

THE IMPACT

of **Covid-19** on Africa's energy sector

AND THE ROLE OF RE

to empower a long term and sustainable recovery

RES4AFRICA FOUNDATION

United Nations Economic Commission for Africa

In partnership with :

SDA Bocconi SCHOOL OF MANAGEMENT

With the support of :

EWIEN Ethiopian Women in Energy

SAPP

Foreword

For several weeks now, Africa has been fighting against an invisible enemy: COVID-19. Although the spread in the continent is much lower than in other parts of the world today, it is not less worrying considering the limited capabilities and resources of African countries to mitigate the potentially devastating effects of the virus, from a public health, social and economic context.

Limited access in the continent to electricity particularly in health centers and facilities increases the vulnerability to COVID-19. As Africa strives to sustain gains in reducing lack of access to electricity to more than 600 million people today, putting the access agenda among the priorities in the health sectors has become timely.

Due to the Covid-19 crisis, the **African economy, similar to the global economy, is impacted by the disruption of supply chains, mainly** through exposures to inputs from Asia, Europe, and the Middle East, as well **as lower demand in global markets for a wide range of African commodity exports.**

Travel bans and lockdowns are not only limiting the movement of people within countries and across borders, but they are also disrupting the way of working for individuals, businesses and government agencies. The **employment effects of COVID-19 are raising social challenges**, as already witnessed in the backstreets of the megacities around the continent.

African leaders of the public and private sectors have been quick to act and the international development community is expected to extend their commitment to work with Africa to safeguard the economies and livelihoods of millions of people.

The **renewable energy sector can play a fundamental role in the fight against the disastrous effects of COVID-19**. Access to reliable and sustainable energy is a crucial need, and is even more important today for supporting essential services during a global crisis. In a period of extreme crisis such as the one we are experiencing, ensuring a continuous flow of electricity is essential to keep the strategic infrastructures of the countries going. Through strategic investment in sustainable energy, **stimulus measures to induce economic recovery will strengthen the foundation of sustainable development**.

Renewable energy investments at scale will contribute to support sustained economic growth, including by strengthening local value chains and supporting local jobs. As factories operate again at full scale, commercial services return to normal functioning and as new business open, and progress towards expanding energy capacity and access gains momentum in Africa, supporting investment in energy capacity and infrastructure will remain fundamental.

Africa should sustain policy attention on increasing the share of sustainable and renewable sources in the energy mix to enable **structural shift towards a low-carbon and more resilient power system**. Certainly, governments must not abandon their climate action commitments in the midst of the pandemic, as the climate emergency requires sustained climate action. Governments must seize the opportunities to create jobs and improve vital infrastructure while accelerating the transitions to cleaner energy. More investments in grid enhancement, interconnections, storage and flexibility solutions are urgently needed for an effective and accelerated deployment of renewables. The private sector must play its part in complementing public sector action towards increasing investment and closing the pre-COVID energy infrastructure gap of $90 to $120 billion USD.

Decisions that governments and public institutions are making now will shape Africa's development for years to come.

As African countries look to give their economies a much-needed jolt in the wake of the COVID-19 outbreak: they can prioritise shifts from decades of polluting, inefficient, high-carbon and unsustainable development, to low-carbon and increasingly affordable energy and transport systems that will bring long-term economic benefits. Development partners and the international private sector should play their part by engaging Africa's development priorities through productive and impactful collaboration with African governments towards increased investment for sustainable development.



Antonio Cammisecra

President, RES4Africa Foundation

INDEX

Index

1. THE ECONOMIC IMPACTS OF COVID-19 IN AFRICA: FROM MACROECONOMIC SHOCKS TO SUSTAINABLE RECOVERY

a. Economic impacts of Covid-19 in Africa
b. COVID-19 and its impacts on both the Macroeconomy and the Energy Sector
c. The electricity sector, its macroeconomic and other miscellaneous impacts
d. Further Ripple Effects throughout the Economy and recommendations

2. COVID-19 IMPACTS ON GLOBAL ELECTRICITY SECTOR

a. The Implications of COVID-19 on the global energy sector
b. The effects of the pandemic on the electricity demand in world major countries
c. The change of the electricity supply and the record of renewables in Europe
d. The impact on investments in renewable energies

3. COVID-19 IMPACTS ON AFRICAN ELECTRICITY SYSTEMS

a. North Africa: Tunisia
b. Western and Eastern Africa: Kenya and Nigeria
c. Special country focus: Ethiopia by EWiEn
d. Central and Southern Africa: Mozambique, Zambia, DR Congo, Namibia and South Africa

4. CONCLUSIONS AND POLICY RECOMMENDATIONS

a. The role of the electricity sector on African development
b. The centrality of renewable energy sources
c. Policy recommendations

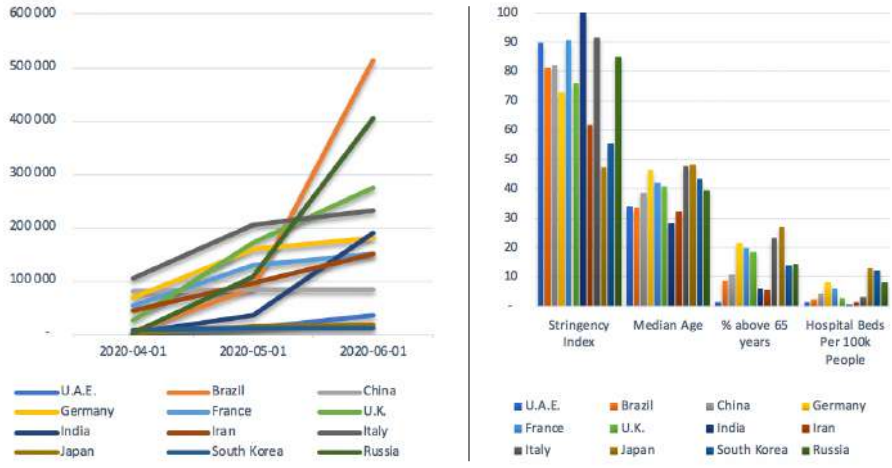
1. The Economic Impacts of COVID-19 in Africa: from Macroeconomic Shocks to Sustainable Recovery

Introduction

The last decade has seen rapid economic growth in Africa, enabled by favorable commodity market performance for key African exports and growing investment in infrastructure and growth-enabling assets in the continent. Africa's economy grew by 3.4% in 2017, and moderated to 3.2% in 2018; with growth in Eastern Africa taking a fast pace at 6.2% in 2018, followed by 3.2% in West Africa, while other regions of Africa grew moderately (UN Economic Commission for Africa (UNECA), 2019). Implementation of SDGs since 2015 and unprecedented progress concluding the African Continental Free Trade Agreement (AfCFTA) in record time have improved Africa's long-term growth outlook. While African economies were on the trajectory to growth, the unexpected and unforeseen external shock stemming from the Coronavirus (COVID-19) has hit the global and African with a potential growth thwarting prospect for Africa.

From early January 2020, COVID-19 has spread rapidly from the on-set epicenter to all regions of the world precipitating diverse set of measures to stem the pandemic. In the U.A.E., cases increased from 664 in early April to over 34,000 two months later. In Latin America, Brazil saw a sharp increase from a little over 5,000 by April 1 to over 500,000 by June 1. In Europe, cases escalated rapidly from about 67,000 in Germany, 52,000 in France and 106,000 in Italy by April 1 to above 181,000 in Germany, 151,000 in France and 233,000 in Italy by June 1. In Russia, a low level spread of about 2,000 by April 1 has escalated to over 405,000 by June 1 (Fig. 1). In the United States, an initial onset grew to about 190,000 by April 1, before geometrically spreading to afflict about 1.7 million people by June 1. This has clearly altered the global macroeconomy by precipitating moderate to highly stringent measures that resulted in lockdown in many of these leading global economies. Though these economies have a relatively better health care infrastructure, higher median age and significant population above the age of 65 have intensified vulnerabilities and relatively higher death rates.

Figure 1. COVID-19 global spread, response measures and underlying vulnerabilities



Source: based on data from European CDC, shared by https://ourworldindata.org/coronavirus-data. The stringency index is based on nine indicators including closure of schools and workplace travel bans and measures ranging from 0-100, 100 being the most stringent measure a country takes.

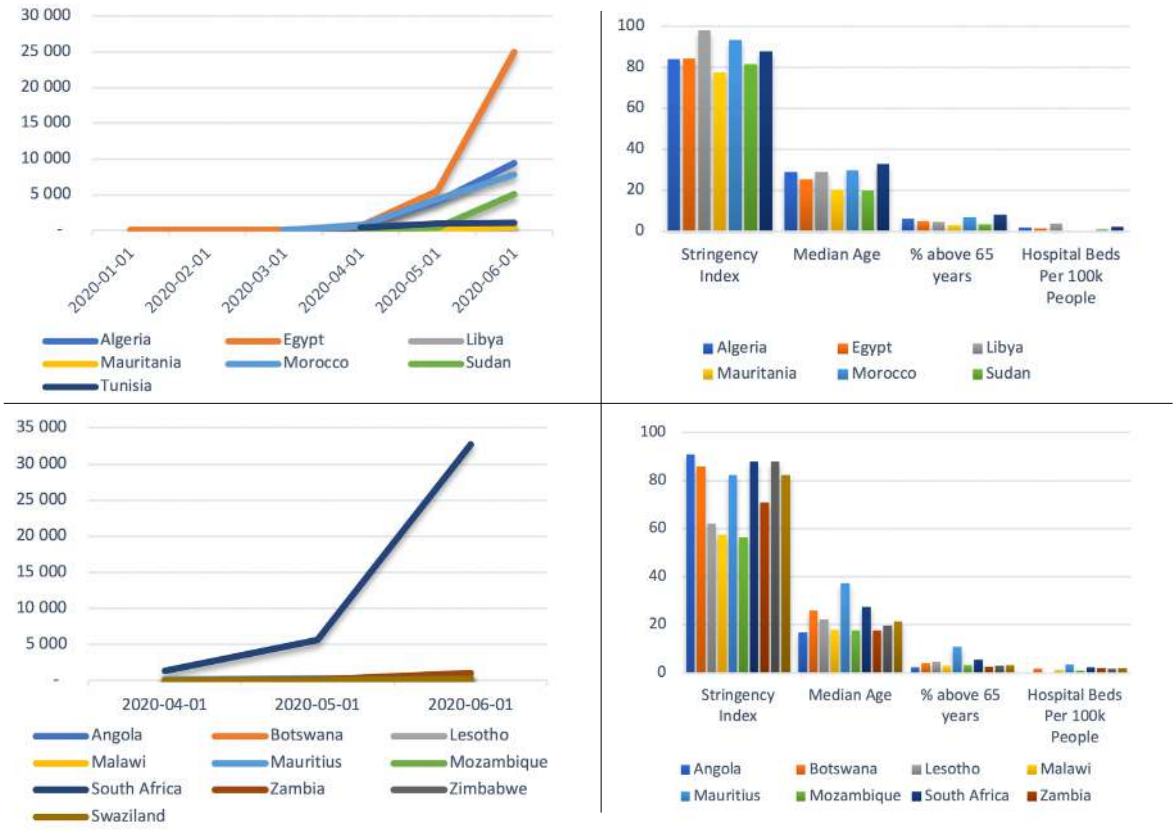
By June 6, out of 6.6 million global cases, Africa reported about 176,000 cases, with new daily infections of about 6,000 people, representing 2.67% of global infections. Out of nearly 393,000 global deaths attributed to COVID-19, Africa saw 4,900 deaths representing 1.2% of the global death rate.

However, UNECA (2020) warns that given the nearly 600 million people (43.5% of Africa's population) reside in urban areas, of which 56% reside in congested settlements, and with an average of 1.8 hospital beds per 1,000 people, Africa faces high risk of escalation. Based on Imperial College Epidemiological Model of 25 March 2020, UNECA (2020) further warned that under worst case scenario of no governments action, up to 1.2 billion infections are projected; while under conditions of stringent measures, nearly 123 million infections are expected. While these projections appear vastly higher than the relatively low livelihoods current levels of infection, what is nonetheless clear is that African governments have taken one of the stringent measures under lockdown beneficial for public health protection; however, acutely challenging to and macroeconomic stability.

The economic effect of COVID-19 in Africa largely depends on the response govenrments have given to the trajectory of the pandemic in their respective countries. Looking at the Africa case regionally, North Africa has seen rapid increase in infection rates since April 2020. Egypt, Algeria and Morocco are the most affected countries in this region. All of the North African countries implemented one of the most stringent lockdown measures, mostly rated above 80, out of 100 (Fig. 2). The region has better healthcare infrastructure in Africa, with youthful population. However, relatively high levels of urbanization and gaps in healthcare capacity pose major risks.

The Southern Africa region has similarly seen increases in COVID-19 infections since April. South Afica has seen a much higher infection trajectory, increasing from about 1,353 cases by April 1 to over 32,000 cases by June 1 (Fig.2). Gibson and Rush (2020) have shown that the high infection rates in South Africa are exacerbated by informal settlements constraining effective implementation of social distancing and other preventive measures. In response, countries have taken lockdown measures of varying intensity. The relatively low share of population above 65 years old can help contain death rates; however, healthcare infrastructure limitations can overburden response capacity.

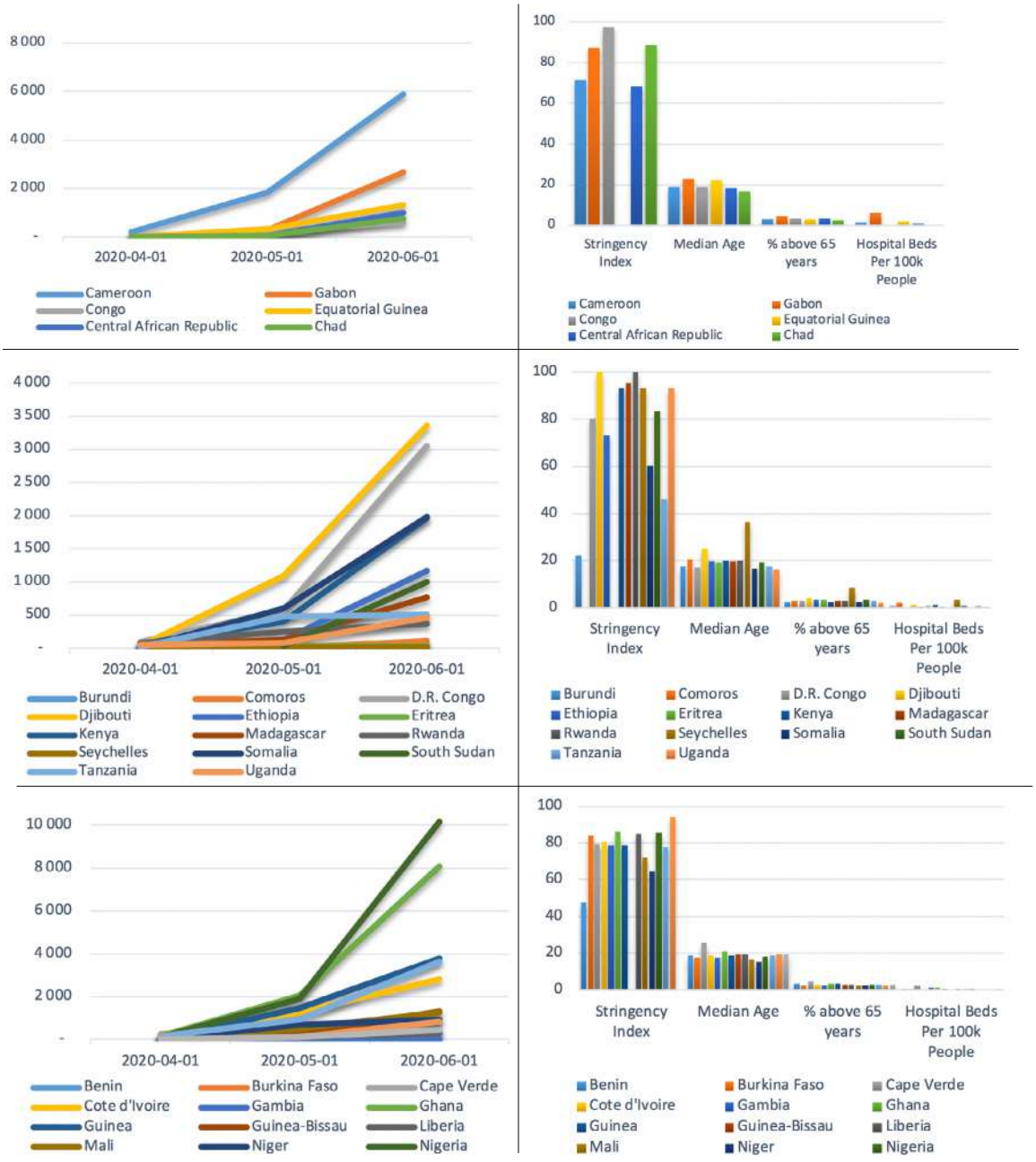
Figure 2. COVID-19 North and South Africa, response measures and underlying vulnerabilities



Source: based on data taken from European CDC, shared by https://ourworldindata.org/coronavirus-data.

