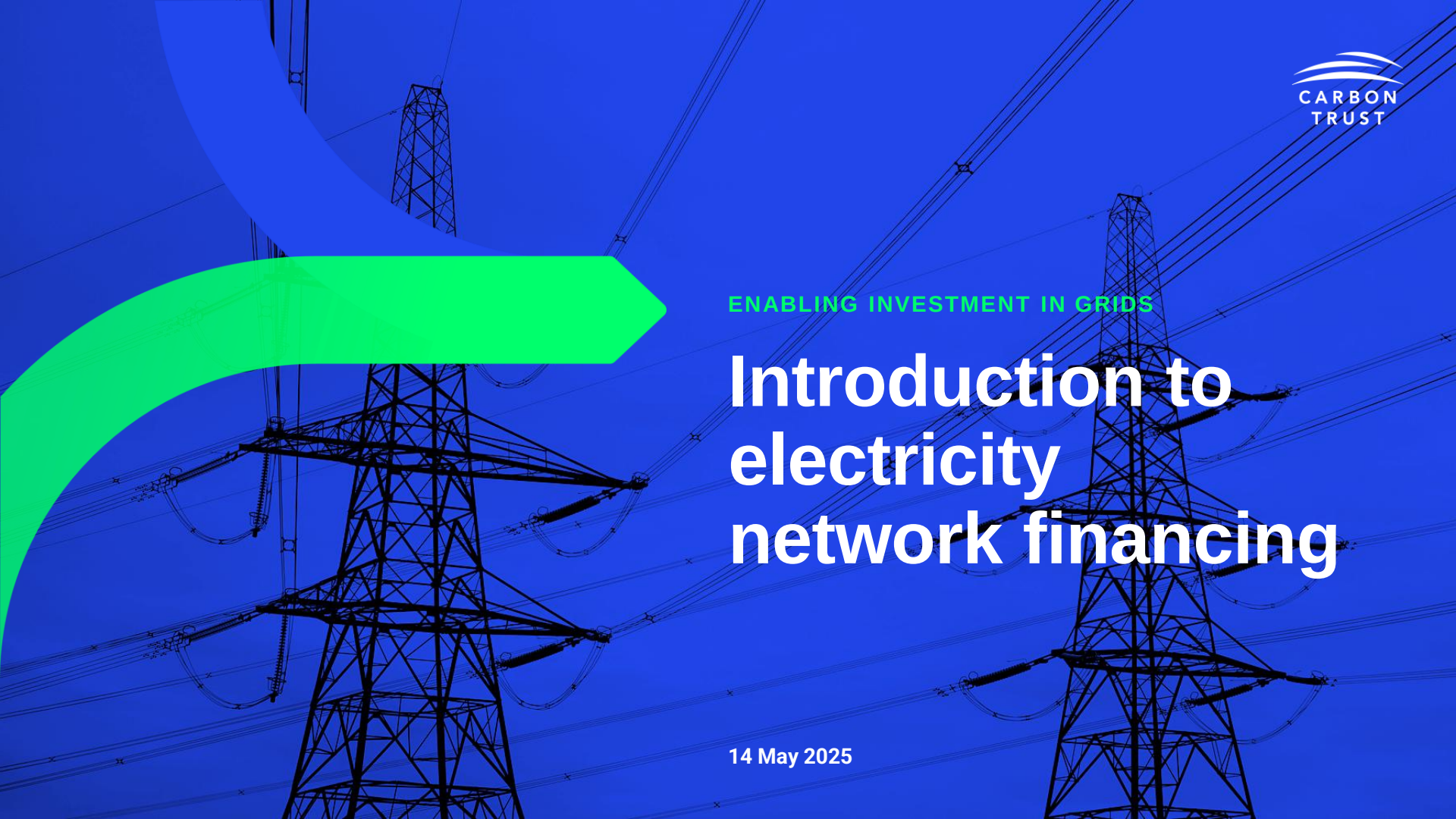


CARBON TRUST

ENABLING INVESTMENT IN GRIDS

Introduction to electricity network financing

14 May 2025

Grid financing is an essential facilitator of the energy transition

Grid Investment supports renewable energy deployment

Without available grid to transmit power, revenues and subsequent investment returns from renewable power is at risk. Without available transmission capacity, assets are curtailed. The IEA estimates that upwards of 2,000 terawatt-hours of potential renewable energy could be curtailed by the end of this decade without significant grid improvements.

Huge investment in grid infrastructure is needed to facilitate the energy transition

The IEA forecasts that ~$820 billion per year in grid investments is needed by 2030 to support the energy transition, with 10 million km of new transmission lines needed by 2050. According to BloombergNEF, achieving global net-zero emissions by 2050 will require transmission investment amounting to $21 trillion and concerns are being raised globally that insufficient action is being taken to secure this investment at the pace required.

About this document

This document offers a comprehensive overview of organisational structures and funding mechanisms employed by grid companies to invest in new infrastructure. While the case studies primarily focus on grid financing, it's important to note that other factors out of scope for this document, such as policy, regulatory, operational, technological, and market considerations, may also play significant roles in supporting grid expansion and optimisation.

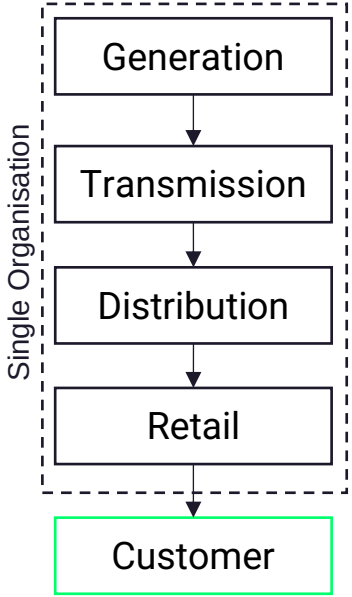
Grid organisation and ownership

Grid organisational structure and ownership model are fundamental to the types of financing used both currently and what may be appropriate going forwards to unlock future investment.

