IGES Institute for Global Environmental Strategies

Implications of COVID-19 for the Environment and Sustainability (Version 2): Perspectives from the Triple R (Response, Recovery, Redesign) Framework

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IGES

I. Purpose of the Position Paper (version 2)

COVID-19 has morphed from a dangerous regional health threat to an all-consuming global pandemic and economic disaster. COVID-19's rapid spread has had far-reaching implications on the everyday lives of people in nearly all corners of the world. In fact, as of October 2020, at least 50 million people globally have tested positive for the virus, and the official death toll exceeds a 1.5 million people. These numbers are rapidly growing as cold weather causes more people to come together indoors in the Northern Hemisphere. The sharp increase underlines the need for governments at all levels to coordinate cross-cutting and cross-boundary response and recovery programs.

Based upon the above understanding, IGES published its first position paper on this subject, entitled, "Implications of COVID-19 for the Environment and Sustainability" in May 2020 (IGES, 2020), after which relevant analyses and activities have been carried out. Moreover, in collaboration with national governments, international organisations, and other partner institutes, IGES has contributed to the establishment of several relevant platforms and prepared necessary guidelines on risk management.

Considering the progress achieved from May to November, this position paper (version 2) revisits how to factor environmental and sustainability concerns into decisions related to COVID-19. The paper focuses on issues particularly relevant to the pandemic such as medical waste management, wildlife-human relationships, and the adverse effects of air pollution, as they have substantial bearings on strengthening resilience in the future. In addition, a few untapped strategies such as changes in lifestyles and working arrangements are highlighted for bolstering future decarbonisation efforts.

The first position paper analysed COVID-19 and its implications from a short-term, medium-term and long-term perspective and suggested future actions. This paper builds on that initial analysis with a new framework called the "Triple R Framework (Response, Recovery, and Redesign)" (Zusman E. et al. 2020) and proposes a set of integrated and coherent measures based on that framework.

II. **Basic Approach**

The COVID-19 crisis was triggered by a combination of two related factors. The first factor is the "spillover" of a zoonotic disease or zoonosis (diseases that can be transmitted from animals to humans). As exemplified by COVID-19, the capture and trade of wildlife sometimes pose a threat to human health through this phenomenon. More troubling is tha studies on infectious disease outbreaks over the last few decades show that pandemics like COVID-19 are more likely to occur in the future (World Economic Forum, 2019). The second factor is the accelerated movement of people and goods across national borders, a characteristic of modern globalisation. The first factor enabled the transmission of SARS-CoV-2 (the virus causing COVID-19) from animals to humans, and the second factor caused it to spread to pandemic proportions.

The COVID-19 pandemic is closely related to many environmental issues and sustainability itself. With this relationship in mind, the 11th Petersberg Climate Dialogue, held in April 2020, attended by ministers from about 30 major developed and developing countries, agreed on the importance of a "green recovery,"which calls for an environmentally sustainable recovery from the economic crisis caused by COVID-19 as well as policies tackling climate change and other environmental priorities (Petersberg Climate Dialogue Co-Chairs, 2020).
Subsequently, the Japanese Minister of the Environment Shinjiro Koizumi held a ministerial-level meeting in September 2020 to set up an online "Platform 2020 for Redesign"[1], stressing the need to recover from COVID-19 while implementing measures to tackle climate change and other environmental crises. Here, it was agreed that in order to "build back better", it is necessary to incorporate the concept of "redesign" in moving towards a sustainable and resilient society.

Accordingly, these two international conferences confirmed the importance of recovery and redesign as critical building blocks for enhancing resilience to pandemics and other environmental emergencies. IGES has been advocating a consistent approach towards COVID-19, underpinned by this Triple R Framework as its foundation, in which "response" during an emergency is complemented by "recovery" and "redesign".

Figure 1 depicts the Triple R Framework, while Table 1 describes how the framework is related to the short-, medium-, long-term time frames adopted in the first position paper. The Triple R framework presents building blocks for realising a resilient society in the long run and can be used to plan, analyse, and evaluate different options and measures needed for various time frames. Generally speaking, the three elements of the Triple R framework, i.e. response, recovery and redesign, correspond to short-term, medium-term, and long-term measures.

[1] This platform is lead by the Ministry of the Environment, Japan, supported by United Nations, and managed by IGES.

Response refers to actions to address emergencies, which include mandates for masks, social distancing, teleworking, and even lockdowns when considered necessary. From an environmental point of view, emergency measures to deal with the rapidly increasing medical and other wastes could be an important response measure.

Recovery refers to programs (economic stimulus, etc.) aimed at stimulating a depressed economy and employment. The 'Go To' Campaign in Japan that aimed to promote local tourism and restaurants is a typical example. Recovery could be understood as an opportunity to create a better society. Thus, it is important to consider what should be incorporated into the program to "build back better". From the environmental perspective, not just any recovery but a *green* recovery is essential.

