Recovery from Covid-19 towards a low-carbon economy - a role for accounting technologies in designing, implementing, and assessing stimulus packages

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Abstract

Accounting technologies can be used to help stimulus packages achieve the twin goals of economic stimulus and climate mitigation. Utilizing an institutional logic perspective, we show that despite the massive financial consequences of climate change, the current climate response is dominated by the economising logic that justifies limited action. Further, despite its strong potential, accounting technologies are not extensively used in the design of stimulus packages. We develop a framework to explicitly integrate accounting technologies in the design, delivery and review of stimulus packages, thereby simultaneously enabling economic growth and social equity whilst addressing the climate crisis.

Keywords: green recovery, accounting technologies, institutional logics, Covid-19, stimulus package

1. Introduction

The 2015 Paris Agreement, in pursuit of the objectives of the United Nations Framework Convention on Climate Change (UNFCCC), aimed toward "*holding the increase in the global average temperature to well below 2°C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5°C above preindustrial levels*" (UNFCC, 2015). This is an increase in ambition beyond the agreement in Copenhagen in 2009 and Cancun in 2010, to simply hold warming below 2°C. The UN advises that global emissions have to reduce at a rate of 7.6% per year from 2020 to 2030 to meet the 1.5°C Paris target (UNFCC, 2019). In response, 197 countries have ratified the Paris Agreement with 146 out of them having formalized their national pledges to reduce national emissions, known as nationally determined contributions (NDC). In total, these pledges account for roughly 90% of global emissions. The ability of the world to achieve the target of 1.5°C warming absolutely depends on the commitment of different countries to deliver these pledges (UNFCC, 2019). The cost of global warming is significant, with estimates indicating that the cumulative damage of climate change will reach 8 trillion US dollars and 3% of global GDP by 2050 (The Economist Intelligence Unit, 2019).

Against this important climate crisis, the Covid-19 pandemic arrived in 2020 and is seen as the "worst global crisis since World War II" (Blondeel, 2020). Within eight months (30 September 2020), it has infected over 33 million people with over a million dying from the disease (Worldometers, 2020). Further, Covid-19 is increasingly seen as "the Great lockdown" with grim economic outcomes and long term impacts that will be the most severe since the Great Depression. The International Monetary Fund predicts a 4.9% reduction of GDP in 2020, and 6.5% reduction for 2021 compared to pre-Covid projections (IMF, 2020).

The immediate economic threat posed by Covid-19 has seen the longer-term threat of climate change recede into the background. Covid-induced job losses, revenue declines and the likelihood of prolonged economic recession have led governments around the world to make unprecedented financial resources available to soften the blow, already exceeding $10 trillion (McKinsey, 2020). The Covid-19 response has not only reduced focus on the climate change agenda, but many of the stimulus packages focus on protecting and creating employment via infrastructure projects that will lock in greenhouse gas (GHG) emission increases for decades. Post-crisis emissions are highly dependent on the mode of recovery, e.g. after the global financial crisis (2008-2009), emissions rose by almost six percent in 2010 (CarbonBrief, 2020). If low carbon development strategies and policies are not implemented during the current Covid-19 crisis, emissions may overtake previously made projections by 2030 (Climate Action Tracker 2020). The role played by the state in economic decision-making and facilitating post-Covid economic recovery is particularly pertinent. The design of the stimulus package will not only influence 2020 emission levels, but will influence emissions for decades to come. The possibility to stay within the 1.5°C degree target and mitigate the destructive consequences of climate change will be lost forever.

The timing of the economic recovery from Covid-19 coincides with a pivotal moment in the fight against climate change, as stated by the UN's Secretary-General:

> *The impact of the coronavirus is both immediate and dreadful. But there is another, deep emergency -- the planet's unfolding environmental crisis... We must prioritise the sustainable use of planetary resources when pursuing industrial growth – notably in food production and agriculture. We need to protect biodiversity in our climate action efforts, industrial practices and urban expansion.* (UN's Secretary-General, 2020*)*

The current "once in a generation" opportunity is to jumpstart the economy using methods that address the climate crisis. Instead of using the stimulus packages to support 'business as usual' (BAU) – locking in obsolete economic models and investment in soon-to-be stranded assets, governments should invest in a new economy that is "fit for the future: sustainable, inclusive, competitive and prepared" (Piccard & Timmermans, 2020). The question remains, how can this be achieved? How can budgets and stimulus packages be designed to enable economic recovery whilst effectively moving the economy to a low or zero-carbon mode? The stimulus packages are driven by multiple and potentially competing objectives: economic recovery, public health response, social equity and well-being, job creation, as well as the ongoing need for climate change mitigation and adaptation (De Villiers et al., 2020).

Prior literature shows accounting technologies, such as public sector audit, value for money assessments, cost-benefit analysis plays a critical role in public policy and public sector operations (Hay & Cordery, 2018; Deis & Giroux, 1992; Jacobs, 1998; Pearce, 1998). Accounting technology is an all-inclusive term and "can be an artifact (a budget document), the processes or uses of the technology (e.g. producing and making use of a budget) and the knowledge of people in designing or operating the technology (e.g. the "know how" that specifies the relationship between predicted costs and specific activities)" (Preston et al., 1992, p. 563). Following this definition, accounting technologies refer firstly to artifacts, including accounting measurements, stimulus budget documents, risk assessment matrixes, and reports, and secondly to processes such as budget allocation, auditing, internal and external reporting. Thirdly, they also encompass the know-how (knowledge) related to these artifacts and processes. For example, policy makers understand the implications of budgeting processes and budget documents for the implementation of the stimulus packages and the activities they support and the policy outcomes they seek to achieve through such packages.

Individuals, organizations and societies increasingly find models, metrics and tools (i.e. accounting technologies) valuable in assessing the extent to which, and the ways in which, current activities are unsustainable (Bebbington et al., 2007). Whilst there is considerable literature on sustainability accounting technologies at the organizational level, there is little research on how accounting technologies help realise sustainability goals at the governmental/national level (Bebbington et al., 2007). Furthermore, there are increasing calls for exploring the role played by accounting technologies in enabling and furthering a new sustainability agenda, such as pursuing the Sustainable Development Goals (SDGs) (Bebbington & Unerman, 2018). Yet it is unclear whether accounting technologies can help governments produce an appropriate budgetary response to the Covid-19 pandemic, while simultaneously moving to a low-carbon economy to thwart the destructive consequences of climate change. Given that accounting technologies have been useful in addressing different sustainability and environmental agendas in the past, it is critical to explore how accounting technologies can rise to the current challenge of ensuring climate progress in a pandemic world.

This paper has two objectives. First, it seeks to examine how accounting technologies have been implicated in the debate regarding climate science and the corresponding climate response, and how these accounting technologies have been present or absent in the design of Covid-19 stimulus packages around the world. Second, the paper aims to explore the potential of accounting technologies to contribute to delivering positive climate benefits by being integrated into Covid-19 stimulus packages. Towards these objectives, the paper utilizes an institutional logic perspective. Institutional logic refers to how broader belief systems shape the cognition and behavior of actors

(Lounsbury, 2007; Thornton, 2004). Climate response can be guided by multiple logics: ecological – focused on emissions reductions to stay within warming targets; economising – focused on minimising costs associated with emissions reduction, whilst not sacrificing economic growth; or social – focused on transition and adaptation for populations, sectors and groups, to climate change (York et al., 2016).

The paper makes at least three contributions to the literature. First, using an institutional logic perspective, we show that despite the massive financial consequences of climate change, the current climate response is dominated by the economising logic that justifies limited action. Second, we show that despite its strong potential, there have not been explicit efforts to incorporate accounting technologies in the design of stimulus packages. Third, we develop a framework to explicitly integrated accounting technologies in the design, delivery and review of stimulus package, thereby simultaneously enabling economic growth and social progress whilst moving the world towards a lower-carbon future.

The rest of the paper is organised as follows. The next section reviews extant literature to gain an understanding of different logics and accounting technologies in organisations' climate response. The methods are presented next. This is followed by the analysis of competing logics in climate science and climate response and the supporting accounts for each logic. The Covid-19 stimulus packages by different countries are then reviewed to highlight their risk and inadequacy in responding to the climate change urgency. Based on accounting literature, we develop a framework that allows accounting technologies to provide a monitoring and surveillance tool so that Covid-19 stimulus packages can advance climate change progress while achieving social and economic objectives. The relevance of this framework is illustrated by using the specific example of New Zealand (NZ) Government's Covid-19 stimulus package. The last section concludes the paper with key findings, contributions, and limitations.

2. Institutional logics and accounting technologies in organization's climate response

Friedland and Alford (1991, p.248) defined institutional logics as "a set of material practices and symbolic constructions [that] constitute organizing principles" for institutions or "supraorganizational patterns of human activity". These broader belief systems provide different "organizing principles" for social life, such as the state, the market, and the family (Friedland & Alford, 1991). Particularly, institutional logics researchers are concerned with the "interests, identities, values and assumptions" of individuals and organisations that are "embedded within prevailing institutional logics' (Thornton & Ocasio, 2008, p.103).

Institutional theorists (Greenwood et al., 2011; Marquis & Lounsbury, 2007; Reay & Hinings, 2009; Thornton et al., 2012) have underlined that multiple intermingling and oftentimes conflicting or incompatible institutional logics constitute organizational fields. In the organizational field of sustainability management, economising and ecological logic interweave. While a compliance logic relates to fulfilling legal and regulatory requirements, an economising logic to cost control, profit-maximization and efficiency gains, and an ecological logic to preserving the eco-system (York et al., 2016).

Organisations with a compliance logic engage with sustainability activities to meet government requirements and stakeholder expectations without undertaking substantive action to improve their

sustainability performance (Herremans et al., 2009; Passetti et al., 2014). In the corporate reporting literature, green accounting technologies such as the amount of carbon emissions can help firms diagnose non-compliance events (with environmental rules and regulations) and/or improve firms' communication and external reporting (Cooper & Owen 2007; Unerman & O'Dwyer, 2007). However, firms pursuing a compliance logic is not motivated to use these technologies to considerably mitigate or avoid carbon emissions in their operations. In the case of government's climate response, a compliance logic can signify reporting practices of the government by disclosing the country's emissions accounts to cater to public's increasing demand for climate responsibility, or to comply with international obligations, such as annual reporting required under the Paris agreement, but such reporting is not necessarily supported by meaningful and effective emissions reduction measures. Furthermore, countries set emissions reduction targets under the Paris agreement, but these targets are voluntary pledges and therefore they are not enforceable. Consequently, national climate response is mostly not driven by a compliance logic.

An ecological logic means that organisations and governments place sustainability issues at the core of their practices and decision making, as they are driven by an intrinsic motivation of being ethical and responsible for the environment and society (York et al., 2016; Figge & Hahn, 2013). Green accounting is useful in collecting and quantifying information about a firm or a country's carbon footprint, and such information will enable policy making and decisions regarding addressing or reducing the emissions levels (Burritt & Schaltegger, 2014). Accounting technologies such as sustainability reporting, can help engage with external stakeholders, e.g. the public, regarding how the organisation or the government contributes to the fighting of climate change and this engagement can in turn stimulate change (Higgins & Coffey, 2016). Overall, a government pursuing an ecological account is likely to commit to using emissions-focused accounting technologies to monitor and adjust its policy making and specific projects and programmes and report to the public for oversight and generating debate and dialogue.

