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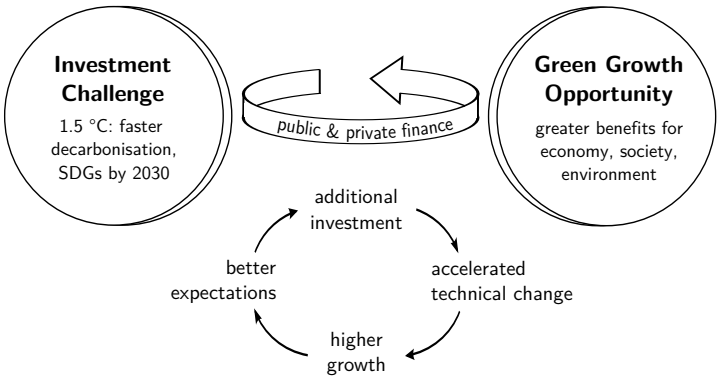
Framing 1.5°C – Turning an investment challenge into a green growth opportunity

Sarah Wolf[α*] · **Carlo Jaeger**[β] · **Jahel Mielke**[γ] · **Franziska Schütze**[δ] · **Richard Rosen**[ε]

Two sides of the same coin



[α*] S. Wolf
Global Climate Forum, E-mail: sarah.wolf@globalclimateforum.org

[β] C. Jaeger
Global Climate Forum and Arizona State University

[γ] J. Mielke
Global Climate Forum and Potsdam University

[δ] F. Schütze
Global Climate Forum and Potsdam University

[ε] R. Rosen
Tellus Institute (retired)

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Abstract In 2018, the Intergovernmental Panel on Climate Change (IPCC) will produce a special report on the impacts of average global warming of 1.5°C above pre-industrial levels and related global greenhouse gas (GHG) emission pathways. A strengthening of the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty set the context for this report. This paper differs from the classical perspective on climate policy, which focuses on the net costs of mitigation efforts for society. Instead, it proposes a win-win framing: The 1.5°C scenario should be seen as an opportunity for the world to achieve a Great Transition to green growth. Since the latter combines ecological, economic and social aspects of development, it is closely linked to and shows synergies with the idea of sustainable development as described by the Sustainable Development Goals. With this article, the authors outline the investment needs of such a scenario and the mechanisms that can turn this challenge into a green growth opportunity, e.g. technical progress and a re-coordination of expectations. Furthermore, the article discusses investment sources for the fundamentally needed energy and SDG transition. Since interest rates are low and investment remains below pre-crisis levels, there is room for a substantial increase in investment for the Great Transition without necessarily crowding-out other types of investment.

Keywords 1.5° · Green Growth · Investment · Framing

1 Introduction

In 2015, at COP21 in Paris, it was agreed to "keep global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius". In parallel, the UN adopted the 2030 Agenda for Sustainable Development, with its 17 Sustainable Development Goals (SDGs), that address poverty eradication and climate change, among other issues. These SDGs open a perspective for green growth, which we interpret as combining ecological, economic and social aspects of development (e.g. OECD 2011). However, the green growth concept has, in the past, been criticised for being synonymous with consumerism (Confino 2012), or as failing to appropriately conceptualise social welfare (Jakob and Edenhofer 2014). There have also been discussions on "degrowth" (e.g. Kallis et al 2012), "post-growth" (e.g. Hardt and O'Neill 2017), as well as "a-growth" – an approach that disregards GDP growth as an overall measure of progress (Van den Bergh 2017). However, along the lines of the argument by Hepburn and Bowen (2012), who state that continued economic growth is feasible and desirable if the understanding of growth significantly changes in its characteristics by transitioning from material output towards an "intellectual economy", we use the term "green growth" in the spirit of a win-win opportunity between environmental and human well-being in both economic and social terms. GDP growth seems to be a necessary, albeit far from sufficient, condition for increasing well-being (no poverty, zero

This is a slightly amended version of GCF Working Paper 2/2017.

hunger, quality education, etc. – as formulated by the SDGs), at least in the medium term. One could, therefore, interpret green growth as a means to an end, namely 'green well-being'. Nevertheless, since this is not a common term, we will use the concept of green growth here.

