



Working Paper

Sustainable economic policies: exploring the effects of sustainability-linked money creation

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Ecological policy mix: the SDSN France report.

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Abstract

The SDSN France report attempts to respond to the UN Secretary-General's recent call for "*innovative approaches and bold policy decisions*" to tackle the SDGs (UN, 2023). It attributes the existing finance gap to the unrealistic assumptions of the dominant macroeconomic paradigm, which it proposes to replace with new assumptions that are better able to address the sustainability crisis. It then shows that impact materiality enables the deployment of new macroeconomic tools, including the quantification of the SDG financing needs, as well as a series of innovative instruments making it possible to “close the brown money tap”, “open the green money tap”, and "embed money circulation" in virtuous circuits. The potential effects of this new *ecological policy mix* are analysed using Philia 1.0, an ecological stock-flow consistent model.

Key words : SDG finance, policy-mix.

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1. Introduction

Blinded by the ideology of the gold standard (that "barbaric relic"), the calamitous macroeconomic management of the 1930s threw millions of people into involuntary unemployment and poverty, leading to the rise of totalitarian regimes and the disaster of the Second World War (Eichengreen, 1996). But it was also during this decade that the work of John Maynard Keynes reached maturity with the publication of *General Theory* (1936). This work, which served as a manual for post-war policies, helped lay the foundations for prosperity during the best years of the 20th century.

The SDSN France report² argues that today's decision-makers are, in turn, held captive by outdated economic beliefs that stand in the way of achieving the Sustainable Development Goals of the Paris Agreements. Since the outbreak of the pandemic in 2020 and other simultaneous crises, progress on the SDGs has stalled globally and less than 20% of the SDGs are on track (Sachs et al., 2024). In the European Union, around two-thirds of the SDG targets have been met, but this figure masks major disparities between European sub-regions and countries (Lafortune et al., 2024). Indeed, less than a third of the SDG targets have been achieved or are likely to be achieved in the candidate countries (Lafortune et al., 2024).

These financing gaps, which are the result of misguided macroeconomic policies, are at the heart of the ongoing sustainable development crisis. Achieving the SDGs requires substantial investment in physical infrastructure (including renewable energy and digital technologies) and human capital (health, education, social protection), but many countries, particularly the poorest and most vulnerable, face severe fiscal constraints that prevent them from investing adequately in sustainable development (Massa and Bermont Díaz, 2023). In addition, the global financial architecture is failing to finance the SDGs at the pace and scale required. On the one hand, external concessional financing is inadequate, limited and unevenly distributed across countries and sectors. On the other hand, on the global financial markets, poor and vulnerable countries cannot borrow on acceptable terms due to a lack of credit ratings, resulting in high borrowing costs and short debt maturities. As a result of these financial failures, large SDG financing gaps (i.e. the difference between the financial needs to achieve the SDGs and the available financing) have emerged around the world, particularly in poor countries.

It therefore appears necessary to introduce a new approach to macroeconomic policy. This considerable task, referred to in the United Nations Secretary-General for "*innovative approaches and bold policy decisions*" (UN, 2023), will certainly require time and collective intelligence. The members of SDSN France's economics committee have committed themselves to this approach by publishing several books shedding new light on monetary instruments (Grandjean & Dufrêne, 2020; Dufrêne, 2023; Couppey-Soubeyran, Delandre & Sersiron, 2024), accounting standards (Richard & Rambaud, 2022), organisational governance (Aubert & Hollandts, 2023), the finance-society nexus (Scialom, 2019), and the organisation of the monetary and financial system (Lagoarde-Ségot, 2025). All this work is now part of a discussion on a new '*ecological policy mix*' aimed at identifying new paths to shared prosperity in the 21st century.

This chapter provides an overview of this work, which was presented at a workshop held on 12 December 2024 on the campus of KEDGE Business School in Paris. It begins by proposing a methodology for estimating the needs and shortfalls involved in financing the SDGs at national and sub-national level, by SDG priority area, by budget category and by sector of activity. It then reviews a series of prototype macroeconomic instruments aimed at bridging the observed financing gaps.

The keystone of this new approach is adapting the reporting of the financial and monetary authorities to new criteria of impact materiality. Adopting more realistic accounting would indeed lead the monetary authorities to deploy new monetary, prudential and structural instruments to "turn off the brown money tap", "turn on the green money tap", and "embed money circulation" within virtuous circuits. This new *ecological policy mix* could thus help to lift some of the constraints weighing on ecological transition policies - including in the countries of the global South - without resorting to financial markets or public debt.

