Energy Cost and Carbon Footprint Reduction for Telecom Companies

Roland Berger Study

June 2020

Cover Photo
Ericsson

Layout
Vanessa Tanujaya

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CHAPTER 1:

URGENT NEED FOR TELECOM OPERATORS TO CUT ENERGY COSTS AND CARBON FOOTPRINT

Targets for the sector have been set

The telecom sector has set ambitious targets to tackle climate change and de-carbonize. GSMA, in partnership with the International Telecommunication Union (ITU) and the Global e-Sustainability Initiative (GeSI), has developed a pathway to reduce greenhouse gas emissions across the sector[1)].

The pathway targets a 45% emission reduction by 2030 and net zero emissions by 2050 for the sector. Leading telecommunication companies have already announced their own ambitious decarbonization goals. For example, Singtel and Telenor have announced net zero emissions by 2050, in line with the overall sector targets, and Orange by 2040.

Figure 1 - Emissions targets of leading telecom companies (not exhaustive)

verizon

"To be **carbon neutral by 2035** (Scope 1 and Scope 2 emissions)"

AT&T

"Enable **carbon savings 10 times the footprint of our operations by 2025**"

Telefónica

"Use **50% of electricity from renewable sources in 2020 and 100% in 2030**"

Deutsche Telekom

"**100% use of electricity from renewable energy sources as early as 2021** and reduce **CO2 emissions by 90% by 2030 compared to 2017**"

telenor

"**50 per cent reduction in carbon emissions by 2030** for Asian operations and **group-wide carbon neutral by 2050**"

orange

"Increase use of **renewable energy sources to account for over 50% of the Group's energy mix by 2025** and **achieve net zero carbon by 2040**"

Singtel

"Reduce our carbon **emissions intensity of kWh/TB by 50% by 2030** using 2015 as baseline and **net-zero emissions by 2050**"

NTT docomo

"Amount of contribution to the reduction of CO2 emissions across society: **at least 40 million tons**"

kpn

"In 2040 our CO_2 emissions will be **reduced by 50% within the entire chain** (compared to 2010)"

Taiwan Mobile

"GHG emissions in **2030 to decrease by 30% compared** with 2016"

BT

"BT will reduce its **CO_2 by 87% by 2030** and is also well on its way to achieving its **commitment to purchase 100% RE for its operations** by 2020"

elisa

"Our target is to reduce **50% of our energy consumption carbon footprint by 2025** (from the 2016 level)."

1) The pathway was approved in February 2020 by the Science-Based Target initiative (SBTi)

Without mitigation measures, energy consumption will increase rapidly due to 5G

Realizing telecom companies' decarbonization targets will require a major shift in how operators, tower companies and data centers manage their energy needs. Indeed, in a "business-as-usual" scenario without carbon footprint or cost reduction measures, telecom companies' energy consumption and footprint would actually increase rapidly, due to 5G. Even though 5G is more energy-efficient on a per-bit basis, overall energy consumption can be significantly higher because of two main factors:

1 More sites and antennas

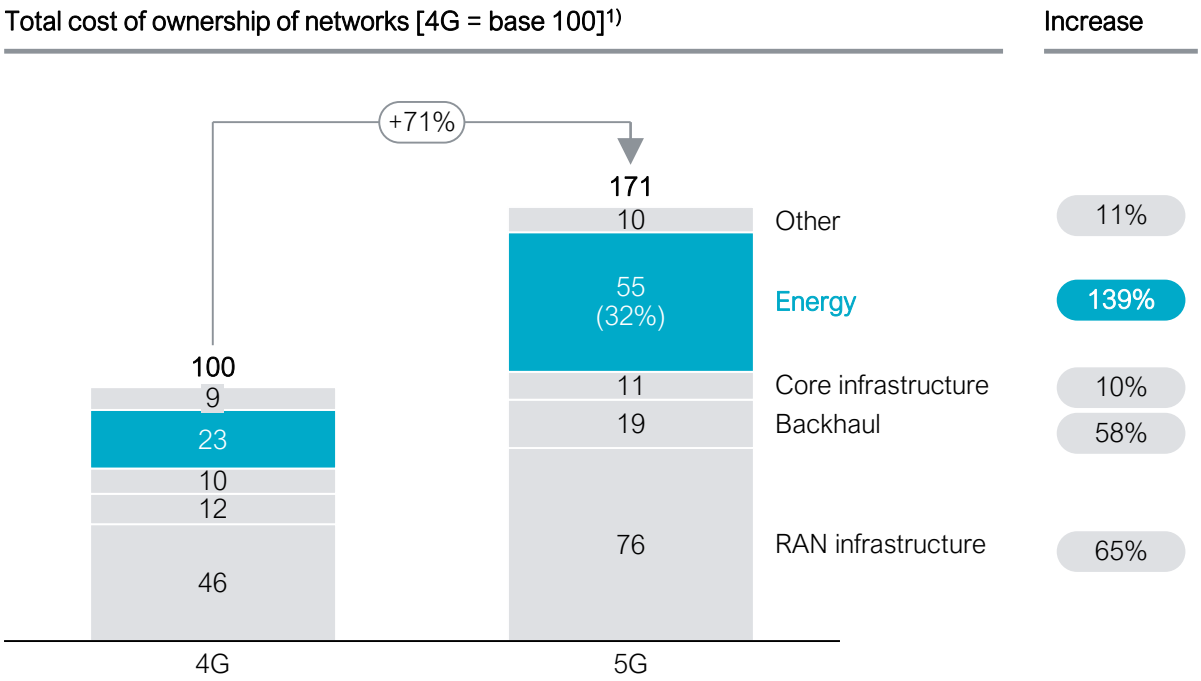
5G will lead to a rapid increase in macro and small cell sites. In addition, operators may run 2G, 3G, 4G and 5G networks in parallel, further increasing energy consumption.

2 Accelerated increase in data

Exponential growth in data load is expected, due to data-intensive 5G use cases. This will lead to an increase in data centers and greater energy consumption.

Currently, energy constitutes ~20-25% of network costs, with operators spending approximately USD 17 billion per year on energy globally[2]. Without mitigation measures, GSMA forecasts that telecom operators' energy costs will increase by 139%, driving up overall 5G network costs.

