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This submission can be made public.

Submission re 5G:

There seem to be a number of important points being overlooked in Minister Fletcher's enthusiasm to roll out 5G in Australia. To overlook these and roll ahead would be irresponsible and possibly disastrous on several fronts. 5G is not a done deal. It's likely consequences must be looked into in depth prior to adoption.

1 Regarding the **economic benefits** purported to be made by having 5G: has consideration been given to possible **health effects** on the public and workers, and consequent **legal and medical costs** involved? This technology involves adding substantially to the radiation load endured by the population. There is more than adequate peer reviewed research to show current levels of radiation involved in the telecommunications networks are harmful not only to man but also to other species and the environment. Frequencies planned for use in 5G are untested in terms of health and environmental effects when used 24/7. These frequencies should not be used until properly tested.

The two factors here are : 1) 5G will vastly increase the amount of electromagnetic radiation blanketing our country and 2) will be ongoingly exposing people to millimeter frequencies only ever used momentarily during airport scans or for crowd control.

I am baffled as to why a Minister in the government, supposedly representing the good of the people, would expose the population to untested and potentially harmful technology such as this. Before being deployed, this technology needs to be independently tested by bodies entirely free of conflict of interest. This rules out ARPANSA and ICNIRP.

The costs of ill health of people to the economy may be significant. The cost of ill health of other species and the environment could be catastrophic.

2 At a time when **climate change** is seen as of the utmost urgency to address by many countries around the world, and by many of our state governments, why would the Minister seek to hasten technology which will have the opposite of the desired effect and will add to global warming and climate change, according to research already done?

Belgian engineer, Miguel Coma, who has extensively researched the environmental ramifications of widely adopting 5G: "Every bit of data that travels the Internet consumes energy. The more data used, the more energy consumed. While 5G will use less energy than 4G to transmit the same data (and so we can call 5G more energy efficient), 5G will consume about three times more electricity than 4G. 5G will use much shorter waves to transmit data faster. These waves do not travel far. So, they require millions of new radiation-emitting small antennas, located much closer to homes, schools and offices. Constructing millions of new antennas and billions of 5G compatible devices will require a

long series of energy-intensive processes, ranging from ore extraction to manufacturing of devices and infrastructure. Building a new, international network that operates in every city and rural area will create unimaginable amounts of greenhouse gases, toxic emissions, radiation and electronic waste.

In spite of the industry's claims, 5G will not help to reduce climate change. It will speed it up. “

He continues, in a letter published in the Wall Street International Magazine (Included are end notes):

“Green 5G or red alert?”

A letter to Greta Thunberg: questioning Huawei's *Green 5G* report

By Miguel Coma

In August 2020, Huawei published a white paper called *Green 5G: Building a Sustainable World*.^[1] (Huawei is the Chinese telecom corporation that has begun installing 5G infrastructure internationally.) The report claims that 5G can have a significant positive effect on climate by increasing energy efficiency and enabling industries to reduce their greenhouse gas emissions and reach their climate targets.

Before I discuss Huawei's report, let me first acknowledge how complex our world has become, even for engineers like me who love figuring out how things work. Writing this letter, I aim to decipher some controversies about 5G and its implications for climate change. I will do my best to stick to essential matters. If you think this letter is absurdly detailed and technical, you'd be right. But please bear with me. In response to Huawei's unproven claims, we need technical details.

