), will recreate existing power and interest relations. In the current context, where the market is the space for innovations, this is essentially what is to be expected: the reproduction of inequalities and the lack of environmental sustainability. But technological change, if we consciously reflect on its course and nature, can also be used to create and 'set in stone' new social relations. In other words, technological innovation will not solve global problems, but the re-creation of our technological systems is essential to address them. Issues such as distribution, usability, equity, sustainability are not an afterthought. They are not simply the result of social decision-making processes following the emergence of innovations, but are an integral part of the innovation process.

Lastly, transformative change cannot be based on the primacy of economic growth. If it does, it confuses the means of development with its end. Growth makes sense if it then helps society to achieve its important goals. At present, however, it is far from clear that this is the case. It is also quite clear in the economics literature that higher real incomes do not necessarily lead to a "better life" and that GDP has never been a welfare indicator. The economic growth of our time (and of previous decades) has not served the goals of preserving the ecological foundations of societies (and thus humanity's basic

living conditions), creating just societies, meaningfully reducing global North-South inequities, or promoting intergenerational justice. If these are seen as goals to be pursued, then there is a need to rethink the institutions that currently make recession (and hence social crisis) the only alternative to growth. If the idea of infinite growth is rejected, then it is necessary to open up the debate on distribution in a meaningful way. And the green transition must not build on mechanisms that maintain the dependency of the global South, in which the opportunity for growth in the North are sustained by the exploitation of the South's natural capital in the form of resources or compensation for pollution.

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