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Study on Unlocking the Potential of the Fourth Industrial Revolution in Africa

Country case: Cameroon



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List of acronyms

4IR	Fourth Industrial Revolution
AfDB	African Development Bank
AER	Rural Electrification Agency
AI	Artificial Intelligence
CCAA	Cameroon Civil Aviation Authority
CEMAC	Central African Economic and Monetary Community
CONAC	National Anti-Corruption Commission
CPI	Corruption Perception Index
DAS	Data Acquisition Systems
DER	Distributed Energy Sources
EDC	Electricity Development Corporation
EMR	Energy Management System
ENEO	Electricity of Cameroon
ENSP	National Advanced School of Engineering
ESS	Energy Storage System
ETRI	Electronics and Telecommunications Research Institute
EV	Electric Vehicles
LNG	Liquefied natural gas
LTE	Long Term Evolution
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GESP	Growth and Employment Strategy Paper
HDI	Human Development Index
ICT	Information and Communication Technologies
IIAG	Ibrahim Index of African Governance
INDC	Intended Nationally Determined Contributions
IoT	Internet of Things
IP	Intellectual Property
IT	Information Technology
JICA	Japan International Cooperation Agency
KPDC	Kribi Power Development Company
MINADER	Ministry of Agriculture and Rural Development

MINDAF	Ministry of State Property and Land Tenure
MINEE	Ministry of Water Resources and Energy
MINEPIA	Ministry for Livestock, Fisheries and Animal Industries
MINFI	Ministry of Finance
MINFOF	Ministry of Forestry and Fauna
MINMIDT	Ministry of Mines, Industry and Technological Development
NIA	National Information Society Agency
OECD	Organisation for Economic Cooperation and Development
PDSEN	Energy Sector Development Project
PDER	Rural Electrification Master Plan
PNEE	National Energy Efficiency Plan
PNIA	National Agricultural Investment Plan
PTU	Emergency Thermal Program
R&D	Research and Development
SDSR	Agricultural Strategy
SME	Small and Medium Sized Enterprise
SONATREL	National Electricity Transmission Corporation
SSA	Sub-Saharan Africa
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics
SUP-TIC	National Advanced School of Post and Telecommunications and Information & Communication Technologies
US	United States
UNECA	United Nations Economic Commission for Africa
WEF	World Economic Forum
WIPO	World Intellectual Property Organization

1 Introduction

This document is one of the five country case studies drafted in the framework of the Study to Unlock the Potential of the Fourth Industrial Revolution (4IR) in Africa. The overall study aims at i) understanding the preconditions for the adoption of 4IR technologies, challenges and drivers, positive and negative effects; ii) describing the technologies for knowledge dissemination, including domains of application; iii) benchmarking emerging countries; iv) demonstrating applications in Africa; v) in order to conclude on a business case and vi) recommend interventions and vii) design specific ICT components for AfDB projects which will showcase the feasibility of supporting the 4IR in Africa.

This case study thus looks in depth at the potential for the adoption of key 4IR applications with diverse geographic, political, economic, technological and social preconditions:

- It reviews the socioeconomic situation of the country and the implications for technological readiness for the 4IR.
- It assesses the potential for the 4IR to be used in the key economic sectors of the country, i.e. the High Five AfDB priority fields, which are agriculture, energy supply, industry manufacturing, regional integration and well-being (including financial inclusion, smart cities, education and healthcare).
- It concludes on the business case for the 4IR in the country.
- It proposes recommendations at the national level.
- It envisions potential AfDB interventions or projects.

Our team collected data by drawing on existing research and public policy documents and by consulting local stakeholders. This was done either on the telephone, online or in person. One field visit per case study country was organised to allow the team to gain a deeper understanding of the local conditions and peculiarities and to be able to identify the most relevant use cases. The field visit occurred on a five day trip and included face to face meetings with key stakeholders from government, the private sector, researchers and NGOs (about 25 meetings).

The structure of the document is based on eight chapters. It has been enriched and finalised thanks to a workshop with stakeholders that was held in early June 2019.

2 Country presentation

2.1 Economic, socio-demographic and industrial profile

Cameroon is a **lower-middle-income country and one whose population came to roughly 24.5 million** in 2017¹. The population is growing by 2.6% per year, a rate which has remained relatively stable in the past decade² and is comparable to the average growth rate in Sub-Saharan Africa (SSA)³. Both French and English act as official languages for the country, although French is by far the most understood language (understood by 80%), with Pidgin English being predominantly spoken in the western border regions. The country's capital is Yaoundé, whereas the largest city and economic capital is the port city of Douala, with an urban population accounting for 73.6% of the country's population⁴. Cameroon is very urbanised, with over half of its population living in urban areas. This is comparatively higher than the overall urbanisation rate of SSA (40%)⁵. Cameroon's population is distinctly young, with a median age of 18.6 years. The youth unemployment rate (15-24) in 2018 stood at 4%, and Cameroon is one of the five African countries which had an employment rate above 2% in 2018, but there is still invisible underemployment in urban cities⁶. On average, Cameroonians spend 13 years in education (primary to tertiary), with a literacy rate of 75% in 2015.

Cameroon has a Gross Domestic Product (GDP, PPP) of \$32.6 billion⁷, which makes it the **14th largest economy in Africa and the largest in the six member states of the Central African Economic and Monetary Community (CEMAC)**⁸. The tertiary sector contributes almost half of the GDP, with retail and hospitality activities representing 20% of the GDP⁹. Oil is Cameroon's largest export earner (45% of exports in 2016) and the country is SSA's sixth largest crude oil producer. The primary sector also makes a big contribution to domestic economic activity: Cacao is the country's largest export commodity by value and Cameroon is the world's fifth largest producer of the commodity. Cameroon's economic situation has suffered a setback with the far-reaching 2014 oil price shock and worsening domestic challenges. Cameroon's economic growth averaged 5.8% during the 2013-2015 period and dropped to 3.5% in 2017 owing especially to a huge drop in oil production but is expected to rise to 3.8% in 2018, 4.4% in 2019 and 4.7% in 2020¹⁰. Despite sustained economic growth, poverty rates have scarcely fallen between 2001 and 2014 (from 40.2% to 37.5%), with pronounced and increasing regional disparities: the rural northern regions have poverty levels of 72% (55.8% of the country's poor) whereas, in urban areas, poverty stands at only 4.8% (3.2% of the poor).

Figure 1 below represents the indicators for Cameroon for 2016, based on the Africa development dynamics on growth, jobs and inequalities database of the Organisation for Economic Cooperation and Development (OECD). Based on this report, even though it shows that central Africa has seen a strong growth dynamic at an average of 5.6%, the prosperity of sustainable growth reducing poverty and inequalities still remain weak. Countries (Cameroon included) share a dependence on oil and minerals, with a dominating informal economy. However, some indicators still seem troubling for Cameroon as it shows that inequalities have risen between 2001 and 2014. Poverty has increased, fluctuating between a staggering 23.1% , in 2001 to a 24% in 2014 (when using the USD threshold of \$1.90) even though the poverty rate has reduced based on national thresholds.

¹ AfDB

² <https://www.statista.com/statistics/446520/population-growth-in-cameroon/>

³ World Development Indicators Database, World Bank, 3 April 2019

⁴ AfDB

⁵ <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=IN-ZG>

⁶ African Economic Outlook, 2018.

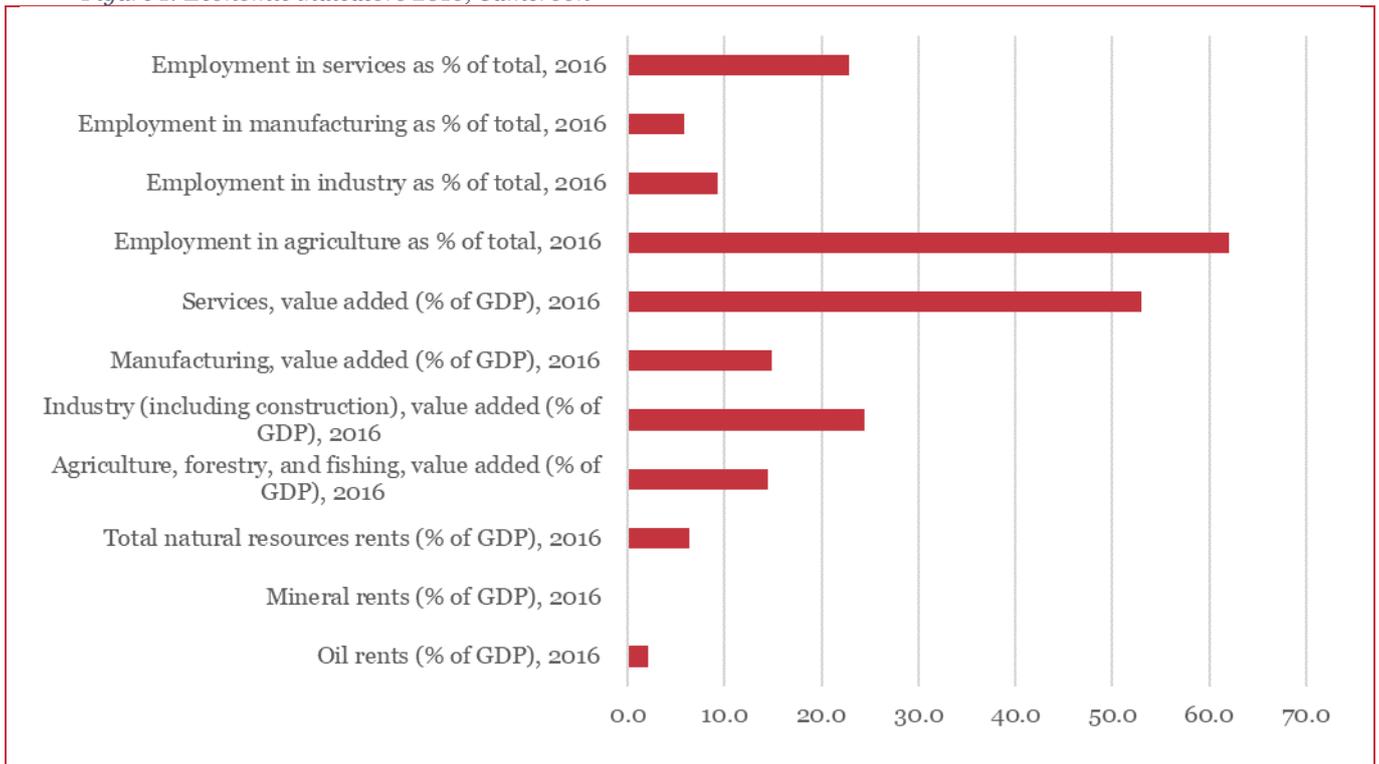
⁷ AfDB

⁸ World Development Indicators Database, World Bank, 3 April 2019

⁹ KPMG, Cameroon Economic Snapshot H2, 2017

¹⁰ AfDB 2015-2020 Country Strategy Paper

Figure 1: Economic indicators 2016, Cameroon



Source: OECD Africa's development dynamics statistical database, 2018

2.2 Broad policy objectives

Cameroon's government has launched several policy initiatives that reflect a willingness to lay the groundwork for a take-up of 4IR technologies for economic development. The goal of Cameroon's government is to transform the country into an emerging economy by 2035, a goal which has been anchored in the government's long-term planning document, **Vision 2035**, since 2009. The country plans to achieve this objective through strategic means, including through renewed support for the private sector, by fostering national integration, promoting responsible governance and partnering for development assistance. Vision 2035 contains numerous sectoral strategies, of which the most relevant are:

An Industrialisation Strategy, which aims to promote the manufacturing sector, ensure infrastructure development and social development. In terms of manufacturing, the strategy prioritises agricultural productivity; strengthening the extractive industries; promoting SMEs and upgrading enterprises (including technological and managerial assistance and promoting clusters); promoting sectors with high growth potential (timber, tourism and ICT); improving the business environment, and the development of research, innovation and technical standardisation. Cameroon's infrastructure needs are also highlighted, for which substantial and sustainable investments are needed. The Industrialisation Strategy prioritises investment in communication and telecommunications infrastructure as well as in energy infrastructure. Another key axis in this strategy is the establishment of industrial zones and the development of technopoles across the country. Lastly, the strategy emphasises social development to develop the country's human capital.

A Regional and International Integration Strategy, which aims to strengthen and rationalise institutions and mechanisms of convergence and integration (political, economic and monetary) in Africa, beginning with Central Africa (ECCAS and CEMAC). Cameroon intends to work together with the other countries of the sub-region to fast track actions towards easing the free movement of persons, goods and services and improving the infrastructure network linking the countries together.

A Strategic Role of the State and Partnerships Strategy, which aims to improve strategic planning, economic regulation and proportioned and targeted interventionism. The government also aims to improve its public and private partnerships through consultation and dialogue; the promotion of SMEs and through its participation in strategic sectors.

A Good Governance Strategy, which stresses the importance of fighting corruption, improving the judicial system and decentralisation through capacity building for local governments.

A Growth and Employment Strategy Paper (GESP)¹¹ which represents the operational strategy of Vision 2035 over the period from 2010 until 2020. It states the objective of GDP growth rates of 5.5% and the creation of tens of thousands of formal jobs each year.

2.3 Policies specific to 4IR technologies

There is **no specific strategy in Cameroon dedicated to 4IR** but there are several government initiatives in relation to ICT policies (especially e-government), public (technopoles) and a number of private initiatives in the field of ICT and the 4IR. Within the IT sector, strategic documents include the **Digital Cameroon-2020** adopted in 2016, which identifies the development of broadband communication infrastructure, ICT development, and the integration of ICT in existing sectors as main priorities¹²; the **E-government Master plan of Cameroon** showing the road map to develop the legal framework, organisation framework, e-government services, infrastructure and capacity building for public officials on e-government. These build on the vision of the **Telecommunications & ICT Strategy** established in 2005-2015.

Cameroon's president has continually stressed the development and integration of ICTs in the nation's activities as an important catalyst for growth and the need to "rapidly bridge the digital economy development gap as it is a genuine growth driver as well as a niche for new jobs for our youth"¹³. Two strategies have recently been adopted since 2016 (added to the many other sectorial strategies) related to the digital economy and to the establishment of an e-government master plan. The IT industry is rapidly evolving in Cameroon but infrastructure is still a major problem. According to the AfDB, there are about six internet users per 100 people in Cameroon but the internet penetration rate was 35.64% in 2017¹⁴, but this is increasing constantly as a result of the increase in mobile phone users (the mobile penetration rate was 83%¹⁵ in 2016). However, it is important to reduce the cost of internet access. Having a good connection costs an average of 30,000 FCFA-40,000 FCFA, where the minimum wage in Cameroon is 36,000 FCFA. ITU ICT development index statistics put Cameroon in 149th position in 2017 and the country is also ranked 18th in Africa. Figure 2 below shows the position of Cameroon in the ITUs ICT development index.

¹¹ DSCE in French (Document de Stratégie pour la Croissance et l'Emploi)

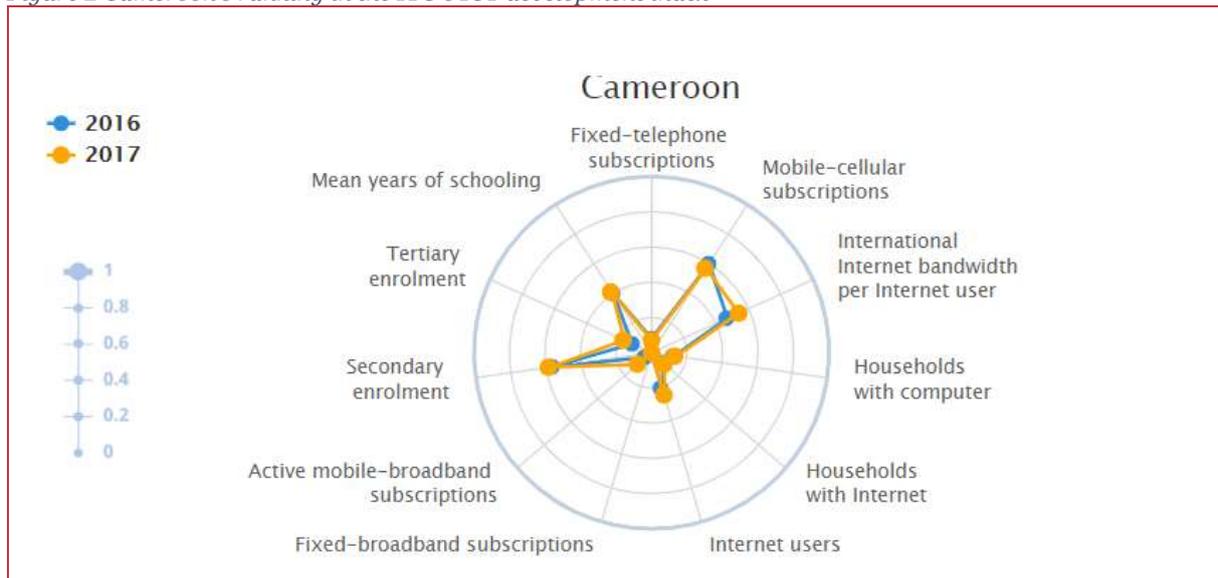
¹² MINSPOTEL 2016, "Strategic Plan for a Digital Cameroon by 2020".

¹³ Excerpt from the Head of State's new year address to the nation on the occasion of the end-of-year 2016.

