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The case for committing to greener telecom networks

Operators' energy costs keep rising, but efficiency measures and organizational change can lower them by 15 to 20 percent in a year, benefiting company profits and the environment.

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Energy costs for telecom operators around the world are already high: at the end of 2018, they accounted, on average, for around 5 percent of operating expenditures. In emerging markets, where low grid coverage often means operators must supply their own power with a generator set, energy can account for as much as 7 percent of expenditures.[1] And costs look set to rise further, putting greater pressure on margins at a time when the industry can scarcely handle any additional financial burden.

This growing energy challenge is, in large measure, a result of the exponential growth in traffic that new 5G services are likely to deliver. Although the 5G-new-radio standard is more energy efficient per gigabyte than are the 4G standards, the proposed 5G use cases and new spectrum bands will require many more mobile sites, outstripping potential energy efficiencies. Each 5G site will need two to three times more power than the 4G-equivalent site, according to industry estimates. At the same time, as more services are provided at the edge, the number of data centers will need to rise. By our calculations, these already account for 5 to 10 percent of a telecom operator's energy costs.

Supply-side costs are also likely to increase. On average, global power prices have risen by about 1 percent a year over the past decade, although in Australia, Canada, Egypt, France, and South Africa, they have climbed by between 3 and 7 percent.[2] There is no reason to believe this trend will abate, particularly given the likely shift to electric vehicles in many markets and the extra demand for grid power that this will unleash.

Costs are not the only concern, however. Telecom operators already account for 2 to 3 percent of total global energy demand,[3] often making them some of the most energy-intensive companies in their geographic markets. As operators' energy consumption expands, so will their carbon footprint, hurting not just the environment but also their reputation and standing, particularly among the expanding class of socially responsible investors.

But this does not have to be the case. All operators have considerable scope to cut energy costs and consumption. In current mobile networks, for example, transferring data only consumes around 15 percent of energy.[4] Some 85 percent is wasted because of heat loss in power amplifiers, equipment kept idling when there is no data transmission, and inefficiency in systems such as rectifiers, cooling systems, and battery units.

Some savings lie in deploying artificial intelligence (AI) and the Internet of Things (IoT): some in structural and architectural transformations, and some in cheaper and more sustainable energy sourcing. The extent of the potential savings will vary by operator and market. Regulations governing distribution and retailing, green-energy incentives, OEM choice, and an operator's starting point in energy efficiency will all make a difference. Nevertheless, our work suggests that many operators can reduce energy costs by at least 15 to 20 percent in the space of just one year—and more over a longer period.

Seizing these opportunities, however, requires major organizational and mind-set shifts. Energy costs may well be aggregated at company level, but responsibility for the cost drivers is split across many different functions and divisions, such as network and infrastructure planning, field operations, facilities management, procurement, and IT, making managing this level of change all the more challenging. Moreover, reducing energy costs requires resources (labor and capital) at a time when operators are concentrating their investments on expanding the capacity and reach of their networks. For both these reasons, energy consumption and costs are unlikely to fall without high-level recognition of the importance of reducing them and a comprehensive strategy for doing so.

[1] McKinsey benchmarks for mobile and fixed operators.
[2] Enerdata; Energy Insights by McKinsey.
[3] GSM Association.
[4] *5G network energy efficiency*, Nokia, December 2016.

Where the opportunities lie

The biggest opportunities for energy-consumption and cost reductions lie in four areas. Some are more complex than others to capture, and some require more capital spending than others (Exhibit 1).

Artificial-intelligence-driven sleep and shutdown
Running systems that are not in constant use consumes significant amounts of energy. Typically, radio access network (RAN) accounts for about 60 percent of the power used at a mobile site. Data-traffic loads are intermittent, though, so that different parts of RAN can be put briefly into sleep mode, even during periods of peak traffic. A mobile operator in Australia found that simply turning off the power-amplifier symbol at a site could cut consumption by more than 7 percent, without any service degradation.

Exhibit 1

Telcos' energy costs continue to rise, but they have a range of new tools to cut consumption and alter supply.

