Vodacom Report:
Decarbonising Africa's ICT sector

Chapter 2

Possible solutions to the challenges

April 2026

Further together

Chapter 2

Possible solutions to the challenges

RECAP:

Chapter 1, titled "Challenges to Decarbonisation," outlined the significant obstacles faced by the ICT and other electricity-intensive sectors in Africa, including unreliable electricity supply, financial constraints, carbon-intensive grids, and complex regulatory frameworks, which hindered their efforts to decarbonise. The primary challenges stem from weak or absent grid infrastructure, leading to a heavy reliance on diesel generators and carbon-intensive electricity. The chapter highlighted issues such as unreliable electricity supply, financial constraints and limited capacity of utilities, the carbon intensity of the grid, the absence of market mechanisms to procure renewable energy, complex regulatory frameworks, political risk, and limited private sector participation in transmission and distribution. Additionally, it addressed the cost and technical challenges of powering base stations with green mini-grids.

Overcoming decarbonisation barriers requires solutions that are suitable to Africa's context. **Chapter 2** explores solutions which rely on improving grid infrastructure and decarbonising electricity supply through power sector reforms and public-private partnerships, developing off-grid renewables electricity infrastructure (i.e. micro- and mini-grids), and developing and using different market mechanisms to generate and procure renewable energy. Institutional, policy and regulatory barriers must be overcome to realise these solutions. Key stakeholders must work closely to realise opportunities.

Contents

2.1 Power sector reforms and private sector participation

An analysis by the International Energy Agency (IEA) showed that extending national grids is the most cost-effective and sensible option for almost 45% of businesses and households to gain access to electricity by 2030.

Case study 1

How Rwanda boosted its electricity access rate to 75% in 15 years

In 2009, Rwanda had a mere 6% electricity access rate. By 2024, this figure had skyrocketed to 75%[1]. This remarkable transformation results from a strategic blend of government policy, institutional reforms, public-private partnerships (PPPs) and international aid.

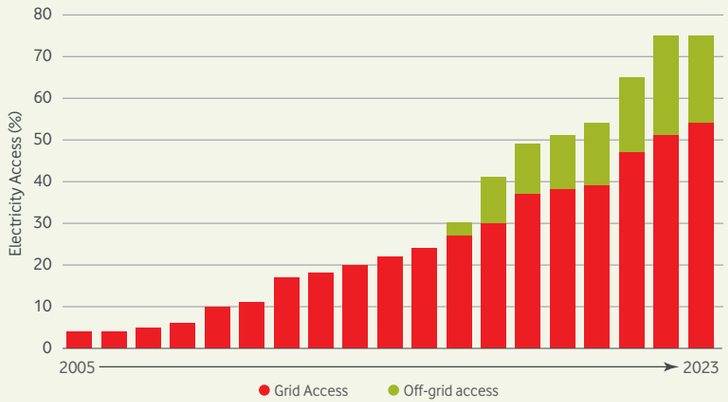


Figure 1. Electricity access expansion in Rwanda during 2005–2024[1]

The key strategies that Rwanda employed included:

Government commitment and strategic planning:
The Rwandan government adapted its national development strategies to include ambitious goals to increase electricity access. The targets focused on on-grid and off-grid solutions to ensure all areas have full access to electricity.

Institutional reforms, performance monitoring and accountability:
Significant sector reforms in 2013 established clear roles for key institutions:

1. The Ministry of Infrastructure (MINIFRA) handled overall policy and strategy.
2. The Rwanda Utilities Regulatory Authority (RURA) was responsible for regulation.
3. The Rwanda Energy Group (REG) managed utility operations and energy development through its subsidiaries, the Electricity Utility Corporation Limited (EUCL) and the Energy Development Corporation Limited (EDCL).

Implementing performance contracts for Rwanda Energy Group and EDCL management ensured accountability and progress towards electrification targets. These contracts were crucial for maintaining focus and delivering results efficiently.

PPPs and international support: Rwanda's electrification success was a national and global collaboration effort. The country leveraged partnerships with the private sector and secured substantial funding from international partners. For example, the Belgian government provided €39 million to help with the construction of transmission networks (transmission lines and substations) and other electrification projects. The World Bank and other development partners have contributed over US$1.4 billion in funding since 2009.

