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FINANCING FOR CLIMATE ACTION

Introduction

April 2021 saw the launch of the Glasgow Financial Alliance for Net Zero (GFANZ), chaired by Mark Carney, the UN Special Envoy on Climate Action and Finance, which brings together leading banks and financial corporations to redirect finance towards achieving the COP26 goal of net zero by 2050. Many GFANZ signatories, however, remain among the world's top backers of fossil fuels, some issuing new financing to companies expanding fossil fuel infrastructure since signing with GFANZ (Mazzucato 2021). The agreements reached are voluntary, non-binding, and discretionary rather than — as they should be — mandatory, systematic, and publicly accountable. GFANZ is at the 'cutting edge' of current attempts to reform the financial system for combatting climate change — and it is clearly inadequate.

Given the urgency of reaching net zero by 2050, it is time to move beyond such ineffective reformism and pursue radical transformation. This policy brief sets out the latest thinking from UCL's Institute for Innovation and Public Purpose on how to transform the financial system to combat climate change and transition to a green economy. Climate change can only be addressed by transforming capitalism through market shaping measures by introducing new tools, regulatory frameworks, conditionalities and metrics across relevant institutions and policy spheres.

To achieve a socially and environmentally sustainable future, new economic thinking is needed that can direct purpose-driven innovation; unlock alternative forms of investment and financial models; prohibit clearly damaging forms of finance; and reimagine public value to help society accelerate a green transition for a more climate-resilient economy.

There is a huge asymmetry between who is responsible for the climate crisis and who is affected by the impacts of it. Definitive action is required from the wealthiest



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approximately 10% of the global population. In the immediate and near term, regulations need to target high-energy users and in fact, if the wealthiest 10% were regulated to reduce their carbon footprint to the level of the average EU citizen, which is still a comfortable lifestyle and the remaining 90% of the global population made no changes to their lifestyles, then global emissions would be still cut by over 30% (Anderson 2018; Taylor 2020).

If we are to limit global temperature rises to 1.5 degrees above pre-industrial levels in an equitable way, it is essential that developed countries and the largest emitters take the lead and radically reduce their emissions over the next decade. While the COP26 pact will not hold wealthy countries to the necessary financial commitments to help nations who are and will be the most impacted by climate change, they must still deliver on their promise to raise at least \$100 billion every year in climate finance to support developing countries. Our best hope of achieving this is through massive, coordinated state investment aimed at innovation leaps that can accelerate a green transition through positive feedback loops and multiplier effects alongside sufficient funding to support adaptation and a loss and damages in those countries worst effected by climate change.



In alignment with the goals of the 2021 United Nations Climate Change Conference in Glasgow (COP26), finance needs to be put in place to build resilient cities, places and infrastructure; to scale up clean power and increase energy efficiency; to protect and avoid further loss of natural habitats and biodiversity; and to fund transformative technology and innovation. However, simply increasing the availability and quantity of finance for green initiatives alone will not bring about the re-directed economy that we need. To reorient growth in a green direction, what matters is not just the *quantity* of available finance, but the *quality* of finance.

Three factors are fundamental: the direction of finance; and the terms and conditions on which finance is provided. First, finance needs to be directed towards riskier innovations and early-stage R&D in key sectors identified as crucial in achieving clearly defined goals – such as decarbonising the steel industry – in the mission of mitigating climate change. Second, finance needs to be patient, bespoke and tailored to the specific needs of this innovation process; it needs to come wrapped up in technical support and financial expertise. Thirdly and concurrently, clearly unsustainable forms of finance – most obviously that supporting fossil-fuel extraction but also activities that damage biodiversity – needs to be rapidly phased out.

How can public and private financial institutions become more purpose-driven to unleash the investments required to secure global net zero? This policy brief argues that, first, the state needs to step into the financial governance space through developing new public institutions, such as national investment banks and public wealth funds, to take the lead in creating new markets and offering the financial instruments required for a green transition. Second, governments, central banks and financial supervisors also need to shape existing markets through new regulatory measures that align private finance products more closely with the net-zero carbon mission.

This policy brief summarises some of the recent research produced by researchers at UCL's Institute for Innovation and Public Purpose (IIPP) exploring key questions around climate-aligned finance and sustainable growth.