An economising logic reflects a focus on short- and long-term monetary interest when considering climate change issues (Figge & Hahn, 2013). Organizations with an economising logic utilise sustainability management as opportunity to increase operational efficiency and identify financial risks with the ultimate objective to maximize profits. Governments concerned with this logic will undertake programmes and projects that provide cost efficiency and/or stimulate economic growth rather than direct environmental benefits. Accounting technologies such as performance measures, can be used for monitoring performance, evaluating risk, developing improvement plans, and linking to compensation systems (Comoglio & Botta 2012; Schaltegger & Wagner, 2006). Furthermore, due to the focus on efficiency, firms and governments will be primarily interested in monetary accounts that highlight quantified risks, carbon liability or carbon revenue/gains from when considering a policy, regulation or specific programmes (Schaltegger & Csutora, 2012; Bui & de Villiers, 2017).

Finally, with regards to national climate response, social logic focusing on social justice and equality arising from climate change and climate action, has received significant attention. As shown in Section 4, there are social costs of climate change, with certain countries and populations becoming more vulnerable and suffering more loss from climate change than others. It has been argued that low-income countries are less able to adapt to climate change, and that adaptation and mitigation measures need to be planned to protect human rights and social justice and avoid creating new problems or exacerbating existing problems for vulnerable populations (Levy and Patz, 2015). A review by Markkanen and Anger-Kraavi (2019) suggests the risk of negative social outcomes

associated with mitigation policies increases as countries step up their ambition to meet the Paris agreement pledges. It argues that the inequality impacts can be mitigated in the presence of conscious efforts, careful policy planning and multi-stakeholder engagement.

Climate change is inherently weaved with competing logics (Ansari et al., 2013; Hoffman, 2011) and hence any government when formulating a climate action will be faced with the potential trade-offs and tensions, between, on the one hand, climate responsibility and international climate obligation, and on the other hand, the need to maintain economic growth and cautious fiscal spending (e.g. lowering or stabilizing the economy's debt-to-GDP ratio ("debt ratio") over time) (Tofan et al., 2020; Bivens, 2019).

Existing accounting literature has started to explore how accounting technologies can enable organisations to respond to multiple and oftentimes incompatible logics (e.g., Carlsson-Wall et al., 2017; Dai et al., 2017; Schäffer et al., 2015). Schäffer et al. (2015) show how management selectively couple or separate different accounting mechanisms and controls to address competing logics. So each control is shaped by only one logic, while management is able to bridge between different logics. Dai et al. (2017) find that target setting and budget procedures can help combine the state, corporate and capital market logics and hence help to sustain the operations of a Chinese state owned enterprise (SOE). Further, the logics are separated by separating different dimensions of its key performance indicators (KPIs) into different units/departments. Carlsson-Wall et al. (2017) show how a Swedish government agency selected and integrated elements of different controls and accounting systems to match the dominating logic within the country's migrant crisis. Overall, accounting technologies can help bridge and combine different logics via different strategies, such as combing, separating, or decoupling different logics.

3. Methods

Using this institutional logics perspective, we will analyse the catastrophe of climate change and climate response by different countries in the world, and how Covid-19 pandemic and associated stimulus package may negatively influence the effectiveness of such response. We rely on mostly extant literature and publicly available data. Three analyses are conducted. Please note that due to the multiple level analyses and the diverse sources involved, our review does not follow a systematic literature review approach (e.g. Linnenluecke et al., 2020), but rather adopt content analysis to identify the arguments relevant to the issues of interest.

In the first analysis, we examine the existing literature on climate change and climate response and associated accounting technologies.[1] Besides the academic literature, we collect data from research institutes, newspapers and magazines. This literature is classified based on their alignment with either the ecological or economising logic. The focus is to understand how accounting technologies (e.g. physical and financial numbers and indicators) are employed to justify and disseminate each logic. We follow prior literature in data collecting and clearing processes (Linnenluecke et al., 2020; Marrone & Hammerle, 2017). We use a dedicated database for sustainability issues, namely, JSTOR

[1] Though there have been some literature reviews on climate policy (mitigation and adaptation) none focused on specifically reviewing the various accounts (e.g. costs and benefits) and how they support potentially conflicting logics. Furthermore, most reviews focus on particular countries or regions (Shaffril et al, 2020; Klock and Nunn, 2019). No review has combined both practitioner and academic literature. For example, Sharifi (2020) examine climate change measures but in an urban (city) context, and only include scholar literature.

Sustainability, to search for relevant academic literature. We search for the various combinations of the following keywords: climate response, climate policy, costs, and benefits, limiting to the fields of Business, Economics, and Public Policy and Administration, and the time period from 2015 to 2020 to focus on developments around and since the Paris Agreement (signed on 12 Dec 2015). This resulted in 918 search results. We scan the abstract and introduction to remove papers that focus on a particular industry or sector (e.g. tourism or electricity), or a particular local geography (e.g. state or regions) to focus on papers that discuss the costs and benefits of *national/international* climate response, and associated accounting technologies. The final data include 198 articles and reports and briefs.

For practitioner literature, we use FACTIVA database, using the similar keywords and combinations as with the academic literature (Marrone & Hammerle, 2017). We supplement with articles from sources most relevant to climate change and global warming topics[2]. A further Google search is conducted to pick up new/review articles (e.g. on personal blogs) that have been cited by other sources that do not fall into the formal practitioner newspapers and magazines. After manual scanning and exclusion of irrelevant articles a total of 264 articles are identified to discuss the costs and benefits of climate change and climate action. The break-down of the academic and practitioner literature data by year is provided in Table 1.

Table 1: *Break-down of first analysis data – Climate change, climate response and associated accounting technologies*

Year	**Academic literature – JSTOR Sustainability**	**Practitioner literature - FACTIVA**
2015	72	61
2016	42	52
2017	22	42
2018	31	37
2019	15	49
2020	16	23
Total number of articles	**198**	**264**

The second analysis focus on Covid-19 stimulus packages around the world. We examine studies and expert arguments from the academic and practitioner literature that propose a green recovery mode to understand the potential for combining ecological and economising logics. This is contrasted with the actual design of the stimulus packages seen so far. Again, we analyse how certain accounts and other accounting technologies have been present or absent in those packages' design. Search terms newspapers. For practitioner literature, we use FACTIVA and the relevant keywords (stimulus

[2] These include: NYT, the Guardian, Dailymail, the independent, AccuWeather Climate Change Centre, Climate Central, Climate Wire, EcoWatch, Live Science's Climate Section, The Washington Post, National Geographic. Offical sources include UN, World Bank, IMF, IPCC, OCED. Non profit organisations that provide live/updated tracking of climate news including the Aspen Institute, C2ES Blog, Climate Interactive Blog, WWF Climate and Energy Section, Our world in data.

package, economic recovery, financial assistance, coronavirus) and we use Google scholar and ResearchGate to identify relevant academic research[3]. After manual exclusion of irrelevant sources (such as the announcement of a certain stimulus measure rather than an analysis of the driver or consequence of such measure), 98 relevant media and practitioner articles and 95 academic articles are identified.

Thirdly, we develop a framework to advance the role played by accounting technologies in combining different logics in designing and implementing Covid-19 stimulus packages. We base on both academic and practical literature to highlight how accounting technologies can play out this role, from what we know in the existing literature, as well as what have been applied around the world as part of different countries' Covid response. In particular, we illustrate the usefulness of the framework by analysing the case of NZ Government's Covid-19 budgetary response, and what types of accounting technologies have been used in the Government's climate policy and response, and could be used in informing its Covid-19 budgetary processes. To this end, we collect publicly available data, including government releases, speeches, documents, and reactions to understand the rationales for the Budget and funding decisions, and assess the extent that they align with ecological or economising logic. We also collect documents from the media and relevant experts and other stakeholders, in particular those aligning with an ecological logic, to understand the potential impact of the Budget and funding decisions on climate progress (progress on mitigating and adapting to climate change). In total, 122 documents including articles, reports, and media releases are identified from both internet sources and hard-copy sources (from Index New Zealand, database for NZ newspapers and magazines in original formats).

Findings from these three analyses are presented in the next three sections.

4. Competing logics in climate science and climate response

Climate change catastrophe (ecological logic and supporting accounts)

Evidence is mounting regarding the distrausous impact of climate change, supported by leading climate scientists. There are two types of carbon accounts: accounts for unsustainability and accounts for sustainability improvement. Accounts for unsustainability (Schaltegger & Csutora, 2012) are utilised to substantiate the negative impacts of climate change, hence increasing awareness regarding the urgency for climate action and response.

The first group of accounts concerns the forecasted impacts of climate change. The seminal source is IPCC's reports. Over the years the forecasts have changed with many scenarios and uncertainty assumptions. IPCC (2018) upgraded its risk warning from previous reports, and warned that every fraction of additional warming would worsen the impact. In particular, it used comparative indicators to highlight the lower impacts (and hence higher benefits) of 1.5°C compared to 2°C warming targets, include:

- An 10cm lower in global sea level increase of 1.5°C compared with 2°C.
- 14% as opposed to a third of the world's population experience extreme heatwaves at least once every five years at 1.5°C rather than 2°C.

[3] The reason being the at-pace development of the coronavirus and related stimulus packages. Google scholar, SSRN and ResearchGate platforms are able to capture in-press, early-cite and upcoming publications that may otherwise not yet available in print and traditional journal databases.

- Arctic sea ice would remain during most summers under 1.5°C, as opposed to ice free summers being 10 times more likely under 2°C.
- The decline of 70-90% of coral reefs under 1.5°C, as opposed to their likely total disappearance under 2°C.
- Reduced number of people both exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050 under 1.5°C compared to 2°C.

The second group of accounts focus on two indicators: emissions levels (historical and current) and required rates of emissions reduction to achieve warming targets, which can clearly show the magnitude and urgency of climate response. For example, Richie & Roser (2019) showed that CO2 concentrations in the atmosphere are now well over 400ppm, their highest levels in over 800,000 years. Further, globally the world emits over 36 billion tons of CO2 per year and this continues to increase (Richie & Roser, 2019). IPCC (2018) emphasized that the only way to limit global warming to 1.5°C is by reducing emissions of GHG by 45% by 2030 and to net zero by 2050. Interestingly, the economy is brought into the debate to warn against existing economic model and urge for a transformation in the economising logic. Stern (2018) estimated that between 2015 and 2030, the infrastructure would more than double, and the global economy will double in the next two decades at a rate of 3% per year, and population in major cities will double in the next 40 years. If the emissions levels are kept constant as 2019 level, the world has eight years left until the remaining carbon budget is depleted to stay within the 1.5°C warming target, estimated to be about 380 GtCO2 by 2100 (Andrew, 2020) .