Off-grid solutions and solar home systems (SHS):
Rwanda recognised the importance of off-grid solutions and promoted using SHS. The Development Bank of Rwanda facilitated financial mechanisms to support private sector involvement in SHS deployment, ensuring even remote areas gained access to electricity.

Technical and financial planning:
The Electricity Access Rollout Program, established in 2008, implemented a spatial least-cost electricity investment plan, which aims to expand electricity in the cheapest and most efficient way by choosing the best places to build electricity infrastructure based on cost, population and demand. The program integrated technical, financial and implementation planning to enable effective and efficient electrification rollouts.

Rwanda's success offers valuable lessons for other countries aiming to increase electricity access:

- Strong government leadership: Commitment at the highest levels of government is crucial.
- Clear institutional roles: Well-defined roles and responsibilities among institutions prevent overlap and enhance efficiency.
- Public-private collaboration: Engaging the private sector and securing international funding is essential for large-scale infrastructure projects.
- Holistic planning: Integrating technical, financial and implementation planning ensures systematic and cost-effective rollouts.
- Adaptability: Continuously adapting strategies based on real-time feedback and evolving circumstances can significantly improve project outcomes[2].

1 World Bank. (2024, August 23). Ingredients for Accelerating Universal Electricity Access: Lessons from Rwanda's Inspirational Approach.
2 ESI Africa. (2024, April 11). How Rwanda boosted its electricity access rate to 75 in 15 years.

Increasing generation capacity and expanding and upgrading the grid requires strategic and regulatory reforms in the power sector to improve financial health and encourage private sector involvement.

Addressing challenges within the power sector, such as lack of grid infrastructure and generation capacity, requires reforms that are techno-economically (combining technological and economic factors), administratively, and politically feasible. Public utilities across Africa need to increase generation capacity and expand and modernise grid infrastructure. This daunting task, coupled with financial limitations and substantial investment requirements, means that public funds will not be viable[3]. It is estimated that US$20 billion a year in investments will be required to achieve the goal of universal access to clean energy by 2030[4]. African utilities must take proactive measures to bolster their financial health and encourage increased private sector involvement in generation, transmission, and distribution[5].

To reform the power sector, improve the financial health of utilities and stimulate private sector participation, tariff systems need to be restructured, subsidies need to be phased out and concession agreements need to be leveraged to grant rights to private operators[3]. Creating regulatory frameworks will encourage private sector investment and ownership. Implementing auction mechanisms and mitigating investment risks are essential steps. South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) is an example, using competitive bidding processes and long-term power purchase agreements (PPAs) to attract private investment and enhance the integration of renewable energy into the national grid. To attract private sector participation, public concessional finance, likely from development finance institutions (DFIs) and multilateral development banks (MDBs), are necessary to mitigate risks, particularly in the project's beginning stages.

Increased private sector participation in the transmission and distribution sector would require an enabling regulatory environment and the ability to de-risk investment. Concessions and regulatory carve-outs can encourage competition and private sector participation by allowing other grid operators to build and operate transmission and distribution assets where utilities operate, under certain conditions. This and other models are being tested in Nigeria, which has some of the most unreliable electricity services in Africa[5]. More details on de-risking investment will be unpacked in Chapter 4, which discusses financing for utility-scale generation, transmission, and distribution projects.

Independent transmission projects (ITP) operate under a build-operate-transfer scheme. In this model, transmission networks are transferred to utilities after a predetermined timeframe. This business model is considered as one of the most promising ways to facilitate PPP in transmission and distribution for Africa[6]. However, no African countries have adopted this model yet, proof of concept would need to be demonstrated before adoption. Some African countries are considering piloting private sector participation in the transmission network.

Example of countries that are introducing private sector participation in transmission and distribution networks

South Africa

South Africa recently announced its intentions to involve the private sector in transmission to supplement investment into expanding transmission and distribution infrastructure. Government will create a dedicated office, similar to the IPP Procurement Office, to procure private companies. It will likely adopt the build-operate-transfer model, and the state's newly formed National Transmission Company will retain ownership. A pilot model will be implemented to test market appetite[7],[8].

Kenya

The government signed a deal in January 2022 with India's state-owned Power Grid and Africa50, an infrastructure investment platform owned by the African Development Bank (AfDB) and African governments, to launch the first independent power transmission project in Africa. The Kenya Transmission PPP project will result in the construction of two new power lines and includes the development, financing, construction and operation of the 400kV Lessos – Loosuk and 220kV Kisumu – Musaga transmission lines under PPP[9],[10].

