GREENING CHINA'S FINANCIAL SYSTEM

CHAPTER 8:

INTERNALIZING CLIMATE MITIGATION FOR FINANCIAL POLICY-MAKERS

SONY KAPOOR, RE-DEFINE

DRC - FINANCE RESEARCH INSTITUTE

IISD International Institute for Sustainable Development

IN ASSOCIATION WITH

UNEP

Inquiry: Design of a Sustainable Financial System

WITH SUPPORT FROM

FRIDTJOF NANSENS INSTITUTT
FRIDTJOF NANSEN INSTITUTE

CONTENTS

EXECUTIVE SUMMARY

Climate change is already upon us and, in the absence of urgent national and global action to sharply cut greenhouse gas emissions, it will have an ever-bigger negative impact on the economy, security and welfare globally. Related problems of the overexploitation of the environment in the form of falling water tables and imminent water stress (Gassert, Reig, Luo, & Maddocks, 2013) and concentrated urban air pollution in cities such as Beijing and New Delhi have also become far too urgent to ignore (Killalea, 2014).

While one expects a global deal on climate and more national- and local-level action on other environmental challenges, the reality is that we do not have the luxury of delaying action. The sheer gap, for example, between the demand and need for clean energy and the world's supply of it is such that only frontloaded large-scale investments in renewables will leave us with any hope of mitigating climate change. In the meantime, the world continues to increase its use of fossil fuels and the sector enjoys subsidies of more than USD 523 billion (Gurria, 2013; International Energy Agency [IEA], 2013) in the developing and emerging world alone. Fossil fuels attract new investments in exploration, the development of reserves and the construction of carbon-intensive power plants several times larger than the investments that go into renewables. In 2012, USD 674 billion was spent by listed companies alone on the discovery of new fossil fuel deposits (Carbon Tracker & London School of Economics' Grantham Research Institute, LSE, 2013), a multiple of what the world spent on clean energy.

While subsidy elimination and a higher effective price on carbon emissions are essential elements of any successful effort to limit climate change, a large-scale change in the allocation of capital both within firms and by the financial system away from "dirty" into "clean" investments is equally critical. Taxes, subsidies and actual price on carbon emissions are important for capital reallocation because they change incentives. But even without these, there are several policy measures that can be enacted to "green" the financial system.

One of the biggest challenges to this necessary and urgent task is that the world of financial and economic policy-making and the world of environmental policy appear to inhabit parallel universes. There are few overlaps between the environment ministries, development agencies, energy departments, non-governmental organizations (NGOs), academics and United Nations agencies that inhabit the world of climate change policy and the International Monetary Fund (IMF), the Bank for International Settlement (BIS), central banks, treasuries, financial regulators and supervisors that dominate financial policy-making. This is only starting to change with the heads of the IMF, the World Bank, the Organisation for Economic Co-operation and Development (OECD) and some national-level policy-makers beginning to address this chasm, but this process is far too slow and far too superficial. No matter how much regulators and central bankers may care about the environment and climate change personally, very few regard looking at these issues as part of their day-to-day job. This may not have been too big a problem, as policy-making is often done in siloes and is far too fragmented, were it not for the fact that the financial system as a whole is heavily biased against the greening of the economy and in favour of the dirty economy. Some of this is down to the fundamental nature of finance, but perverse regulations, short-termism, misaligned incentives and a collective under-appreciation of the financial and economic risks of continuing fossil fuel investments all play a significant part.

The financial system, as well as households and corporations, also systemically underinvest in energy-efficiency measures—despite the fact that the annual returns on such investments can reach double or even triple digits in a global environment where financial returns on other more mainstream investments have collapsed. Without urgent corrective actions by financial policy-makers, not only will other policies be insufficient to mitigate climate change, but the economy will continue to "lock in" future emissions through continuing investments in energy-intensive power generation and "waste" capital in the development and

exploration of fossil fuel sources that are essentially "unburnable" if we are to limit global warming within reasonable limits (Carbon Tracker & Grantham Research Institute, LSE, 2013). It will also continue to forego potentially high-return investments in energy efficiency, leaving everyone worse off.

Despite this, most financial policy-makers regard these matters as lying outside their traditional, relatively narrow interpretations of their mandates, and the objectives of economic and financial policy-making. This paper focuses on demonstrating why climate and environmental considerations fit naturally into the most widely accepted objectives of mainstream economic and financial policy-making. We show, for example, that the widely accepted policy objectives of increasing growth, employment and productivity, and providing stability and security are not just compatible with action to tackle climate change, but are likely to be undermined in the absence of such action.

As Jim Kim (2014), president of the World Bank said, "Financial regulators need to lead ... Sooner rather than later, they must address the systemic risk associated with carbon-intensive activities in their economies, made clear, of course, by price signals. Start now by enforcing disclosure of climate risk and requiring companies and financial institutions to access their exposure to climate-related impacts." A recent study from the Asian Development Bank (ADB), for example, shows how GDP in South Asia would seriously suffer because of a failure to tackle climate change (ADB, 2014). Investments in renewables can not only deliver a short-term economic stimulus, but can also enhance total factor productivity and generate much needed additional jobs. Particularly for countries such as India and China that are heavily dependent on fossil fuel imports, these can also help improve the balance of payments and contribute positively to both energy security and reducing macroeconomic vulnerability.

The paper also shows how the somewhat narrower objectives of financial policy-makers—such as investor protection, transparency, maintaining the safety and soundness of financial firms, financial stability, tackling systemic risk, reducing information asymmetries, tacking market failures and developmental objectives—offer multiple avenues to legitimize policy measures that can contribute to the greening of the financial system. In particular, objectives of investor protection, financial stability, tackling market failures and mitigating systemic risk may actually not be achievable even in a narrow and conservative interpretation of mandates without explicit action from policy-makers to take climate mitigation and other important environmental matters such as water scarcity into account.

The last part of the paper discusses what tangible policy measures financial policy-makers can undertake to green the financial system and shows how these fit neatly into the existing objectives and mandates of regulators and the central banks. Some of these are highlighted below.

Because risk measurements in the financial system are mostly backward looking, the system as a whole is underpricing the possibility of policy action to mitigate climate change (Campiglio, 2014). As such, actions have proliferated at local, regional and national levels. Even in the absence of a global deal to replace the Kyoto Protocol, it is foolhardy to ignore policy risks. Since renewable investments are less familiar than tried and tested technologies of fossil fuel power generation and have shorter "track records," the financial system overestimates the risk of such investments.

Policy action that introduces strict disclosure of carbon and other environmental risks is urgently needed in China. This will need to be applied to both listed companies in the real economy and financial institutions of all kinds, including banks, asset managers and insurance firms. These disclosures would help comparability, but, given that the market is expecting a very low likelihood of strict policy action to curb climate change, they are likely to only change behaviour in the margins. The guidelines unveiled by the Securities and Exchange Commission (2010), the stock market regulator in the United States, can be instructive. This measure is compatible with the obligation to promote disclosure and transparency and reduce information asymmetries.

Chinese financial regulators need to go beyond simple disclosure and introduce a strict carbon stress regime, modelled on the EU-wide bank stress tests carried out by the European Banking Authority (2014). The EBA does not perform carbon stress tests, but instead it tests for unlikely but possible stresses in the housing markets and growth shocks that are conceptually similar. China ought to introduce mandatory carbon stress tests for all financial institutions, not just banks, but also insurance firms and asset managers. Like the EBA stress tests, the results of these carbon stress tests ought to be made public, as this will have a far bigger impact than if these are reported only to regulators. Financial institutions, which are heavily exposed to carbon or other serious environmental risks, must be forced to either build up capital buffers or reduce exposure, or both. This is consistent with the regulator's duty to safeguard financial institutions as well as protect investors and address market failures.