Electricity system organisational structures

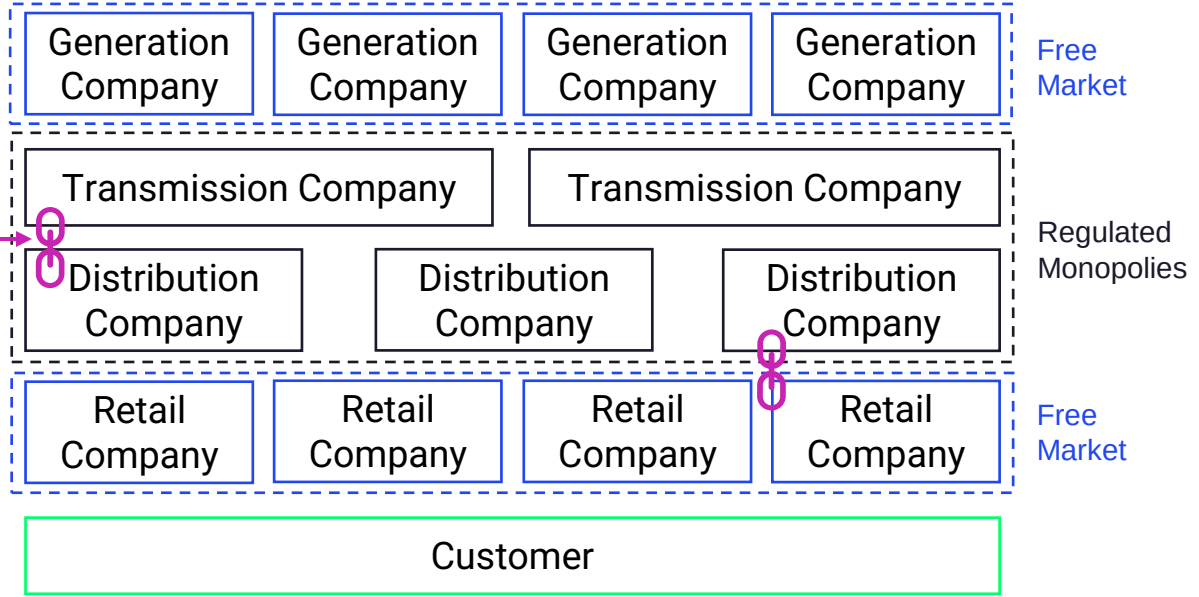
Electricity system organisational structures vary globally, with the two most common structures being “vertically integrated” and “unbundled”. Some systems may contain components of both vertically integrated and unbundled system – referred to as “mixed” systems.

Vertically Integrated



Some unbundled systems **may have vertically integrated elements**, such as a single organisation controlling transmission and distribution, or distribution and retail. These systems can be **referred to as “mixed”**

Unbundled



Electricity system organisational structures

Organisational structure influences system Bloomberg NEF operation, planning and regulation and optimal financing mechanisms. Although many energy systems globally are undergoing unbundling to leverage the efficiencies of market competition, challenges persist, such as intricate stakeholder coordination and complex regulatory frameworks.

	Ownership + Operation	Investment Incentives	Regulation	Financing Dynamics	System Operation
Unbundled separation of the electricity supply chain into distinct entities	Separate ownership and operation among different entities	TSOs invest based on grid needs and regulatory mandates	Requires more complex regulatory frameworks to manage independent entities	May face higher financing costs due to their focused but narrower revenue streams	System operator can be a public body or private organization, often separate from the network owner(s).
Vertically Integrated the same entity owns and operates the entire electricity supply chain	Centralised control and ownership	Invest to support their generation and distribution assets	Simpler, but potentially less transparent	May benefit from economies of scale and a broader revenue base	System operator is typically part of the vertically integrated utility

Vertically integrated vs unbundled: global trends

Europe

Mostly unbundled due to EU regulations such as the Third Energy Package

Africa

Largely vertically integrated, with some nations (e.g. South Africa) transitioning to unbundled.

North America

USA: mostly unbundled, but some areas (e.g. the South-West) are vertically integrated.

Canada: Mix of unbundled and vertically integrated.

Oceania

Mostly Unbundled.

Asia

China: vertically integrated.

India: Mix of unbundled and vertically integrated.

Japan: unbundled.

SEA: Largely vertically integrated.

South America

Largely vertically integrated, with reforms leading to mixed systems in places like Brazil and Chile.

Transmission ownership and operational models

Transmission networks can be owned and operated under various models depending on the country, regulatory environment, and market structure, with each model leading to a different mix of key stakeholders involved in grid investment decisions. Key ownership models include:

Full State Ownership → **Full Private Ownership**

State Ownership

Fully Owned and operated by the government or a state-owned entity. The government may directly manage the network or delegate it to a public utility.

Examples: China (State Grid Corporation of China), France (Réseau de Transport d'Électricité - RTE)

Public-Private Partnerships

Transmission network is owned jointly by the government and private entities. Combines the efficiency of private sector with public sector oversight.

Examples: Some transmission projects in Australia and India have used PPP models.

NB: Fully privately owned energy systems can be *either* vertically integrated *or* unbundled. Ownership is independent of organisational structure.

Concession Agreements

Government retains ownership of the transmission network but leases it to a private company for operation, maintenance and investments.

Examples: Some countries in Latin America and Africa have used concession agreements for their transmission networks.

Independent System Operator

Ownership of transmission assets may be separate from their operation. An ISO manages the operation of the transmission system, and may be publicly or privately owned.

Examples: California ISO (CAISO) in the United States, which operates but does not own the transmission network.