Key energy-demand and cost-reduction opportunities, illustrative[1]

Levers	Description	Energy costs addressed, %[2]	Potential cost improvement, %	Energy cost savings, %[3]	Capex[4]	Complexity	Achievable within a year
Smart sleep and shutdowns	Site level: power-amplifier symbol, adaptive power consumption, multiple-input and multiple-output muting	20	10	2	Low	Low	✓
	Multisite level: carrier shutdown, cell shutdown, cross-base-station optimization, cross-radio (3G/4G) optimization	40	15	6	Low	Medium	✓
Internet of Things–enabled energy optimization	Sensors to optimize cooling	25	15	4	Low	Low	✓
	ToU[5]/Smart metering	100	5	5	Low	Low	✓
	Fuel monitoring	5	15	1	Low	Low	
Structural and architectural transformation	2G or legacy shutdowns	3	100	3	Medium	Medium	
	Newer cooling systems, insulation, reflective paints	15	20	3	Medium	Medium	
Strategic and sustainable energy sourcing	Purchase or generate green energy	100	30	30	None	Medium	
	Direct procurement/ competitive sourcing	100	5	5	None	Low	✓

[1] Figures are indicative only and will differ by market and operator, depending on various factors (eg, regulations governing distribution/retailing, green-energy incentives, OEM choice, operator's starting point in energy efficiency). [2] Share of network energy costs addressed. [3] Network energy-cost savings.
[4] Capital expenditures. [5] Time of usage.

AI expands the potential for such energy-saving opportunities across the network. The ability to analyze vast amounts of data relating to traffic patterns, real-time demand, and network-resource availability allows for quick, automated decisions on the parts of the system that can be put into sleep mode or shut down. For example, this could involve shutting down frequency carriers or shutting down a site momentarily in areas where there is overlapping coverage. We estimate that such energy-conserving AI tools can deliver 5 to 7 percent savings for some operators, in addition to savings that accrue from stand-alone, site-level efficiency measures. And the potential will surely rise further. As open and cloud-native approaches to building RAN gain ground, additional AI solutions that not only save energy but also minimize related customer-experience issues, such as latency, are emerging. They can also be used on all networks, from 2G to 5G.

Similar energy-saving advances are occurring with AI on fixed networks. For example, AI can reduce the energy cost of central offices by between 3 and 5 percent by continuously calibrating the optimal settings of chillers, pumps, and fans to guard against waste.

The AI tools for managing energy efficiency in data centers (where the cloud RAN will be located) are considerably more mature. Google, for example, has reported 30 percent energy savings using AI at its data centers, illustrating just how high telecom operators could set their sights.[5]

Internet of Things–based energy optimization

It is hard, if not impossible, to reduce energy consumption and costs if you cannot measure consumption accurately. That is the starting point of any concerted energy-efficiency program. But until recently, accurate measurement on an industrial scale has been difficult. Old equipment does not always measure consumption, and even if it does, recording it requires hundreds of employees to make and submit accurate readings. The IoT, by contrast, uses sensors to track consumption.

That advance opens up all sorts of new ways for operators to save energy. Sensors that read consumption—essentially, smart meters—give companies access to time-of-usage discounts in markets where they are offered. One Southeast Asian operator saved 5 percent on its energy costs because of a differential pricing offer from the utility provider.

And the IoT can counter the theft of fuel and grid power, which is a serious concern in some developing markets, where it can raise energy consumption and costs for some operators by 10 to 15 percent. By placing sensors at various points to gauge grid-power input, fuel levels, the number of hours the generation set has been running, battery voltages, and consumption by different types of equipment and then analyzing the data, operators could uncover potentially costly anomalies. What's more, the IoT platform could provide real-time alerts when they occur.

Like AI, the IoT also makes it much easier to optimize consumption—with air conditioners, for example. Many operators have already moved heat-generating equipment outdoors to take advantage of natural convection cooling. Nevertheless, our analysis shows that, on average, about 20 percent of a telecom operator's sites and other facilities still use air conditioning. On mobile sites where this is the set case, air conditioning accounts for 30 percent of energy consumption. Here, the installation of sensors would allow monitoring and remote adjustment of the site temperature. The sensors could even alert the operations center if a door was left ajar or the maintenance crew altered the setting, forcing the air conditioning to work unnecessarily hard. The overall result could be a 1 to 3 percent reduction in a site's energy consumption.

