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MEASURING WHAT MATTERS IN THE ERA OF GLOBAL WARMING AND THE AGE OF ALGORITHMIC PROMISES

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MEASURING WHAT MATTERS IN THE ERA OF GLOBAL WARMING AND THE AGE OF ALGORITHMIC PROMISES

INTRODUCTION

The future has already arrived in the form of our children. These children are raising their voices all around the world, demanding policy makers and technologists take the necessary steps to secure their futures. This includes utilizing emerging technologies in a way that prioritizes people and planet over power and profits.

At a physical level, human wellbeing is critically dependent on environmental sustainability. Beyond questions of happiness or mood, basic human flourishing means having access to potable water and clean air. Our symbiotic relationship with nature, however, has been severely damaged due to actions that have resulted in a climate crisis that, if not immediately addressed, will lead to irreversible ecological and human devastation. A combination of a courageous socioeconomic transformation and accelerated technological innovation is necessary to mitigate this threat.

At a political level, having agency over our identity is a precondition for self-determination and freedom. Translated into the algorithmic age, this means agency over our digital footprint and access to and the ability to utilize our data. It has become evident that artificial intelligence (AI) systems also have a downside; in conjunction with other technologies and behavioral marketing practices they can cause harm, especially for children. Therefore, it is imperative to move beyond business as usual and to prioritize the wellbeing of our children, starting with protecting their privacy and security online. If we fail to do this, their agency, mental health, and self-actualization as humans in any culture will be reliant on forces beyond their control.

We must avoid a future where we have ignored the urgency of these issues or, as young people of today are clearly saying: "We (our generation) will never forgive you."[1]

Artificial Intelligence systems can provide key enabling solutions to address the systems level changes required for humanity to stem the tide of global warming and restore a symbiotic flourishing between

[1]As stated by Greta Thunberg in her address to the United Nations Climate Action Summit on September 23rd in New York City.

earth and its inhabitants. Likewise, regulation in the United Kingdom,[2] USA,[3] China[4] and elsewhere already exists with the intent to afford some protections to children and their caregivers while fostering the development and use of algorithmic systems supportive of a better future for us all. By identifying and championing metrics that fully recognize the environment and caregiving efforts to restore our climate and protect children's wellbeing will be framed in ways that best speak to power and redefine societal prosperity in a more holistic and sustainable way.

Measuring What Matters in the Era of Global Warming and The Age of Algorithmic Promises provides the following three sections/recommendations:

- Recommendation One:
  Shift Society to the New Climate Economy and Identify "Earth-Friendly" AI
- Recommendation Two:
  Protect Children's Lives, Future, and Data
- Recommendation Three:
  Maximize New Metrics

[2]See updates on UK Information Commissioner's Office efforts to protect children's data online.
[3]See https://www.ftc.gov/enforcement/rules/rulemaking-regulatory-reform-proceedings/childrens-online-privacy-protection-rule.
[4]See Cyberspace Administration of China's Draft Regulation on the Protection of Children's Personal Information Online.

1 RECOMMENDATION ONE
SHIFT SOCIETY TO THE NEW CLIMATE ECONOMY AND IDENTIFY "EARTH-FRIENDLY" AI

"Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate."[5]

The UN Intergovernmental Panel on Climate Change (IPCC), which featured the empirical findings of more than one hundred climate experts from around the world, is clear: human activity has accelerated climate change to the point where unified global action must be taken immediately to avoid massive economic, ecological, and human loss.