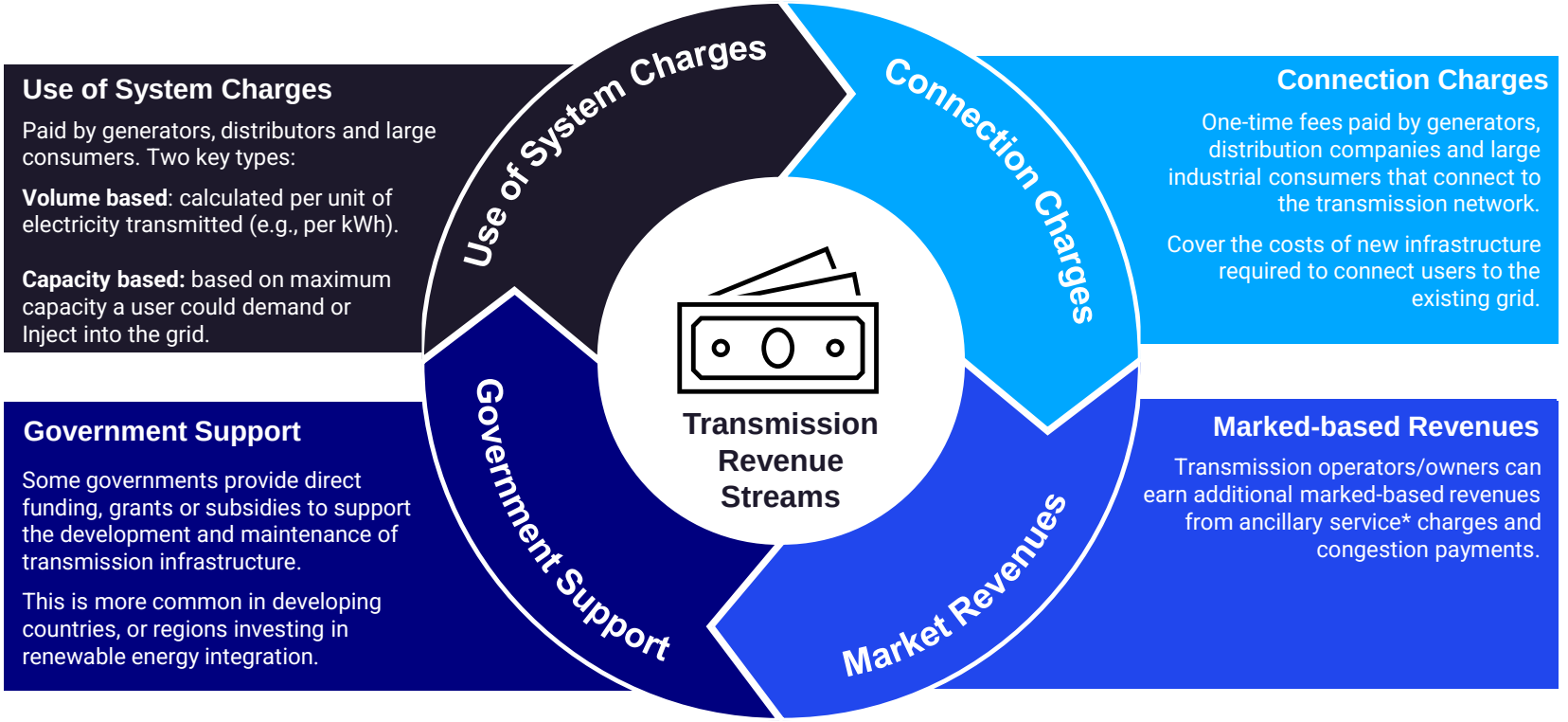
Private Ownership

Fully owned by private companies. These companies can be investor-owned utilities, independent transmission companies, or consortiums.

Examples: United States (many regional transmission organisations like PJM Interconnection), the UK (National Grid)

There are four main revenue models used in grids

Transmission systems are funded through a variety of revenue streams that ensure infrastructure is maintained, upgraded and expanded as needed in a financially sustainable manner.



Use of System Charges

Paid by generators, distributors and large consumers. Two key types:

Volume based: calculated per unit of electricity transmitted (e.g., per kWh).

Capacity based: based on maximum capacity a user could demand or Inject into the grid.

Connection Charges

One-time fees paid by generators, distribution companies and large industrial consumers that connect to the transmission network.

Cover the costs of new infrastructure required to connect users to the existing grid.

Government Support

Some governments provide direct funding, grants or subsidies to support the development and maintenance of transmission infrastructure.

This is more common in developing countries, or regions investing in renewable energy integration.

Marked-based Revenues

Transmission operators/owners can earn additional marked-based revenues from ancillary service* charges and congestion payments.

*Ancillary services are a set of processes that enable the transportation of electricity around the grid while keeping the power system operating in a stable, efficient and safe way.

Financing Options

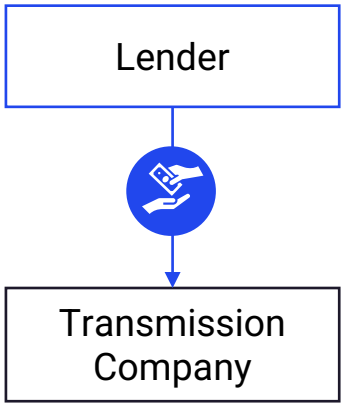
Corporate vs Project Financing as methods for supporting investment in grids

Corporate vs Project Financing

Financing of transmission networks can be split into two key categories: Project Financing and Corporate Financing

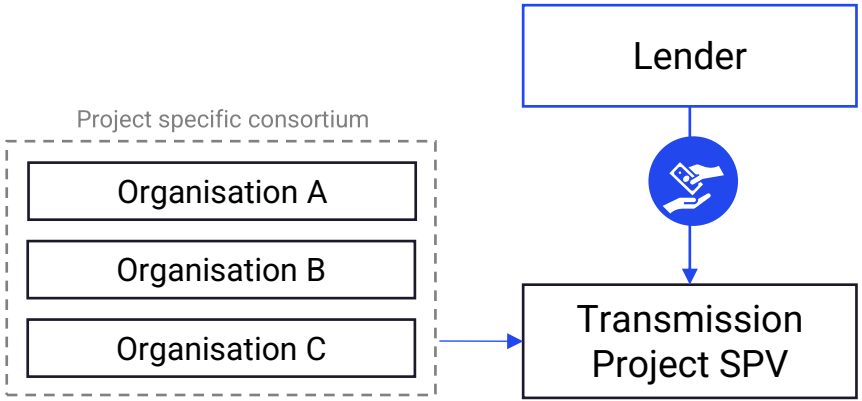
Corporate Finance

- Relies on the transmission company's balance sheet to secure loans.
- Typically used by state-owned transmission companies or privately-owned transmission companies with a strong balance sheet.



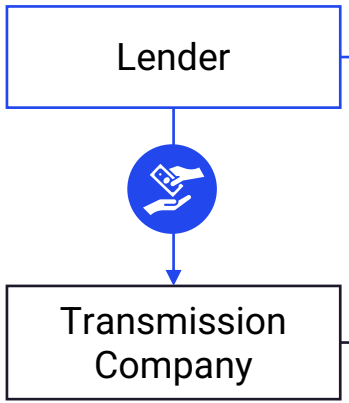
Project Finance

- Secures funding based on the commercial rational and cash flow of a specific project.
- Typically used by private/independent transmission companies, or state-owned companies with poor financial health.



Corporate Financing

Relies on the transmission company's balance sheet to secure loans to cover the initial capital cost of investments.