Setting a direction of innovation in the energy transition

Mobilising finance for investment and innovation in the energy sector is a key challenge for climate change mitigation (Mazzucato and Semieniuk 2018). Successful



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financing of innovation in renewable energy requires a deeper understanding of the relationship between different types of finance and the difference in their willingness to invest in renewable energy. The directionality of financial instruments is key to the success of innovation and the resilience of the renewable energy system.

Awareness that finance can create directions for innovation, whether planned by policy makers or not, is an important point to highlight when designing policies. Mapping the effects that policies have on the direction – and not just the amount – of finance before implementing policies will help prevent surprises and lock-ins later.

The direction of investment becomes even more important in the context of innovative economic sectors. Successful policies that have led to radical innovations have been more about market shaping and creating through direct and pervasive public financing, rather than 'market fixing' via price based interventions such as carbon taxes or greater disclosure of climate exposures. Innovation is highly uncertain, cumulative, collective and has very long lead times. Due to short-termism and risk-aversion, the private sector often does not invest in higher-risk areas until future returns become more certain.

We have observed how the investment share of the public sector has taken a more important role over time in the deployment of renewable energy technologies. We have also observed a public sector that persistently finances high-risk technologies and that has a higher risk exposure relative to the private sector (Mazzucato and Semieniuk 2018). Understanding the strategic role of public financing of innovation and the way it can shape and create markets is key.

Public financing of transformative innovation

To achieve the mission of transitioning to a zero-carbon economy, the public sector must take a more entrepreneurial role in the innovation process: as a risk-taker that welcomes uncertainty to accelerate climate action; as an investor in patient, long-term finance; and as a co-creator of zero-carbon markets.

To unleash a clean energy revolution, investments are required across the entire innovation chain, with a focus on both supply and demand (Mazzucato and Semieniuk 2018; Mazzucato and Semieniuk 2017). Capital does exist in the significant amounts needed to get us to a sustainable, inclusive green economy; the problem is that the channels through which it might reasonably flow require unclogging and, in many cases, rerouting entirely. Green growth means economy-wide redirection.

The state plays a central role in supporting the availability of, and access to, the entire innovation chain of both public and private investments, from upstream R&D to downstream commercialisation, and across the phases of the business cycle (Mazzucato and Semieniuk 2017). Key here in creating new technological and industrial landscapes are mission-oriented agencies, such as ARPA-E in the US and a potential CERN for climate technology, as recommended by the G7 Panel on Economic Resilience.

To both catalyse a new sector and to ensure the new technologies are fully diffused and deployed, the use of mission-oriented policies will be equally important for the clean energy sector. The IT revolution serves as a good example of how to enable this transition (Mazzucato and McPherson 2019a; 2019b): most of the technological innovations we now take for granted – smartphones, GPS, the internet itself – were catalysed initially by public financing and state-directed R&D.

Such historical lessons show how the invisible hand of the market only ever plays a secondary role in developing and commercialising innovations primarily steered by the visible public hand. These lessons demonstrate that public financing must be distributed across the whole innovation chain through different actors; that justifications for public investments cannot be limited to periods with low interest rates. Even if the world was experiencing high growth, it would not be enough to incentivise green investments with tax breaks alone. They would need to be crowded in by public funding, simply because there is as yet no market that can work efficiently with private actors at its centre.

Heterogeneous investors, scale economies, and commercialisation

Financing costly upfront investments is a problematic bottleneck in a fast transition to a low-carbon economy. In the energy sector the presence of scale effects implies that ensuring the deployment of large-scale projects is necessary to supply affordable green energy. Institutional investors may not be the best source for realising scale economies in relatively new and yet to be commercialised technologies, whereas public financing has proven to be effective at mobilising private finance to make larger investments and thus generate scale economies and accelerate the commercialisation of new technologies (Semieniuk, Coronado and Mazzucato 2021).

Heterogeneity in sources of finance in renewable energy deployment is key for identifying which investors are most appropriate to a specific phase of the innovation landscape and who can improve the risk-return trade-off by financing at larger scale. Targeting efforts at mobilising sources of finance that will be more effective at generating scale economies and accelerating the commercialisation of technologies will be equally important in achieving the necessary carbon emission reductions in the energy sector. Due to their propensity for making large investments, utilities and banks have, on average, been more effective in this regard, but the question remains as to how utilities and bank investments can be better incentivised to make more strategic investments at the stage of technology commercialisation.