These accounts provided the motivations for international and national climate action. In response to IPCC (2018) report and the Paris Agreement that support a 1.5°C aspiration, many governments submitted their pledges on National Determined Contributions (NDC). Pledges vary in many factors, including target variables (e.g., emissions, emissions intensity, clean energy shares), stringency (e.g., emission reduction goals vary between 8 and 70 percent), baseline years, and other contingencies. The pledges are basically reduction targets, a form of account for sustainability improvement (Bui & de Villiers, 2017). Yet, the problem with these pledges is they are voluntary in nature and hence can not be enforced across the international community, hence potentially impairing their effectiveness in emissions reductions.

Despite these efforts, the world still is not able to achieve the warming targets, as shown by the following future-oriented accounts (for unsustainability). Both scenarios of BAU and NDC fall well below the overall Paris Agreement targets of 2°C and the aspired 1.5°C (Andrew, 2020). Under the current climate policies, the projected warming by 2100 is 3.1 to 3.7°C. If all countries achieve their current pledges under the Paris Agreement, the average warming will be 2.6 to 3.2°C (Ritchie and Rosie, 2017). If emissions peak in 2020, the required annual reduction rate is monumental – 18% (6%) through to 2030 to limit warming to 1.5°C (2°C) (Andrew, 2020). Indeed, Nordhaus (2018), conclude that it is highly unlikely that countries can achieve even the 2°C target.

This impossibility of steep mitigation gives rise to another account for sustainability improvement – 'negative emissions'. With positive emissions continue to rise, negative emissions would help keep total emissions within the carbon budget (Andrew, 2020). It is estimated that 500 GtCO2 negative emissions need to be removed from the atmosphere to keep within the 380 GtCO2 carbon budget (Andrew, 2020).

The ecological logic and the associated accounts suggests that climate change consequences are dire and urgent action is required. The accounts fall into two categories: for unsustainability and for sustainability improvement, and they are of both short term and long term, historical and future-oriented, whilst being primarily physical and non-financial in nature. Yet, the very reason why little progress has been made in this space is the domination of the economising logic, i.e. the over-reliance and prioritization of the economising logic (rather than environmental benefits) of climate change and climate mitigation, as discussed next.

Economic costs of climate change (economising logic and supporting accounts)

Naturally, an economising logic relies on economic accounts, those concerning with monetary quantification of costs and benefits of certain response/scenario. In contrast to the climate science which has received world's consensus, there are significant variations in calculating the economic costs of climate change.

Nobel prize scientist, Nordhaus (1991), in his 1991 paper "To slow or not to slow," cautioned against the heavy economic costs of the world slowing down global warming and argued that it is optimal to keep warming at 3.5°C over preindustrial levels. His later economic analyses supported this view, that stringent warming targets would involve economic sacrifices in excess of the value of the climate-related benefits (Nordhaus, 2017).[4] Due to this growth-oriented justification, many governments have taken decisions that have support BAU and locked in emissions increase for many years to come.

However, recent studies have highlighted that economic costs of climate change are severe. Using more extreme scenarios, Stern (2018) suggested that annual GDP losses can be up to 20% per year. Future generations will poorer and live in a hotter planet. Kahn et al (2019) found that a persistent increase in average global temperature by 0.04°C per year, in the absence of mitigation policies, reduces world real GDP per capita by more than 7% by 2100. OECD (2017) showed that the annual global weather-related insured losses have increased from about US$10 billion in the 1980s to about US$50 billion in the 2000s and US$138 billion in 2017 (OCED, 2017). Ritchie and Roser (2017) illustrated how disruptive changes can lead to drops in the values of 'stranded assets', as evidenced by the drop of 95% in market valuation of US coal producers between 2010 to 2017 (Ritchie & Roser, 2017).

The economic costs of climate change are not equally distributed, raising concerns regarding social equity (social logic). Diffenbaugh & Burke (2019) study found that global warming will exacerbate global economic inequality by around 25%, with accumulated robust and substantial declines in economic output in hotter, poorer countries and increases in many cooler, wealthier countries. Burke, Hsiang and Miguel (2015) found that regions that contribute relatively little to climate change problems (low per capita emissions), however suffer relatively high climate damage per capita, including Latin America, Africa, and South Asia.

The variations in economic caused by climate change have partly caused lack of political consensus for mitigating climate change, in the name of economic growth. The constant struggle between

[4] The little economic impact caused by climate change, is due to the small percentage of populations and economies directly vulnerable to climate change that contribute to the global GDP (about 4%). . Hence, even if the whole agricultural system breaks down due to the climate change, the loss in global GDP is estimated to be minimal.

growth versus life, hence between the economising versus social and ecological logics, has been predominant in climate change debate (Hickel, 2018). However, the variations and uncertainty of climate change, and its associated economic costs, in this case, being primarily future-oriented and subjected to uncertainty and assumptions, lead to the questioning of the reliability of accounting technologies, hence justifying the lack of international and national action. It is interesting to note that while there is relatively strong consensus around climate change science, hence the validity of physical accounts is irrefutable, the same can not be said of the accounts for the economic costs of climate change. This lack of consistency and hence reliability of the estimates inevitably favoured the domination of the economising logic and underlined the BAU/limited climate action.

Cost-benefit analysis of emissions reduction (tensions between ecological, social and economising logics)

Another way to evaluate whether an economising logic is justifiable is via a cost-benefit analysis of emissions reduction. The benefits of emissions reductions (hence accounts for sustainability improvement) are often non-financial or qualitative in nature. It is estimated that limiting global warming to 1.5°C will avoid the Artic Ocean becoming ice-free in the summer, slow the rate of sea level rise by 30%, enable fewer than 5 million people to be exposed to coastal flooding annually, and prevent a significant portion of the increase in extreme weather events. Overall, both human livelihoods and ecosystems will be significantly better off in a 1.5°C than in a 2°C warmer world (Dietz et al., 2018). Hence, the benefits of climate action clearly favour social and ecological logics.

In contrast, policy-makers, driven by an economising logic, might be more interested in comparing the costs of emissions reduction among alternative global warming scenarios in deciding how ambitious their climate action should be. Rogelj et al (2018), using Integrated Assessment Modelling (IAMs) showed that discounted reductions in global GDP associated with mitigation measures for 1.5°C (compared to a no-climate-policy baseline) are three times higher than for 2°C target. Hare et al. (2018) estimated that GDP losses would be three to four times higher in the next few decades due to the greater need for rapid, near-term reductions in 1.5°C pathways. Differently, Dietz (2018) found that 1.5°C mitigation costs are 150% higher than 2°C cost in the near term (2010-2013), and 50% in the longer term (2010-2100). Ritchie (2020) considered that if all low cost abatement opportunities are pursued, €200-350 billion per year is required by 2030, equating to less than one percent of the forecasted global GDP in 2030. Overall, these studies find that pursuing a 2°C target is a lot more costly than a 1.5°C target.

The ineffectiveness of accounts – "social cost of carbon" and carbon pricing

One important account that have been widely debated in both the scholar literature and policy making context is "social cost of account", namely, the required cost to mitigate carbon emissions to the desired warming targets. This account is then turned into appropriate carbon pricing to stimulate low-carbon investments. Nordhaus (2018) suggest that the required carbon price to keep emissions at zero is 550$ (2010 terms) per tonne from 2015 to 2050 period, and 357$ for the latter half of the century (Nordhaus, 2018).

Calculating the social cost of carbon allows policy makers to convert it into the required carbon pricing to incentivise emissions reduction. Not surprisingly, carbon pricing, as an economic instrument, has been the preferred policy tool for emissions mitigation. This policy allows producers to emit up to the point where the marginal cost is equal to the carbon price and consumers to reduce carbon-intensive goods and services up to the point where marginal welfare benefits equal the price. This represents an effort to promote an ecological logic however within the boundaries of economic

rationality. World Bank (2018) found that carbon prices in implemented initiatives ranged from $1 per metric tonne, up to $139, with 46% of emissions priced below $10. However, IMF (2019) note that these ETS often apply downstream to power generators and large industry, hence in essence missing around 50% of total global emissions. A different study (Dietz et al, 2018) estimates that 85% of global emissions are currently unpriced and approximately three-quarters of the rest are priced below $10/tCO2. Furthermore, the costs of administering emissions and allowances are prohibitive for many small jurisdictions and country. In 2020, only 22.3% of global GHG emissions are covered by carbon pricing initiatives [5]. Carbon prices are at a low level, around US$5-25 per tonne of CO_2, mostly caused by uncertain policy mechanisms and carbon credit markets, as well as overlapping policy instruments (IMF, 2019).

There is an immense gap between the current carbon prices and the required ones to meet various warming targets. Nordhaus (2017) recommends a moderate carbon tax (at about $31 per tonne for "social cost of carbon". Yet, IMF (2019) considers that a carbon price significantly below $35 per ton would be sufficient to meet the pledge for the G20 countries and a projected 3°C warming target but a 2°C warming would require a $70 carbon price.

Therefore, while recent studies propose high carbon prices to support an ecological logic and effective emissions reductions, governments' regulations have been limited in introducing sufficiently high prices. The accounting technologies (the quantification of social cost of carbon and incorporating it in carbon pricing regulations) are not effective in stimulating effective carbon mitigation, hindered by various national and regional institutional and market factors. This is not surprising, if we consider that carbon pricing is a market instrument, hence an account within an economising logic. Though they might lead to emissions reduction, the immediate concerns of those subjecting to the carbon pricing regulations is how to protect their organisation's economic performance rather than how to contribute to the aversion of the climate crisis.

Summary

The above section has highlighted that current climate debate is characterised by two main logics: ecological and economising. Ecological logic (and to a lesser extent, social logic) is supported by accounts for sustainability and unsustainability such as emissions trend, required emissions reductions, and quantified social impacts of climate change. Differently, economising logic is underlined by economic accounts including economic cost of climate change, and cost-benefit analysis of carbon mitigation. The separation of these logics have dominated the public policy space, resulting in less than effective climate mitigation measures at the national and international levels. However, the Covid-19 pandemic has presented an unique opportunity to combine the otherwise competing logics towards a new model of development.

5. Stimulus packages around the world – a triumph of the economising (and social) logic with some compromise for ecological logic

The potential for combining ecological and economising logics

In response to the Covid-19 pandemic, countries have introduced massive stimulus packages to save their economies (Billah, 2020). By May 2020, governments around the world have providing $9

[5] https://carbonpricingdashboard.worldbank.org/

trillion in fiscal support[6], representing 9.3 percent of 2019 G20 GDP (CSIS, 2020). Instead of the 'back to normal' scenario whereby the rise in global temperature more than doubles by 2100, experts have called for a 'build-forward' scenario supported by stimulus package policies that promote green growth, protect biodiversity and embrace renewable energy. The 'build-forward' economy represents a combination of ecological and economising logic, whereby a new form of economy is pursued, a green recovery, that combines growth with life and nature. In fact, it has been pointed out by several experts that the post-pandemic period will determine whether the world hits or misses the Paris Agreement targets (McKinsey & Company, 2020).