That said, since the IPCC special report aims to place humanity's response to the threat of climate change in the context of sustainable development and poverty eradication, a green growth focus seems highly appropriate, especially in developing countries. It entails the idea that limiting the global average temperature increase to 1.5°C can also help the world to achieve the SDGs. On this basis, this paper proposes a complement to the special report. It is organized as follows: Section 2 discusses investment needs for reaching the 1.5°C target and for achieving the SDGs. Section 3 argues that the huge magnitude of green investments needed would lead to a Great Transition towards green growth. The section explains basic economic mechanisms that lead to green growth and relates them to the world's ability to implement the SDGs. Section 4 discusses how such investments can be provided, and Section 5 concludes.

2 The investment challenge

Shifting the political climate target to well below a 2°C temperature increase, and especially to a 1.5°C increase, is mainly a question of the time horizon. Combining this change in time horizon with a discussion of the investment needs for decarbonising the economy should play an important part in reframing the policy debate.

2.1 Comparing 1.5 with 2°C

Whether aiming at no more than 1.5 or 2.0 degrees above pre-industrial global temperature levels, the remaining "safe" emissions budget for GHGs should inform the primary emissions scenario to be followed by the world.[1] This might include the assumption that no temperature overshoot[2] will take place, since many of the physical, chemical, ecological, social, and psychological impacts of overshoot may not be reversible, even in the long run.[3] In both temperature scenarios, the economy, and in particular the energy sector, will need to become essentially GHG emissions free fairly soon.

A major difference between the time horizons for the 1.5 and the 2°C limits is nicely illustrated by Carbon Brief (2017): with a 50% (66%) chance of staying below 1.5°C warming and at the current rate of emissions, the remaining carbon budget would be used up in only 7.8 (4.1) years, versus 26.6 (19.1) years for a 50% (66%) chance of staying below 2°C.[4] A "back-of-the-envelope" type of calculation that assumes a linear decrease in emissions, for reasons of simplicity, implies that emissions have to fall to zero in twice the time that would remain at current emission levels. This corresponds to 15.6 (8.1) years, meaning 2032 (2025), for a 50% (66%) chance to meet the 1.5°C target. For purposes of analysis and policy development in the IPCC's Special Report, the scenario of emissions falling

[1] While carbon budget estimates come with their own uncertainties, they provide a simple and helpful focal point for actions to be taken.

[2] Overshoot means allowing the temperature increase to exceed a target, and then causing it to fall back down to the preferred goal within some reasonable time period (by removing CO_2 from the atmosphere).

[3] In addition, many negative CO_2 emissions technologies require higher amounts of net energy production and investment. Since they currently only exist at small scale, except for re-forestation, it would be difficult to develop, invest in, and install them in significant amounts by 2030. Finally, there may be negative environmental impacts such as localised earthquakes and water pollution. Therefore, the risks and benefits of overshoot scenarios can be evaluated if the designated temperature increase scenario fails.

[4] While IPCC and other reports use the word "probabilities", and we use the word "chances", these numbers merely refer to a distribution derived from the range of outcomes of the various physical climate models. We can not know the actual probabilities of future climate scenarios occurring, unless we consider subjective probabilities, but this goes beyond the scope of this paper.

to roughly zero by 2030 would, therefore, be a useful focal point. A recent perspective by Rockström et al (2016) proposes a pathway in line with the Paris Agreement to keep warming "well below 2°C": namely one which follows a global "carbon law", halving gross anthropogenic CO_2 emissions every decade in all countries and sectors, leading to roughly net-zero-emissions by 2050. This poses a similar focal point for the 2°C case that the 1.5°C scenario can then be contrasted with.

2.2 Advantages of a 2030 timeframe

An advantage of focusing on the shorter timeframe until 2030 is that it reduces uncertainty compared to the AR5 WGIII report, which mostly focused on the entire time period from 2005/2010 through 2100.[5] The 2030 timeframe is also on the active horizon of investors, especially those taking longer-term investment decisions. The introduction of a challenge such as decarbonisation in this shorter timeframe can mobilise capabilities that might not have been available otherwise (Jaeger et al 2011). "Cost-optimal" mitigation scenarios through 2100, which may lead to counterintuitive results (such as emissions being higher in a 1.5°C scenario than in a 2°C scenario until about 2024, see (UNEP 2016, p. xvi)), are much less conducive to mitigation action. Therefore, as a research direction fitting the IPCC's special report, macro-economic analyses of mitigating climate change, with a typical timeframe of about 30 years (until 2050), should be complemented or replaced by analyses focusing on the earlier period from 2020 until 2030. Furthermore, micro-economic analyses will be important when it comes to determining an appropriate mix of new technologies for each major region of the world, and for providing investment guidelines. This technology mix, as well as the financing mix, would depend, in part, on the relative costs of labour versus capital and the decrease in capital costs in each region, the existing policy regime, as well as on factors such as regional weather, climate trends and social and governance aspects.