A positive relation between individual private investments and aggregate public finance directed towards the green energy sector, coupled with a remarkably positive elasticity, suggests that public finance does not only act on mobilising more private finance at the extensive margin, but also on increasing investment size at the intensive margin and unlocking scale economies. The presence of public investments, often critiqued for 'crowding out' private markets, has, on average, beneficial effects on the rate of commercialisation of renewable energy technologies (Deleidi, Mazzucato and Semieniuk 2020).

Institutional investors are now entering the increasingly formed market for renewable energy supply, for instance via green bonds. The ways in which finance can be mobilised for scale economies to create and shape markets in other capital-intensive clean and low-carbon technologies (not yet as advanced as renewable energy supply) is a major issue for future research and development.

Rapid structural change towards clean energy supply will require significant additional investments into innovative but high-risk clean and low-carbon technologies (Deleidi, Mazzucato and Semieniuk 2020). Mobilising greater private investments will require applying the right policy instruments, but the role and effect of public direct investment needs to be further understood. Current theoretical arguments claim that such public (co-) investments either 'crowd out' or 'crowd in' private investors. Both neoclassical microeconomics and evolutionary economics suggest public direct investment has a positive effect due to either externalities or market creation effects.

IIPP is investigating how aggregate public finance flows are mobilising aggregate private investment flows into the green energy sector and comparing its effects to other policy measures. Public investments not only have a positive effect, but also consistently the largest effect on private investment flows relative to feed-in tariffs, taxes and renewable portfolio standards in general, and on wind and solar technologies in particular.

The role of national investment banks and public wealth funds in supporting sustainable growth

The role of the state in financing climate should not be limited to providing regulations and incentives for crowding in heterogeneous private and institutional actors alone. Crucially, this needs to extend to create new public institutions that can play a primary role in financing a green transition. National investment banks and public wealth funds are key here to providing new sources of finance and shaping new financial markets that the private sector is, for whatever reason, incapable of providing independently.

National investment banks (NIBs) have a history going back to reconstruction plans for Europe following the Second World War. While their traditional functions were in infrastructure investment and counter-cyclical lending, more recently NIBs have become key domestic and global actors driving economic growth and innovation, playing risk-taking venture capitalist and mission-oriented roles focused on tackling modern societal challenges, not least climate change.

By placing state investment banks at the centre of industrial strategies and innovation investment processes, countries like Germany and China, as well as the European Union, are steering the path of innovation towards public goals (Mazzucato and MacFarlane 2018).

The Scottish National Investment Bank (SNIB) provides the perfect example of an NIB with clear mission-oriented purpose at its heart. Established in 2017 by the Scottish Government, with expert advice from IIPP, the SNIB has been seeded with £2 billion in public money to provide patient finance over ten years to new firms and technologies across three mission areas, the primary one being climate action. Operational from 2020, the SNIB has made its first strategic investments in innovative Scottish firms specialising in tidal energy turbine manufacturing and heat storage batteries. In this way, NIBs play a central role in directing and shaping new zero-carbon markets towards a green transition. Public wealth funds can also work alongside national investment banks to provide public ownership and governance of key assets in land, enterprise and intellectual property.

The long-term argument for public wealth funds is that, by taking equity in risky start-up firms with good long-run potential, the state can help create businesses and an economy that would otherwise never come into being. Importantly, the state shares in the risks, but also takes a share in the rewards. The public surpluses generated by this stakeholder approach to development can be reinvested into further rounds of innovation. This long-term capital sharing approach is particularly important in meeting three objectives where the private sector is unwilling or unable to take the risks: to create new businesses in regions in decline or in a permanently depressed condition; to promote new businesses at the forefront of technology; and to accelerate the response to climate change (Detter, Fölster and Ryan-Collins 2020).

Recent research has demonstrated that green investments may create larger economic multiplier effects than conventional fiscal stimulus (Hepburn et al. 2020). However, alongside relatively low levels of return compared to more standard asset classes, investments in climate friendly production or innovation can be unduly risky for private investors, given that future policy makers may lack incentives or a political agenda that would sustain current policies.