Redesign is a strategy for improving the post-COVID economy and society in the long run, compared to the pre-COVID world. While promoting digitalisation and decarbonisation are important long-term strategies, increasing societal resilience to pandemics like COVID-19 should be equally critical. Here, resilience is understood as "preventing pandemics from occurring in the first place, stopping their spread if they do occur, and minimising the damage they cause."

Figure 1: Triple R Framework Concept Diagram (platform2020redesign.org)

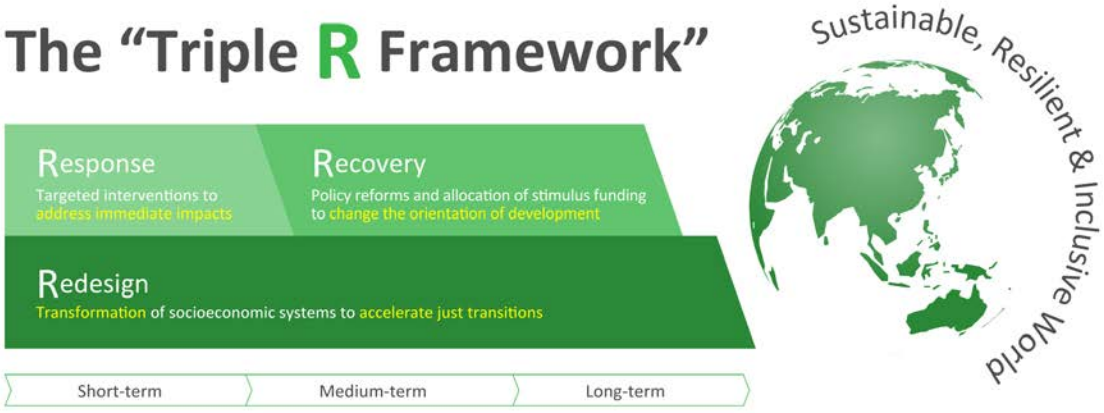


Table 1: Relationship between the Triple R Framework and the Short-Medium-Long Term Framework

	Time horizon	Nature of measures taken	Target stakeholders
Response	**Short term**	**Actions required immediately**	**Institutions and individuals currently seriously impacted**
Recovery	**Medium term**	**Programs by the government for reconstruction**	**Ministries, local governments, and sectors concerned with reconstruction**
Redesign	**Long term**	**Strategies, policies, knowledge systems necessary to build a sustainable and resilient world**	**Governments, both central and local engaged with transformation, companies committed to innovation, and individuals changing their lifestyles**

Broadly speaking, the underlying conditions that precipitated COVID-19 is an unsustainable economic system. Therefore, it is important to ensure environmental and sustainability feature in measures consistently across different time frames. Then, in view of the characteristics of COVID-19 and its countermeasures, it is necessary to promote them with the following three points in mind.

(1) Prevention of the spillover or zoonotic diseases from animals to humans, proper treatment of contaminated medical waste and countermeasures against serious air pollution are actions to strengthen resilience against infectious disease in the future. However, traditionally resilience has been promoted in the context of climate change adaptation and focused upon natural disasters, while playing down the implications of pandemics such as COVID-19. In this sense, this pandemic has broadened the scope of understanding on resilience to include the prevention of pandemics and action on closely related environmental issues.

(2) Achieving decarbonisation by 2050 is presently the most urgent global challenge. Energy efficiency improvements and significant expansion of renewable energy are among the key measures needed to achieve this goal. Meanwhile, lifestyle and workstyle changes introduced as part of COVID-19 responses and enabled by the rapidly spreading teleworking and teleconferencing were found to be

effective in curbing demands for land and air transportation and subsequent reduction of greenhouse gases (GHGs). It is important to pay sufficient attention to these non-traditional mitigation opportunities and consider policies to sustain them.

(3) About 90% of the COVID-19 infections occurred in urban areas (A. Guterres, 2020), and almost all treatment of medical wastes, responses to serious air pollution, and workstyle and lifestyle changes (essential elements of improved resilience) have taken place in urban areas. In other words, most key environmental measures take place in cities; in this sense, the role of local governments is more important than ever.

The Triple R Framework is generally understood to evolve in the order of Response, Recovery, and Redesign along the time axis. However, in reality, this linear model, in which response is completed when the pandemic is over, subsequently replaced by recovery for the depressed economy, after which redesign follows, is rarely applicable. At this point in time, for example, the pandemic appears in waves, which prolongs response actions, and leads to recovery measures that continue at the same time but in an intermittant and fluctuating manner. Similarly, redesign measures may also be introduced in parallel. For example, fossil fuel use may increase as the economy recovers but it may not exceed previous levels or lead to greater consumption of fossil fuel use over the long run. Thus, an increase fossil fuel demands should not be understood as inconsistent with the long-term expansion of renewable energy promoted as a part of green recovery.