Besides, a significant portion of stimulus packages is devoted to supporting social objectives. Most countries implemented measures to support businesses, particularly small and medium enterprises, often in the form of wage subsidy, as well as measures to protect individuals and households with a focus on vulnerable and disadvantaged groups, such as extending income support, unemployment benefits, or easing access to targeted benefits (UNDESA, 2020). In these cases, social logic account for a considerable part on stimulus packages. As far as they represent emergency assistance through Covid-times, and support directly the socially disadvantaged groups and populations, there is little conflict with ecological logic due to the short-term nature of these measures (e.g. a few months to less than one year). It is in the portion of the stimulus packages that directly facilitate the economic recovery via supporting businesses such as business loans or bailouts, or big infrastructure projects, where an ecological logic may be suppressed and the environment be sacrificed by the economising logic. Hence, it is this *part* of the stimulus packages that targets economic recovery that our discussion focuses upon.

Stimulus packages are often capital intensive, focusing on infrastructure development and the like, and hence have the potential to lock increased emissions for many years to come, as evidenced by 2007-2008 economic crisis. The economic slowdown reduced global GHG emissions in 2009, however, emissions have bounced back and even reached a new record high in 2009. This is caused by governments' stimulus measures that focused on economic growth without much concern for environmental consequences (McKinsey & Company, 2020).

Combination of the two logics in the form of a low-carbon economic recovery provides the better alternative with mounting public support. The informal green-recovery alliance, launched in April by 12 environment ministers from European countries, 79 members of the European Parliament, and 37 CEOs and business associations, has been joined by more than 50 banking and insurance CEOs. Top executives at 155 companies signed a public statement calling for a net-zero recovery (Science based targets, 2020). Surveyed populations around the world indicate strong preferences for recovery policies that also address climate change: support ranging from 57% to 81%, with a world average of 65% (IPSOS, 2020). The poll in UK show more than 75% of the respondents support protecting and investing in nature and increasing accessible natural greenspace (RSPB, 2020). Representatives from Climate Assembly UK also strongly urged the government to design economic recovery measures to help reach net zero emissions (Harvey, 2020). There are increasing calls from experts to develop "greener" fiscal response, targeted public spending combined with removal of

[6] Note that the total global numbers vary significantly between different estimates. Reuters estimated by global stimuli reached "15 trillion and counting" by early May (Wilkes & Carvalho, 2020), while Bloomberg indicated a number of 12 trillion by early June, and IMF and IEA posited a 9 trillion figure.

fossil fuel subsidies and carbon pricing (Hepburn et al., 2020; Barbier, 2020; IMF, 2020; The Economist, 2020).

This combination makes sense from both the ecological perspective (i.e. progressing towards the climate targets) and the economising perspective, as evidenced by various accounts. A number of studies have found that green investments provide strong economic returns. McKinsey & Company (2020) analysis of stimulus options for a European country found that investing €75 billion to €150 billion of capital could produce €180 billion to €350 billion of gross value added, leading to three million new jobs, and enabling carbon-emissions reduction of 15 to 30% by 2030. Hepburn et al (2020) surveyed 230 leading economists and officials globally and concluded that stimulus measures targeting good environmental outcomes can produce as much growth and create as many jobs as environmentally neutral or detrimental measures. Another econometric study (Garrett-Peltier, 2020) concluded that government spending on renewable technologies or energy efficiency (industrial energy efficiency, smart grid, mass transit) create five more jobs per million dollar invested than spending on fossil fuels. These areas are also highly recommended by McKinsey & Company as satisfying economic recovery whilst promoting emissions reduction. A study from Oxford University (Hepburn et al., 2020) found green projects create more jobs, deliver higher short-term returns per pound spent by the government, and lead to increased long-term cost savings. Focusing on low carbon energy system development and infrastructure is also a key recommendation in Blondeel (2020) study. Overall, these future-oriented accounts of sustainability provide strongly support the case for green recovery and the combination of the ecological and economising logics.

The reality of stimulus packages – economising over ecological logic

Green measures account for 'loose changes'

The focus on addressing the immediate economic and health fallouts of the pandemic has relegated climate change to the background. To date, very little of the $9 trillion of fiscal spending during the COVID-19 has been directed towards green measures. As noted by Helm (2020, p. 25), "*In the very short term, the coronavirus has dominated almost all political and administrative bandwidth, with little time to pursue other environmental priorities*." In contrast, during the 2008–2009 Great Recession, the G20 and other economies allocated nearly 16% of their total fiscal stimulus to "green investments" (Barbier, 2010, 2016).

Since the beginning of the COVID19 pandemic until September 2020, G20 has committed at least USD 380.91 billion to supporting different energy types (Figure 1). Of this, USD 178.51 billion are for unconditional fossil fuels, USD 27.09 billion for conditional fossil fuels, USD 46.98 billion for unconditional clean energy, 88.60 billion for conditional clean energy, USD 39.73 billion for other energy. In other words, 35% are dedicated to clean energy (12.3% unconditional and 23.3% conditional) (IISD et al., 2020). But this various vastly between countries, with China and the UK proportionately allocate the highest to clean energy, whilst Italy, Mexico and Turkey allocating almost 100% of fossil fuel energy (IISD et al., 2020). Despite these seemingly respectable amounts, they account for a minimal proportion of total stimulus packages. Bloomberg (2020) estimates that a mere 0.2% of the value of stimulus packages has been targeted to climate change priorities.

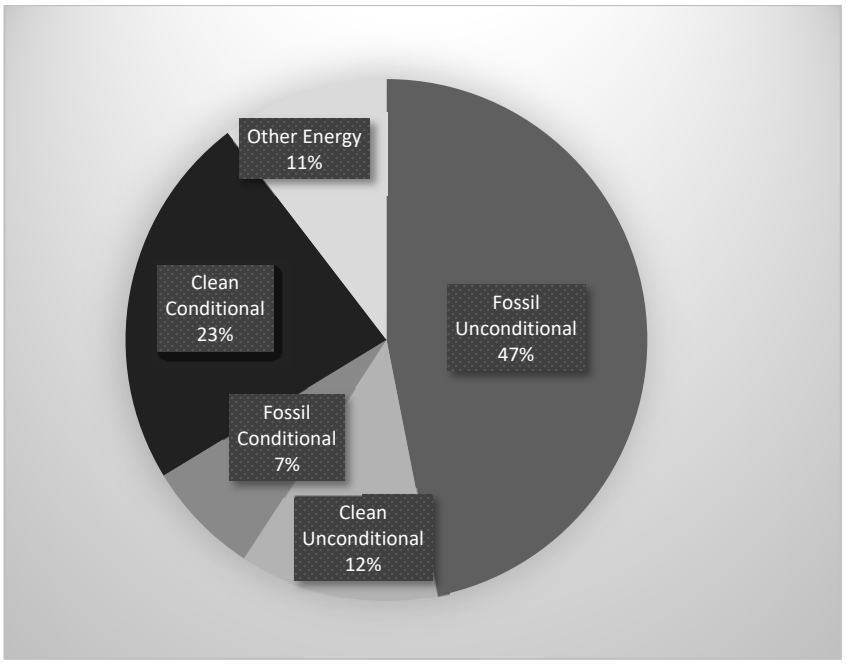

Figure 1*: Distribution of energy support packages among G20 countries as of September 2020 (Energypolicytracker.org)*

Overall, accounting for the funding for green measures indicates that an ecological mode of growth is not the focus of Covid-19 stimulus packages. This is worsened by the significant amount devoted to bailing out polluting sectors as part of these packages.

Bailouts and fossil fuel subsidies still dominate

A new report has found that since agreeing to the Paris Agreement, G20 countries have acted directly counter to it by providing at least USD77 billion a year for fossil fuel subsidies through their public finance institutions. In total European aviation companies have sought 38 billion US$ bailouts, without binding environmental conditions (Tucker & DeAngelis, 2020). In the UK, industries such as aviation, automotive and oil and gas services have been among the largest recipients of Bank of England loans, according to Greenpeace's Unearthed (Boren, 2020). VividEconomics, ranked the stimulus packages of major 17 economies as "nature friendly" or "nature unfriendly" (Green Stimulus Index), and suggested that only the UK, France, and the European Union are ranked as "nature friendly", while potentially damaging contributions dominated the packages by other countries. Of the more developed countries, the United States stands out as the largest scale risk, joined by Australia, Italy and Japan. Though roughly 30% of the stimulus (US$3.5 trillion)[7] are pumped into environmentally-related sectors, most governments are failing to utilise this support to secure environmental benefits (ViVid Economics, 2020). For example, the US there is insufficient underlying environmental performance, widespread deregulation of environmental standards (the announcement of environmental standards pushed back indefinitely), and unconditional airline bailouts ($60 billion) and support to other polluting sectors ($25 billion to the transportation, and

[7] This is based on 11.8trillion stimulus package estimated by July 2020.

$23.5 billion to agriculture). In Australia, some of the damaging measures include: financial fee relief to fossil fuel firms, $437 million support to airlines and airports, suspension of conversation laws in logging industry, opening land for coal and gas exploration[8] (VividEconomics, 2020). China, one of the major contributors to global emissions, allocated $500 billion to new infrastructure, mostly to carbon intensive infrastructure. They also dropped the national energy-intensity targets and environmental standards for firms, and have approved many new coal plants, including $6.6 billion for coal infrastructure and tax-incentives and fast tracking approval process for clearing forests for industrial use (CarbonBrief, 2020).

Hence, despite calls from experts and public pressure, governments around the world continue to introduce stimulus packages and budgetary measures that focus on restarting the old business model. Their discourses may have suggested that they supported climate action, yet, quantifying the exact funding devoted to climate/environmental initiatives show that insufficient effort has been exerted into low-carbon investments and technologies, whilst significant amounts have been approved to support polluting sectors. The lack of environment-related binding conditions on the bailouts and funding to polluting sectors mean that post-Covid economic growth might increase emissions levels and threaten the achievement of warming targets.

Accounting for the amounts dedicated to green versus polluting measures as part of stimulus packages helps highlight the tension between the economising and ecological logics in government fiscal response. Again, this tension reinforces the tension already observed in the general climate response, that economising logic triumphs above the ecological one, though there is some compromise towards the latter in the form of some dedicated, albeit small, funding to environmental measures. Different from the climate science and climate response, there have not been sufficient physical accounts to assess to potential climate impacts of the Covid-19 stimulus packages and specific initiatives. There have only been vague warnings from experts, based on the past 2008-2009 recession, that a lack of green recovery will lead to the reinstatement of pre-Covid emissions levels and threaten the achievement of Paris agreement targets.

6. Accounting technologies for a climate-friendly stimulus package

The above sections highlight that accounting technologies, in particular accounts for sustainability and unsustainability, and budgetary processes, play an important role in disseminating and entrenching different logics, be it ecological or economising ones. Whether ecological logic might dominate or be balanced against economising logic is critical in establishing Covid-19 stimulus package that do not sacrifice Paris Agreement progress and still moves the world positively towards the desired warming targets. In this section we focus on how different accounting technologies can be embedded within government's budgetary processes to ensure effective planning, monitoring and accountability towards climate objectives and targets.

As discussed in the Introduction section, accounting technologies encompasses the artifacts, the processes and the uses, and the knowledge by individuals using the technologies. The analysis in Sections 4 suggests that most accounting technologies in the climate science and climate response have been accounts for emissions or emission reductions, i.e. the artifacts, and their respective uses in supporting ecological or economising logics. Additionally, the development of stimulus packages is potentially supported by measures and indicators (artifacts) that simultaneously satisfy ecological

[8] Some small green support has been announced, such as hydrogen funding and battery energy storage systems.

and economising objectives. However, in reality, accounting technologies have not been explicitly integrated in the planning, implementation and review of the stimulus packages.