The Central Africa region has also seen COVID-19 infections increase since April, mainly in Cameroon and Gabon. The region implemented moderate to high stringent response measures in the face of inadequate healthcare infrastructure in the region. In Eastern Africa, while the demography is largely young, healthcare capacity concerns and population concentration in urban centers, among others, have triggered varying restrictions in most countries, including among the stringent measures in Djibouti, Kenya, Madagascar, Rwanda, Seychelles and Uganda. Rapid increase in infections is observed in Djibouti, D.R. Congo, Ethiopia, Madagascar and Somalia. In Western Africa, given very limited healthcare capacity and overall concern about the implications of COVID-19 community transmission triggered similar restrictions of moderate to high intensity. Cote d'Ivoire, Ghana, Guinea, Nigeria and Senegal saw significant infection increases since April 1, 2020.

Figure 3. COVID-19 Central, West and East Africa, response measures and underlying vulnerabilities



Source: Based on data from European CDC, shared by https://ourworldindata.org/coronavirus-data.

Therefore, despite the relatively low population and COVID-19 infection rates currently experienced in Africa, compared with all the other regions worldwide, Africa faces vulnerabilities caused by population settlements, insufficient healthcare infrastructure capacities, healthcare expenditure limitations and livelihood effects (economic ramifications) triggering the stringent lock-down measures to prevent rapid infection progression, and perhaps enable timely easing of constraints placed on their economies. African economies have suffered substantial impacts, threatening to eliminate the progress gained over the last decade.

a. Economic impacts of COVID-19 in Africa

The COVID-19 pandemic has triggered demand and supply side shocks to African economies. Demand side shocks are impacted through different channels, including trade and external demand contraction, oil and non-oil commodity price and demand shocks, and investment effects with consequences on revenue collection and government expenditure. One of the supply side shocks already realized is in labor supply, drastically reduced as a result of lockdowns, particularly in manufacturing and service sectors. The impacts of demand and supply-side shocks in African economies differ depending, among others, on the structure of their economies, dependence on certain commodities for export, the extent of trade and investment disruptions, prevailing public finance positions, and the stringency and duration of public health measures implemented.

Macroeconomic Impacts

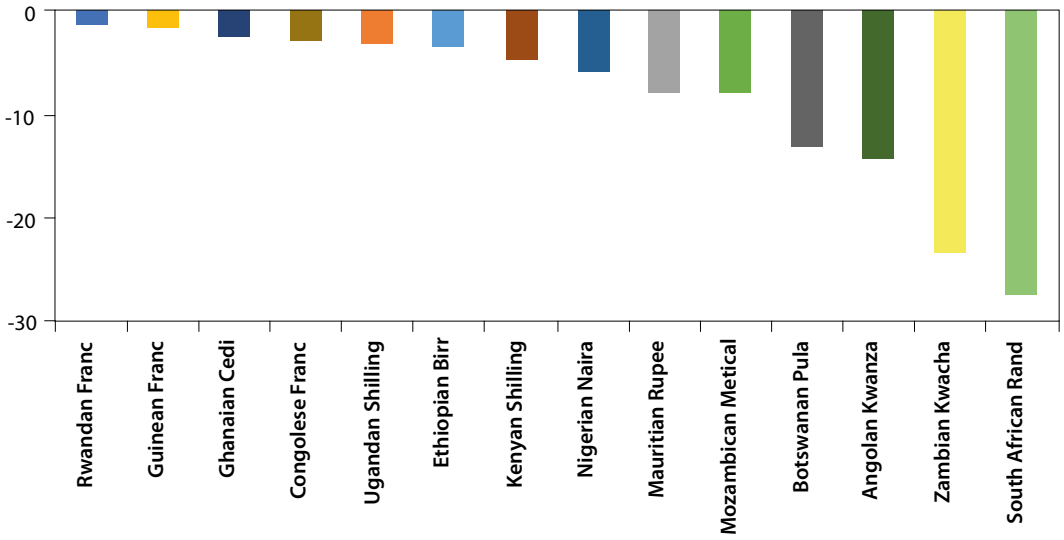
On the basis of the UNECA macroeconomic model, and taking into account predictions about the extent of demand and supply shocks, two scenarios are analysed: best-case and worst-case scenarios. As a result, GDP growth rate for 2020 is expected to decline from 3.2% to 1.8% under best-case scenario; however, if the level of shock is heightened, the worst-case scenario forecast will be a GDP contraction of 1.4 to 2.5% (UNECA, 2020). This slower growth has major implications to poverty reduction and employment growth in the continent. Based on the growth forecast, UNECA estimates that between 5 million – 29 million people could fall back to extreme poverty for a period of time from the reference 2020 African forecasted growth scenario. While majority of those who fall into poverty are expected to be transient, a small percentage are expected to stay in extreme poverty for longer than a decade.

In terms of employment, the International Labor Organization (ILO) forecasts that Africa will face 19 million job losses largely due to closures (ILO, 2020). Countries have already faced pressure related to stringent lockdown measures and unintended consequences to livelihoods, including loss of employment and income, particularly for those in the informal economy. ILO statistics indicate that the share of employment in the informal sector from total non-agricultural employment is above 70% in Cote d'Ivoire, Cameroon, Comoros, Ghana, Madagascar, Mali, Mozambique, Mauritania, Niger, Senegal, Togo, Tanzania and Uganda. For Africa, the share is 71.9%. As a result, lockdowns and resultant economic disruptions is having negative employment impacts mainly in the informal sector.

Beyond employment and household income effects, the lockdown is also having major impact on public finance. The 2019 Economic Report on Africa (ERA) of ECA, which focused on fiscal policy in the continent, indicated that Africa already had low tax-to-GDP ratio of 13.4% by 2018. The onset of COVID-19 and resultant public health protection measures are expected to lead to significant reductions in revenue collection (taxes). In contrast, expenditures are expected to rise, particularly in healthcare and social protection. Under best case scenario where African governments take stringent public health protection measures, UNECA (2020) estimate that an additional $44 billion will be required to meet COVID-19 related healthcare expenditure. Social protection needs, such as allocation of food and other necessities to the vulnerable will require additional resources, constraining the already dissipated revenue, leading to deficits.

These macroeconomic conditions have led to currency depreciation pressure in numerous economies. Currency value instability (see Fig. 4) ranges from less than 5% in Rwanda and Guinea to major disruptions in Botswana, Angola, Zambia and South Africa to 15-25%. Oil and commodity exporting countries are particularly hit hard. The Central African Economic and Monetary Community (CEMAC) will be “severely” impacted by oil price drop precipitating shortage of foreign currency and likely strengthening devaluation of the CFA (African Union, 2020).

Figure 4. COVID-19 and depreciation of currencies in Africa



Source: fitchsolutions.com; Bloomberg.

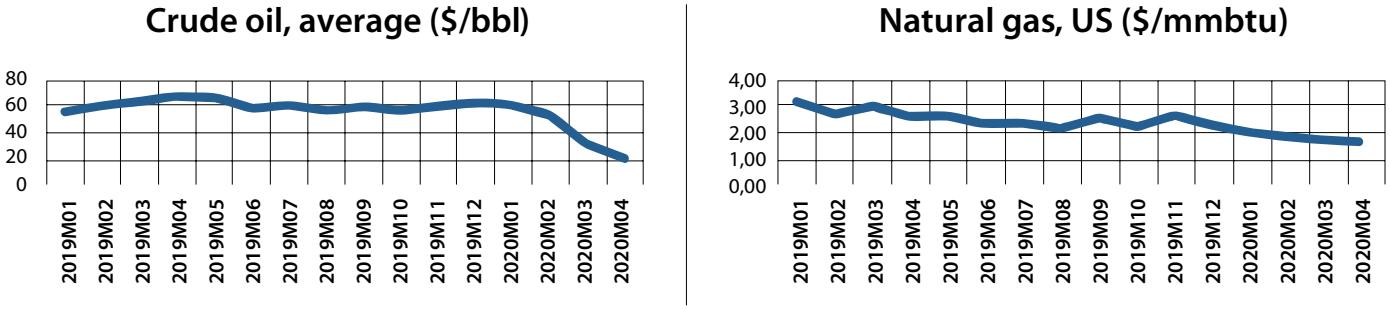
Current fiscal conditions, an unstable macroeconomic environment and the need to re-invigorate economies through semi-stimulus packages requiring a major international call for economic stabilisation support, and hence, a quick response from financial institutions worldwide. Public debt is expected to rise. Prior to the outbreak of COVID-19, 22 African countries had already recorded a debt-to-GDP ratio above the continental average of 61% (UNECA, 2020). Timely efforts are needed in order to stabilise the macroeconomy through the infusion of new capital; however, this will have long-term effects due to the accumulation of further public debt during the post COVID-19 period. This is the reason for UNECA’s urgent call to plenish an initial $100 billion to ensure economic stabilisation in Africa, alongside a 1-year debt-servicing freeze window in order to provide fiscal space in the fight against COVID-19.

b. COVID-19, the Macroeconomy and Energy Sector Impacts

Macroeconomic Impacts in Oil and Gas Exporting Countries in Africa

Restrictions in the travel, commercial, services and manufacturing sectors have led to a global demand shortfall leading to plunges in oil and gas prices. While extreme and very short lived, oil markets even registered negative prices on April 22, 2020. This trend clearly benefits oil importing countries; however, oil exporting African countries are hard hit.

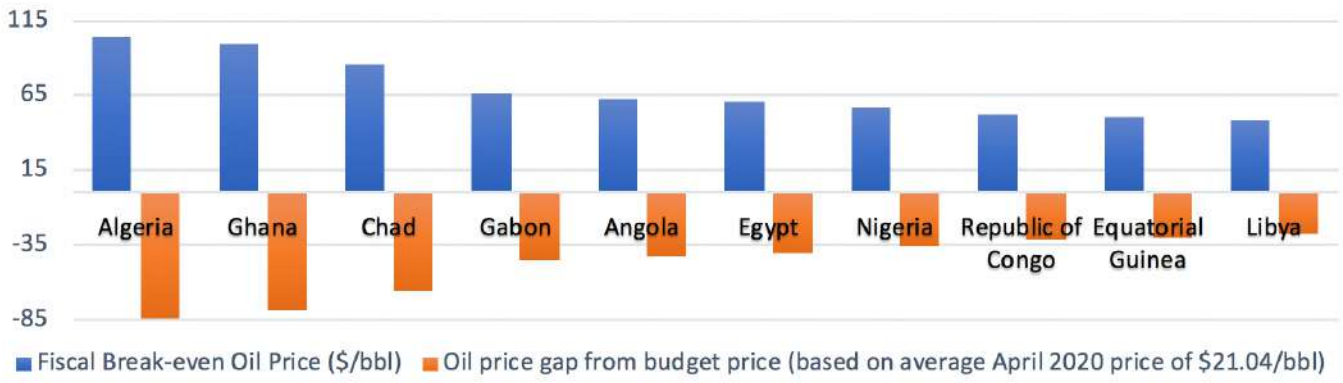
Figure 5. Crude oil and natural gas prices (January 2019 – April 2020)



Source: US Energy Information Administration.

Plunging oil prices had two impacts – decline in export receipts and further budget impacts as 2020 expenditures were planned based on high oil price expectations. For budgetary purposes, oil prices were forecasted to be above $85/bbl in Algeria, Chad and Ghana, and between $55-$70/bbl in Angola, Egypt, Gabon and Nigeria. Therefore, unanticpated plung in oil prices below the budgeted price target introduces fiscal distress. Public debt is required to close this fiscal gap; therefore, placing further strain on the already narrow fiscal space.

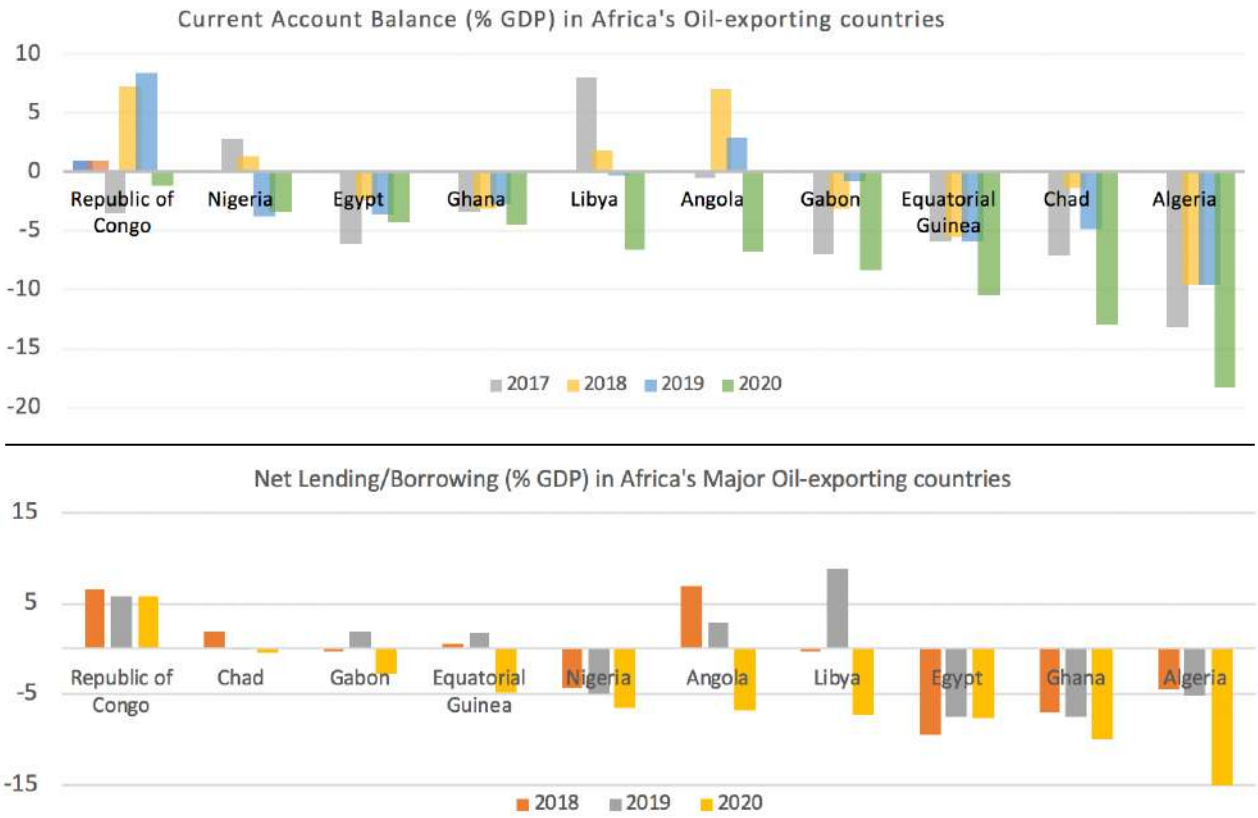
Figure 6. Fiscal distress in Africa's oil exporting countries



Source: Analysis based on data from multiple sources, such as IMF, national documents, budget documents, Fitch's forecast, and Ministerial statements.

Beyond the fiscal effect of the unexpected oil price plunge, the actual price reduction has destabilised the macroeconomy in oil-exporting countries including the deterioration of national currencies. In Equatorial Guinea, Chad and Algeria, current account deficits exceeded 10% of the GDP. The net borrowing position has deteriorated in Angola, Equatorial Guinea, Libya and Algeria. The disruption caused by the Covid-19 shock in oil-dependent countries is alarming.