The world is still in the throes of a systemic financial crisis—the result of excessive leverage in the financial system, losses from the collapse of a housing bubble in some countries and a very high level of interconnectedness among financial institutions. For a risk to be considered "systemic," the initial losses must be large enough, widespread enough and sudden enough to be amplified by the interconnectedness of the financial system so as to trigger large-scale losses that threaten the integrity of the financial system as a whole. In order to judge whether carbon risk poses a systemic threat or not, the Chinese financial authorities will have to first mandate the disclosure and stress tests discussed in the previous paragraphs. Only then will they possess sufficient information about the size and scope of exposure to risks arising from policy action to mitigate climate change, and then a judgment call can be made on whether to treat this as a source of systemic risk. The information from the stress tests will need to be assessed alongside the structure and the nature of interconnectedness in the Chinese financial sector, but prima facie carbon risk may pose a systemic threat. If such a threat is detected, then the authorities can increase risk weights for such exposures, introduce quantitative limits or mandate the holding of additional capital buffers, all of which will make the financial system greener.

Other policy measures, such as preferential risk weights for green investments, quotas, aligning incentives, allowing securitization of energy-efficiency investments etc., are also likely to be necessary alongside risk-based measures in order to effectively green the Chinese financial system, and they can be easily accommodated within the existing objectives and mandates of financial policy-makers.

1 INTRODUCTION

The alarm bells are ringing, as evidence that climate change has already begun accumulates: glaciers are melting; flood risk is increasing; weather patterns more volatile; and global warming is upon us. What is even more alarming is that seeing the shape of a worrying future has done little to spur policy-maker action. An adequate global deal on climate mitigation is still elusive.

However, the world cannot afford to wait for this global-level action to begin, as even under the most optimistic scenario the deal would not be able to mitigate climate change on its own. A plethora of local, national and regional measures is needed to support the global framework. We are starting to see some of this with the emergence of carbon-trading schemes in the European Union, as well as at a state level in the United States and at a municipal level in China (Yu & Elsworth, 2012). Many other initiatives, including by the private sector, are also underway.

Despite this, we have a very long way to go. Investments in fossil fuels still far exceed those in renewables and energy-efficiency measures combined. Even now, USD 674 billion was spent in 2012 by listed companies alone on the discovery of new fossil fuel deposits (Carbon Tracker & Grantham Research Institute, LSE, 2013), a multiple of what the world spent on clean energy investments. We are still in the process of locking in ever more carbon emissions, so even the inflection point of changing over to renewable sources of power is a long way away. In fact, after rising for many years, investments in renewables have fallen for the past two years by 11 per cent in 2012 and 10 per cent 2013 (Bloomberg New Energy Finance, 2014).

Furthermore, the International Energy Agency (IEA, 2013) has reported that "fossil-fuel subsidies amounted to USD 523 billion in 2011, around six times the level of support to renewable energy. Currently, 15% of global CO2 emissions receive an incentive of USD 110 per ton in the form of fossil-fuel subsidies while only 8% are subject to a carbon price." Clearly, the financial, tax and subsidy landscapes are still tilted towards "dirty" investments and away from "green" investments.

In summary, the gap between what is necessary for us to mitigate global warming and how money is actually being invested keeps widening. Without reversing this, we have little hope of ever tackling climate change. This introduces a natural role for financial policy-makers such as market regulators, bank supervisors and regulators, as well as central banks and their international equivalents, to be intimately involved in the fight against climate change. Moreover, the general principle of most of the discussion on climate change and the financial system in this paper can be naturally extended to broader environmental issues such as water stress and local pollution.

Traditionally, environmental matters in general, and the discussion on climate change in particular, have been the preserve of environmental ministries, non-governmental organizations, academics and the United Nations in the domestic and international policy community. Financial policy-makers have had little to do with this discussion at any serious level, no matter how much they might personally care about climate change. The general feeling in this community is that "tackling climate change does not fall under our mandate." In the business and financial community, too, climate change has, until recently, been of interest only to specialist groups and has not become a "mainstream" issue.

Fortunately, this is changing fast. An increasing number of national leaders, heads of international organizations such as the Organisation for Economic Development and Co-operation (OECD) (Gurria, 2013) and the International Monetary Fund (IMF) (Lagarde, 2012), businesses such as Unilever (2014) and investor groups such as Ceres (2013) have professed that climate change and environmental degradation are among the biggest challenges of our times and have urged for a strong and coordinated response. However, this has not gone far enough. Anybody who works in the field of financial or economic policy-making or within

the financial sector will immediately recognize the disconnect between what these thought leaders are saying and what central banks, financial regulators, banks, pension funds and sovereign wealth funds are actually doing. This disconnect between the worlds of finance and environment can no longer be tolerated if the world has any hope of tackling climate change and other serious environmental problems.

The financial sector not only is the "brain" of the economy, allocating resources among competing projects such as a wind farm or gas turbine, but it is also critical in sending price signals to firms in the real economy on which internal capital allocation decisions will be rewarded and which ones might be penalized. How much priority a firm gives to making investments in energy-efficiency measures, whether it decided to invest in oil exploration or not, or whether it puts money into research and development for developing "green products" are influenced by the expected reaction of the stock market and financial analysts.

The financial sector, comprising banks, investment funds, financial markets and ancillary firms such as ratings agencies, operates in a heavily regulated environment, where it gets its cues from policy-makers at central banks, bank regulators, market regulators and tax authorities. It is this regulatory landscape that, through defining the price of money, the tax regimes, and the regulatory restrictions such as capital weights, liquidity requirements, accounting rules, risk limits and disclosure requirements, has the biggest impact on where and how the financial sector directs funds and what price signals it sends.

What rules and regulations are set are in turn governed by a set of explicit and implicit objectives that are legitimate for policy-makers to pursue.

This paper seeks to bridge the gulf that exists between financial policy-makers on the one hand and those involved in tackling climate change and other critical environmental challenges on the other. It does so by:

- Discussing why recognizing and addressing climate change and other big environmental challenges are crucial to the core objectives of policy-makers.
- Highlighting how the financial system is biased against green investments.
- Exploring the sets of policies that financial policy-makers can pursue to counter this bias.

2 HOW GREENING FITS INTO POLICY-MAKING OBJECTIVES

As discussed in the introduction, one of the biggest constraints to urgently needed policy action to green the financial system is a widely held belief among financial policy-makers that this lies outside of their policy-making objectives and mandates. This flows from an unnecessarily narrow interpretation of what the overarching mandates for economic policy-makers are. This section shows how "greening" fits naturally into the framework of a broadly accepted scope for what is legitimate for economic and financial policy-makers to focus on.

In order to identify what the commonly accepted objectives for policy-making are, the author spoke to a number of academics at schools of public policy, as well as to a number of policy-makers themselves. The following list of objectives comprises those that have a high degree of acceptance and are implicitly or explicitly pursued by policy-makers all over the world: 1) enhancing growth, 2) maintaining stability, 3) ensuring security, 4) increasing employment, 5) increasing productivity, 6) addressing market failures, 7) correcting externalities and 8) ensuring sustainability.

To further narrow down the scope of these broad objectives for the purpose of this paper, the author spoke to several central bankers and financial regulators in addition to looking at the published objectives for central bankers and financial regulators. The following lists are based on these two sources and encompass those objectives most commonly assumed to be part of the operational framework of financial regulators and central bankers. The appendix lists detail the official objectives of the central banks of China and India as examples.

For financial regulators, the most commonly pursued objectives are as follows: 1) consumer protection; 2) investor protection; 3) ensuring that markets are fair, efficient and transparent; 4) reducing systemic risk (Financial Stability Board, 2010); 5) promoting competition; 6) ensuring the integrity of the financial system (Financial Conduct Authority, 2014); 7) ensuring the safety and soundness of firms (Bank of England, 2014a); 8) ensuring a fair and efficient distribution of resources; 9) reducing information asymmetries (Di Giorgio, Di Noia, & Piatti, 2000); and 10) correcting market failures. For central banks (many of which are also regulators and/or supervisors) the most commonly pursued objectives are: 1) price stability; 2) financial stability; 3) pursuit of employment, growth, welfare and economic development; and 4) supporting policies of the government (BIS, 2009).

In the context of this paper, "green" policies refer to those directed at: 1) mitigating climate change through renewables, 2) adapting to climate change, 3) tackling other urgent and large environmental challenges such as water scarcity, 4) tackling particulate and other kinds of pollution commonly associated with the burning of fossil fuels.