A key problem facing this challenge lies in addressing potential solutions in isolation, where the assumption that technology or Artificial Intelligence in and of themselves will bring holistic or systemic change. Based on the work of The Global Commission on the Economy and Climate[6] and other organizations, however, there is a massive opportunity to utilize AI to expedite global growth while minimizing harmful climate emissions. The following is a quote from the Commission's report, *Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times*:

> We are on the cusp of a new economic era: one where growth is driven by the interaction between rapid technological innovation, sustainable infrastructure investment, and increased resource productivity. This is the only growth story of the 21st century. It will result in efficient, livable cities; low-carbon, smart and resilient infrastructure; and the restoration of degraded lands while protecting valuable forests. We can have growth that is strong, sustainable, balanced, and inclusive.[7]

By identifying ways to repair or strengthen infrastructure by shifting to a low carbon economy and implementing sustainable and contextual solutions, society can drastically reduce climate crisis costs while increasing jobs and healthy economic growth (see Figure 1).[8]

A myriad of technologies utilizing AI can support this transition, including sensor-based systems, smart cities, and statistical-based probabilistic modelling for analyzing disparate data.

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[5] IPCC, 2018: Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland, 32 pp.*

[6] https://newclimateeconomy.net

[7] *Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times.*

[8] Ibid, page 22.

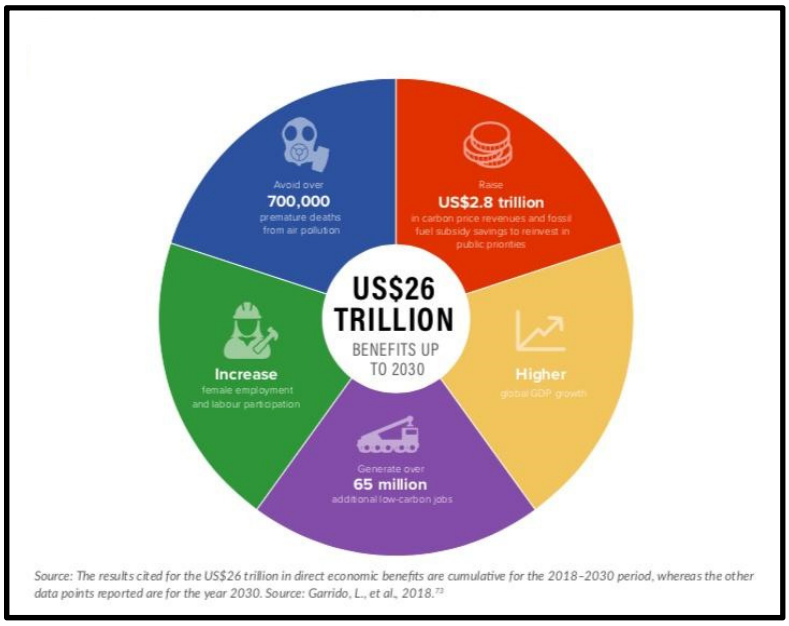

FIGURE 1—GLOBAL BENEFITS OF A DECISIVE SHIFT TO A LOW-CARBON ECONOMY WHEN COMPARED WITH BUSINESS AS USUAL

The following are examples of some top organizations and research focusing on how to utilize AI technologies for the climate:

- Climate Change AI is an organization comprised of volunteers from academia and industry who "believe in using machine learning, where it is relevant, to help tackle the climate crisis...whose... aim is to facilitate meaningful action by a range of stakeholders—researchers and engineers, entrepreneurs and investors, established businesses, the public sector, and more."[9] A seminal contribution by Climate Change AI is their paper, Tackling Climate Change with Machine Learning.[10] The abstract and table from the report are as follows:

> Climate change is one of the greatest challenges facing humanity, and we, as machine learning experts, may wonder how we can help. Here we describe how machine learning can be a powerful tool in reducing greenhouse gas emissions and helping society adapt to a changing climate. From smart grids to disaster management, we identify high impact problems where existing gaps can be filled by machine learning, in collaboration with other fields. Our recommendations encompass exciting research questions as well as promising business opportunities. We call on the machine learning community to join the global effort against climate change.