We analyse the potential effects of these new instruments using *Philia 1.0*, an analytical ecological stock-flow consistent model of intermediate size (455 equations). This model enables us to analyse the trajectory of the economic and financial

²This committee was set up to coincide with the launch of the French network in January 2019. It brings together economists and managers, academics and practitioners from a variety of backgrounds, to work on a three-pronged roadmap: *teaching* (renewing economics and finance courses), *research* (a new economic meta-narrative) and *communicating* with decision-makers (developing macroeconomic instruments that can be turned into pilot projects).

system, income and wealth inequalities, the ecosystem and several post-growth welfare indicators inspired by biomimicry - in comparison with a '*business as usual*' scenario in which climate disruption leads to ecological destruction, increasing scarcity of energy and material resources, an inflationary bias, losses in GDP, rising inequality and reduced resilience. This work, which is still in progress, has already given rise to a series of scientific publications (Lagoarde-Ségot & Revelli, 2023; Lagoarde-Ségot, Le Quang, & Scialom, 2024; Sersiron, Couppey-Soubeyran & Lagoarde-Ségot, 2024; Didier & Lagoarde-Ségot, 2024; Lagoarde-Ségot & Mathieu, 2024).

The remainder of this chapter is structured as follows. The second section presents the key assumptions of the proposed new economic metanarrative. The third section presents the main features of the *Philia 1.0* model. The fourth section reviews the various prototype macroeconomic instruments proposed, based in particular on the results of the simulations. Finally, the conclusion summarises the work carried out and discusses future prospects.

2. Updating biased assumptions

Like any scientific paradigm, the dominant macroeconomic narrative is based on a set of implicit assumptions. While these assumptions affect the methods and tools used by economists, they also determine, more fundamentally, the range of questions that economic science can ask (Ardalan, 2023). Our contention is that, just like the irrational belief in gold led 1920s policymakers to adopt ill-advised monetary tightening policies, the implicit assumptions of current economics are preventing us from tackling the challenges of the 21st century. Developing a new economic narrative therefore requires us first to identify the problematic assumptions, and then to replace them with new, more realistic ones.

Table 1 thus contrasts the presuppositions of the dominant paradigm with the new meta-narrative we are proposing. The first column identifies a set of key topics: the concept of sustainability, the role of ethical values in economics, the nature of the micro-macro link, the mechanisms of money creation, the functioning of financial markets, the governance of organisations, and the epistemological principles underlying economic modelling. For each of these topics, the second column illustrates the dominant narrative with quotes from neoclassical economists (Joseph Stiglitz, Robert Lucas, Kenneth Arrow, Gerard Debreu, Eugene Fama, Michael Jensen, William Meckling, John Gurley, Edward Shaw, William Sharpe). The third column illustrates our position, drawing on institutionalist, neoclassical, post-Keynesian and ecological economists (Elinor Oström, Amartya Sen, Randall Wray, Nicholas Georgescu-Roegen), climate scientists (Johan Rockström), philosophers specialising in social ontology (Tony Lawson), and monetary supervision institutions (Bank of England).

INSERT TABLE 1 HERE

The dominant paradigm is based on a concept of weak sustainability, which assumes that the costs of depleting natural resources in terms of well-being can be offset by a concomitant increase in production and the capital stock. It excludes, as a matter of principle, normative ethical values from economic inquiry, and reduces the explanation of economic mechanisms to supposedly rational individual choices. It also postulates that the stock of savings - i.e. past profits - determines investment capacity, and that deregulated financial markets are the best guides for allocating investments. It follows that maximising the value of shareholders' equity, as quoted on the financial markets, is identified as the sole objective of corporate governance. Finally, this approach presupposes that it is not necessary to inquire into the realism of these hypotheses, since an economic model must be evaluated based on the acceptability of its predictions.

Our meta-narrative retains a different set of hypotheses. We draw on the state of scientific knowledge about planetary limits to adopt a strong concept of sustainability, in which economic activity is embedded in natural and social constraints. We recognise that the results and prescriptions of economic research are inevitably influenced by the ethical choices and values that underpin them. Observing that the "*whole is more than the sum of its parts*" in both the natural and social worlds, we acknowledge the value of a truly macroeconomic approach - where necessary. We draw the full consequences of the endogeneity of money and consider the unfettered development of financial markets as a major source of economic instability. This leads us to reject the shareholder value model to promote instead organizational and governance diversity. Finally, we consider that the role of economic modelling is to set the parameters of an informed and democratic discussion.