Numerous scientific and economic analyses have shown that, unless climate change and other urgent environmental challenges are tackled, growth in economies will seriously suffer. A recent report by the Asian Development Bank (2014), for example, shows that growth in South Asia is likely to lower by 9 per cent because of climate change. Hence, a failure to tackle climate change is likely to lead to lower growth (Stern, 2006). This means that policies designed to address climate change and other key environmental challenges such as water scarcity and acute pollution will lead to higher growth, at least in the long term. As publications on a "green new deal" show (Re-Define, 2011), growth effects are also visible in the near term, so they are relevant to policy-makers with both long- and short-term decision horizons. Importantly, tackling climate change is the pro-growth strategy for the longer term, and it can be done in a way that does not cap the aspirations for growth of rich or poor countries (Stern, 2006). Hence, the pursuit of green

policies fits naturally within policy-makers' remit to maximize growth both in the context of minimizing negative impact on growth and harvesting the fruits of green investments to increase growth.

Maintaining stability is another core objective of policy-making both in economic and broader contexts. As studies have shown (ADB, 2014; Intergovernmental Panel on Climate Change, 2013; Peterson, Hoerling, Stott, & Herring, 2013; World Meteorological Organization, 2013), climate change is likely to increase the volatility of weather patterns, precipitation and extreme weather events such as monsoon rainfall patterns in countries such as India, thus increasing economic volatility. The possibility of the loss of lives and accompanying social unrest means that green policies that help reduce weather and climate volatility are also necessary for the broader stability objective, not just economic stability. Later, this paper will discuss another important aspect of "stability," namely the stability of the financial system and how a failure to tackle climate change can undermine it. Provided overall growth is the same, citizens have a strong preference for less volatile growth outcomes that can only be delivered with proactive green policies.

The provision of "security" is one of the basic functions of a state. This, of course, has multiple interpretations, but for the purpose of this paper, energy security is perhaps the most relevant. There is a long history of problems associated with countries that have a significant dependence on imported fossil fuels. This goes from the oil price spike of the 1970s to the more recent events in the European Union and Ukraine related to their dependence on gas imports from Russia. In a narrower economic sense, one of the biggest drivers of India's large current account deficit, a source of serious macroeconomic vulnerability, is its heavy dependence on fossil fuel imports. India imports 38 per cent of the fossil fuels it uses (Energy Information Administration, 2014), and China's dependence on imports of oil is even higher at 55 per cent (Rostoum, 2014).

The hundreds of billions spent on fossil fuel imports by regions such as the European Union, India, China and Japan often flows to countries where corruption is rife and/or to countries where some of these funds may end up in the hands of terrorist groups, such as the Islamic State, that impose a threat to global security. Thus, green policies are essential not just to provide basic energy security and to reduce economic vulnerability, but they may also help reduce threats from terrorism.

There is a unanimous agreement that the provision of jobs is one of the core tasks of policy-makers. Particularly in a global environment where unemployment levels in the European Union, Africa and emerging countries in Asia are unacceptably high, this policy objective has increased resonance. While employment depends on a number of variables, the level and variability of growth rates are very important. Given the earlier discussion, as well as conclusions from a number of studies on the green new deal, green policies are likely to result in a higher level of employment. There would be a transition cost, as certain fossil fuel-heavy sectors will see a rise in unemployment, but the overall effect is likely to be positive.

Particularly for countries facing high levels of unemployment, a large-scale greening of the economy cannot just provide an economic lift-up and possibly faster growth rates, but it also has the potential to create millions of new jobs (ADB, 2014; World Bank, 2014).

Increasing total factor productivity is an important goal of policy-making, as this is the only route to increasing the income of citizens. While traditionally the focus has been mostly on labour productivity, a serious discussion on increased resource productivity has emerged in parallel (United Nations Industrial Development Organization & Agence Française de Développement, 2013). While measures to improve education and training are crucial to boosting labour productivity in the economy, the emergence of green policies is central in increasing resource productivity. Those policies that focus on the development of new green technologies have the potential to simultaneously provide a big boost to both labour and resource productivity, and therefore should be especially encouraged by policy-makers.

Given that most economies in the world are now "market economies" to some extent or the other, correcting market failures is now one of the most important tasks for policy-makers. Sir Nicolas Stern has said that "climate change is a result of the greatest market failure the world has ever seen" (Benjamin, 2007). This market failure is the result of a failure to appropriately price the externalities imposed by greenhouse gas (GHG) emissions. Policy-makers regularly penalize other public "bads" such as smoking through punitive taxation, but this is mostly still not the case for GHG emissions. The need for green policies to meet the sustainability objective is self-explanatory.

To summarize, green policies that help mitigate climate change, as well as those that tackle other critical environmental challenges, are crucial to policy-makers meeting what are widely regarded to be their core obligations and objectives.

Now let us turn to the somewhat narrower context of legitimate objectives and mandates for financial policy-makers. Are "green" policies consistent with these and do these objectives provide legitimacy for financial policy-makers to proactively pursue such policies?

As discussed in the next section and in other reports (such as Re-Define, 2011), the financial system has a perverse bias against green investments and towards dirty fossil fuel-based activities. This is entirely inconsistent with not just the overarching need to mitigate climate change and other forms of environmental destruction, but also with the often loudly declared objectives of heads of state and international organizations, who have repeatedly voiced support for proactive policies to tackle climate change.

As Carbon Tracker (2013) has shown, the burning of the majority of identified fossil fuel reserves is not consistent with successful efforts to tackle climate change. Yet, as highlighted in the introduction to this paper, the financial system continues to pump more money into fossil fuels than into the renewables that are necessary to tackle climate change. Obviously, these new and existing fossil fuel investments are at tremendous risk from policy action that would mitigate climate change, but the financial system is blithely ignoring such risks.

Greening the financial system to better recognize the risks of carbon-intensive investments can be pursued under a number of objectives such as investor protection, financial soundness and systemic risk. How this fits under "pursuit of employment, welfare and economic development" has largely already been discussed above, and "in support of government policies" is self-explanatory. Because too little is known about carbon risk and the exposure of various businesses and financial institutions to it, requirements for better disclosure naturally flow from mandates for "reducing information asymmetries" and "promoting transparency."

More proactive policies, such as those that deliver preferential credit, will more naturally fit under the broader mandates to "correct market failures," "support growth and employment" and "support government policy." Overall, it is clear that a reasonable interpretation of the broadly accepted mandates and objectives of financial policy-makers leaves them a lot of leeway for proactive policy actions that can help green the financial system. The next section shows why this is necessary.

3 THE FINANCIAL SYSTEM IS BIASED AGAINST GREEN INVESTMENTS

The most important green investments for the purpose of mitigating climate change can be divided into two main categories. The first is energy-efficiency investments and the second is investments in renewable energy production. For a variety of reasons, the financial system is systematically biased against these investments.[1] A related problem is that the financial system continues to overinvest in "dirty" fossil fuel sources of energy. This overinvestment in dirty energy is the flipside of underinvestment in clean energy. Section 3 deals with the drivers behind these three undesirable characteristics of the financial system, and Section 4 will discuss what regulators and central bankers can do to correct them.

Some of the highest returns on investments can be generated through energy-saving measures such as changing light bulbs from the old fashioned incandescent variety to far more energy-efficient fluorescent lamps or LED bulbs, where the payback period can be less than a year and financial returns in excess of 100 per cent. Other energy-saving investments such as buying more efficient household appliances, more fuel-efficient cars, better insulations for homes and offices, etc., typically have longer payback periods, but the financial returns are often positive and in double digits.

The McKinsey cost abatement curve (McKinsey & Company, 2009) clearly shows the variety of energy-saving investments that generate positive returns, often in the double or triple digits. Yet the reality is that consumers, businesses and the financial system all underinvest significantly in efficiency-enhancing investments—the equivalent of leaving dollars lying around on the road. Why is that so? And what can financial policy-makers do to address this?

An even bigger problem is the overinvestment in fossil fuels and the underinvestment in renewable energy, even where the economic and financial case clearly favours the latter (Re-Define, 2011). What drives this behaviour in the financial sector and how can financial policy-makers address this perverse outcome? Most energy-efficiency investments are incremental, both in the context of households or businesses. For example, the installation of green bulbs is typically only a small proportion of a household's or a business's expenses. The installation of better insulation is usually only a small proportion of the cost of a building. Similarly, the purchase of more energy-efficient white goods or vehicles costs incrementally more than less green versions of the same. This means that the decision to make energy-efficiency investments is not one that typically occupies the "top of mind" for households or businesses. It is often a secondary consideration in decisions that are driven primarily by other criteria.