Uganda

In Uganda, some private companies successfully operate networks under a concessional arrangement with the utility. Umeme, a private company, has an arrangement with Uganda Electricity Distribution Company Limited (a public utility) to operate majority of the country's distribution networks. Uganda was the first African country to unbundle its generation, transmission and distribution utilities and offer private concessions for power generation and distribution[11].

3 Eberhard, A., & Godinho, C. (2017). A review and exploration of the status, context and political economy of power sector reforms in sub-Saharan Africa, South Asia and Latin America.
4 IEA. (2023). Financing clean energy in Africa.
5 IEA. (2022). Africa Energy Outlook 2022.
6 World Bank. (2017). Linking up: Public-Private Partnerships in Power Transmission in Africa.
7 Daily Investor. (2024, February 27). Eskom wants R350 billion from private sector to expand transmission grid.
8 MoneyWeb. (2024, January 24). Here comes the transmission IPP office.
9 Africa50, Kenya Transmission PPP Project.
10 Africa Business (2023), Africa's race for transmission investment.
11 GridWorks (2022) Gridworks & Ugandan government announce Amari Power Transmission – a pilot project for private investment in the electricity transmission sector.

Despite challenges, there are successful models of regulatory reform and power market restructuring in emerging and developing economies that could offer valuable insights into Africa's energy sector transformation. A noteworthy example of power sector reform that has enabled IPPs and corporates to enter PPAs is in Namibia, described in Case study 2. Analysis indicates that, where private sector participation is permitted, private operators have performed successfully across various technical and commercial metrics (Grids4Africa, 2021).

Case study 2

Market reform in Namibia

NamPower, the government-owned electricity utility, controls most generation capacity, the entire transmission network and parts of the distribution network, and certain municipalities own certain sections. NamPower either generates electricity or buys it from IPPs and sells it to customers, municipalities and regional electricity distributors.

The government-initiated reforms in the electricity distribution industry, establishing three regional electricity distributors. NamPower is the sole buyer of electricity and operates the country's system and market, with exceptions such as embedded generators, self-generation, and off-grid mini-grids. A new market platform, the modified single buyer market model, was approved in April 2019, allowing certain customers to purchase energy directly from IPPs.

Implementation was phased, starting with transmission-connected customers in September 2019, followed by distribution customers in July 2021. Additional customers are planned for July 2026. Phases 1a and 1b allow bilateral wheeling (where the electricity is transported directly to the buyer), exports and trading of electricity. Phase 2 permits imports once Namibia achieves around 80% self-sufficiency in supply. The modified single buyer platform has enabled organisations to enter into PPAs to purchase renewable energy[12].

12 Baker McKenzie. (2019). Opportunities for corporate procurement of power in sub-Saharan Africa.

2.2 Renewable energy procurement mechanisms

In the face of utility constraints, PPAs and other market mechanisms can support the development of renewable energy generation and enable Mobile network operators (MNOs) to decarbonise. However, power sector markets must evolve to allow for IPPs and private off-taker companies to enter into PPAs.

Renewable energy market mechanisms, such as PPAs, provide a solution to de-risk and support renewable energy generation. In vertically integrated utilities, the off-taker is the utility. In cases where the utility is not creditworthy, wheeling would be necessary through a corporate PPA. To facilitate the entry of IPPs and private companies into PPAs, the power sector market needs to adapt by:

- Implementing feed-in tariffs and other incentives such as take-or-pay arrangements, capacity deals and tax exemptions
- Expanding and modernising grid infrastructure
- Streamlining approval processes and standardising contract terms to speed up PPA negotiations (for example, in South Africa the licence threshold was increased to 100MW, and environmental authorisations were streamlined or exemptions provided for solar PV and battery energy storage system (BESS) projects under specified circumstances)
- Providing clarity and stability in regulatory frameworks to instil investor confidence and attract long-term investments
- Establishing clear procurement guidelines and market rules to promote competition and fair pricing in the power sector to enhance the bankability of PPAs
- Offering guarantees or risk-sharing mechanisms to mitigate political, regulatory and market risks associated with PPA investments

13 Eskom. (2023). Virtual Wheeling Platform.
14 Dr. Langniß Energie & Analyse. (2023). Progressing an Energy Attribute Certification system for South Africa.
15 RCREEE. (2023, May 18). IREC – RCREEE MoU Signing.