Table 1 Alternative assumptions

On :	Dominant paradigm	Our new metanarrative
Sustainability	<p>Weak sustainability</p> <p><i>"Capital accumulation can offset the effects of the declining inputs of natural resources, so long as capital is 'more important' than natural resources"</i> Stiglitz, 1974 (p.130-131)</p>	<p>Strong sustainability</p> <p><i>"For the first time in human history, we are now forced to consider the real risk of destabilizing our home, planet Earth".</i> Rockström et.al, 2021 (p.2)</p>
Ethics	<p>Logical positivism</p> <p><i>"It is well known that, under appropriate assumptions (...) the allocation of resources in a competitive equilibrium is Pareto optimal".</i> (Arrow and Debreu, 1954, p.265)</p>	<p>Economics as a moral science</p> <p><i>"A society or economy can be Pareto-optimal and yet be perfectly disgusting".</i> (Sen, 1970)</p>
Macro/micro link	<p>Reductionism</p> <p><i>"the term 'macroeconomic' will simply disappear from use and the modifier 'micro' will become superfluous".</i> Lucas (1987 p.107-108)</p>	<p>Emergence</p> <p><i>"social structure is (...) causally irreducible to the individual activities which it serves in turn to facilitate and coordinate".</i> Lawson (2019, p.61)</p>
Financial markets	<p>Neutrality/efficiency</p> <p><i>"I regard the assumption of market efficiency as simply a statement that security prices fully reflect all available information".</i> (Fama, 1991, p.1575)</p>	<p>Procyclicality/fragility</p> <p><i>"over periods of prolonged prosperity, the economy transits from financial relations that make for a stable system to financial relations that make for an unstable system" (Minsky, 1992, p. 9).</i></p>
Investment	<p>Loanable funds</p> <p><i>"Neither banks nor other intermediaries create loanable funds. This is the prerogative of spending units with a surplus on the income and product account."</i> (Gurley and Shaw, 1955, p.521)</p>	<p>Endogenous money</p> <p><i>"Saving does not in itself increase deposits or the "funds available" for banks to lend. Indeed, to regard banks as mere intermediaries ignores the fact that in the modern economy commercial banks are in fact the creators of deposit money..."</i> (Bank of England, 2014, p.14)</p>
Corporate governance	<p>Shareholder value</p> <p><i>"How do we want companies in our economy to measure their own performance? (...) the criterion should be the maximisation of the long-term market value of the company. "</i> (Meckling, 2001, p. 8)</p>	<p>Diversit</p> <p><i>"We must overcome the tendency to recommend panaceas and instead encourage considerable experimentation at many levels to reduce the threats of massive collapse of valuable resources. "</i> (Oström, 2012, p.128)</p>
Modelling	<p>Instrumentalism</p> <p><i>"The proper test of a theory is not the realism of its assumptions, but the acceptability of its implications".</i> Sharpe (1964, p. 434)</p>	<p>Realism</p> <p><i>"When abstraction loses contact with reality, science becomes dogmatism".</i> Georgescu-Roegen (1971, p.319)</p>

3. The Philia 1.0 model

Philia 1.0 is an ecological stock-flow consistent of intermediate size (455 equations) built upon the above assumptions. It follows on from the seminal work of Godley & Lavoie (2012) and Dafermos et.al (2017) and integrates the monetary and real spheres of the economy into a coherent accounting structure, linked to a simplified ecosystem block. This makes it possible to analyse the impact of climate disruption and the depletion of material and energy resources on economic and social dynamics, including financial and monetary ones, as an "*organic whole*". Philia 1.0 thus presents a relatively detailed description of monetary and financial operations, such as Treasury operations, monetary and prudential policies, banking decisions, corporate governance and the structure of interest rates. Philia 1.0 is a user-friendly tool for analysing a complex chain of causal mechanisms within a coherent framework, based on flexible hypotheses. Its validation criteria lie in its accounting closure, its numerical stability, the legibility of the causal sequences, and their consistency with the stylised facts.

The main features of Philia 1.0 are as follows:

- The range of possible outcomes is constrained by a closed accounting and geophysical structure, through the specification of transaction matrices, an energy and material balance, and a physical flow-fund matrix.
- The model includes two categories of households. Working households receive wages and the profits distributed by social enterprises and hold their savings in the form of current accounts and deposit accounts. Rentier households receive income in the form of interest and dividends from investment funds, and hold their savings in the form of deposits and investment fund shares.
- The model includes three institutional sectors of companies: public sector companies, social enterprises (owned by working households, whose financing is rationed and which finance their investments solely through retained earnings and bank loans) and listed companies with financial governance (owned by investment funds, and which finance their investments through retained earnings, bank loans, commercial paper and bond or share issues).
- The model includes nine categories of financial instruments: central bank reserves, sight deposits, term deposits, bank loans, bonds, commercial paper, shares, investment fund units and Treasury bills. These various financial instruments are subject to a "brown/green" taxonomy.
- The financial sector includes banks (which issue credit money), investment funds (which channel the savings provided by rentier households into company shares and Treasury bills, hold deposits and own shares in the banking sector) and the Central Bank (which adopts a financial stabilisation behaviour *via* asset purchases and conducts a discretionary interest rate policy).
- Productive capital is the subject of a "brown/green" taxonomy linked to the ecosystemic sphere. Productive investments are backed by financial instruments so as to track the real and monetary 'green' structure of the economy in parallel.
- The Central Bank runs a refinancing office, offers a deposit facility and holds a portfolio of Treasury bills. It buys up portfolios of risky assets through quantitative easing when banks fail to meet their capital adequacy ratios. Its net profits are distributed to the Treasury, which also holds its shares in order to maintain the accounting close.
- The interest rate universe evolves endogenously and respects the risk and term structures. Financial asset prices follow a stationary process and can be modified *by* shocks that affect sectoral balance sheets and portfolio choices.
- Inflation has two components: adaptive inflation expectations and idiosyncratic shocks linked to ecosystemic disruption (ecological destruction, depletion of material and energy reserves) and the margin behaviour of companies.

- The model includes a block of post-growth economic indicators derived from biomimicry: throughput, resilience and evolutionary aptitude, based on the seminal work of Lietaer and Ulanowicz (2009).
- The stationary state represents an economy whose size and structure are comparable to that of the euro zone. Taking into account the ecosystem block generates a temperature rise of 3°C at the end of the simulation window (60 periods). This induces a persistent inflationary bias, a reduction in the wage share, an increase in inequality, a rise in the public deficit, a deterioration in post-growth economic indicators, and macroeconomic losses of around of GDP. This order of magnitude is comparable with recent estimates of the cost of climate disruption (Kotz et al., 2024; Waidelelich et al., 2024).

4. The *ecological policy mix*

4.1. The keystone: impact materiality and *central banking*

Impact-based materiality involves systematically measuring and assessing the impact of organisations on their social and natural environment (Rambaud, 2023). Impact materiality is defined as the severity, extent, probability and urgency of the impact of an organisation and its value chain on an environmental or social factor (Cooper & Michelon, 2022). These impacts must be taken into account even if there are no financial repercussions for the organisation and its shareholders³. Adams et al (2020) have developed standards for *reporting* based on the SDGs. Any information likely to influence the conclusions drawn by an organisation's stakeholders on the positive and negative contribution of its activities to the SDGs, as well as by capital providers on its ability to create long-term value for society and for itself, is therefore considered material (Adams et al., 2020). In the eurozone, impact-based reporting is reflected in the *European Sustainability Reporting Standards* (ESRS), introduced by the Corporate Sustainability Reporting Directive (CSRD).⁴

When one considers accounting developments, the strictly financial balance sheet of the Central Bank and supervisory institutions gives a truncated picture of economic reality. Yet the Central Bank and the regulatory institutions are at the top of the hierarchy of the monetary system, and therefore exert considerable influence on the social and ecological impact of the second-tier players they regulate (such as banks and businesses). In 2020, the Bank of England stated that "*the Bank is at the heart of the financial system and it is therefore important that we hold ourselves to the same high standards as the businesses we regulate*" (Bank of England, 2020, p.3). Moreover, almost half of the world's central banks already include sustainability issues in their mandate, either directly or indirectly (Dikau & Voltz, 2021). The need for monetary authorities to evolve their *reporting* in line with the new impact materiality standards paves the way for the new "*ecological policy mix*" presented in the following sub-sections.

4.2. Measuring the sustainable finance gap

Measuring the financing gap is an essential step in quantifying needs and deploying the green policy mix. However, this is not an easy task, particularly in countries where institutional capacity is limited. In order to provide policy makers with a user-friendly tool to assess the financing gaps for the SDGs, the Sustainable Development Solutions Network (SDSN) has developed a bottom-up unit cost approach to estimate the financing needs and gaps for the SDGs at national and sub-national levels by SDG priority area, budget category and sector of activity. The model is based on simple accounting formulae, avoiding the *black boxes* that characterise more complex methodologies such as modelling-based approaches. As a result, this approach can be easily implemented by local stakeholders. The SDSN's bottom-up unit cost approach is thus built around four main pillars:

³ According to the principle of dynamic materiality, environmental and social impacts may also be financially materialized at a later stage (Cooper & Michelon, 2022).

⁴ The ESRS are public regulations (*hard law*) that will apply to 50,000 European companies from 2024 (and to non-European companies operating in Europe from 2028).

Stage 1: Identification of priority areas for the SDGs through assessments of performance and progress on the SDGs or by using existing development plans and frameworks.

Stage 2: Identification of a set of resources needed to achieve the desired results.