Consequently, we develop a framework to explicitly integrate accounting technologies in the design, delivery, and review of Covid-19 stimulus package (Figure 2). We posit that the design and use of accounting technologies need to be broadened to capture the artifacts (the metrics, measures, criteria, indicators, budget document), the processes and the uses (reporting, budget allocation, risk assessment) as well as the knowledge by the users, i.e. the oversight body and auditors who oversee the appropriateness of the these artifacts and processes in achieving the prescribed policy goals and objectives. Note that all the levels discussed below will necessarily involve all the three aspects of accounting technologies.

To illustrate the use of this framework, we refer to the specific example of NZ. NZ provides an interesting case to show how the pandemic can pivot a government's policies as NZ passed Zero Carbon Act on 13 November 2019, and besides the United Kingdom, it is among the only two countries in the world for having this legislation in place. This legislation sets dual long-term targets for emission reductions, namely i) reducing net emissions of all greenhouse gases (except biogenic methane) to zero by 2050, and ii) reducing emissions of biogenic methane to 24–47 per cent below 2017 levels by 2050, including to 10 per cent below 2017 levels by 2030. A series of emissions budgets will be established as stepping stones towards these long term targets. This legislation clearly shows that climate change is one of the biggest challenges and priorities for NZ government. Examining the potential of accounting technologies within the case of New Zealand will help provide a stronger case for the formal monitoring and surveillance of climate implications and commitments within Covid-19 stimulus packages to ensure that we do not digress on what has been achieved to fight climate change.

This framework will allow the balancing of climate change objectives and other objectives in the development and delivery of Government's budget during and post-Covid pandemic. It will stimulate an economy that creates jobs and a welfare base that ensures social justice, whilst moving NZ towards a lower-carbon future. This is achieved by explicitly integrating accounting mechanisms into the budgeting framework that emphasizes investment modelling, performance evaluation, reporting and accountability. It comprises of five levels.

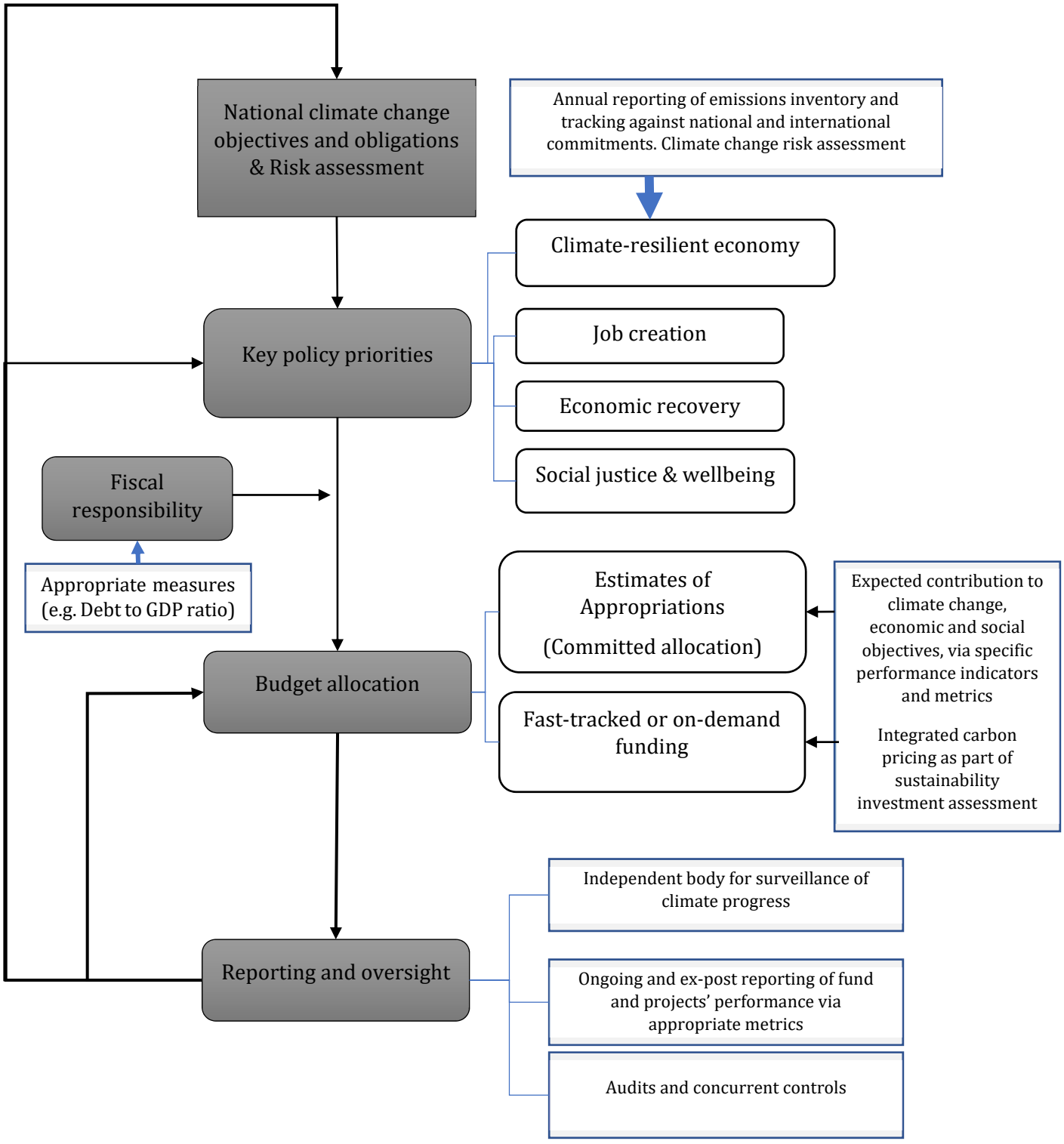

***Figure 2**: Framework for COVID19 budget stimulus packages and accounting technologies*

1st level: Climate objectives and obligations and climate change risk assessment (ecological logic)

In this first level, the government needs to review the country's climate objectives and obligations, on both short term and long term. Accounting reports are critical at this stage, such as reporting from Ministry the the Environment and review from the Climate Change Commission regarding NZ's progress in moving towards zero emissions targets and achieving its Paris Agreement obligation.

Under Zero Carbon Act, this annual and medium term reporting is provisioned for. The website of the Ministry for the Environment provides information on NZs's greenhouse gas emissions inventory and an interactive tracker to enable the public to assess the changes in emissions levels over time.[9] For example, it is reported that in 2018 NZ's gross emissions were 78.9 million tonnes, representing 24% increase compared to 1990. The key indicators used in this reporting is gross emissions, net emissions (gross emissions less removals, change in land use and forestry) breakdown of emissions by gas type, by sectors, and by year (MfE, 2020a). It is interesting, however, that such reporting does not allow for the tracking of emissions inventory against NZ's Paris agreement NDCs or its Zero Carbon Act targets. Hence, we argue for the need for additional indicators, e.g. the *gap* between current emissions and NDC targets or allowed emission levels under various national and international reduction targets. This will provide more transparency of NZ's progress towards fulfilling its climate commitment.

Climate change risk assessment is also critical at this stage. What are the key risks and opportunities and the challenges with regards to climate change for the country? What are the country's main capabilities and resources to deal with these risks? Understanding those risks and resources will enable the determination of what strategic policy priorities for the coming year and the forecast period (medium to long term). The Zero Carbon Act 2019 requires a risk assessment at least every six years. The first National climate change risk assessment for NZ was published in August 2020, served two purposes. First, it identifies the most significant risks and opportunities for NZ. Second, it highlights gaps in the information and data needed to properly assess and manage the risks and opportunities (MfE, 2020b). This report hence identifies 43 priority risks across five value domains (natural environment, human, economy, built environment and governance) and highlights 10 risks considered to be the most significant that require to be urgently addressed via Government's priority actions, including a national adaptation plan (MfE, 2020b). These risks will directly inform the Government's priority areas for the budgeting year in the second level.

The role played by independent monitoring will ensure effective and accountable reporting of performance and risk assessment. An independent Climate Change Commission was established in mid-December 2019 as part of ZCA to provide advice to Government on climate change mitigation and adaptation, and to monitor progress towards the new 2050 target emissions budgets and the implementation of a National Adaptation Plan. Hence, we suggest that the annual reporting of emissions inventory and risk assessment report by the Ministry for the Environment will need to be independently reviewed and assessed by the Climate Change Commission, and such review be made available to the public alongside the government's reporting.

[9] https://emissionstracker.mfe.govt.nz/#NrAMBoEYF12TwCIByBTALo2wBM4eiQAc2RSW0QA

2nd level: Government key priorities for the coming year (multiple logics)
In the second level, at the start of each budgetary cycle, the Government identifies the key budget priorities. Examples of key priorities during the Covid-19 times would be job creation and economic recovery. Besides, governments need to address social well-being and justice caused by the pandemic and lockdown measures. Governments that have climate commitments will also place climate response as a core budgetary priority. Risk assessment and annual emissions reporting in 1st level would inform which level of prioritisation to be placed on climate-focused objectives.

In 2019, the policy statement of 2020 NZ Budget clarified that climate was not only one of the give budget priorities.

- Just Transition – Supporting NZers in the transition to a *climate-resilient*, sustainable and low-emissions economy
- Future of Work – Enabling all New Zealanders to benefit from new technologies and lift productivity through innovation
- Māori and Pacific – Lifting Māori and Pacific incomes, skills and opportunities
- Child Wellbeing – Reducing child poverty and improving child wellbeing
- Physical and Mental Wellbeing – Supporting improved health outcomes for all New Zealanders.

It is clear from these five priorities that climate was of the highest order, followed by economic (innovation and technologies) and social concerns (skills, well being and health). However, the Budget announcement in May 2020 changed these policy priorities. In making the budget announcement in May 2020, the Government emphasized the health, social and economic challenges rather than the climate change urgency. There is a significant shift from a long term approach and environmental concerns with the five priorities of 2019 to those that focus on "immediate needs of New Zealanders", targeting short term adaptability and the economy (Jacinda, 2020). Further, the Government justified this shift that the long term challenges such as climate change takes more than single year budget to mitigate:

> *We know that we cannot meaningfully address long-term problems like child poverty, inequality and climate change through a single Budget. This is why the Government committed to taking a wellbeing approach to Budget 2020 and beyond to build on the successes of our first Wellbeing Budget.* (Jacinda, 2020).

Had the Government be required to incorporate the risk assessment that highlighted the 10 risks that demanded urgent action, it is hard to see how the government can justify why Budget 2020 push climate action to future generations and political terms rather than in the coming year.

Unsurprisingly, this step requires the consideration of multiple and potentially conflicting logics, not only ecological (climate change), economising (economic growth), but also social (jobs, wellbeing, etc.) and particularly health-related. Stimulus packages in response to a pandemic naturally will prioritise economic and social objectives. Our emphasis is that to ensure that the Government does not degrade its climate progress, climate-focused accounting technologies (accounts, indicators) need to be formally integrated in the policy setting and budgetary processes. Further, the independent monitoring by the Climate Commission further makes it hard for government to ignore its climate commitments.