[9] About Climate Change AI

[10] Tackling Climate Change with Machine Learning: arXiv:1906.05433 [cs.CY]

	Causal inference	Computer vision	Interpretable models	NLP	RL & Control	Time-series analysis	Transfer learning	Uncertainty quantification	Unsupervised learning
1 Electricity systems									
Enabling low-carbon electricity		•	•		•	•		•	•
Reducing current-system impacts		•				•		•	•
Ensuring global impact		•					•		•
2 Transportation									
Reducing transport activity		•				•		•	•
Improving vehicle efficiency		•			•				
Alternative fuels & electrification					•				•
Modal shift	•	•				•		•	
3 Buildings and cities									
Optimizing buildings	•				•	•	•		
Urban planning		•				•	•		•
The future of cities				•			•	•	•
4 Industry									
Optimizing supply chains		•			•	•			
Improving materials									•
Production & energy		•	•		•				
5 Farms & forests									
Remote sensing of emissions		•							
Precision agriculture		•			•	•			
Monitoring peatlands		•							
Managing forests		•			•	•			
6 Carbon dioxide removal									
Direct air capture									•
Sequestering CO_2		•						•	•
7 Climate prediction									
Uniting data, ML & climate science		•	•			•		•	
Forecasting extreme events		•	•			•		•	
8 Societal impacts									
Ecology		•					•		
Infrastructure					•	•		•	
Social systems		•				•			•
Crisis		•		•					
9 Solar geoengineering									
Understanding & improving aerosols						•		•	
Engineering a planetary control system					•			•	
Modeling impacts						•		•	
10 Individual action									
Understanding personal footprint	•			•	•	•			
Facilitating behavior change				•					•
11 Collective decisions									
Modeling social interactions			•		•				
Informing policy	•	•		•				•	•
Designing markets					•	•			•
12 Education				•	•				
13 Finance				•		•		•	

TABLE 1—CLIMATE CHANGE SOLUTION DOMAINS, CORRESPONDING TO SECTIONS OF THIS PAPER, MATCHED WITH SELECTED AREAS OF ML THAT ARE RELEVANT TO EACH

- Fourth Industrial Revolution for the Earth: Harnessing Artificial Intelligence for the Earth: PwC and The World Economic Forum, January 2018. Here is an excerpt from the foreword of the report:

> Developing approaches to guide "human-friendly" AI is arguably one of the biggest unsolved AI problems today. As the scale of the economic and human health impacts from our deteriorating natural environment grows, it is becoming increasingly important to extend the rapidly growing field of AI safety to incorporate "Earth- friendly" AI. As the technology evolves, its direct and indirect applications for the environment will need to be better understood in order to harness the opportunities, while assessing the potential risks and developing approaches for mitigating them. For example, AI could be developed to support the creation of distributed, "off- grid" water and energy resources; to improve climate modelling; or to improve natural disaster resilience planning. Ongoing cooperation among governments, technology developers, investors and civil society will be essential to realizing this vision. As AI is the "electricity" for the Fourth Industrial Revolution, harnessing its potential could help to create sustainable, beneficial outcomes for humanity and the planet we inhabit.

Top priority challenges identified in the report are shown in Figure 2.