Figure 7. Current Account Balance (% GDP) and net lending/borrowing position



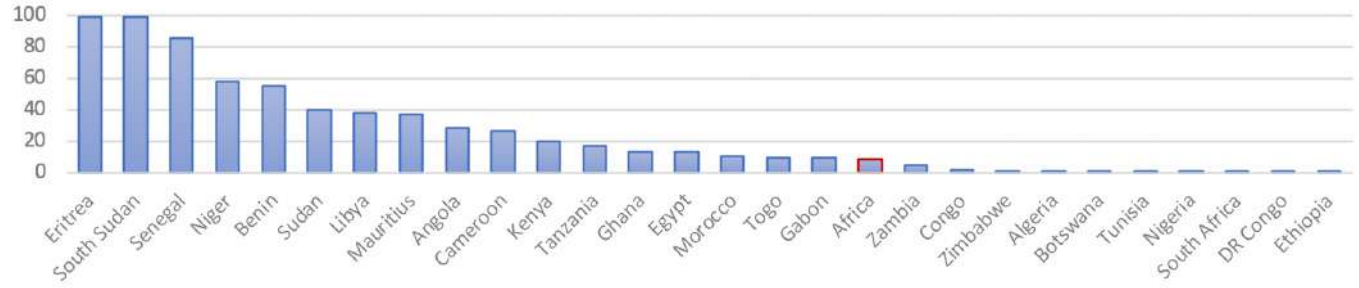
Source: Analysis based on data from the IMF.

c. The Electricity Sector and its Macroeconomic and Other Impacts

The public health measures to contain COVID-19 has diminished energy demand at large, and electricity demand especially in the commercial and industrial demand classes. Furthermore, economic recovery will require availability of adequate and stable electricty supply. On employment, Mensah (2018) argues that electricity shortages reduce the likelihood of employability by 35 to 41% due to effects on industry, export setors and overall competitiveness. The implication of this is that power shortages will undermine the recovery process in labor markets. Furthermore, in a study focused on Africa, Burke and Csereklyei (2016) demonstrated that industrial output response to electricity supply is slightly elastic (1.06), and that a 1% GDP growth is associated with 0.66% additional demand from households, 0.53% additional demand from the services sector and 1.06% more demand from the industrial sector. Therefore, through direct and indirect linkages, the performance of the electricity sector is linked to a degree with macroeconomic conditions.

The effect of COVID-19 on the electricity sector of Africa is mixed. From a generation perspective, drastic declines in heavy fuel prices have reduced electricty generation cost in high share of thermal generation countries (Fig. 8). Eritrea, Senegal, Niger, Benin and the Sudan have over 40% reliance on thermal generation, benefiting from lower oil prices. The benefit is unlikely to pass to consumers due to tariff regulation. In these countries, it is an opportune time to invest the windfall gain towards diversification to sustainable and domestic energy sources that will reduce fuel-import dependence long-term.

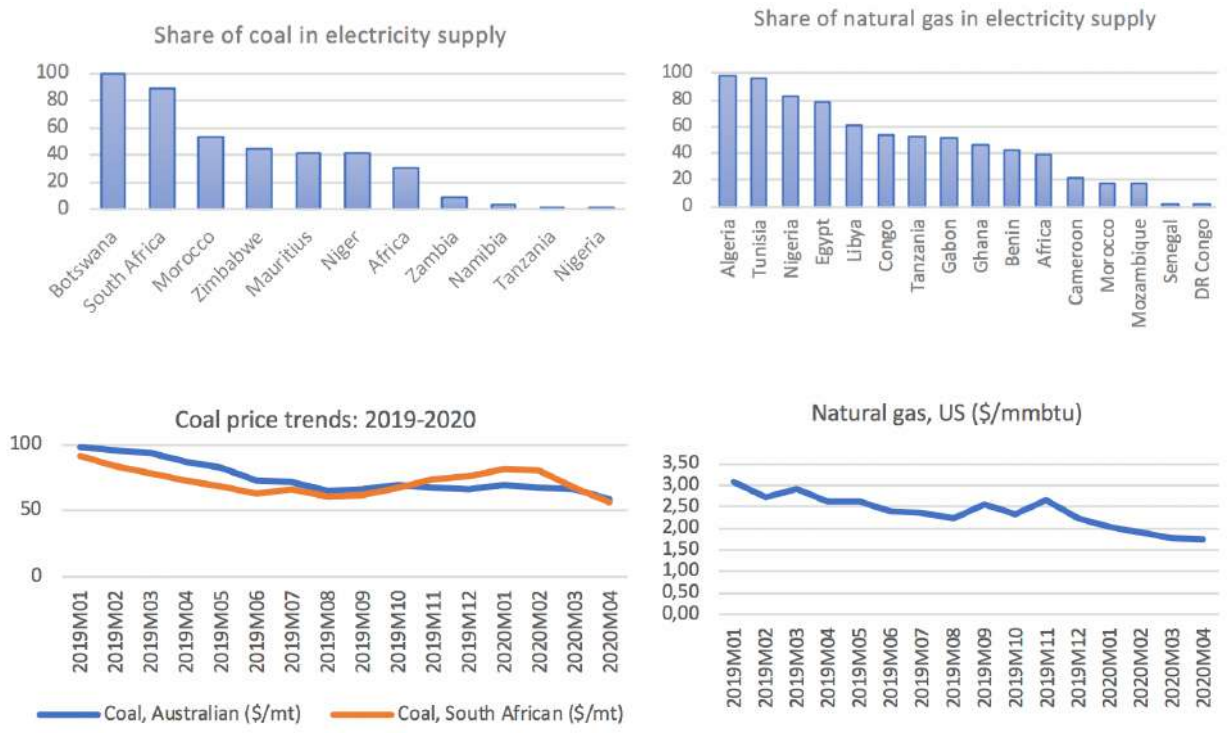
Figure 8. Oil share in electricity generation in Africa



Source: Analysis based on data from the International Energy Agency.

Spill-over effects in energy commodities are observed in coal and natural gas markets. For African countries reliant on coal and natural gas as major baseload power, the windfall gains from lower input prices are not as strong as heavy fuel-based electricity systems; however, appreciable declines in coal and natural gas prices offer the scope to reduce generation costs for supplies not governed by preexisting contracts with locked prices. These benefits should strategically be invested in creating new generation capacity from sustainable energy sources to accelerate energy transition. Beyond macro level impacts, further effects of COVID-19 on the electricity system of Africa are analyzed in-depth in this report. Strategic areas of intervention in COVID-19 recovery within the sector include the following: (1) sustaining investment in energy infrastructure in Africa, including through deepening the participation of private capital; (2) addressing regulatory and business climate to complement constrained public resources with private sector investment; (3) accelerating energy transition while expanding energy access; (4) addressing the challenge of transmission and distribution systems upgrade and expansion with effective participation of investment under public, private and public-private partnership models; and (5) amidst a public health emergency and requirements for public expenditure in socail protection and health, finding a fiscal space for capital expenditure in infrastructure to support sustainable recovery and growth in Africa.

Figure 9. Share of coal and natural gas in electricity supply and their prices



Source: Analysis based on data from the US Energy Information Administration and the International Energy Agency.

d. Further Ripple Effects in the Economy

Demand and supply side shocks induced by COVID-19 will lead to cutting growth prospects in Africa in 2020 and beyond. Certain sectors; however, are particularly hard hit. As a result of lockdown measures, particularly travel bans, Africa's aviation industry came to a halt, except for repatriation and cargo services, disrupting travel of estimated 77 million annual travelers. The UNECA report (2020) assesses that the industry supports 6.2 million jobs and contributes 56 billion USD to Africa's GDP. Therefore, COVID-19 will have major employment and GDP effects, amplified by the duration of the lockdown and anticipated lag before demand returns to pre-COVID levels.

A direct implication from travel bans is the full effect on the tourism sector, particularly in countries that heavily rely on the sector, such as Cote d'Ivoire, Egypt, Kenya, Mauritius, Morocco, South Africa, Tunisia, Uganda and Zimbabwe. The sector contributes an average of 8.5% to GDP in the continent, and brings over 1.4 billion visitors per year, 95% of which are from outside Africa (UNECA, 2020). Therefore, the economic impacts of travel bans are consequential.

Beyond air transport, logistics is also disrupted causing economic implications. More than 90% of global trade is sea-bound. Measures taken in the sea freight industry include 14-days quarantine, reduced sea transport frequency, closure of some terminals (except for essential cargo), connecting road transport constraints and reduced number of trucks, and additional border inspection and control mesures have increased the cost of

transit. For most African countries already facing higher transport component in their export commodities, these additional logistical costs reduce competitiveness and impose higher import prices. Specific measures such as Tunisia's closure of maritime entry points, congesion in Cameroon's Douala Port, and restriction on crew disembarkement from vessels in Eritrea are examples. Overall, compared with similar period in 2019, 2020 forecasted container activity in Africa is expected to decline by 12% (UNECA, 2020).

Finally, another notable ripple effect of COVID-19 on Africa's economies was the effect on remittances. Due partly to rising unemployment and economic uncertainties in different regions of the world, Africa's diaspora has reduced remittance transfers from the expected $65 billion in 2020. This will particularly impact remittance-dependent countries, such as Comoros, Egypt, the Gambia, Lesotho, Liberia, Senegal, Togo and Zimbabwe where remittances account for 8 to 21% of GDP (based on 2015 World Bank remittance data). Given the expected global economic recession, the negative remittance effect of COVID-19 is expected to last at least in the short term. This will further constrain balance of payments, and public finance.

Macroeconomic recommendations

The onset and spread of the COVID-19 pandemic has caused negative macroeconomic and sectoral impacts with effects that could be felt into the medium term. Growth is expected to slowdown, public debt will rise, public finance is constrained, trade is disrupted, travel is halted, and millions of livelihoods are disrupted, thus continually eroding the gains of poverty reduction in the last decade. Overall, economic and social vulnerabilities have increased. Countries are facing three fundamental challenges. First, COVID-19 has imposed painful trade-offs between public health security related lockdowns and severe economic impacts that require lifting constraints on the economy. Balancing these dual challenges continues to grapple policymakers. Second, countries are pursuing diverse strategies to contain COVID-19 such that common exit strategy and return to relative normalcy within a broader regional and global system has proven complex, leading in some cases to bubble solutions. Third, the duration through which painful measures can be sustained in the face of millions of livelihoods at stake has complicated policy choices.

The UN framework for the immediate socio-economic response to COVID-19 (UN, April 2020) offers the following recommendations:

- Health First – protecting health services and systems during the COVID-19 crisis
- Protecting People – providing social protection as well as basic services
- Economic Response and Recovery: protecting jobs, Micro, Small and Medium Enterprises (MSMEs) and informal sector workers
- Macroeconomic Response and Miltilateral Collaborations – macroeconomic stability support to countries and international collabrations to address the economic effects of COVID-19
- Social Cohesion and Community Resilience – solidarity and social dynamism to deal with the ramifications of COVID-19.

UNECA advocates the following policy measures to moderate the effect of COVID-19 on African economies:

- Mobilize $100 billion as a fiscal stimulus to address health and social safety net, and other economic challenges
- Mobilize a further $100 billion for Africa's private sector via special drawing rights to provide liquidity and access to foreign exchange
- Initiate temporary debt service standstill for two years for all African countries
- Ensure access to the IMF Emergency Financing Facility and increase special
- drawing rights allocations to enhance liquidity
- Speed-up budget support through fast disbursement facilities, such as the Crisis Response Window, the Global Pandemic Window and reprogramming other support programs at the World Bank Group; solicit significant support from the European Union and other Group of 20 members.

References

African Union. 2020. "Impact of the Coronavirus (COVID 19) on the African Economy." AU, Addis Ababa, Ethiopia.

Economic Commission for Africa. 2020. "COVID-19 in Africa: Protecting Lives and Economies." UNECA, Addis Ababa, Ethiopia.

Fiscal Policy for Sustainable Development in Africa. UNECA, 2019. Available [Online] at https://www.uneca.org/sites/default/files/PublicationFiles/era-en-final-web.pdf.

International Labour Organisation. 7th April 2020. "COVID-19 causes devastating losses in working hours and employment." Available [Online] at www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_740893/lang--en/index.htm.

Mensah, J.T. 2018. "Jobs! Electricity Shortages and Unemployment in Africa." Policy Research Working Paper 815. The World Bank, Washington, D.C., USA.

Paul J. B. and Z. Csereklyei. 2016. "Understanding the Energy-GDP Elasticity: a Sectoral Approach." Centre for Applied Macroeconomic Analysis, Austrian National University. Available [Online] at https://core.ac.uk/download/pdf/156709088.pdf.

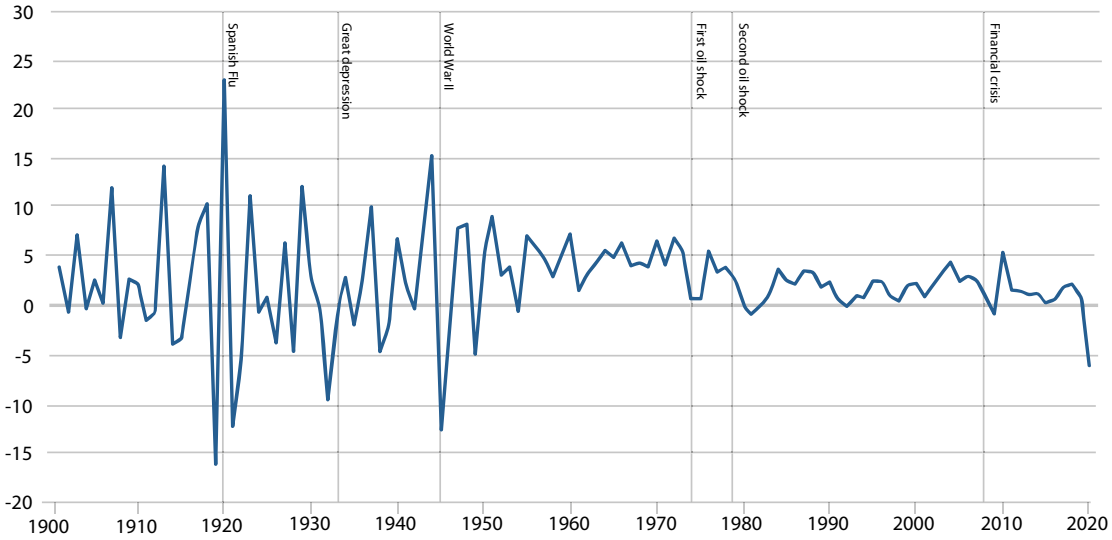
2. COVID-19 impacts on global electricity sector

It has long been acknowledged in the literature that economic growth has been the most important driver of energy demand. Furthermore, electricity demand has historically increased at a higher rate than both the Gross Domestic Product (GDP) and the total energy demand. Although in recent years economic activity and power demand have begun to decouple - mainly thanks to energy efficiency, the penetration of new technologies and the decline in energy intensity of the GDP – there is wide consensus regarding the fact that access to reliable energy still represents the backbone of any country's economic development. Moreover, today more than ever, it has been confirmed that a reliable power system plays a crucial role in supporting healthcare systems worldwide during global crisis such as the one the world is now suffering[1].

a. Implications of COVID-19 on the global energy sector

Since January 2020, in order to limit the spread of the virus, governments around the world have enacted new measures restricting social and economic activities. Today, certain countries are starting to ease the measures they have imposed, aiming to gradually come out of lockdown over the forthcoming months; however, COVID-19 impacts are likely to last for a long time with shock waves on the global economy and, as a consequence, on the energy sector. Indeed, data published in mid-April shows that countries under full lockdown experienced an average 25% decline in energy demand per week and those under partial lockdown an average 18% decline[2]. Generally speaking, assuming a gradual easing of lockdown measures, even if some energy uses – such as residential consumption – have been unaffected or even more pronounced, the latest forecasts suggest that the annual global energy demand will drop by 6% in 2020, the largest shockwave of the past 70 years[3] (see Fig. 1.1). This decline will occur in all major regions, yet advanced economies will experience it the most. Indeed, in the European Union and the United States, demand is likely to fall by around 10% to below levels witnessed in 2019.