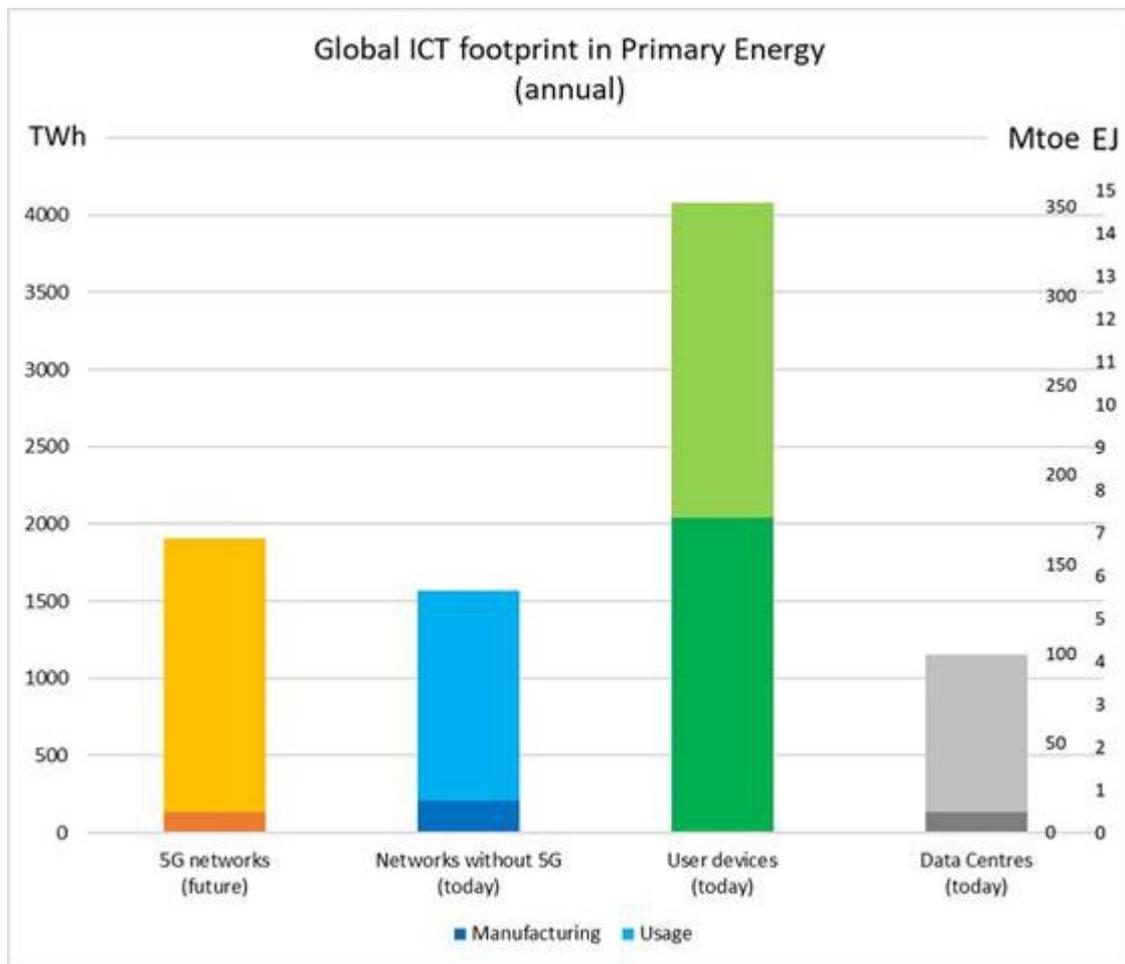
To begin, I put figures about 5G's footprint on a bar chart. I love bar charts. You can compare and focus on important things. Bars can also reveal surprises. Here, they show the total, worldwide energy needed to manufacture (low part of the bars) and use (higher part of the bars) digital technologies in four categories: 5G, networks, devices and data centres. All bars show *primary energy*: the energy used from natural resources, renewable or not. For references and calculations, please check the end notes^[2]

The left bar shows the *additional* energy needed to build and operate 5G networks. By “5G” I mean worldwide 5G public networks.

The second bar represents the energy footprint of all (wired and wireless) networks that connect digital devices *today*. It shows that 5G could double the energy used by all of these networks.

The third bar, the elephant in the room, shows the energy consumed to make and use tens of billions of user devices.

The last bar really surprised me: it shows that with or without 5G, compared to networks and user devices, data centres use the least amount of energy of all digital infrastructures.



If 5G becomes the backbone of our future connectivity as its providers aim, then it would increase mobile traffic 10-100 times.[3] Indirectly, more traffic would raise each bar. (In a future letter, I will describe viable wired and wireless alternatives to 5G that could absorb the increase in data traffic—and use much less energy.)

For today, I want us to realize how much energy 5G would consume: over three times the total amount of energy that Sweden uses for industries, transportation, electricity, residences, schools, etc., combined.[4] Powering 5G globally would require building 36 new-generation nuclear reactor,[5] 7800 massive offshore wind turbines[6] or equivalent power plants using other energy sources. In this bar chart, I did not calculate the energy required to build these giants of concrete and metal—though we should.

What would 5G's electricity bill mean for climate change? 5G would increase CO₂ emissions by 250 megatons (Mt CO₂).[7] This is seven times Sweden's total CO₂ emissions, or one fourth of the emissions generated by aviation worldwide (before Covid-19).[8] It would most likely compromise our targets for carbon neutrality and reduced emissions.

Could 5G technologies reduce or offset the environmental impacts caused by 5G? To answer this question, let me return to Huawei's *Green 5G* white paper, especially its claims regarding 5G's potential to benefit the environment. Huawei's report praises 5G's energy efficiency at length. However, as I explained in my October 23rd letter, energy efficiency cannot prevent a significant increase in energy usage, since it leads to increased data traffic.

