Our Web of Inconvenient Truths/Part I
by Katie Singer

Because resources are not limitless, and unregulated consumption leads to degradation and depletion of biological systems, ecological economist Herman Daly proposed two principles for a sustainable world:

- Do not use natural resources faster than the Earth can replenish them.
- Do not deposit waste faster than the Earth can absorb them.

Could we apply these principles to the Internet, the largest thing that humanity has built? Every online activity (every video, video conference, email, text, Skype call, Google search, GPS search, social media post, "smart" meter data collection, marketing data collection, medical or financial or educational record accessed and transferred, "smart" "energy-saving" Internet-of-Things-connected refrigerator messaging its owner to buy more orange juice, etc.) engages an international network of cell sites and data storage centers that consumes huge amounts of greenhouse-gas emitting electricity. Manufacturing every smartphone, tablet, appliance, WiFi router, infrastructure part and even every solar PV system and wind turbine starts with extraction of natural resources including coal, copper, quartz, coltan, cobalt, lithium, petroleum coke and fracked natural gas. Manufacturing every device depends on refineries, CO_2-emitting power plants, nuclear plants, chemical plants, steel mills, metal smelters, wood (for smelters) and factories of all kinds. Each energy-guzzling, toxic-waste and greenhouse-gas emitting operation depends on all of the others. They interconnect by networks of power lines, natural gas lines, cargo ships, trains, trucks, shipping lanes, railways, highways, telecom access networks and data storage centers to form one gigantic global super-factory.

To unpack this further, one smartphone contains about 1000 different ingredients. It includes millions of transistors--a computer's basic building blocks. Transistors are made from silicon wafers, which start with mining pure quartz gravel, charcoal and slow-burning wood and transporting them to a smelter kept at 3000 degrees Fahrenheit to produce 98% pure silicon. Next, this metallurgical grade silicon ships to a bell jar reactor kept at 2012 degrees Fahrenheit to produce polysilicon. Several more energy-intensive steps generate electronic-grade silicon with one only impurity part per billion. (Silicon for solar panels can tolerate one impurity part per million, though greater purity makes solar systems more efficient. In any case, manufacturing solar photo-voltaic systems is not carbon neutral; and neither solar nor wind systems can generate sufficient power for manufacturing transistors.)

By 2013, manufacturers began making more transistors than farmers grow grains of wheat or rice. Call this the culmination of our valuing telecommunications more than nature. Perhaps the balance began to shift in 1934, when Congress established the Federal Communications Commission (FCC). The agency defined "harmful interference" as anything that interferes with existing radio and TV broadcasts. This definition now extends to cellular and Internet services. It has never included biological harm.

In 1996, Congress passed the Telecommunications Act. Section 704 states that no health or environmental concern may interfere with the placement of a cellular antenna as long as its radiofrequency radiation (RFR) emissions comply with FCC limits. Also, in the mid-90s, the FCC determined that mobile devices are safe to market because after six minutes of use, they do not heat the liquid in a plastic dummy's head by two degrees Celsius. And so, telecom industries and the public's love affair with mobile electronics have flourished. Our world now has more cell phones than toilets or toothbrushes.

Let's name the Internet's main energy guzzlers:
Access networks: world-wide infrastructure for cellular and Internet services including antennas, radio transmitters and routers. Wireless technologies consume ten times as much energy as wired.

Data storage centers: run by businesses, universities, governments and hospitals; packed with cooling systems and computers that store websites, records, GPS, etc. Data centers' CO_2 emissions grow annually by 13%.
Embodied energy: used to mine and transport raw materials to smelters; transport refined materials to factories; then manufacture, box and ship each item to its end-user.
Automated processes: i.e. advertising bots, automatic updates and backups for apps, video games, websites and operating systems.

In fact, our world wide web has just begun to rev up. For machine-to-machine communication, we now build the Internet of Things (IoT). The IoT provides faster speeds for health care, business, education and entertainment by video. The only place we need is online. Chipped diapers can message a smartphone that your baby's diaper needs changing. A toilet can measure blood pressure, analyze stools and send your doctor the data. Your smartphone can adjust your thermostat while you're away from home. To support the IoT, the industry deploys 5G (fifth generation wireless, millimeter wave infrastructure) via cellular antennas on public right-of-ways (PROWs) such as utility and light poles every three to twelve houses. As "small" cell sites go up around the U.S., residents have no recourse. They're installed on publicly-owned property; but federal and state legislation (passed since 2016) has eliminated local authority over telecom facilities.

The total volume of Internet traffic from year 2000 is equal to one hour of Internet traffic from 2015. Because of the IoT (the average Westerner will own 26 IoT-connected devices) and increased video streaming, e-technologies' power demands increase 20% per year. Annually, data traffic increases 30 to 40%. If this rate continues, then by 2026, information and communications technologies (ICT) could consume about 60% of the world's energy resources. ICT could generate 3.5% of greenhouse gas emissions (more than aviation and shipping industries) by 2020, and 14% by 2040.