Figure 2 - Telecom network costs (source: GSMA)



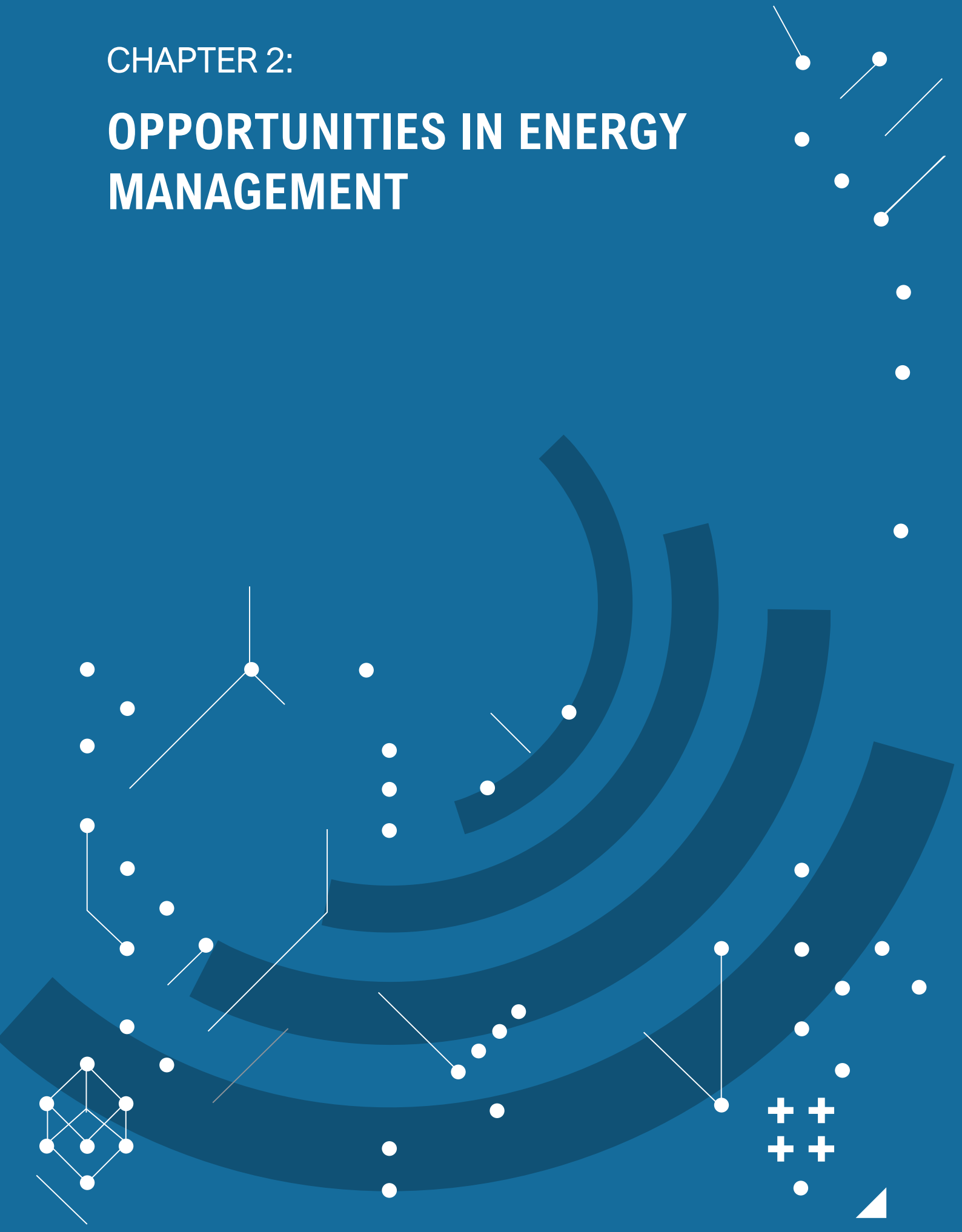
1) 5G Baseline & Optimized Cases = average annual TCO for the 2021-2025 period for a European mobile operator rolling out a 5G network in 3.4-3.6 GHz band. 4G Reference Case = the average 2013-2018 annual network TCO

Without mitigation measures, energy costs would increase to around 32% of network costs. Therefore, with operators moving to 5G, reducing energy costs will become imperative for telecom companies.

2) Source: GSMA

CHAPTER 2:

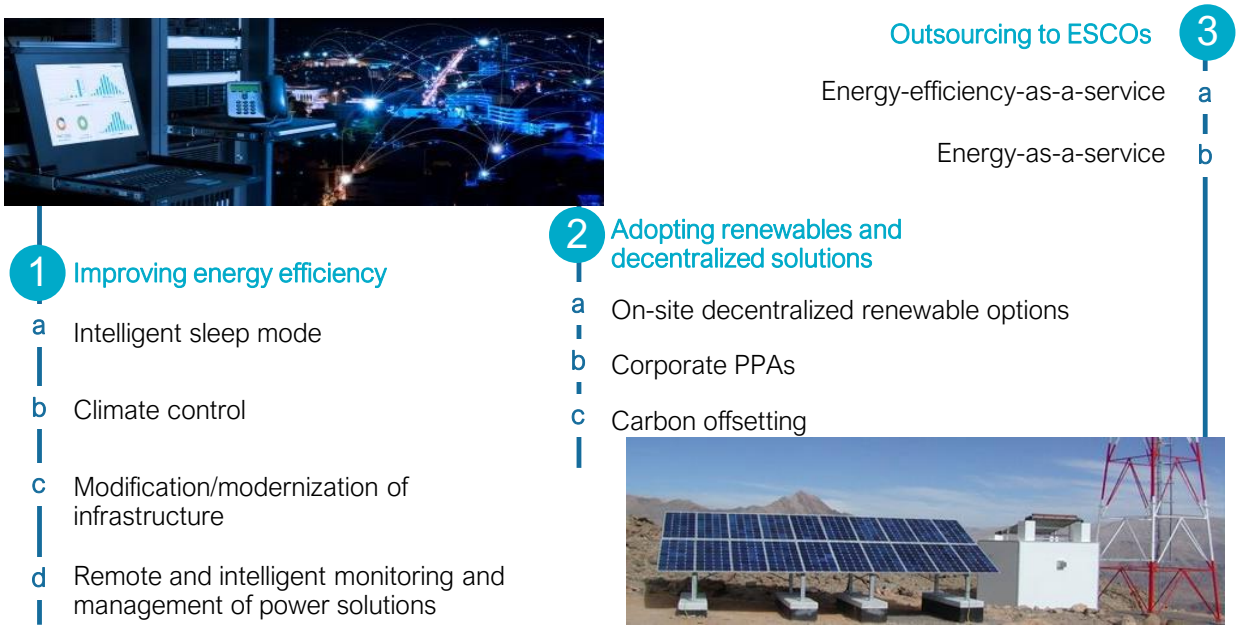
OPPORTUNITIES IN ENERGY MANAGEMENT



To reduce energy costs and carbon emissions, telecom companies can tap into three opportunities:

1. Improving energy efficiency of its operations to lower energy demand;
2. Adopting renewable energy sources and decentralized solutions, whereby renewable electricity is generated locally; and
3. Outsourcing energy to specialized providers.