Also, as the timeframe of the SDGs is 2030, synergies may be reaped by coordinating investments needed for reducing emissions with those needed for achieving many of the SDGs. Potential synergies are outlined in Section 3.2 below.

2.3 Investment needs

The total investment needs for a 1.5°C target are not yet to be found in the literature. The comparison of timeframes above, however, implies that the total capital investment requirements for the transformation to a zero-emissions-economy must be fulfilled within about one decade – rather than in 3 decades for a 2°C scenario. This includes replacing the entire existing fossil fuel energy system, increasing energy efficiency substantially, reducing land-use emissions to roughly zero, and meeting new energy demand growth much more quickly. We explicitly highlight the importance of additional investment needs, e.g. in the electricity distribution and transmission systems, for mass transit and for new transportation technologies such as electric vehicles, which were often ignored in previous IPCC assessments and which go beyond "business-as-usual" levels.

To get a rough idea of the magnitude of the required investments, the World Economic Forum (2013) calculated an annual investment need of $5.7 trillion from 2015 to 2030 to keep global infrastructure in line with a 2°C target, amounting to $85 trillion overall, whereas the New Climate Economy Report (Global Commission on the Economy and Climate 2014) calculated a higher annual investment need of $6.27 trillion ($94 trillion overall) for the same period of time. However, many investments needed for carrying out a comprehensive energy transition, such as investments for additional mass transit and the electrification of all freight train lines, are omitted by the models relied on by such reports.

[5] For a critical review of this type of analysis, see Rosen and Guenther (2016).

As a rough calculation, when averaging over the much shorter time frame until 2030, the rate of investment per year to meet a 1.5°C target would need to be about three times as high (in today's dollars) as the respective rate to meet a 2°C target. Of course, this would depend on how the unit capital costs of the replacement technologies change over time, and on how fast energy demand grows (or shrinks). However, the higher temperature increase allowed in the 2°C scenario implies that in the 1.5°C scenario, investment needs for adaptation to climate change will be somewhat lower.

Given the much higher annual investment requirements of the 1.5°C scenario for the energy sector and related upstream and downstream sectors, other sectors of the global economy may have to, or will, shrink. This will lead to a structural shift in economic activities. However, the total investment pool of the world would not be limited to current global investment levels of about 25 percent of global GDP; rather the envisaged level would need to be several percentage points higher, including both public and private investments. Also, additional capital investments between 2020 and 2030 will be required in order to be able to accomplish all the non-climate change related SDGs. These would include, for example, funding for water and sewage systems, for educational and health institutions, as well as for organic agricultural systems. The additional and redirected investment needs for complying with the 1.5°C scenario, plus SDGs, would, probably, require more than $10 trillion of annual capital investment. The ramp-up-period for implementation would have to occur within about 2-3 years from 2018 on. Effects of these investments are discussed in the following section.

3 The investment opportunity: Green Growth and SDGs

When it comes to analysing the economic impacts of a 1.5°C target, the focus should be on the impact of the additional capital investments needed for a decarbonisation of the global economy, relative to business-as-usual. Also, the associated change in operating and fuel costs of various alternative technologies should be taken into account, as substantial shifts between sectors of the economy would occur.

To date, the effects of policies to mitigate climate change have largely been explored by combining an economic model, including some technological details for the supply side of the energy sector, with a climate system model (together called "integrated assessment model" (IAM)). A paramount assumption in most of these integrated assessment models is that labour and capital resources are employed at "optimal" levels in the reference scenario. Thus, in such models additional investments to further mitigate climate change would never be optimal over a time horizon of a few decades, and would come at a "net cost" to society during this period. "Net cost" typically means that GDP (or a measure of welfare) would be somewhat lower than otherwise. This occurs because mitigation investments are forcibly redirected from other areas of the economy where they would be "optimally" employed (this effect is known as crowding-out). A second result of the optimal use of production factors usually assumed within these models is that involuntary unemployment cannot be represented and hence not addressed.