Renewable energy markets in Africa

South Africa

PPAs: In South Africa, most corporate PPAs are either on-site or off-site (where electricity is generated at or nearby to the location where it will be used, without using the national grid) private agreements, or are offsite physical PPAs that use wheeling, with a mechanism to charge for wheeling. Wheeling helps more renewable energy to be developed in South Africa. To use traditional wheeling, the customer must be connected to a medium to high-voltage network and must be on a time-of-use (TOU) tariff (which has on-peak and off-peak pricing). The electricity supplier (such as the utility, Eskom or local council) needs to have wheeling frameworks in place. Energy supply agreements between the electricity buyer, Eskom, and, in some cases, municipalities need to be updated to support wheeling. Few municipalities can support wheeling, and the uptake of wheeling has therefore been restricted to large Eskom-connected buyers.

Virtual wheeling: In 2023, Eskom announced a collaboration with Vodacom and Mezzanine to develop a virtual wheeling platform (VWP). This platform aims to facilitate renewable energy generation for buyers in multiple locations and low-voltage buyers. Virtual wheeling will connect buyers that have multiple off-take sites (including those behind municipal boundaries) to generators, either via the Eskom or municipal grids. The VWP is a digital tool used to collect, combine, process and report TOU data for electricity generation and consumption. This enables Eskom to calculate the buyer's wheeled energy refund (not a credit as with traditional wheeling). The VWP will provide oversight of wheeling transactions and wheeling activities from the IPP generation and the load off-takers, namely end-users connected through their municipality and Eskom direct[13].

Renewable Energy Certificates: South Africa has two Energy Attribute Certificate (EAC) systems. An international REC system, and a local system, Renewable Energy Certificate South Africa market participant's association. In 2021, 482GWh of certificates were issued in South Africa. At the end of 2023, the JSE launch the JSE Ventures Carbon Market, a new trading platform to buy and sell RECs in local or global registries. Nevertheless, the impact on the electricity market has been limited since Renewable Energy IPP Procurement Plan plants are not covered by the scheme[14].

Egypt

Egypt has seen positive developments related to RECs. The Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) and the International Renewable Energy Certificates Standard Foundation (I-REC Standard) signed a memorandum of understanding in May 2023. This agreement is a step towards facilitating standardised REC schemes in the Middle East and North Africa and the wider Arab world. The agreement aims to engage more RCREEE member states to adopt, issue and participate in the REC market[15]. Vodacom Egypt successfully negotiated the use of renewable power purchasing with Egypt's government. Approximately 65% of electricity consumed by Vodacom Egypt is through this agreement, with the goal to increase this percentage in future.

Democratic Republic of Congo (DRC)

Energy Peace Partners (EPP) is a non-profit dedicated to creating climate and finance solutions for vulnerable countries in sub-Saharan Africa. They introduced the "Peace Renewable Energy Credit" (P-REC) to help companies procure renewable energy while supporting projects in communities. P-RECs are international renewable energy certificates with additional benefits certified by EPP. Microsoft and Google have invested in P-RECs in DRC and South Sudan. Microsoft recently made a second investment in P-RECs for a solar project in Congo. Microsoft's latest deal involves partnering with a Congo-based solar developer facilitated by 3Degrees, making them the first repeat buyer of this type of certificate. This transaction is Microsoft's largest P-REC purchase to date, following their initial investment in 2020, which funded streetlights connected to a solar mini-grid in DRC.

2.3 Mini-grids

Most people without electricity (over 80%) live in rural areas. In these areas, mini-grids and stand-alone SHS are considered the most cost-effective solutions.

Using mini-grids to power mobile network base stations will require lower connection costs through grants, collaboration between MNOs and developers to secure funding and addressing logistical challenges, among others.

To realise the opportunity presented by mini-grids to power mobile network base stations, connection costs could be lowered through a grant or public funding to make the business case more attractive for mini-grid developers and base station companies, especially for base stations in remote locations that require long electrical distribution connections. MNOs and mini-grid developers need to collaborate to access energy transition funding. MNOs can use their strong balance sheet and serve as reliable off-takers to increase the bankability of the mini-grid, supporting the mini-grid developer in accessing finance. Mini-grids powered by run-of-river hydropower generators can provide a more reliable supply of renewable energy throughout the day at a competitive cost. Potential run-of-river locations that can serve base stations need to be identified.