In this way, the measures relating to each element of the framework are not always consistent. Still, overall, they need to be conceived as synergistic wherever possible, and consistent with a sustainable and resilient future. In this way, the consistency between each element of Triple R will be enhanced. As a result, the economy and society can effectively shift to a more sustainable and resilient path compared to that of business as usual (BAU). Here, it is essential to understand that economic recovery, job creation, and digitalisation can be designed to be compatible with sustainability and resilience, as elaborated below:

(1) Synergy with economy and employment: Greening the economy towards more sustainable and resilient could promote innovation, realise long-term economic growth, and generate employment opportunities.

(2) Synergy with digitalisation: There exist many synergies between digitalisation and greening infrastructure. For example, digitalisation is essential to the development of smart grids, electric vehicles capable of autonomous driving, and the promotion of zero-emission housing.

III. Response: Addressing Urgent Concerns

Governments around the world are currently taking measures such as declaring states of emergency and promoting social distancing to slow down the spread of COVID-19 and avoiding overwhelming healthcare systems. First and foremost, containing the infection to protect human life and cope with the associated socioeconomic impacts is of the utmost priority druing the respons phase. From an environmental perspective, effective measures to deal with increasing medical waste are vitally important.

1. Management of Medical Waste

With the increasing use of disposable masks, gloves and other medical devices, hospitals and other medical institutions in many countries are facing a rapid increase in medical waste (ADB, 2020). Due to the increase in waste, the need to respond to this problem is urgent, particularly in developing countries where waste treatment systems are vulnerable. To help address this issue, IGES started to work with UNEP and developed a report in September of this year. The report, entitled "Waste Disposal in the COVID-19 Pandemic: From Response to Recovery" (IGES/UNEP, 2020), has provided a set of technical guidelines based upon surveys and analysis.

The report demonstrates: (i) in West Java, Indonesia, medical waste increased by 30% between January and April of this year, (ii) developing countries have a limited capacity to implement the international guidelines to deal with medical waste prepared by the WHO (WHO 2020), and (iii) emergency response plans need to be developed in order to appropriately deal with limited capability.
Based on this report, IGES held an international session on medical waste in October this year as part of the International Forum on Sustainable Asia and the Pacific (ISAP) 2020.[2] The following three points were raised at the session:

First, it was confirmed that efforts to address medical waste related to COVID-19 can be implemented in a flexible manner, taking into account the amount of medical waste and the treatment capacity of each locality. For example, Japan was able to take appropriate measures by thoroughly implementing existing medical waste guidelines and utilising existing facilities. Indonesia formulated and strictly enforced new guidelines for COVID-19. In terms of disposal, cement kilns were utilised where appropriate, and the existing incineration facilities were fully utilised beyond their approved capacity when necessary. In this way, the maximum treatment capacity was secured based on adaptable strategies and approaches. Meanwhile, in Nepal the amount of medical waste was relatively small and concentrated in specific hospitals, making on-site autoclaving a viable treatment option.

[2] One session entitled
"Waste Management in Response to COVID-19: Exploring Ways of Response and Recovery", held on November 11, 2020.

Second, all countries reported that protecting waste management personnel from infection was critical, and preparing protections in advance was important. Even in developed countries like Japan, personal protective equipment (PPE) was not fully available. In fact, there was a competition between healthcare professionals to secure adequate PPE. In the future, it is important to stockpile PPE in advance for the proper treatment of infectious waste.

Third, it was reaffirmed that it is important to disseminate correct information about contaminated waste among the staff members concerned and the general public. COVID-19 is one of many infectious diseases. Therefore, the treatment should be carried out in accordance with the guidelines developed for other infectious wastes already in place. However, due to the newness of the pandemic and the spread of false information around COVID-19 risks, some staff involved in waste treatment were initially reluctant to be involved in the actual work. As a result, in some cases, there were serious impacts on not only waste that may be infected with the virus but also general waste. These cases reaffirmed the importance of sharing an understanding regarding contaminated waste among all stakeholders concerned, including the general public.