¹⁴ ART, 2017

¹⁵ <https://www.businessincameroon.com/telecom/1708-8263-cameroon-mobile-penetration-surged-from-12-in-2005-to-83-in-2016>

Figure 2 Cameroon's ranking in the ITU's ICT development index



Source: ITU.

Within the public sector in Cameroon, e-government services seem to be the government's priority. Cameroon's vision is to develop "a trusted and open government for a hyper-connected society with good governance"¹⁶. Most ministerial departments and agencies have recognised the need to integrate ICTs in their business functions (with the development of multiple applications, systems, mini-data centres, organising training sessions, etc). However, not many of them have quite integrated advanced 4IR technologies. Strategic applications used by the government such as SIGIPES (for the management of the career advancement of civil servants), ANTILOPE for the management of the state payroll, an e-procurement system at the Ministry of Public Contracts, the e-taxation system in the Directorate of Taxation, e-customs in the Directorate of Customs, etc. are strong cases for the integration of technologies such as AI and Big Data analytics, given the data which is available for their exploitation, but this is not the case yet. As a result of the political will from the presidency, almost all (Ministerial Departments and Agencies) MDAs are digitalising their services in one way or another and interoperability between MDAs has also been increasing since 2017. The fact that there is an increased understanding about the need to digitalise and to improve on service delivery shows the increased awareness on the side of the government even though it happens to a very limited extent. In addition, young people are not closely involved in such actions.

Some ministries, such as MINFI, have understood the importance of ICTs and have even already established their own IT Master Plan, building in the integration of AI and Big Data into the development of some of their applications that have already been developed (or are to be developed). This is the case for applications hosted at the Treasury such as SYSTAG and SIGMA for the management and transactions of huge sums of money internally and with the Central Bank-BEAC. Most importantly, Cameroon's government also has **data centres**, which are owned by state corporations such as **CAMPOST**¹⁷, established in 2015, and **CAMTEL**¹⁸, which are in the process of constructing their own data centres to be completed by 2020. If well developed, such data centres can, as a result of their high capacity to store information and their high level of security, also play host to Big Data analytics and serve to expand possibilities for cloud computing for many ministerial departments (who have their own mini-servers) to host their applications and systems which do not conform to acceptable standards

¹⁶ Cameroon's E-government Master Plan

¹⁷ <https://www.minpostel.gov.cm/index.php/fr/les-grands-chantiers/148-presentation-du-projet-e-post>

¹⁸ <http://www.camtel.cm/en/2018/10/29/les-data-center-moteurs-de-la-transformation-digitale-au-cameroun/>

(security, etc). Other major world class data centres are owned by telecoms companies such as MTN Cameroon¹⁹ and Orange Cameroun²⁰, of which the development of this infrastructure has allowed them to launch cloud services in Cameroon²¹.

In the 2020 Digital Economy Strategy of Cameroon, which seems to be the strategy tilted towards such issues, most of these technologies are not explicitly mentioned except for the ambitions to construct data centres to promote cloud technology and Big Data. Cameroon understands the need to support ICT development amongst youths and the development of start-ups where many youths have been venturing in recent years. The government is keen to support the development of local content and applications through the development ecosystem in general²². There is also political will to promote and support the development of incubators and technopoles. The government has already **created some technopoles**: the **Sup Valor Technopole** at the National Advanced School of Engineering (ENSP) set up by the Ministry of Higher Education; an incubator at the National Advanced School of Post and Telecommunications and Information & Communication Technologies (SUP-TIC) both by MINPOSTEL and MINESUP; and another technopole in the industrial city of Edea set up by the Ministry of Mines, Industry and Technological Development (MINMIDT). There are some other private incubators in Cameroon, with the most functional (in terms of effectiveness and dynamism) being based in Douala and Buea (with multiple functional technological communities related to the 4IR already created within it). Similarly, another technological ecosystem of innovators, developers, designers, business professionals, technology communities, blogs, etc. is building up in the academic city of Buea called **Silicon Mountain**. It hosts numerous start-ups and incubators and has been built by the town's youths and students. According to 'The Observers' online news site, **Silicon Mountain is Africa's next tech hub**²³. Unfortunately, activities here have been hugely slowed down by the political crisis in the Anglophone regions plus the multiple government shutdowns of internet access in this area²⁴.

Blockchains are picking up steam in Cameroon and, following a conference held on the impact of Blockchain technology on the emergence of Cameroon in 2018, numerous stakeholders from the public and private sector were interested in how Blockchains can improve their business functions. Most companies using this technology in Cameroon are involved in the financial sector and are mostly operating sales of cryptocurrencies. According to a report produced by the United Nations Economic Commission for Africa (UNECA) in 2017, there are very few cases of the use of or adoption of Blockchain technology in Africa and solutions are developed with the constraints of poor understanding and knowledge of the technology²⁵. Unlike countries like Ghana, South Africa (including the country's Reserve Bank are beginning to accept the innovation of digital currencies and Blockchains); Tunisia (as the first country in the world and Africa to issue its national currency via an application that operates on Blockchain); Uganda (where regulations have started to be established on bitcoins) and also Senegal (where there are plans to introduce a digital currency the e-CFA based on Blockchain technology)²⁶; **Cameroonian banks have not started using this technology and banking stakeholders confirm that they have little knowledge of this technology to integrate it within the banks' activities**²⁷. Just like Blockchains, other 4IR initiatives are mostly undertaken by start-ups, which operate under the mentoring of incubators or independently. Generally, the majority of tech start-ups in Cameroon are involved in the development of applications and websites, to solve/facilitate the

¹⁹ <https://www.slideshare.net/ngiambus/mtn-cameroon-hosting-datacenter-67576511>

²⁰ <https://cameroon-report.com/economie/telecommunications/data-center-inauguration-orange-cameroun/>

²¹ <https://www.investiraucameroun.com/tic/2804-8838-mtn-cameroon-elargit-sa-gamme-de-produits-et-services-avec-office-365-de-microsoft>

²² Digital Economy strategy of Cameroon 2020

²³ <https://observers.france24.com/en/20160909-welcome-silicon-mountain-africa-next-tech-hub>

²⁴ <https://www.aljazeera.com/news/2018/01/cameroon-internet-shutdowns-cost-anglophones-millions-180123202824701.html>

²⁵ UNECA, Blockchain Technology in Africa, November 2017

²⁶ Idem

²⁷ Interviews with local actors

activities of companies or to provide solutions to local problems. Hitherto, there are a couple of start-ups using applications with AI, Big Data, VR [Virtual Reality], smart homes and 3D printing.

High technology in Cameroon is also strongly supported by the Israeli government, which has financed the establishment of a **High Tech Center in the National Advanced School of Engineering (ENSP)** by putting in place an industrial 3D printing machine²⁸ which happens to be one of the biggest in west and central Africa, the objective of which is to introduce students and give them hands-on exposure to the applications of such technologies²⁹.

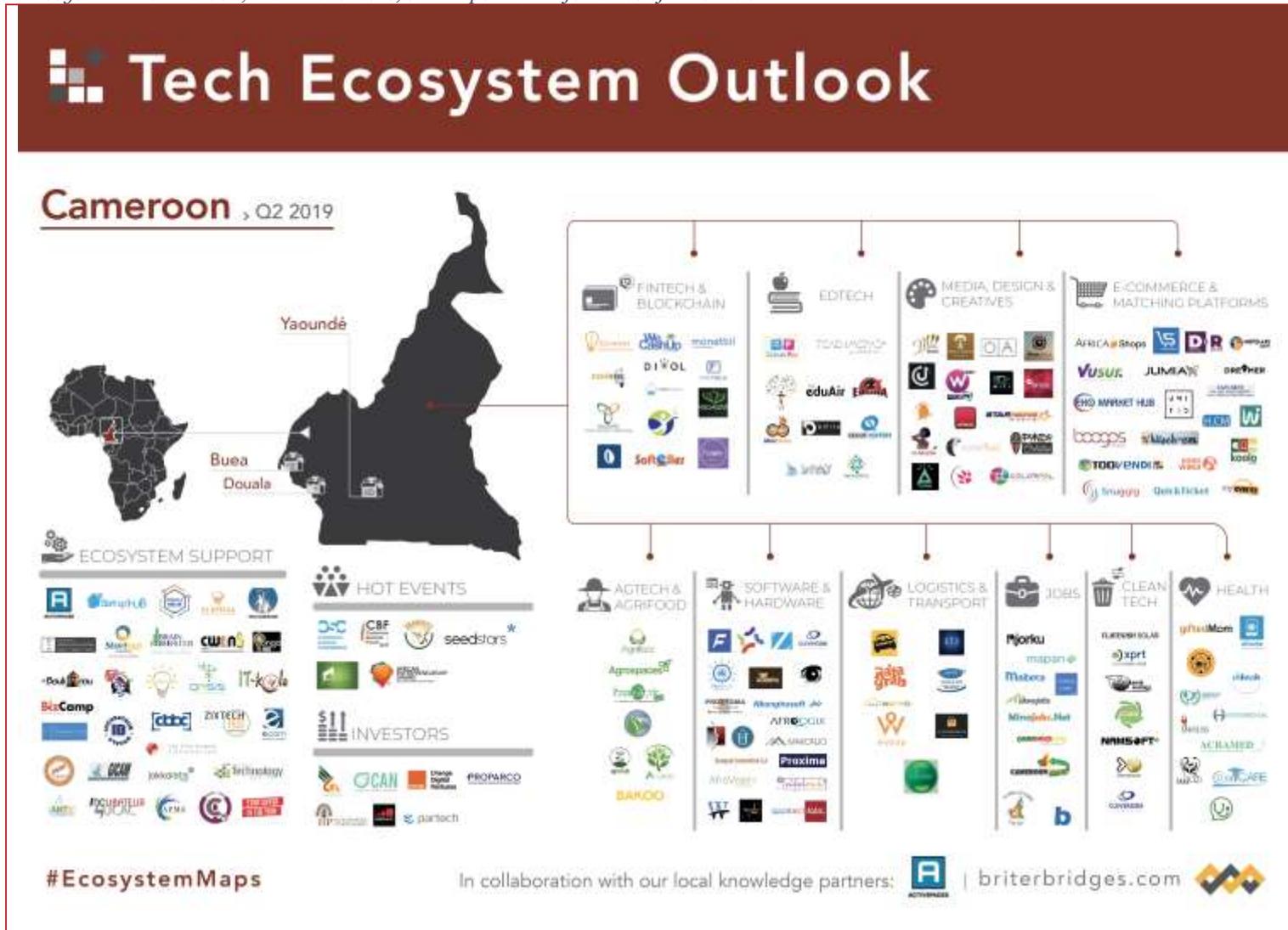
Similarly, renewable energy development is achieving strong growth in Cameroon, as Section 3 shows. Financial technologies (**FinTech**) is also booming in Cameroon just as it is in many other African countries and even though there is no specific policy orienting the development of FinTechs, financial technologies (particularly mobile money transactions) have done a lot to break down traditional barriers for people in remote areas³⁰, and such transactions are mostly operated by telco companies, with MTN Cameroon and Orange Cameroon accounting for the bulk of the market share. Activities relating to mobile transfers in 2017 alone reached 3,500 billion FCFA and have caught the interest of multiple banks in Cameroon to offer such services too (Afriland First Bank, UBC, Ecobank, etc), but microfinance institutions are not yet allowed to do so. Figure 3 below shows the technology ecosystem in Cameroon with the principal actors involved in 4IR technologies and others.

²⁸ <https://cetic.cm/fr/1st-3d-printing-center-in-africa-national-advanced-school-of-engineering-of-yaounde/>

²⁹ Interview with local actors

³⁰ <https://www.businessincameroon.com/finance/3108-8300-cameroon-mobile-money-transactions-surged-to-cfa3-500bn-in-2017>

Figure 3 Tech ecosystem in Cameroon, with incubators, start-ups and major cities of innovation.



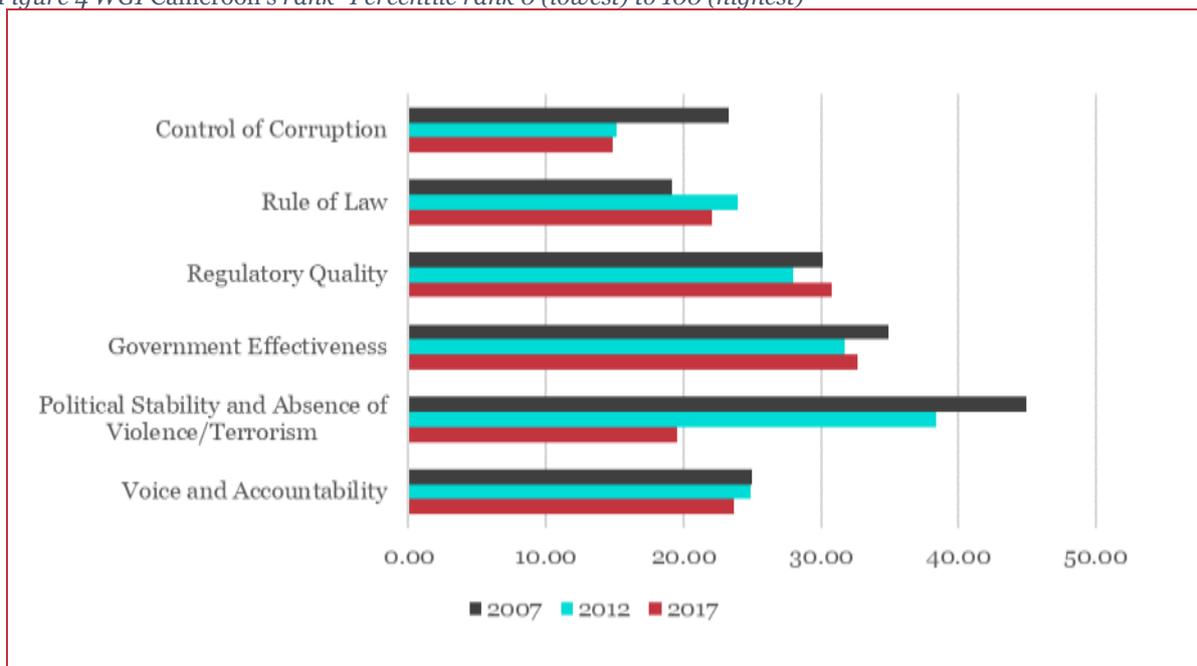
Source: Active Spaces and Briter Bridges

2.4 Level of readiness of the country for the 4IR

Although Cameroon is endowed with abundant natural resources, steady economic growth and is in a key location in central Africa, the investment climate is plagued by corruption and a slow bureaucracy. According to the World Bank, in terms of **government effectiveness** (quality of public services, degree of independence from political pressure), a necessary precondition to create a regulatory environment in which innovation can thrive, Cameroon ranks 22/100 in 2017, lower than the overall ranking for Sub-Saharan Africa (33)³¹. Cameroon also performs comparatively worse than the SSA average in indicators on regulatory quality (20 vs 28) and the rule of law (14 vs 30). In the World Bank’s Ease of Doing Business Index measuring regulatory performance, Cameroon ranks 166th out of 190 economies with a score of 48/100, slightly below the overall score of SSA (52)³².

In another, Africa-specific index – the Ibrahim Index of African Governance (IIAG) – Cameroon ranks 36th out of 54 African countries, with the country performing moderately well to average on economic and human development criteria, but negatively on human rights and security indicators. Indeed, outbreaks of violence in the far north regions, coupled with a secessionist movement in the English-speaking regions have taken a toll on the economy and governance of the country. Cameroon suffers from weak governance, hindering its development and ability to attract foreign direct investment (FDI). It ranks 152nd out of 180 countries in the 2018 Transparency International corruption perceptions index³³ with a score of 25/100, comparable to Nigeria’s score (27). Figure 4 below shows Cameroon’s ranking as regards the World Bank’s Worldwide Governance Indicators.

Figure 4 WGI Cameroon’s rank- Percentile rank 0 (lowest) to 100 (highest)



Source: World Bank’s Worldwide Governance Indicators (WGI) Database

Considering Cameroon’s overall readiness for 4IR technologies, the **World Economic Forum’s (WEF) 2018 Global Competitiveness Index (GCI)** provides a useful indication, as it explicitly

³¹ <http://info.worldbank.org/governance/wgi/#reports>

³² <http://www.doingbusiness.org/en/data/exploreconomies/cameroon>

³³ https://www.transparency.org/news/pressrelease/corruption_perceptions_index_2017_shows_high_corruption_burden_in_more_than

considers 4IR readiness in its methodology³⁴. Overall, Cameroon ranks 117th out of 140 countries in terms of its readiness.

Following WIPO's Global Innovation 2018 index report, which measures the state of innovation in 126 countries around the world, the table below shows the indicators for Cameroon, which is in 111th position. Even though Cameroon has improved since 2017, its innovation level is still quite low and much still needs to be done.

Cameroon has a low ranking for many of the indicators in this report and it shows that there is a huge amount of structure and systemic change needed to prepare Cameroon for the future of jobs and production. Even though there are certain meagre actions/activities which are ongoing, the government needs to do a lot to enhance and strengthen this. Some of these critical areas include improving on the education system (with the low rate of STEM graduates standing at 21.3) and knowledge creation (with a low score for online creativity standing at 0.5 as well as creative goods and services at 13.5), improving on research and development (which has a score of 0.0).

