



THE BROAD DIMENSION

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Going All-Electric

Net zero has been a rallying cry for environmentalists for quite a while, and it has become a national goal for countries like the UK and France, who have both legally committed to achieving it by 2050. The State of California’s Net Zero Mandate requires all new residential construction to be net zero energy (NZE) by 2020 (i.e. now) and all new commercial construction to be NZE by 2030. Other jurisdictions, including Washington, DC, and New York City, have committed to net-zero for new buildings. Then there is the architectural 2030 Challenge which targets having all new buildings, developments and major renovations become carbon-neutral.

To achieve net zero with a building entails preparing an energy budget and reducing the required energy loads by ensuring the envelope doesn’t leak too much energy (except when you want to dispose of internal heat), using energy efficient equipment, utilizing solar and/or wind power, and incorporating other innovative features. The building may still have a ‘carbon footprint’, but that can be offset by feeding excess green energy produced on site back into the grid, or in some situations by planting trees to absorb carbon, buying carbon credits, etc.



But how about eliminating the carbon footprint by stopping burning fossil-fuels as an energy source? The City of Berkeley, California, has enacted the world's first all-electric ordinance for new buildings, and other cities are following suit. Actually, other cities, such as Carlsbad in southern California, had already made moves in the same direction, but had acted through the Reach Code process. That involves a local jurisdiction, like a city or county, enacting rules that extend the California Title 24 (Building Energy Efficiency Standards) requirements and means working through the CEC (California Energy Commission). One important aspect of the reach code process is that the code must be cost effective. Berkeley enacted their legislation as a health and safety measure on the basis that gas mains are a serious fire danger in the event of earthquakes, although they have since also moved through the reach code process.

Buildings tend to be second only to vehicles in the emission of greenhouse gasses and other pollutants, and Elon Musk is doing his bit to clean up vehicle emissions. When one talks about going all-electric we cannot forget that power stations often still burn fossil fuels to produce electricity, but California already has a large proportion of its electrical supply coming from renewable resources and is mandated to have 100% of its electricity production carbon-free by 2045.

Removing natural gas from buildings will normally affect the heating and hot water systems and, especially with residential and hospitality buildings, the cooking appliances and maybe gas fires. Where heating is concerned, the obvious options include heat pumps and heat-recovery systems. The cost of such installations tend to be higher than gas ones, but you save on the cost of bringing gas supplies into the building. Induction cooking is a cost effective alternative to gas stoves, but there is a small learning curve with their use.

Berkeley's ordinance covered new single-family residences, townhomes and low-rise apartment buildings from the start of this year, but the legislation is worded so that it can be extended when the California Energy Commission has analyzed other building types as suitable for electrification. With other new buildings, the technology for going all-electric is not necessarily available at present so they are only required to be made ready for later conversion. The Berkeley ordinance does permit exemptions where all-electric systems cannot currently be modelled in the California building code compliance software. Some other jurisdictions enacting all-electric requirements are following a similar route to Berkeley, while others are implementing incentives to build that way rather than requiring it.

Gas has been an efficient and economical means of providing heating and hot water for buildings, so effort is now going into advancing all-electric alternatives that can compete economically. California Senate Bill 1477 provides funding to assist the development of such clean heating technologies.

New buildings only make up a small proportion of our towns and cities, and so far nobody is really addressing the conversion of older buildings to all-electric. But that is coming. We will probably first see financial incentives and grants for converting existing buildings, but requirements to do so will probably follow. A large part of the financial incentive will be the fact that gas prices will start to rise as a smaller and smaller number of buildings have to cover the cost of maintaining the infrastructure for delivering the gas. Gas prices are already rising, due partly to the need to upgrade aging pipelines and other infrastructure. The concern is that lower-income families in older dwelling will end up paying a high price to support the remaining infrastructure, so the search is on for cost effective ways to convert existing buildings.

5G in Construction

The fifth-generation cellular wireless communication system, 5G, is hitting the headlines, and it is expected to have a big influence on the construction industry. The advances that 5G brings include blazingly fast speeds (10 to 100 times faster than the current 4G LTE), much lower

latencies which will reduce the need for wired connections, and it promises increased bandwidth that will let you connect as many pieces of equipment as you like (great for the Internet of Things).

We have been used to cellular networks with their cell towers, but 5G will also require smaller local cells and even dedicated in-building and home access points that connect users and wireless devices to the core network. That is because 5G uses a range of frequencies (initially around 600-700MHz, 3-4 GHz, 26-28GHz, and 38-42GHz) and it is the higher frequencies that give the higher speeds, but those frequencies won't carry far and are more easily blocked by structures. Small millimeter wave (mmWave) cells, designed for short-range connections of about 30 feet to a few hundred yards, will be grouped in regions where there are high numbers of connected devices.



To speed access to resources even more, 'Edge' computing will be used. That involves installing 'cloudlet' servers and the like much closer to the end user, possibly in 5G base stations. In effect that moves the applications and content close to the radio transmitter at the 'edge' of the network.

5G's increased speed and reduced latency (the lag time in communication between devices and servers) makes remote operation of equipment feel like it's in real time, and the faster transfer of data to autonomous equipment (such as an excavator) will substantially improve safety. The latency on a 5G network should be around one millisecond, whereas it is around 40 milliseconds with 4G. Autonomous cars are used on roads that can be mapped once and then only need updating occasionally. Construction sites are constantly changing and have people moving supplies from place to place. Autonomous trucks and other site vehicles need to keep track of these changing conditions and 5G will facilitate the transfer of this vital information almost instantaneously. Work in confined spaces has its hazards, and the use of remote-controlled machines can

improve safety here; the variety of operational wavelengths for 5G means that the control signals can reliably be sent long distances through building materials and soil. Control has been demonstrated for a machine at least 400 meters below ground, controlled from the surface.