Figure 1.1 Rate of change of global primary energy demand, 1900-2020



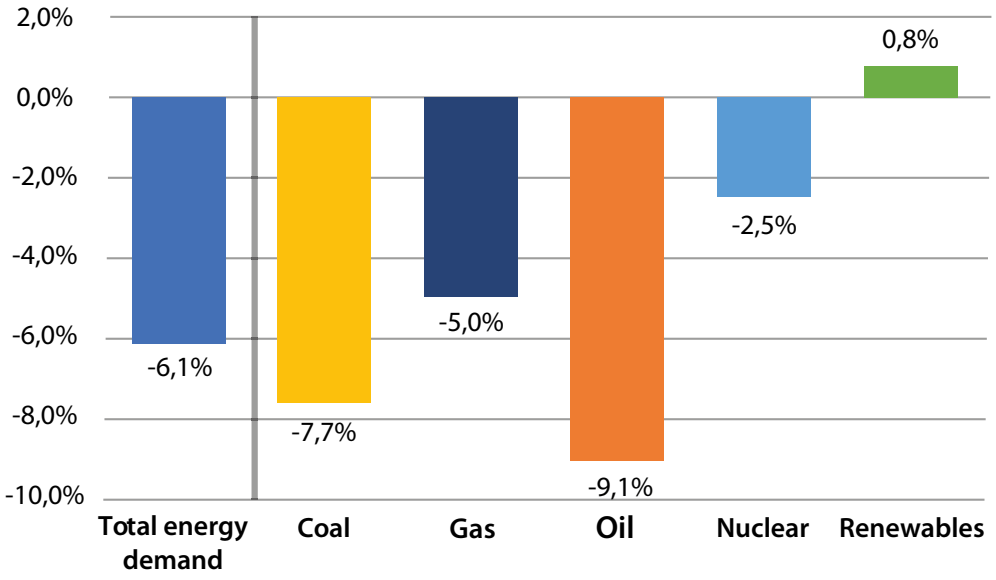
Source: IEA 2020

[1] Energy access takes centre stage in fighting COVID-19 and powering recovery in Africa, The World Bank 2020
[2] Global Energy Review 2020, IEA 2020
[3] Ibidem

Fossil fuels were the energy sources mostly affected by the drop in energy demand and, during the first quarter of the year, the hardest hit source was coal mainly due to a significant reduction of electricity needs and competition from the cheapest natural gas. Travel restrictions, as well as a sharply reduced demand from shipping and aviation industries, contributed to a fall in oil demand that could drop by an average of 9% across the entire year. Moreover, even if the demand for natural gas declined only by around 2% during the first quarter of 2020 - softened by continued low prices - the annual gas demand could fall much further, due to a reduced consumption of power and industry applications.

In this scenario, renewable energy sources were the only energy typology to witness an increase in demand during the first quarter of the year and the latest forecasts suggest that this data is expected to be positive throughout the entire year, mainly due to falling operating costs and preferential access to many power systems (see Fig. 1.2). Although several projections suggest that renewable added capacity in 2020 will be 13% less than the previous year, renewable power sources have so far showed impressive resilience despite changes and disruptions caused by the Coronavirus pandemic and their growth is expected to resume rapidly within a short period of time[4].

Figure 1.2 Projected change in primary energy demand by fuel in 2020 relative to 2019



Source: IEA 2020

Another consequence of the COVID-19 pandemic is the widespread re-shaping of financial trends in the energy sector that will lead to a fall by one-fifth in energy investments during 2020, as stated in the latest report published by IEA in mid-May. Indeed, data suggests that investment cuts are occurring as a consequence of lower demand and reduced earnings (particularly severe in the oil industry) and due to the practical disruption to investment activity caused by the lockdown measures[5]. This decline occurs in situation that was already negative for energy investments in terms of GDP that have declined over recent years and are now expected to fall below 2% in 2020. This trend is of particular concern, and has to be reversed in order to meet rising global needs and to address climate change. However, even if renewable investments declined due to COVID-19, in any case they are expected to recover in 2021.

[4] Renewable energy market update, IEA 2020
[5] World energy investments, IEA 2020

b. The effects of the pandemic on electricity demand in the rest of the world

Before going into further details regarding the effect the pandemic has had on the African electricity market, it is important to understand the reaction of the rest of the world to this crisis, that has also left its mark on the African energy sector. The lockdown imposed by the COVID-19 emergency has led to inevitable consequences on the electricity consumption of several regions worldwide. Different economies have responded in different ways as can be seen in the next chapter. In fact, electricity demand in many countries has experienced a significant decline following the introduction of confinement measures aimed at containing the pandemic.

Every month of full lockdown witnessed a decrease in electricity demand by an average of 20%, with a trend similar to that which would be experienced on a prolonged holiday break[6]. More specifically, the global electricity demand declined by 2.5% in the first quarter of 2020, when compared to 2019 values. China was the first to introduce containment measures, starting in mid-January, experiencing the world's largest demand reduction of 6.5%.

On the other hand, the residential electricity demand registered an increase as a consequence of lockdowns. However, the dramatic reduction of industrial and commercial businesses, as well as the suspension of a large portion of service sector-related activities, has more than offset the growth of household consumption. Countries adopting more stringent containment measures showed a sharp contraction of the demand. The case of Italy, one of the worst affected countries in Europe, is a prominent example: the electricity demand plummeted by more than 25%, with a significant drop in electricity consumption coming from the service sector, i.e., 75% lower when compared to the last year.

Furthermore, the electricity demand showed the first signs of recovery following the softening of the restriction measures. The demand, after correction due to effects caused by the weather, in most countries dropped 10% below the original values recorded prior to the introduction of the first lockdown measures, except for India, where the recovery has been more pronounced.

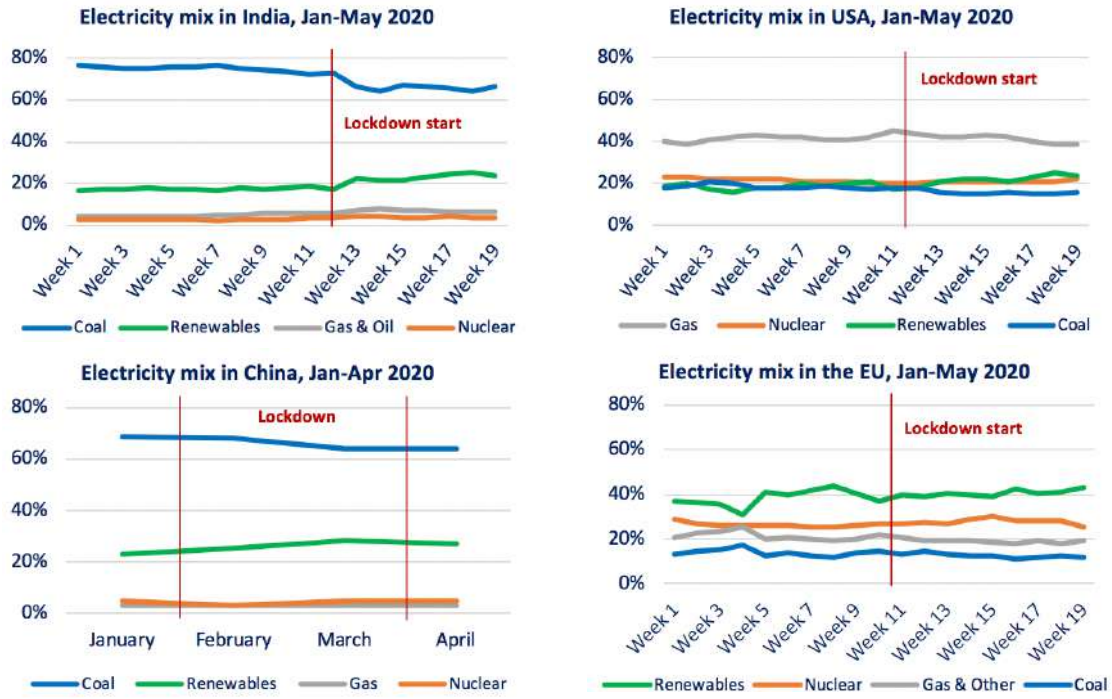
The IEA estimates that the global electricity demand will decline by 5% this year, reaching the lowest numbers ever. The impact of the pandemic on electricity demand would represent the largest decline since the economic crisis suffered in the 1930s and would be eight times the reduction recorded in 2009 following the global financial crisis.

[6] Global Energy Review 2020, IEA 2020

c. The change in electricity supply and the record of renewables in Europe

The lockdown measures introduced following the spread of the virus did not only affect the electricity demand on a global scale but it also considerably influenced the electricity generation as well as the electricity mix. On the other hand, the electricity mix has shifted towards Renewable Energy Sources (RES), especially wind and solar PV power. Renewable Energy Source-based generation increased by 3% and the share of renewables in electricity supply neared 28% in Q1 2020, a 26% increase from Q1 2019. Hence, the strong decline in electricity demand due to the closure of businesses, combined with the low operating costs of renewables and their priority access to the grid, led to the increase in many countries of the green electricity share.

Figure 1.3 – Electricity mix in different countries worldwide that implemented lockdown measures

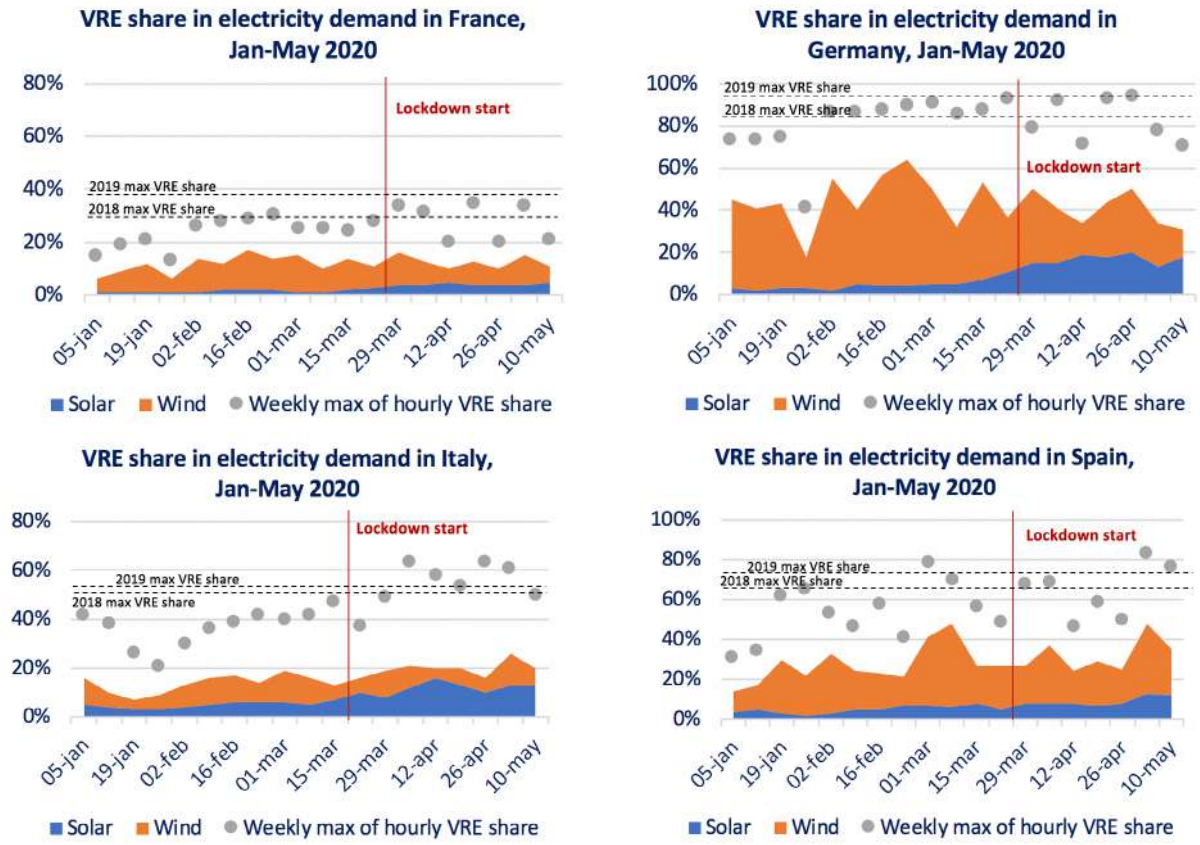


Source: IEA, Statistic Report, May 2020

Observing what happened to the electricity mix in different countries (Fig. 1.2), it is relatively clear that the share of renewables significantly increased following the introduction of lockdown measures combined with a reduction in fossil fuels, especially coal. As reported by the IEA, China had the largest reduction in coal-fired power generation (approximately 100 TWh), whereas in India the gap between the share of coal and renewables has considerably narrowed. In the USA, natural gas has continued to play a crucial role as a primary source of electricity, yet at the same time RES have overcome the contribution of coal-fired power plants.

Similarly, there is strong evidence of RES-related growth in the electricity mix of European regions and certain countries reached new records in the share of variable Renewable Energy Sources (Fig. 1.4), especially Italy, Spain and Germany. These countries were able to absorb large percentages of hourly VRE share, also close to 100% in the case of Germany, without incurring any disruption of the electricity grid. Furthermore, as reported by the IEA, the share of variable renewables continues to remain high as lockdown measures are easing.

Figure 1.4 – VRE share in electricity demand of France, Germany, Italy and Spain, Jan-May 2020



Source: IEA, Statistic Report, May 2020

In the UK[7], wind power also reached record levels during the first quarter of this year. In fact, wind power supplied 30.5% of Britain's electricity, driving the supply coming from all RES to over 40% of the total power consumed, overtaking fossil fuels for the first time. At the same time, due to the weak electricity demand caused by lockdown measures, generation of fossil fuels was down 25% during Q1 2020 when compared to 2019, the largest fall ever recorded.

Gas-fired power stations ran at an average of just 38% of their installed capacity over the quarter (a much lower use than onshore wind farms). However, when the electricity demand peaked and renewable output was low, there was still the need to rely on fossil fuel-generating power plants, especially gas.

Indeed, these last months represented a proper "stress test" for grids worldwide, that were also able to cope with a combination of larger portions of VER and a lower electricity demand. Referring back to Italy, the strong hydroelectric component within the electricity mix allowed variable renewable energies to be balanced. In this case, of course, thermal power plants have not been completely shut down but were kept at minimum levels, in order to guarantee the grid stability in case of unforeseen events.

Thus, in Europe and Asia, especially in countries that experienced stringent lockdown measures, the pandemic did not stop the growth of renewables that showed a remarkable resistance emphasising the huge potential of green energy sources for the future of our planet.

[7] Electric Insights Quarterly – Q1 2020.

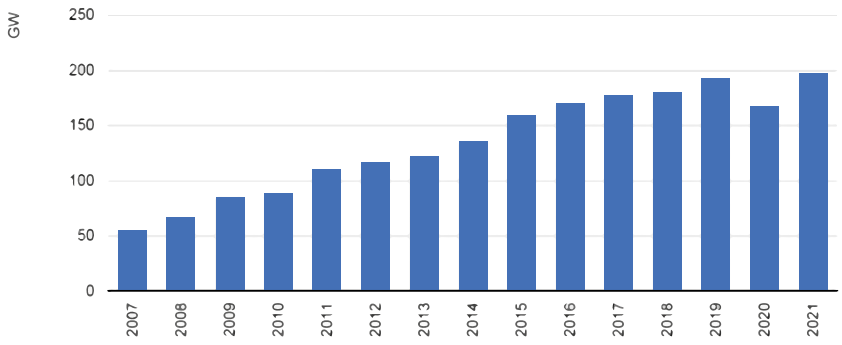
d. The impact on investments in renewable energies

Before the COVID-19 crisis, new RES installations were expected to reach record levels in 2020. However, due to the impact of the pandemic, the power sector was considerably struck by the disruption of global supply chains and the delay of renewable energy projects.

The world is going to generate a lower amount of RES capacity this year, marking the first annual decline in new additions in 20 years, according to the latest update[8]. However, RES investments are expected to recover in 2021 with most of the delayed projects being implemented also supported by government policies (Fig. 1.5). In fact, despite the fact that RES have been severely affected by the COVID-19 crisis, they have proved to be more resilient with respect to fossil fuels and the pandemic could represent an opportunity for their development.

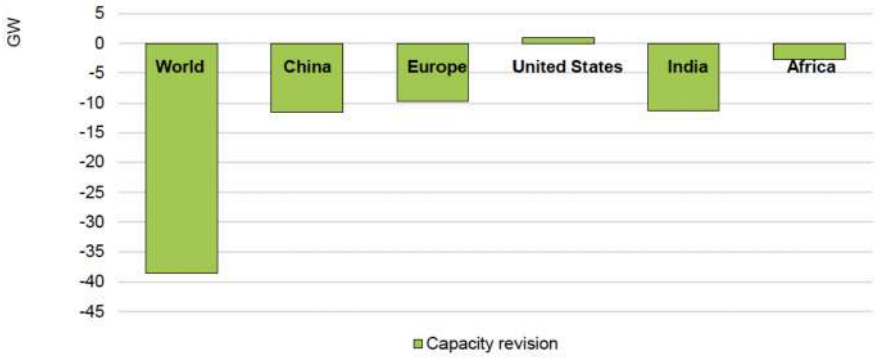
Furthermore, according to the IEA, the COVID-19 crisis is going to exacerbate existing challenges that renewable energies are currently facing, starting with the rooftop solar PV as investors lack short-term liquidity and need to re-prioritise spending. The pandemic is going to impact hard all countries worldwide, especially China, Europe, and India, with a negative impact on financing in Africa (Figure 1.6).