Step 3: Calculation of current and optimal expenditure lines. Current expenditure lines are obtained by matching the actual inputs required to achieve the selected outcomes with their corresponding unit costs. The optimal expenditure lines are obtained by matching the optimal inputs, defined on the basis of the SDG principles/targets, global targets or scientific targets, with their corresponding unit costs.

Step 4: Calculation of the financing gaps for the SDGs (at different levels of disaggregation) defined as the difference between optimal spending and current spending.

This tool is very flexible and can be adapted to the specificities of different contexts. In addition, by using local data from surveys, censuses or public programmes, it can help to improve the availability and quality of data at local level.

4.3. Ecosystem-based macroprudential regulation

In order to break the vicious circle of finance and climate change, several experts are now recommending the adoption of new "ecosystem-based macroprudential regulation" tools linking banking regulations to scientific knowledge on global warming. Indeed, according to existing estimates, 77% of fossil fuel reserves need to be left in the ground to keep global warming below 2°C. Therefore, no more than 23% of fossil fuel reserves would need to be extracted to achieve the 2 degree scenario with a probability of 83% (Carbon Tracker, 2013). Unfortunately, banks and financial markets have no reason to leave lucrative resources in the ground. The carbon budget is in fact a physical reference linked to material and energy flows. Market benchmarks, which are only interested in prices, are incapable of integrating these concepts. Without strict regulation, no market mechanism can, in order to respect planetary limits, lead to the conservation of fossil reserves in the ground, the exploitation of which would be highly profitable. Paradoxically, the climate change induced by these practices is a major vector of financial instability (Scialom, 2023).

The aim would be to force banks to keep brown credit flows below the carrying capacity of the Earth system. The NGO Finance Watch (2023) recommends the adoption of a "loan-to-value" (LTV) ratio to limit the creation of money allocated to "brown" projects. By noting L_B^D the demand for loans from brown industries and L_B^S the loans offered by banks to these industries, the LTV constraint would stipulate that $\frac{L_B^S}{L_B^D} < 23\%$. This policy would thus make it possible to reduce the use of fossil fuels below a threshold set by science, which is currently estimated at 77% of fossil fuel resources (Carbon Tracker, 2013).

Lagoarde-Ségot, Le Quang and Scialom (2024) simulate the implications of such a reform using Philia 1.0. Holding all other parameters constant, they analyse a scenario in which the threshold of 23% of solvent demand for brown credit would apply to all listed and public companies, but not to SMEs and social enterprises. Their results suggest that such a reform could rapidly green bank balance sheets and credit flows, and significantly reduce brown investments. In addition, the systematic transfer of demand for brown financing to the equity markets, by diluting earnings per share, reduces the appetite of investment funds for brown projects and limits their financing. Nevertheless, the drying up of brownfield financing is causing a fall in investment and significant macroeconomic losses in the short term. In the long term, however, the resulting green transition puts the economy on a more sustainable temperature path, reduces inflationary pressures and keeps real GDP at the level of the reference scenario, with favourable distributional effects.

Macro-prudential ecosystem regulation of this kind, whose logic could be extended to other "negative externalities", would therefore have the effect of aligning the maximum amount of brown investments with the state of scientific knowledge on planetary limits. In the context of the *ecological policy mix*, it would therefore constitute a restrictive policy aimed at "turning off the brown money tap"

4.4. Reform of refinancing mechanisms

In a modern monetary system, banks must hold reserves at the Central Bank in proportion to the public deposits shown as liabilities on their balance sheet. The Central Bank has a monopoly on the issue of reserves and ensures that the supply of reserves corresponds to the needs of the banks. In addition, the system by which the Central Bank lends these reserves

created *ex nihilo* to the banks is based on strictly financial expectations. For example, in a repurchase agreement, the Central Bank determines the haircut and the interest rate by assessing the default risk of the borrower underlying the collateral provided by the banks, without taking into account their materiality in terms of impact.

This mechanism encases the chain of economic agents in a strictly financial *Logos*: the Central Bank's reserve loans are pledged against the financial solvency of the banks. To maintain this solvency, the banks charge borrowing rates higher than the reserve rate. Lastly, this borrowing rate is a key element in the "cost of capital" used by companies to select their investments. The structure of interest rates is therefore blind to the impact of the activities financed. This can lead to planetary limits being crossed, and to the under-financing of activities that are socially useful but not profitable in the short term.

To remedy this, Lagoarde-Ségot & Revelli (2023) therefore propose making banks' access to reserve requirements conditional on an analysis of the materiality of the retrospective impact of their loan portfolios. This prototype would involve the following steps:

Stage 1: Impact assessment bodies (under the supervision of the Central Bank) assess the materiality of the impact of loan portfolios designated by the banks and recorded on their balance sheets.