Because the costs of efficiency are often incremental to the main costs for households and businesses, it also means that the financial returns offered are relatively small compared to the main financial metrics that govern decision-making, even though the return on these incremental investments are generally quite high. The other critical matter is that energy efficiency is often not the main line of business or motivation for decision-makers. Both of these mean that many efficiency investments are often foregone.

This also creates challenges for the financial sector, as it makes energy-efficiency investments harder to "monetize" as a standalone category. Far too many of the investments needed are quite small, and their fragmented nature means that such investments are expensive if not altogether impossible for banks and investors to fund. It is also hard to disentangle the financial flows associated with such investments from the larger income flows and expenditures for households and firms.

[1] Re-Define (2011) has a very comprehensive treatment of this subject.

Attention (or the lack thereof), access (which is hard) and the need for aggregation across a number of relatively small investments are three of the biggest challenges resulting in the real economy and the financial sector underinvesting in energy-efficiency measures.

In theory, it is considerations of risk and return that ought to be the primary drivers of allocation of resources by the financial sector. In reality, these are tempered by the limited availability of information, the difference between perceived and actual risk, regulations, the time horizon of decisions and the incentives of those making the decisions.

The cost structure of investments in fossil fuel sources of energy generation and renewables, for example, is structurally different. For coal- and gas-fired plants, for example, the upfront capital investment is no doubt significant, but a large bulk of the costs arise in the future in the form of fuel costs. For renewables such as wind and solar power, the main cost is that of the upfront capital investment, as there are no fuel costs. Typically, then, renewable power sources are more capital intensive than an equivalent amount of fossil fuel power generators (Campiglio, 2014).

A short-term-oriented financial system of the kind we have will favour investments that have cost structures associated with gas turbines over those associated with solar and wind power installations. This bias is strongly observable in actual capital allocation. The longer the decision-making horizon, the more relatively attractive a wind turbine will look relative to a gas turbine, but the pursuit of short-term profitability biases the financial system and internal corporate investments against renewables.

A cost-plus billing model, wherein utilities are able to pass through potentially higher as well as more volatile future costs of fossil fuels to their customers, further distorts their incentive to make green investments even if these may be intrinsically more profitable.

If one looks at prevailing market norms, not only is the present explicit or implicit price of carbon too low (Howard, 2014; Organisation for Economic Co-operation and Development [OECD], 2013), but financial market players appear to give little weight to the likelihood that robust policy action in the form of a higher price on carbon emissions or quantitative limits to emissions may be forthcoming (Campiglio, 2014). The risk of fossil fuels is thus underpriced, particularly if one assumes that policy action will have to crystallize if the world has any chance of even partially mitigating the disastrous effects of climate change. Similarly, if one assumes that there is any substance to policy-makers' claims of their oft-repeated commitment to "robust action" to tackle climate change, then the market is clearly underpricing the "risk" of such policy action (Allianz Group & WWF, 2005).

Lord Nicholas Stern, author of the influential Stern Review (2006) on the economics of climate change, has argued that investors' current practice of zero pricing of carbon in their valuations is effectively betting on, indeed encouraging, the development of a carbon-intensive economy. Financial markets, on the whole, are failing to account for system-wide risks that endanger private investments and society as a whole. Investor surveys show that only about 2 per cent of assets are valued with any carbon price (Zadek & Chenghui, 2014). This leads financial actors and corporations making decisions on allocating capital to extracting fossil fuels (coal mining, oil and gas drilling), as well as the generation of power from fossil fuels (coal-fired plans or gas turbines) or making fossil fuel-intensive products (gas-guzzling SUVs), to over-allocate funds into activities that look far less attractive once the potential rise in the price of carbon emissions is accounted for.

For example, the oil industry has invested USD 341 billion into the development of new tar sands resources (Wells, 2012), which would be strongly hit by any policy action against climate change, and in any case have a high marginal cost of extraction. Another example is that ExxonMobil plans to invest USD 190 billion in the exploration and development of new oil and gas resources over the next five years (Warner, 2013), even as it becomes clear that large chunks of already identified reserves are unburnable.

Low prices on carbon in making capital allocation decisions, along with the relative profitability of "dirty" versus "green" investments and the failure of the market to account for policy action that is likely to come, diverts large amounts of capital away from greener investments into those that are fossil fuel intensive. For example, investments in renewables have actually declined in the past two years according to Bloomberg New Energy Finance (2014).

The failure of markets to account for the possibility of higher carbon prices in the future means that the value of fossil fuel reserves, for example, may be significantly overestimated. This failure has been clearly highlighted by the stranded asset debate (Carbon Tracker & London School of Economics' Grantham Research Institute, LSE, 2013; Generation Foundation, 2013; Carbon Tracker Initiative, n.d.), which shows how the burning of already monetized "fossil fuel reserves" is inconsistent with our ability to mitigate climate change.

Given that green technologies are relatively new and unproven, they are typically considered to be more "risky," so they attract a higher-risk premium than more traditional investments in fossil fuels and power generation from such sources. This typically means that the market applies a higher-risk premium to green investments such as solar and wind power. In short, the market underestimates the risk of dirty investments and overestimates their profitability. The situation is reversed with respect to clean investments. Additionally, financial markets are currently characterized by the widespread desire for liquid, short-term assets, which is at odds with the illiquid, long-term features of typical green investments (Spencer & Stevenson, 2013).

The lack of visibility on future regulations and the low carbon price to date, however, have prevented current efforts from having a significant effect on industrial strategies. The policy risks created are not material enough, and in the next 5–10 years are unlikely to drive capital allocation more into line with climate scenarios (Dupré & Chenet, 2012). Banks and other commercial entities routinely use an internal carbon price that is far too low—if they use one at all (Carbon Disclosure Project, 2013). They also still apply a risk premium to renewable investments that is not always justified, given the maturing of the technology and the regulatory environment. The combination of these factors means that banks put far too much money into the "dirty" economy and too little into the green economy. Investors in bond and stock markets increasingly track indices that reflect prevailing market capitalization rather than what is likely to happen in the future.

Because present market indices have a much larger proportion of fossil fuel firms and dirty utilities, far too much capital is blindly allocated to large oil and gas majors, as well as utilities that depend on "dirty" sources of energy, while too little capital makes its way into greener investments. Even when fund managers have discretion to deviate from the index, their short time horizons that are linked to annual bonus payments mean that the system is biased against high-upfront capital cost green investments. It also means that fund managers can and do ignore the longer-term financial risks to the development of fossil fuel reserves from policy action to tackle climate change. Even where managers may have a longer-term horizon, regulations that increasingly force them to mark the value of their assets to prevailing market prices (even when the market is obviously wrong) and the need to perform well against prevailing "market benchmarks" mean that the cards are stacked against greener behaviour. Michael Liebreich of Bloomberg New Energy Finance has described "a systemic failure of valuation, an overvaluation of the fossil-related and extractive industries and various other utilities and some other asset classes" (House of Commons, 2014, p. 7).

Large capital allocation decisions happen within corporate entities rather than capital being raised afresh for every project a firm invests in. But these decisions are often made on the same criteria as those in the financial markets, which send price signals to chief financial officers and are afflicted by the same short-termism and incentive misalignment problems that affect the broader financial sector (Re-Define, 2011).

In summary, efforts to green the financial system must 1) increase the perceived risk of dirty investments, while reducing their profitability; 2) reduce the perceived risk of green investments, while increasing their profitability; 3) limit short-termism in financial markets; 4) address regulations that might skew the landscape against green investments; 5) change market norms of behaviour and benchmarking; and 6) better align incentives of financial actors with the need for a greening of the economy. A good summary of the kinds of financial reforms that can help better align the financial system with the real economy that is greener can be found in reports such as Kapoor (2010) and Re-Define (2011).

4 WHAT FINANCIAL POLICY-MAKERS CAN DO TO GREEN THE FINANCIAL SYSTEM

Financial regulators, central bankers and other financial policy-makers have thus far mostly failed to take on board how the financial system is failing to allocate sufficient capital to the greening of the economy. While many of them are personally concerned about impending climate change and broader environmental degradation, most do not consider tackling climate change to be part of their job description.