Another weak driver not explicitly mentioned in this WIPO report which requires improvement is the low rate of technology and innovation. According to the 2018 Readiness for the Future of Production Report of the World Economic Forum - a report which analyses the readiness of countries for future production opportunities - out of 100 countries included, Cameroon ranks 89 for her structures of production (baseline of production) and on the drivers of production (key enablers for the country to capitalise on the 4IR production systems). Notably, Cameroon needs to improve on the technology platforms and the ability to innovate (such as values averaging three points on a scale of 0-10 for the state of cluster development, company investment in emerging technology, companies embracing disruptive ideas, multi-stakeholder collaboration, R&D expenditures, scientific and technical publications and, worse still, patent applications). These elements are corroborated with the low number of technology hubs, with an average of five technology hubs in Cameroon³⁵.

According to the index, **Cameroon's overall infrastructure is poor**, receiving a score of 42.1 (125th/140), compared to an overall score of 46.3 for SSA. The country's electrification rate stands at 63.3% (112th) whilst it ranks 120th for the quality of its roads and 109th for road connectivity. The country fares better for its liner shipping connectivity, where it is ranked in 73rd place. Only one quarter of Cameroon's population has access to the internet (111th position), whilst, out of 100 people, 81.9 had mobile telephone subscriptions (118th), 10.5 had mobile broadband subscriptions (135th) and 0.2 had fixed broadband subscriptions (128th). Furthermore, only 7% of secondary schools in Cameroon have access to the internet³⁶. These figures show that Cameroon is lagging behind in terms of its physical transport and ICT infrastructure necessary for the deployment of 4IR technologies.

Despite the shortcomings of Cameroon's infrastructure, its population shows **above average skills compared to other countries in Sub-Saharan Africa**. The skillset of graduates in Cameroon receives a score of 3.9 by the GCI (scale of 1-7, 7 being the best). This score places Cameroon as the 77th best performing country, ahead of South Africa (85th), Botswana (119th) and Nigeria (135th), but behind Kenya (56th). The country also performs moderately well in terms of the digital skills of its population, ranked 92nd, ahead of Botswana (100th), South Africa (116th) and Nigeria (121st) but again behind Kenya (43rd).

Only 35% of Cameroonians have a bank account, which, while higher than in Morocco (29%), is lower than in Nigeria (40%) and considerably lower than in South Africa (69%) and in Kenya (82%)³⁷. Mobile transactions are also not well developed, with only 16% of the population having a mobile banking

³⁴ <http://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobalCompetitivenessReport2018.pdf>

³⁵ Frontier Economics' Report on Africa Technology Business Network, November 2018

³⁶ UNESCO, 2015. "Information and Communication Technology (ICT) in Education in Sub-Saharan Africa," Information Paper no. 25. <http://uis.unesco.org/sites/default/files/documents/information-and-communication-technology-ict-in-education-in-sub-saharan-africa-2015-en.pdf>

³⁷ World Bank FINDEX data

account. However, this remains comparable to other SSA countries (23% for South Africa, 25% for Botswana), and higher than in Morocco (1%) and Nigeria (8%). Domestic credit to the private sector by banks is notably low, representing only 15% of GDP and ranking Cameroon in 131st place out of 140 countries on the WEF-GCI.

Aside from quality of regulation and governance, the innovation capabilities of a country are an important indicator of its readiness to apply 4IR technologies. The 2018 WIPO Innovation Index ranks Cameroon 111th out of 126 countries which, while low, is comparatively better than the ranking achieved by Nigeria (118th) and Côte d'Ivoire (123rd)³⁸. The country ranks 24th out of 30 when considering only lower-middle-income countries and 12th out of 24 in SSA. Cameroon performs markedly better in terms of its innovation output (98th) than its innovation input (115th). This means that the country is performing better in terms of its knowledge, technology and creative outputs than in terms of its institutions, infrastructure, human capital and research, and market and business sophistication. Put another way, whilst there is potential in Cameroon's innovation landscape, much more needs to be done to prepare the underlying groundwork to promote its output.

Numerous reforms have been made by the government to improve the business environment and promote entrepreneurship and job insertion . Statistics from the Global Entrepreneurship Monitor report in 2014 show that the rate of entrepreneurial activity in Cameroon stands at 37%, and 56.6% of Cameroonians have entrepreneurship intentions³⁹, higher than many African countries and other middle-income countries. The country also comes third on entrepreneurship perceived opportunities (69.34%), behind Uganda and Angola, but has the highest entrepreneurship competences in Africa (74%) and based on the 2014 GEM report, 26.35% of Cameroonians are born entrepreneurs, a score which also puts Cameroon highest in Africa. While there are many reasons that account for the high results in entrepreneurial tendencies in Cameroon, many of the businesses created are either in the informal sector, start-ups or SMEs and still need numerous measures of accompaniment in order to stabilise and grow. Nevertheless, an entrepreneurial spirit seems to exist already. However, there are still a lot of things to be done to improve the business environment in Cameroon, some of which might strongly and positively impact on entrepreneurship and productivity in the country. However, a lot still needs to be done as Cameroon ranks quite far down, in 166th position in the Doing Business 2019 report, with numerous setbacks associated most particularly with delays in starting a business, complications in dealing with construction permits, access to sustained energy, taxes, protecting minority investors and many others⁴⁰.

Concerning regulations on the 4IR, as mentioned in section 4.4.5 below, Cameroon has less stringent legislation concerning the use of 4IR technologies than in parts of Europe and north America. Amongst all the predominant technologies of 4IR, the only one specifically regulated in Cameroon is drones, with the adoption of Law No 2016/1426 OF 24th October 2016, on the security and use of civil drones. Other related IT laws in Cameroon include Law No 2010/013 of 21st December 2010 regulating electronic communications and modified in Law No 2015/006 of 20th April 2015; Law No 2010/012 of 21st December 2010 relating to cyber security and cyber criminality and Law No 2010/013 of 21st December 2010 on electronic commerce in Cameroon.

³⁸ https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2018.pdf

³⁹ Adult population survey of the Global entrepreneurship monitor (GEM) report 2014.

⁴⁰ Doing Business report, 2017

3 Agriculture

Current level of use of technologies in the agriculture sector⁴¹

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT
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Potential use in the future

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT
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Scale: Red: not very present; Orange: nascent; Green: numerous examples/potential

3.1 Presentation

Agriculture is a key sector within the Cameroonian economy, contributing 22.9% of Cameroon’s GDP and roughly 23% of the country’s total exports (2013 figures)⁴². Moreover, the sector represents the country’s principal employer, employing 62% of the active population, 75% of whom are women⁴³. About nine million people are engaged in agriculture, with over three million women involved⁴⁴. **National agricultural production is increasing in Cameroon**, although it remains stable as a share of national GDP. The agricultural productivity index (which measures the relative level of aggregate volume of agricultural production for each year by comparison with the base period of 2004-2006) of Cameroon has been on constantly increasing and stood at 175, up from 126 in 2006⁴⁵. In addition, national production does not cover the country’s domestic demand, which has resulted in increases in the country’s agricultural imports. The World Bank, the European Union and France are the three main international donors financing the State’s agricultural activities.

There is **considerable agricultural potential in Cameroon**, both in terms of its richness and diversity. Cameroon’s climate and soils are extremely varied, from the high plateaus and savannahs in the north to the forested, humid regions to the west, which allow it to offer a diverse range of agricultural products. In addition, the country hosts a large amount of agricultural land. Across the country, there are 7.2 million hectares of available arable land, of which only 3.7 million hectares (51%) had been cultivated by 2010. The country also houses 240,000 hectares of irrigable land, of which only 33,000 hectares have been irrigated (17% of the potential). Products grown in the country range from subsistence crops (sorghum, cassava, yams) to export crops (coffee, cacao, palm oil, cotton, bananas, pineapples). The country’s main export crops in terms of volumes are bananas, cacao, coffee, cotton and rubber. More recently, certain non-traditional crops have begun to be grown in higher numbers, such as potatoes, onions and beans.

There are **myriad institutional, legal, financial and economic weaknesses** in Cameroon, which negatively affect agricultural production⁴⁶. These weaknesses include inadequate agricultural funding;

⁴¹ Based on use cases identified and interviews conducted

⁴² FAO Programming Framework 2013-2017.

⁴³ <https://www.gafspfund.org/projects/modernizing-agricultural-value-chains-cameroon>

⁴⁴ AfDB

⁴⁵ idem

⁴⁶ FAO Programming Framework 2013-2017.

a lack of reliable statistics; ill-adapted taxation; discrepancies in land-use legislation which make access to land difficult, particularly for women and young people; weaknesses in the legislative and regulatory frameworks; difficulties in the provision and transportation of agricultural produce due to the isolation of production regions; a lack of infrastructure for the conservation, processing and marketing of produce; a lack of information on market opportunities and the weak competitiveness of produce.

Agriculture is overwhelmingly informal. According to the Ministry of State Property and Land Tenure (MINDAF), less than 2% of land in Cameroon is registered or titled. Most land is held and managed informally through local tenure arrangements, often a combination of statutory and customary tenure rules. They form a complex, locally-specific and sometimes malleable set of rules that creates uncertainty, fosters land conflicts and hampers local development.

Cameroon's **Growth and Employment Strategy Paper (GESP)** (operational programming component (2010-2020) within the country's long-term planning strategy – Vision 2035) identifies the agriculture sector as the engine for economic growth and job creation and recognises the need for agricultural diversification, increased productivity and large-scale investment in the sector. The goal is to increase agricultural production to satisfy the needs not only of the Cameroonian population, but also of agribusinesses. The GESP outlines four objectives: ensuring the self-sufficiency and food security of households; improving the living conditions of producers; ensuring a more efficient use and management of natural resources and contributing towards the economic growth of the country, with the following indicators: GDP growth of the agricultural sector: 6.5% per annum; promotion of agricultural employment through relevant professional training and the addition of 50,000 young people to the sector by 2020; development of agricultural exports, with a yearly growth of 6-7%.

These objectives are reinforced by the **Agricultural Strategy (SDSR)**⁴⁷, which covers the 2015-2020 planning period. The SDSR contains the overall objective of ensuring the transition of the agricultural sector towards a green and inclusive economy, allowing the country to become an emerging economy by 2035. Four specific objectives are outlined: modernising operations, developing production chains and improving the marketing of produce; developing and modernising agricultural infrastructure, facilitating access to production inputs, financing and insurance; sustainably managing natural resources; fostering private initiatives, sector financing, as well as the institutional and information system. Cameroon's government has also stated its objective to establish an agriculture funding agency (agriculture bank) but faces several obstacles to achieving this, notably due to a lack of funds.

The **National Agricultural Investment Plan (PNIA) 2014-2020** has also been elaborated, following the African Union's (AU) 2011 initiative to strengthen African countries' capacity for addressing nutrition through⁴⁸ the formulation and implementation of National Agricultural and Food Security Investment Plans. Cameroon's PNIA, which was adopted in 2015, is aimed at developing production chains (plant, animal, fisheries and forestry) and the improvement of food and nutritional security; the modernisation of rural production infrastructure and the improvement of mechanisms to increase access to finance; management and sustainable development of natural resources; strengthening the capacities of development actors within the agricultural sector, amongst others. Over 1,300 billion FCFA has already been mobilised since 2015 out of the over 3,500 billion FCFA required to implement the plan.

Four government ministries are tasked with agricultural sector development: the Ministry of Agriculture and Rural Development (MINADER), the Ministry for Livestock, Fisheries and Animal Industries (MINEPIA), the Ministry of Forestry and Fauna (MINFOF) and the Ministry of Environment, Nature Protection and Sustainable Development. Local and regional authorities liaise with ministries to resolve local issues. Due to Cameroon's decentralised nature, these authorities are called on to play a key role in

⁴⁷ <https://info.undp.org/docs/pdc/Documents/CMR/Strategie%20du%20Secteur%20Rural.pdf>

⁴⁸ <http://www.fao.org/nutrition/policies-programmes/capacity-development/caadp/en/>

the planning and financing of local development, most important of which are agriculture, livestock, fisheries and forestry issues.

Cameroon also hosts several semi-public institutions which contribute to modernising production and other strategic interventions. MINADER has over 35 projects, programmes and institutions affiliated to it which are being operated with different objectives throughout the national territory⁴⁹.

3.2 Rationale for supporting the adoption of 4IR technologies

3.2.1 Potential applications and impacts

Whilst there is a high potential for growth in Cameroon’s agricultural sector, as of yet this potential remains underexploited. Cameroon’s agricultural production is very inefficient, typified by: a low valorisation of the results of agricultural research, particularly of highly-efficient technology; soil degradation and low levels of modern agricultural inputs; a high prevalence of plant and animal disease as well as myriad crop predators; rudimentary or obsolete production equipment and low levels of training among producers; weak water management; small farms and a low level of modernisation. These constraints together translate into low crop yields. Only 51% of the available arable land in Cameroon has so far been cultivated. Whilst this means that there is room to increase the total level of production, any increases in land use should also be concurrent with more sustainable and efficient practices. There has been a steady degradation of the soil quality in western Cameroon. It is important to restore the fertility of these soils through the use of modern technologies. Since 2016, the national development agencies of Germany (GIZ) and Israel (Mashav) have been supporting the development of mango production in Cameroon through training and technology transfer. In particular, Israeli drip irrigation kits have been installed in demonstration plots in Binguela⁵⁰.

There are many programmes and projects to improve on agricultural productivity in Cameroon (throughout the entire agricultural value chain) and a review of some of the investments from 2010-2020 goes beyond 800 billion FCFA funded by diverse donors. However, there appears to not be specific focus on the promotion or integration of new information and telecommunication technologies in agriculture. In 2015, the credits given to the agricultural sector from banks stood at a total of 313.6 billion FCFA, representing a 7.6% rise from 2010⁵¹, implying that people are quite interested in engaging in agricultural activities. Similarly, in 2017, the Ministry of Agriculture stated that its contribution to Cameroon’s economic growth was 76.38%, rising from 68% in 2016, and that more emphasis will be put on improving mechanisation, equipment in strategic sectors (such as cocoa, coffee, cotton, rubber, rice, cassava, etc) and investing in sectors with high value-added potential⁵². However, there is no mention of the promotion of any technologies in improving agricultural productivity on any part of the supply chain. In addition, no strategy has been developed by the government in this respect and the only government administration which has made use of a dedicated project on agriculture in ICTs was CAMTEL, with the CAMAGRO project.

The incipient emergence of 4IR technologies in Cameroon is encouraging as it is these technologies that will improve the efficiency and sustainability of agriculture whilst also fostering an increase in production levels. It is in this context that technologies such as drones, Big Data, AI and smart farming have considerable potential to transform Cameroon’s agriculture. They would also complement and contribute towards the attainment of the objectives of Cameroon’s Agricultural Strategy. Agriculture already employs over 60% of the population and makes a big contribution to Cameroon’s growth and so, by extrapolation, integrating such technologies will not only optimise productivity, increasing the

⁴⁹ Répertoire des projets et programmes du MINADER/ Directory of projects and programmes of MINADER, MINADER 2012

⁵⁰<http://www.israelscienceinfo.com/environnement/cameroon-mou-avec-israel-et-lallemagne-pour-la-production-de-mangues-avec-le-goutte-a-goutte-israelien/>

⁵¹ <https://www.investiraucameroun.com/agriculture/0504-7275-les-financements-au-secteur-agricole-ont-represente-14-9-du-credit-bancaire-au-cameroun-en-2015>

⁵² <https://www.investiraucameroun.com/agriculture/2208-11237-la-contribution-de-l-agriculture-a-la-croissance-economique-du-cameroun-a-ete-de-76-38-en-2017>

value added by agriculture to GDP from less than 20% (and this percentage includes primary sectors such as agriculture, fishing and forestry) but will also increase the income of farmers or agricultural producers, enhance their knowledge patterns and boost creativity.

3.2.2 Current use cases and level of technology take-up

Modern technologies in Cameroonian agriculture are not yet widespread and their use continues to be at a low level. That being said, there are some examples of innovative technologies being developed and employed to improve the efficiency of agricultural production, either through technologies manufactured domestically within Cameroon or through technologies transferred by other countries.

In industrial supply-side terms, technology providers exist in the form of domestic start-ups, which are emerging as potential favourable actors to ensure the take-up of 4IR technology. These start-ups also partner with international firms, particularly to import certain parts of the manufactured technologies. Some domestic start-ups also import technologies from abroad, although the costs involved (both initial and maintenance) are less competitive.

In terms of industrial demand, it is not clear if the internal demand for these technologies has grown significantly. The start-ups supplying technologies domestically have noted that their role is also one of teaching the population about the benefits of using these technologies within their agricultural practices. There is some evidence that these technologies have attracted some domestic media attention and are starting to be taken up by small-scale/large-scale farmers (e.g. Green House Ventures). Whilst 4IR technologies would intuitively be more suited to large-scale farmers since they have a greater amount of land to survey and have more readily-available funds, start-ups are also targeting their technologies towards small-scale farmers. In order to avoid small-scale farmers paying exorbitant costs for the technologies, the start-ups are aiming to offer packages of services for agricultural cooperatives for instance⁵³.