Step 2: The Central Bank credits (or debits) the banks in a new specific account entitled "environmental risk-free assets" (ERFA) measuring the impact materiality of the portfolios assessed in step 1.

Step 3: Banks can ask to convert their ecologically risk-free assets into reserve money at the Central Bank. During this conversion operation, the ecologically risk-free assets are destroyed and new reserves are created.

In this way, the central bank uses its status as lender of last resort to align credit and money creation with sustainable development objectives. Banks would thus be encouraged to assess *ex ante* the materiality of the impact of loans requested by businesses, to adjust their loan offers accordingly, and to keep their loan portfolios on their balance sheets until maturity. For its part, the Central Bank retains control over the supply of reserves and key rates by adjusting the rate at which ecological risk-free assets can be converted into reserves when necessary (stage 3).

Simulations carried out under Philia 1.0 suggest that this prototype would help to redirect credit flows towards the green sector and reduce the financing constraints on impact businesses (particularly SMEs). As a result, it could help to reduce inequalities and increase resilience.

This prototype contributes simultaneously to "opening the green money tap" and "closing the brown money tap". It should be remembered, however, that there is no causal relationship between the initial stock of reserves and the amount of bank credit granted. The transformative impact of this prototype will therefore *ultimately* depend on its ability to generate solvent demand for credit from impact entrepreneurs. Nevertheless, this system balances the power of banks to create money with a genuine ecological and social responsibility, and could therefore help to reincorporate finance into social and natural constraints. In addition, the ecological risk-free asset (presented in step 2) is an institutional innovation that can be used in various forms as part of the *ecological policy mix*.

4.5. Sustainability-linked money (SMC)

A number of authors are now calling for the opening of a new, targeted and democratically governed channel for money creation, in the service of sustainable structural change (Dufrêne & Grandjean 2020; Dufrêne, 2021, 2023; Couppey-Soubeyran et al., 2024). The work of Sersiron, Couppey-Soubeyran & Lagoarde-Ségot (2024) is in line with this approach. The idea is to accelerate the *replacement* of brown productive assets by green productive assets in all sectors of the economy, in line with the transformation of the SDGs, using both a *top-down* and *bottom-up* approach. Sersiron et.al (2024) break down the process of issuing this *sustainability linked money* (SMC) as follows:

Stage 1: Local players (including members of parliament, other representatives of civil society (trade unions, associations, etc.) and scientists (climatologists, economists, sociologists, etc.) identify and budget for projects eligible for this type of funding: non-profitable green productive investments likely to replace profitable brown productive investments.

Step 2: The stakeholders' recommendations are examined and adjusted by Parliament, in line with the State's commitment to the Paris Agreement, and then transferred to the Central Bank. In some institutional contexts, this may require amending the legal texts setting out the conditions for the independence of the Central Bank.

Stage 3: The Central Bank's Monetary Policy Committee decides on the volume of SMC issues, taking into account the other elements of its decision rule.

Step 4: The Central Bank credits non-bank financial institutions (for example, a mixed-governance Territorial Sustainable Development Fund) with the new SMC. The sustainable development funds then spend the SMC in the economy on the projects selected in Step 1.

Stage 5: After an impact audit based on the principles of impact materiality, the Central Bank shows a new non-transferable asset on its balance sheet called Contribution to the SDGs (CSDG).

The governance of the SMC thus envisages a clear separation of powers, by establishing four distinct public mandates: (i) the choice of eligible projects, decided democratically, (ii) the calculation of annual SMC emissions, which is the responsibility of the Central Bank, (iii) the allocation of emissions to identified projects, which is the responsibility of local agencies, (iv) *reporting* on the impact of the scheme, which is the responsibility of independent extra-financial evaluation agencies. These agencies will assess the impact of the projects financed according to a methodology developed around the SDGs, the indicators of which will be adapted to the local realities of each project.

Sersiron, Couppey-Soubeyran & Lagoarde-Ségot (2024) simulate the implications of such a reform using Philia 1.0. Holding all other parameters constant, they calibrate annual issuance (smc) at 3.5% of annual nominal GDP throughout the simulation. The corresponding stock of SMC money (SMC) is accounted for as a new central bank commitment, balanced by a new asset, the contribution to the SDGs (CSDG), defined as a fraction (τ) of the SMC stock. Their results suggest that this tool mitigates negative inflationary feedback from the ecosystem, reduces income inequality, increases resilience, maintains or increases Central Bank equity valued in materiality to impact, and reduces the public deficit ratio.

The SMC would thus facilitate the ecological transition by rapidly financing green investments that are not profitable but essential, and that have been democratically identified by stakeholders. As part of an ecological *policy mix*, it would constitute an accommodating policy aimed at "opening the green money tap".