The Lender:
In corporate financing, the lender is providing capital to a known entity with a history. If the project fails, the lender has recourse, and it can claim the transmission company's assets.

The sources of capital could be:

- **The Government**, allocating funds from its national budget.
- **Export Credit Agencies (ECAs)**, like the US Export-Import Bank and UK Export Finance support financing by providing direct loans or guarantees for exports.
- **Commercial Banks**, providing debt financing, typically supported by DFIs or ECAs.
- **Development Banks**, such as Development Financial Institutions (DFIs) or Multilateral Development Banks (MDBs).
- **Equity**, where financing is provided by project developers, contractors, infrastructure funds, and sometimes industrial sponsors like mining companies.
- **Debt financing**, can come from public or private institutions.

The Borrower:

State-owned transmission companies or utilities, but also large private/publicly listed energy/transmission companies. For example, National Grid in the UK employs cooperate dept, equity and commercial financing. The debt is paid off through the company's revenue model.

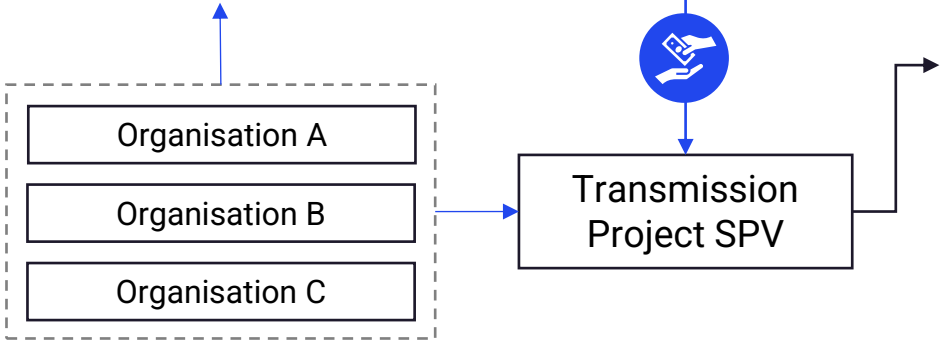
NB: lenders will rarely write a blank check to a transmission company. Funding is typically raised for a specific project or business plan.

Project Financing

Secures funding based on the commercial rational and cash flow of a specific project. Typically used by private/independent transmission companies or for private-public partnerships.

Project specific consortium

SPVs are typically owned by a combination of shareholders, which might include independent transmission companies, project developers, contractors, investors or financial institutions.



The Lender:

In project financing, the lender is providing capital to a project company/SPV. There is typically less recourse for the lender if things go wrong, as they can only claim the project company's/SPVs assets, rather than the wider transmission network. The sources of capital are the same as corporate financing, typically a mix of debt and equity where cash flow from the project itself is used to repay loans.

The Borrower:

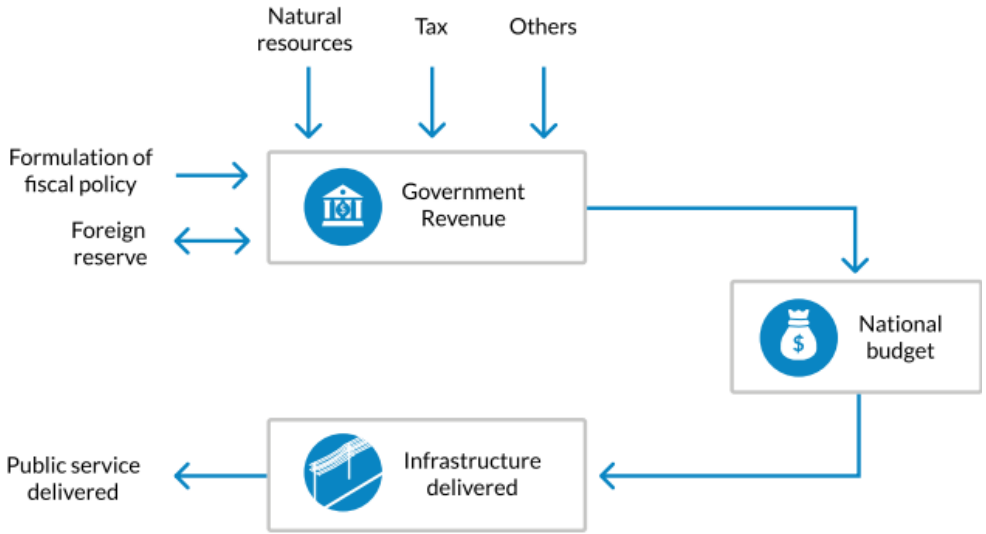
A Special Purpose Vehicle (SPV) is a legal entity set up specifically for a project. It isolates the projects financial risks from the other organisations involved in the project. In a transmission project, an SPV could be created to finance, build and operate the network. The SPV would raise debt and equity specifically for the project, and its revenues would be used to repay the lenders and provide returns to equity investors.

Capital Sources

Different capital sources are appropriate in different circumstances. Often all of those listed in the section below can be applied to both project or corporate financing models.

Capital Sources: Direct Government Investment

Including sovereign wealth funds. Direct government investment used to be commonplace but is becoming increasingly rare.



Advantages:

- **Control:** The government retains full ownership and control over the transmission infrastructure.
- **Lower Financing Costs:** Government funding often comes at a lower cost, as there is no need to raise expensive external capital.

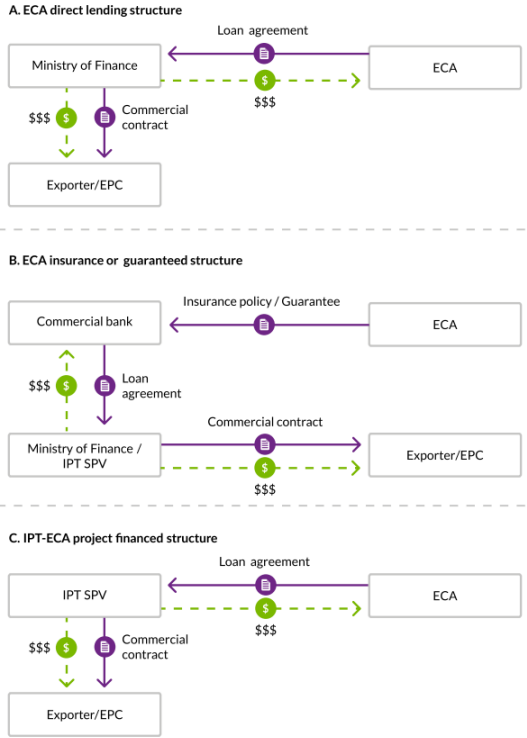
Disadvantages:

- **Budgetary Pressure:** Large investments in transmission infrastructure can put significant strain on national budgets, often leading to delays or underfunding as government priorities shift.
- **Slow Accumulation:** Accumulating funds over time can delay project execution, slowing down grid expansion.