Use cases are presented below:

- **Drones in particular are emerging as an innovative technology** that could help farmers and foster the emergence of more efficient agricultural management systems which support precision agriculture in Cameroon. Drones are extremely important for the modernisation of African agriculture as they bring greater efficiency, precision and reliability at a much lower cost. Drones enable an optimisation of agricultural yields as they significantly reduce costs linked to production. In general, farmers use fertilisers and crop protection products across their entire farm although only certain specific areas really require the treatment. Drones enable farmers to identify the precise areas where intervention is required, therefore reducing the costs linked to agricultural inputs and labour. ‘Spraying drones’ (i.e. drones equipped with fertiliser or pesticides following pre-mapped routes and spraying crops accordingly) perfectly complement this process as they are then able to apply the products with even greater precision.
- In Cameroon, services have emerged providing advice to farmers who use drones, as well as others which import drones from abroad. More significantly, **drones have also begun to be manufactured domestically within Cameroon**. Two associated start-ups launched in Douala in 2015, Will & Brothers⁵⁴ and Drone Africa (in addition to other domestic start-ups⁵⁵) offer drones to Cameroonian farmers, which are made in Cameroon. These Cameroonian-made drones are more cost-efficient than imported drones as customers avoid paying for transport costs, customs fees and for importing additional parts. The manufacturing costs are lower than those of foreign manufacturers, meaning that the drones produced will be priced competitively across the African marketplace. Some of the parts are manufactured in Cameroon, whilst others are supplied from abroad. Will & Brothers is also working on an **Artificial Intelligence (AI)** system called Cyclops,

⁵³ <https://futuramobility.org/william-elong-drone-africa-2/>

⁵⁴ <https://will-brothers.com>

⁵⁵ <https://flyinglabs.org/cameroon/>

which will enable drones to detect people and identify different types of animals, again serving a purpose for Cameroonian farmers.

- Within the project to digitalise the national land registry, the Ministry of State Property and Land Tenure (MINDCAF) is, through its **PAMOCA project**, using **drones** as a pilot for the first phase of land mapping. Elsewhere, the Douala city council has also used locally-manufactured drones for mapping purposes.
- Cameroonian entrepreneurs have also recently launched an **application called AGRI'APP** in Douala, a web and mobile app that uses **Big Data analytics** to enable farmers to connect with potential buyers to facilitate commercial exchanges and even the home delivery of agricultural produce⁵⁶.
- Another application launched by the parastatal CAMTEL is called **CAMAGRO**⁵⁷, which provides market price information on agricultural products as updated by the Ministry of Commerce producers, traders and buyers⁵⁸.
- Another start-up venturing into AI within agriculture is called **AllGreen**, where they are developing intelligent modules to identify diseases in plants, which are capable of analysing and diagnosing crop diseases in real time and with precision as well as notifying the farmers of good practices which can be adopted to remedy such diseases. Their technology is incorporated into drones that are deployed on various plantations and, thanks to its 4K camera, it detects and analyses different diseases and then generates a detailed report as well as appropriate solutions for the farmer⁵⁹.
- In the conservation and distribution of African foods, **Kenza market**⁶⁰ is becoming a reputable start-up for many Cameroonians and people living abroad. Based on a model to transform and package Cameroonian foods, they have developed an e-commerce platform to sell their products worldwide⁶¹.
- The **Agropad** created by a start-up called Global Initiative is an intelligent agricultural irrigation system appliance which permits farmers to irrigate their farms remotely by sending them an SMS to inform them. It allows for intelligent water distribution when it is required and at the right quantity. It also provides real-time weather reports, providing users with information on temperature, solar radiation, wind speed and precipitation, thus allowing them to adapt their irrigation to the weather conditions⁶².
- Another project being developed by some youth Cameroonians is the **Projet Agria**⁶³, which analyses climatic and meteorological conditions, with a real-time alert system installed, and providing notifications to phones. Weekly forecasts are provided and the objective is to enable municipalities or villages to have weather information and agricultural predictions with AI, meteorological forecasts, rainfall measurements, air & soil temperature and humidity, wind speed

⁵⁶ <https://cameroonceo.com/2018/12/20/agriapp-lapplication-africaine-qui-connecte-les-consommateurs-aux-agriculteurs-est-la/>

⁵⁷ <http://www.camagro.cm/>

⁵⁸ <https://www.digitalbusiness.africa/camagro-la-plateforme-web-camerounaise-de-lagro-business-va-desormais-comparer-les-prix/>

⁵⁹ <http://allgreen-ai.com/>

⁶⁰ <https://www.kenzamarket.com/blogs/news>

⁶¹ <https://www.voafrique.com/a/succes-des-start-up-camerounaises-dans-l-agro-alimentaire-et-la-transformation-des-produits-locaux/4005417.html>

⁶² <https://www.investiraucameroun.com/index.php/tic/1305-12632-le-camerounais-erik-dzembouong-tiam-va-presenter-son-agropad-systeme-intelligent-d-irrigation-agricole-a-viva-tech-en-france>

⁶³ <https://237actu.com/pid/8860>

and direction, an education platform, etc⁶⁴. The project is being developed by **Kirinno labs**, with plans to install it in all 360 municipalities in Cameroon.

- Agrix tech, another Cameroonian start-up, is using AI to help farmers tackle crop diseases and pests through its technology, which helps to detect diseases and offers both chemical and physical treatment as well as prevention measures. Farmers can install the app on their phones and scan a sample of the affected plant to discover the solution and the app provides both text and voice recognition technology in customised African languages such as pidgin, wolof, fan, French and English, etc. This application has two forms: a mobile application for organisations which do not have AI teams and also an AI library to help developers add crop disease detection and diagnosis features into their apps⁶⁵.
- Jangoloa is an e-commerce platform for the sale of agri-food products, from farm products to provision of agro-pastoral services. It offers the possibility to order products from local farmers/breeders and also provides a management solution for a network of over 9,000 farmers⁶⁶. This is the same for e farms, which is a web and mobile platform for buying and selling agricultural products. It allows access to agricultural products in Cameroon⁶⁷.

According to the CTA Digitalisation report on African Agriculture, Cameroon's readiness for digitalisation is assessed to be at a low EBA⁶⁸ score and is high on the Mobile connectivity index. This shows that government policies have not been able to enhance innovation effectively and this hinders inclusive agricultural digitalisation expansion, hence limiting investment too.

There is some evidence that there has been a **steady increase in domestic interest in 4IR technologies for agricultural purposes**. Drones in particular have begun to receive a more widespread level of attention due in part to the rise of Cameroonian start-ups providing drones to the population, which are either manufactured domestically or imported, in addition to advisory and maintenance services once these drones are bought. These start-ups, such as Drone Africa, have also undertaken an awareness-raising campaign to disseminate the benefits of drones for precision agriculture. The Cameroonian technology experts behind these efforts have noted an increased level of interest among Cameroonian farmers: where once they were reaching out to farmers, they are now receiving unsolicited requests at the domestic level, showing an increased level of awareness⁶⁹. Elsewhere, mobile applications using Big Data analytics, such as AGRI'APP⁷⁰ and Agro-Hub⁷¹, have recently been created to facilitate exchanges between agricultural producers and buyers.

Aside from drones and emerging mobile applications, it has not been possible to identify other 4IR technologies which are receiving a similar level of commercial awareness in Cameroon in the agricultural sector. This suggests that drones remain by far the preferred innovative technological solution in the sector and the technology with the highest degree of potential.

⁶⁴ <https://www.kirinnolabs.com/agriasspecificationsfr>

⁶⁵ <https://qz.com/africa/1680695/cameroon-agric-startup-helps-african-farmers-using-ai/>

⁶⁶ <https://blog.jangolo.cm/a-propos/>

⁶⁷ <https://www.efarm.cm/aboutUs/What-Is-Efarm>

⁶⁸ World bank measurement for Enabling the Business of Agriculture (EBA) which measures laws and regulations that impact the business environment for a sustainable and thriving agricultural sector

⁶⁹ <https://futuramobility.org/william-elong-drone-africa-2/>

⁷⁰ <https://cameroonceo.com/2018/12/20/agriapp-application-africaine-qui-connecte-les-consommateurs-aux-agriculteurs-est-la/>

⁷¹ <http://www.agro-hub.com>

3.3 Drivers and challenges specific to agriculture

- **Knowledge and skills.** Cameroon's population demonstrates above average skills compared to other countries in Sub-Saharan Africa. According to the WEF's GCI index, Cameroon performs better than Botswana, Nigeria and South Africa in terms of the skill set of its graduates and the digital skills of its population. In addition, 21% of Cameroonian graduates study science and engineering, with the country ranked 50th/126 countries in the WIPO index⁷². This shows that, on the supply side, Cameroon boasts a good pool of talent in terms of knowledge and skills which can facilitate the development and adoption of 4IR technologies. However, without a dedicated national level technology ecosystem in place, supporting local talent is difficult. Indeed, many young Cameroonians engaged in the new 4IR technology sector therefore find it more enticing to relocate and work within the same sector but in Europe or North America.

Recently, the government has been increasing the number of agriculture schools in most state universities (University of Dschang, University of Buea, Insitut Supérieur du Sahel) with innovative learning programmes along the entire agriculture value chain. Elsewhere, a number of donors (the World Bank, the AfDB, the AFD, the JICA, etc) are supporting vocational training to help young people go into agricultural professions.

- **Innovation ecosystems.** Cameroon's innovation ecosystems are not yet well established. Whilst this lack of a dedicated ecosystem for agriculture means that there is a concomitant lack of encouragement for new innovations, in practice, new technological solutions are emerging in Cameroon despite this obstacle.
- **Finance.** A lack of access to funding remains a common problem experienced by actors involved within Cameroon's innovation ecosystem. Loans tend to be predominantly attributed to larger private companies rather than to SMEs and, where loans are available to SMEs, these tend to take the form of short-term lending or non-performing loans⁷³. Furthermore, the cost of starting a business in Cameroon is also relatively high, acting as an obstacle to innovation development.
- **Systems governance.** The governance of the agricultural sector and innovative technologies in Cameroon is disjointed and uneven. At least four government ministries have direct visibility over agricultural policies, which they implement at the ground level. This situation is further complicated by the fact that agriculture in Cameroon is overwhelmingly informal, with less than 2% of land in Cameroon being registered or titled. MINADER supervises many value chain development programmes funded by numerous donors and the government, but there are still shortcomings in terms of the effectiveness of and results from these programmes.
- **Institutions.** The quality of institutions in Cameroon is severely hampered by the fact that domestic administration plays host to endemic corruption, for which the country is ranked 129th/140 on the WEF's GCI index and 152nd/180 countries, according to Transparency International. The negative effect of corruption on the development of all sectors, including agriculture, is very well known and documented. This has had a direct impact on Cameroonian agriculture in the past, with examples of agriculture ministry officials misappropriating funds⁷⁴. Whilst Cameroon has launched many anti-corruption drives, such as the National Anti-Corruption Commission (CONAC), corruption remains very much present across the country.
- **Regulations.** Cameroon has less stringent legislation concerning the use of 4IR technologies than in parts of Europe and North America. This provides a more conducive environment in which to test new ideas and concepts, such as innovative drones. Whilst permits are required through the Cameroon Civil Aviation Authority (CCAA), which also specifies general rules, in practice these regulations are not overly demanding. Cameroon's Agricultural Strategy also specifies its desire to

⁷² https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2018.pdf

⁷³ <https://www.imf.org/external/np/seminars/eng/2015/brazzaville/pdf/AfrilandENG.pdf>

⁷⁴ <http://www.cameroonvoice.com/news/article-news-2098.html>

encourage the increased possession and use of innovative and modern ICT technologies to help farmers make their agricultural production more sustainable.

4 Energy

Current level of utilisation of technologies

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT	FinTech
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Potential use in the future in the agriculture sector

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT	FinTech
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Scale: Red: not very present; Orange: nascent; Green: numerous examples/potential

4.1 Presentation

Cameroon is a country with one of the most diversified energy mixes and with one of the highest energy potentials within Africa, of which a significant amount remains untapped. Access to electricity remains an issue, with about 71.48% of the population having access to electricity in 2017⁷⁵, with marked inequality between urban and rural areas (91.9% in urban areas and 21.3% for the rural population)⁷⁶.

Cameroon's energy mix consists of vast deposits of fossil fuels such as oil (with a production capacity of 1,00,000 barrels/day in 2015) and natural gas (exportation began in 2018 with an LNG production capacity of 1.2 million tonnes per year⁷⁷). The renewable energy potential also varies, ranging from solar energy (5kwh/day/m²); wind energy (wind speed in the northern and littoral areas of about 5-7m/s);, biomass (over 200,00 hectares/year), mostly for cooking; geothermal energy, and most importantly hydropower energy (with the second highest potential in Africa, estimated at 20GW).

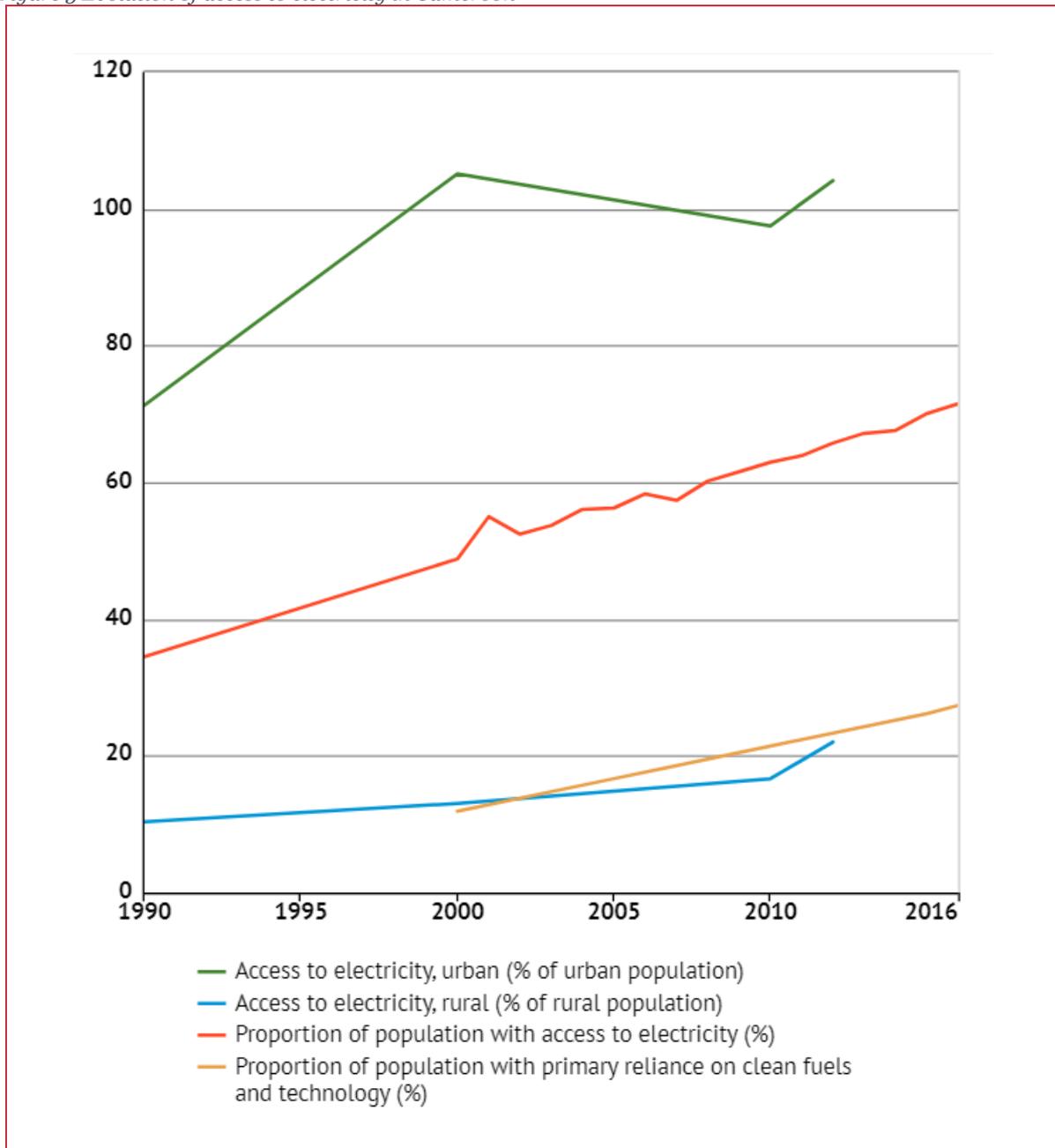
National production is still very low. Macro-level production is powered by electricity power plants which are of two types: hydroelectric power stations and thermal power stations. As of 2014, about 2,327.45MW was produced by both sources. This figure has been steadily increasing since 2005, when total production stood at around 1,300MW.

⁷⁵ AfDb

⁷⁶ <https://www.se4all-africa.org/seforall-in-africa/country-data/cameroon/>

⁷⁷ <http://www.snh.cm/index.php/en/19-contenu-en/projects>

Figure 5 Evolution of access to electricity in Cameroon



Source: AfDB.

The breakdown of production (which is inserted in the current national grid) is shared between ENEO and other private producers such as DPDC, (86MW), KPDC (216MW), EDC (100MW) and numerous small independent power producers with a cumulative capacity of 973.6MW⁷⁸. Outside the national grid, the government recently completed the first of a series of projects to electrify 10,000 rural areas, beginning with 166 localities and the installation of PV systems with a capacity of about 30kw-300kw and an aggregate total of 17MKWh; increasing the rural electricity coverage rate from 18% to 20%. Based on the forecasts of the electricity demand in Cameroon as in the ESDP, which was revised in 2014 in the

⁷⁸ <https://www.get-invest.eu/market-information/cameroon/energy-sector/>

Energy Sector Development Project (PDSEN), electricity forecasts until 2035 stand at an annual growth rate of 6.7%. But it is low for the rural areas and over 38% of Cameroonian households do not have access to power, with up to 65% of rural households not having access to power (MINEE, 2015, 75).