3rd level – Setting fiscal responsibility (economising logic)

The third level involves setting the overall expenditure for the budget/stimulus package. It is very important when setting annual budget that governments stay within certain fiscal limits (one type of accounting technology). The most often indicator used to measure the fiscal responsibility is debt-to-GDP ratio, the ratio between a country's government debt and its gross domestic product (WB & IMF, 2001). This indicator is a key tool of economising logic – as it ensures that growth is not achieved at excessive debt, which in turn requires future tax increases and resultant decreasing investment and consumption, less employment and lower output growth (Afonso & Jalles, 2011).

Pre-Covid, the NZ Government remains committed to a prudent fiscal strategy, presented by a target of a range between 15 and 25 per cent of GDP (NZ Government, 2019). The choice of a range target serves several purposes. First, it provides a degree of flexibility for the Government to use debt to progress high-value investments in New Zealand. Second, it encourages a longer-term perspective for fiscal policy by allowing the Government short-term volatility in net debt (NZ Government, 2019).

By June 2020, stimulus package involved $62.1 billion including of the $12.1 billion Economic Recovery Package and $50 billion COVID-19 Response and Recovery Fund (CRRF), being funded by increasing public debt. Hence, NZ's net core Crown debt as a percentage of GDP is forecast to increase from around 20% pre COVID-19 to more than 50% by 2023 (The Treasury, 2020). This number is small compared to some major countries, such as the US, Japan or Italy, where public debt exceed GDP (Gramlich, 2020).

Despite the unprecedented challenges of the pandemic, it is important the Government recognises and sets a limit on its debt-to-GDP ratio to ensure that future growth and social wellbeing of the next generations are not sacrificed by the fiscal response of a current crisis. Accounting technologies here support the economising logic by ensuring that stimulus packages do not sacrifice long term fiscal sustainability in achieving various competing objectives such as ecological, economising (economic growth), social or health.

4th level: Budget allocation to green projects and project-specific KPIs (balancing ecological with economising and social logics)

Once the key priorities are identified and the overall amount (total value of stimulus package) determined based on fiscal responsibility principles, the fourth step involves allocating the budget to specific programmes and projects. Here we only focus on how to allocate funding to ensure that climate-related objectives are achieved.

As seen above, the stimulus package has two components: the core part of the budget, called Estimates of Appropriations, comprise the $12.1 billion Economy Recovery Package, relate to the main sectors/areas of priority, and the $50 billion of CRRF, relating to fast-tracked and on-demand infrastructure funding allocation, of which $30 billion are committed and $20 billion unallocated.

As discussed, the focus of the NZ government is to "get the economy moving again" and "positioning NZ for an economic recovery" (Robertson, 2020). Among these big committed expenditures, it is apparent that economising and social logics dominate. For example, roads, infrastructure investment and bailouts for various sectors aim at an economising logic while extension of the wage subsidy, disability support, and extension of school lunches target disadvantaged populations and communities from a social logic perspective. Besides, the ecological logic is served by dedicated funds for environmental purposes, the largest of which is the $1.1billion for creating environmental jobs

(e.g. for cleaning waterways), boosting funding for home insulation and the $1.2 billion rail project (Figure 3).

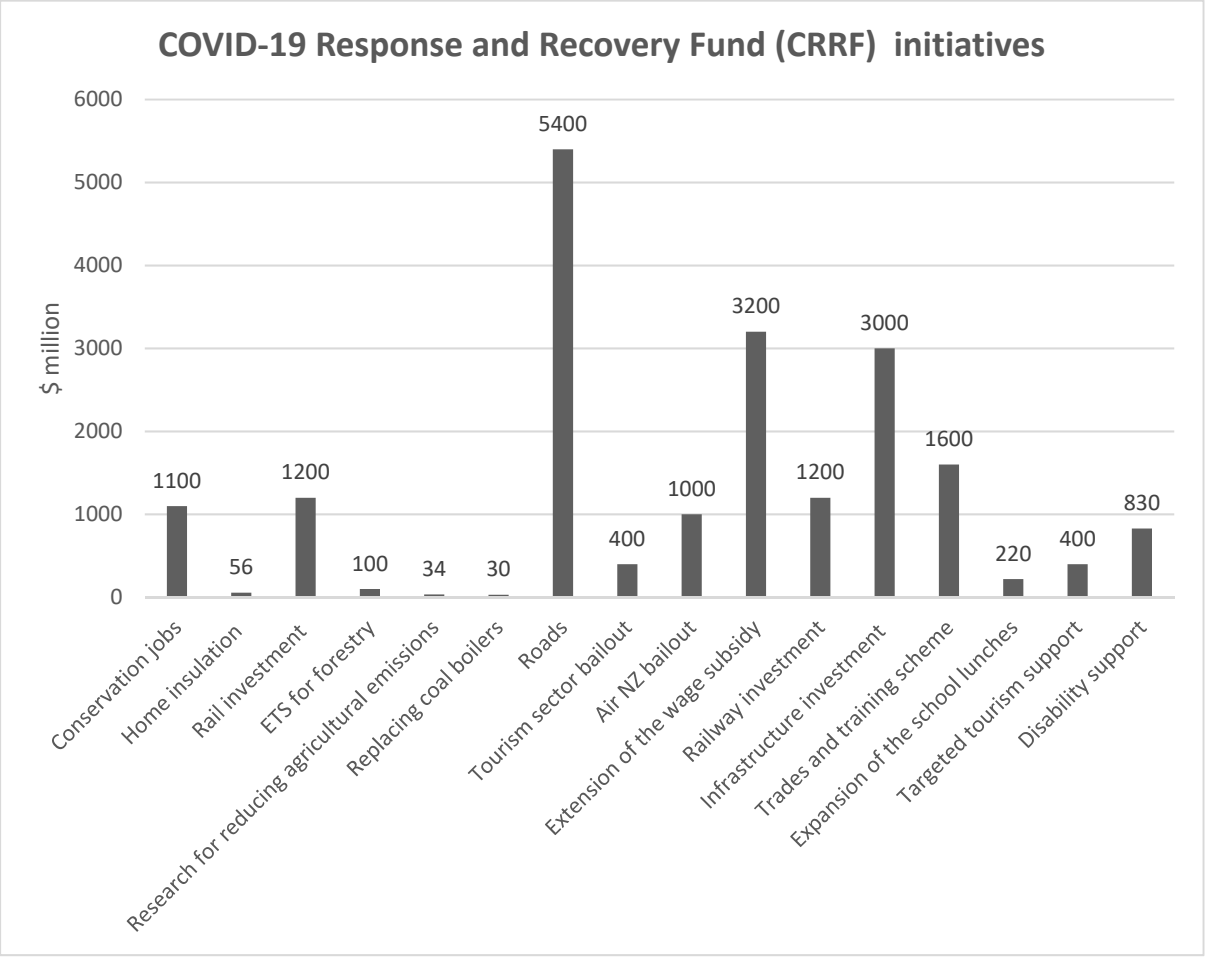

***Figure 3**: Covid-19 Response and Recovery Fund initiatives of NZ Government*

(graph created by the authors based on official data released by the Treasury)

The Budget 2020 have received criticisms from climate change experts. Greenpeace pointed out that the environmental funding is minimal in the total budget. "*Unfortunately there's only account for "loose change from Grant Roberson's pocket to address our most pressing existential challenge- climate change"* (Norman, 2020). For example, the $1.1 billion for cleaning waterways though welcomed do not address directly climate change. Investing in rail upgrade might not necessarily reduce emissions if diesel or bunker fuel locomotives and ferries are continued to be used (Climate Commission, 2020). Not only the Budget 2020 did not deliver on climate promises of Budget policy 2019 and the ambition of ZCA, it also further perpetuates the increasing emissions trend. For example, Budget 2020 dedicated extensive funding to bail out polluting industries: $400 for tourism, and $600 for aviation. These decisions are likely to create path dependency as *"[if you choose] the wrong directions in the very first phase, well actually at the second phase it becomes proportionally harder to make different decisions*", i.e. revering the trend of increasing emissions (Daalder, 2020). In other words, the domination of the economising logic in the stimulus package would have negative climate impacts.

As part the Estimates of Appropriations in Budget Policy Statement 2019, the allocation to climate change objective is not significant (Figure 4): $127 in 2018 for Green Investment Fund and National New Energy Development centre, and $229 million in 2019 for productive and sustainable land use package. In 2020 there are no direct initiative that relates to reducing emissions and climate change mitigation or adaptation. The investment in rail infrastructure is needed, and it helps supporting lower-carbon public transportation. However, this leaves private transport untouched, such as the move to electric cars or improving bus systems. Conservation jobs though benefiting the environment, does not help to directly reduce emissions. Investing in forestry ETS helps to incentivise more forestation, which helps with offsetting, and not emissions reduction at source. The small amount funded to climate initiatives suggest that there is some compromise for ecological logic, but this is insufficient to realise NZ's climate commitments.