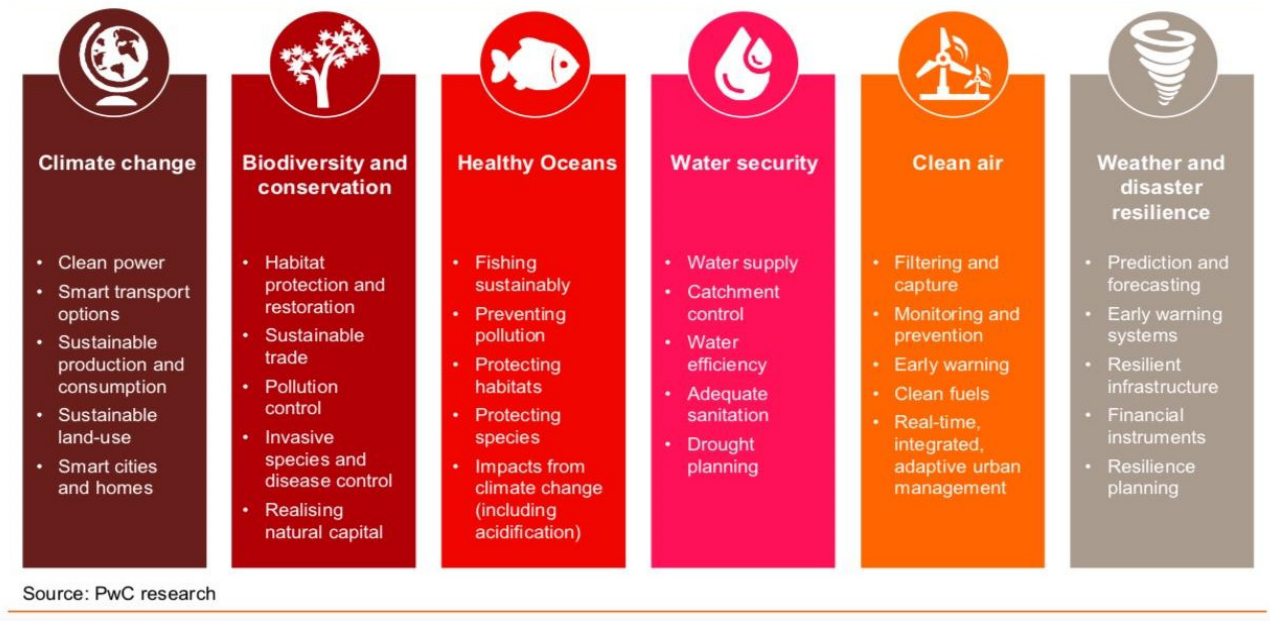

FIGURE 2—PRIORITY ACTION AREAS FOR ADDRESSING EARTH CHALLENGE AREAS

Multiple other organizations including Mila, Element AI, and IEEE are focusing on how to utilize AI and related technologies to directly address issues of climate change.

2 RECOMMENDATION TWO
PROTECT CHILDREN'S LIVES, FUTURE, AND DATA

AI is based on the human, environmental, or other data it collects and tracks. To avoid harms based on biased data or a lack of access to people's personal information, society must avoid the technosolutionist or short-term financial growth traps of the existing Internet Economy or any form of surveillance that would violate children's rights or self-deterministic choice. In a very specific sense, providing access and control to a person when that person is a child means one is protecting that child's digital, virtual, and actual life now and in the future.

Recognizing that cultural and regional mindsets vary regarding issues of data and privacy, human wellbeing cannot flourish where children or their families and communities cannot access, share, or utilize the data that so fundamentally shapes their choices, values, and future. Children must be able to explore, learn, and develop in trustworthy environments that enable them to fulfill their curiosities at an age-appropriate level and within the context of their familial societies. Others should not be defining their future based on the exploitative approaches that exists today.

The following is an excerpt of a speech presented by Dr. Ing. Konstantinos Karachalios, Managing Director IEEE Standards Association for a Workshop on Data Ethics delivered to the **European Commission**.[11]

> **Operationalizing Data Ethics: A Checklist:**
>
> *How could data ethics be operationalized from the phase of collection to the use of the data?*
> As we think about design first principles in technical implementations it is important to account for the need to first understand the minimal viable need, source, application, storage and sharing of the data. Allow me to elaborate on a specific category of online users: children. Tech was designed with the ambition to treat all users equally well—if you treat everyone equally, then *de facto*, you treat a child as if they were an adult. And—as my good friend and campaigner Baroness Beeban Kidron says "a child is a child until they reach maturity—not until they reach for their smartphone."
>
> In every environment in the physical world, we make special provisions for children. We educate them, we provide specialized doctors and medicines, we age rate films, we put crossing guards near schools, we consider them differently in our laws and cultural norms. In every setting, that is—except the digital world.
>
> There is a movement that is gathering pace around the world to embed children's rights into the digital systems that children are using. This is not a question of children's digital rights as they are sometimes referred to—rather—it is a question of the existing rights of children being embedded into digital systems and services **by design and default**. The difference is profound. The first assumes that the center of gravity is the newly conceived digital world and that children's rights should be reconceived to adapt to it—the latter presupposes that the center of gravity is children and the digital world should be designed

[11] *Operationalizing Data Ethics: A Checklist*: Konstantinos Karachalios to the European Commission, Luxemburg, September 26, 2019. Used with permission.

accounting for children's rights and needs.