IV. Recovery: Paving the Way for Post-Crisis Green Recovery

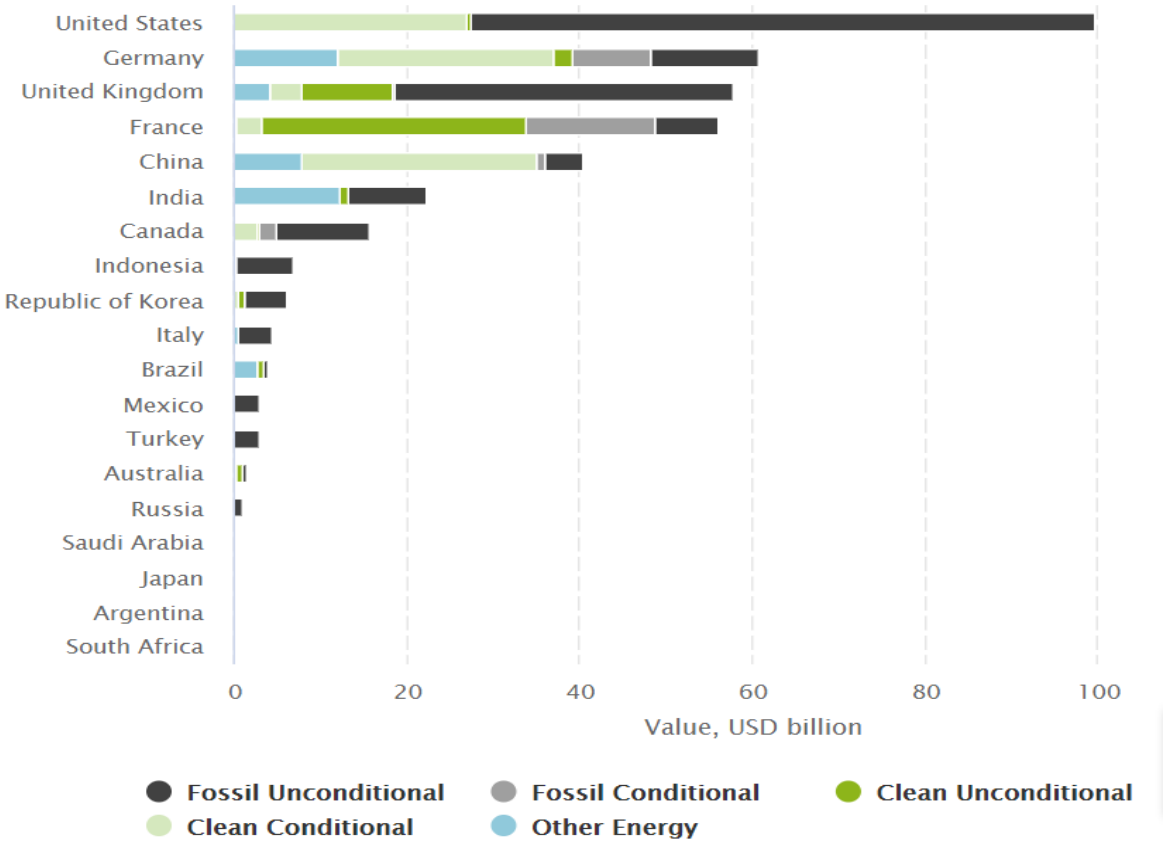
Many experts suggest that with additional measures being taken to contain the current crisis, the world will eventually shift from a state of emergency to a "new normal". Office and business closures have had a large impact on income and employment, thus it is a given that measures that directly address economic impacts will be prioritised once the threat of infection declines. For many, however, measures such as income compensation will be insufficient. It is important to take actions that equips government and society with the knowledge and tools to better manage similar crises in the future, i.e. "build back better." Going forward, it will be important that each country's economic recovery measures contribute to building a more sustainable, resilient and inclusive society in the future.

1. Promotion of Green Recovery

Currently, countries are trying to introduce and implement stimulus packages to recover from closure or loss of business, or unemployment. However, conventional economic stimulus measures (e.g. support for fossil fuel-intensive industries, for example) may bring about short-term economic recovery, but lock-in unsustainable production and consumption patterns, thereby failing to achieve the long-term changes in the socioeconomic structure necessary to prevent similar crises. Thus, economic stimulus directed at recovery from COVID-19 should contribute not only to promoting key agendas for the future such as digitalisation and decarbonisation, but also to strengthening resilience against future pandemics; i.e. "preventing pandemics from occurring in the first place, stopping their spread if they do occur, and minimising the damage they cause." It is essential to design recovery based on such long-term visions.

Currently, economic stimulus packages are being implemented in many countries around the world. The total amount is estimated to be about 12 to 15 trillion US dollars, of which only about 3-5% is allocated to environmental and sustainability-related measures (C40 Cities Climate Leadership Group, 2020). The OECD similarly finds that economic stimulus packages do not adequately respond to measures that help improve the environment (OECD, 2020). In addition, the IMF, having provided substantial reconstruction assistance centred chiefly on health insurance and medical care, underlined the importnace of promoting green policies compatible with economic growth and employment—e.g. transition to a low-carbon and digital economy utilising carbon pricing (IMF, 2020). The World Economic Forum (WEF, 2020) shared the same view, pointing to the need for a "great reset" for reconstruction through promoting decarbonisation of the economy by means of public investment, tax reform, investment, and job creation, which will enable the accelerated transition to a sustainable society as envisioned by "Vision 2050" (WBCSD, 2020).