Still, electrical energy contributes a small share of the total energy produced nationally. Figure 3 below shows the production level of different forms of energy in Cameroon. As can be seen, 48% comes from crude oil, 44% from bio-energy, 5% in electricity and 3% in gas. It is not yet clear what the generation level is for the newly independent actors of renewable energy in Cameroon. However, there has been a proliferation of individuals, NGOs or small companies which produce electrical energy at local levels. Figure 4 below shows the generation potentials for renewable energy in Cameroon.

Figure 6 Status of generational capacity by source in Cameroon, units: MW

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Public									
Hydro	719.0	719.0	719.0	719.0	723.0	732.2	732.2	732.2	732.2
Thermal	205.9	202.5	217.9	305.6	286.7	284.5	384.6	600.6	621.6
Subtotal	924.9	921.5	936.9	1,024.6	1,009.7	1,016.7	1,116.8	1,332.8	1,353.8
Private									
Thermal	352.6	413.2	439.8	561.2	599.5	710.2	772.2	854.6	971.1
Renewable	0.0006	–	–	0.0956	0.0966	0.0966	0.0984	0.0984	2.5484
Solar	–	–	–	–	–	–	–	–	2.45
Wind	–	–	–	0.0016	0.0026	0.0026	0.0044	0.0044	0.0044
Small-scale hydro	–	–	–	0.94	0.94	0.94	0.94	0.94	0.94
Biomass	–	–	–	–	–	–	–	–	–
Subtotal	352.6	413.2	439.8	561.3	599.6	710.3	772.3	854.7	973.6
Total generation capacity	1,277.5	1,334.7	1,376.7	1,585.9	1,609.3	1,727.0	1,889.1	2,187.5	2,327.4

Source: REMP

Electricity production in Cameroon stands at 2,327.4MW, with 57.56% produced by hydroelectric plants, 21.6% by thermal plants about 20% from gas and less than 0.1% from renewable sources except biomass⁷⁹. According to the 2017 ENEO annual report, the electricity access rate in Cameroon now stands at 62%.

The electrical energy sector is regulated by Law No 98/022 of 24 December 1998, which has been modified by Law 2011/022 of 14 December 2011, governing the electricity sector in Cameroon. This law revoked the previous monopoly on electricity production and distribution, meaning there are now diverse institutions involved depending on the type of energy. The Ministry of Water Resources and Energy supervises the institutions in this sector.

Box 1: Legal and strategic frameworks for electrical energy in Cameroon.

- **Legal framework**
 - **Law No. 98/022 of 24 December 1998**, modified by Law N°2011/022 of 14 December 2011, governing the electricity sector in Cameroon;
 - **DECREE No. 2000/462 of 26 June 2000** renewing concessions and licences, authorisations and declarations in force at the time of the entry into force of Law N°98/022 of 24 December 1998 governing the electricity sector;
 - **Prime ministerial Decree No. 2000/464/PM** of 30 June 2000 regulating the activities of the electricity sector;

⁷⁹ <https://www.get-invest.eu/market-information/cameroon/energy-sector/>

- **DECREE No. 2012/2806 of 24 December 2012** implementing certain provisions of Law No. 2011/022 of 14 December 2011. In this decree, the Department of Renewable Energies and Control of Energy (DERME) in MINEE is in charge of renewable energies' policy formulation and monitoring, prospection and promotion of renewable energies.

- **Strategic plans**

- **Cameroon Vision 2035:** highlights the vision of Cameroon for the next two decades as "Cameroon: An Emerging, Democratic and United Country in Diversity". It contains expectations regarding infrastructure development as preconditions for economic development of which potable water and energy supply are major anchors of growth. Here, economic growth rate is forecast to be at 9.9% and energy consumption is expected to account for 45% (from 27% now) of GDP. Also, renewable energies like wind, bio-fuel, solar and nuclear energy are suggested to replace fossil energy.
- **Electricity Sector Development Plan 2035:** This is aimed at developing the country's electricity sector and to ensure supply with the enhancement of electricity generation through the construction of multiple dams, network development through constructing internal lines and interconnection with neighbouring countries; and distribution of electricity with rural electrification densification.
- **Energy Sector Development Project (PDSEN):** Forecasts of electricity demands and the construction of hydroelectric power plants to meet demands are increasing annually at 6.7% by 2035.
- **Intended Nationally Determined Contributions (INDC):** These set the plans of the government to reduce greenhouse gas emissions by up to 32% based on the Paris Agreement of 2015. In this plan, the government also has renewable energy source goals at 11% for small hydropower, 7% for biomass, 6% for solar, 1% for wind power.
- **Rural Electrification Master Plan (PDER):** This serves to expand access to electricity for rural households which are not connected to the grid by adding up to a further 50MW for regional electrification by 2020 and a further 300MW by 2030.
- **National Energy Efficiency Plan (PNEE):** This was developed by the ARSEL with the goal to save 30% of projected national energy consumption by 2025, equivalent to 2,250GWh out of 7,040GWh by that time. Achieving this will be equivalent to the construction of 450MW of electricity generation capacity.
- **Renewable Energy Master Plan of Cameroon (REMP):** This serves to set up the national vision and deployment goals by sources of renewable energy and to set up the basic directions to accomplish the goals.

Table 2: Overview of institutions and their roles in the electrical energy sector in Cameroon

<i>Abbreviation</i>	<i>Name</i>	<i>Decree/law of creation and role</i>
MINEE	Ministry of Water Resources and Energy	Created by Decree No 2005/087 of 29 March 2005 on the organisation of the Ministry of Water resources and Energy, MINEE elaborates and develops, implements and evaluates the government's policy on the production, transport and distribution of energy and water. Assures supervises all the other institutions/agencies.
ENEO	Electricity of Cameroon	The main private electricity producer and distributor in Cameroon (until the creation of SONATREL in 2015).
EDC	Electricity Development Corporation	Created in 2006 by Presidential decree No 2006/406 of 29th November 2006, the mission is to develop state projects in the hydroelectricity sector.
SONATREL	National Electricity Transmission Corporation	Created by Presidential decree No 2015/454 of 8 October 2015, SONATREL's mission is to ensure the operation, maintenance and development of public electricity transmission networks throughout Cameroon.

ARSEL	Electricity Sector Regulation Agency	Created by Decree No 99/193 of 8 September 1999, the ARSEL is endowed with the Rural Energy Funds (FER, since 2009) to promote rural electrification by elaborating and monitoring state projects while supervising private operators in the rural sector.
AER	Rural Electrification Agency	Created by Decree no 99/193 of September 1999, the AER has the role of promoting electrification through the elaboration and implementation of state projects in this sector while supervising the private operators in the rural sector.

Reforms have been carried out on an ongoing basis, of which the most recent is the operationalisation of the SONATREL. Cameroon’s vision in the energy sector, as identified by the ESDP and strengthened through the GESP, takes into account the demands of the public sector and industry. **The realisation of the Cameroon 2035 vision relies heavily on the development and exploitation of these energy potentials for industrial purposes.** It is estimated that energy production should grow at an annual capacity of 13% by 2020 in order to meet the demand and tackle the problem of shortages by reducing energy losses, exploiting more alternative energy potentials and modernising distribution networks. In other words, based on the generated power capacity of 1,009MW in 2010, the vision is to triple production to 3,000MW by 2020 and to 6,000MW by 2030. This implies accelerating electricity production at a growth rate of more than 10% per year. The GESP envisages a combined growth rate of the electricity, gas and water sector between 2016 and 2020 of 16.7%⁸⁰. Additionally, the goal is to increase access up to 75% by 2020.

Cameroon’s government has engaged in a vast campaign since 2011 to implement structural projects to boost electricity production in order to provide solid bases for industrialisation and to meet national demand. Some of the actions include:

- Construction of dams and power plants since 2012 such as the Lom Pangar Dam with a capacity of six billion cubic metres of water and 30MW production level; construction of the Memve’ele dam with a production capacity of 200MW and the Mekin dam with a capacity of 15MW; commencement of construction works for the Nachtigal power plant with a 400MW capacity.
- Based on the Emergency Thermal Programme (PTU) initiated in 2009, over 100MW of additional energy was inserted into the Southern Interconnected Grid and power plants installed in about four major cities (Yaoundé-Ahala, Mbalmayo, Ebolowa and Bamenda) in Cameroon.
- With its rural Electrification Master Plan in 2017, Cameroon intends to connect several parts of the country, totalling 10,000 towns and villages, to one electricity grid by 2035. The first phase of the solar energy project has been completed, with the installation of off-grid solutions in 166 localities in Cameroon with a varying capacity of around 70-220KW in rural areas. The management is based on a prepaid system with the local inhabitants, through which FinTech applications are used to pay for electricity consumption (100 FCFA/KWh)⁸¹.
- Construction works are ongoing for the 75MW Bini à Warak dam, based on the three-year emergency plan for accelerating growth in Cameroon, which was launched in 2015.

In 2015, the National Electricity Transmission Corporation (SONATREL) was created as a way to ensure the efficient transportation of electrical energy and also to drive reforms for better performance in the sector. The objectives of SONATREL are to ensure the operation, maintenance and development of public electricity transmission networks throughout Cameroon⁸². Among the priority projects of

⁸⁰ GESP pg 103

⁸¹ Interviews with interlocutors local actors.

⁸² <https://sonatrel-cmr.cm/nous-connaitre/notre-mission/>

SONATREL are the Electricity Transmission and Sector Reform Network Upgrade Project (PRRTERS) to enhance the capacity, efficiency and reliability of Cameroon's public electricity transmission network⁸³.

4.2 Rationale for supporting the adoption of 4IR technologies

4.2.1 Potential applications and impacts

Cameroon is one of Sub-Saharan Africa's favourite places for electricity projects, either large scale or mini projects. Recently, the development of the Nachtigal power project, with a capacity of 420MW and the commencement of construction works, including a consortium of investors including the EDF, the IFC, the World Bank, the AfDB, the Africa50fund and many others (a project which won the best global project in the field of financing structuring awarded by the Thomson Reuters Project Finance International Magazine) made the World Bank label Cameroon one of SSA's favourite destinations for electricity investment⁸⁴.

The challenge in Cameroon is to increase the rate of electrification, which is currently provided to a meagre 50%-60% of the population, so as to facilitate access to electricity for many more people. This will increase the annual *per capita* electricity consumption, which currently stands at 165kwh in Cameroon (meanwhile this rate stands at about 1,650kwh in southern Africa). MINEE is one of the ministries which has therefore been allocated colossal sums of the budget in a bid to hasten the development of different energy infrastructure projects and reforms. In the 2019 budget, MINEE had the 3rd highest with 242.871 billion FCFA, with most of the funding geared towards the construction of dams. There are no specific projects identified from the government or private sector which involve the integration of 4IR technologies in energy. Nonetheless, prior to the integration of such technologies and optimisation of energy production and distribution, numerous challenges and reforms are required in the electricity sector, including ensuring effective and efficient functioning of the institutions and improving on the transmission of energy while reducing energy losses.

⁸³ <https://energies-media.com/cameroun-chantiers-de-societe-nationale-de-transport-de-lelectricite/>

⁸⁴ <https://www.businessincameroon.com/electricity/1103-8926-cameroon-becomes-ssa-s-most-favorable-places-for-electricity-projects-development-through-public-private-partnerships-world-bank>

Figure 7 Future issues for the electrical energy sector in Cameroon



Adapted from the study on the State of electricity production and distribution in Cameroon, Durano Ndongsok and Oliver Ruppel, 2017

As far as renewable energy is concerned, a big gap in the policy area is the lack of renewable energy law. Despite the revolution in renewable energy worldwide and the fact that Cameroon has considerable potential here, a law has not been enacted to guide the sector. Along the same lines, there is no clear road map and strategy to support and encourage mini producers of renewable energy in Cameroon yet, even though the government has carried out some intermittent actions. However, there appear to be certain incentives (reduced taxes and/or customs duties) offered to investors in the renewable energy sector in the Investment Law of 2013.

On the demand side, it is very important to ensure energy efficiency, as studies based on the National Energy Efficiency Plan developed by the ARSEL have shown that up to 30% of efficiency can be realised per year by 2025⁸⁵. Both MINEE and ENEO have engaged in some pilot projects to test the means of enhancing energy efficiency in Cameroon by raising the awareness of the population, through the elaboration of the National Plan for Energy Efficiency (PNEE) and trials with smart meters installed at some clients' homes, which can serve to collect data to understand user trends for electricity better. The REMP of Cameroon does not specifically tackle the role of smart grids in Cameroon, but reinforces the

⁸⁵State of electricity production and distribution in Cameroon, Durano Ndongsok and Oliver Ruppel, 2017

importance of them. Among Cameroon's renewable energy strategies, two of them have made mention of fostering and integrating the use of smart grids:

- The INDC plans to accelerate the implementation of the PDER and to set up a financial scheme for rural electrification and mini-smart grids.
- As one of the urgent measures to address the renewable energy problem, the REMP advises, among other things, building a national energy supply system and connecting it to the electrical grid but also the supply of small-scale renewable energy and the construction of small-scale smart grids for areas which are not connected to the electrical grid; and also building an energy storage system (ESS) which is a core technology of smart grids to increase efficiency by storing generated electricity in a secondary battery, supplying it when needed and storing the excess; as these initiatives can serve to supplement the areas where power generation and consumption must occur simultaneously.

Unfortunately, there has been no clear budgetary engagement from the government in relation to these initiatives.

At the private level, ENEO started with a pilot project to install smart meters in Cameroonian homes in 2014 and has plans to expand this project from 2019. ENEO is the main electricity distribution company in Cameroon and most 'smart' related projects in this domain can come from them. ENEO is making plans for the installation of more prepaid and smart meters in 2019. SCADA systems, which permit automation of electrical distribution, are currently being used but this is far away from what smart grids can do. There are no concrete plans/projects for the installations of smart grids, but ENEO has developed a business case for Advanced Metering Infrastructure (AMI). However, this is far from a smart grid.

Other distributors do so at the local levels and use quite archaic distribution schemes. To boost investment in the energy sector, initiatives such as the **AFD funded Sunref project** have been launched in partnership with **GICAM**. The project seeks to provide funding and a technical assistance programme for renewable energy projects. Through this programme, there is a possibility for promoters of renewable energy to acquire high tech expertise, training and support on the use and integration of advanced technologies in renewable energy projects that are deployed nationally⁸⁶. This can be an interesting case to boost the take-up and integration of 4IR technologies in the projects which are being funded. Similarly, through the Invest'Elec project launched by ARSEL in 2015, they plan to build the capacities of over 1,000 SMEs and private sector actors in terms of investing in renewable energy and rural electrification.

Apart from FinTech, Other 4IR technologies do not seem to have a business case. FinTech has become a part of life for Cameroonians and also for the electricity distribution company ENEO, which has integrated the payment of electricity bills through mobile money transactions and signed partnerships with money transfer agencies and micro-finance institutions for the payment of bills, still through the use of mobile phones. This scenario has also been adopted by the project to create Microgrid systems in 166 localities in Cameroon by the government, of which mobile money payments are used based on a prepaid model in the localities concerned.

4.2.2 *Current use cases and level of technology take-up*

According to an AFD study carried out in 2013, over 24% of electrical energy producers in Cameroon are independent power projects. By comparison with a select few countries such as Cameroon, Côte d'Ivoire, Uganda and Kenya, most African governments do not charge their citizens the real price of electricity, thus discouraging credible independent production⁸⁷. Nonetheless, numerous initiatives have recently been developed by different individuals and SMEs or NGOs, based for example on mini

⁸⁶ <https://www.legicam.cm/index.php/p/les-activites-du-programme-sunref-demarrent-au-gicam>

⁸⁷ Le producteurs prive d'electricite, Une solution pour l'Afrique, Proparco-RevuesPD-IPPs-HORS-SERIE, pg 13

grids for off-grid electrification in some secondary towns and villages for a population of up to 50 households. The distribution networks of such initiatives are organised remotely and cannot be integrated into the national transmission network, nor are they under the supervision of SONATREL. Still, such initiatives contribute significantly towards the local economy and improve the livelihoods of the local population⁸⁸. Some of the use cases include:

- A government project to **install microgrid PV systems** to power 166 localities has recently been completed in terms of the first phase of installing PV systems with a capacity of 30kw-300kw and a total of 17M KWh has been installed. This has increased the rural electricity coverage rate from 18% to 20%. Installed by Huawei, this system functions as through a prepaid model and has advanced Power Point Tracker (MPPT) technology with a background management system which processes the automated electricity metering by recording the sales details and usage information⁸⁹.
- **ENEO** has started with pilot projects to test the applicability of about 500 smart meters in Douala in Cameroon in 2017, which are linked to a Metering Management System (MMS)⁹⁰. This project involves a component of Big Data and AI. ENEO has also launched its prepaid card electricity meters, which function with an AMR (Automated Meter Reading) technology, measuring the consumption of electricity in a precise manner and in real time. ENEO is currently planning to install 20,000 prepaid meters and 40,000 smart meters in 2019⁹¹.
- The start-up **UR power**, which was incubated under Active Spaces in Cameroon, is also developing a solution to provide rechargeable solar batteries for households. Their solution integrates virtual reality into the company website so that clients can easily understand their installations in different home types; plus, the device has built-in smart sensors and AI to easily collect data and analyse the functioning of the devices. The packages for the devices are fabricated with a 3D printer (they already have three 3D printers)⁹².
- **The Ministry of Water Resources and Energy (MINEE) is trying out a pilot project on energy efficiency involving the integration of Big Data with a company called Energy Pro**. The objective is to be able to conserve, through energy efficiency, up to 100MW of electrical energy by collecting data and understanding the trends and use of electricity by clients, while only providing them with the required energy at the times that they need it. Other objectives are to save more energy for enterprises in the daytime and give more energy to households at night (1am-6am).
- With regard to **mini hydro**, the potentials for this are also enormous. According to a study carried out by Tractebel Engineering, the ‘Study on the Development of Hydroelectricity of Small and Medium Power in Sub-Saharan Africa’, the potentials of this in Cameroon go as high as 750MW, with the possibility of generating between 10MW and 50MW in some areas. Many Cameroonians have ventured into this but, at the local level or in villages, their technology level will probably be very low.