Furthermore, most of these models consider technological progress as exogenously given. Therefore, higher investment levels do not lead to increased technological progress. Also, financial markets are usually considered an intermediary that allocates resources efficiently in climate economic models. Yet, additional financing needs (for larger capital investments[6]) must be accommodated by financial market actors and financial authorities and, hence, must be represented in the models. Thus, the effect of large additional investments in mitigation, as required for a 1.5°C target, cannot be investigated with this kind of model. A new report by the IPCC chairman, advising the AR6, acknowledges a "pushback" against IAMs due to a "perceived lack of transparency surrounding the assumptions and structure

[6] It is useful to note that low-carbon technologies are, typically, more capital intensive (little or no variable costs during operation) than high-carbon technologies, which use fossil fuels while operating.

of the IAMs underpinning the assessment of global emission pathways" (IPCC Chairman 2017, p. 34). The green growth literature, on the other hand, is rarely model-based (Wolf et al 2016).

3.1 Mechanisms that lead to green growth

The large additional investments of a 1.5°C scenario can have positive impacts on the economy and society via several mechanisms:

- The development of low-carbon and more energy efficient technologies is key for a transition to a low-carbon economy. A considerable increase in investments in low-carbon technologies will increase the production and productivity levels of these sectors. This will spur technical progress through product and process innovation, known as "learning by doing", and through "spillover" effects to upstream and downstream activities. More generally, technical progress will also increase in other sectors where large investments are made, for example for reaching SDGs that are not environmentally focused.
- It can be expected that the large additional investment requirements for the period 2020-2030 in the 1.5°C scenario would cause a significant increase in the absolute number of jobs in all large economic regions of the world relative to a 2°C scenario. To reach the SDGs relating to decent work and reduced inequalities, higher wages and salaries have to be ensured and, therefore, should be complemented by progressive labour market policies. In the EU, the financial crisis has caused investment levels and growth to fall, both of which have remained low in recent years (Baldi et al 2014). Decreasing inequality, as required by many SDGs, can also be achieved by additional investment and economic growth, and is likely to help meet the other non-climate SDGs, such as the elimination of hunger, improvements in education, etc.
- In turn, such actions would raise expectations relative to the current situation of low investment levels, high unemployment, and low economic growth in most economic regions (OECD 2015). Expecting accelerating growth, companies will decide to invest to be able to meet the increasing demands for their products and services, which in turn – and partly as a self-fulfilling prophecy – will lead to growth due to the expansion of the capital goods sector.
- This said, a re-coordination and re-orientation of investments, both in magnitude and between sectors of the economy is needed to shift the world economy to a green growth path (Jaeger et al 2011, 2015). Seriously aiming at the 1.5°C target would be an important signal for investors that could trigger such a change (Mielke 2018 forthcoming). The magnitude of the investments, and the timeframe outlined above, have the clear potential to provide a strong policy signal (Bowen et al 2009). In order to be credible, this signal for private investors also needs to be backed by public investment, which will then lead to further private investment following the logic of "animal spirits".

This last mechanism in particular and the sources of investment will be considered in more detail in Section 4. Recent work (**?**) suggests that, by including these mechanisms in conventional economic models, a more appropriate analysis of a transition towards green growth becomes possible. Identifying green growth opportunities – arising from environment-related investments on the scale described above – can play an important role for the global response to climate change. Win-win opportunities between climate, on the one hand, and the economy and society, on the other, can make emission reductions a strategy of global self-interest. This would strengthen the response to climate change compared to a situation in which this respective response is perceived as being a burden that needs to be shared (Jaeger et al 2012).

3.2 Synergies with achieving the SDGs

Similarly, the following arguments can help strengthen the global response to climate change: If a level of capital investment is pursued worldwide that would enable a 1.5°C scenario to develop, the additional growth in employment and GDP, as well as changes in the composition of GDP, could facilitate the achievement of many other SDGs. This is a very important theme that should be emphasised by the IPCC's special report on 1.5°C. For example, the rapid expansion of decentralised solar and wind electricity supply technologies in developing countries could provide hundreds of millions of people with access to electricity and, thus, help to achieve SDG #7 (affordable and clean energy). It would also prevent a carbon lock-in to older energy supply technologies, and enable developing countries to leapfrog developed countries in the energy sector. To limit the need to expand existing electricity grids, major investments could also be directed to the purchase of energy storage devices such as batteries for shared community use. The expansion of the geographical range of electricity supplies would also help to implement SDG #7 (affordable and clean energy). The increase of investment in industries consistent with sustainable development, should also go along with both the establishment of living wages for employees and extensive job training in order to upgrade the skill levels of new employees in line with SDG #4 (quality education) and SDG #5 (gender equality). Digitalisation constitutes a big opportunity to provide this type of training on a global scale. This could further help to realise SDGs #8 (decent work and economic growth), #9 (industry, innovation and infrastructure) and #11 (sustainable cities and communities). Ceasing the use of fossil fuels for energy services in all industries and implementing efficiency measures would also help to make them more sustainable, as required by SDG #9. The achievement of 100 percent sustainable agriculture throughout the world would likewise support climate change mitigation (SDG #13) and improve life on land (SDG #15) as well as below water (SDG #14). These actions could greatly decrease poverty (SDG #1), help to eliminate hunger (SDG #2) and lead to good health and well-being (SDG #3). There exist many additional synergies between strengthening the global plan for mitigating climate change and achieving all non-climate SDGs by 2030. Of course, in order to enable the green growth scenario described above, these additional investment needs have to be successfully financed. The next section considers how this could be done.