Figure 2: Percentage of funds allocated to fossil fuels and renewable energy in economic stimulus measures



According to the IEA, the total clean energy investment in 2020 will decrease due to the impact of COVID-19, but its share in the overall energy investment will increase from around 33% since 2016 to

38% (IEA, 2020). IISD and IGES have collaborated with other institutes to create a database called the "Energy Policy Tracker "(IISD, 2020) that compiles data on COVID-19 related government spending in the energy sector (See Fig. 2 above). According to this database, 233.7 billion US dollars (56% of the total) have been allocated to promote the production and consumption of fossil fuels worldwide, while funds allocated to the production and consumption of renewable energy amounted to only 149.7 billion US dollars (35% of the total). However, the situation varies greatly from country to country, with Germany, France and China devoting high proportions of stimulus measures to promote the production and consumption of renewable energy.

This result reflects the basic policies of the European Union (EU) and China. The EU announced the "European Green Deal" (EGD) in December 2019, which includes a range of EU environmental policies aimied at achieving carbon neutrality by 2050 (EC, 2020). The EU has confirmed that it will maintain and promote the EGD, despite the economic crisis caused by COVID-19. In July of this year, the EU created the *NextGenerationEU* recovery instrument of 750 billion euros and formulated the EU's Multiannual Financial Framework (MFF: 1,074.3 billion euros between 2021-2027). The EU announced that it would devote 30% of their total amount of about 1.8 trillion euros to climate change countermeasures (EC, November 2020). Meanwhile, China declared at the United Nations General Assembly in September 2020 that it would achieve carbon neutrality by 2060, and pointed out the importance of promoting green recovery in the reconstruction of the world economy (UN News, 2020).

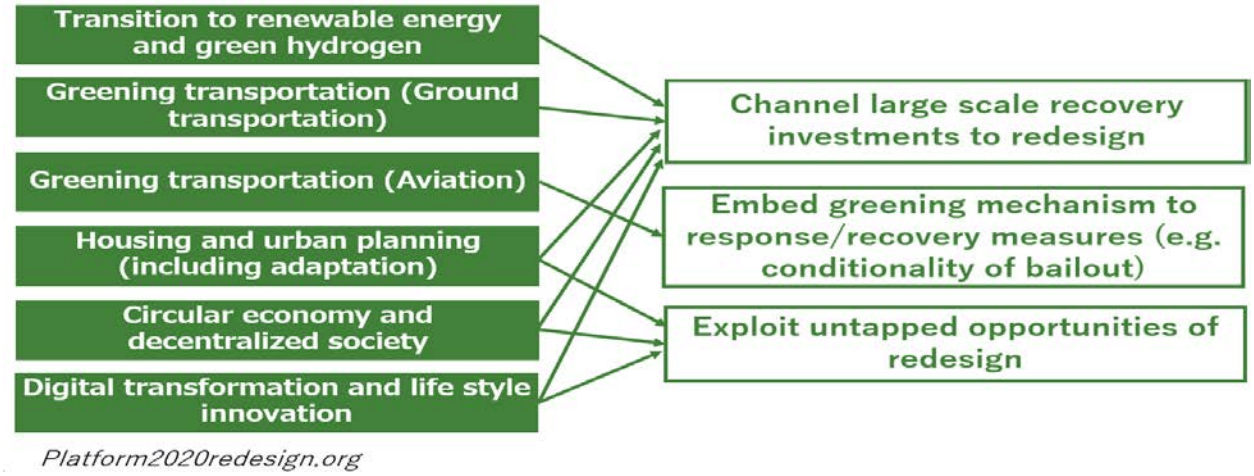
Then, in October, Japan and South Korea announced one after the other that they would achieve carbon neutrality by 2050. South Korea already was promoting its version of the Green New Deal, along with the Digital New Deal (Korean Presidential Office, September 2020). These two countries are expected to seriously consider strengthening their efforts to promote green recovery with a focus on substantial investment in renewable energy.

2. Three Notable Developments in the Economic Stimulus

The previously mentioned "Platform for Redesign 2020" managed by IGES showcases specific actions to which each country is committed for the promotion of green recovery towards the future redesign of the economy and society. Figure 3 shows that such actions can be broadly divided into three categories. The first category is large-scale investment in renewable energy and greening of land transportation, which account for most of the investment in green recovery discussed in section 1 above. The second category consists of actions that impose environmental conditions on bailouts of industries that are not considered green at the moment. In other words, this involves promoting efforts to link response or recovery measures to the greening of industry. The third category consists of efforts to provide support for COVID-19 related actions that were considered effective from the perspective of redesign for sustainability. These measures include lifestyle changes, such as teleworking, and the promotion of a decentralised society, including measures such as giving local governments greater autonomy in public functions and introducing a circular economy. Below, we will discuss three specific

examples from the second and third categories: (i) lifestyle changes, (ii) environmental conditions on the aviation industry, and (iii) promotion of a decentralized society.