4.6. Endogenisation of complementary local currencies

Impact materiality can also support the development of complementary local currencies (CLCs). These are exchange instruments backed by a guarantee fund in legal tender, and used primarily to exchange goods and services within a territorial community. Numerous international case studies have shown that LCCs make it possible to enclose monetary circulation within a "territorial ethical sphere". However, their issuing mechanisms are pledged against pre-existing deposits, like a *currency board*, which hampers their development on the scale required by the SDGs.

Didier & Lagoarde-Ségot (2023) and Lagoarde-Ségot & Mathieu (2024) therefore propose to use impact materiality to endogenise the creation and destruction of LCC. The accounting and monetary logic of this prototype is similar to that of the "ecological risk-free asset" described in subsection 3.2.3.

Stage 1: Law guarantees the convertibility of LCCs into legal tender at a fixed rate: banks accept payments in LCCs in repayment of debts owed to them, the Treasury accepts LCCs in payment of taxes, and banks have a conversion office that allows households to convert their deposits into LCCs, and vice versa (with or without a discount).

Stage 2: Banks grant productive loans denominated in LCC. The investment project financed must contribute to sustainable development objectives within the LCC framework.

Stage 3: Extra-financial agencies under the authority of the Central Bank calculate the materiality of the retrospective impact of LCCs.

Step 4: The Central Bank credits (or debits) a new specific account entitled "ecological risk-free assets" measuring the materiality of the impact of complementary local currency loans.

Step 5: Any bank can ask the Central Bank to convert its ecologically risk-free assets into reserve money. During this conversion operation, the ecologically risk-free assets are destroyed and reserve money is created. The Central Bank retains control over the supply of reserves by adjusting the rate at which risk-free assets are converted into reserve money, as part of its monetary policy mandate.

This prototype would make it possible to extend the well-known effects of LCCs to the entire monetary system: increased circulation of money in marginalised areas, preferential financing of organisations with a positive impact, and increased ecological awareness among stakeholders. It would also strengthen the soundness of the monetary system, by linking the

Central Bank, banks, communities and sustainable development objectives on a territorial scale. Various simulations carried out under *Philia 1.0* (as well as in a simpler model) indicate that such a policy would encourage a change of scale in the social enterprise sector, and would significantly increase the resilience of the economy by increasing the circulation of money within marginalised territories. It would also help to strengthen the banking sector by increasing the reserve ratio. In the context of the ecological *policy mix*, this system therefore makes it possible to "*embed monetary circulation*" in a virtuous circuit.

4.7. Government debt swaps

This prototype is based on the work of Dufrière (2023) and Peters (2021), as well as on the open letter from 150 European economists to Christine Lagarde published in the European press in 2020. In the case of the eurozone, in 2023 the European Central Bank held around €4,000 billion of public debt of the Member States - around a third of total public debt. This debt was bought by the ECB on the secondary market, i.e. from the private financial players who had purchased it. These purchases of public debt securities by the ECB make it possible to maintain low or even negative rates on the primary market for sovereign securities. Following this transaction, the private creditors are paid, but the European States remain indebted to their Central Banks.

The public debt swap consists of transforming this stock of debt into an investment lever for the ecological transition, via a conditional cancellation of the public debt held by the Central Bank. The proposed stages are as follows:

Stage 1: The Central Bank buys back public debt instruments on the secondary markets and writes them off as a realised loss on the liabilities side of its profit and loss account.

Stage 2: In exchange for this cancellation, the Member States undertake to immediately re-debt the same amount on the markets in order to finance the investments needed for the ecological transition and with a high materiality and impact.

Stage 3: The central bank's balance sheet would then be unbalanced: in the case of the eurozone, the assets side of the ECB's balance sheet would fall from €7,730 billion to €3,730 billion, while the liabilities side would remain at €7,730 billion. The central bank money put into circulation in step 1 circulates permanently and no longer has a counterpart in the central bank's accounts.

Step 4: In accordance with the principle of impact materiality, the Central Bank records a new asset on its balance sheet, which could be called "Definitive contribution to sustainable development objectives". This entry transfers the claim on the public sector held for monetary policy purposes to a heading where it is considered as an accounting asset.