When the state becomes a shareholder through a sizable investment in, or recapitalisation of, an asset, the risk calculus changes. Policy makers then have to factor in that the state itself bears economic and political costs if they change climate policies in a way that generates losses in the government-owned firm. In theory, this makes climate policies relatively more consistent and directional over time, and reduces the risk for private investors, thereby encouraging crowding in of private finance. A public climate wealth fund could thus play a market-shaping role in supporting the UK's decarbonisation agenda.

A market-shaping, precautionary approach to tackling climate-related financial risks

The need to account for climate risks in both monetary policy and financial supervision is recognised by financial authorities worldwide (NGFS 2021). Moreover, financial authorities should also react to environmental threats beyond climate change. These might include biodiversity loss, water scarcity, ocean acidification and chemical pollution. The financial sector is both exposed to environmental-related financial risks and contributes to their development via its lending, and via the propagation and amplification of financial shocks.

Being systemic, endogenous and subject to 'radical uncertainty', these risks cannot be sufficiently managed through 'market-fixing' approaches based on information disclosure and quantitative risk estimates (Kedward, Ryan-Collins and Chenet 2021; Kedward, Ryan-Collins and Chenet 2020). Instead, a 'market-shaping' approach to financial policy is required (Ryan-Collins 2019; Chenet, Ryan-Collins and van Lerven 2021). A 'market-shaping' policy framework acknowledges the uncertainty faced by market actors and strives to actively steer capital allocation in a clear direction — towards an orderly but rapid green transition — but still allows space for the necessary innovation and experimentation needed to enable such a transition.

Both financial regulation and monetary policy should be deployed to tilt markets in a broadly climate-aligned direction. For example, macroprudential-type rules should be used to manage systemic climate-related risks and encourage a rapid shift in capital reallocation in order to prevent catastrophic losses in the future. In terms of implementation, we propose the comprehensive integration of climate-related financial risks into capital adequacy requirements, monetary policy operations, quantitative credit controls, and measures aimed at enhancing financial system resilience. Existing initiatives such as risk disclosures, benchmarks and taxonomies should also be strengthened, standardised and made mandatory.

Such interventions can be justified by the need for a 'precautionary policy approach'; one which prioritises preventative action in the face of unpredictable tipping points, and which makes greater use of qualitative methods of managing risk to support a controlled regime shift towards more sustainable capital allocation. Such an approach builds system resilience as a superior means of managing radical uncertainty.

Policy makers adopting a precautionary approach should be aware of the likely short-term trade-off between efficiency and resilience, and likely resistance from market actors with shorter-term time horizons. There is a need to 'learn by doing' in this new environment, just as policy makers are learning from the success and failures of macroprudential policy interventions over the past few

Table 1: Market-fixing versus market-shaping financial regulatory frameworks to address climate-related financial risks*

	Market fixing	Market shaping
Justification for regulatory intervention	Market or coordination failures: Imperfect information, asymmetric information, adverse selection or competition (e.g. failure to disclose climate risk)	All markets and institutions are co-created or shaped by public, private and third sectors, including regulators. Regulation should ensure markets support public purposes or missions, including, zero net carbon transition and financial stability.
Understanding of climate risk	Climate risks are exogenous shocks which can be subject to probabilistic estimation with sufficient disclosure of exposures using statistical techniques. Risk is invariant to policy intervention.	Climate risk is 'uncertain', better understood as being inherently endogenous, driven by policy action/inaction, technological change and interaction with market actors. Characterised by non-linear dynamics, feedback loops and complexity; risks are not invariant to policy itself.
Policy emphasis	Encouraging disclosure of risk by market participants on a voluntary or compulsory basis to aid price discovery.	Favour precautionary approach to reduce chance of catastrophic losses even in the face of uncertainty; focus on whether financial system as a whole is moving in direction of mission via achievement of intermediate milestones and user engagement. Focus on portfolio of policies and interventions, and their interaction.

*Source: Ryan-Collins 2019 - Adapted from Kattel et al. 2018.

decades (Lim et al. 2011). Not all precautionary-type interventions will be successful. But, on balance, valuable information can be gained from intervening and learning from the endogenous reactions that follow a particular intervention in order to inform future policy decisions (Chenet, Ryan-Collins and van Lerven 2021; Kedward, Chenet and Ryan-Collins 2020).