Figure 3 - Carbon footprint and energy cost reduction opportunities for telecom companies



1 Improving energy efficiency

Telecom companies often have significant potential to further improve energy efficiency, as reducing energy costs may not have been high on the agenda in the past, and as new technologies, such as Artificial Intelligence (AI) and machine learning provide new opportunities to use energy more efficiently. Key energy efficiency measures include intelligent sleep mode, climate control, modification or modernization of infrastructure, as well as remote and intelligent monitoring and management of power solutions.

Intelligent sleep mode

Intelligent sleep control allows operators to automatically switch on and off parts of the network to save energy. For example, Base Transceiver Stations (BTS) can be put in sleep mode or turned off intelligently, based on traffic. While in sleep mode, the BTS does not receive or transmit traffic, and only its wake-up receiver module, which consumes minimal power, remains active.

Artificial Intelligence (AI) and machine learning now allow smarter and dynamic sleep mode functions in real-time, based on detailed network data. For example, Elisa[3], a Finnish telecom operator, has implemented an AI-driven intelligent energy saver to optimize energy consumption, allowing to shut down sites with idle capacity. This has allowed Elisa to reduce energy costs by 14%. Similarly, Vodafone partnered with Ericsson to develop a machine learning algorithm to observe, predict and respond to user traffic. The algorithm sets radio transmitters into power-saving sleep mode when user traffic falls below a certain level, leading to 14% savings in energy consumption[4].

Huawei has developed an AI-based energy saving software (PowerStar) at equipment, site, and network levels. The tool also enables energy saving among networks of different radio access technologies operating on multiple bands.

3) Source: Elisa Automate
4) Source: Ericsson

Climate Control

There are various climate control and energy recovery measures that increase energy efficiency.

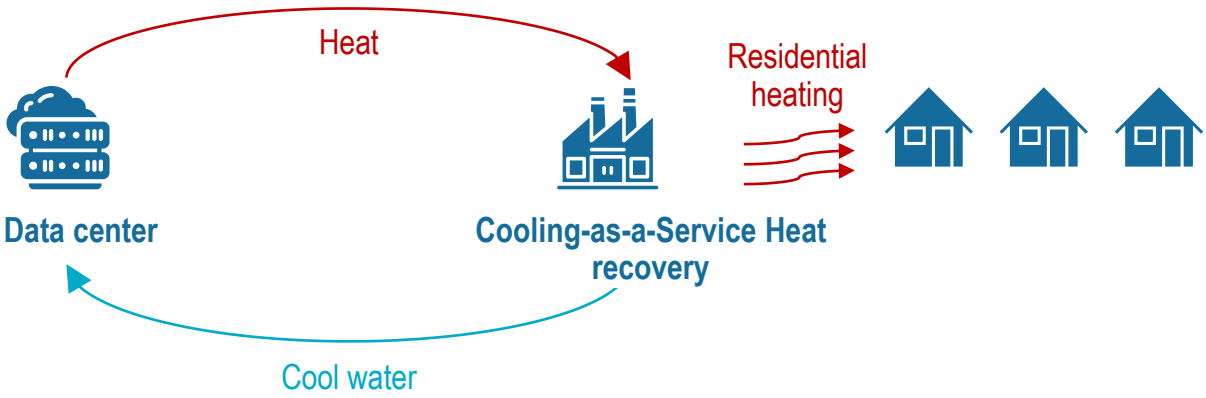
Smart ventilation, for example, adjusts ventilation in real-time to bring fresh air in and pump hot air out, in function of factors such as temperature and air quality. Free air cooling, whereby external air temperature is used for cooling, is another measure to improve efficiency. Temperature can also be dynamically regulated, for example using a thermotank to isolate batteries from other equipment that are less sensitive to heat – hence reducing the workload for air-conditioning.

The use of heat pipes to transfer heat outdoors, as well a the relocation of heat generating equipment (e.g. radio power equipment) to exterior shelters are effective measures to reduce the air-conditioning consumption and hence energy costs.

Other climate control measures that telecom companies can employ to increase energy efficiency are upgrading of end-of-life cooling systems with more efficient cooling equipment, using insulation materials (especially in warmer climates), and applying reflective paints and materials to reflect heat.

In addition to climate control measures, telecom companies can also employ energy recovery opportunities. For instance, heat exchangers can be installed to transfer heat for other productive uses. In Stockholm, for example, heat waste from data centers can heat around 20,000 residential apartments, converting its waste into a new revenue stream. Through the deployment of heat recovery, the green data center can achieve a CO_2 emissions reduction of approximately 8,000 tons[5)].

Figure 4 - Stockholm data center heating system



Modification and modernization of infrastructure

Telecom companies typically also have significant opportunities to improve energy efficiency by modifying or modernizing equipment. For example, installing new batteries can enhance storage capacity and reduce costs of decentralized generation, or where grid supply is unavailable or unstable. Telenor Pakistan, for example, modernized its network by upgrading its battery technologies and energy solutions to enhance the capacity to store energy available from the grid whilst mitigating the impact of grid outages and shortfalls[6)].