Huawei states that information communication technologies (ICT) could help reduce

greenhouse gas emissions in other industries by 15% in 2020. This claim is based on an old (2008) report[9] that examined most aspects of worldwide ICT. Regarding broadband mobile networks (3G, 4G, 5G), it actually reported soaring greenhouse gas emissions, and no potential CO₂ savings in other sectors.

And yet, Huawei's *Green 5G* paper confidently states that when coupled with other technologies (Artificial Intelligence, the Cloud, virtualization, the Internet of Things), 5G could help various industries increase their energy efficiency. Combining "5G" with one or more buzzwords in one phrase creates a smoke screen and hides a simple reality: 5G is a wireless connection technology. Using a 5G connection does not prove that 5G is the best or only possible connection available. Actually, we could realize many environmental benefits by using less energy-hungry technologies.

Without proof, Huawei's report incorrectly assumes that Internet of Things (IoT) technologies (such as autonomous vehicles, electric vehicles, traffic optimization, smart cities and smart grids) require 5G. Actually, independent analysts have seriously challenged the benefit of 5G for the IoT.[10] Huawei's claims that 5G *enables* these technologies and energy efficiency are absolutely incorrect.

Saying that buying or producing "green energy" for 5G makes it more energy efficient is also a pure sham. Compared to non-renewable power, renewable energy is scarce. Building and disposing of "renewable" power systems (e.g. solar, wind, hydro) also has enormous ecological consequences. Further, using "renewables" for 5G would reduce available renewable energy for other applications. Huawei also misses the point when it says that "smart" lithium batteries would increase energy efficiency: 5G antennas will need *much* larger batteries[11] than 4G antennas, only adding to global energy use. Manufacturing larger batteries will increase ore extraction and greenhouse gas emissions. Charging and discharging 5G's larger batteries will waste even more electricity.

The report provides only three concrete case studies with quantified benefits. Each one incorrectly concludes that 5G enables sustainability.

In the case study about transportation, workers traveling by car to inspect gas pipelines are replaced by a fast, oil-fueled, 5G-connected drone equipped with an ultra-high-definition video camera. I identify four flaws here. First, deploying 5G around pipelines is uneconomical and energy-intensive. Mobile networks are not designed to connect drones[12] Huawei provides no evidence that only 5G can connect those drones. The report does not explain why (existing) 4G can't do this job. Secondly, compared to cars, even long-range drones still have very limited range (80 km/50 miles). Thirdly, Huawei does not account for the energy used to build or run 5G networks. Last, despite Huawei's enthusiasm, saving an annual 2.1 megatons of CO₂ is insignificant (less than 1%) given 5G's estimated annual emissions of 250 megatons.

When Huawei shows how 5G could benefit telemedicine by reducing doctors' travel, it fails to report that such health care requires a highly reliable connection. 5G might be more reliable than 4G, however wireless connections like 5G typically are not reliable enough for telemedicine.[13] Secondly, healthcare does not need 5G's high-performance speeds or response times.[14] Huawei is simply incorrect in stating that healthcare requires 5G. In fact, telemedicine already takes advantage of existing high-speed, secure, wired connections that use less energy.

Huawei also reports on a smartphone factory that automates its quality control by connecting video cameras to Artificial Intelligence (AI) with 5G. Compared to human workers, AI identifies defects with much more energy efficiency. But again, because of the

rebound effect, greater energy efficiency results in no savings. It can even increase energy use. This case is no exception. Huawei even admits that energy use did not decrease after this smartphone factory introduced 5G.

With each of these case studies, Huawei fails to consider the substantial amounts of energy consumed by 5G infrastructure. By using alternatives to 5G that use less power, we would not need such energy. While 5G could handle a tremendous increase in mobile data, it would also incentivize us to consume increasing volumes of mobile data—and, thereby, increasing volumes of electricity. 5G would be the main contributor to the problem it promises to fix: a lack of network capacity to stream larger videos. *Is this irony or intention?* When the industry creates new consumer needs by enabling virtually unlimited mobile data, it encourages mobile data addiction. This reminds me of strategies deployed decades ago by tobacco, sugar and chemical industries, strategies that led to out-of-control consumption.

5G is also expected to shift data traffic from existing, wired networks toward much less efficient mobile networks.[15] Given the huge amounts of energy (three times Sweden's footprint) that 5G will need, mainly from fossil fuels, Huawei's repeated use of the term "sustainable" when describing 5G is confusing at best. Curiously, in 2019, Huawei published another white paper[16] warning the industry about never-before-seen electricity needs with 5G. This report is referenced by various websites, including the International Energy Agency. Less surprisingly, after the *Green 5G* report went to press last August, the 2019 report disappeared from the Web.