However, as we have discussed in a previous section, greening the financial system can be an integral part of even narrow interpretations of their self-declared and widely understood policy objectives. Not only do they have the legitimacy to work on this matter, but one might also say that not helping green the financial system may actually constitute a dereliction of duty on their part. Once one accepts this in principle, the challenge becomes more practical. What specific policy measures should financial policy-makers undertake within their remit that can help green the financial system? That is the question this section seeks to address. The measures discussed fit into several categories and can often be justified under multiple objectives.

4.1 DISCLOSE OF CARBON EXPOSURE

Lack of information and understanding about the carbon intensity of various businesses and financial portfolios is a basic constraint on the greening of the financial system (Dupré & Chenet, 2012). It is hard to draft policy measures on something if the basic information is missing. It is a chicken and egg situation, where the financial market largely appears to discount the possibility of policy action against climate change, so it does not consider information on carbon exposures as important. Regulatory intervention to correct this conundrum can be justified under a number of objectives.

As part of their mandate to make markets more efficient and transparent, as well as to reduce information asymmetries and to correct market failures, there is a strong case for authorities to intervene to increase disclosure of exposure to carbon. In order to do that, regulators have a number of tools at their disposal. The mandatory disclosure of the carbon exposure of all listed firms, both financial and non-financial corporate ones, is a good starting point. This disclosure would include not just utilities, manufacturing firms and others from the real economy, but would also cover most large banks and insurance firms. This action would be in line with measures taken recently by the Securities Exchange Commission (SEC) in the United States (SEC, 2010). The disclosure by non-financial firms would need to be in place for financial firms to be accurately able to report on how exposed their portfolios are.

Importantly, this same mechanism can be used to introduce requirements to report on other sources of environmental exposure such as dependence on scarce water or contribution to pollution against which policy action is likely. A related measure that would apply to fund and asset managers such as pension funds would be to report the carbon emissions that are implicit in their portfolio of investments and can be justified under similar objectives for disclosure, fairness and reduction of information asymmetries.

While measuring the degree of carbon emissions implicit in a company's business or a financial company's portfolio is a necessary first step, it may not necessarily result in greener behaviour, as long as financial markets continue to discount the likelihood of policy action.

4.2 INCREASE THE PERCEIVED RISKINESS OF CARBON EXPOSURE

This action is justified, if financial policy-makers believe that financial firms are failing to properly account for a real and material source of risk. If that is the case, then action can be justified under objectives such as investor protection, ensuring the integrity of the financial system and ensuring the safety and soundness of firms.

Perhaps the best way to do this would be, once carbon disclosure rules are in place, to force financial firms to perform stress tests on how their balance sheets would perform under different scenarios of the evolution of a carbon price. The same approach can be applied more widely to water stress as well as policy action against pollutants. These stress tests could be internal, so that regulators can check that financial firms such as banks will stay solvent under unlikely but plausible scenarios, say, of the carbon price rising to EUR 30 or EUR 50 per tonne. For long-term investors, scenarios that stretch further out in time and use even higher prices for carbon emissions can be applied.

Such an approach is now widely accepted for other sources of financial risk, such as macroeconomic slowdowns, as well as sharp falls in stock markets and real estate prices. Often the scenarios used are plausible, but unlikely. This means that a realistic interpretation of the state of the climate debate—that robust policy action is unlikely in the near term but still possible—already provides enough of a "burden of proof" to legitimately use the stress test methodology. Another strong case for regulatory intervention also arises because most risk management methodologies, such as "Value at Risk" and credit ratings used in the financial sector, are backward looking in that they are incapable of recognizing future risks unless they fit historical patterns (Kapoor, 2010).

In the European Union, for example, the European Banking Authority (EBA, 2014) performs regular stress tests to monitor the risks and vulnerabilities of the banking system:

> One of the responsibilities of the European Banking Authority (EBA) is to ensure the orderly functioning and integrity of financial markets and the stability of the financial system in the EU. To this end, the EBA is mandated to monitor and assess market developments as well as to identify trends, potential risks and vulnerabilities stemming from the micro-prudential level. One of the primary supervisory tools to conduct such an analysis is the EU-wide stress test exercise.

In case stress tests are not disclosed, the regulator simply requires companies to demonstrate that they will be financially sound even if such a policy action occurs. If that turns out not to be the case for particular firms, the regulator can oblige them to either: 1) raise more capital, particularly in the case of banks; 2) reduce exposure to carbon and other environmental risks to more acceptable levels; or 3) undertake a combination of both.

In our opinion, the introduction of carbon stress tests for all financial firms, be it banks, funds or insurance firms, would be far more effective if they were forced to publicly disclose the results of these stress tests. The excellent work done on stranded assets in Europe (Carbon Tracker & London School of Economics' Grantham Research Institute, LSE, 2013; Caldecott & McDaniels, 2014) that highlights the potential for financial losses related to policy action against climate change points the way; however, financial policy-makers have not yet gotten involved.

This would not only fit in neatly with the regulatory objectives of more transparency and reducing information asymmetries, but also additional ones of increasing competition and correcting market failures. It is expected that the public reporting of the results of carbon and environmental stress tests

would significantly improve how effectively such risks are factored into decision making within financial markets, and thus contribute to greening the financial system.

4.3 TACKLE SYSTEMIC RISK

Talk to most investment funds, insurers and banks about the possibility of large losses on their exposure to fossil fuel/carbon-intensive sectors, and they are confident that they will be able to reduce this exposure when a rise in the price of carbon or restrictions on the quantity of emissions becomes imminent. Individually, assuming no other financial actor was trying to do the same at the same time, this makes sense—but collectively, this is delusional.

This is too close for comfort to Citigroup CEO Chuck Prince's now immortalized line on the eve of the financial crisis: "As long as the music is playing, you've got to get up and dance. We're still dancing" (Nakamoto & Wighton 2007). When Citigroup had to be bailed out, Prince was talking about risks that he recognized, but felt compelled to take as long as the competition was taking them too. He also felt confident that when problems arose, Citigroup would be able to sell out of risky positions, which was also what every other bank was thinking.

We are at a similar point with carbon risks. That is why looking at the soundness of each financial institution as a standalone entity, as the stress tests discussed in the previous section do, is simply not good enough. As the likelihood of policy action to tackle climate change nears, it will have consequences for how financial institutions behave and what they do. Anticipating the rise in carbon price, institutions will all rush for the exit to reduce their exposure to carbon-intensive assets.

This is exactly what happened in the ongoing financial crisis, when, as soon as problems in the real estate sector became apparent, there was a rush for the exit as banks and investors alike sought to reduce their exposure to assets they knew were likely to fall in value. This exacerbated the fall in price, which further increased the incentive to sell quickly before the price fell even further. This "fire sale externality" is often an integral part of systemic financial risk—the risk of system-wide large-scale losses in the financial system (Brunnermeier et al., 2009).

A second important element of systemic risk is that interconnectedness in the financial system increases such risk. One mechanism for the propagation of such risk is that once a loss becomes likely at Financial Institution A, its counterparties, for example in the interbank market, seek to reduce their exposure to it by withdrawing lines of credit and stopping trade with the institution. This further weakens its market position and, given that it is often highly interconnected to other financial institutions too, this reduction in exposure imposes a negative externality on the other counterparties of Financial Institution A. This is another mechanism for the amplification of losses and overshooting in the financial system that makes the system as a whole vulnerable.

As discussed earlier in this paper, the role of financial regulators and central bankers is not just to ensure that each institution is making sensible choices in recognizing and dealing with risks, but even more so that that the financial system as a whole adequately recognizes and deals with risks.

Systemic risk is more an inherent characteristic of the financial system, rather than a risk flowing from a single source. Moreover, large, widespread and sudden losses can trigger the downward spiral of the sell-offs discussed above. So the question of whether carbon is a potential source of systemic risk hinges on whether the risk of losses 1) is large, 2) is widespread and 3) could crystallize suddenly. A reason that housing is unanimously considered to be a trigger for systemic risk is that, typically: it constitutes a very large proportion of bank lending portfolios (large); most financial institutions are exposed to mortgage

assets (widespread); and house prices can fall suddenly in response to external shocks like an unexpected recession.