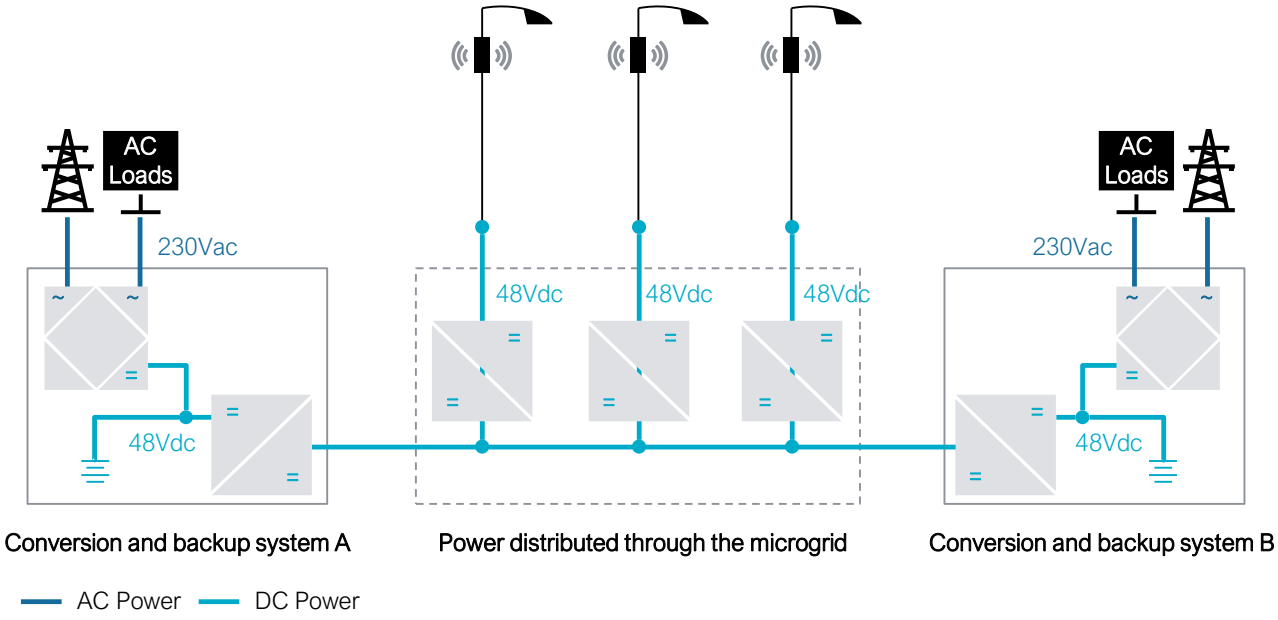
Internet of Things (IoT) technologies and sensors enable smart metering, allowing operators to benefit from time-of-use electricity pricing models where they exist. For example, cooling can be reduced during peak hour tariffs to achieve cost savings. In addition, IoT can help monitor fuel consumption by measuring total energy input and matching it against actual energy used by all equipment to develop a site specific consumption profile, as well as uncover anomalies such as fuel theft and provide real-time alerts.

Other infrastructure modifications that improve energy efficiency include moving conventional cellular networks to cloud radio access network and cloud data centers, reducing AC to DC conversions through modernizing rectifiers, and replacing conventional lighting with LED technologies.

5) Source: Stockholm Data Parks
6) Source: GSMA

For example, CE+T, in collaboration with CommScope, has developed a microgrid solution[7], whereby power from the grid is first converted to charge a local battery. Using this storage and power converters, the solution can both secure AC loads and up to 10 small cells. Other grid sources or renewables can be plugged in to the DC distribution. As the solution requires only one grid source to connect up to 10 small cells, operators can avoid the cost of grid-connecting each individual small cell, as well avoiding local storage on each pole cabinet by having a centralized backup solution.

Figure 5 - Example of new microgrid solution (by CE+T)



Remote and intelligent monitoring and management of power solutions

As described above, telecom companies have a range of opportunities to improve their energy efficiency, from intelligent sleep mode, to climate control and modifying or modernizing equipment – using new and innovative technologies. In addition, telecom companies can digitize and automate the entire suite of such smart power solutions. Remote and intelligent monitoring of power solutions allows efficient energy planning and utilization, by having real-time data on energy consumption across the network and across assets, allowing to optimize energy consumption remotely and automatically.

For example, Telenor Pakistan's Remote Monitoring System allows real-time management and control of the grid infrastructure. Critical information such as fuel consumption, grid availability and energy usage of various power sources can be monitored and managed in real-time[8]. This enables site specific energy solutions to be deployed, ensuring efficient energy planning and utilization.

2 Adopting renewables and decentralized solutions

In addition to energy efficiency improvements, telecom companies can also lower their energy costs and carbon footprint by adopting renewables and decentralized solutions, whereby renewable electricity is generated locally.

Today, only 7% of energy in telecom is from renewable sources – the second lowest among key sectors[9].

Renewables such as solar, wind, (small) hydro, biomass and geothermal are becoming increasingly attractive alternatives to traditional energy sources. This is because the cost of renewable generation continues to fall, with many renewables now being cost-competitive with traditional energy sources in most countries. In particular, solar and offshore wind are expected to see the largest cost improvements over the next 10 years.

7) Source: https://www.cet-power.com/en/market/telecom/
8) Source: GSMA
9) Source: IRENA

In addition, fuel cells and microturbines offer opportunities for telecom companies. Fuel cells convert fuel, such as hydrogen or methanol, and oxygen into electricity. Telecom sites or data centers can employ fuel cell technologies for backup power. For example, Digi has deployed a hydrogen fuel cell system to power base stations in Malaysia[10]. Microturbines, which can be powered through gas, hydrogen or biomass offer benefits due to their compact size, greater efficiency and lower emissions compared to diesel-based gensets. For example, Alkan CIT will begin using microturbine gensets at telecom towers in Africa and Middle East. These microturbines can be powered by a mix of fuel to offer fuel flexibility and require minimal site maintenance. It is expected to offer a 30% cost reduction from conventional diesel gensets[11].