Figure 3: Three major categories of initiatives implemented by countries for green recovery, based on the Platform for Redesign 2020



(1) Promotion of Sustainable Lifestyles and Workstyles

In many countries where the COVID-19 situation was serious, strong measures such as lockdowns were introduced, placing restrictions on human contact and movement. In Japan, even though the restrictions were less strict than other countries, necessary measures such as reduction of human contacts by 80% were part of a national state of emergency that was declared in April. In response to these mobility restrictions, information technology-based measures such as teleworking and teleconferencing have been promoted worldwide as a means to make business and daily life possible. Now, universities and international conferences are mostly online. Various social and economic activities are conducted remotely. Lifestyles and workstyles are undergoing major changes.

In addition to these lifsetyle and workstyle changes, the dramatic reduction in demand for land transportation and aviation due to COVID-19 lockdowns resulted in a corresponding reduction of greenhouse gas (GHG) emissions. In fact, a recently published paper found that, between January and June this year, about 8.8% of greenhouse gases (GHGs) were reduced worldwide since the COVID-19 outbreak (Zhu Liu et al., 2020). The biggest factor in this reduction was the decline in emissions from land transport and aviation sectors.

Reduction in mobility through compulsory infection control measures such as lockdowns are not necessarily desirable. improving work-life balance, alleviating rush hours during commuting, and increasing the freedom in choosing a place of residence (i.e. possible migration to rural areas). It is

important that these changes be maintained to the maximum extent possible after the emergency ends.

It is desirable that the latter be promoted and mainstreamed as a part of a range of efforts aimed at changing behaviors required as part of shifting to a zero-carbon society[3].

Already, there are some attempts that have been introduced to sustain these lifestyle and workstyle changes. For example, El Salvador and Costa Rica have introduced legislative measures regarding teleworking to support its smooth implementation (Platform for Redesign 2020). In response to changes in mobility during the COVID-19 crisis, Paris, Berlin and Buenos Aires have begun to further strengthen their infrastructure for cyclists and pedestrians (Pipa & Bouchet, 2020). In addition, in Japan, the Japan Climate Leaders Partnership (JCLP), a corporate group active in climate change countermeasures, has recoginzed need to take measures against climate change based on the lessons learned from the COVID-19 crisis. JCLP suggested policy support to mainstream new lifestyles and behaviors that are consistent with decarbonisation as one of its three policy recommendations (JCLP 2020).

IGES, in collaboration with research institutes in Europe, published the "1.5-Degree Lifestyles: Targets and options for reducing lifestyle carbon footprints" report in February 2019 (IGES, Aalto University 2019). Currently, this research is in its second phase, where it is being expanded to cover additional countries (Brazil, India, South Africa and Thailand). This research studies decarbonised lifestyles that can help achieve the 1.5°C target under the Paris Agreement and improve the quality of life at the same time. Already, a few workshops have been held in several countries involving citizens, and diverse views and opinions have been exchanged on implications of COVID-19 for lifestyles.

(2) Environmental Conditioning for Airline Bailouts

As mentioned above, the aviation industry contributed significantly to the reduction of greenhouse gases by about 8.8% during the COVID period (Zhu Liu et.al, 2020). This reduction, however, was due to a sharp decline in aviation demand that hurt the aviation industry. Reducing greenhouse gases from the aviation industry has been an important issue for many years. The governments of Austria, Switzerland and Sweden have combined the bailout of airlines from the plight of COVID-19 with a redesign of the industry towards a carbon-free society.

Notably, national airlines in Austria were required to stop their flights to destinations that could be reached within three hours by train. Switzerland has demanded cooperation in future climate change measures, and consent to the taxation of airfares as a condition for aviation industry bailouts. Sweden

[3] However, at the same time, we need to recognise the importance of addressing the challenges of the digital divide. Not everyone has access to ICT equipment for teleworking or distance learning. In addition, many poor communities may not even have access to electricity.

has imposed strict environmental conditions on its recapitalisation of the Scandinavian Airlines, resulting in a 25% reduction in CO_2 emissions five years ahead of schedule by 2025 (Platform for Redesign 2020). These are interesting examples of how a long-term redesign perspective was successfully incorporated into response and recovery.

(3) Initiatives by Local Governments toward a Decentralised Society

In this regard, several international forums composed of the world's leading cities are calling for the promotion of green recovery led by local governments based on the idea of building back better.

ICLEI held the Daring Cities Forum for three weeks in October this year with nearly 100 sessions on COVID-19 and climate change. At this Forum, Japanese Environment Minister Shinjiro Koizumi gave a special lecture in a session entitled "Green Recovery and Redesign" held on 21 October. During that lecture, he emphasised the importance of local governments' efforts for green recovery, highlighting that as many as 163 local governments in Japan have declared their intent to achieve carbon neutrality by 2050. In addition, several mayors selected from cities in five countries, including Yokohama, reported on specific initiatives they have taken to promote green recovery (Vigran, 2020).