Importantly, companies can retrofit the IoT for use by old equipment, even as OEMs are integrating it into newer equipment.

[5] *Data centers and infrastructure*, "Safety-first AI for autonomous data center cooling and industrial control," blog entry by Chris Gamble, Jim Gao, and Amanda Gasparik, August 17, 2018, blog.google.

Structural and architectural transformation

Structural and architectural changes can deliver sizeable energy savings. Energy is the primary source of cost savings when decommissioning legacy networks, for example. A Southeast Asian operator realized a 3 percent saving on its total energy bill when it decommissioned its stand-alone 2G network and moved to a single-RAN architecture, as the legacy 2G equipment, although underused, was more energy intensive. Similarly, migrating to architectures such as cloud-RAN and "clean cloud" data centers can deliver energy savings of more than 10 percent.

Another opportunity lies in customizing RAN as well as passive infrastructure specifications site by site, depending on load conditions. One size does not need to fit all. The size of battery trays for backup power can be custom designed, for example, as can multiple-input and multiple-output (MIMO) configurations. China Mobile says it is improving energy efficiency through site-specific MIMO configurations, using 32T32R arrays—or even 8T8R—in some locations instead of 64T64R at every site.[6]

Strategic and sustainable energy sourcing

Energy demand is only one part of the equation. Too often, operators fail to give enough attention to the supply sides of their energy expenditures. It is still rare to find an energy-sourcing specialist in a telecom operator's procurement department, even though sizeable cost savings lie in better sourcing. The following are the areas in which companies can find savings:

— *Procurement.* An operator in the Asia–Pacific region was purchasing power for some of its sites through intermediaries, such as the site landlord or mall owner, rather than directly from the utility. This is not uncommon. Teams negotiating site rentals tend not to scrutinize energy costs, and site-deployment crews sometimes bypass required energy-assessment steps to meet strict schedules. An operator's energy costs then become unnecessarily high because the prices that intermediaries pay for their power are often more than those charged to industrial customers—and because the intermediaries themselves charge a commission. By going directly to a power supplier, this operator reduced its energy costs on affected sites by 15 percent. Even when operators procure directly from a utility and adhere to a structured procurement process, a close examination of supply market trends and pass-through costs can reveal room for renegotiation. Such scrutiny helped another operator in the Asia–Pacific market cut unit costs by 5 percent.

— *Diversification.* Green-energy suppliers are cheaper in some markets. In India, the cost per kilowatt-hour of solar power is about 35 percent lower than grid power and about 65 percent lower than generator-set power. Some telecom operators are already taking advantage of such price differentials. Telefónica México, for example, sources 40 percent of its energy needs from a solar-energy provider,[7] and Australia's Telstra has a contract with various solar and wind farms in New South Wales to buy and use all their output.[8]

— *Generation.* There are opportunities for companies to cut costs by generating their own green power on site. Japan's NTT DOCOMO is reported to have reduced grid-power usage by as much as 40 percent at some of its base stations by using solar panels and higher-capacity batteries.[9] The extent to which a company can scale such a model will depend on the suitability of the site locations for solar power, availability of space, and cooperation of the site's landlord. Nevertheless, by sourcing from green suppliers or generating on-site green energy, we see no reason why all the energy needs of most telecom operators should not be met with green energy by 2030.

[6] Robert Clark, "China Mobile exec calls for 5G power subsidies," Light Reading, November 14, 2019, lightreading.com.
[7] Lourdes Tejedor, "Telefónica's renewable energy plan obtains a GLOMO Award at the MWC," Telefónica, February 26, 2019, telefónica.com.
[8] Perry Williams, "Telstra backs solar, wind farms," *Australian Business Review*, March 21, 2019, theaustralian.com.au.
[9] "Case study: NTT DOCOMO," GSM Association, January 9, 2019, gsma.com.

Keys to seizing the opportunities

Although there is huge potential to reduce the energy consumption and costs of telecom networks, realizing that potential is no easy task. Any successful strategy will include the following elements:

— *Establish accountability.* Unless a senior leader has a charge to reduce energy consumption and costs, it is unlikely to happen. That leader will need influence across the company, which means they will ideally be a top executive from network operations.