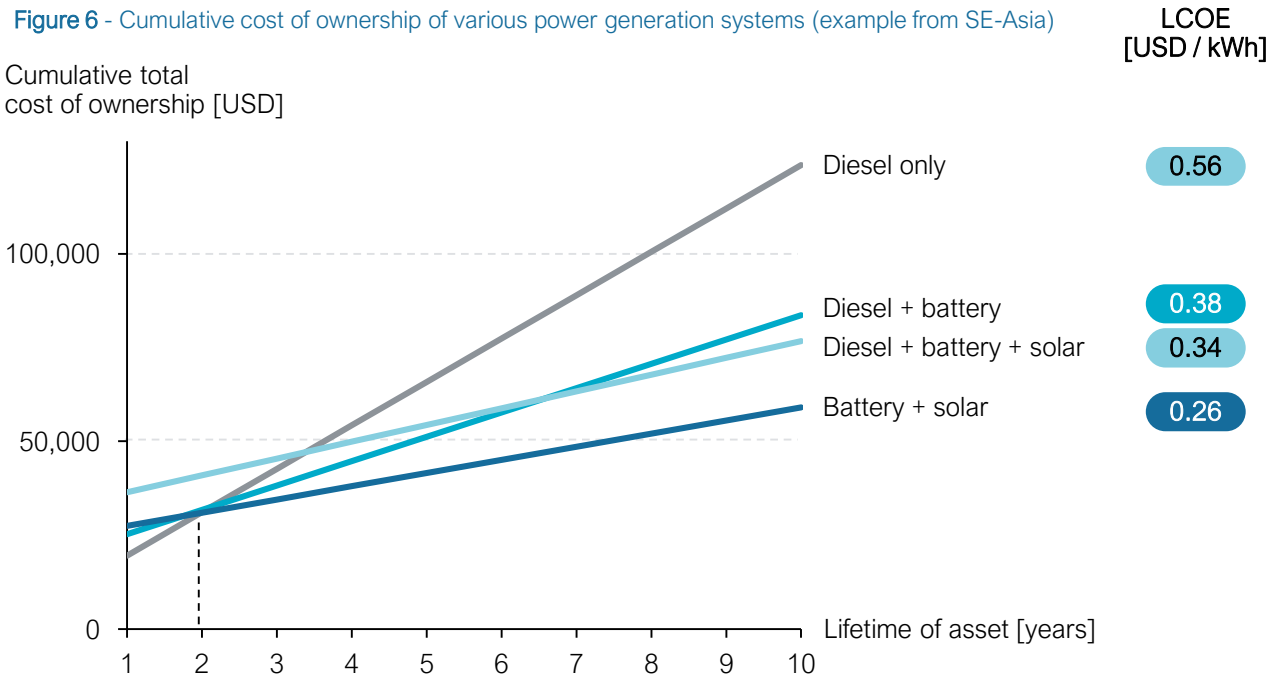
Such renewable sources can be employed locally, for example at the telecom towers, through decentralized solutions, or not decentralized. Even if the electricity is not generated locally, telecom companies can reduce their carbon footprint through renewable power purchase agreements (PPAs), guarantees of origin or carbon offsetting.

Decentralized renewables

The electricity landscape is swiftly transforming from a centralized model, with large power plants, to a decentralized model, with smaller-scale localized production. This transformation is occurring in countries where grid infrastructure is already in place as well as in markets where parts of the country are not yet connected to the electricity grid, or where electricity supply is unstable.

In markets with poor grid infrastructure, off-grid telecom towers traditionally rely on diesel gensets, sometimes backed up by battery solutions. Thanks to rapidly declining costs of renewables and batteries, it is now profitable in most markets to replace such gensets by renewable decentralized solutions. Renewable decentralized solutions still have a higher upfront cost as compared to diesel gensets. However, over the lifetime of the asset and already from the second year onwards, fuel savings from the hybrid system outweigh this upfront investment.

Figure 6 - Cumulative cost of ownership of various power generation systems (example from SE-Asia)



Decentralized renewable solutions developed for telecom towers can also be used to serve the surrounding community. For example, Yoma Micro Power in Myanmar builds solar mini-grids that supply power to off-grid telecom towers and villages. In case the distance between the village and the telecom tower is relatively small, this can be a profitable model, as the generation infrastructure can serve a larger demand. Additionally, in some markets, such models may apply for incentives or subsidies. Finally, it creates opportunities to provide value-added services, such as mobile money solutions for electricity payment and apps to track power consumption.

10) Source: Telenor Group
11) Source: Bladon

Corporate Renewable Power Purchase Agreements (PPAs)

Corporate Power Purchasing Agreements (corporate PPAs) are contracts under which a business, such as a telecom company, agrees to off-take electricity from the power producer at pre-agreed prices for a pre-agreed duration. In the case of a renewable PPA, it can additionally specify that the power must come from renewable sources.

Globally, telecom operators are optimizing their energy procurement through corporate PPAs with renewable energy providers. Such agreements are mutually beneficial for both parties. For renewable energy providers, corporate PPAs provide more demand certainty, which is critical for project financing. For telecom operators, corporate renewable PPAs are becoming a key means of fulfilling carbon emission reduction goals, while also providing more price stability and energy supply security.

For example, in early 2020, Orange entered into an agreement with Iberdrola in Spain for an annual supply of 200 GWh solar energy for 12 years. Similarly, T-Mobile signed a 10-year corporate PPA with Vattenfall for energy supply from a new solar farm in Germany.

Carbon offsetting

If telecom companies procure their electricity from the grid, they can have assurance that the electricity is from renewable sources, through guarantees of origin – at least in markets where such guarantees exist. Renewable energy credits (RECs) can then also be used to offset carbon from non-renewable sources.

In markets where such guarantees do not exist and where non-renewable sources constitute a major part of the country's energy mix, telecom companies can reduce their carbon footprint by funding third party renewable projects or through forestry sequestration projects. For example, Microsoft invests in carbon offset community projects to purchase carbon credits that compensate for emissions from business operations in countries where renewable energy cannot yet be procured. One such project is the community reforestation project in Kenya where Microsoft supports the planting of trees to sequester carbon[12)].

3 Outsourcing energy management to specialized providers

As described above, telecom companies have significant opportunities to improve their energy efficiency and to adopt renewable and decentralized solutions. They can either to do so themselves or outsource energy management to specialized providers.

Outsourcing energy supply to ESCOs

Telecom companies, such as operators or tower companies, can outsource their energy supply to energy services companies (ESCOs). In such a model, the ESCO is responsible for managing the energy supply, including, depending on the contract, owning, maintaining and operating electricity generation assets and storage solutions. Clear service level agreements such as uptime, are defined between the ESCO and the telecom company.