Andy Purdy, Huawei's chief security officer in the U.S. and a councilmember at Forbes, praised 5G in a recent Forbes article.[17] He reported that 5G "promises to dramatically reduce the energy consumption in telecom networks" while his own industry opposes this claim. The mobile industry's association, GSMA,[18] and French mobile operator Bouygues Telecom[19] both warn that all networks operators will see inevitable increased energy use with 5G. The energy savings examples that Purdy cites are irrelevant. He claims energy savings that do not rely on 5G technology. He also mistakes the industry's ambition to reduce its carbon footprint with the reality that 5G will lead to soaring energy demands.

Greta, this letter has been so full of technical stuff. Still, I have only discussed the most obvious of Huawei's incorrect claims that 5G is "green."

In sum, Huawei's suggestion that 5G would reduce climate change is not true. Its report provides no evidence that 5G has a role to play in reducing energy use. The company carefully avoided discussion about 5G's massive environmental footprint (seven times Sweden's CO₂ emissions). In fact, 5G's footprint would likely compromise energy savings and reduced carbon emissions targets.

Exploring other information-communication technologies could lead to reduced energy. A new vision of connectivity could emerge, with significantly reduced greenhouse gas emissions, increased user satisfaction, and true progress for future generations. Our society *can* reach climate targets, but only if we question the new digital needs created by the industry, and explore truly economical and more sustainable alternatives to 5G. Indeed, I find myself challenged to envision an Internet wherein we replace "smart" endless growth with wise consistent progress.

Miguel

ENDNOTES

1. <https://www.huawei.com/en/public-policy/green-5g-building-a-sustainable-world>

2. Calculations behind the bar chart: studies about our environmental footprint tend to include large error margins. However, error margins do not compromise this article's conclusions.

a) 5G's USAGE ENERGY (energy consumed while operating 5G networks):

Ferreboeuf & Jancovici report that 5G's annual electricity consumption would reach 10 TWh in France. To find the order of magnitude of 5G's worldwide consumption, we can use a simple rule of three: $10 \text{ TWh (5G electricity use France)} \times 24\,738 \text{ TWh (2018 world's electricity use)} \div 474 \text{ TWh (France's 2018 electricity use)} = \mathbf{522 \text{ TWh}}$ (5G annual worldwide electricity use). Then, to find the Primary Energy (PE) needed to produce this electricity, multiply 522 TWh by a number called Primary Energy Factor (PEF) = 3.4. This is the PEF used by Green IT France, and in my calculations. Green IT reported on worldwide digital footprint (link below). $522 \text{ TWh} \times 3.4 \text{ (PEF)} = \mathbf{1770 \text{ TWh}}$ (5G annual PE used to run 5G networks). Sources: H. Ferreboeuf, J.-M. Jancovici, "Faut-il faire la 5G?" <https://jancovici.com/publications-et-co/articles-de-presse/faut-il-faire-la-5g/>; <https://www.iea.org/data-and-statistics> (consumption of electricity by country and internationally)

b) 5G's MANUFACTURING ENERGY (energy used to build 5G networks):

Nokia reports that 7% of cellular antennas' CO₂ is emitted while manufacturing them, while 93% of CO₂ is emitted while operating them. However, 5G uses much more electricity than 4G. This might reduce manufacturing CO₂ to less than 7%, and increase CO₂ emissions during 5G's operations to above 93%. Roughly, we can approximate 5G's manufacturing Primary Energy (PE) as up to 7% of its total PE use. Based on 5G's usage-related PE (1770 TWh), 5G's manufacturing would add an annual $1770 \text{ TWh} \div 93\% \times 7\% = \mathbf{133 \text{ TWh}}$ (5G annual PE used to build 5G networks). Source: Nokia People & Planet Report 2019 (pg 28).

https://www.nokia.com/sites/default/files/2020-03/Nokia_People_and_Planet_Report_2019.pdf

c) ENERGY FOR NETWORKS, USER DEVICES, DATA CENTRES:

F. Bordage, GreenIT.fr, "Environmental footprint of the digital world", 2019

<https://www.greenit.fr/environmental-footprint-of-the-digital-world/>

3. Cisco predicts 46% annual growth (CAGR) in mobile traffic. This represents a 10-fold increase in 6 years, and a 100-fold increase in 12 years (each mobile generation spans about a decade). https://www.cisco.com/c/dam/m/en_us/network-intelligence/service-provider/digital-transformation/knowledge-network-webinars/pdfs/1213-business-services-ckn.pdf