— *Draw up a transformation plan.* As with any transformation program, companies will need to set targets against current consumption, put detail behind planned initiatives for which line leaders are willing to take responsibility, pilot initiatives before extending what works across the company, and develop new capabilities (Exhibit 2). Bear in mind, however, that the data needed to assess current consumption versus what is achievable may not be readily available. Most companies do not have site-level energy-consumption data, for example, let alone an understanding of the consumption of various pieces of equipment on each site. When internal data are not available, much can be gleaned from other sources, such as element-management systems, vendor invoices, interviews with operations personnel, sample site measurements, and equipment-specification sheets. Predictive models will also be necessary to ascertain likely consumption given anticipated traffic growth and the addition of new equipment at mobile sites, central offices, and data centers.

Remember, too, that like any other transformation program, implementing this one will require a significant cultural shift that builds awareness of the extent of energy waste and the importance of reversing the trend. Network planners should come to regard energy efficiency as of importance similar to other parameters they currently prioritize, such as data speed and signal strength. There are carrots as well as sticks that companies can use to foster a change of attitude. Encouraging employees across a company to submit ideas

Exhibit 2

Telcos can use a five-part transformation plan to help reduce energy consumption and cost.

5-part energy-efficiency program

Key step Enabler

Size the opportunity
Establish a baseline, accounting for current costs and consumption and future growth

Identify gap between baseline figure and what is technically feasible

Brainstorm energy-efficiency ideas and decide which to prioritize

2–3 weeks

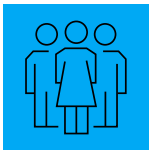
Use bottom-up planning
Put detail behind proposed initiatives, including benefits, capital required, and complexity

Lay out a transformation plan owned by line leaders

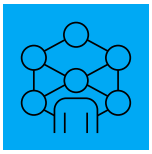
4–6 weeks

Implement and track benefits
Launch pilots and track benefits, with appropriate key performance indicators, before scaling successful efforts across the company

6–9+ months



Prioritize cultural change
Build awareness of energy wastage and company's focus on reducing it



Build capabilities
Develop new abilities or hire talent to build consumption models, make good use of artificial intelligence and automation, and source green energy

on how to save energy and rewarding those who consciously try to reduce waste can be helpful. So can setting strict, site-level energy budgets.

— *Build partnerships.* Telecom operators should not fight this battle alone. Their suppliers—telecom OEMs and software-solution providers, for example—can help by improving the energy efficiency of equipment they sell, and operators can insist on this as a prerequisite for their business. Another option is partnering with specialists in energy management, such as energy-as-a-service providers that help with large-scale enterprise energy-efficiency projects. In Spain Telefónica works with Vertiv to help it improve its energy efficiency.

  Regulators may have a role to play too. For example, reducing network capacity at night, when demand is low, could save energy. But operators might hesitate to make such a move independently if they felt the regulator would view any dip in performance negatively, damaging their competitive standing. Regulators working with companies to set minimum off-peak network-performance requirements or energy-efficiency standards might overcome such a problem.

— *Raise the bar and make the business case.* Besides reducing energy consumption, companies should set themselves high ambitions when it comes to using green energy to reduce their carbon footprints further. Indeed, they should work toward carbon neutrality, taking their lead from other companies and other industries. Amazon, for example, is working toward meeting 80 percent of its energy needs from sustainable sources by 2024, while its Amazon Web Services division has a policy that only permits setting up a new data center anywhere in the world if there are sustainable energy sources to run it.

  Winning support for such lofty goals will be easier with the help of a good business case. When calculating total energy costs, companies should consider the high cost of carbon credits that many markets require to offset the use of fossil fuels. This is not uncommon in other industries. Leading consumer-packaged-goods companies, such as P&G and Unilever, have taken this approach to drive efficiencies across their supply chains. And the better the business case, the easier it will be for an energy-efficiency-transformation program to compete for resources against network expansion and capacity increases.

There is a huge gap between most operators' high levels of energy consumption and costs and the lower levels that are technically possible, even today. Companies that fail to take advantage of new tools being developed to cut consumption and of cheaper, sustainable energy sources will see that gap widen further as traffic grows, causing potentially lasting damage to their competitive positions. They can no longer afford to shy away from setting audacious goals that will benefit not just the company and the industry but also the environment and world at large.

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