Figure 1.5 - Renewable net capacity additions



Source: IEA, Renewable Energy Market Update - Outlook for 2020 and 2021

Figure 1.6 - Renewable capacity addition revisions in 2020 and 2021



Source: IEA, Renewable Energy Market Update - Outlook for 2020 and 2021

[8] Renewable Energy Market Update - Outlook for 2020 and 2021

3. COVID-19 impacts on African electricity systems

In order to give a more comprehensive view of what occurred in Western, Eastern and Southern countries on the African Continent, data will be shown according to a scheme that summarises, first of all, data regarding access to electricity, the final power consumption rate as per sector and the lockdown measures adopted. Then, data will focus on the trend of the electricity demand (expressed in the majority of cases only in MW), due to data limitations and, when available, how it changed with respect to previous years.

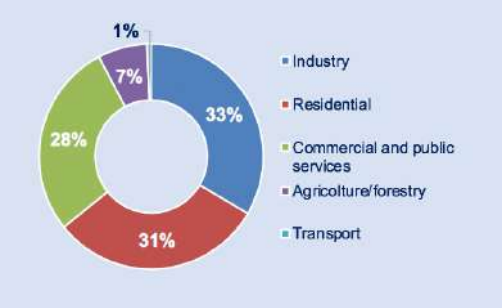
With regards to Nigeria, we were not able to provide a complete framework due to the lack of data relating to the electricity trend. However, it is an interesting case to mention since the demand would seem to have behaved in a totally different way with respect to the countries analysed in the rest of the world. Thus, in this paragraph, the way in which the lockdown measures imposed by the COVID-19 emergency has impacted on the power demand will be discussed, starting with Western and Eastern Africa and concluding with the analysis of Southern African countries.

a. North Africa: Tunisia

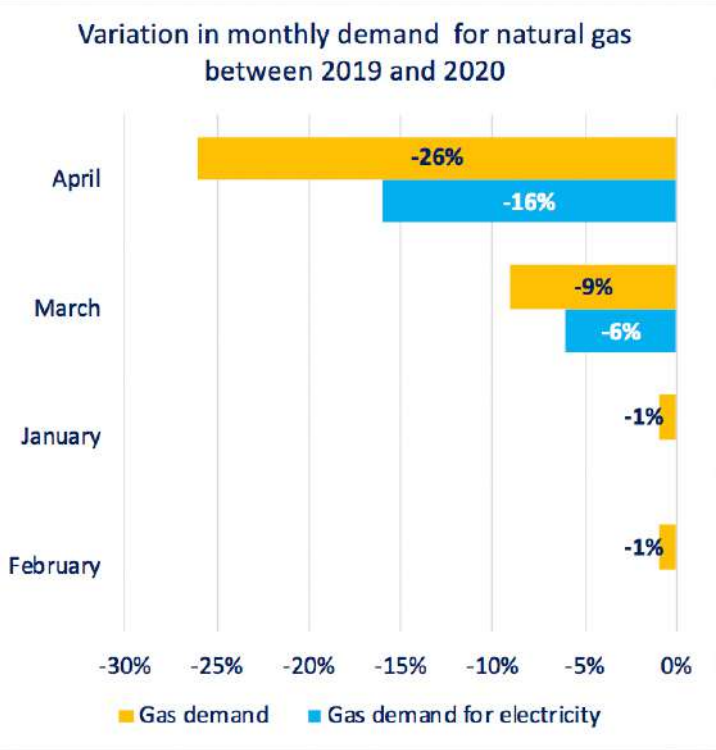
Tunisia

COUNTRY DATA:

- **Electricity access (IEA, 2019): 99,8%**
- **Electricity final consumption by sector (IEA, 2017):**



- **Lockdown measures adopted:**
  - **18th March:** curfew prohibiting outdoor movement from 6 pm till 6 am.
  - **20th May:** general confinement.
  - **4th May:** selective lockdown



Source: 1) MEMTE 2020 2) Athir Nouice, The Tunisian power system and the COVID-19 pandemic. FSR, 13th May, 2020

Following the onset of the lockdown, over the period ranging between 19th March to 30th March, the daily electricity generation dropped from 47,469 MWh to 33,263 MWh[9].

[9] Athir Nouice, The Tunisian power system and the COVID-19 pandemic. Florence School of Regulation, 13th May 2020.

Despite an increase in household consumption, April registered a 20% reduction in overall electricity demand compared to the same period in 2019. In the same month, the evening peak recorded on 1st April in 2019 was 2,398 MW, while in 2020, it registered only 2,067 MW. During the spring months, energy consumption reached its minimum levels compared to the rest of the year. However, in 2020, the off-peak rate recorded its lowest values for decades.

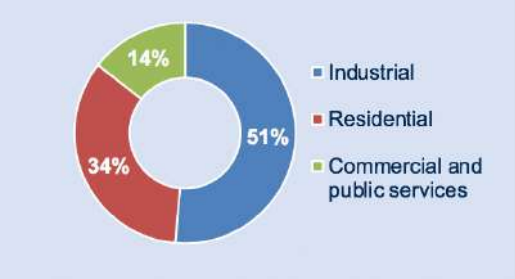
Furthermore, due to the reduction in electricity demand and the closing of certain industries, there was a 26% decrease in the natural gas demand compared to the same period in 2019 and a 16% decrease in gas demand for the electricity sector. Thus, just as in most countries around the world under confinement, the electricity demand in Tunisia has experienced a significant reduction with negative effects also on gas demand.

b. Western and Eastern Africa: Kenya and Nigeria – Special focus on Ethiopia

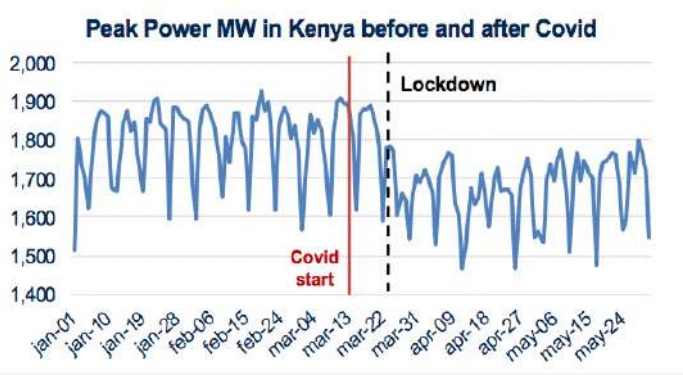
Kenya

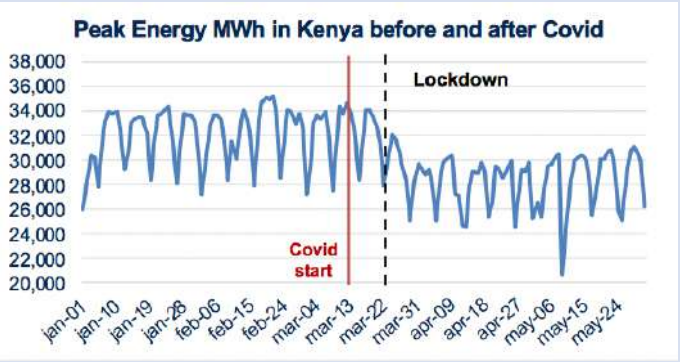
COUNTRY DATA:

- **Electricity access (IEA, 2019): 75%**
- **Electricity final consumption by sector (IEA 2017)**



- **Lockdown measures adopted:**
  – **25th March:** national lockdown





In Kenya, the lockdown measures resulted in a drop in peak power, compared to two months prior to the COVID-19 outbreak (January and Feb 2020), of approximately 6.5% (i.e. 117 MW) and in energy around 11% (3,609 MWh).
Kenya is facing a rigid lockdown and some fundamental sectors for its economy such as the tourism sector have been dramatically affected by the global pandemic resulting in a decrease in energy consumption.

Special Focus on Ethiopia by EWiEn (Association of Ethiopian Woman in Energy)

This section assesses the impact that measures taken to prevent and control the COVID-19 pandemic has had on the Ethiopian electricity sector. The report covers the period from February to April 2020.
Ethiopia has been recording cases of COVID-19 infection since mid-March. Accordingly, different restrictive measures have been issued by the government to prevent and control the public health crisis. The impact of these restrictions has also been observed on the electricity sector in Ethiopia, although this impact can be considered as mild. The overall trend of the energy supply witnessed in February, March and April 2020 did not show any significant change, compared to the trend in the same months in the previous two years. However, power consumption in the country underwent a decrease while exported energy through interconnection experienced an increase. From the power consumption in the country itself, the commercial sector was significantly more affected by such measures compared to the industrial and residential sectors.

Introduction

Since COVID-19 was declared by the World Health Organisation as a global pandemic on 11th March 2020, Ethiopia has adopted several prevention measures. The first case of contagion in Ethiopia was recorded on 13th March 2020. In order to prevent and control the pandemic, the Government of Ethiopia passed the following resolutions.

- On 16th March 2020, the directive to close schools throughout the country was passed and public gatherings were suspended, as publicly announced by the Prime Minister via mass media. (7)
- On 20th March 2020, the directive introducing a 14-day quarantine period for every air traveller entering Ethiopia was passed, becoming effective as of 23rd March 2020. Moreover, on the same date, all cross-border transport services, with the exception of essential goods were suspended. (8) At the time of the announcement, the number of confirmed cases of infection amounted to 11. It is believed that this directive marked the beginning of the economic effect due to COVID-19 restrictions, especially influencing the service sector.
- On 8th April 2020, a state of health emergency was declared. On 18th April 2020, a state of health emergency declaration and guidelines were approved by the House of Representatives. The general guidelines gave directives with regard to a new transport scheme, changes in working hours and conditions. The working conditions guidelines included directives to reduce the numbers of employees working in the federal public and private sectors in order to avoid crowding of working places and inappropriate working conditions. Based on the general directives, all federal public sectors saw their workforces reduced by at least 50% (5). When the state of health emergency was declared, the number of recorded cases of infection reached 96.

At the time this report was completed, lockdown measures had still not been enforced in Ethiopia.

The effect of COVID-19 on the Ethiopian economy partly depends on the structure of its economy. The service sector is among the leading sectors in terms of GDP contribution and employment creation. This sector has proved to be one of the sectors that has been the most vulnerable to COVID-19, according to the report of the Planning and Development Commission of Ethiopia published on 25th April 2020. More specifically, certain subsectors including tourism, airlines, hospitality (Hotels and Restaurants) and

distribution services will be hit particularly hard due to the travel ban. The manufacturing sector in Ethiopia is dominated by labour-intensive industries that will be impacted by measures to implement physical distancing. Employment distribution in Ethiopia shows that the Hotels and Restaurants category takes up 5.6% of the employment distribution share and Industry, especially the manufacturing sector, takes up to 12.3% of the total employment distribution share. (6)

Both sectors, highly dependent on power supplies, are considered to have been severely affected by the pandemic. In this section, the power supply trend has been reviewed and analysed over the last three years to determine the impact of the pandemic on sectors between the periods ranging between February and April 2020.

The Ethiopian Power Supply Trend

Ethiopia's power supply is mainly dependent on hydro-power generation which accounts for up to 95.6% of the daily MWH production. The remaining 4.4% of the power supply is generated by wind and thermal energy. As shown in reports issued by the Ministry of Water, Irrigation and Energy, the power supply coverage in the country reaches a peak of 71% based on access to the power grid. Other reports show that household connections to the power grid are much lower than 44.98% (9). Beyond the domestic demand, the Ethiopian power system also supplies electricity to neighbouring countries of Djibouti and the Sudan. The grid supply trend in the months of February, March and April over the past 3 years is shown in Figures 1 and 2.

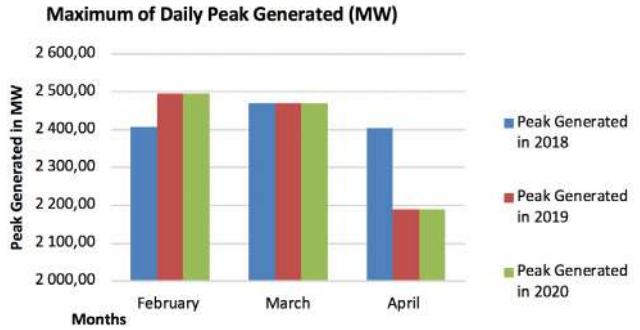


Fig. 1 - maximum daily peak power supply (mw) in February, march and April over the past 3-year period.

As can be seen in Fig. 1, the peak generation in April 2019 significantly decreased due to the 'load shedding' of EEP to tackle the power generation shortage at the Gilgel Gibe-3 hydropower plant.

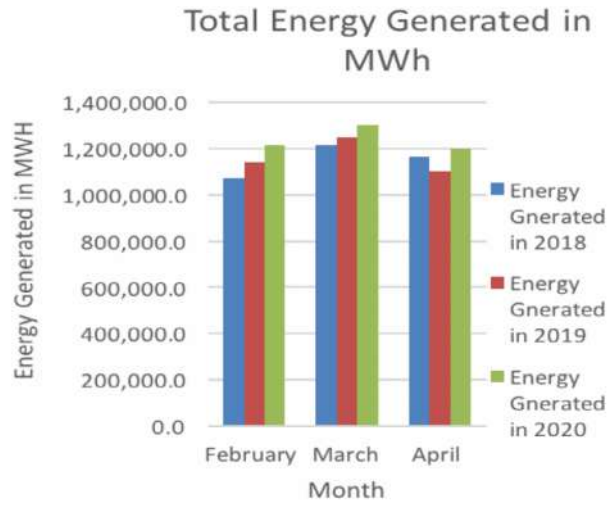


Fig. 2: Total energy supply in February, March and April over the past 3-year period

The amount of energy supplied in 2020 has been higher throughout the three-month period in question when compared to 2018 and 2019 (Fig. 2). The rise in energy supply can be attributed to the increase in generation capacity that resulted in the implementation of a new grid network connection as well as new load demands. For instance, in 2020, two new generation plants were connected to the grid. Reppi Waste to Energy Power plant with a 25 MW generation capacity became operational on 1st January 2020 and the Genale Dawa (GD3) hydro-power plant with a 254 MW generation capacity became operational on 20th March 2020. Hence, the total amount of energy generated has increased to 3,717,523.16 MWh. In addition, as from 1st January 2020 a new heavy industry load namely Wonji Sugar factory was connected to the power grid network.

On the other hand, when comparing the amount of energy supplied between the months of February, March, and April in 2020, this latter month shows a declining supply trend.

Sector-related power consumption

The Ethiopian power grid supply can be divided into three main wholesale customers, namely the Utility customers, heavy industries and the power grid system (energy export) connected to neighbouring countries). The Utility customer is responsible for power distribution and retail to residential and commercial customers as well as medium and low-voltage industries. Heavy industries on the Ethiopian power grid include categories of customers that have dedicated substations or intakes of dedicated high voltage lines amounting to 132 kV or more.

A. Heavy industry power consumption

Heavy industries in Ethiopia mainly consist of construction material manufacturers such as concrete-producing and steel working factories. Out of the 13 industries in this category, 9 of these are construction material manufacturers. The power supply to heavy industries on average accounts to 5.6% of the country's total energy production, relating to the months under consideration. The data shown in Fig. 3 shows the energy supply to heavy industries in 2019 and 2020.