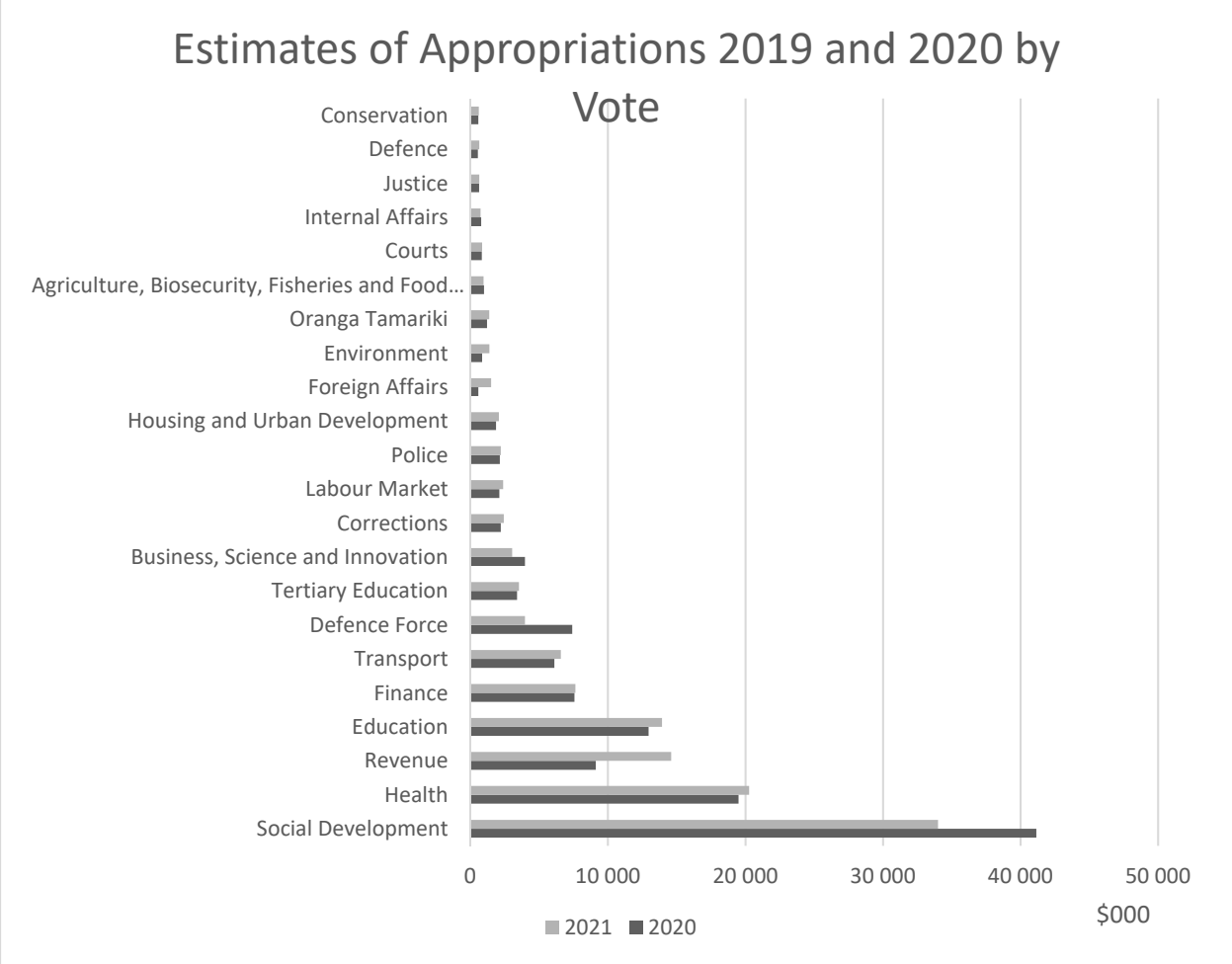

***Figure 4**: Estimates of Appropriations in Budget Policy Statement 2019 for 2019 and 2020*

(graph created by the authors based on official data released in the document)

It is important that the stimulus package requires formal accounting technologies dedicated to climate objectives, to ensure the balancing of ecological and economising logics. In the annual budget of 12.1 billion, certain votes (sectors) relate specifically to climate objectives, i.e. environment and conservation, hence it is natural that there are specific KPIs developed for these votes to track

progress against climate targets and objectives. For the other votes, especially economy and construction, to ensure that they do not go against or degrade climate progress, the budget allocation should include a requirement/condition of how their spending contributes or does not sacrifice climate change objectives, for example, not increasing emissions levels than current levels. This aligns with suggestions in the extant literature. For example, Blondeel (2020) called for bailouts for fossil fuel companies or heavy emitting sectors to have conditions that require firms to reduce their climate impact, phasing out of fossil fuel subsidies and no easing of environmental regulations.

The $50 billion of extrabudgetary fiscal response and the associated shovel-ready projects to be funded under it are an area that has attracted intensive public concern. A Bill, titled COVID-19 Recovery (Fast-track) Bill and released on 15 June 2020, designs an fast consenting process for infrastructure projects. Accordingly, fast-tracked projects will have resource consents processed in 70 working days, instead of four to six months. Under this Bill, the Minister for the Environment will identify projects to go into the fast track process, and they will be considered by an Expert Consenting Panel. This Bill provides that the Minister will "have regard to" a 'public benefits' test involving whether the project contributes to New Zealand's efforts to mitigate climate change, and strengthens our environmental, economic, and social resilience, However, the Climate Commission pointed out that this is insufficient to safeguard New Zealand's climate progress:

> *In our view, given the significance and increasing urgency of responding to changes in our climate merely "having regard to" the matters above is inadequate* (Climate Commission, 2020).

This "having regard to" provision indicates a compromise approach to competing logics – whereby a dominating logic may give some leeway or space for the secondary logic to exert influence (Carlsson-Wall et al., 2017). However, only considering climate issues in assessing projects is not sufficient as certain polluting projects may still be chosen to be fast-tracked if the Minister can justify that he had considered climate issues but it is impractical for such projects to achieve emissions reduction. Alternatively, certain polluting projects might be chosen to focus on economic and job creation, being justified that emissions reduction will be achieved by other fast-tracked projects. This 'compromise' approach will threaten the NZ Government's climate commitment due to the risk of different projects offsetting each other in terms of emissions impact and hence making no difference to or causing a net increase to NZ's emissions levels. There need to be environmental safeguards to ensure emissions-intensive projects are not approved (Climate Action Tracker, 2020).

This Bill have caused significant concerns for environmental experts as it removes the provision for public engagement and input into major infrastructure projects. This has been warned as reducing "the transparency of decision making, removing the check on "the discretion of decision makers, and producing less defense of the environment as well as less robust debate" (AsiaPacific Infrastructure, 2020). Existing literature is unanimous regarding the benefits of public and stakeholder engagement in assessing sustainability projects. Such engagement, when conducted in an open and participatory manner, enables systematically ranking the potential conflicts and considering and combining multiple viewpoints of stakeholders (Bahadorestani et al., 2020), allows sensitivity to issues of values, plurality and local knowledge (Brown, 2009).

An example of where a trade-off is made without adequate public engagement is the case of a private "green" school that received $12 million funding under the $3 billion government funding for shovel-ready projects as part of the CRRF fund. The Minster for the Environment, James Shaw, justified that

the project complied with the criteria under the Bill, "it was given the green light because it ticked all the boxes, including offering quick jobs in a region that needs them as part of its transition away from fossil fuels". This funding has been slammed as "unacceptable, elitist, and completely inequitable" as this worsen the gaps between high and low socio-economic schools and regions (Sadler, 2020). This case highlights the prioritisation of climate change and employment objectives at the expense of social equity. Hence, it is crucial that fast-tracked projects need to involve stakeholders, and any trade-offs be clearly justified. The justification will more transparent when the positive and negative impacts on various social, economic and environmental aspects are quantified using accounting technologies.

The Climate Commission proposes six criteria that the Government should use in making decisions to help deliver an economic recovery that keeps New Zealand on track to achieve our climate goals (Climate Commission, 2020). In particular, they require that stimulus investments need to "deliver long-term climate benefits", "maintain incentives to reduce emissions and adapt to climate change" and "change how we measure the success of economic recovery". In a similar lens, UN's Secretary-General, Mr. Guterres proposed that stimulus packages must deliver six climate-related actions to shape the recovery (UN's Secretary-General, 2020), including, among others: ending fossil fuel subsidy, business bailout with ties to achieving green jobs and sustainable growth, incorporating climate risks and opportunities in the financial system and public policy making and infrastructure. His suggestions highlight the potential of accounting to enable the green recovery via clear indicators, criteria/standards that emphasize green jobs and growth, as well as enable the measurement and modelling of climate change risks and opportunities.

It is via the combination of multiple criteria that speak to different logics that accounting technologies enable the combination of logics towards a model of green recovery. Inevitably, in some case, the consideration of multiple criteria will lead to the awareness of tension and a trade-offs may be required, especially when certain logic is dominant. For example, significant funding is dedicated to Covid-19 health response and it is unreasonable to expect that the health response needs to deliver climate benefits. However, as far as economic recovery is concerned, the economising logic needs to be balanced, and combined with the ecological benefit whenever possible. It is generally desirable to specify the relevant climate objectives and criteria as completely and realistically as possible before projects are designed and considered by the government (Marcelino-Sádaba et al., 2015). The criteria and the associated measures as part of sustainability project assessment can be financial, focusing on the monetary benefits gained from sustainability or non-financial, focusing on the natural resources invested (Gasparatos & Scolobig, 2012).

According to McKinsey & Company (2020), these indicators need to capture a wide range of considerations including, social and climate benefits, timeframe and feasibility (Table 2). Clarifying these criteria and associated indicators will allow the balancing of various objectives and logics. For example, stimulus measure that can be implemented immediately as it requires minimal training or planning. When considering carbon reduction, short term and immediate reductions should be balanced against measures that take longer term but once deployed widely can produce widespread decarbonisation effect.

Table 2: *Examples of indicators to assess funding for stimuli initiatives (adapted from McKinsey & Company, 2020)*

Considerations	**Examples of indicators**
Social economic benefits	Number of jobs created per unit of currency, GDP or gross value added, or benefits to particular sectors
Climate benefits	Tones of GHG avoided or removed per year, or enabling other emissions reducing changes.
Timeframe for stimuli to take place	Short term versus long term indicators e.g. Short term: less than one year/12 months Medium term: 2 years to 5 years Long term: over 5 years
Timeframe that carbon emissions are reduced	Short term versus long term indicators. The timeframe can measure the delay from implementation to the time where emissions reductions are achieved. e.g. emissions reduced within one year; emissions reduced from 2 to 5 years, emissions reduced after 5 years. Indicators of whether the emissions reductions are one-off or ongoing. e.g. emissions reductions are one-off, or ongoing for a number of years (specify the years)
Feasibility	Difficult versus easy implementation. Qualitative measures, using a 3-point or 5-point Likert scale from "very easy to implement" to "very hard to implement".

A more direct way to ensure that all fast-tracked projects contribute to climate progress is via carbon pricing. As discussed above, carbon pricing remains one of the most widely adopted policy mechanism to incentivise low carbon investment. The danger of Covid-19 stimulus package is in over-allocation to polluting projects at the expense of low-carbon projects. To prevent suboptimal investment into polluting projects, such projects need to incorporate appropriate levels of carbon pricing. IMF (2019) suggest that Paris Agreement pledges for 3°C warming a can only be achieved at a price from $US35 to $US70, but a price over $US70 will be required to attain the 2°C warming target. The investment modelling and assessment of the proposed projects need to incorporate such carbon prices. The reformed NZ Emissions Trading Scheme in June 2020 had lifts the cap on the price of carbon from NZ$25 (US$17) to NZ$35 (US$23) per New Zealand unit. However, to achieve its climate obligations, the Government will need higher carbon prices. It is estimated by various modelling studies by The Concept, Motu and Vivid (CMV) and New Zealand Institute of Economic Research (NZIER) that economy-wide carbon prices need to rise in the range of $75-885/tCO2 to achieve net zero emissions or a stabilised methane target in 2050 (MfE, 2019).

The appropriate level of pricing will need to be adjusted annually or aligned with the Climate Change Risk Assessment, and the monitoring of performance against Paris Agreement obligation and ZCA targets. Carbon pricing directly delivers the combination of ecological and economising logics, whereby only projects that deliver sufficient financial returns whilst not being polluting. In a similar lens, low-carbon projects can benefit from carbon pricing by monetarising the cost savings from future emissions reductions. When this is not possible, these projects can be supported by physical accounts of emissions reductions, and hence comparative analysis can be made among competing projects in terms of climate benefits. Such monetary quantification of benefits and costs via carbon pricing will ensure that investment assessment not only minimise negative effects, but also produce sustainability gains and encourage positive steps towards a low-carbon economy (Bond et al., 2012).

5th level: Reporting and oversight mechanisms

Reporting and accountability mechanisms are crucial to ensure the on-going monitoring of projects and budget spending against committed objectives (logics). There has been extensive body of literature on social and environmental disclosure (Hahn & Kühnen, 2013; Gray et al., 1996), yet there is little research focused on reporting by public sector organisations (Ball & Bebbington, 2008; Guthrie et al., 2010; Osborne & Ball, 2011). However, it is increasingly expected that public sector organisations, especially those with an explicit environmental mission, would disclose environmental information to the public (Lodhia et al., 2012). The estimates of the quantified benefits and costs, such as emissions reduction, efficiency gains, carbon cost savings, that have been used as part of assessing and approving these projects, should be continued to be used in the on-going monitoring of performance against the expected outcomes.