4 Investment sources

The transition required to achieve the 1.5°C target can be called a "Great Transition" or a "Great Transformation". While the investment needs for the scenario identified above may seem huge, they are not historically unheard of in scale: Massive additional investment yielded full employment in the United States during the beginning of World War II (1939-1942)(see Delina 2016). This historical analogy demonstrates that in conditions of significant slack – as presently given – the world economy can be mobilised and changed very quickly if backed by a respective political will. In fact, policies can be very effective in increasing private investment. The introduction of the feed-in-tariff in Germany, which increased investment in renewable energy while decreasing capital costs much faster than expected, provides an example. Since currently interest rates are low and investment remains below pre-crisis levels, there is room for a substantial increase in investment for a Great Transition without necessarily crowding-out other types of investments. However, financial sector regulation better aligned with the 1.5°C pathway and the SDGs is essential. The mix between public and private investment will necessarily vary over time and by region. It will depend partly on the speed of the reduction of unit capital costs of no- and low-carbon technologies, and the policy mix (more market-based or more regulatory policy solutions; as well as the combinations of fiscal, financial and monetary policies) adopted.

4.1 Public investment

The change of the world economy that would be required to achieve a 1.5°C scenario is so significant that market mechanisms alone are not sufficient to realise a phase out of almost all GHG emissions by 2030. Since the capital costs are still relatively high, though falling rapidly, in order to effectively promote some low-carbon technologies (i.e. solar electric), public capital must be invested and used to incentivise large-scale private investment – in some if not all regions. Thus, governments will be required to provide the primary management and investment institutions to spark and implement the necessary transitions, both to achieve the 1.5°C scenario and the other SDGs. This need comes at a time when many governments, in the European Union and elsewhere, reduced their public spending for infrastructure in the wake of austerity measures triggered by the sovereign debt crisis (Revoltella et al 2016; Egler and Frazao 2016). The US government under Trump may increase infrastructure spending, but has at the same time emphasised support for fossil-based industries such as coal, oil, gas, conventional cars, etc., which could result in a carbon lock-in of the US economy. In a 1.5°C scenario, austerity policies would have to exempt many energy system investments, at least the low-carbon ones required to achieve that scenario. To "crowd-in" private investors, governments would need to incentivise and regulate low-carbon infrastructure and technology investments beyond merely establishing high carbon taxes. Public expenditure can also be geared towards a green economy by redirecting existing public investment and greening public procurement processes (UNEP 2011). Existing support schemes like feed-in tariffs and other revenue guarantees, quotas, resource portfolio standards or tax cuts for project investment could be massively scaled up. Apart from governments, the regional development banks could also play a leading role in this process due to their mandate and state backing. Public (development) banks need to be aligned with the 1.5°C scenario and the SDGs. They can, for instance, offer guarantees where needed and issue green bonds[7], whose proceeds are dedicated to low-carbon investments. They can also support private investment by offering technical assistance and capacity building, as well as by supporting flagship projects and good practices in the field of zero-carbon technologies and infrastructure. Governments can also help to leverage private capital through public-private partnerships or other investment vehicles. For example, the European Union's Fund for Strategic Investments aims at using 21 billion Euro of public money to leverage private investment in order to reach a total of 315 billion Euro for European small and medium-sized enterprises (SME), mid-caps, innovation and infrastructure. In terms of the 1.5°C target, such a support scheme would have to be limited to exclusively financing climate-friendly projects as well as scaled up massively[8]. Another possibility would be to scale-up an instrument like the Green Climate Fund to collect and re-direct public capital towards mitigation and adaptation projects. At the same time, fossil fuel subsidies should be eliminated globally, as well as all other subsidies that could hinder the decarbonisation process. This needs to be done cautiously, though, without neglecting the social dimension that the SDGs emphasise.