Various pricing models are possible between the ESCO and the telecom company. In case of a cost pass-through model, the ESCO charges the cost, plus a defined margin, to the telecom company. In such case, the ESCO may not have a strong incentive to reduce its energy generation cost. Alternatively, the ESCO may charge a fixed fee per month, or a fixed price per unit of electricity consumed – in which cases the ESCO has incentives to do so. Therefore, ESCO models are moving away from cost pass-through models to pricing structures with a fixed fee or fixed price per unit.

12) Source: Microsoft

Similarly, mobile network operators can (re-)negotiate their electricity pricing model with tower companies. In case of a cost pass-through of electricity costs between the tower company and the operator, the tower company may have little incentive to optimize electricity generation and, therefore, pricing models with a fixed for or fixed price per unit can provide opportunities to incentivize efficiencies.

The benefit of outsourcing energy supply is that ESCOs can specialize in electricity services and generate economies of scale, for example working for multiple tower companies or mobile network operators, while telecom companies can focus on their core activities. As ESCOs are emerging, telecom companies have an increasing range of parties to negotiate with.

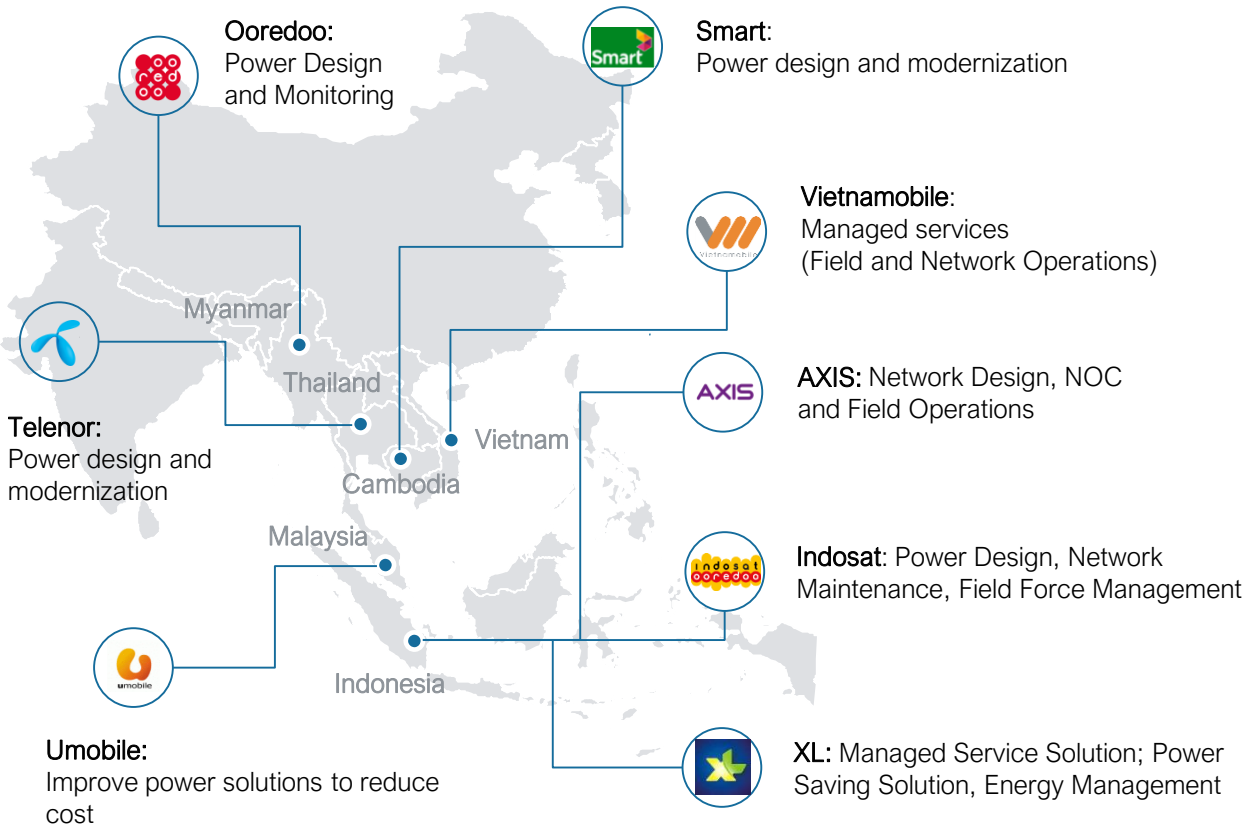
Working with specialized vendors and combining mobile power with field services

In cases where telecom companies do not outsource their energy supply to ESCOs, they can still team up with specialized vendors and solution providers to optimize energy management. Compared to the ESCO model, the telecom company is then in charge and owns the electricity generation assets – but maintenance and servicing for example can still be done by external parties.

In such case, telecom companies can outsource mobile power in combination with field services ("Mobile Power and Field Services" or MPFS). Indeed, power field services affect power availability and thus optimizing power (design, operations management and monitoring) might not be sufficient to achieve high power availability targets if field services capabilities are not aligned. Therefore, including power field services as a joint package provides greater room for cost optimization. The same engineers can also perform preventive and level-1 corrective maintenance for active equipment and site management which can lead to cost optimization from field force management.

Many telecom companies are already outsourcing MPFS activities and reaping the benefits. Typically, telecom operators that outsource MPFS can generate savings of around 10%. Telecom companies that do not optimize MPFS activities risk falling behind on cost competitiveness.