In our understanding, carbon risk meets many of the same criteria, and the question of whether it poses a systemic threat to the stability of the financial system or not is a matter of judgment. A recent study (Weyzig, Kuepper, van Gelder, & van Tilburg, 2014) on the European financial system, for example, concludes that the risk from policy action on emissions is not yet systemic for the European financial system, but this is not a universally held view.

Given how large utility firms, as well as oil and gas majors, are, the exposure of the financial system to such firms is definitely large—though not as large as that to the housing markets. It is also more widespread, as the exposure is not just directly limited to banks as with real estate markets, but also to pension funds, insurance firms, retail shareholders and other asset managers. The possibility of a sudden manifestation of risk is also highly likely, as any international deal is likely to be only fully credible once announced—a point-in-time event that could lead to global market upheaval and sell-offs of carbon-intensive assets.

The judgment on whether this constitutes a potential source of systemic risk for China depends, first of all, on the measurement of the size and scope of carbon exposure in the Chinese financial system. That is why the carbon stress tests of the previous section are so important.

Measuring such exposure would achieve multiple objectives. First, it would increase the awareness of carbon risks among bank and fund management. This should automatically lead to some reduction in such exposures. Second, disclosing carbon exposures would allow bank shareholders and asset owners, who ultimately own investment funds, to compare them against others and put pressure on management to reduce excessive exposures to sunset industries in favour of safer assets. Third, it would reveal the extent of system-wide risk exposure to regulators, allowing them to take corrective measures on the macro-prudential front too.

These actions are not only justifiable under the "financial stability" and "tackling systemic risk" mandates of financial policy-makers, including central banks, but also not undertaking them may actually constitute a dereliction of duty. Macro-prudential measures such as imposing additional capital buffers for carbon exposures, introducing hard limits on how much exposure each firm can have or introducing higher risk weights for such exposures are all part of the toolkit regulators can use.

Such regulatory actions recognizing carbon as a source of systemic risk should also change the relative cost of dirty versus clean investments by making the financing of carbon-intensive activities and industries more expensive, and it ought to provide a significant boost to the funding of the green transition.

4.4 OTHER MEASURES

The earlier discussion in this section was kept relatively narrow to address a small but important set of policy measures that financial policy-makers in China and elsewhere need to implement as a matter of urgency. Importantly, they are targeted at a more accurate reflection and mitigation of the risks arising from the carbon-intensive investment bias of the financial system. Many other sets of reforms are both possible and necessary in order to better green the financial system, as partially correcting for the lack of proper carbon risk assessment will simply not have an impact that is large enough to help us effectively mitigate climate change. Transitioning to a low-carbon society will require a very large amount of economic resources to be invested in "green" sectors (Ceres, 2014; IEA, 2012; World Economic Forum, 2013), so we will need to go further than these narrow measures.

These measures can largely be divided into two main categories. The first is the set of reforms that better align the functioning of the financial system with the needs of the real economy. These include measures that tackle short-termism, measures directed at making the system simpler and more transparent, and steps that provide for a better measurement of risk and make the financial system less vulnerable to pro-cyclical swings. They are not specific to the environment or to tackling climate change and are comprehensively treated in publications by Kapoor (2010, 2012).

The second category of measures includes those that positively discriminate in favour of green investments. These can encompass a range of policy options such as special discounted loans to the sector, lower risk weights, lower capital requirements, better treatment of collateral, lower reserves, mandatory lending quotas and so on. The question this raises is whether these "interventionist" policies can be justified within the existing objectives and mandates of financial policy-makers, or whether an expansion of their powers may be necessary. The mainstream thinking on this is that for emerging-market central banks and regulators, such as those in India and China, these measures are easier to enact than for policy-makers in OECD economies (Campiglio, 2014). The very broad nature of explicit mandates given to central banks in emerging economies is clear from the Appendix. There is an element of truth in this mainstream thinking, but this is often used to justify green inaction by financial policy-makers in OECD economies and to criticize the more interventionist stance of their counterparts in the emerging world. We believe that this view needs to be challenged.

The European Central Bank, often thought to have a relatively narrow mandate, has introduced a Targeted Long Term Refinancing Operation (TLTRO) and will seek to reward banks with discounted loans for additional lending into the real economy, particularly to small and medium-sized enterprises (SMEs) (European Central Bank, 2014a, 2014b). The European Union also applies a zero-risk weight for its member sovereigns, even though some, such as Greece, have actually defaulted. The Bank of England has now been pursuing a Funding for Lending program that also rewards banks for increasing lending to SMEs (Bank of England, 2012, 2014b). The U.S. Federal Reserve Bank has long followed the Community Reinvestment Act (Federal Reserve Bank, 2014) that judges banks on the basis of the strength of their operations in poor parts of the community and rewards those who have a bigger operations. The Bank of Japan has long had a reputation for pursuing "unconventional" policies. In short, all of the biggest OECD country central banks have been pursuing "interventionist" policies of some kind or the other. The Reserve Bank of India sets targets for lending to preferential sectors (RBI, 2014) as well as into rural areas, and many other governments in the emerging world use their central banks proactively to pursue broader economic development goals. The BNDES in Brazil, the Green Investment Bank in the United Kingdom and KfW, Germany's publicly owned development bank, all do policy-based lending, as does the European Investment Bank that is owned by the European Union. Freddie Mac and Fannie Mae are among the world's largest de-facto public sector financial institutions dedicated to the promotion of home ownership in the United States.

The idea that financial policy-makers in the OECD only pursue hands-off policies that do not take on broader public-policy goals is simply not borne out by evidence. If space can be found within existing mandates to have programs and regulations that favour economic actors such as SMEs or sectors of the economy such as housing, there is absolutely no reason to believe that the same positive discrimination cannot be extended to the greening of the financial sector. In fact, an increasing number of financial policy-makers around the world have already embarked on this path, and we expect a broadening and deepening of such positive discrimination for the green economy to take hold in financial supervision, regulation and central banking all over the world. The faster this happens, the higher the likelihood the world will be able to successfully mitigate climate change.

Among others, the Central Bank in Bangladesh and the Brazilian banking association (Febraban) in Brazil have already taken steps towards an attempt to implement a common sustainability agenda for the financial sector. In Bangladesh, the Environmental Risk Management Guidelines encourage banks

and financial institutions to integrate Environmental Risk Management policies into existing Credit Risk Management procedures (Bangladesh Bank, 2011). These guidelines thus make it mandatory for banks to address environmental and social issues in their lending processes, develop internal frameworks, introduce sector-specific policies, train staff and start reporting on environmental and social issues (United Nations Environment Programme Finance Initiative, 2011). In Brazil, similarly, commitments made under the Green Protocol include the promotion of green/social financing, internal environmental management and awareness raising (Febraban, 2011). Indonesia has set out an ambitious plan for a green transformation of the economy. The central bank is looking into how it could help make green finance work in Indonesia (Volz et al., forthcoming). China's green credit guidelines also show China's commitment to do more on greening its own financial system (Zadek & Chenghui, 2014).

5 CONCLUSION

The world is fighting a losing battle against climate change, and the lack of a comprehensive global deal on tackling climate change is glaring. Nevertheless, an increasing number of local, national and regional initiatives are now underway to put a price on carbon, encourage energy efficiency or catalyze green investments. However, it is clear a green transformation cannot happen without large-scale investments in the green economy and without stopping the ongoing investments in the dirty economy that continue to lock in future GHG emissions.

We have run out of time to wait for a more coordinated global response, and, no matter how robust the deal in Paris next year is, it is unlikely to be enough to limit global warming to within reasonable limits on its own.

The financial system is directly and indirectly (through price signals and incentives for businesses) responsible for where investments are made. As discussed in detail in this paper, the system is heavily biased against the green economy and in favour of fossil fuel and energy-intensive investments. This bias is demonstrated by the much greater amount of money that still flows into the dirty economy when compared to what is invested into renewable energy and efficiency measures. This bias is widely known and acknowledged, but to date not much has been done to address it. Instead, it is further exacerbated by the huge subsidies provided for fossil fuels.