4. Energy use of Sweden = 49,8 Mtoe = 579 TWh.

<http://energyatlas.iea.org/#!/profile/WORLD/SWE>

5. In note #2, we found that worldwide 5G would annually need 522 TWh of electricity. Converted to gigawatts of electric power, this is 59 GW. The largest last-generation nuclear reactor (the EPR) produces 1.65 GW of continuous power. We would therefore need about $59 \div 1.65 = 36$ EPRs to power 5G. <https://www.edf.fr/en/the-edf-group/our-commitments/innovation/the-epr-is-a-third-generation-reactor-the-most-powerful-in-the-world>

6. Note #5 explains that 5G would need 59 gigawatts (GW) of continuous power. The largest offshore wind turbine (the Haliade-X) produces 12 megawatts (MW) of power when there is strong wind. 12 MW is 0.012 GW. To compensate for lack of wind, we must apply a capacity factor (a very generous 0.63 for this turbine). To power 5G, we therefore need about $59 \div (0.63 \times 0.012) = 7804$ Haliade-X.

<https://www.ge.com/renewableenergy/wind-energy/offshore-wind/haliade-x-offshore-turbine>

7. On average, each kilowatt hour (kWh) of electricity produced in the world emits 475 grams of CO₂. <https://www.iea.org/articles/global-co2-emissions-in-2019>

Global electricity production to feed 5G (522 TWh) would emit 522×0.475 MtCO₂ = 248 megatons (MtCO₂ annually).

8. CO₂ annual emissions of Sweden = 34.5 megatons

<http://energyatlas.iea.org/#!/profile/WORLD/SWE>

CO₂ annual emissions from aviation = 900 megatons

<https://www.iea.org/topics/transport>

9. <https://gesi.org/research/smart-2020-enabling-the-low-carbon-economy-in-the-information-age>

10. William Webb, The 5G Myth, 3rd Edition, 2019.

Matt Hatton, William Webb, The Internet of Things Myth, 2020.

11. “5G commercial application is getting closer and closer, base station construction will drive demand for lithium battery above 155 GWh”. (gigawatt hours)

<https://www.marketwatch.com/press-release/battery-for-5g-base-station-market-2020-industry-size-share-global-analysis-development-status-regional-trends-opportunity-assessment-and-comprehensive-research-study-till-2026-2020-10-07>

12. <https://www.roboticsbusinessreview.com/opinion/5g-and-future-connectivity-requirements-for-drones-and-uavs/>

13. Telehealth consultations function perfectly at speeds as low as 1.5 to 10 megabits per second (Mbps). <https://broadbandnow.com/report/telehealth-requires-broadband-availability/>

14. Telesurgery and telehealth require a response time (RTL latency) below 300 milliseconds (ms). <https://www.news-medical.net/news/20151005/How-feasible-is-telesurgery-An-interview-with-Dr-Roger-Smith-CTO-Florida-Hospital-Nicholson-Center.aspx>

15. Use of wireless networks for « fixed » connections is called Fixed Wireless Access (FWA). According to Ericsson, FWA would reach 25% of mobile traffic in 2025

<https://www.ericsson.com/en/mobility-report/reports/june-2020>

16. Huawei, “5G Telecom Power Target Network White Paper,” October 2019, (now removed from Huawei’s website for operators; <https://carrier.huawei.com>).

17. <https://www.forbes.com/sites/forbestechcouncil/2020/11/10/the-biggest-5g-benefit-most-people-dont-know-about/?sh=19a7f09b6ca2>

18. GSMA reports that the highest cost increase factor for operators will be the energy used by 5G, compared to 4G. <https://www.gsma.com/futurenetworks/wiki/5g-era-mobile-network-cost-evolution/>

19. Senate Audition in France on June 10th 2020 of O. Roussat, CEO of Bouygues Telecom.

“It is wrong to claim that 5G will allow energy efforts. After the first year of deployment, the energy consumption of all operators will show a significant increase.” (translation)

<https://www.senat.fr/compte-rendu-commissions/20200608/devdur.html>

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This article was originally published by Wall Street International Magazine here:
<https://wsimag.com/science-and-technology/64080-green-5g-or-red-alert>”

I hope and trust that the Minister and other decision-makers involved in the planned 5G rollout will take these important factors into account before exposing the public and the environment to this largely unnecessary potential threat. Newer is not always better. The application of wisdom needs to temper technology if it is to be useful rather than harmful.

Sincerely,

Paula Polson