Our Web of Inconvenient Truths/Part II
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Even though the FCC's definition of harmful interference does not include biological harm, thousands of peer-reviewed studies show that telecommunications' Radio Frequency Radiation (RFR) emissions harm living creatures. The National Toxicology Program's $25 million study demonstrated that 2G cell phone radiation causes brain tumors, heart tumors, and damages DNA. Thousands of other studies show plausible links between RFR exposure and the brain's metabolic rate, heart rate and blood pressure variability, autism, Alzheimers, sperm damage, insomnia, headaches, nosebleeds, depression, addiction and general unwellness. Reducing screen-time exposure has been shown to alleviate autism, ADHD and even psychotic behavior.

We might also consider e-tech's impacts on agriculture:

- RFR emitted by cellular antennas and devices disrupts pollinators' cryptochrome-based navigation. Cryptochrome is magnetically sensitive protein (used to determine magnetic north) located in pollinators' eyes. If only pesticides, the Varroa mite or harsh winters caused bee colony collapse, then we would see ill or dead bees. A hive's disappearance signals a navigational issue.
- Washing ores (cobalt, copper, lithium, quartz, etc.) for electronics takes water from farmers. Cooling systems used by data centers also require water. In 2014, the National Security Administration's Utah data center daily consumed 1.7 million gallons.
- Computer-laden tractors can determine a parcel of land's mineral and moisture content; expected weather; and the seed, herbicide, pesticide and fungicide needed to yield the most lucrative harvest. Such artificial intelligence takes know-how from farmers. Operating a tractor's computers requires cellular access networks, which in turn transmit RFs that disrupt pollinators' navigation and demand greenhouse-gas emitting electricity.
- To feed our increasing electricity demands, coal-fired power plants emit acid rain, which acidifies waterways, disrupts our climate and leads to mercury in fish. To maintain comfortable lifestyles, electricity-producing solar and wind "farms" now cover what had been farmland.

Every baby born today arrives in an electronic ecosystem, a society that values technology more than nature, an unsustainable civilization. Species go extinct at unprecedented rates. Sea levels and global temperatures rise drastically. Human health and democratic processes diminish. I am humbled by my contribution to this mess. Like other privileged humans, I don't know how to live without electricity for more than a few days. Without the Internet, I could not share this report so widely. Indeed, few people can work or attend school without a mobile phone. After several decades of an exponentially expanding Internet opposed to Herman Daly's principles, how do we proceed?

Could every municipality, manufacturer, service provider, school and household immediately begin reducing Internet use by three percent every month? Even in combination, my recommendations will not come close to reducing consumption by 70 or 80%, as climatologists advise. Still, they can move us toward living within our means.

All Internet users: Since wireless tech uses ten times as much energy as copper or fiber wires, consider mobility a luxury. Get wired access. Pressure manufacturers to build repairable, upgradable, modular electronics. Wait at least four years to upgrade. Grant prestige to those who reduce their consumption. Shrink your video consumption.

Municipalities and Congress: Repeal legislation that restricts local authority over telecom facilities. Support copper wiring to every premises. Warn workers and residents to keep at least nine feet from

"small" cellular antennas, as FCC requires. Ban "mining" of digital currencies like Bitcoin (awarded by computers solving complex math problems) because they already consume one percent of the world's electricity.

Utilities: Replace digital, transmitting "smart" meters with electro-mechanical utility meters.

Businesses and schools: With volume purchases, insist on verification of workers' and environmental protections at mines and assembly plants.

Web designers: Minimize videos, pop-ups and slide shows: they consume lots of energy and thereby emit lots of CO_2. Link or embed videos. Do not re-post them.

Parents and schools: Do not allow children to use electronics at least until reading, writing and math are mastered on paper. Follow *Shedong*, China schools' directive: no more than 15 minutes per session with electronics, and no more than one hour of total, daily electronic use. Teach skills like growing and cooking food, composting, building and repairing mechanical tools.

SPREAD THE WORD: Downloading a video uses more data and takes more energy than downloading a photo, which takes more energy than transmitting text. Skyping uses more energy than plain talk. With the Internet-of-Things, energy use, toxic waste and RFR exposure grow exponentially. Don't buy into it *or* 5G.

If the three billion people who do not yet have access get online, the Internet's energy consumption, greenhouse-gas emissions and waste will increase exponentially. Would those with decadent media use decrease their time online? Would those who currently have minimal media not increase their use too much? Who will decide these questions?

Despite its seductive powers, will we limit our Internet use and our children’s, and educate them for a more sustainable use of technology? Are we willing to address the Internet’s problematic aspects that are within our control?

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