Source: United State Department of Commerce: Understanding Transmission Financing

Capital Sources: Export Credit Agencies (ECA)

Export Credit Agencies (ECAs), like the US Export-Import Bank and UK Export Finance support financing by providing direct loans or guarantees for exports.



Advantages:

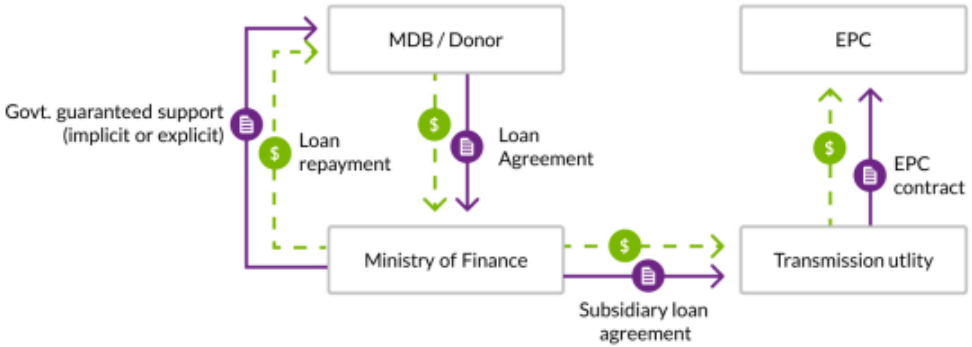
- **Risk Mitigation:** provide guarantees, insurance, and loans to reduce the risk for exporters and lenders, helping projects attract commercial financing.
- **Flexible Terms:** offer loans with longer repayment periods (up to 12-18 years) compared to commercial banks.
- **High Loan Coverage:** can finance up to 85% of the export contract value, which provides significant financial support.

Disadvantages:

- **Higher Costs:** financing is generally more expensive than concessional financing from MDBs due to the commercial nature of their loans.
- **Country and Supplier Ties:** loans often come with conditions to purchase goods and services from the lender's country, limiting procurement options.

Source: United State Department of Commerce: Understanding Transmission Financing

Capital Sources: Multilateral Development Banks (MBDs)



MDBs and donor-funded institutions can provide concessional loans or grants to governments for approved projects that adhere to their procurement standards. They can also finance private-sector independent power transmission projects.

Advantages:

- **Low-Cost Financing:** MDBs, such as the World Bank and African Development Bank, offer concessional loans with low interest rates and long repayment terms.
- **Political Risk Mitigation:** MDB involvement can mitigate political risks and signal project credibility to other investors.

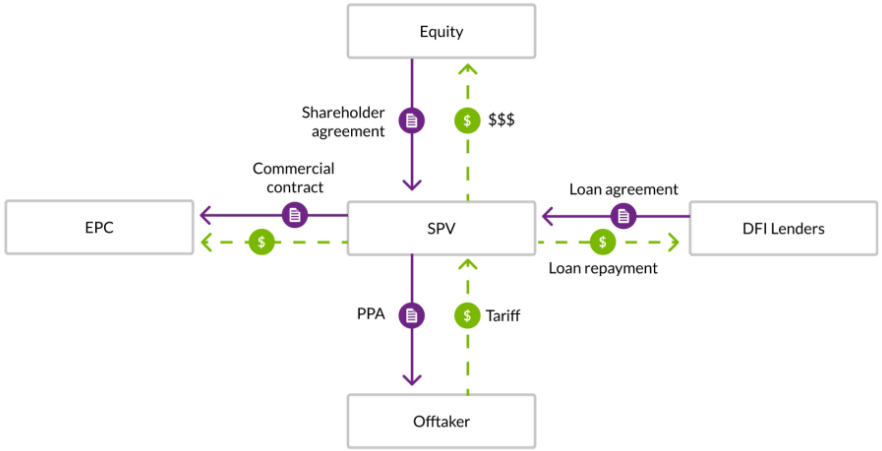
Disadvantages:

- **Lengthy Processes:** Securing financing from MDBs can be time-consuming due to the need to meet strict procurement guidelines and compliance requirements.
- **Country Limits:** MDBs have sectoral and country-specific limits, so countries may have to prioritise projects to stay within funding envelopes.
- **Conditionality:** MDB financing often comes with requirements that can limit a country's flexibility in project design and execution.

Source: United State Department of Commerce: Understanding Transmission Financing

Capital Sources: Development Financial Institutions (DFIs)

DFIs, including MDBs, are often majority-owned by governments and obtain capital from national or international development funds or government guarantees. Their strong creditworthiness allows them to raise substantial capital from international markets and offer competitive financing terms.



Advantages:

- **Long-Term Financing:** offer long-tenor commercial loans (up to 20 years) - suitable for infrastructure projects.
- **Private Sector Participation:** often support private sector involvement, especially in IPT projects
- **Risk Guarantees:** provide risk guarantees (e.g., partial credit and risk guarantees) to cover political and commercial risks, improving project bankability.

Disadvantages:

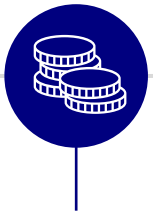
- **Conditional Lending:** often require borrowers to meet strict governance and transparency requirements, which can complicate project approval and execution.
- **Dependency on Governance:** may hesitate to provide loans to state-owned utilities without proven independent governance and financial stability.

Source: United State Department of Commerce: Understanding Transmission Financing

Capital Sources: Risk Allocation

Four key high investment models in relation to allocation of financial risks

Risk to taxpayers



Risk to private sector

Direct Government Funding

The Government directly funds the expansion and maintenance of transmission infrastructure from its fiscal budget.

Pros: Public control, long term planning and lower cost of capital

Cons: Budget constraints, inefficiency, bureaucracy and politicisation

Example country:
China/France

Government Backed Borrowing

The Government borrows funds to finance transmission infrastructure. Loans are typically backed by the government's credit, making them more secure for lenders.

Pros: Access to large volumes of capital at low cost.