One of the reasons for inaction on the part of financial policy-makers is that the worlds of financial and economic policy-making and those involved in policy discussions on climate mitigation seldom intersect; however, this is starting to change very slowly. Central bankers, financial regulators and supervisors widely hold the view that tackling climate does not fall within their mandates. That is why we spend so much time in this paper showing that this view is, at best, unjustified and, at worst, outright irresponsible. We have also shown that, in a number of instances, a failure to enact policy measures to green the financial system may actually amount to a dereliction of duty on behalf of central bankers and regulators.

Towards this end, we have proposed a set of three complementary policies on carbon disclosure, stress tests and checking if carbon risk is potentially systemic, which is the minimum framework that financial policy-makers all over the world, including China, should adopt as a matter of urgency. However, this is likely to be far from sufficient, and more activist "interventionist" policies that positively discriminate in favour of the green economy would also be necessary. The paper gives some examples of what these might be.

In order to get policy-makers to treat these second sets of policies with the same level of seriousness as the first set, we have also challenged the view that it is only financial policy-makers in the emerging world that are "interventionist," and that OECD country policy-makers are entirely "hands-off." There are many examples of interventionist, policy-directed regulation, supervision and preferential treatment in both sets of countries with the Eurozone, the Bank of England and the U.S. Federal Reserve Bank all having recently enacted significant "sectoral" policies that discriminate in favour of a particular part of the economy. It is as legitimate for financial policy-makers to enact policies that favour the green economy, as it is for them to target the housing sector, SME lending or sovereign bonds.

REFERENCES

Allianz Group & WWF. (2005). *Climate change & the financial sector: An agenda for action*. Retrieved from http://www.wwf.org.uk/filelibrary/pdf/allianz_rep_0605.pdf

Asian Development Bank. (2014). *Assessing the costs of climate change and adaptation in South Asia*. Mandaluyong City, Philippines: Asian Development Bank. Retrieved from http://www.adb.org/sites/default/files/pub/2014/assessing-costs-climate-change-and-adaptation-south-asia.pdf

Bangladesh Bank. (2011). *Environmental Risk Management (ERM) guidelines for banks and financial institutions in Bangladesh*. Retrieved from http://www.bangladesh-bank.org/openpdf.php

Bank of England, (2012). The Funding for Lending Scheme. *Quarterly Bulletin Q4*. Retrieved from http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/qb120401.pdf

Bank of England. (2014a). *Prudential Regulation Authority*. Retrieved from http://www.bankofengland.co.uk/pra/pages/default.aspx

Bank of England. (2014b). *Funding for Lending Scheme*. Retrieved from http://www.bankofengland.co.uk/markets/Pages/FLS/default.aspx

Benjamin, A. (2007). Stern: Climate change a 'market failure.' *The Guardian*. Retrieved from http://www.theguardian.com/environment/2007/nov/29/climatechange.carbonemissions

BIS (2009). *Roles and objectives of modern central banks.* Retrieved from http://www.bis.org/publ/othp04_2.pdf

BNEF (2014). *Global trends in clean energy investment: Q4 2013 fact pack*. Retrieved from http://about.bnef.com/fact-packs/

Brunnermeier, M. et al. (2009). *The fundamental principles of financial regulation: Preliminary conference draft: Nature of systemic risk*. International Center for Monetary and Banking Studies & Centre for Economic Policy Research. Retrieved from http://www.econ.tcu.edu/quinn/crisis/Deleveraging/Nature%20of%20Systemic%20Risk.pdf

Caldecott, B. & McDaniels, J. (2014). *Stranded generation assets: Implications for European capacity mechanisms, energy markets and climate policy*. Working Paper. Retrieved from http://www.businessgreen.com/digital_assets/7445/Stranded_Generation_Assets_-_Working_Paper_(2).pdf

Campiglio, E. (2014). *Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy*. Centre for Climate Change Economics and Policy Working Paper No. 181. Retrieved from http://www.cccep.ac.uk/Publications/Working-papers/Papers/180-189/WP181-Beyond-carbon-pricing.pdf

Carbon Disclosure Project. (2013). *Use of internal carbon price by companies as incentive and strategic planning tool.* London: CDP. Retrieved from https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf

Carbon Tracker Initiative (n.d.). *Stranded assets*. Retrieved from http://www.carbontracker.org/stranded-assets

Carbon Tracker & the London School of Economics' Grantham Research Institute, LSE. (2013). *Unburnable carbon: Wasted capital and stranded assets.* Retrieved from http://carbontracker.live.kiln.it/Unburnable-Carbon-2-Web-Version.pdf

Ceres. (2013). *Insurer climate risk disclosure survey: 2012 findings & recommendations*. Retrieved from http://www.ceres.org/resources/reports/naic-report/

Ceres. (2014). *Investing in the clean trillion: Closing the clean energy investment gap*. Boston: Ceres.

Di Giorgio, G., Di Noia, C. & Piatti, L. (2000). *Financial market regulation: The case of Italy and a proposal for the Euro Area.* Financial Institutions Center, The Wharton School. Retrieved from http://fic.wharton.upenn.edu/fic/papers/00/0024.pdf

Dupré, S. & Chenet, H. (2012). *Connecting the dots between climate goals, portfolio allocation and financial regulation.* Retrieved from http://dx.doi.org/10.2139/ssrn.2223008

Energy Information Administration. (2014). *India is increasingly dependent on imported fossil fuels as demand continues to rise*. Retrieved from http://www.eia.gov/todayinenergy/detail.cfm?id=17551

European Banking Authority. (2014). *EU-wide stress testing: EBA's role in stress-testing*. Retrieved from http://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing

European Banking Authority. (2014a). *ECB announces further details of the targeted longer-term refinancing operations*. Press release. Retrieved from https://www.ecb.europa.eu/press/pr/date/2014/html/pr140703_2.en.html

European Central Bank. (2014b). *ECB announces monetary policy measures to enhance the functioning of the monetary policy transmission mechanism*. Press Release. Retrieved from https://www.ecb.europa.eu/press/pr/date/2014/html/pr140605_2.en.html

Financial Conduct Authority. (2014). What we do. Retrieved from http://www.fca.org.uk/about/what/regulating

Febraban. (2011). *Ferbraban Apresenta Matriz de Indicadores de Protocolo Verde*. Retrieved from http://www.febraban.org.br/Noticias1.asp?id_texto=1203

Federal Reserve Bank. (2014). Community Reinvestment Act. Retrieved from http://www.federalreserve.gov/communitydev/cra_about.htm

Financial Stability Board. (2010). *Objectives and principles of securities regulation*. Retrieved from http://www.financialstabilityboard.org/cos/cos_100601.htm

Gassert, F., Reig, P., Luo, T., & Maddocks, A. (2013). *Aqueduct country and river basin rankings: A weighted aggregation of spatially distinct hydrological indicators*. Working Paper, World Resources Institute. Retrieved from http://www.wri.org/sites/default/files/aqueduct_coutnry_rankings_010914.pdf

Generation Foundation. (2013). *Stranded carbon assets: Why and how carbon risks should be incorporated in investment analysis.* Retrieved from http://genfound.org/media/pdf-generation-foundation-stranded-carbon-assets-v1.pdf

Gurria, A. (2013). *The climate challenge: Achieving zero emissions*. Lecture presented in London, October 2013. Retrieved from http://www.oecd.org/env/the-climate-challenge-achieving-zero-emissions.htm

House of Commons (2014). *Green finance: Twelfth report of session 2013-14, Vol I.* House of Commons Environmental Audit Committee. Retrieved from http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenvaud/191/191.pdf

Howard, P. (2014). *Omitted damages: What's missing from the social cost of carbon*. Retrieved from http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf

Intergovernmental Panel on Climate Change. (2013). *Climate change 2013: The physical science basis*. Retrieved from http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf

International Energy Agency. (2012). *Energy technology perspectives 2012*. Paris: International Energy Agency.

International Energy Agency. (2013). *Redrawing the energy-climate map: World energy outlook special report*. Retrieved from http://www.iea.org/publications/freepublications/publication/WEO_Special_Report_2013_Redrawing_the_Energy_Climate_Map.pdf

Kapoor, S. (2010). *The crisis: Causes & cures*. Retrieved online from: http://re-define.org/sites/default/files/Re-Define%20Book%20The%20Financial%20Crisis%20-%20Causes%20and%20Cures%20by%20Sony%20Kapoor(1).pdf

Kapoor, S. (2012). *Finance for the real economy*. Project FIRE.