The favourable effects anticipated by Dufrière (2023) include (i) a net fall in the debt/GDP ratio, (ii) a reduced dependence of governments on financial markets, (iii) an acceleration in public investment for the ecological transition, and (iv) the possibility for governments to rapidly regain room for manoeuvre in their budgets. In the near future, simulations with *Philia 1.0* will shed analytical light on this innovative treatment of public debt. In the context of the *ecological policy mix*, this prototype would have the effect of "opening the green money tap" by facilitating massive investment in the ecological transition, while easing the financial pressure on governments

4.8. Promoting employee share ownership

By extending ownership of productive capital to employees, employee share ownership helps to combat income inequality. Indeed, wealth inequality is exacerbated when returns on capital exceed economic growth, as Piketty (2014) has pointed out. The concentration of capital in the hands of a few therefore encourages inequality, destabilises democratic values and gives rise to public discontent. Several authors therefore recommend democratising capital ownership. For example, if all private US companies were 30% employee-owned, the Gini coefficient (a measure of income inequality) would fall by almost 10% (Dudley and Rouen, 2021). Moreover, this increase in wealth would disproportionately benefit low-income communities, closing the wealth gap between races and genders. Developing employee share ownership would therefore make it possible to reduce wealth disparities, while strengthening employee commitment and company stability. A number of studies have shown that companies with a high level of employee share ownership enjoy greater participation, inclusion

and confidence on the part of their employees. This ownership model fosters a culture of fairness and justice within companies, improving job quality, leadership and skills development.

In addition, companies with significant employee ownership are more likely to integrate environmental, social and governance (ESG) principles into their operations. This alignment with ESG objectives is explained by the fact that employees who are also owners tend to prioritise the long-term health of the company, including its impact on the environment, over short-term profits. For example, the European Union has recognised the potential of employee ownership to promote employee buy-outs. This model, already implemented in Slovenia, is seen as a tool for ensuring business continuity and avoiding the collapse of SMEs when owners retire (Ellerman et.al, 2022). In the context of the *ecological policy mix*, this prototype would have a "structural" effect, by aligning corporate governance with society's interests, while diluting corporate ownership and limiting the power of investment funds. In the near future, simulations with Philia 1.0 will shed analytical light on the potential effects of this system

4.9. De-dollarising the international monetary system

Finally, it should be noted that the *ecological policy mix* will be all the more effective if it is implemented within a more balanced international monetary and financial system. The current system, based on the supremacy of the international dollar and the free movement of capital, generates instability and major financing constraints, particularly for developing economies (De Paula & al. 2024, Ponsot, 2016). Forced to take on debt in dollars rather than in their own currencies and to adjust to repeated shocks, developing countries favour *export-led growth* strategies to obtain the foreign currency they need to integrate internationally. The dollarisation of the international system thus severely limits their ability to finance their development and climate actions, and even locks them into an extractivist logic that consists of exploiting natural resources ever more (Olk, 2024). The BRICS and emerging countries are undoubtedly right to multiply their initiatives aimed at emancipating themselves from the dollar, but for the time being their scope remains limited and this process is leading to a fragmentation of the international system that is a source of tension. It would be better to opt for an in-depth reform based on international cooperation. The option of a supranational currency, along the lines of Keynes's *bancor*, is the ideal solution on paper, but it remains difficult to implement quickly: (i) the United States would have to give up the exorbitant privilege of the dollar; (ii) international finance would have to give up its main source of speculative income, derived from the volatility of exchange rates and the free movement of capital. Two less ambitious but more realistic options are to change the role of SDRs allocated by the IMF to contribute to ecological financing (Spain & al. 2023) and to introduce international payment systems in domestic currencies by mobilising central bank digital currencies. In the near future, simulations with Philia 1.0 will shed analytical light on the effects of such a system.

5. Conclusion

The global sustainability crisis requires "*innovative approaches and bold policy decisions*" (UN, 2023). In response, the SDSN France report has introduced the various components of a new *ecological policy mix*. The development of this new macroeconomic approach is made possible by the introduction of new assumptions that are more realistic than those of the dominant paradigm. The keystone of the proposed instruments lies in adapting the *reporting of* financial and monetary authorities to the new criteria of impact materiality. This would lead the monetary authorities to deploy new monetary, prudential and structural instruments in order to "turn off the brown money tap", "turn on the green money tap", and "embed money circulation" within positive-impact territories, businesses and projects.

The prototypes presented in this report include new methods for measuring the *SDG finance gap*, new ecosystem-based macroprudential regulation, new mechanisms for issuing reserve money, the issue of sustainability-linked money, the endogenisation of complementary local currencies, reforms in favour of employee share ownership, and new multilateral tools for de-dollarising the international monetary system. This new *ecological policy mix* could help to lift some of the constraints weighing on ecological transition policies - including in the countries of the global South - without resorting to financial markets or public debt.

In what we hope will be the near future, readers will be able to consult an educational book and watch a documentary film presenting our new macroeconomic approach in a clear and concise way. We also hope to participate in the development of a pilot project in partnership with policy-makers and multilateral institutions.

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