Ultimately, this comes down to two issues. First, if we want to continue to recognize the concept of childhood. If we do, we must make sure that it is recognized in the digital space children inhabit and interact with. Second, what kind of digital technologies we want. Ones that ignore the needs of their users or ones that empower the individuals and communities that it engages with—starting with the youngest.

We have answered this question in favor of childhood and empowering individuals, and this is why we launched a new standards project at IEEE, IEEE P2089™ for an Age Appropriate Digital Services Framework Based on 5Rights Principles, which will establish a framework for developing age appropriate digital services for situations where users are children.

Such standards will help those developing solutions for children, and more tools have to be available, such as an ingrained framework, architectures, and ontologies that natively incorporates the European General Data Protection Regulation (GDPR), the US Children's Online Privacy Protection Rule (COPPA), and pertinent Personally Identifiable Information (PII) principles in combination with lightweight and accessible technological solutions. It would also warrant that solutions targeted towards children meet a level of data certification and derivative solution delivery certification.

A second important question is what elements of a data ethics framework need to be sector-specific and what elements should be defined across all sectors and domains?

For this question, I want to offer a framework for Data Ethics with key considerations that apply broadly to dealing with data as much as possible, and also help within sectorial data considerations where sector-specific decisions need to be made:

1. Understand your data's landscape. Always understand not only the intent of the data you are generating; but also consider how the data may be used beyond your use case.
2. Data is an asset. If data is considered an asset, then taking data that you do not own is stealing. Don't steal. Get permission.
3. Governance is important. Governance of data sets must be considered on multiple levels. While tempting, it is a risk to host too much data. This is important to realize.
4. Behavioral data-nomics. All sources of data are not only not equal, but they may also be agency-impairing. Data must be treated as DNA sequencing of any individual. We should be careful in what we share; and the behaviors we expect to induce as a result of exposing it.
5. Origin of data matters. Data captured from children is a trust-breaker when it comes to establishing an environment that benefits society. It is important to architect structures to understand source, licensing, use, and limitations of application of data prior to using or sharing that data.

One example is the IEEE Global Initiative to Standardize Fairness in the Trade of Data, which works toward proposing new standards to enable different stakeholders to use personal data at global scale and trade the data fairly. Data agency and data ethics are critical concepts to be addressed in a cross-sector view as much as possible, and sub-groups will address specific sectorial needs, such as healthcare or finance.

In summary, the collection of data needs to take a minimalistic approach (minimal viable data), the use of data needs to be restricted to the specific use agreed upon, the sharing (or sale) of data needs to be known, and the storage of data needs to be time limited, and needs to be predicated on a contract between the individual data owner and the data requestor. These considerations complement technical considerations, and provide a path towards improved data ethics, governance, and hygiene.

3 RECOMMENDATION THREE
MAXIMIZE NEW METRICS

It is widely recognized that global wealth inequality is a key issue to address regarding the distribution of benefits from AI and other emerging technologies. Metrics like The Sustainable Development Goals provide a holistic sense of societal prosperity, demonstrating how AI and other technologies can be utilized to address all 17 sustainable development goals (SDGs) in unison. Likewise, tools like the OECD's Better Life Index or The Genuine Progress Indicator[12] should be utilized when designing or evaluating AI to help ensure human wellbeing and ecological sustainability replace exponential growth as our new metrics of societal success. These are also the metrics that can speak to power in providing a picture of the *goals of AI* versus simply their functionality. For a broad introduction to metrics along these lines, please see IEEE's The State of Well-being Metrics (an introduction) part of the Wellbeing Chapter of *Ethically Aligned Design*, First Edition.