For the net-zero transition, greater policy coordination with broader government strategy will be necessary to minimise risks to the financial system and the risks the financial system poses to the environment (Robins, Dikau and Volz 2021). Central banks cannot prevent climate change without interventions from the government. However, it is also true that government policy changes are unlikely to be successful if the financial system remains blind to climate-related financial risks.

Central banks need to drop principles of ‘market neutrality’ and adopt explicitly green strategies in their various policy tools. There are a number of policies central banks can take to align their operations fully with the goal of net zero. First, by integrating climate-related financial risks into central bank asset-purchase programmes, as has been recently announced by the Bank of England (Bank of England 2021). Second, by ‘greening’ the refinancing programmes by which central banks provide liquidity to commercial banks: lowering interest rates for green asset lending, and increasing rates for unsustainable lending. Third, by regulating banks to hold more capital against the most unsustainable assets, such as loans financing fossil-fuel extraction. As public financial institutions, central bank policy toolkits must at the very least be aligned with government targets towards net zero. However, such policies can and should also be used more proactively to strategically guide finance in order to accelerate the green transition.

Cities for climate action

Cities are responsible for over 70% of global greenhouse gas emissions, yet by virtue of high population densities, economies of scale and agglomerations of co-productive activities with great potential for circular economies they also hold the key to a more sustainable future. To address this challenge, cities need to utilise bold market-shaping approaches to steer innovation towards systems change that will enable a net-zero future.

Municipal governments have considerable authority over land-use planning, water and waste management, and can play an important role in climate mitigation, adaptation and resilience building. However, there are often institutional barriers that make it difficult for cities to move from political rhetoric to policy action (Betsill 2001). Often there are no institutions for climate change policy making.



Mayor Andy Burnham with youth climate activists, 2019 Greater Manchester Green Summit

How can cities efficiently improve the lack of skills, and administrative capacity and technical knowledge, that will be necessary to develop local policies and programmes for controlling, managing and analysing environmental issues related to greenhouse gas emissions?

Among the most forward-thinking authorities, the city-region of Greater Manchester in Northwest England has taken a mission-oriented approach to achieve its goal of ensuring net-zero carbon living within the local economy by 2038 (Bellinson et al. 2021).

This mission was developed through a top-down, expert-led process to determine a carbon neutrality target aligned with the UK’s commitment to the Paris Climate Accord and broad, bottom-up participation to engage the city-region’s diverse residents to determine what policy actions would both enable decarbonisation and improve life in the city.

Conclusions

Current emissions targets still support the status quo and business-as-usual. This policy brief has outlined how, through enhanced public leadership, financial innovation can be tilted towards addressing precisely this urgent global challenge. It has shown that investment is not neutral; that the quality and quantity of finance are both important; and that choosing the source and setting the direction of financing are pivotal to meeting ambitious missions with public value and purpose – not least the mission of transitioning to a green economy.

Identifying barriers and enablers for the financing of the green transition — across the macro, meso and micro levels of the financial ecosystem — is key to influencing the mandates, policies, and activities of public sector financial institutions, and aligning these with climate objectives.

This includes the monetary and prudential policies of central banks and financial regulators, the provision of long-term patient finance by state investment banks and other public financial institutions, as well as the public support of firms seeking finance to invest in green innovation projects.

Designing, financing, delivering, and monitoring a green growth agenda requires courage and tenacity from all actors involved to move away from traditional ways of thinking about climate change and innovation; to develop targeted, directed policies and protocols; and to start out quickly with aspirational, achievable, and galvanising missions. To battle climate change, we should transform today's fears of uncertain outcomes into a mission to be accomplished, as bold and inspirational as the 1969 Apollo moon shot. This will require visionary leadership, patient strategic finance, greater policy coordination, social movement mobilisation and grassroots innovation. It must be economy-wide and occur at all scales — locally, regionally, nationally and internationally; from the federal to the city to the neighbourhood level. Only by having wide stakeholder governance of green transitions can we enable growth that is sustainable, resilient, and inclusive.

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