⁸⁸ <https://rei-cameroon.com/solutions>;

<https://www.juliustangka.org/>;

https://maguysama.odoo.com/en_US/

<https://www.legicam.cm/index.php/p/assistance-technique-au-programme-dappui-aux-investissements-defficacite-energetique-denergie-renouvelable-et-de-performance-environnementale-au-cameroun-sunref-cameroun>

⁸⁹ <https://e.huawei.com/en/case-studies/global/2017/201707101504>

⁹⁰ <https://www.businessincameroon.com/electricity/3011-8631-at-the-end-of-2017-500-eneo-smart-meters-were-activated-in-douala-and-yaounde>

⁹¹ <https://www.investiraucameroun.com/electricite/0605-12589-l-electricien-eneo-projet-d-installer-20-000-compteurs-prepayes-et-40-000-compteurs-communicants-postpaid-au-cameroun-en-2019>

⁹² Interviews with local actors.

4.3 Key enablers and obstacles

- **Knowledge and skills:** Apart from structural hydro projects, production of renewable energy is carried out by small companies or individuals who do not have the updated technology and knowledge to manage such technologies. The potential for generating energy to meet local demand is huge and can create many jobs and more opportunities. Most local producers need strong support and accompaniment from the state. Nevertheless, the government has created schools where renewable energy technologies are studied, such as the SAHEL institute in Maroua, the energy efficiency programme at the Catholic University of Central Africa and the Masters programme in renewable energies at the National Advanced School of Public Works. Another private higher education institution providing such studies is the African Institute of Computer Sciences (IAI) on solar energy⁹³.
- **Innovation ecosystems:** There is little accompaniment from the state to small producers of energy. Despite the numerous strategies elaborated to promote the take-up of renewables, no clear actions have been taken (particularly to support local producers). New programmes have been developed in academia and also at industry level with the association of industries to promote their development. Apparently, the most innovative technologies, which have been widely used and are innovative in terms of their applicability, relate to FinTech.
- **Finance:** Financing projects might be very expensive, particularly regarding the big hydro energy projects. Nevertheless, mini hydro and other solar projects are less expensive and there is limited financing available. Some donors, such as AFD through the Sunref project, are providing both technical and financial resources to boost the development of renewable energy projects. Nonetheless, on the demand side, small players who can produce such energy still suffer from basic problems of Cameroonian SMEs (poor restructuring of companies, limited funding, limited organisational expertise and limited capacity to develop and manage projects professionally). Also, there is no or very limited financing from local banks and, just as mentioned by Durando and Rupepel in 2017, it is important to train the local banks to enter this new business. Some renewable energy (RE) incentives from the government include:
 - VAT reduction between 5 and 10 years and reduced custom duties for RE equipment. Solar products are subject to a 10% import tax but no VAT.
 - Establishment of the Rural Energy Fund to promote the implementation of rural electrification.
- **Infrastructure:** Infrastructure development is still lacking in terms of energy, transport and information technology. Even though Cameroon has taken major steps to boost growth and improve on infrastructure investment, there is still much to be done. The position of Cameroon is also strategic as it is the main economy in central Africa and connects central Africa to west Africa. This means that boosting infrastructure development will provide twice the benefit, for the country as well as for both of these regions.
- **Regulations:** The fact in itself that there is no renewable energy law in Cameroon is already a limitation and a law in the sector will galvanise the sector. Still, different institutions have been put in place to ensure that consumer rights are met and that producers and distributors of electricity stick to their commitments *vis à vis* government and consumers such as the ARSEL.
- **Institutions and system governance:** Institutions have been set up to manage different aspects of electricity production and distribution, with the most recent being SONATREL - to manage the transmission of electricity - and it has a huge task ahead of it. Beyond the clear distribution of roles between these institutions, they need to ensure that they meet their mission statements effectively in each sector in which they operate, be it production, transportation or distribution.

⁹³ <https://www.cameroon-tribune.cm/article.html/24277/fr.html/energie-solaire-une-formation-ouverte>

5 Industrialisation

Current level of use of technologies within industrialisation

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT
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Potential use in the future within industrialisation

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT
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Scale: Red: not very present; Orange: nascent; Green: numerous examples/potential

5.1 Presentation

Cameroon's GDP has shifted in the past two decades, notably through a contraction in manufacturing activities and a growth in construction activities and other activities within the tertiary sector. In terms of the secondary sector, extractive industries activities fell by 1% between 2000-2009 and further by 8% between 2010-2016, while manufacturing industries activities 3% between 2000-2009 and by 15% between 2010-2016⁹⁴. This is in part explained by the 2014 oil price shock, which drastically reduced demand for oil and other agricultural products exported by Cameroon as well as by the aftermath of the 2009 global financial crisis, which undermined economic growth in some of the country's main commercial partners, including the EU and China. The construction sector has seen a remarkable expansion in recent years. According to the National Institute of Statistics in 2017, industrial activity improved by +0.8% compared to the same period last year. This good performance is attributable to the following sub-sectors of activity; agro-food industries (+32%); chemical industries and chemical manufacturing (+37.6%) and chemical products manufacturing (+37.6%), showing some slow growth. However, the manufacturing production index (which shows the total amount of value-added in terms of manufacturing production only) of Cameroon has been increasing up to about 155 in 2006 from about 100 in the year 2000⁹⁵.

Based on the 2018 UNIDO CIP report which assesses and benchmarks industrial competitiveness across economies, Cameroon is ranked 117 out of 150 countries. Even though Cameroon has gained eight points compared to the analysis between 2010-2016 and is ranked 12th in Africa, there are still numerous weaknesses and challenges which Cameroon faces. Just like many other Sub-Saharan countries, Cameroon has witnessed a process of deindustrialisation since 1990 and there is need for a marked increase in competitiveness to drive structural change as the performance in the CIP dimensions 1 and 3 (capacity to produce and export and world impact respectively) is still very poor.

Cameroon's long-term planning document, Vision 2035, states the objective of manufactured products ('made in Cameroon' products) gaining a more prominent position within its exports, with a goal of manufacturing representing 23% to 24% of its GDP by 2035. The Industrialisation Master Plan (PDI) outlines Cameroon's industrial strategy up until 2035 by emphasising three economic priorities: the digital economy, agroindustry and energy; five strategic industrial pillars: textiles, mining and metals, forestry, hydrocarbons and petrochemicals, and chemicals and pharmaceuticals; two economic bases: infrastructure and finance; and one 'cloak': strategic monitoring and economic intelligence. Construction has also grown thanks in part to the construction of road infrastructure as part of the Triennial Emergency Plan to accelerate Growth (PLANUT). Cameroon's vision, as set out in the PDI, is,

⁹⁴ UNECA data.

⁹⁵AfDB

by 2015, to enable the secondary sector to contribute up to 40% of GDP, where manufacturing is taking up to 25% and the value from manufactured products is contributing up to 50% of exports.

In the PDI, digitalisation (technology and innovation) is prioritised as one of the structural horizontal strategies but there is no specific mention of any 4IR technologies nor the kinds of technologies involved. Ironically, aspects of digitalisation mentioned are the reconfiguration of the national digital ecosystem; enhancing digital infrastructure, enhancing production of national content and use of digital services. There is no discussion as to the future of manufacturing, the kinds of technology to be promoted, preparing the labour force for the future and upgrading R&D.

5.2 Rationale for supporting the adoption of 4IR technologies

5.2.1 Potential applications and impacts

Up to now, Cameroon's industry has failed to take off and deliver on its full potential. This situation can be attributed to a combination of factors, including timid industrial responses domestically to external crises as well as to a global shift in the foundations of industrial competitiveness. Cameroon is blessed with considerable agricultural, forestry and mineral resources and yet the rate of transforming these resources into manufacturing products remains considerably low. The adoption of technology in industrialisation can have a promising impact on productivity and thus contribute to improving revenue and increasing the value added of the sector. It appears that ICTs have a positive impact on the productivity of industrial enterprises in Cameroon and that companies that make efficient use of them see their overall productivity and labour productivity increase⁹⁶. This study does not mention other modern applicable technologies in industrialisation. In a similar manner, there is no mention in the PDI of technologies such as enhancing robotics, Blockchains, AI, 3D or additive manufacturing.

Cameroon has plans to accelerate the development of technopoles as identified in the PDI. Creating zones for agro-industrial technopoles is envisaged as a priority and developing other technopoles in industrial cities is also envisaged. A technopole has already been created in the industrial city of Edea by MINMIDT and the government recently launched a tender to finance and develop the ambitious Ouassa-Baboute Agro Industrial Technology park.

5.2.2 Current use cases and level of technology take-up

In terms of industrial supply, few start-ups are emerging within Cameroon to offer technological solutions for industrial purposes although these are still at a very early stage.

Whilst industrial demand tends to be at a low level for the moment, there is some evidence of increasing demand within Cameroon's financial services sector for Big Data and Blockchain technologies as well as demand within domestic engineering schools for 3D printing solutions⁹⁷. There is a dearth of evidence of industrial demand within the construction, manufacturing and mining industries proper.

Use cases are discussed below:

- **Big Data.** The use of Big Data analytic solutions seems to be at a very early stage in Cameroon. However, start-ups such as SiQueries, a SaaS data analysis and visualisation start-up providing massively scalable data warehousing services, seem promising. Big Data has considerable potential within all of the most important industries in Cameroon. Also, Cardiopad⁹⁸ is one of the flagship projects that is making use of Big Data in Cameroon.
- **Blockchain.** There are few concrete cases of Blockchain being applied in Cameroon. Although the low-friction qualities and inherently secure nature of Blockchain could lend themselves well to

⁹⁶ <https://www.journalducameroun.com/strategies-entreprises-industrielles-et-tic-au-cameroun/>

⁹⁷ The first 3D printing facility established in the country, the '3D Printing High-Tech Centre', is hosted by the National Advance School of Engineering (ENSP) located within the University of Yaoundé I.

⁹⁸ <https://himore-medical.com/>

Cameroon's financial services sector, bypassing significant hurdles in terms of cumbersome bureaucracy, cryptocurrencies in Cameroon remain some years away from being fully developed. Nevertheless, Cameroon's ecosystem is well prepared for the latest innovations. The Cameroon Blockchain Business Council (CBBC) acts as a hub for actors in which they can share. Start-ups in the Blockchain sector are mostly involved in different cryptocurrencies such as the cases of Camertechtrends⁹⁹ and CryptoAfrica¹⁰⁰. Elsewhere, FinTech Ltd. is a Cameroon-based technology company that develops innovative Blockchain applications for the global banking and financial services sector.

- **3D printing.** Whilst 3D printing facilities have emerged in Cameroon, there is no evidence of their significant use within the country's industrial processes. Looking at other countries and cases shows that there is a potential for 3D printing to become a major technology for industrial uses. Although the technology's maturity is low at the moment in Cameroon and its use is not widespread in industry, its basic existence in the country through select factories¹⁰¹ demonstrates that it could have potential for growth. Most Cameroonian companies outsource a significant share of their manufacturing to Asian countries, which are tasks that 3D printers could instead provide.
- **Artificial Intelligence.** The development of AI solutions for industrialisation is in its infancy and its use is not widespread.

5.3 Drivers and challenges specific to industrialisation

- **Systems governance and regulations:** There are numerous regulatory barriers to the financial services sector in Cameroon, including the relatively high tax rate applied to e-money transfer, insofar as money transfer is still considered a postal service in Cameroon instead of a simple financial transaction. Implementation of the action plans of the PDI will modernise industrialisation in Cameroon but a lot more is required to integrate modern or 4IR technologies.
- **Innovation ecosystems:** Cameroon's innovation ecosystems are not yet well established, with a low level of cluster development. That being said, the quality of Cameroon's research institutions is good and there are hubs to foster technological partnerships, including the Cameroon Blockchain Business Council (CBBC).
- **Infrastructure:** The quality and connectivity of Cameroon's general infrastructure is poor. The country lags behind in terms of its physical transport and ICT infrastructure, which need to be developed for the deployment of 4IR technologies in its industry.
- **Knowledge and skills:** Cameroon's population shows above average skills compared to other countries in Sub-Saharan Africa. This shows that, on a supply-side level, Cameroon boasts a good pool of talent in terms of knowledge and skills, which can facilitate the development and adoption of 4IR technologies. Nevertheless, the Cameroonian education system is slowly increasing the take-up of STEM education throughout the universities and more will need to be done to prepare the labour force for the Fourth Industrial Revolution.

⁹⁹ <https://camertechtrends.com/>

¹⁰⁰ <https://cryptoafrica.com/>

¹⁰¹ <https://www.jpost.com/Jpost-Tech/Israel-and-Cameroon-inaugurate-3D-printing-facility-in-Yaoundé-587162>

6 Regional integration

Current level of use of technologies within regional integration

Artificial Intelligence	Big Data analytics	Blockchain	Drones	Cloud computing	IoT	FinTech
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Potential use in the future within regional integration

Artificial Intelligence	Big Data analytics	Blockchain	Drones	Cloud computing	IoT	FinTech
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Scale: Red: not very present; Orange: nascent; Green: numerous examples/potential

6.1 Presentation

Cameroon has a **naturally advantageous position at the heart of Africa**, representing the gateway to the economy of central Africa and a trade route between the economies of west and central Africa. The region’s only main port, Douala, plays a pivotal role in the regional economy, but has been suffering from high levels of congestion in recent years. Thanks to the road and rail networks that radiate towards its hinterlands, Cameroon controls the flow of exports and imports out of and into central Africa and Chad. Since 90% of goods destined for Central Africa pass through the port of Douala, delays there have a disastrous impact not only on Cameroon’s economy but also on the economies of neighbouring Central African Republic (CAR) and Chad. This has been one of the pivotal reasons for the construction of the Kribi deep seaport and the pipeline built to export Chadian oil passes through Cameroon on its way to Kribi, where authorities have recently completed a new deep-water port as a solution to Douala’s saturation problem.

Thanks to the extent of its territory, Cameroon is also a trading route connecting central and west Africa. It thereby dominates the Central African Economic and Monetary Community (CEMAC), with 44% of the community’s GDP and 39% of its exports, with the country maintaining a trade surplus with all of its partners except Equatorial Guinea. Despite the establishment of the free trade area among CEMAC countries, the level of intra-community trade has remained low overall. Imports into Cameroon originating from the Economic Community of Central Africa States (ECCAS), of which it is also part, amounted to less than 0.1% in 2013, whilst Cameroonian exports to the ECCAS stood at 2%¹⁰². Distortion of the common external tariff (CET) and numerous non-tariff barriers form impediments to trade in the region such as the overtaxing of goods, random checkpoints along corridors and highways remaining in poor condition. There has been a lack of growth in exports since 2007 due to incessant supply-side constraints including poor energy, communications, water and transport infrastructure as well as an overall unfavourable business climate.

In 2018, African countries made a commitment to sign the Agreement on the Continental Free Trade Area in Rwanda and even though it might be a long road for this to be fully implemented, its success will be underpinned by regional integration. Unlike other African sub-regions, central Africa is still lagging behind and this region has a key role to play in the political and economic integration of Africa. From the point of view of its central location in Africa, its ability to link other sub-regions, its rich and enormous potential energy and natural resources, some have said that “African integration will only be

¹⁰² United Nations Statistics Division, UNSD, 2015.

achieved through ECCAS or not”¹⁰³. But again, there are numerous challenges in this region when it comes to infrastructure (especially roads) and most importantly socio-political situations and security.

According to the Africa Regional Integration Index¹⁰⁴, Cameroon performs strongly in trade integration and financial integration but less well on productive integration, infrastructure integration and the free movement of persons. It advises that Cameroon could consider eliminating visa requirements or granting visas on arrival for nationals of a greater number of African countries; improving internet infrastructure; and taking measures to support the development of regional value chains in the ECCAS zone.

Regional integration holds a central position within Cameroon’s overall strategic considerations. Cameroon’s Regional and International Integration Strategy, which forms part of the Vision 2035 strategy, aims primarily at strengthening and rationalising institutions and mechanisms of convergence and integration (political, economic and monetary) in Africa, beginning with central Africa (CEMAC, ECCAS). Elsewhere, the strategy underlines the need to eliminate all barriers to intra-regional exchange to encourage the movement of people, the development of integration infrastructure, the establishment of common socioeconomic policies, the development of the region’s high agricultural potential and labour-intensive and added value sectors. Regional infrastructure projects are particularly emphasised, whether for communication, telecommunication or energy infrastructure.