Cons: National dept, politicisation and dependency on market conditions

Example country:
The Netherlands/Germany

Public-Private Partnership

A collaboration between Government and the private sector. The private sector typically provides funding and expertise, while the government may offer guarantees, subsidies or regulatory support.

Pros: Private sector efficiencies, risk sharing, attracts investment

Cons: Complex contracts, profit motives, long term commitments

Example country:
Brazil/Peru

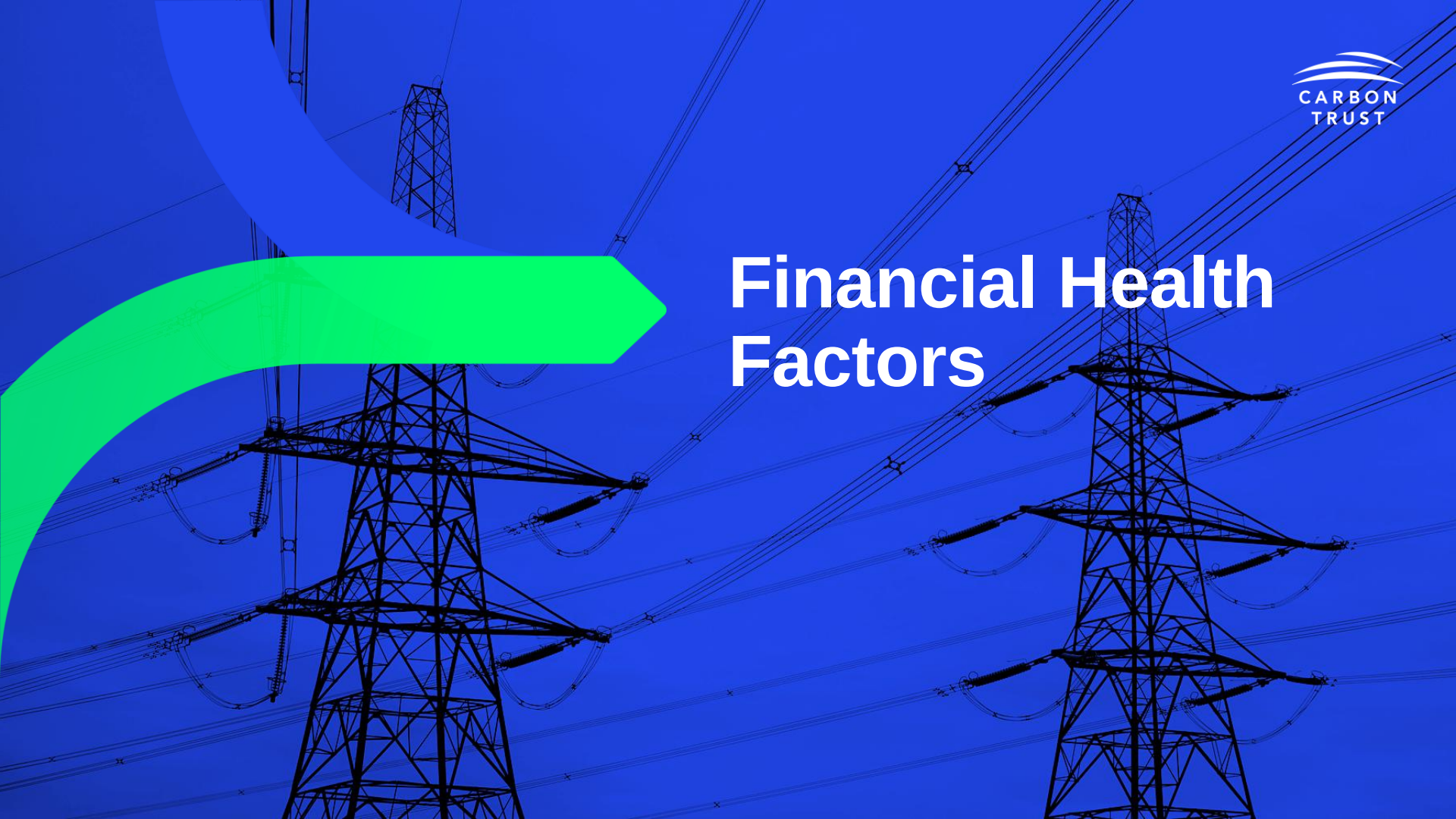
Private Investment

Private companies finance, build, own, and operate electricity transmission infrastructure. Normally involves significant regulatory oversight.

Pros: Efficient resource allocation, innovation, reduced public debt

Cons: Profit driven, complex regulation, market risks

Example country:
India/Chile



Financial Health Factors

Financial Health factors

Introducing private sector investment models becomes challenging when utilities are not financially sustainable

Metric	Description
National credit rating	Reflects a countries ability to meet its debt obligations, which impacts the borrowing costs for transmission infrastructure projects.
Network company debt to equity ratio	Indicates the financial leverage of network companies, which influences their capacity to finance transmission infrastructure. 1:1 is low; 1:2 is relatively high.
Energy theft rate	Energy theft and criminal damage affects the revenue of transmission companies, undermining financial sustainability.
Consumer debt rate	The rate of unpaid electricity bills affects the cash flow of transmission companies, impacting their ability to invest in infrastructure.
Energy bill caps	Government-imposed caps on energy bills can limit revenue for transmission companies, affecting profitability and long-term financial health.
Exchange rates	Exchange rates can affect the cost of imported equipment and foreign debt repayment for transmission companies.
Corruption	Corruption can impact procurement processes and the operational integrity of transmission companies.
Political stability	A volatile political environment can cause uncertainty that impacts the cost of capital for infrastructure projects.

Physical network characteristics

Physical network characteristics

Physical network characteristics can help assess the value of transmission system investments and expected revenue

Metric	Description
% of population with grid connection	The proportion of the population that has access to electricity through the grid. A higher percentage suggests a well-developed infrastructure and a larger customer base
Geographical network configuration	layout and design of the transmission network. Efficient network configuration can reduce transmission losses and improve reliability.
Average age of grid	Average age of the infrastructure components within the grid. Older grids may require significant upgrades or replacements, which can be costly but also present investment opportunities.
Renewable deployment targets	Government or corporate goals for the amount of renewable energy capacity to be installed by a certain date. High renewable deployment targets can drive the need for new transmission infrastructure to connect renewable energy sources to the grid.
Demand growth projections	Forecasts the future increase in electricity demand. Indicates scale of investment/reinforcement that may be required.
Network reliability	Ability of the transmission network to deliver electricity consistently without interruptions. Low reliability can be characterised as a revenue risk, or investment opportunity.
Level of interconnection	Extent to which the transmission network is connected to other regional or national grids. An indicate opportunities for exporting and importing electricity through interconnectors.