Killalea, D. (2014). Beijing to close coal-burning power stations to clean up air pollution. Retrieved from http://www.news.com.au/technology/environment/beijing-to-close-coalburning-power-stations-to-clean-up-air-pollution/story-e6frflp0-1227014059863

Kim, J. (2014). *World Bank Group President Jim Yong Kim remarks at Davos Press Conference*. Retrieved from http://www.worldbank.org/en/news/speech/2014/01/23/world-bank-group-president-jim-yong-kim-remarks-at-davos-press-conference

Lagarde, C. (2012). *Back to Rio: The road to a sustainable economic future*. Speech in Washington, D.C., June 12, 2012. Retrieved from https://www.imf.org/external/np/speeches/2012/061212.htm

McKinsey & Company. (2009). *Pathways to a low-carbon economy: Version 2 of the global greenhouse gas abatement cost curve.* Retrieved from http://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/sustainability/cost%20curve%20pdfs/pathways_lowcarbon_economy_version2.ashx

Nakamoto, M. & Wighton, D. (2007). Citigroup chief stays bullish on buy-outs. *Financial Times*. Retrieved from http://www.ft.com/intl/cms/s/0/80e2987a-2e50-11dc-821c-0000779fd2ac.html?siteedition=intl#axzz3BJBxXQaS

Organisation for Economic Co-operation and Development. (2013). *Pricing carbon: Policy perspectives*. Retrieved from http://www.oecd.org/env/tools-evaluation/Policy%20Perspectives%20PRICING%20CARBON%20web.pdf

People's Bank of China. (2014). About PBC. Retrieved from http://www.pbc.gov.cn:8080/publish/english/952/index.html

Peterson, T. C., Hoerling, M. P., Stott, P. A. & Herring, S. (Eds.) (2013). Explaining extreme events of 2012 from a climate perspective. *Bulletin of the American Meteorological Society, 94* (9), S1–S74.

Reserve Bank of India. (2014). *Brochure: About us.* Retrieved from http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/RBIB140520012.pdf

Re-Define (2011). *Funding the green new deal: Building a green financial system: A policy maker report from Re-Define.* Retrieved from http://re-define.org/sites/default/files/GEF-Funding%20the%20GND%20web.pdf

Rostoum, E. (2014). China reaches the equivalent of peak U.S. energy imports dependence. Retrieved from http://foreignpolicyblogs.com/2014/07/14/china-reaches-the-equivalent-of-peak-u-s-energy-imports-dependence/

Securities and Exchange Commission. (2010). *SEC issues interpretive guidance on disclosure related to business or legal developments regarding climate change*. Press Release. Retrieved from http://www.sec.gov/news/press/2010/2010-15.htm

Spencer, T. & Stevenson, J. (2013). *EU low-carbon investment and new financial sector regulation: What impacts and what policy response?* Working Paper 05/13; Paris: IDDRI. Retrieved from http://www.iddri.org/Publications/Collections/Idees-pour-le-debat/WP0513_TS%20JS_financial%20regulation.pdf

Stern, N. (2006). *Stern Review: The economics of climate change*. Retrieved from http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/sternreview_report_complete.pdf

United Nations Environment Programme Finance Initiative (2011). *UNEP FI guide to banking & sustainability*. Retrieved from http://www.unepfi.org/fileadmin/documents/guide_banking_statements.pdf

United Nations Industrial Development Organization & Agence Française de Développement. (2013). *Green growth: From labour to resource productivity.* Retrieved from https://www.unido.org/fileadmin/user_media_upgrade/Media_center/2013/GREENBOOK.pdf

Unilever (2014). Unilever CEO calls for decisive action to tackle climate change. Retrieved from http://www.unilever.com/mediacentre/pressreleases/2014/UnileverCEOcallsfordecisiveactiontotackleclimatechange.aspx

Volz, U. et al. (forthcoming). *Financing the green transformation: How to make green finance work in Indonesia.* Houndmills, Basingstoke: Palgrave Macmillan.

Warner, M. (2013). Exxon to invest $190B over next 5 years on new resource opportunities. *Wall Street Journal*. Retrieved from http://online.wsj.com/article/BT-CO-20130306-707397.html

Wells, K. (2012). Big oil's big in biofuels. *BusinessWeek: Global economics*. Retrieved from http://www.businessweek.com/articles/2012-05-10/big-oils-big-in-biofuels

Weyzig, F., Kuepper, B., van Gelder, J. W., & van Tilburg, R. (2014). *The price of doing too little too late: The impact of the carbon bubble on the EU financial system*. Green New Deal Series 11. Green European Foundation. Retrieved from http://reinhardbuetikofer.eu/wp-content/uploads/2014/03/GND-Carbon-Bubble-web1.pdf

World Bank (2014). *Climate Smart Development.* Retrieved from http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/06/20/000456286_20140620100846/Rendered/PDF/889080WP0v10RE0SmartoDevelopmentoMa.pdf

World Economic Forum. (2013). *The green investment report*. Geneva: World Economic Forum. Retrieved from http://www3.weforum.org/docs/WEF_GreenInvestment_Report_2013.pdf

World Meteorological Organization. (2013). *The global climate 2001–2010: A decade of climate extremes.* Summary report. Retrieved from http://library.wmo.int/pmb_ged/wmo_1119_en.pdf

Yu, G. & Elsworth, R. (2012). *Turning the tanker: China's changing economic imperatives and its tentative look to emissions trading.* Sandbag. Retrieved from http://www.sandbag.org.uk/site_media/pdfs/reports/Sandbag_Turning_the_Tanker_Final.pdf

Zadek, S. & Chenghui, Z. (2014). *Greening China's financial system: An initial exploration*. IISD. Retrieved from http://www.zadek.net/wp-content/uploads/2014/01/IISD_GCFS-LR-FIN.pdf

APPENDIX A: OBJECTIVES OF THE PEOPLE'S BANK OF CHINA

1. Drafting and enforcing relevant laws, rules and regulations that are related to fulfilling its functions
2. Formulating and implementing monetary policy in accordance with law
3. Issuing the renminbi and administering its circulation
4. Regulating financial markets, including the interbank lending market, the interbank bond market, foreign exchange market and gold market
5. Preventing and mitigating systemic financial risks to safeguard financial stability
6. Maintaining the renminbi exchange rate at adaptive and equilibrium level; holding and managing the state foreign exchange and gold reserves
7. Managing the State treasury as fiscal agent
8. Making payment and settlement rules in collaboration with relevant departments and ensuring normal operation of the payment and settlement systems
9. Providing guidance to anti-money laundering work in the financial sector and monitoring money-laundering-related suspicious fund movement
10. Developing a statistics system for the financial industry and responsible for the consolidation of financial statistics as well as the conduct of economic analysis and forecast
11. Administering a credit-reporting industry in China and promoting the building up of a credit information system
12. Participating in international financial activities at the capacity of the central bank
13. Engaging in financial business operations in line with relevant rules
14. Performing other functions prescribed by the State Council

Source: People's Bank of China (2014)

APPENDIX B: FUNCTIONS OF THE RESERVE BANK OF INDIA

Monetary authority:

Formulates, implements and monitors the monetary policy.

Objective: maintain price stability and ensure adequate flow of credit to productive sectors.

Regulator and supervisor of the financial system:

Prescribes broad parameters of banking operations within which the country's banking and financial system functions.

Objective: maintain public confidence in the system, protect depositors' interest and provide cost-effective banking services to the public.

Manager of foreign exchange

Manages the Foreign Exchange Management Act, 1999.

Objective: facilitate external trade and payment and promote orderly development and maintenance of the foreign exchange market in India.

Issuer of currency:

Issues and exchanges or destroys currency and coins not fit for circulation.

Objective: give the public adequate quantity of supplies of currency notes and coins and in good quality.

Developmental role:

Performs a wide range of promotional functions to support national objectives.

Related Functions

Banker to the government:

Performs merchant banking function for the central and the state governments; also acts as their banker.

Banker to banks:

Maintains banking accounts of all scheduled banks.

Source: Reserve Bank of India (2014)