The most recent and applicable example of note in terms of the connection between AI and wellbeing metrics is how New Zealand is creating its policy and economy. Below is an excerpt of the Budget Speech from the Hon Grant Robertson, Minister of Finance for New Zealand for the Wellbeing Budget of 2019:

> It is my great pleasure to present the second Budget of this Coalition Government and the first Wellbeing Budget for New Zealand.
>
> From the day we took office, this Government has committed to putting the wellbeing of current and future generations of New Zealanders at the heart of everything we do. Budget 2019 shows we are delivering on that commitment.
>
> It shows a Government that is not satisfied with the status quo. In the election that led to the formation of this Government New Zealanders were asking a core question: If we have declared success because we have a relatively high rate of GDP growth, why are the things that we value going backwards like child wellbeing, a warm, dry home for all, mental health services or rivers and lakes that we can swim in?
>
> And the answer to that question was that the things that New Zealanders valued were not being sufficiently valued by the Government. And because they were not being valued they were not being measured, and because they were not being measured, they were not being done.
>
> So, today in this first Wellbeing Budget, we are measuring and focusing on what New Zealanders value the health of our people and our environment, the strengths of our communities and the prosperity of our nation. Success is making New Zealand both a great place to make a living, and a great place to make a life.

The Treasury's Approach to Wellbeing is not based on emotions or a broad definition of happiness, but rather an in-depth Living Standards Framework, shown in Figure 3.