Case study: South Africa

Case Study: South Africa

Energy System Structure and Ownership

South Africa's energy system is **currently in the process of transitioning from a vertically integrated model to an unbundled structure**. Historically, Eskom, the **state-owned utility, has held a monopoly over the generation, transmission, and distribution of electricity,** but there are **efforts to introduce more privatisation** due to financial difficulties.

Funding mechanism and sources of capital

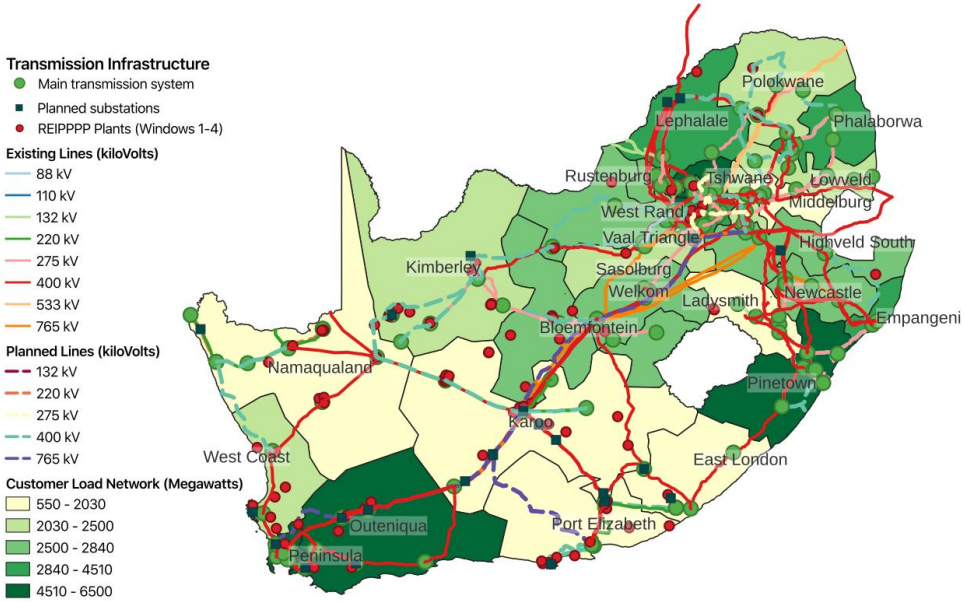
The transmission system has **historically been reliant on direct government investment and dept financing.** It is **increasingly leaning towards project financing models, especially through PPPs** to address the significant investment needs and reduce the financial burden on the government and Eskom.

Key challenges

- **Ageing infrastructure** leading to frequent load shedding and power cuts.
- **Huge investment needed** to integrate renewable generation sources.
- **Funding constraints** due to Eskom's huge dept burdens and historical mismanagement.
- **Political instability and industrial sabotage** of transmission infrastructure by those with vested interests in coal plants.

South Africa load-shedding: The roots of Eskom's power problem - BBC News

South African Transmission System: Physical Network Characteristics

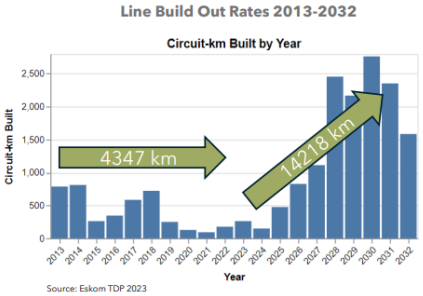


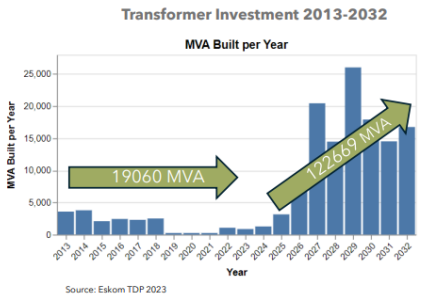
Metric	Status in South Africa
% of population with grid connection	~89.6% (2022)
Geographical network configuration	~28,000 km of HV lines (400 kV to 765 kV); 325,000 km of LV lines.
Average age of grid	~40 years. Some parts 50 years or older.
Renewable deployment targets	~190GW by 2050. Best load factors in the south.
Demand growth projections	~0.41% per year (2025-2029).
Network reliability	SAIDI: 48 hours; SAIFI: 20 interruptions.
Level of interconnection	Interconnected with 6 neighbouring countries.

Physical Network Characteristics

Massive transmission system reinforcement is needed to integrate renewable energy sources.

- South Africa's generation and transmission infrastructure is old, leading to regular power cuts and load shedding.
- Most of the best load factors for renewable generation are in the Southern Cape region, while most of the demand is in the North.
- Eskom's Transmission Development Plan aims to:
  - Increase the deployment of transmission infrastructure by 325% in the next ten years.
  - Increase transformer capacity by 600% in the next ten years.





South African Transmission System: Financial Health factors

The biggest hurdles for philanthropies investing in South African transmission infrastructure is the socio-political risks – these challenges introduce regulatory and policy uncertainty and put potential revenue at risk. Corruption is of particular concern, with reports of industrial sabotage of investments that undermine the business interests of state officials

Metric	Status in South Africa
National credit rating	Generally stable: Fitch: BB-, Moody's: Ba2, S&P BB-.
Network company debt to equity ratio	High. Eskom's debt to equity ratio is approximately 2.0.
Energy theft rate	Significant. In Johannesburg it is estimated that ~32% of electricity is lost to theft or non-payment. Eskom reports R20 billion a year total revenue losses due to theft.
Consumer debt rate	Moderate. The household debt to income ratio in South Africa is around 60%. In the UK, it's about 130%.
Energy bill caps	Yes. Set by As of the National Energy Regulator of South Africa (NERSA). Recently increased from R1.84/kWh to R2.07/kWh
Exchange rates	1 South African Rand (ZAR) is approximately equal to 0.043 British Pounds (GBP) (as of 11th of September).
Corruption	High. Ranks 83/180 countries in the Corruption Perceptions Index.
Political stability	Moderate. Political violence and internal conflicts within the ruling party contribute to political instability, such as the July 2021 unrest following the imprisonment of Jacob Zuma.