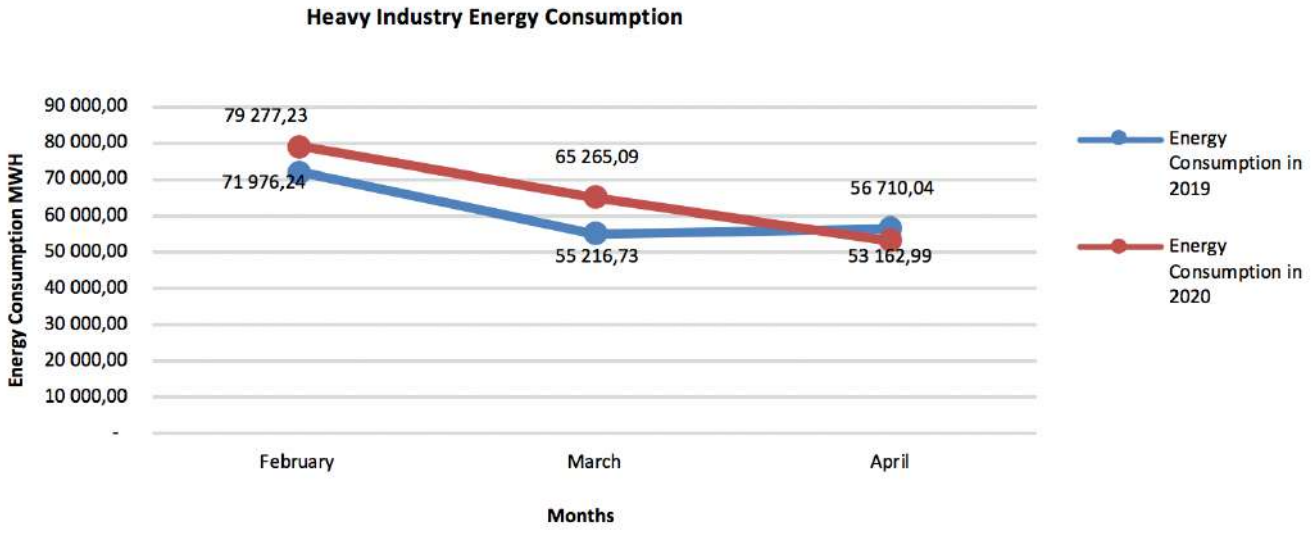


Fig. 3: Heavy industry energy consumption from February to April in 2019 and 2020.

Comparing the three months under study in 2019 and 2020, the power supplied to the heavy industrial sector has increased by 6.9%. However, comparison made between these three months in 2020 shows that supply has declined from February to March and then from March to April by 17.7% and 13.11%, respectively. Considering no particular measure has been passed to restrict construction activities in the country, a major impact on energy consumption in this category is not expected in the near future.

B. Exported energy

The Ethiopian power grid network exports power through interconnection to Djibouti and the Sudan. The graph below shows the energy retail trend over the three months under study over the last three years.

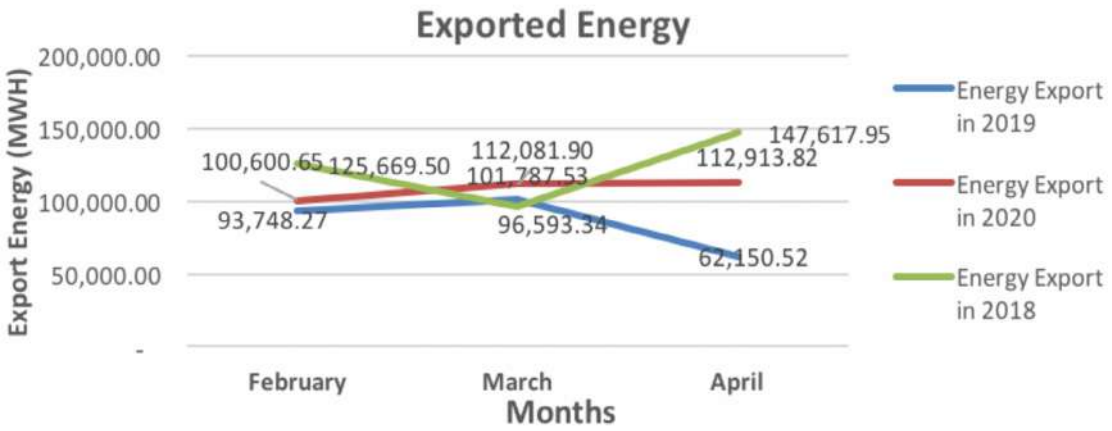


Fig. 4: Exported energy – from February to April in 2018, 2019 and 2020

- The amount of energy exported in 2018 plummeted in March and a relatively similar supply trend was experienced in both February and April. 2019 also showed a sharp fall in April, which could be attributed to a power generation shortage in the country, due to a water level decrease at the Gibe-III HPP, the largest functional dam in Ethiopia. However, to date, the 2020 trend has witnessed a much flatter curve related to exports over the three-month period.
- When comparing 2019 and 2020, the energy exported in this latter year has experienced a 21% increase.
- In addition, when comparing the energy exported between the months of February, March, and April 2020, the energy exported in April 2020 increased by 10.9% and 0.74%, respectively compared to February and March 2020.

This shows that there had been no impact on energy export figures due to COVID-19-related measures.

C. Power Consumption in Residential, Commercial, Medium and Low-Voltage Industries

The Ethiopian Electric Utility (EEU) company provides power to residential and commercial customers as well as Medium and Low-Voltage industries. Considering that the Ethiopian power sector unbundling process is still in progress, direct data relating to power supplies from the grid operator to the distributor and retailer is not currently available. At the same time, since the invoice and billing data recording system was initiated after November 2019, consumption data regarding the months in question was only available for 2020. Besides, measuring the MWh demand at all substation feeders is a demanding feat as Electricity Meter installations are currently underway. Hence, the demand data for customer categories is taken from the Invoices collected by the Business Intelligence (BI) team.

Hence, evalaution for this section is limited only to 2020. Moreover, from the billing data, it can be observed how the number of customers varies each month for all customer categories. This could be due to lack of meter readings and uncollected payments.

Fig. 5 and Fig. 6 demonstrate the relationship between the number of customers per month and the relevant power consumption.

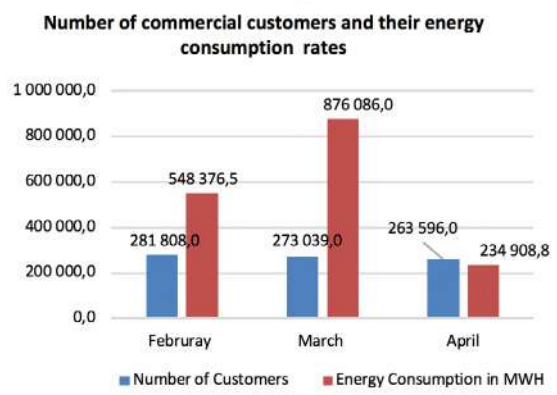


Fig.5: Commercial sector energy consumption - February-April 2020

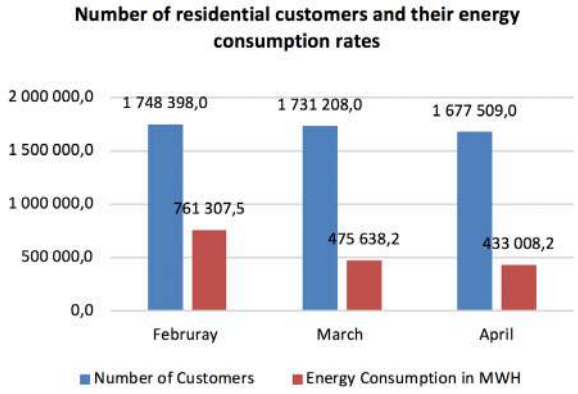


Fig. 6: Residential sector energy consumption - February-April 2020

The findings demonstrate that the number of commercial customers decreased over the period from February to April showing 3.11% and 3.46%, Respectively. However, it can be seen that the energy consumption rose in March and fell sharply in April, with a 59.76% rise in March and 73.19% fall in April compared to the level observed in March 2020. Considering restrictions regarding social gatherings and events imposed after mid-March alongside travel bans enforced in early April, it can be assumed that the impact of the pandemic on the service sector, categorised as commercial energy customers, also had an impact on energy consumption.

Similarly, the number of residential customers also decreased between February and April showing 0.98% and 3.10%, respectively (Fig. 6). The energy consumption also showed a sharp decline in March with 37.52% and a relatively slight decrease 8.96% in April.

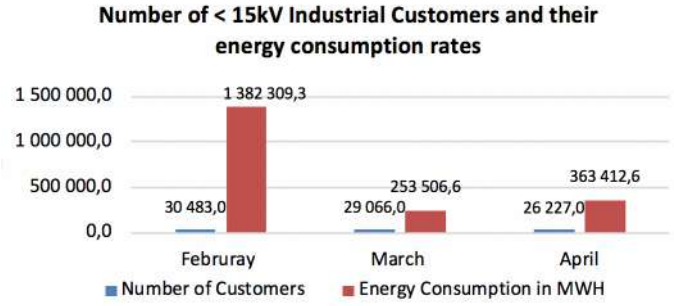


Fig.7: Low Voltage (<15kV) Industries energy consumption - February April 2020

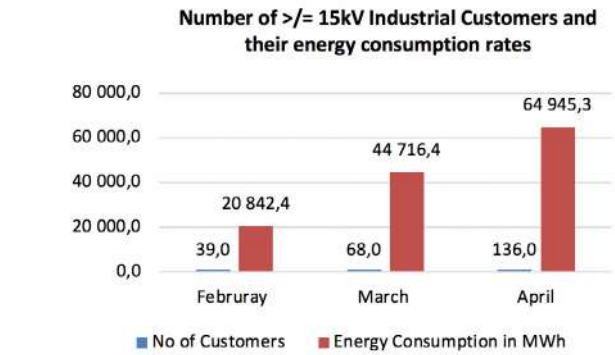


Fig. 8: Medium-voltage (>/= 15kV) industries energy consumption - February-April 2020

On the other hand, the low-voltage (<15kV) industry's energy consumption decreased by 81.66% in March compared to February and shows a 43.35% rise when compared to April while the decline in the number of customers amounts to 4.6% and 9.7% from February to March and then from March to April, respectively.

Energy consumption with regards to residential and commercial customers alongside low-voltage industries, the difference in the number of customers between the months under study may be due to lacking meter readings and manual bill collection methodologies the Utility company performs. Due to the transport restrictions in force within the country, revenue collection may be affected due to customers' failure to pay their bills on time and a reduction in workforce may have influenced meter reading and billing procedures.

In contrast to the three customer categories of the Utility company, Fig. 8 shows different characteristics for medium-voltage (>/= 15kV) industry customers. This industry sector showed a significant increase in the number of customers as well as in its energy consumption rates. The data implies that from February to March 2020, the number of customers in this industry sector increased by 74.3% and in April 2020 it even doubled, showing a 100% increase. On the other hand, energy consumption increased by 114.55% in March compared to February and showed a progressive increase reaching a peak of 45.24% in April. The increase in the number of medium-voltage industry customers could be due to new industrial load demands connected with the recently energised power plant (GD-III) as well as connections with transmission and substation infrastructure (initiated after mid-March 2020). At the same time, new billing invoice methods that had not been generated in previous months for a variety of reasons could have also influenced the increase in figures.

When the sum relating to the energy consumption of the four categories of customers is analysed from the standpoint of the Utility company, a decrease can be seen in both the number of customers and the energy consumption rates.

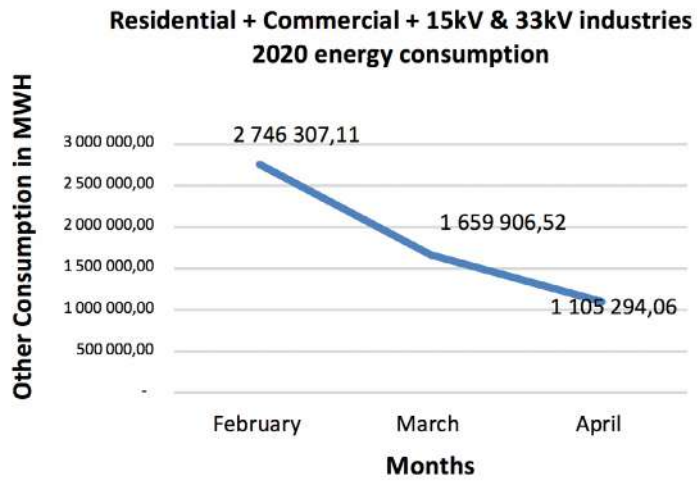


Fig. 9: Utility energy consumption - February-April 2020

The demand declined from February to March and then from March to April by 39.56% and 33.41%, respectively with the number of consumers decreasing by 1.3% for March and 3.24% for April (Fig. 9).

Summary

Due to the spreading of COVID-19, prevention and control measures were adopted in Ethiopia after mid-March. Consequently, impacts became more evident after this period. Out of the three categories of wholesale electricity customers, the Utility, heavy industry and interconnection sales, it can be observed that only the interconnection electricity supply was unaffected by the pandemic. The impact of the health crisis management measures on the other two sectors in April was closely observed, showing a 13.11% decline on heavy industry consumption and a 33.41% decline on the utility energy consumption compared with consumption rates witnessed in March.

From the Utility company standpoint, while medium-voltage energy consumption rates experienced an unexpected boost, the consumption rate of commercial customers rapidly decreased. A moderate decline was also observed on the residential load demand. Meanwhile, it should be noted that the energy consumption changes observed in the utility sector were also underwent a change in the number of customers that could be attributed to lacking meter readings and uncollected payments.

While a significant change could be seen in sector-related percentages of energy consumption in April 2020 compared to February and March 2020, the overall trend in energy supply in 2020 for the three-month period under study underwent no significant change when compared to the same period in the previous two years. On the other hand, the energy supplyin April 2020 showed an increase compared to the same month in the previous two years. This is mainly attributed to the increase in the interconnection energy supply (export energy).

Conclusion

The impact of the pandemic both on the number of infections as well as its influence on the electricity sector seems mild for the period ranging between the beginning of February 2020 to the end of April 2020. However, after April, the cases of infection started to rapidly increase. A significant rise in the number of infections was recorded during the month of May, amounting to 133 individuals on 1st May 2020 and then this figure rocketed to 1,172 individuals on 31st May 2020. As of 12th June 2020, the total number of recorded COVID-19 cases amounted to 2,915 resulting in 47 deaths.

The factor for the mild impact of COVID-19 on the Ethiopian electricity sector could be due to sustained energy export and not attributed to consumption within the country. This can be clearly observed with the local energy consumption rates declining from February to March and then from March to April by 39.56% and 33.41% coherently with the number of consumers, while the export supply has increased by 10.24% and 0.74% for the same periods respectively.

Although there is no indication that the government will decide upon the adoption of further restrictions to prevent and control the spread of COVID-19, it could be estimated that most of the impacts on the electricity sector observed during April will continue to persist if not worsen.

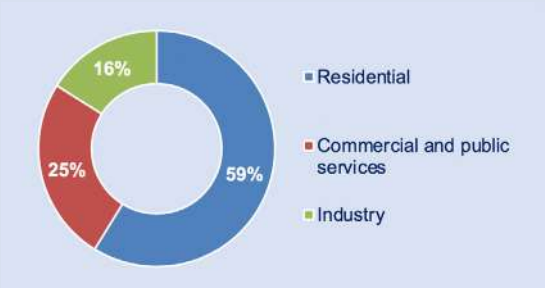
Reference

1. Ethiopian Electric Power, Transmission Substation Operation Daily energy supply data, 2018, 2019 & 2020
2. Ethiopian Electric Power, Marketing Directorate, Monthly energy sales data, 2019 & 2020
3. Ethiopian Electric Power, National Load Dispatch Centre, Energy Accounting Data 2018, 2019 & 2020
4. Ethiopian Electric Utility, Distribution Billing Data, Business Intelligence Department, 2020
5. (ውሳኔ30-18/214 dated 18th April 2020 Directive 1/1212 COVID-19 Transmission prevention, control, and effect reduction guideline, FDRE, Office of The Prime Minister
6. The impact of COVID-19 on Ethiopian Economic Growth, Federal Democratic Republic of Ethiopia, Planning and Development Commission, Addis Ababa, April 2020 publication
7. Ethiopian Broadcasting Corporation, 16th March 2020 News feed
8. Ethiopian Broadcasting Corporation, 20th March 2020 News feed
9. https://energypedia.info/wiki/Ethiopia_Energy_Situation, 2019

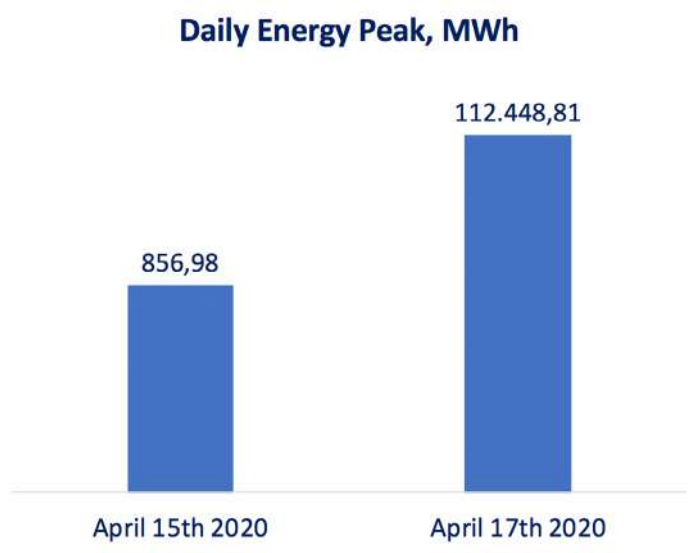
Nigeria

COUNTRY DATA:

- **Electricity access (IEA, 2019): 60%**
- **Electricity final consumption by sector (IEA 2017):**



- **Lockdown measures adopted:**
  - **29th March:** localized lockdown
  - **4th may** :softening of lockdown measures



Source: Transmission Company of Nigeria (TCN)

In Nigeria, the COVID-19 lockdown has led to a shutdown of essential economic activities across the country. Consequently, the electricity demand from industrial and commercial customers has declined significantly while the residential demand is expected to have increased[10] .