[12]Available at https://sustainable-economy.org/genuine-progress/

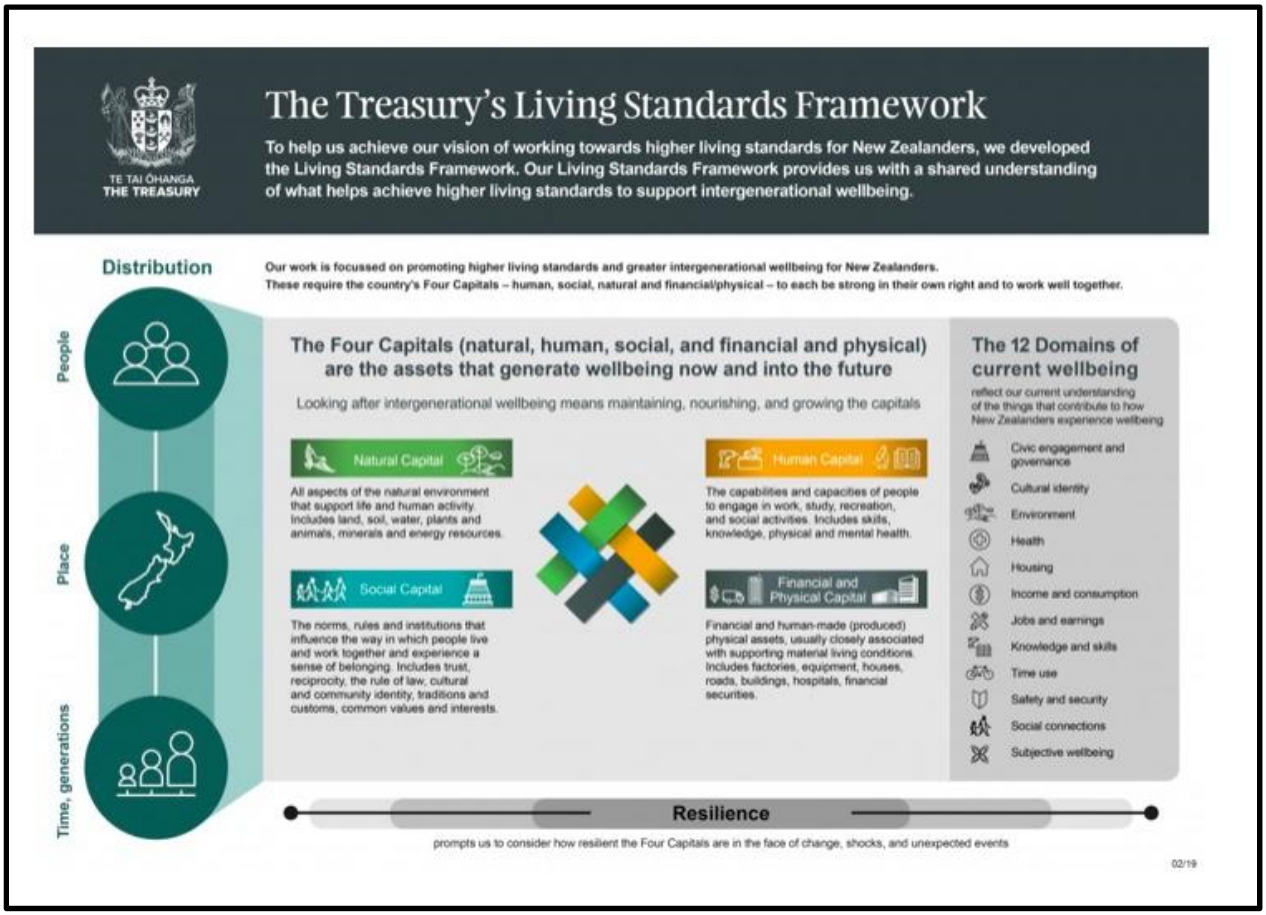

FIGURE 3—THE TREASURY'S LIVING STANDARDS FRAMEWORK

The Domains of wellbeing (listed on the right of the figure) along with the Four Capitals (listed on top) reflect values New Zealand wishes to prioritize in complement to, but over and above financial metrics alone. There are both objective and subjective ways of measuring these Indicators and Capitals, all of which can be assisted via machine learning, algorithms, or AI in general. (A new field of AI called probabilistic computing is used specifically to measure statistical aspects of economics for wellbeing, aggregating multiple and often disparate data sets to analyze various inputs for consistent recommendations. For more on this, please see Developing "Enlightened" Indicators of Sustainable Human Progress from the paper, *The Case for Extended Intelligence*).

In the recently released report, Towards our intelligent future: An AI Roadmap for New Zealand, authors from The AI Forum of New Zealand show a direct connection between their defined and measurable wellbeing metrics and their AI Strategy:

> **New Zealand Shouldn't Wait for an AI Strategy**
> Earlier we noted the lack of momentum to advance towards a national AI Strategy for New Zealand. It is imperative that New Zealand institutions and businesses act with agency rather than adopting a passive "wait and see" approach for AI to roll over us—AI technologies are ready to be applied to achieving our existing goals.
>
> The introduction of the Government's national wellbeing objectives has provided a ready-made framework towards which AI policy and investment can be targeted. The UN's 17 Sustainable Development Goals provide a global set of goals towards which AI investment can be targeted directly, whether through private, public or other partnership funding models. Furthermore, AI as the newest general purpose technology should feature in every one of the Government's forthcoming Industry Development Plans for economic growth.

The Genuine Progress Indicator has been adopted in multiple states[13] in the US and contains a number of simple formulas (like calculating the worth of caregivers at home) that could be assisted by machine learning. The 2019 Global Happiness and Wellbeing Policy Report features dozens of case studies where economic factors are tied to citizen health (mental and physical) and other factors being measured and improved by AI and other technology. The IEEE Draft Standard for Well-being Metrics for Autonomous and Intelligent Systems is entirely based on analyzing how top well-being metrics should influence the design, manufacture, and use of AI. Metrics including climate Indicators, children's mental health (that can be increased via safe use and exchange of their data), and multiple other areas beyond finances alone can and should be utilized to best increase the positive potential of Artificial Intelligence.

FIGURE 4—GENUINE PROGRESS INDICATOR GRAPHIC

Measuring What Matters in the Era of Global Warming and the Age of Algorithmic Promises was prepared as a contribution to the three-part Eminent Thinkers on AI Governance meetings hosted by The Minderoo Foundation in 2019–2020.

[13] Beyond GDP: US states have adopted genuine progress indicators: The Guardian, Marta Ceroni, September, 2014.

RAISING THE WORLD'S STANDARDS

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