Meanwhile, C40 has formed the "COVID-19 Reconstruction Task Force" consisting of 11 mayors. The taskforce is organised around the realisation that it is important for cities to work together to build a "better, more sustainable, more resilient and more just society" (C40 Cities, 2020). The technical report produced by this taskforce indicates that over the next five years the implementation of accelerated green recovery in about 100 major cities around the world belonging to the C40 Climate Leadership Group will reduce GHG emissions per capita by two-thirds by 2030. At the same time, it estimates more than 80 million sustainable jobs would be generated (C40 Cities Climate Leadership Group, 2020).

On October 2, 2020, the Urban 20 Engagement Group announced a communiqué to the G20 governments, emphasizing that cooperation between national and local governments is essential for a better recovery (U20, 2020). In fact, in the face of the COVID-19 pandemic, a decentralised approach that puts a greater emphasis on the role of local governments is drawing renewed attention. Possessing deeper knowledge about local contexts, local governments are able to make national initiatives more effective through their appropriate localisation (Aubrecht et al, 2020).

V. Redesign: Building a Sustainable and Resilient Society

In order to reduce the risk of similar pandemics in the future, the socioeconomic system requires a better understanding of the root cause of "spillover" of zoonotic diseases, and resilience to their effects. As COVID-19 is a zoonotic disease, a better understanding of the particular risks associated with interacting with wild species is needed. In addition, it was revealed that air pollution is a factor that

aggravates the health effects of COVID-19 and increases the mortality rate. Therefore, air pollution control measures are indispensable for increasing resilience to similar infectious diseases in the future.

1. Addressing the Root Causes of Pandemics

COVID-19 is only one example of zoonotic disease. It is believed first to have entered the human population at a wet market in Wuhan, China in late 2019 (Zhou *et al*. 2020). Broadly speaking, spillover from wild animals to human beings is believed to be due to a "human induced disturbance of host-parasite co-evolutionary relationships" (Goka et al., 2020). Zoonoses have been emerging at an increasing rate and this trend is likely to be anthropogenic (Jones *et al.* 2008). Frequently cited causes include: habitat fragmentation and land use change (Keusch *et al.* 2009; Allen *et al.* 2017, IPBES, 2020), changing trends in species abundance, richness, composition or behaviour (Johnson *et al.,* 2020), intensive agricultural practices and socioeconomic demands for wildlife products (Romanelli *et al.,* 2015). In addition, the impact of climate change on ecosystems could be an indirect cause (see Box 1).

Box 1: COVID-19 and Climate Change

COVID-19 is not seen to be directly related to climate change. However, ecosystems are changing dramatically due to climate change (IPCC, 2019). Expanding transition zones between different ecosystems, where species from different habitats interact, elevate the risk of pathogen spillover (Jones, 2013). In this way, climate change can indirectly contribute to the rise in the frequency of infectious diseases like COVID-19. As illustrated by this current crisis, it is therefore necessary to consider infectious disease risk as another important impact of climate change. The scope of national climate change adaptation plans should be expanded to address potential risks posed by zoonoses like COVID-19.

These underlying drivers are not yet fully understood, are seldom elucidated, and are likely to be context-dependent, as indicated by a grwing body of reserch (e.g. Carlson et al., 2017; Kilpatrick et al. 2017; Rubio *et al.,* 2016; Rohr *et al.,* 2020). Although these counter arguments are fewer in number, they nevertheless indicate that common assetions regarding causal relationships between land cover change and spillover are not cetrtain and that a better understanding of our realtionship and interactions with nature and wild species is needed.

Short-term responses seen this year have included government restrictions on wildlife trade (Borzée, 2020). China instated a temporary ban on the wildlife trade for food in February. While a permanent blanket ban is welcomed by some (Yang *et al.,* 2020), others argue that such a ban will simply drive trade "underground", where regulation is more difficult (Roe *et al.,* 2020).

Besides direct regulation of wildlife capture and trade, educational programs aimed at reducing demand for these products could ultimately prove effective in curtailing the emergence of zoonoses in the long-term. Where consumption of wildlife is based not on preference but on the need for protein,

agriculture might provide alternatives. They too carry some risk of spillover, however, for example when agricultural expansion fragments and degrades natural areas (Faust *et al.* 2018), and when livestock prove to be suitable vectors of zoonotic disease (Kreuder-Johnson, 2015; Kock, 2014). Reducing the susceptibility of livestock is thus an important step in breaking the chain of zoonotic emergence. Redesigning agricultural facilities to reduce wildlife-livestock overlap, improving livestock health and living conditions, and removing wildlife food sources from agricultural land are examples of preventative solutions that embody the concept of redesign, and would complement existing, largely reactive spillover countermeasures (Sokolow *et al.* 2019).

The executive summary of a recent IPBES workshop report on "biodiversity and pandemics" (IPBES, 2020) supports the "One Health" approach (One Health Initiative, 2020) to link human health, animal health and environmental sectors. This approach proposes broad international agreement on pandemic prevention, in contrast with the current reactive and fragmented approach. In addition, the United Nations Environment Programme (UNEP) states that prevention of future outbreaks requires properly addressing threats to ecosystems and wildlife, including habitat loss, illegal trade, pollution and climate change. It further suggests the need to increase the ambitiousness of, and commitment to, revised biodiversity targets and their means of implementation (UNEP, 2020).