In addition to the annual reporting of emissions inventory and climate change risk assessment (every six years) as currently provisioned under the ZCA, the projects funded under Covid-19 Stimulus package should be subjected to the similar reporting mechanisms. The annual reporting from the Government (Ministry for the Environment and other relevant agencies in charge of environment-related activities) should include an assessment of the progress of the projects against the expected performance (in terms of emissions reduction or cost savings) and how they contribute to the achieving the ZCB targets and NZ's Paris Agreement pledge. This reporting will inform the risk analysis in the 1st step of the framework. The measures reported need to be high quality, consistent, and comparable, across government agencies, projects, and over time (Lodhia et al., 2012).

In case of shovel-ready projects, there should be a mechanism for public engagement and consultation, as this ensures accountability but also can stimulate subsequent change in policy making and decisions (Higgins & Coffey, 2016). The Climate Commission, set up under ZCA, provides a ready mechanism to infuse public accountability into the budgetary process. Specifically, any budget allocation and ad hoc investment allocation is to be subjected to the approval from the Minister of Climate Change, and fully consulted with the Climate Change Commission who will provide the expertise and advice on the appropriateness of the investment for and contribution to the climate change objectives. Indeed, various countries around the world has set up independent committees or commissions to oversee climate progress. For example, a citizen assembly in Ireland that enable the development of climate change action plan, a citizens' convention of climate in France, a cola commission in Germany to assist communities that are affected by phasing out of cola production, and a Just Transition unit for helping populations and communities affected by oil and gas transitions (Sasse et al., 2020). In Honduras, a civil society organization has monitored and supervised the fund's spending operations (Rahim et al., 2020). It is recommended that the UK set up a new climate emergency committee, led by ministers, to provide oversight over climate targets (Sasse et al., 2020). A discussion paper by IMF (Rahim et al, 2020) also suggests that extrabudgetary measures need to be governed by appropriate oversight, such as an independent management committee or board responsible for making strategic decisions, and a chief administrator to manage the fund's day-to-day activities.

Furthermore, information and transparency is never more important when there is a risk that climate progress is degraded in favour of economic and health imperatives (Espinosa, 2020). Furthermore, governments increasingly rely on extrabudgetary measures to support Covid-19 response and recovery, which represent a break from otherwise robust and unified approach to

budgeting and spending. The forgoing of important accounting procedures may threaten the accountability and transparency of these spending.

Secondly, ex-ante and ex-post assessment of the fund's effectiveness should be delivered via appropriate performance indicators (Rahim et al., 2020). There should be full disclosure regarding each project's expected climate, social and economic benefits, quantified and monetarised whenever possible (ex-ante assessment). The annual reporting by the Government should clearly track how the projects perform against these expected outcomes (ex-post assessment). Any trade-offs made at the point of consenting and funding the projects, as well as in the course of project implementation, need to be fully disclosed and justified to the public (Gibson, 2006). Where an investment may satisfy other objectives but not the climate change objectives, this has to be justified, and publicly available, and mitigation measures are put in place so that investment does not jeopardise the achievement of climate change objectives and obligations. The fast-tracking Bill should also preserve a mechanism in which public consultation and recall on the projects that have high likelihood of increasing emissions or make unacceptable trade-offs between climate, social and economic objectives. Overall, public and stakeholder engagement needs to take place at all major steps in any budgetary process if not continuously, and follow-up provisions to monitor and report back on implementation success (Bond & Morrison-Saunders 2012). Such engagement will deliver the best benefits when informed by multi-criteria indicators, ranging from timeframe of implementation and impact (long-term and short term orientation), nature of information (monetary and non-financial), objectives supported (climate as well as social and economic objectives) and feasibility (McKinsey & Company, 2020; Cinelli et al., 2014). Hence, multi-dimensional sustainability performance measures (Burritt & Schaltegger, 2012) will be useful to bridge and combine otherwise competing logics (Carlsson-Wall et al., 2017; Dai et al., 2017; Schäffer et al., 2015).

Some countries have put in place specific disclosure and oversight mechanisms to compensate for the relaxation of controls on crisis-related spending. These mechanisms include dedicated portals to publish information on the execution of COVID-19 spending. In Honduras, the portal covers both resources channeled through the budget and through EBFs, including one fund that finances nearly half of the COVID-19-related spending. In Togo, a dedicated portal provided daily updates on payments made on a flagship social transfer program. In both Côte d'Ivoire and Gabon, the authorities have announced the establishment of an independent audit of COVID-19-related spending (Rahim et al., 2020)

Besides, IMF also suggest that audit must be mandated and these audits be published in a timely manner (Rahim et al., 2020). Innovative mechanisms, such as interim audits and concurrent controls, can also be explored. A chart of accounts can also be used to control and track the implementation of policy measures, and report the revenues and expenditures from the funds on relevant government's websites (Rahim et al., 2020).

These reporting and oversight mechanisms will provide information and insight to inform the Risk assessment in the 1st step. Ideally, the independent and public oversight should also occur during the setting of policy priorities to ensure that climate objectives constitute an important pillar among any government's policies and ensure long-term commitment to climate change mitigation, beyond short term political cycles and government changes.

Overall, aligned with practitioner and scholar literature, we argue and set up a framework in which accounting technologies provide budgeting and planning, performance measurement, reporting and

oversight mechanisms to stimulus package and its associated funding, thereby ensuring climate objectives and progress are not sacrificed in the name of economic growth. Furthermore, the accounting technologies ensure that not only negative impacts are avoided but net climate gains are ensured and achieved whilst satisfying other criteria such as job creation, social equity and economic development.

7. Conclusion

The objective of this paper is to understand the role played by accounting technologies in enabling a sustainable fiscal response to Covid-19 pandemic without sacrificing the climate progress. Relying on secondary data, this paper has analysed the accounts associated with climate change, climate response and governments' Covid-19 stimulus package. An overview of the landscape surrounding climate change and climate response provides a big picture of the current logics operational in the space of climate politics. Based on this, we understand the urgency and yet inadequacy of climate policies and therefore realise the importance of utilising the opportunity of using the Covid-19 fiscal response to maintain, if not accelerate, progress on climate action.

The analysis provides the following insights. The accounts for climate change consequences and supporting the ecological (and social) logics are mostly physical and non-financial in nature, though they cover both short and long term, historical and future-oriented. They are consistent in promoting a grim picture of climate change which ideally would spur urgent and extensive climate action. In contrast, the accounts for economic costs of climate change vary significantly across different studies. Further, the relatively small economic benefits compared with significant mitigation costs, and in particular, the significantly higher costs of pursuing a 2°C target compared to a 1.5°C target, have justified relative inaction/ insufficient climate action by governments. These accounts highlight the constant tension and conflicts between ecological, social, and economising logics in setting climate policies. We argue that the reliability of accounting technologies (or lack thereof) may contribute to the action (inaction) at the international and national levels, and have underlined the domination of the economising logic over ecological one. We also argue that carbon pricing, as a proxy for the social cost of carbon, have not been effective in stimulating effective carbon mitigation. The effort to promote ecological logic within the boundaries of economic rationality might not work well given the urgency of climate change consequences.

Our second analysis focuses on the design stimulus packages and the extent they support climate objectives. Theoretically, stimulus package presents an ideal opportunity, a "once in a generation" chance to jumpstart the economy towards a green recovery model. The combination of the ecological and economising logics makes sense and are evidenced by various accounts that show green investments make strong economic returns. However, the reality of current stimulus packages is that green investments account for only 'loose changes' and bailout and funding for polluting sectors still dominate in the packages. Part of this is caused by the failure to incorporate accounting technologies, i.e. carbon-focused indicators, metrics, and criteria, in the planning of the package, and assessment and approval of specific budget allocations.

Based on the first and second analyses, we argue that accounting technologies can play a more meaningful role as part of stimulus packages to promote the movement towards a low-carbon economy. We propose a framework with five levels, within all of which accounting technologies provides the budgeting and planning, performance measurement, reporting and oversight mechanisms to stimulus packages and their associated funding, thereby ensuring climate objectives

and progress are not sacrificed in the name of economic growth. The integration of accounting technologies throughout the steps of designing and implementing stimulus packages ensure the combination of ecological and economising (and other) logics, specifically, net climate gains are achieved whist fulfilling satisfying other criteria such as social equity and economic development. This systematic approach would ensure that progress towards achieving warming targets is not sidelined and degraded in the pursuit of post-Covid economic growth.

Our paper makes the following contributions to the literature. First, it is among the first to provide an analysis of the role played by accounting technologies in the Covid-19 stimulus package. We argue that despite a strong potential, there have not been explicit effort to incorporate accounting in the design and implementation of stimulus packages and their associated initiatives. Second, we use an institutional logic perspective to explore how accounting technologies have been interweaved in disseminating climate science and developing climate response by various governments. The domination of the economising logic explains why despite overwhelming accounts for climate change consequences, climate response has been limited and potentially incapable of keeping the world within the 1.5°C or 2°C warming targets. Third, we suggest that the balancing and combination of ecological, social and economising logics can be achieved by the formal and explicit incorporation of different accounting technologies such as planning, risk assessment and annual reporting, setting fiscal responsibility limits, KPIs and metrics, and oversight mechanisms throughout the steps of designing and delivering stimulus package.

These insights will be relevant to general public, researchers, and policy makers. The general public will be further informed regarding the current struggle and debate in climate science and response, and how different accounts may promote a certain view of reality whilst being used by policy makers to justify action or inaction. The insights also emphasize the role played by practitioners, academics and stakeholders in providing the accounts, and utilising other accounting technologies, to hold governments responsible for undertaking appropriate climate action. Particularly, researchers should use their expertise to provide accurate and reliable accounts from different logics (perspectives) as such accounts enable public insight and scrutiny into government's' actions which in turn will motivate stronger government response towards addressing the climate change challenges. Policy-makers can utilise our framework to ensure that accounting technologies are appropriately integrated in their budgetary and fiscal Covid-19 response so that in addressing a short-term health and economic crisis caused by the pandemic, they do not sacrifice and forgo their long-term climate commitments and responsibility.

The study is subject to certain limitations. By relying on secondary data and existing literature, our analysis do not garner or reflect the direct perceptions or justification from governments. The accounts presented regarding the physical and economic costs of climate change and carbon mitigation do not aspire to be comprehensive, and hence our analysis is only as valid as the accounts and the data sources we gather. Further, the stimulus packages are evolving and there are constant alterations to reflect shifting challenges and priorities caused the pandemic, as well as public and political preferences. There will be emerging insights worth exploring as these stimulus packages are adjusted over time. Further, as most stimulus initiatives are only at the design stage, there would be research opportunities to examine the extent that accounting technologies are used in the implementation, monitoring and ex-post review of stimulus package and specific initiatives. Further, other studies can explore how the framework might work in the context of other countries, besides the example of NZ Government used in the paper.

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