BIM and collaborative management systems (CDEs, common data environments) are becoming standard practice, but file sizes can be large. The speed and bandwidth of 5G networks will make the sharing of data between office and site eminently practical, even with mobile devices. 5G will also help improve the quality of images that can be sent to augmented reality and VR headsets, so you can get a clearer image of what is planned or go for a virtual site inspection from your office desk.

Contractors and design professionals are already using cameras and drones to monitor and record construction progress, and the increased bandwidth will allow streaming of ultra-high-definition video. Laser imaging generates massive data files which will be so much easier to transfer. The increases in speed and bandwidth mean that a video download that might have taken seven minutes on 4G would only take about ten seconds with a 5G network. Waiting for a download to catch up should become at least as rare as a Windows' "out of memory" message.

Another of the major improvements is the number of possible connections. With 4G it is ten thousand connections per square kilometers whereas 5G promises a million, a hundred-fold improvement. This is great for the Internet of Things, because you can now have sensors, controllers, and other smart technology everywhere and not be concerned about their ability to connect wirelessly through the Internet. This should also allow improvements in the tracking of tools, equipment, and material deliveries, leading to improvements in productivity and uptime. Improved safety on site can come with the use of wearable health and safety sensors, if privacy issues can be satisfactorily resolved. All this connectivity does mean that there will be more backdoors for hackers to work through, so security must be taken seriously.

However, 5G is itself still in construction. Cellular companies will initially integrate 5G into existing 4G networks, with 4G providing the initial connections and control signals, and then 5G providing fast data. One carrier claims to have a nationwide 5G network now, but they are using the kind of lower frequency airwaves currently used by 4G, resulting in a 20% (1.2x) increase in speed, not the 10,000% (100x)

improvement that a full 5G implementation should bring. But a 20% improvement is good. The infrastructure is being built and we should be seeing the full benefits by around 2025, with intermediate benefits coming available in the meantime. With the construction industry being historically slow in adopting new technology, this delay might give contractors and design teams time to prepare for the coming benefits.

Voldemort Strikes Back

Something invisible to the human eye, but which can take over a person's body, is driving us apart while showing just how connected we all are. As a strip of RNA wrapped in a minute protein sack, it doesn't meet any of the recognized definitions of a living being. Perhaps it is no coincidence that 'virus' and 'Voldemort' both start with the same letter.

When the NBA cancels the 2020 season it becomes obvious that things are serious. Since we don't have Prof. Sybill Trelawney available to read the tealeaves, we'll try to come up with our own prophecies for the coming year.

The Covid-19 virus is believed to have first made its leap to humans in China's Wuhan City in Hubei province around the beginning of December 2019 and in the single month between January and February China's factory activity dropped 28.6% and their service sector fell 48.8%. And that was with millions of people forced into quarantine as the authorities tried to contain the virus's spread. After 4 months, the spread of the virus in China had been brought under some measure of control, but by that time the coronavirus had spread around the globe, with about 30 countries in all continents except Antarctica reporting cases.

It was at the end of the first quarter of this year that the virus started spreading in the US. The airline and leisure industries were being hammered as people stopped traveling unless necessary, and anything involving large gatherings of people was being discouraged or banned, and that was followed by stay-at-home orders, businesses being shuttered and people laid off. So, for the first quarter the GDP will be reduced from what might otherwise be expected and the panic buying as shelter-in-place orders started being issued is unlikely to stop the GDP figures for Q1 ending below those for 2019-Q4.

The second quarter, April through June, is when we can expect to see the virus really take off in the US, along with even tougher social distancing restrictions to slow the spread and stop medical facilities from being completely overwhelmed. That will mean that businesses will be suffering severely, and continuing layoffs will be a hammer blow to public confidence, so the likelihood of the GDP dropping again seems inevitable. The Fed used up most of its ammunition in the first quarter, but there was never really anything wrong with the economy itself. This is not an economic crisis, but a health crisis that stops business being conducted so, hopefully, test kits will become more available so that the virus can really be tracked.

By the third quarter, we will almost certainly have met the common definition of a recession, which is two consecutive quarters of negative growth. By July, hopefully the spread of the virus will be slowing down, although there are no guarantees. There is no clear evidence at the time of writing (end of March) that summer weather will deter the virus, but it had been spreading slower in the southern hemisphere than in the north so, as the Sun moves closer to us, the prolonged sunshine may bring some relief. There will also be the fact that a lot of the population will have built up immunity by having already been infected. That should enable commerce to start moving back onto a firmer footing again. However, consumer confidence will have taken a battering by the unprecedented events, so the crystal ball is still a bit murky about how quick the pick up of economic activity will be.

By the end of the fourth quarter, hopefully the worldwide efforts to produce a vaccine for Covid-19 will be producing results, and mass production and distribution of it will mean that real control of the situation has been regained. That should be a shot in the arm for consumer confidence.

And we had thought that the biggest problem we'd have this year was a presidential election. We set up imaginary barriers between nations, but the virus has shown us how connected we all are. That connectedness enables business, but it also lets diseases spread, destroying the ability to trade while showing how much we depend on everyone else. As the Sorting Hat said, "We must unite ... or we'll crumble from within." This pandemic will be almost unimaginably disruptive, but we might be able to learn something from the experience. Please keep healthy.

Geoff Canham, Editor, TBD San Francisco