Figure 7 - Selected examples of MPFS outsourcing activities in South-East Asia



CHAPTER 3:

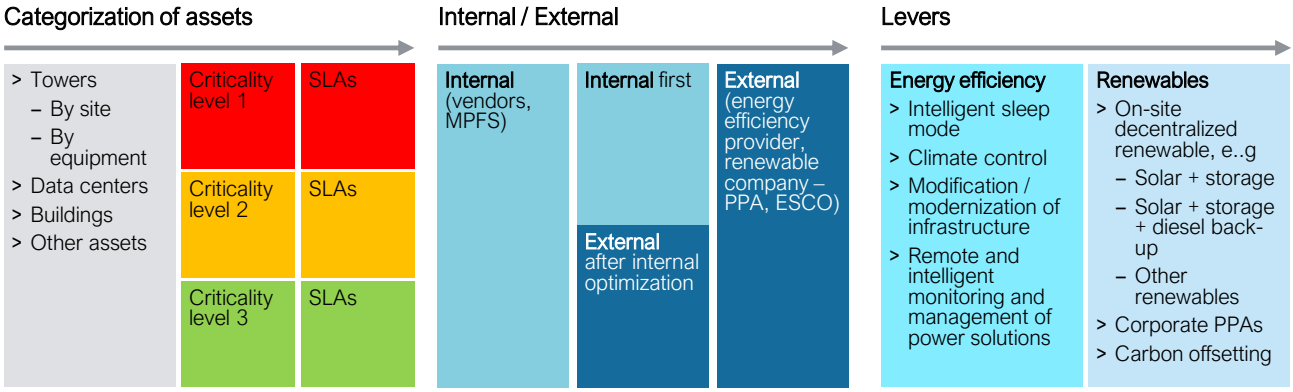
HOW TELECOM COMPANIES SHOULD APPROACH ENERGY COST AND CARBON FOOTPRINT REDUCTIONS

Options space

There is a wide range of options available for telecom companies to reduce their energy costs and carbon footprint. As described in the previous chapter, telecom companies can improve energy efficiency (e.g. through intelligent sleep mode, climate control, modification or modernization of infrastructure, remote and intelligent monitoring and management of power solutions) and adopt renewable and decentralized solutions (e.g., on-site decentralized renewables, corporate PPAs or carbon offsetting). These options can be done internally or by outsourcing to specialized providers, such as ESCOs.

Whether to outsource energy supply or not, and which levers to employ, also depends on the type of asset or individual site. Assets first need to be categorized in terms of criticality (for example, profit impact in case of power failure), including by tower location and by type of equipment (RAN, MIMO, battery trays, etc). Service level agreements, such as uptime, need to be defined for each asset type, depending on the criticality. Each level of criticality is tied to a corresponding SLAs that need to be defined first, before engaging with external parties (e.g. ESCOs).

Figure 8 - Options space



Key learnings

We have identified six key learnings for telecom companies to reduce their carbon footprint and energy costs:

1. **Set ambitious targets.** The telecom sector has an ambitious aim to achieve net zero emissions by 2050. This offers untapped opportunities for most telecom companies to achieve cost reductions through renewables and new technologies. Ambitious targets can help mobilize the organization.

2. **Differentiate assets by criticality.** Prioritize assets based on criticality and adjust power needs (e.g. backup requirements, service level agreements) accordingly.

3. **Collaborate and outsource to external providers with clear incentives and service level agreements.** Tap into the expertise and incentives of specialized firms providing energy efficiency or energy services, such as ESCOs.

4. **Adjust the decarbonization strategy along the way.** Technologies, policies and incentives change frequently, hence a strategic plan needs to be adequately flexible to capitalize on the best opportunities along the way.

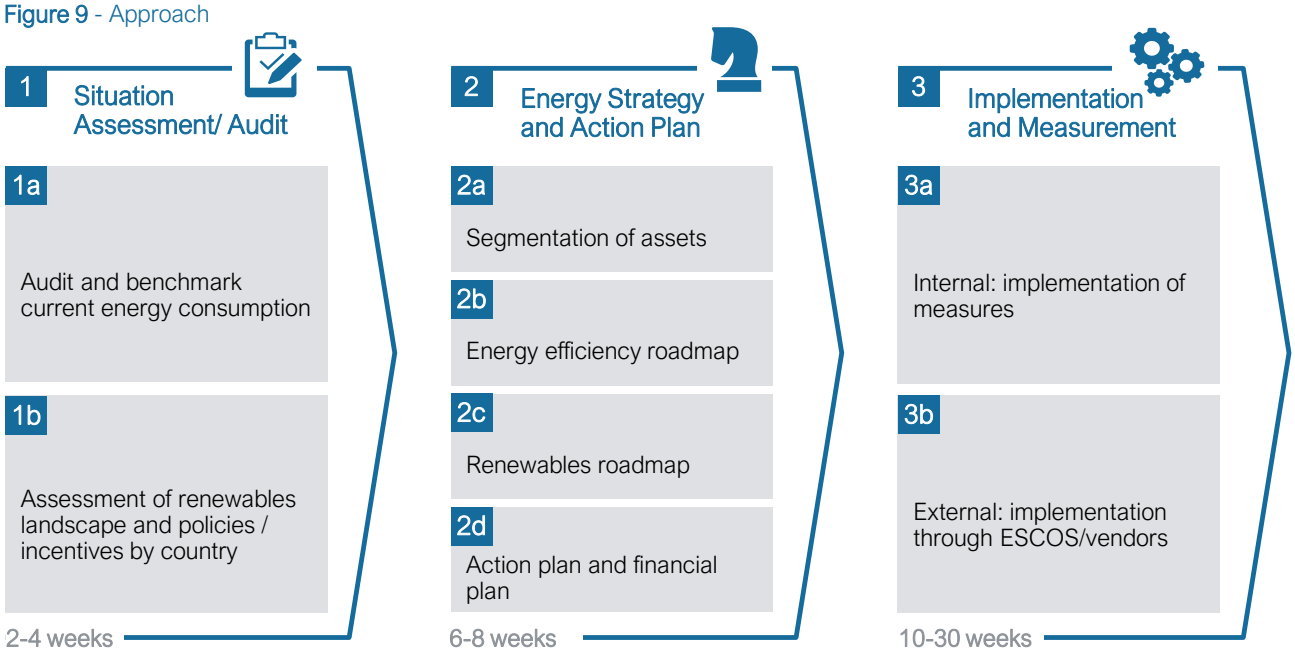
5. **Engage the organization.** Responsibilities for energy are typically dispersed across the organization. Conveying top-level commitment and setting up a cross-department working group can improve collaboration and engagement.

6. **Communicate the results.** Communicate carbon reduction objectives within the organization and with outside stakeholders. Leverage carbon reduction results achieved for marketing and government engagement.

Approach for telecom companies to improve energy management

Telecom companies can realize carbon footprint and energy cost reductions through a 3-phase approach:

Figure 9 - Approach



First, telecom companies need to establish a baseline on where they currently stand with regards to energy consumption, costs and carbon footprint. Key performance metrics such as energy efficiency and energy cost metrics should be mapped for existing equipment and technologies. This baseline can then be used for benchmarking both internally, as well as externally, with comparable peers. This allows quantification for improvement potential of energy efficiency and costs.