Moreover, it is important to build resilient localities that can work cooperatively with one another in times of emergency, so that risks can be managed more effectively. Frameworks such as the Sendai Framework and the 2030 Agenda for Sustainable Development already provide the basis for increasing resilience and sustainability. Furthermore, the promotion of regional circulating and ecological spheres (CES) (Takeuchi et al., 2019), which aim for holistic sustainable development at the regional level through integrated efforts toward achieving a diverse range of social, economic and environmental targets, could also prove useful in the long term. As many cities around the world are now embarking on concrete actions towards a zero carbon future, it is important to combine such initiatives with more comprehensive efforts to build resilient communities (ISAP2020).

2. Combined Health Impacts: COVID-19 and Air Pollution

Air pollution is responsible for roughly seven million premature deaths annually (WHO, 2016). In locations with high levels of air pollution, the proportion of residents suffering from respiratory illnesses is high. Thus, individuals infected with COVID-19 in such polluted locations are likely to be at higher risk for serious illness and premature death. Air pollution is indeed considered to be a major factor that exacerbates the health effects of COVID-19.

This has been demonstrated in early studies conducted in counties in the United States (Wu et al., 2020), and a few regions of Italy (Conticini et al, 2020) as well as more recent research in Asia (Gupta et al. 2020). Also, in October this year, a comprehensive paper on how air pollution in Europe, North America, East Asia contributed to the fatality rate of COVID-19 was published. The paper found that, on average, 15% of COVID-19 deaths were due to the contribution of air pollution (Pozzer et al., 2020). The paper also estimated that, as of June this year, about 40,000 of the 220,000 deaths caused by COVID-19 in the United States could be attributed to air pollution. Moreover, the air quality in India and many developing countries is among the worst in the world (UNEP, 2020; Marlow et al., 2020), and high mortality and morbidity rates due to the combined effects of COVID-19 and air pollution can reach enormous numbers (Marlow et al., 2020). A recent analysis performed based on the data obtained from 25 cities in India revealed a direct relationship between death by COVID-19 and air pollution from January to May 2020 (Mele & Magazzino, 2020).

This research makes clear that strengthening air pollution control measures is essential to keep the mortality rate low from diseases such as COVID-19. COVID-19 emergency lockdowns and stay-at-home restrictions have indeed made the ambient air quality significantly better in China, Korea, the United States, Spain and many other countries and cities (Biswas and Soutik, 2020; Gardiner 2020, Zhu et al., 2020; Ju, Oh, and Choi 2020; Berman and Ebisu, 2020). However, in some locations, reductions in some pollutants (notably NOx and PM) accompanied increases in ground-level ozone (Le, et al. 2020). Further, once COVID-19 is contained and economic activities resume, air pollution could return to its original level. Thus, strengthening air pollution control measures after the COVID-19 crisis as a part of the recovery and redesign is essential to secure an improved air environment on a sustainable basis. In particular, effective measures in developing countries are important as air pollution tends to be worse. Efforts to improve air quality can also be done in unison with efforts to redesign energy systems: the IEA recently announced a sustainable recovery plan, stating that clean energy can not only reduce greenhouse gases but air pollution by 5% (IEA 2020).

IGES has contributed significantly to "Air Pollution in Asia and the Pacific: Science-based Solutions" published jointly by UNEP and the Asia Pacific Clean Air Partnership (APCAP) in 2019 (UNEP, 2019). The "Solutions Report" proposes 25 concrete measures that can be implemented in developing countries, such as the promotion of co-benefits measures for air pollution and climate change, as well as $PM_{2.5}$ control measures. A possible important area for redesign in the wake of COVID-19 could be the transport sector, particularly in large cities in Asia. Some urban areas have already begun to promote non-motorised transport (particularly cycling and walking), teleworking and some other

alternative working arrangements. Others will need to contemplate new forms of public transport, electric vehicles, and emissions control as possible solutions. In the future, consistently taking effective measures from both environmental and economic perspectives according to different local conditions, will make the future more resilient against potential infectious diseases such as COVID-19.

VI. **Conclusion**

To help create a resilient and sustainable world and to understand ways to minimise pandemic risks in the future, IGES has promoted a number of initiatives not limited to those discussed in this paper, as well as on issues not higlighted by this paper, such as those related to fresh water manabgement and climate change adaptation. All of the initiatives promoted by IGES have made it clear again that COVID-19 is closely related to many environmental and sustainability issuses. Indeed, COVID-19 has broadened the conventional scope of sustainability and resilience and more explicitly underlined the importance of an integrated approach. With this in mind, IGES will continue to work with subnational, national and international partners to drive the transformation towards ensuring people's health and strengthening global sustainability and resilience.

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