There is no specific ministry in Cameroon that deals with regional integration. Rather, there are **a number of government ministries which oversee different policies involving furthering regional integration as an objective.** This includes the Ministry of Economy, Planning and Regional Development (MINEPAT) and Ministry of External Relations (MINREX). Advancing regional integration requires considering policies that may appear to have little bearing on regional integration.

Cameroon is a founding member of the main regional economic communities: CEMAC and ECCAS. As a member of the CEMAC Customs Union, Cameroon has adopted the CEMAC common external tariff (CET). The **government of Cameroon has given a leading role to trade integration in its Vision 2035** strategy to transform Cameroon into an emerging economy, including further integration with Nigeria and within the ECCAS. However, the government acknowledges that improvements to market access and cross-border trade are required to achieve these ambitious goals.

The CEMAC and ECCAS agreements **do not specify strategies for the development of 4IR technologies within their integration frameworks but do consider the harmonisation of information and communication technology (ICT) more generally.** Elsewhere, the CEMAC agreements contain two articles dealing with the harmonisation of technical and health regulations, standards and conformity assessments. However, they do not mention technical barriers to trade agreements although they call for the elimination of any measure that negatively affects trade between parties. Among CEMAC countries, only Cameroon has a sanitary and phytosanitary (SPS) enquiry point, which remains non-operational due to a lack of internet access and is therefore in need of capacity-building assistance.

Based on the new **Strategic Document for Regional Integration in Central Africa (DSIR 2019-2025)**¹⁰⁵ developed by the World Bank and the ECCAS, and adopted in 2019, priorities are in the **development of infrastructure, environment, energy, water, agriculture, capacity building for education, culture and youth projects and institutional reforms**¹⁰⁶. The population of Central Africa comes to 130 million and the AfDB is highly predisposed to support this

¹⁰³ <https://www.jeuneafrique.com/mag/602778/politique/tribune-lafrrique-centrale-moteur-de-lintegration-continentale-en-panne-francois-lounceny-fall/>

¹⁰⁴ The ARII measures the extent to which each country in Africa is meeting its commitments under the various pan-African integration frameworks, such as Africa 2063 and the Abuja Treaty

¹⁰⁵ <https://www.agencecofin.com/integration/1604-65419-la-bad-enterine-sa-strategie-pour-l-afrique-centrale-indispensable-a-l-integration-economique-de-la-region>

¹⁰⁶ <https://agencecofin.com/gouvernance-economique/1707-58655-le-nouveau-document-strategique-pour-l-integration-regionale-en-afrique-centrale-bientot-disponible>

programme and to strengthen regional infrastructure (focusing on electricity grids, transport and ICTs), and support reforms to develop intraregional trade and cross-border investment. This will also contribute to strengthening the institutional capacities of regional organisations, in particular those of ECCAS and the Central African Economic and Monetary Community (CEMAC).

6.2 Rationale for supporting the adoption of 4IR technologies

6.2.1 Potential applications and impacts

Regional integration has **considerable potential for driving more robust and equitable economic growth** in Africa and for promoting poverty and unemployment reduction. Experience has shown, however, that these opportunities only result from the careful harnessing of the available opportunities for deeper regional integration. Giving Africa's producers access to regional markets and linking them up into more sophisticated regional value chains will boost their levels of competitiveness and enhance their capacity for transformation into more competitive global niches. Viewed this way, regional integration is key to boosting productivity and achieving lasting improvements in living standards. Regional integration also promotes the transfer of technological innovation and enables countries to compete with more advanced economies on the international market.

Regional integration in central Africa remains underdeveloped, especially compared to other African sub-regions, primarily due to high trade costs, making exports less competitive. Whilst formal tariff barriers have fallen, non-tariff barriers are considerable. There is huge potential for the development of supply chains across the region, where a predominantly monocultural economic base can be altered by adding value to goods produced on the continent. Economies of the region often rank amongst some of those with the lowest social indicators and are characterised by the poor performance of their business environments¹⁰⁷.

In central Africa, promotion of technology development is evident on three fronts. Firstly, in terms of infrastructure development, the World Bank- and AfDB-funded **Central African Backbone Project (CAB Project)** aims to improve communication technologies by connecting ECCAS countries with high-speed internet (optic fibre). However, the implementation of the CAB project has been very slow, limiting the widespread impact the project should have across central Africa. Secondly, this trend is also apparent through the flourishing FinTech, mobile and international transfers, for which the Bank of Central African States (BEAC) has announced elaboration of regulation to control this activity. In addition, a project sponsored by the governments of the ECCAS aims to connect the capitals of the member countries, in addition to capacity-building services for citizens. For the moment, whilst the fibre connection within ECCAS is improving, services are severely lacking. There is no common strategy for the development of IT content and services and, given the low take-up of IT as well as governance and financial challenges, it is beneficial for member countries to pool their efforts in terms of capacity-building and services development.

Cameroon and its central African neighbours still have a long way to go before reaching a significant degree of integration. The same is also true for 4IR technologies, which are not yet present in a significant number or referenced in policy strategies for regional integration. Indeed, regional integration between Cameroon and its neighbours still necessitates the adoption of basic information and communication technology (ICT), in addition to the establishment of the correct regulatory groundwork and infrastructure.

Movement of goods and services is still low in central Africa. Following the World Bank Doing Business report in 2014 till 2016, this region scored the lowest in terms of the ease of trading across borders. Transborder trade in Central Africa is still weak. Still at around 2% of the total trade of ECCAS and CEMAC combined¹⁰⁸. This is as a result of the poor transportation networks as well as the complex customs and tax regimes, and this region ranks poorly compared to other African sub-regions according

¹⁰⁷ <http://www.banquemonde.org/fr/news/feature/2010/01/21/regional-integration-a-top-priority-for-central-africa-bloc>

¹⁰⁸ UNDP Central African Strategy, 2017.

to all types of connecting infrastructure. Political integration seems to be growing quite slowly but there are still institutional weaknesses. A free trade agreement was launched in 2004, but member states reduced only 34% of tariff lines on intra-ECCAS tariffs to zero, making ECCAS the region with the lowest share of intra-regional trade in terms of GDP produced compared to other sub-regions in Africa. All of these show that intra-regional trade - either formal or informal - should be a key aspect for improvement.

Strategically, developing a common regional IT strategy with integration of 4IR technologies will be quite resourceful for the region, and integrating axes to promote such technologies, foster the knowledge on these by the youth and building the required infrastructure required will be important. Similarly, considering the weak skills' level and difficulty to access finance in this region, it can be strategic for the region to target develop competences in 4IR through investing in a common joint education program for example, targeting the most important priority technologies which can solve some of the regions challenges. 4IR technologies can play an incipient role in fostering trade across countries through e-commerce (examples of platforms mentioned in section 2.2.2) and also this can drive harmonisation of customs tariffs faster.

- **Drones** can be very instrumental for the development and security challenges of this region. Given the multiple socio-political crisis in Cameroon and in central Africa as a whole, drones will certainly be an ideal solution for surveillance, ensuring easy, faster and efficient means to collect data. Cameroon already uses drones for this purpose (and the country is dotted with them) and the United States supported Cameroon with surveillance drones to enforce their fight against Boko Haram in 2015.
- In the area of agriculture, fertile arable land is quite available in this region and **drones** can help in crop production and monitoring their growth. There is noticeable move for such projects to be used across countries or by a company providing such services in CEMAC countries, but in Cameroon, some start-ups are already venturing into applications of drone technology, as seen in section 2.3.2.
- **Blockchain-based systems** in particular have the potential to boost cross-border trade due to their low-friction qualities and their inherently secure nature. Blockchain shows the potential to enhance transparency and reduce long-standing inefficiencies and costs within multiple sectors by streamlining the current intermediation of services. Blockchain can offer opportunities to cross-border trade with a potentially trusted and transparent supply chain. The technology could be used to connect components of the financial trade system, providing a common framework for commerce management. Since the presence of corruption and governance issues remains one of the biggest challenges for doing business in the region, having more secure systems could reduce a reliance on these countries' bureaucracies and increase total trade, essentially removing reliance on a third party.
- Other 4IR technologies such as **Big Data** and **Artificial Intelligence (AI)** also have the potential to speed up and improve regional central African integration. Firstly, the use of Big Data can help to close data gaps and to better assess the impacts of non-tariff measures on economies and their competitiveness. Both Big Data and AI also have the potential to accelerate the growth of e-commerce and e-trade in central Africa.
- **E-commerce** is, however, on the rise and can contribute to bridge many gaps in central Africa, including economic integration, cross-border transactions and also cultural integration (especially for the youths who use such novel platforms more).
- The proliferation of **FinTech and mobile banking**, as in the cases of Orange money, MTN mobile Money, bank payment card (example: VISA card) and any other technical process allowing electronic payments to be made has recently gained ground and a new regulation was adopted by the Ministerial Committee of CEMAC.
- **Cloud computing** also has huge potential in central Africa. Given the huge inherent costs of IT infrastructure and construction of data centres, some countries with limited resources and low levels of digitalisation can benefit from this for the good of their citizens. A pilot project of such a nature has been identified in the CAB project funded by the AfDB in Cameroon, which has carried out feasibility studies and previewed construction of a data centre. Nonetheless, cloud services are

already being proposed by some telecommunication providers in Cameroon (MTN Cameroon and Orange Cameroon). However, according to a recent report by Xalam analytics on the ‘rise of the African Cloud’, whilst the African cloud market has grown at 30% over the past 3 years, no country in central Africa is forecasted to be amongst the most cloud-ready.

6.2.2 Current use cases and level of technology take-up

In industrial supply-side terms, there is not as of yet a significant number of technology providers providing 4IR technologies for regional integration purposes in Cameroon. The **Cameroon Blockchain Business Council (CBBC)** brings together entrepreneurs, business leaders and leading businesses to highlight the latest innovations and advances in Blockchain and Distributed Ledger Technology. Realistically, however, cross-border trade based on cryptocurrencies in Cameroon and Central Africa is still some years away, being also in its infancy in the developed world. This aspect of Blockchain applications is also not well understood or regulated at present and authorities need time to develop regulatory frameworks.

Several domestic start-ups in Cameroon have emerged supplying **drones**, including Will & Brothers, Drone Africa and Flying Labs Cameroon. These have the potential to serve diverse purposes for regional integration, such as informing regional infrastructure projects as well as applications for ensuring security within parts of the country and the region at large.

In terms of industrial demand, **it is clear that domestic demand is at a latent stage**. E-commerce in Cameroon is becoming more and more pronounced and this has been highly influenced by the high mobile penetration rate. According to a United Nations Conference on Trade and Development (UNCTAD), **Cameroon was ranked as the 10th African destination for e-commerce**, with key players being Jumia¹⁰⁹(which in 2019 received their IPO in the New York stock Exchange), Afrimarket, Sellamquick, etc. Figure 1 above on the tech ecosystem gives more information on this.

The start-ups supplying technologies domestically have noted that their role is also one of teaching the population about the benefits of using these technologies. The purpose of the CBBC is also to foster partnerships and raise awareness about the potential of Blockchain within the country.

6.3 Drivers and challenges specific to regional integration

- **Systems governance and institutions.** Whilst the emergence of 4IR technologies has been received positively at the government level, there is at present no defined strategic governmental support for the technologies in supporting integration. At the regional level, there is currently limited political traction for economic regional integration in central Africa. The aspirational agenda associated with future gains from improved market integration seems to face entrenched interests with political prioritisation focused elsewhere, while reliance on oil revenues has so far minimised the push factors towards more economic integration. Corruption remains endemic.
- **Regulations.** In order to better promote the development of 4IR technologies, it will be necessary to broaden the regional integration agenda, focusing to a greater extent on competition, investment, intellectual property and supply-side issues rather than merely tariff barriers.
- **Infrastructure.** Within ECCAS, Cameroon ranks 7th out of the 11 member countries in terms of its infrastructure¹¹⁰. Whilst Cameroon plays a key role in intra-regional trade for its neighbouring landlocked countries (CAR, Chad), this figure show that Cameroon nevertheless lags behind in terms of its physical transport and ICT infrastructure, which in turn poses problems for the deployment of 4IR technologies.

¹⁰⁹ <https://techcrunch.com/2019/04/12/african-e-commerce-startup-jumias-shares-open-at-14-50-in-nyse-ipo/>

¹¹⁰ <https://www.integrate-africa.org/rankings/dimensions/regional-infrastructure/>

- **Innovation ecosystems.** Cameroon’s innovation ecosystems are not yet well established, with a low level of cluster development. That being said, the quality of Cameroon’s research institutions is good and there are hubs to foster technological partnerships, including the Cameroon Blockchain Business Council (CBBC).

7 Well-being

Current level of use of technologies for well-being

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT	FinTech
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Potential use in the future for well-being

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT	FinTech
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Scale: Red: not very present; Orange: nascent; Green: numerous examples/potential

7.1 Presentation

Although Cameroon’s proportion of doctors (1.9 per 1,000 inhabitants) is twice the minimum recommended by the World Health Organization (WHO), the country’s health statistics are, paradoxically, behind the curve. Life expectancy for Cameroonians has decreased by about two years since 1990 whilst it has increased by an average of five years in the rest of Sub-Saharan Africa. Worldwide, Cameroon is among the countries where the mortality rate for children under five years of age (112 deaths/1,000 live births) has decreased the least. Yet Cameroon spends more money on health than any other SSA country (except South Africa): \$61 per capita, as opposed to \$51 on average.

There are also severe inequalities in healthcare delivery to the extent that, the richer a person is, the more likely they are to receive qualified professional healthcare. The geographical disparities are also striking: 40% of the country’s doctors practise in the centre region (which includes Yaoundé), where only 18% of the population lives. On the other hand, the far north region, which also hosts 18% of the population, employs only 8% of Cameroon’s doctors.

The Ministry of Public Health is responsible for Cameroon’s general health policy. In order to achieve national and international health objectives (MDGs, GESP) and progress towards universal healthcare coverage, Cameroon has outlined a Strategy for the Health Sector (SSH) for 2016-2027. Its vision is as follows: “A country in which universal access to quality health services is guaranteed for all social groups by 2035 with the full participation of communities”. The policy relies on government documents, especially GESP and Vision 2035. In Cameroon’s digital economy plan, emphasis is laid on the role of new technologies and applications which can improve on the health conditions of Cameroonians. The E-government Master Plan has also suggested some e-health services which can be developed or promoted by the government to improve the conditions of Cameroonians but also to improve on health system delivery.

7.2 Rationale for supporting the adoption of 4IR technologies

7.2.1 Potential applications and impacts

In general, the performance of the health system in Cameroon is poor and unevenly resourced. Although Cameroon has shown improvement along certain indicators, such as on vertical programmes on malaria, HIV/AIDS, tuberculosis and immunisation, there has been a stagnation in life expectancy and public funding in addition to regression in other indicators such as maternal mortality rates, family planning

and disease coverage¹¹¹. Disparities in service provision between rural and urban areas is also a challenge which, in addition to poor road infrastructure, ageing power infrastructure and prevailing poverty levels, means that pregnant women often do not have access to healthcare service on time. There are many opportunities for significant improvement in the delivery of healthcare, towards which 4IR technologies can contribute. Drones can be a good solution to resolve the difficulties and inaccessibility of certain rural areas in terms of delivery of goods.

7.2.2 Current use cases and level of technology take-up

4IR technologies have begun to emerge in Cameroon to tackle the prevailing problems experienced in healthcare delivery. Although no 4IR technologies are as of yet being used extensively, some examples of their use are emerging. In particular, **Artificial Intelligence, Big Data analytics, 3D printing and IoT** represent incipient technological solution potential for the health sector and commerce in Cameroon.

On the supply side, technology providers are mixed, ranging from start-ups to large multinationals. Innovations are predominantly imported from abroad, but do occur within some domestic-level start-ups, especially for IoT- and Big Data-related innovations. The industrial demand for 4IR technologies in the health sector remains at a very early stage. However, for the e-commerce sector, many SMEs, retail stores and businesses operating in transportation and other sectors have partnered with e-commerce companies already and the numbers of use cases for this will grow in the coming years.

Use cases are described below:

- **Artificial intelligence (AI)** has begun to be integrated into healthcare solutions in Cameroon. Since 2017, the Bonassama District Hospital in Douala has integrated SOPHiA, AI developed by the multinational Sophia Genetics, into the clinical workflow to advance patients' care. By using this AI solution, the hospital now forms part of a larger network of 260 hospitals in 46 countries that share clinical insights using **Big Data analytics** across patient cases, feeding a knowledge base of biomedical findings to accelerate diagnostics and care¹¹². This allows the hospital to rapidly analyse genomic data and decide on the most effective care. Another example of AI and Machine Learning for the healthcare sector comes from the Songhai Labs. The Yaoundé-based start-up is working on a DataReach¹¹³ project in partnership with the WHO in Cameroon and a UCLA start-up from California¹¹⁴. Within this project, the HSPC polyclinic in Kumba, a private hospital in south west Cameroon, was provided with a digital application which helps it to compile data on patients for epidemiological surveillance via Artificial Intelligence¹¹⁵. Also, a data analytics company called Philjohn Technologies is making plans to expand and create a Data Analysis Innovation Centre in Cameroon, even raising funds of up to 700,000 euro for this¹¹⁶.
- Songhai Labs also wants to create the first **3D printing** tech space in Francophone Africa dedicated to locally producing medical equipment for rural clinics. The project is also designed to be based on a circular model of zero waste and will integrate a strong educational component. Cameroon also possesses an industrial 3D printer, which is one of the biggest in west and central Africa. It is hosted within the premises of the National Advanced School of Engineering (ENSP) and has produced

¹¹¹ WHO 2016 Health Analytical Profile Cameroon.