An assessment of the renewable energy landscape in each relevant geography is also needed, including grid readiness, renewable energy potential and cost, and identification of players along the renewable value chain. This is required, as measures will need to be customized to the specific situation in each geography.

Second, assets (including sites and equipment) need to be segmented by criticality to identify appropriate energy solutions and service levels. Key criteria to assess criticality include profit impact in case of failure, probability of failure, energy consumption and population density, among other factors.

Energy efficiency measures as well as renewables and decentralized solutions can then be defined and detailed. The roadmap should include quantification of impact of energy consumption, cost and carbon footprint, an overall action plan and corresponding financials.

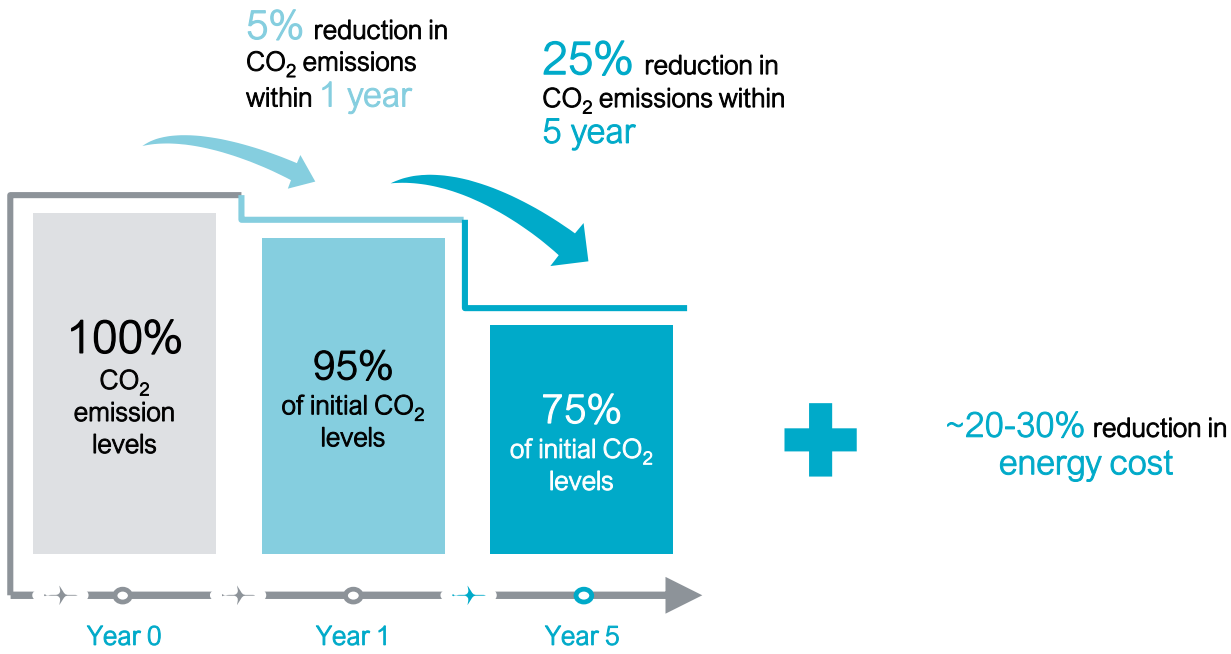
In the third and final phase, the roadmap is implemented, either internally or through external partners. In case of outsourcing to external parties, such as ESCOs, selecting the right partner and negotiating the right service level agreements, incentives and pricing structure is naturally critical.

In total, the whole process typically takes between 4 to 10 months, largely depending on the scope of works during the implementation phase.

Results

In our experience, a comprehensive carbon footprint and energy cost reduction strategy can reduce CO_2 emissions by 20-25% and reduce energy cost by 20-30%. Naturally, these savings depend on the maturity of energy management of the company, as well as renewable landscape and regulations of the geography in scope.

Figure 10 - Expected impact of measures within the first few years only



		% emission savings	% energy cost savings
1	**Improving energy efficiency** Telecom sites can account for between 50% to 70% of telecom companies' total energy consumption, thus making it a focus of green programs and energy efficiency efforts. Energy efficiency efforts can typically be implemented swiftly, offering quick win results within a year	~10%	~10%
2	**Adopting renewables and decentralized solutions** Many emerging markets remain highly dependent on diesel fuel to power off- and bad-grid sites, resulting in high fuel cost, ranging between 30% to 70% of site expenses; This makes renewables not only a carbon friendly solution, but also economically attractive. In addition, corporate PPAs offer opportunities globally	~15%	~10%
3	**Outsourcing to ESCOs** Outsourcing to specialized companies provides additional savings, as ESCOs have economies of scale, specialization and, depending on the contractual arrangement, incentives to improve efficiency	~0%[13]	~10%

13) Already captured through "improving energy efficiency" and "adopting renewables and decentralized solutions"

About Roland Berger

Roland Berger, founded in 1967, is the only leading global consultancy of German heritage and European origin. With 2,400 employees working from 35 countries, we have successful operations in all major international markets. Our 52 offices are located in the key global business hubs. The consultancy is an independent partnership owned exclusively by 250 Partners.

We have deep experience in renewables, having supported our clients on 1,000+ projects in renewables in the last few years, including energy storage solutions. Our expertise in renewables also covers the telecom sector where we have assisted our clients with adoption of renewable technologies in their operations, as well as supporting governments to develop the investment & regulatory framework. Besides renewables, we have a deep understanding of the TMT sector, having worked with numerous leading operators, especially in emerging markets (Asia, Africa, Middle East and Latin America).

Contact Details

Damien Dujacquier
Partner, Asia

damien.dujacquier@rolandberger.com

Denis Depoux
Partner, Asia

denis.depoux@rolandberger.com

Dieter Billen
Principal, Asia

dieter.billen@rolandberger.com

Nicolas Teisseyre
Partner, Europe and Africa

nicolas.teisseyre@rolandberger.com

Kushal Shah
Partner, Middle East and Africa

kushal.shah@rolandberger.com

Wim D'Hondt
Principal, North America

wim.dhondt@rolandberger.com

Jorge Pereira Da Costa
Partner, Latin America

jorge.pereiradacosta@rolandberger.com