[10] COVID-19 and the Power Sector. Macro Economics, consumer purchasing power and cost reflective tariff. PwC Nigeria webinar, April 2020

On the 17th of April 2020, the National Control Centre (NCC) Osogbo announced an unprecedented New Daily Energy Peak of 112,448.81 MWh which is higher than the previous maximum value achieved on 15th April 2020, showing an increase of 856.98 MWh.

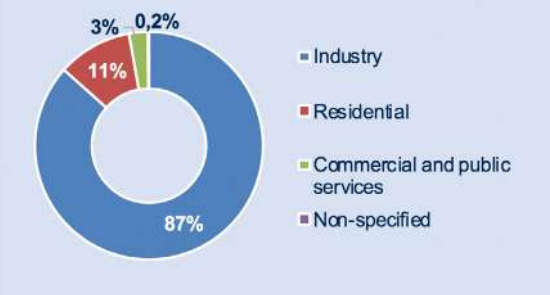
Considering that the household demand represents nearly 60% of the total electricity consumption, it is expected that in Nigeria, the total electricity demand could even increase.

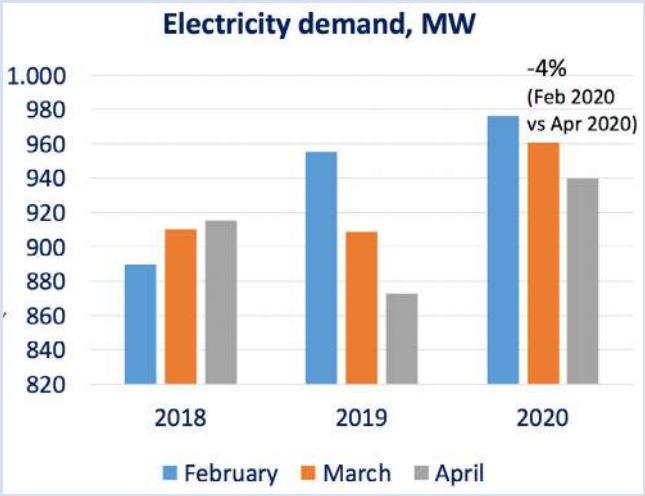
c. Central and Southern Africa: Mozambique, Zambia, DR Congo, Namibia and South Africa

MOZAMBIQUE

COUNTRY DATA:

- **Electricity access (IEA, 2019): 29%**
- **Electricity final consumption by sector (IEA 2017):**





Source: Southern Africa Power Pool (SAPP)

- **Lockdown measures adopted:**
  - **1st April :** localised recommendations. People encouraged to carry out remote working (from home)

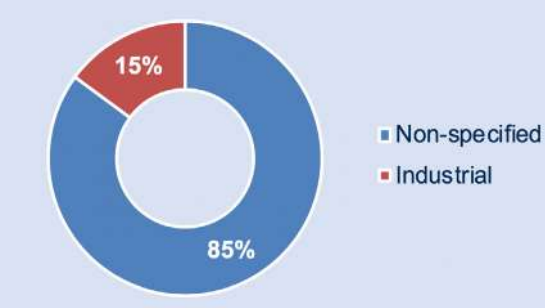
Since 2018, the electricity demand in Mozambique has shown a substantial growth, probably due to improving electricity access over the years. The pattern registered in 2020 is similar to what happened during the same period in 2019, when the Cyclone Idai, and subsequent flooding, struck the country[11]. Therefore, the slight decrease in 2020 demand due to the COVID-19 pandemic is coherent with what happened the year before, during another emergency period.

[11] Massive flooding in Mozambique, Malawi, and Zimbabwe. UNICEF 2019

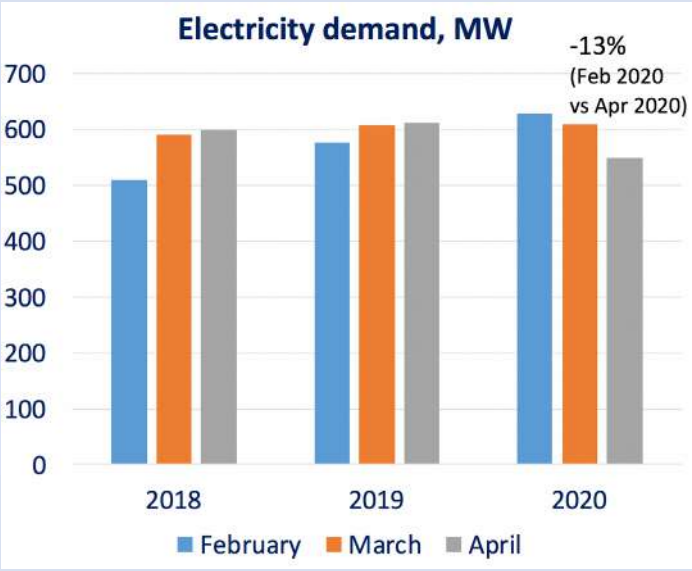
NAMIBIA

COUNTRY DATA:

- **Electricity access (IEA, 2019): 56%**
- **Electricity final consumption by sector (IEA 2017):**



- **Lockdown measures adopted:**
  - **28th march :** partial lockdown, eased after 4 weeks

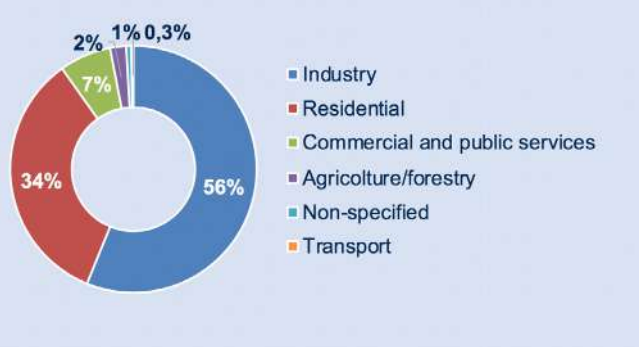


In Namibia, the electricity demand has remained high over the 2018-2020 period, with a slight upward trend, both in 2018 and 2019, in March and April with respect to values recorded in February. However, in 2020, the demand has undergone a pronounced decrease, especially in April. Thus, it is supposed that the containment measures adopted in the country, although not too restrictive, have had an impact on electricity demand.

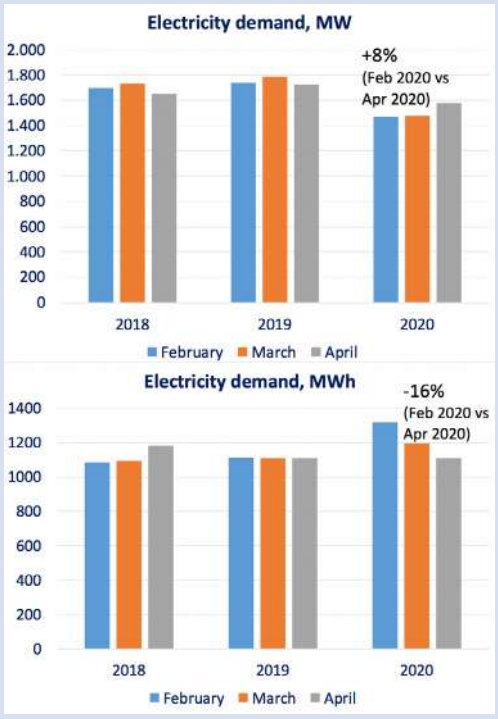
ZAMBIA

COUNTRY DATA:

- **Electricity access (IEA, 2019): 37%**
- **Electricity final consumption by sector (IEA 2017):**



- **Lockdown measures adopted:**
  - **25th march :** partial lockdown in selected towns



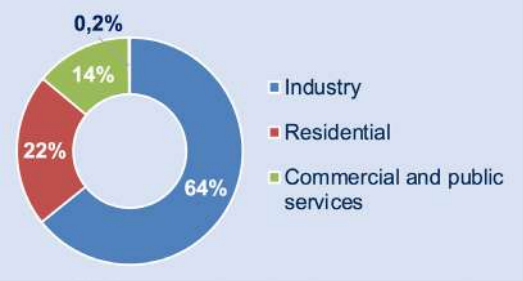
Source: Southern Africa Power Pool (SAPP)

Observing the electricity demand trend, expressed both in MW and MWh, it is evident that this year, the demand figures have behaved differently with respect to 2018 and 2019. Despite a greater request in total energy (MW), the demand expressed in MWh showed a considerable decrease from February to April 2020, reflecting the adoption of containment measures, although only partial.

DEMOCRATIC REPUBLIC OF CONGO

COUNTRY DATA:

- **Electricity access (IEA, 2019): 9%**
- **Electricity final consumption by sector (IEA 2017):**





Source: Southern Africa Power Pool (SAPP)

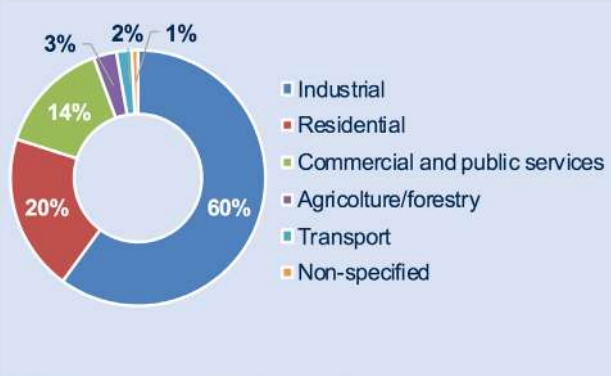
- **Lockdown measures adopted:**
  - **25th march :** partial lockdown in Kinshasa and the nationwide state of emergency

Considering the extremely low consumption, as well as the absence of data, it is quite difficult to detect the impact of COVID-19 emergency on the electricity demand of the Democratic Republic of Congo. Nevertheless, it is indeed interesting to mention that considering these conditions, together with the introduction of a partial lockdown only, the country experienced a slight decline in electricity demand during 2020, whereas in the previous year, it increased over the same period.

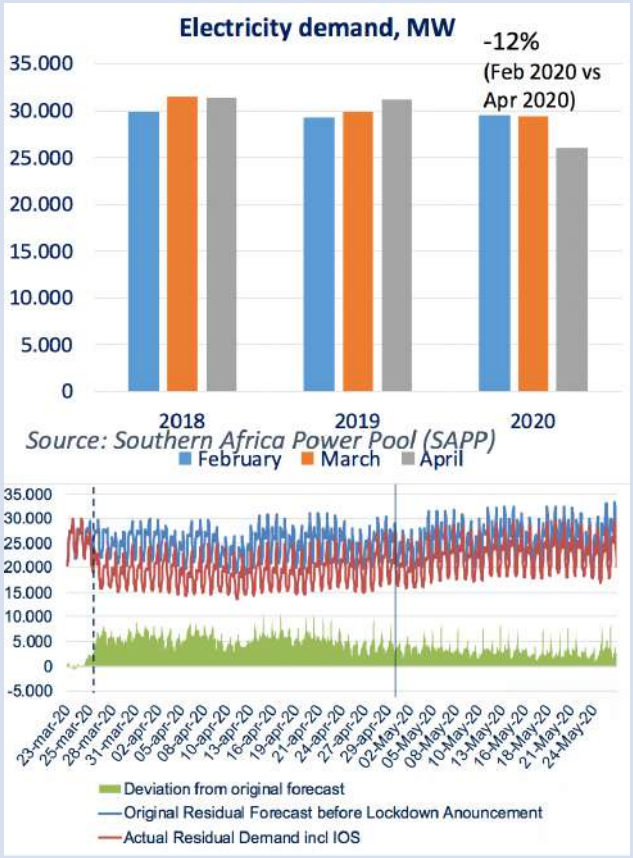
SOUTH AFRICA

COUNTRY DATA:

- **Electricity access (IEA, 2019): 95%**
- **Electricity final consumption by sector (IEA 2017):**



- **Lockdown measures adopted:**
  - **25th march :** national lockdown
  - Eased from level 5 to 4 on 1st may
  - Eased further from level 3 on 1st june



Source: ESKOM, as at 27th May 2020

By analysing the impact of the pandemic crisis on electricity demand in South Africa, it is possible to observe that the electricity demand has been strongly influenced by the containment measures adopted by the government. Moreover, taking into account that the majority of the final electricity consumption comes from the industry sector, the shutdown of businesses played a pivotal role in the fall of the demand.

Thus, the case of South Africa is in line with what was observed worldwide, with a decreasing electricity demand as a response of the emergency. In particular, the impact of COVID-19, and especially the lockdown measures, have reduced demand by an average of 6,000 MW up to a maximum of 11,000 MW. Moreover, Eskom stated that maintenance has roughly doubled to over 9,000 MW, **with the delay at the same time of some reliability outages.**

In summary, compared with what is happening in the rest of the world, where the lockdown measures and the economic crisis are driving the decrease in energy demand, the general trend in Africa with regard to electricity demand is similar (reduced demand), albeit with differences in the magnitude of impact among African countries. This is mainly due to a high share of residential electricity consumption in Africa and a comparably less energy-intensive economy.

Within this general trend, differences are observed among countries in Africa related to the impact of COVID-19 on the electricity sector. Data given in this report has highlighted that countries such as Mozambique and the Democratic Republic of Congo experienced higher electricity demand in 2020 compared to previous years, mainly thanks to recent progress made in expanding such access. However, demand has been decreasing over the last months due to the pandemic and lockdown measures. On the other hand, in countries such as South Africa and Tunisia, where almost the entire population has access to energy, electricity demand in April 2020 decreased with respects to 2019 levels. Overall, the impact of COVID-19 in the electricity sector of Africa is evident.

4. Conclusions and policy recommendations

a. The role of the electricity sector in African economic development

Nowadays, 860 million people worldwide still live without any electricity while hundreds of millions of people have an insufficient or unreliable access to it. Among those who have no access to electricity, 600 million – corresponding to more than two-thirds of the global total - live in sub-Saharan Africa where the electrification rate in 2018 was 45%[12], and the latest World Bank access data shows 594 million today. In addition, more than 70% of the population, i.e. around 900 million people, lack access to clean cooking and rely on other means that cause 500,000 premature deaths a year[13]. Generally speaking, in forthcoming years, energy demand in Africa will grow twice as fast as the global average, mainly driven by the continent's demographic growth and economic development. Therefore, it is becoming even more urgent to build energy infrastructure that are able to provide life-saving energy access to the entire population and, more generally, foster the development of the African continent.

Today, the global energy landscape is undergoing a major transformation and renewable energy is playing an increasingly vital role in helping countries develop modern, sustainable, and secure energy systems. Moreover, thanks to their decreasing costs, renewable energies, technological advancements and greater resilience, as demonstrated during the coronavirus pandemic, are helping with this transition on a global scale, enabling society to make progress on several of the seventeen Sustainable Development Goals (SDGs). In Africa, clean energy technologies display an even larger potential since they allow transition to sustainable energy mix, and contribute to improvements towards achieving the various SDGs.

In this crisis time, the fundamental role electricity access needs to play in order to secure health, food and education around the world has become even more crucial.

- **Renewable energy for health in Africa**

Energy services are key to preventing diseases and building an efficient, reliable healthcare system: from powering healthcare facilities and supply of clean water to enabling communications and IT services. However, in sub-Saharan Africa only 28% of healthcare facilities benefit from reliable electricity, meaning that the vast majority of hospitals and clinics are unable to guarantee emergency responses[14]. Today, COVID-19 is worsening the situation while the pandemic is spreading across sub-Saharan Africa. Health facilities require stable power to provide 24/7 care and power ventilators, oxygen concentrators, and other essential medical equipment. However, many hospitals and health clinics are currently working without any power or being able to use any diesel backup generators during blackouts.