¹¹² <https://www.journalducameroun.com/en/douala-hospital-adopts-artificial-intelligence-trigger-healthcare-leapfrogging-movt/>

¹¹³ <http://datareach.org/projects.html>

¹¹⁴ <http://www.songhailabs.net/healthcare/>

¹¹⁵ <https://www.businessincameroon.com/ict/2012-7658-one-of-the-first-african-experiments-on-epidemiological-surveillance-via-artificial-intelligence-to-be-conducted-in-cameroon-from-2018>

¹¹⁶ <https://www.investiraucameroun.com/finance/2407-13029-une-start-up-veut-lever-pres-d-un-demi-milliard-de-fcfa-pour-lancer-le-ier-data-analysis-innovation-center-du-cameroon>

many 3D samples for mannequins and organs to be used by hospitals. This project was funded by the Israeli government.

- Many **IoT** solutions are emerging within the healthcare sector in Cameroon. ICT-based tools such as **GiftedMom**¹¹⁷ and Happy Mothers¹¹⁸ are apps which allow mothers and pregnant women in Cameroon to access medical advice in rural communities. In a similar vein, Himore Medical has designed a wireless solution called **CardioPad** that enables the monitoring of cardiovascular diseases (CVDs). While the majority of CVD specialists practise in Yaoundé, 80% of the country's population lives in rural areas. CardioPad provides improved access to CVD healthcare for patients living in remote areas. It is a touchscreen tablet that includes a set of four wireless electrodes and a sensor that is attached to the patient's chest. This generates a signal, which is then transmitted via Bluetooth to the tablet. A digested electrocardiogram (ECG) of the patient's heart function is then transmitted through a mobile network to a second CardioPad device situated in a city hospital, where a registered cardiologist can make a diagnosis.

In the health sector, the start-up CleverSide Engineering has developed an **IoT** solution through their **CleverHome** solution to manage home security, pilot home appliances with smartphones and manage electrical energy consumption.

There is also the **Kiro'o Games studios**, which is a private game, animation, development and publishing company, which develops its own video games based on African stories and content. The interesting part of Kiro'o games is their ability to have mobilised funding for the development of their products for up to \$one million through their crowdfunding platform called **Rebuntu**¹¹⁹. Through their Rebuntu platform, the start-up shares its experience on development and raising funding through crowdfunding, mentoring youth all over Africa, with 1,400 subscribers and 700 premium accounts registered.

Box 2: Cameroon's e-higher education vision.

In the education sector, in 2015 Cameroon's government established a strategy for higher education based on governance and quality assurance, professionalisation and provision of more funding and digitalisation of higher education. Based on this, the e-higher education vision programme was established with plans to enhance e-learning, e-administration and the construction and equipment of nine digital centres in each of the state universities and in one inter-state university; plus, 500,000 laptops have been distributed to university students (32GB SSD with 2GB RAM) since then, with the objective being to connect the laptops to a cloud service and interconnect the universities with common services.

This project can be a good use case for the development of cloud services but the quality of laptops is quite weak for exploitation by the students. This is one of the few cases where there has been dedicated funding for a digitalisation strategy in Cameroon (up to 75 billion FCFA), but the roll-out of the execution is flawed and appears to have been done in the opposite way to the way one would imagine as the logical thing would be that the infrastructure should be set up first for such services to flourish and local content should be developed and encouraged to boost the IT industry *before* distributing the laptops. As already mentioned earlier in this report, education is primordial in the take-up of the 4IR and this e-vision neither mentions any specifics as to the teaching of these 4IR high technologies nor is there dedicated awareness raising of tertiary education students about these technologies (apart from general ICT awareness raising, which has seemingly been identified). If this project comes to fruition as planned, then it will be a very good use case for the spread of cloud technologies nationwide.

7.3 Drivers and challenges specific to well-being

- **Systems governance and regulations.** As mentioned above, there is no specific regulation on 4IR technologies but there is a law guiding e-commerce in Cameroon, which was enacted in 2010.

¹¹⁷ <http://giftedmom.co/index.html>

¹¹⁸ <http://www.innovation-factory.info/ehealth/ehealth-cameroon/>

¹¹⁹ <https://kiroorebuntu.com/>

- **Ecosystem:** The government has established the digital economy strategy 2020, whose implementation should end in two years' time and, even though there is no proper evaluation of the state of its implementation, it fails to address Industry 4.0 specifically. However, indirectly, the development of such new technologies is being encouraged through the plans to create technopoles and incubators in major cities and universities in Cameroon.
- **Finance.** Despite the large proportion of doctors and levels of funding in Cameroon compared to the average for Sub-Saharan Africa, the healthcare sector remains considerably underfinanced, especially in rural areas. This undermines the capacity of hospitals to purchase 4IR technologies for medical purposes.

There is generally limited funding, very few Business Angels and Venture Capitalists (VCs) and not many competitions to provide funding to start-ups, and as per a complaint made by Cameroonian start-ups, most of them do not have 'love money'¹²⁰ to engage in their projects and so are very limited in terms of making progress with their ideas. Cameroonian banks confirmed that, even though they want to and are more predisposed to fund SMEs, the situation of start-ups is more critical as they are usually characterised by youths with little professional experience and exposure, no organised structure, no guarantees and limited capacity to lead a company. However, if the government can reorganise this sector, they can be willing to finance.

- **Infrastructure.** Whilst the physical road and IT infrastructure in Cameroon is severely lacking, the use of 4IR technologies such as AI and IoT can serve to bypass this weakness for better service delivery. Still, access to the internet is quite high and there is only 4G in the major cities.
- **Institutions.** There is no agency or government institution dedicated to the advancement and promotion of technologies in 4IR and, more specifically, start-ups. The National Agency for Information and Communication Technologies (ANTIC), has the role to do this but its actions are mostly focused on monitoring the development of ICT for the government and private sectors and it does not have specific actions/a strategy for Industry 4.0. ANTIC started by organising competitions to fund Cameroonian start-ups but stopped this in 2018. Given the ambiance and movement of tech start-ups in Cameroon, it will be beneficial for there to be a specific agency/institution/department in charge of uniting/federating/coordinating/and directing government and private actions in IT and 4IR, as the case may be.

8 Overall conclusion for a business case in the country

8.1 Is there a business case for 4IR technologies in Cameroon?

Cameroon is at an early stage in the 4IR where one would say there is awareness of it and manufacturing and industrial companies have the intent to transform their efforts, expand and optimise their entire value chain of the products and services that they offer and to understand the need to develop a broader strategy but do not have the expertise or finances to carry out these actions. Within government circles, e-government is the order of the day and the valorisation and application of 4IR technologies has not yet been mastered. Whilst the major state corporations operating in IT, such as CAMTEL, CAMPOST and ANTIC understand the issues relating to the 4IR, they do not have a clear orientation towards 4IR yet. Nevertheless, CAMTEL and CAMPOST understand the value of data and cloud services and have built (or are building) their own state of the art data centres to serve for such purposes and beyond. Within the Ministry in charge of Information Technologies, MINPOSTEL, the issues have been understood and **an informal working group has been set up within the Department of Research and Projects to understand more about the applications of these technologies.** Unfortunately the present missions only relate to the IoT but there are more technologies which can be covered. On the bright side, given that the clustering of these technologies

¹²⁰ Seed capital for business which may come from family, friends, or other relatives.

requires internet access, the government is doing much to make improvements to IT infrastructure, increasing access to faster broadband internet.

On the demand side, **there is an invigorating awareness and energy with the start-ups and with young people and with some knowledgeable individual experts.** Even though there has clearly not been much evidence in terms of concrete projects to prove their success, these players are not asleep and, despite the challenges in the ecosystem, they are studying, researching, creating and finding more opportunities. This has been evident in the case of Silicon Mountain in Buea although the activities have considerably slowed down there due to the advent of the socio-political crisis and some periodic internet shutdowns in the past two years in this area. If one adds the limited amount of support provided by the government to private actors and start-ups plus the internet shutdowns, one would therefore doubt if the government understands the issues surrounding such an industry and the requirements to develop it. In terms of fostering knowledge, there **are no Cameroonian institutions which have specialised degree or graduate programmes for technologies in Industry 4.0, but there are modules/courses in some technical institutions which cover them, such as AI, Big Data, 3D printing and other high-tech specialties.** Beyond formal institutions, incubators can also play a very critical role in building up knowledge and building up the capacities of start-ups whilst giving them hands-on accompaniment and exposure to 4IR, as testified by the expert from Technopole Yaoundé¹²¹.

Overall, the assessment is that **there is a real business case for the use of drones in agriculture in Cameroon.** Technologies which can be targeted in Cameroon are drones, Big Data, AI, FinTech, renewable energy and Blockchains. However, there is still need for proper awareness raising for and education of those using these technologies in terms of their applicability.

Domains of application

Agriculture	Energy	Industrialisation	Regional integration	Well-being
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Technologies to be targeted

Artificial Intelligence	Big Data analytics	Blockchain	Drones	3D printing	IoT	FinTech
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8.2 Overall SWOT

Strengths	Weaknesses
Political will from the government Existence of some IT strategies Very dynamic and educated youth force Strategic position in central Africa and Africa Bustling creation of incubators and technopoles	High cost of internet access Limited or no funding for starting up businesses Limited direct dialogue and financial support to private tech ecosystem actors by the government No strategy addressing 4IR technologies No dedicated training sessions and graduate programmes about 4IR technologies
Opportunities	Threats
Some incentives given to investors	Missing the train

¹²¹ Interview with Georges Kamande, Expert, Technopole Sup-Valor, Yaounde.

Deployment of optic fibre nationally Players in the ecosystem continue to be active despite the challenges and difficulties	Failure of start ups
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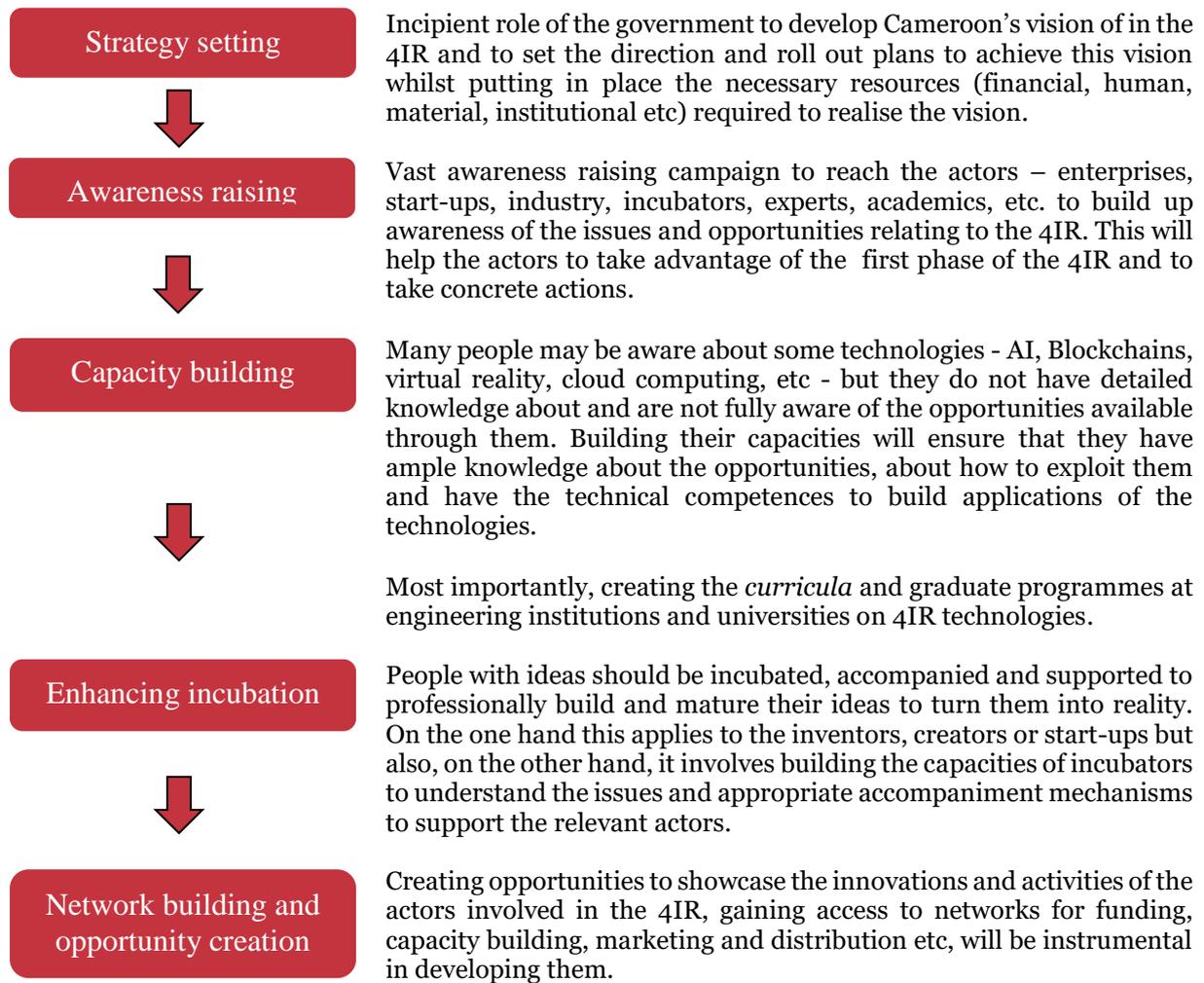
8.3 List of stakeholders

- MINFI
- MINPOSTEL
- Technopole Sup-Valor
- African Development Bank
- GICAM
- UNECA
- ANTIC
- CENADI
- POLYTECH
- 3D Printing Center
- Active Spaces
- Njoku Labs
- Gifted Mom
- Kiro Games
- Pneu Pur
- AIMS-TTP programme
- MINEE
- HIMORE Medical
- YES Cameroon
- CAMTEL
- UNESCO
- Afriland First Bank
- BUNEC

9 Recommendations for the AfDB

9.1 Recommendations at the national level

The diagramme to the left with arrows below could therefore serve as strategic direction for re-dynamising and developing the 4IR in Cameroon:



Specifically, for the energy sector, strategic options to revamp the sector can circulate around enforcing regulation, providing professional experience/technical assistance for local actors and enabling access to finance. Some of the following will be critical:

- Establishing regulations and enacting the renewable energies law;
- Establishing a clear road map to support mini electricity producers (especially those who have started doing so at local levels as their installations are quite amateur) and providing them with more training;
- Putting in place funds for private sector operators to have access to funding or to render the Rural Energy Fund more effective and efficient;
- Also, given the limited finance available, it is important for government to engage local banks to invest in this sector.

9.2 Potential AfDB projects

Below are some project ideas to highlight and in the roll-out of the following project ideas, it will be important to properly engage **sustainable partnerships with associations of industries and associations** (in order to properly ensure the utility and take-up of 4IR technologies, it can be instrumental to establish support programmes and discussions of this nature with such associations such as GICAM, ECCAM, or other associations which bring together companies):

- **Strategy development and orientation:** Support government to establish a strategic direction for the 4IR in Cameroon and set out an action plan focusing on the agriculture sector.
- **Awareness raising of actors:** Sponsor awareness campaigns to enlighten the entire ecosystem about the issues and opportunities relating to the 4IR (this can go to policy stakeholders, academic stakeholders and young people who are interested but also to start-ups and to industry).
- **Regulation:** Support the development of regulation to allow the use of drones in the agriculture sector.
- **Support research and development:** The government should establish funds for research and enforce the role of the Ministry of Scientific Research and Innovation in supporting technological research.
- **Support and accompany start-ups:** This can be done in many different ways:
 - Putting technopoles/incubators and ICT institutions (such as ANTIC experts) who understand such technologies at the disposal of local institutions. These experts can offer a technical advisory role and support the local institutions in developing their own strategy/actions and eventually they will indirectly support the start-ups.
 - Establishing incubation and acceleration programmes for start-ups involved in such technologies whilst creating opportunities for networking and exposure, such as recognitions or awards.
 - Equipping incubators and technopoles with easy-to-use equipment which can build their capacities and give exposure to other inventors of 4IR applications, such as 3D printers, virtual reality sets, etc.
- **Funding:** Put in place funding mechanisms for the benefit of start-ups such as seed funding, small business administration (SBA) funding (which can allow start-ups to acquire basic equipment and appliances to function, such as computers, printers and other basic office support equipment), launch competitions, etc.
- **Capacity building**
 - To incubators, on how to best mentor and coach start-ups in the 4IR.
 - Education programmes and certification programmes for the benefit of young people about 4IR technologies (which can be done **on-site or online as Massive Open Online Course (MOOC) programmes**), organise seminars and workshops.
 - Support and sponsor **degree and graduate programmes** in engineering schools.

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