4.2 Private investment

Certainly, in the first few years of pursuing a 1.5°C scenario, some investments which would otherwise occur in a business-as-usual scenario would have to be redirected. First, this could happen via corporations in all industries diverting their own investments from their traditional products to renewable energies, enhanced resource efficiency technologies and to decentralised solar energy production at their building sites as well as in the communities in which they operate. Second, government or quasi-public mechanisms have to be established

[7] For a definition of green bonds see Climate Bonds Initiative (2017).

[8] The European Commission has proposed extending and scaling up the EFSI to 33.5 billion of public money to reach an investment total of 500 billion Euro.

to redirect investment between major sectors of the economy. In combination with scaled-up public spending for the decarbonisation of the economy, both would have a great impact on creating a credible green growth narrative, as laid out in Section 3.1 This narrative is necessary to re-orient investors' expectations towards a low-carbon economy with a credible and large demand for green products and infrastructure. Already today, private sources of funding play a big role in financing green investments, with $243 billion in 2014, as compared to only $148 billion of public investments (Buchner et al 2015). In the last few years, in addition to an increasing volume of public green bonds being issued, private actors such as energy companies (EDF, Iberdrola), technology companies (Apple, Mitsubishi) and banks (BNP Paribas, Rabobank) have also issued green bonds. The total issuance of labeled green bonds has, thus, reached $81 billion in 2016 (The Climate Bonds Initiative Markets Team 2017). Institutional investors, who have a long-term focus and are currently looking for investment opportunities, could also be important players in financing the Great Transition.[9]

If uncertainty as to the credibility of climate policies and support mechanisms can be greatly reduced, private investors could coordinate around green investment, and, thus, further influence the expectations of actors in other sectors (Mielke and Steudle 2017). To support the 1.5°C target, a critical mass of economic actors needs to coordinate around a new and different global growth path. One possibility to enhance credibility would be a short-term but large public investment impulse that would trigger technical progress, thus positively influencing investors' expectations and leading to fewer GHG emissions and, in some regions, higher growth rates at the same time (Jaeger et al 2015). A credible green growth narrative could help to establish such a re-coordination of public and private investment to support a 1.5°C world.

A set of papers by Zenghelis and colleagues (see Zenghelis 2011, 2012; Romani et al 2011) analyzes the possibility of stimulating additional net private sector investment in detail. Given investment levels close to record lows in most OECD countries, the authors detect a "lack of confidence to invest rather than a lack of liquidity" (Romani et al 2011, p. 4) and they argue that credible long-term green growth policies provide opportunities for restoring confidence and leveraging additional, rather than only displacing, investment (Zenghelis 2012). Similarly, the UNEP Green Economy Report calls for the private sectors' "understanding and sizing the true opportunity represented by green economy transitions across a number of key sectors" (UNEP 2011).

5 Conclusions

The IPCC Special Report must be complemented with a focus on the idea that a 1.5°C non-overshoot scenario can only be realised with a massive mobilisation of financial and human resources. This requires a huge and immediate effort on the part of all governments, financial institutions, businesses, and civil society organisations. Analysis must stress that such a mobilisation may even be required in order to achieve a 2°C non-overshoot scenario, including the SDGs, but at a lower annual level of investment with more time for ramping-up.[10] The special report, therefore, has the opportunity to significantly change the narrative from previous IPCC reports. In order to achieve the 1.5°C target, large scale investments involving a significant fraction of global GDP per year are required – and possible, as history has shown. They would also be beneficial for realising more immediate economic and social goals through a coordination of investors' expectations and technological progress. Additionally, there are many economic and social synergies to be reaped between strict

[9] McKinsey estimates that institutional investors could fill up one third to half of the estimated infrastructure investment gap of about three trillion dollars a year under a 2°C scenario, if the right incentives and policies were put in place (Bielenberg et al 2016). For a 1.5 degree scenario, the investment gap would be much larger and of shorter duration.

[10] Note that "just" achieving the non-climate SDGs by 2030, as currently scheduled, would require its own mobilisation of global financial and human resources.

climate change mitigation policies and policies needed to implement the other SDGs. To this end, for a credible green growth narrative, climate policies have to be complemented with political incentives that substantially increase (public and private) investment levels. Countries and businesses will be more likely to work towards a 1.5°C scenario, if they expect economic benefits from doing so.

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