In this context, renewable and sustainable energy solutions present a crucial opportunity to provide clean, cost-effective electricity to health centres, especially in rural areas. Research published in 2018 by the Rocky

[12] SDG 7: data and projections, IEA 2019
[13] Africa energy outlook, IEA 2019
[14] Energy access takes center stage in fighting COVID-19 and powering recovery in Africa, The World Bank 2020.

Mountain Institute (RMI) highlighted that distributed renewable energy systems are more resilient during crises and can be an alternative to, or supplemented by, diesel generator usage[15]. Moreover, economic savings are an important long-term consideration for health facilities and renewables are becoming an increasingly more cost-competitive energy source in rural off-grid applications. The development of the off-grid sustainable energy sector, with the combined efforts of the private and public sectors, will benefit health care facilities and will facilitate growth in electricity access.

- **Renewable energy for food in Africa**

Agriculture is one of the most important economic sectors in Africa, accounting for 23% of the continent's GDP[16]. However, evidence shows that in 2018, the percentage of the population suffering undernourishment reached almost 20%, with an even higher rate in sub-Saharan countries[17]. Increased efforts to provide sustainableenergy in Africa can increase agricultural production – through the usage of stationary machines, irrigating pumps, digital technologies etc. - and thus provide the means to ensure food security, ending hunger and further strengthening a strategic economic sector for the continent. Moreover, sustainable energy sources can help make progress in food security by reducing the threat of climate change. Indeed, according to the Intergovernmental Panel on Climate Change (IPCC), one of the most important climate change impacts in Africa is on food security through reduced crop productivity and adverse effects on livestock[18].

Today, Africa's food system is even more threatened due to the impact of COVID-19 pandemic with serious shocks that might emerge in the medium to long-term, including reduced demand within the continent, a decrease in trade and exports as well as damage caused to agricultural production[19].

These factors, together with the projection that food demand will increase by 60% in 2030 (compared to 2015 levels)[20] as a consequence of the demographic boom, is making the use of sustainable energy sources in agriculture one of the most urgent actions required to ensure the continent makes the necessary transition towards a more sustainable and resilient future. The nexus between Food, Water and Energy remains an important policy and development importance to Africa. Africa can build back better from the effects of COVID-19 by implementing successful food, water and energy nexus programs.

- **Renewable energy for education in Africa**

Education and schools play a key role in any country's development and access to electricity is a fundamental enabler to guarantee quality learning services. However, two-thirds of schools in Africa do not have reliable electricity, thereby interrupting regular school services in many communities[21]. Such situation is often worsened by the lack of electricity access in households, where pupils can neither study nor continue their distance learning.

[15] Critical facilities: where governments and utility services re-define resilience, Rocky Mountain Institute 2018.
[16] Safeguarding Africa's food systems through and beyond the crisis, McKinsey & Company 2020
[17] Food security and nutrition in the world, FAO 2019
[18] Climate Change – impacts, adaptation, and vulnerability. Part B: regional aspects, IPCC 2014
[19] Safeguarding Africa's food systems through and beyond the crisis, McKinsey & Company 2020
[20] Africa future counts, RES4Africa 2019
[21] Energy access takes centre stage in fighting COVID-19 and powering recovery in Africa, The World Bank 2020.

Indeed, in this scenario, the effect of green energy technologies on education is particularly evident in those countries with the weakest electricity access, where renewable powered systems could improve the quality of education and youth literacy rate. Thanks to their flexibility and adaptability, renewable energy source development could have several positive impacts such as the extension of study hours. Indeed, even if school attendance is limited only to daytime, homework and personal study are usually carried out using inefficient and health threatening kerosene lamps. Sustainable and clean electrification could allow an increase in the use of school infrastructure. Moreover, electricity can facilitate the introduction of information and communication technologies, such as computers and internet access, providing an improved school experience both in-class as through distance learning. Another positive influence that clean energy sources could exert on African education regards the teacher attraction and retention. Electrified schools can attract better qualified teachers offering them the possibility to develop their skills and evolve by acquiring new ones[23].

In addition, school electrified by clean and renewable technologies can also produce other multiple effects such as improved sanitation and health, reduced migration, and gender empowerment and so they can actively contribute to the majority of SDGs[24]. Given than education is central to sustainable development, the enabling role of energy and investment in clean energy resources to increase school and off-school electricity access should be considered by policymakers as part of their building back better strategy of Africa.

b. The centrality of sustainable energy sources

COVID-19 pandemic is currently threatening the lives of millions of people and influencing all industries around the world. In Africa, the crisis is highlighting the urgent need for policies and actions to increase energy access, so as to provide vital services to the entire African population.

Compared with what is happening in the rest of the world, where the lockdown measures and the consequent economic crisis have led to a significant decrease in energy demand, the impact in Africa, based on select countries observed in this report, appears to be rather different and a relatively minor drop has occurred, mainly due to high share of household electricity consumption and a relatively less energy intensive economy.

The COVID-19 impact on the African power industry is likely to yield effects on the progress made in the last few years in expanding energy access and improving the health system. Given the current limitations to electricity access, it is difficult to ensure that all health facilities are powered in a reliable way to ensure reliable access to healthcare facilities. Moreover, as lockdown measures are implemented across the continent, the provision of reliable energy becomes even more fundamental in order to sustain all the daily activities, such as lighting, internet access and refrigeration and remote work performance.

[22] Electricity and education: The benefits, barriers, and recommendations for achieving the electrification of primary and secondary schools, UNDESA 2014.
[23] Ibidem.

The new global economic crisis makes it harder for existing customers and businesses to pay for their energy services and African utilities, some of which were already in difficult financial conditions, may face added strains[24].

It is, therefore, evident that the deployment of reliable and sustainable energy solutions in a manner to sustain and surpass the fast pace of electricity access observed in Africa can positively contribute to the post-COVID-19 recovery in Africa and to improve the quality of life of millions of people, even long after the pandemic enters a manageable phase. Indeed, as stated by UNECA, the African Union and IRENA, sustainable energy has the power to stimulate Africa's response to COVID-19, supporting the ability of communities to cope with the health and economic challenges[25].

At a global level, the analysis of the projected changes in primary energy demand for 2020 shows that renewable energy sources are the only type of energy set to witness growth as coal, oil and gas are expected to significantly decrease[26]. Despite the disruptions and changes caused by the Coronavirus, so far, renewable power sources have shown resilience while their share in the electricity mix has increased in several countries[27].

Overall, the financial performance of renewable power investments has significantly improved over the last five years worldwide while their volatility has decreased with respect to fossil fuels, demonstrating positive signs for investors[28]. Furthermore, the rapidly improving competitiveness of renewable power is creating new opportunities and spill-over effects into other industrial sectors. In particular, synergies with gas and oil businesses are already in place, especially with oil companies investing in renewable energy sources. The recent collapse of oil prices due to COVID-19 may represent an unprecedented opportunity for investors to focus more on sustainable and clean energy sources.

c. Policy recommendations

The pandemic has further enhanced the need for a global clean energy transition, in order to guarantee a sustainable path of recovery and a more stable and resilient economy in the future.

Indeed, African leaders and policy makers face an historical opportunity to co-ordinate their recovery initiatives in response to the pandemic, in order to increase their efforts in achieving the Sustainable Development Goal 7 (SDG 7), which aims at ensuring access to affordable, reliable, sustainable and modern energy for all by 2030. This implies building more robust and efficient energy infrastructure systems as well as implementing decentralised energy solutions using sustainable energy sources.

Recovery packages that seek synergies between climate and economic goals are likely to have better prospects for building back better[29]. In particular, in order to foster a sustainable growth and allow the African economy to recover from the pandemic, the following policy recommendations are forwarded:

[24] Africa and COVID-19: economic recovery and electricity access go hand in hand, IEA 2020
[25] African Union and IRENA to advance renewables in response to COVID-19, IRENA 2020
[26] Global Energy Review 2020, IEA 2020
[27] The COVID-19 crisis is hurting but not halting global growth in renewable power capacity, IEA 2020
[28] Energy Investing: Exploring Risk and Return in the Capital Markets. A Joint Report by the International Energy Agency and the Centre for Climate Finance & Investment June 2020, 2nd Edition. Imperial College Business School, Centre for Climate, Finance & Investment
[29] Hepburn, C., O'Callaghan, B., Stern, N., Stiglitz, J., and Zenghelis, D. (2020), 'Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?', Smith School Working Paper 20-02

- **Government stimulus packages should aim at accelerating decarbonisation and sustainable economic transition, including to green technologies.**
- In order to face the COVID-19-related health challenge, it is crucial **to support investments in mini-grids** and off-grids that could power thousands of health centre in sub-Saharan Africa.
- **Sustainable Development Goal number 7 should be part of a broader stimulus package to address the COVID-19 crises and build back better towards sustainable development.**
- **Governments need to address stimulus packages to foster private investment in Low Carbon Technologies (LCT) deployment through Public-Private Partnerships and private investments through de-risking mechanisms**[30,31]**.**
- **Fostering investments in education and training to address unemployment challenges** resulting from COVID-19, as well as structural unemployment from de-carbonisation[32].
- Africa faced **infrastructure investment gap before COVID-19 to the tune of $90 to $120 billion per year. Post COVID-19, Africa will face increased constraint on public financing of infrastructure beyond recovery spending**. It is, therefore, vital that **Africa review its electricity sector regulatory environment to enable greater participation of private sector** investment across the electricity value chain.
- **Stimulus packages should also be addressed towards rural support schemes,** supporting sustainable agriculture, ecosystem regeneration, and clean energy solutions[33].
- **Last but not least, COVID-19 may represent an opportunity for the utility sector to adopt innovative business models and flexibility.** Digitalisation is vital in this regard, and therefore, it is fundamental to foster investments and resources in order to promote a new and flexible approach to energy.

[30] "Pigato, Miria; Black, Simon J.; Dussaux, Damien; Mao, Zhimin; McKenna, Miles; Rafaty, Ryan; Touboul, Simon. 2020. Technology Transfer and Innovation for Low-Carbon Development. International Development in Focus. Washington, DC: World Bank.
[31] In this respect, industry-led initiatives like RenewAfrica appear as particularly welcome and timely.
[32] "Pigato, Miria; Black, Simon J.; Dussaux, Damien; Mao, Zhimin; McKenna, Miles; Rafaty, Ryan; Touboul, Simon. 2020. Technology Transfer and Innovation for Low-Carbon Development. International Development in Focus. Washington, DC: World Bank.
[33] Ibidem

Acknowledgement

Production: RES4Africa Foundation Secretariat in Rome, Italy
Project management team: Roberto Vigotti, Luca Marena, Antonio Passero, Daniele Paladini – RES4Africa Foundation
Editor & Project lead: Antonio Passero, Daniele Paladini - RES4Africa Foundation

Authors: Matteo Di Castelnuovo, Virginia Allevi, Paola Casati (SDA Bocconi), Filagot Tesfaye., Adey Getachew., Mizan W.R., Bilen D., Helen N. (EWiEn), Sydney Zimba, Brian Dlamini (SAPP), Yohannes Hailu (UNECA) Daniele Paladini, Antonio Passero, Marianna Petrosillo (RES4Africa).

Analysis of the economic impacts of COVID-19 in Africa presented in this report is contributed by the UN Economic Commission for Africa (ECA). The discussion benefited greatly from recent macroeconomic and sectoral analyses of the impacts of COVID-19 in Africa at ECA under the leadership of Dr. Vera Songwe, Executive Secretary of ECA. The contribution was developed by Mr. Yohannes G. Hailu, Economic Affairs Officer and Energy Policy Expert at ECA with guidance from Mr. William Lugemwa, Director of the Private Sector Development and Finance Division at ECA and Mr. Robert Lisinge, Section Chief for Energy, Infrastructure and Services Section (EISS) at ECA. Contributions from Mr. Soteri Gatera and Mr. Anthony Monganeli Mehlwana of EISS were appreciated. Review and feedback from Mr. Allan Mukungu, Ms. Jane John Mpapalika, Ms. Christine Achieng Awiti, Mr. Opeyemi Akinyemi and Mr. Muazu Ibrahim from the Macroeconomic Policy and Governance Division of ECA are also greatly appreciated.

The views expressed are solely those of the authors.

This publication was publicly launched on 24 June 2020 during RES4Africa Foundation Webinar.

References

- ESKOM (2020). “System Status Briefing. May 2020”
- FAO (2019). “The state of food security and nutrition in the world”. Available [Online] at http://www.fao.org/3/ca5162en/ca5162en.pdf
- Hepburn, C., O’Callaghan, B., Stern, N., Stiglitz, J., and Zenghelis, D. (2020), “Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?”. Oxford Smith School of Enterprise and the Environment. Available [Online] at https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper20-02.pdf
- IEA, (2020). “Africa and Covid-19: economic recovery and electricity access go hand in hand”. Available [Online] at https://www.iea.org/commentaries/africa-and-covid-19-economic-recovery-and-electricity-access-go-hand-in-hand
- IEA, (2020). “COVID-19 Impact on Electricity”. Available [Online] at https://www.iea.org/reports/covid-19-impact-on-electricity
- IEA, (2020). “Global Energy Review 2020”. Available [Online] at https://www.iea.org/reports/global-energy-review-2020
- IEA, (2020). “Renewable Energy Market Update”. Available [Online] at https://www.iea.org/reports/renewable-energy-market-update
- IEA, (2020). “The Covid-19 crisis is hurting but not halting global growth in renewable power capacity”. Available [Online] at https://www.iea.org/news/the-covid-19-crisis-is-hurting-but-not-halting-global-growth-in-renewable-power-capacity
- IEA, (2020). “World Energy Investments”. Available [Online] at https://www.iea.org/reports/world-energy-investment-2020
- IEA, Centre for Climate Finance & Investment, (2020). “Energy Investing: Exploring Risk and Return in the Capital Markets”. Available [Online] at https://imperialcollegelondon.app.box.com/s/f1r832z4apqypw0fakk1k4ya5w30961g
- IEA, (2019). “Africa Energy Outlook”. Available [Online] at https://www.iea.org/reports/africa-energy-outlook-2019
- IEA, (2019). “SDG7: Data and Projections”. Available [Online] at https://www.iea.org/reports/sdg7-data-and-projections
- IPCC, (2014). “Climate Change – Impacts, Adaptation and Vulnerability. Part B: Regional As-pects”. Available [Online] at https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-FrontMatterB_FINAL.pdf
- IRENA, (2020). “African Union and IRENA to advance renewables in response to COVID-19”. Available [Online] at https://www.irena.org/newsroom/pressreleases/2020/Apr/African-Union-and-IRENA-to-Advance-Renewables-in-Response-to-Covid19
- IRENA, (2020). “Global Renewables Outlook. Energy Transformation 2050”. Available [Online] at https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020
- McKinsey & Company, (2020). “Safeguarding Africa’s food systems through and beyond the crisis”. Available [Online] at https://www.mckinsey.com/featured-insights/middle-east-and-africa/safeguarding-africas-food-systems-through-and-beyond-the-crisis
- Nouice A. (2020), “The Tunisian power system and the COVID-19 pandemic”. Florence School of Regulation. Available [Online] at https://fsr.eui.eu/tunisian-power-system-and-the-covid-19-pandemic/
- Pigato M., Black S., Dussaux D. et al., (2020). “Technology Transfer and Innovation for Low-Carbon Development”. World Bank Group
- RES4Africa Foundation, (2019). “Africa future’s counts”. Available [Online] at https://www.res4africa.org/wp-content/uploads/2019/06/RES4Africa_flagship_2019.pdf
- Rocky Mountain Institute, (2018). “Critical facilities: where governments and utility services redefine resilience”. Available [Online] at https://rmi.org/government-utility-redefine-resilience/
- Staffell, I. (2020), “Electric Insights Quarterly – Q1 2020”. Available [Online] at https://www.drax.com/wp-content/uploads/2020/05/200515_Drax_20Q1_A2.pdf
- The World Bank, (2020). “Energy access takes center stage in fighting COVID-19 and power-ing recovery in Africa”. Available [Online] at https://www.worldbank.org/en/news/opinion/2020/04/22/energy-access-critical-to-overcoming-covid-19-in-africa
- UNDESA, (2014). “Electricity and education: The benefits, barriers, and recommendations for achieving the electrification of primary and secondary schools”. Available [Online] at https://sustainabledevelopment.un.org/content/documents/1608Electricity%20and%20Education.pdf
- UNICEF, (2019). “Massive flooding in Mozambique, Malawi and Zimbabwe”. Available [Online] at https://www.unicef.org/stories/massive-flooding-malawi-mozambique-and-zimbabwe#:~:text=On%2014%20March%2C%20tropical%20Cyclone,in%20at%20least%20two%20decades.