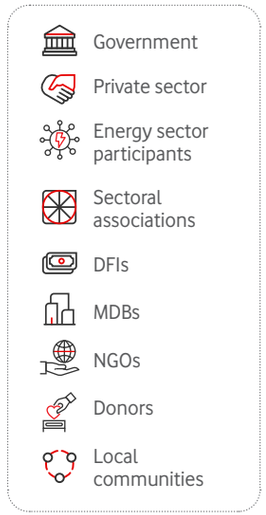
2.4 Collaboration opportunities

To overcome electricity infrastructure, policy and regulatory challenges, Table 1 outlines opportunities for various stakeholders to collaborate and implement practical solutions to the challenges.

Each opportunity is categorised by its primary focus area, the potential magnitude of carbon mitigation, the complexity of realisation, and the key stakeholders involved. This comprehensive overview highlights the critical areas where MNOs can drive meaningful change and foster partnerships to support sustainable energy practices.

Table 1 Multi-stakeholder collaboration opportunities for overcoming electricity infrastructure, policy and regulation decarbonisation barriers and realising opportunities

Collaboration opportunity	Opportunity description	Primary solution areas	Key stakeholders	Potential carbon mitigation impact	Complexity of realising opportunity
PPPs	Collaboration between MNOs, government and private sector developers can drive investment in grid infrastructure improvements and renewable energy projects. These partnerships leverage financial and technical strengths for mutual benefit.	• Power sector reform • Private sector participation • Renewable energy • Procurement mechanisms			High
Power sector reforms	Advocating for and participating in power sector reforms can help enhance utilities' financial stability, enabling increased investment in renewable energy and grid modernisation. This involves restructuring tariff systems and facilitating private sector participation.	• Power sector reform • Private sector involvement			High



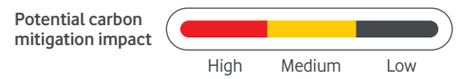


Table 1 **Multi-stakeholder collaboration opportunities for overcoming electricity infrastructure, policy and regulation decarbonisation barriers and realising opportunities** continued

Collaboration opportunity

	Opportunity description	Primary solution areas	Key stakeholders	Potential carbon mitigation impact	Complexity of realising opportunity
Development and utilisation of off-grid solutions	Partnering with mini-grid developers allows MNOs to power mobile base stations in off-grid areas. As anchor customers, they provide a stable revenue stream, making projects financially viable and ensuring reliable power for operations.	• Mini-grids			Medium
Renewable energy market mechanisms	Developing and procuring renewable energy through PPAs, RECs and green tariffs help MNOs secure clean energy while supporting the growth of the renewable energy market in Africa.	• Renewable energy procurement mechanisms			Medium
Capacity building and technical assistance	Collaborating with DFIs and MDBs will build utilities' and other stakeholders' technical and institutional capacity. This includes training programmes, technical assistance and financial resources to improve energy infrastructure.	• Power sector reform • Private sector involvement			Medium
Policy advocacy and regulatory engagement	Policy advocacy helps streamline regulatory frameworks and reduce barriers to renewable energy investment. By engaging with regulatory authorities, MNOs help create a conducive environment for decarbonisation initiatives.	• Power sector reform • Private sector involvement • Renewable energy procurement mechanisms			High
Innovative financing mechanisms	Innovative financing mechanisms such as green bonds, climate funds and blended finance can support renewable energy projects. These mechanisms attract investment and reduce the financial risks associated with decarbonisation efforts.	• Renewable energy procurement mechanisms			Medium
Community engagement and social impact initiatives	Engaging with local communities and non-governmental organisations (NGOs) enables MNOs to develop socially inclusive decarbonisation projects. These include community-owned renewable energy projects, job creation and improving access to clean energy in underserved areas.	• Mini-grids			Low

Potential carbon mitigation impact

High Medium Low

Government
Private sector
Energy sector participants
Sectoral associations
DFIs
MDBs
NGOs
Donors
Local communities

Ensuring effective and successful collaboration among these stakeholders will require the following:

- **Clear roles and responsibilities:** Roles and responsibilities for stakeholders should be clearly outlined. Defining interactions among ministries, roles of developers, and duties of MNOs are essential for effective collaboration and accountability, as demonstrated in Rwanda (Case study 1).
- **Building trust and relationships:** Establishing trust between the private sector, particularly MNOs, and the government is paramount. Addressing distrust is essential for fostering collaboration.
- **Building a solid case:** Advocating for a shift towards green energy and grid upgrades is essential. However, a strong case needs to presented to justify why limited public resources should be invested in energy projects instead of other critical areas like health and infrastructure. MNOs have a strong case to support reliable energy provision to communities, as they provide communication services. Mobile services, including mobile broadband, play a pivotal role in unlocking opportunities for underserved populations, contributing to economic growth and aligning with the United Nations Sustainable Development Goals, as the GSMA's Mobile for Development initiatives emphasised.

2.5 Conclusion

The solutions discussed above are summarised below:

Table 2 Primary electricity infrastructure, policy and regulatory decarbonisation related challenges and solutions for governments and utilities identified in this report.

Primary challenges to decarbonisation

	Summary of challenges	Summary of solutions
Absent or unreliable electricity supply	Many regions in sub-Saharan Africa, mainly rural areas, lack adequate grid infrastructure. About 600 million people do not have access to electricity, and others suffer frequent power outages[5]. This severely limits socioeconomic development and impacts business operations.	Substantial investment in Africa's grids and generation capacity is critical. Investment will go to modernising and expanding grid infrastructure, improving system reliability, and increasing generation capacity with clean and reliable energy, which are essential steps.
Financial constraints and limited capacity of utilities	African utilities often operate at financial deficits due to underpriced tariffs, poor payment collection, theft, vandalism, operational problems, and high network losses. Thus, utilities cannot extend the grid, maintain existing infrastructure and develop new generation capacity to meet demand.	Major system-wide changes and private sector involvement can address these challenges. Actions include restructuring tariff systems, phasing out subsidies, leveraging concession agreements, and creating regulatory frameworks that support private investment. Private sector companies, such as MNOs, can serve as creditworthy off-takers (for example, through PPAs).
Carbon intensity of the grid	The amount of carbon emitted by electricity grids varies significantly across Africa. Some countries rely heavily on fossil fuels, which leads to high greenhouse gas emissions.	Developing a robust renewable energy market can support decarbonisation. This involves implementing PPAs, RECs, and green tariffs to promote renewable energy investments and reduce grid carbon intensity.
New market mechanisms to procure renewable energy	The lack of methods to procure renewable energy is a challenge to decarbonisation. Most African countries lack frameworks for PPAs, RECs, and other market instruments.	Establishing renewable energy procurement mechanisms such as PPAs, RECs, and green tariffs can accelerate decarbonisation. This includes creating standardised contract terms, offering regulatory clarity, and providing financial incentives for renewable energy projects.
Complex regulatory frameworks and political risk	Unclear and complex regulatory frameworks and political instability deter investment in renewable energy. Inconsistent policies and shifting government agendas create uncertainty for investors.	Streamlining approval processes, providing regulatory stability, and implementing clear procurement guidelines can attract investment. Offering guarantees and risk-sharing mechanisms can mitigate political and market risks.
Limited private sector participation in transmission and distribution	Governments are often reluctant to allow private companies to run electricity networks (transmission and distribution methods), and the private sector is hesitant to invest due to complexity (affordability, regulations and policy) and uncertainty about return on investment.	Encouraging private sector participation through concessions (where the government owns a utility, but a private company runs it), regulatory carve-outs (where certain projects are exempt from standard regulations), and PPPs can improve grid infrastructure. Implementing feasible business models, such as ITPs under build-operate-transfer schemes, can facilitate private investment.
Cost and technical challenges of powering base stations with green mini-grids	Powering mobile network base stations through mini-grids is challenging due to high connection costs, especially in remote locations requiring long, medium-voltage transmission lines. Achieving a 100% renewable energy supply is not profitable currently.	Lowering connection costs through grants and public funding, collaborating to access energy transition funding, and identifying hydropower opportunities (using flowing rivers) can make mini-grids viable for powering base stations.

Decarbonisation solutions currently available to MNOs will be outlined in the next chapter of this series.

Footnote 5 referenced above can be found on page 03