Summary: key opportunities and risks to investors

Opportunities:

- Great renewable generation potential in a country with high carbon emissions – huge grid investment is needed to unlock this potential.
- Transition from a vertically integrated to unbundled model opens opportunities for project financing, which could allow investors to insulate themselves from Eskom's debt burden.

Risks:

- Corruption and political instability introduce uncertainty and risk for investors, driving up cost of capital.
- Energy theft rates impact revenues. This is an issue for project financing, as project cash flows are used to repay loans.
- Recent reforms, such Eskom's unbundling into separate entities, are still in transition and outcomes

Case study: Nigeria

Case Study: Nigeria

Energy System Structure and Ownership

Nigeria's energy system was unbundled in 2005, and partially privatised in 2013, leading to the division of the National Electric Power Authority (NEPA) into several entities, including generation companies (GENCOs), distribution companies (DISCOs), and the Transmission Company of Nigeria (TCN). **The TCN remains a state-owned entity, while GENCOs and DISCOs have largely been privatised.**

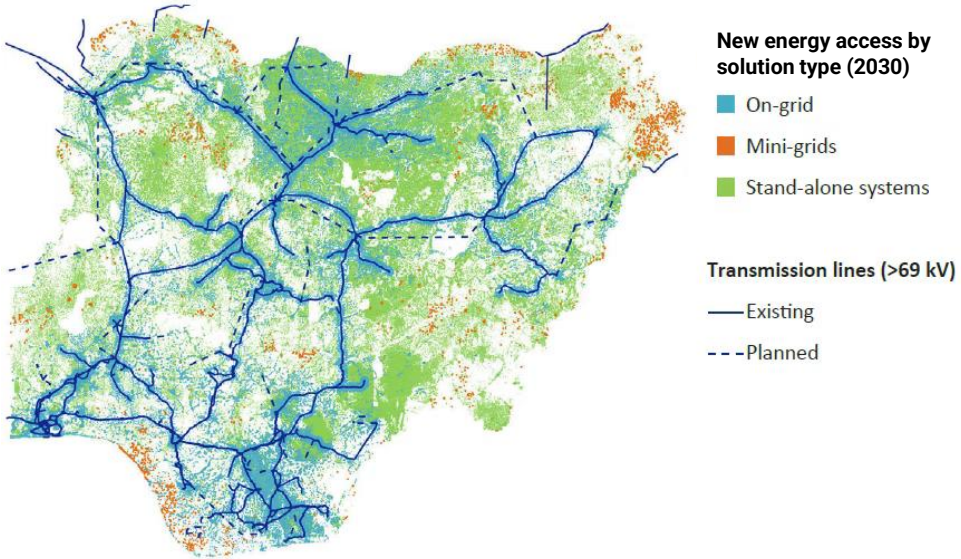
Funding mechanism and sources of capital

Established **GENCOs and DISCOs often rely on corporate financing**, but project financing is more common for microgrid and IPPs. **The state-owned TCN relies on a mix of funding from the government, development banks and PPPs.** Since its unbundling, Nigeria's microgrid sector has attracted substantial private investment from companies like Husk Power systems and PowerGen.

Microgrid expansion

Nigeria's microgrid plans are among the most advanced in Africa. Nigeria already has over 100 microgrids, which are vital to rural areas where approximately 75% of residents lack reliable access to electricity. Along with large level of private investment, the Nigerian government, African Development Bank and World bank have supported microgrid development through various policy and funding initiatives, including the Nigeria Electrification project.

Nigerian Transmission System: Physical Network Characteristics



While new transmission lines are planned in Nigeria, **most of the new connections by 2030 are expected to be from microgrids and standalone systems.** Source: World Economic Forum.

Metric	Status in Nigeria
% of population with grid connection	~50-60% have access to electricity (2024)
Geographical network configuration	Mix of 330kV and 132kV transmission lines that span over 20,000 km
Average age of grid	Ageing, some parts of the system are more than 40 years old
Renewable deployment targets	30% renewable mix by 2030 (~18% is currently hydroelectric with the remainder from natural gas).
Demand growth projections	High. ~5-7% a year.
Network reliability	Low. SAIDI and SAIFI not published.
Level of interconnection	Interconnected with the West African Power Pool (WAPP)

Nigerian Transmission System: Financial Health factors

Nigeria's state-owned transmission company (TNC) faces significant challenges in attracting corporate financing. High rates of energy theft, corruption, and a low national credit rating, coupled with the TNC's substantial debt, deter investors. These factors mean investors are more attracted to project financing of micro/minigrid systems, which are seen as less risky and often require lower upfront capital.

Metric	Status in Nigeria
National credit rating	Low. Nigeria's credit rating was downgraded to B- (Fitch) in recent years due to economic challenges and political instability.
Network company debt to equity ratio	High. TNC's debt to equity ratio is not published, but TNC faces financial challenges with high levels of debt relative to equity.
Energy theft rate	High. Up to 40% of distributed power is lost to illegal connections and unpaid bills.
Energy bill caps	Yes. Nigeria implements a Multi-Year Tariff Order (MYTO), which caps electricity tariffs based on inflation and exchange rate variations
Exchange rates	1 Nigerian Naira = 0.001 Pound Sterling (2024)
Corruption	High. Nigeria ranks 150/180 in the Corruption Perceptions Index, reflecting high levels of corruption across sectors, including power.
Political stability	Moderate. Challenges such as regional conflicts, economic disparity, and political tensions.

Summary: key opportunities and risks to investors

Opportunities:

- Around 85 million Nigerians still lack reliable access to electricity, and Nigeria has one of the highest population growth rates in the world of ~2.38%. This huge increase in demand is **an opportunity for substantial transmission investment and growth.**
- **Project financing could allow private investors to shield themselves from the debt burdens of TNC**. This has already been successful for microgrid projects, which could facilitate affordable energy access for millions.

Risks:

- **Nigeria's energy theft and corruption diminish the potential revenue of transmission companies**. This poses a substantial risk to project financing, as these initiatives rely heavily on consistent cash flow to repay investors.
- Despite supportive policies, **Nigeria's transmission sector faces a largely underdeveloped regulatory framework**. This includes ambiguities in defining private company roles, setting clear tariff structures, and incentivising rural investments.

Case study: Australia

Case Study: Australia

Energy System Structure and Ownership

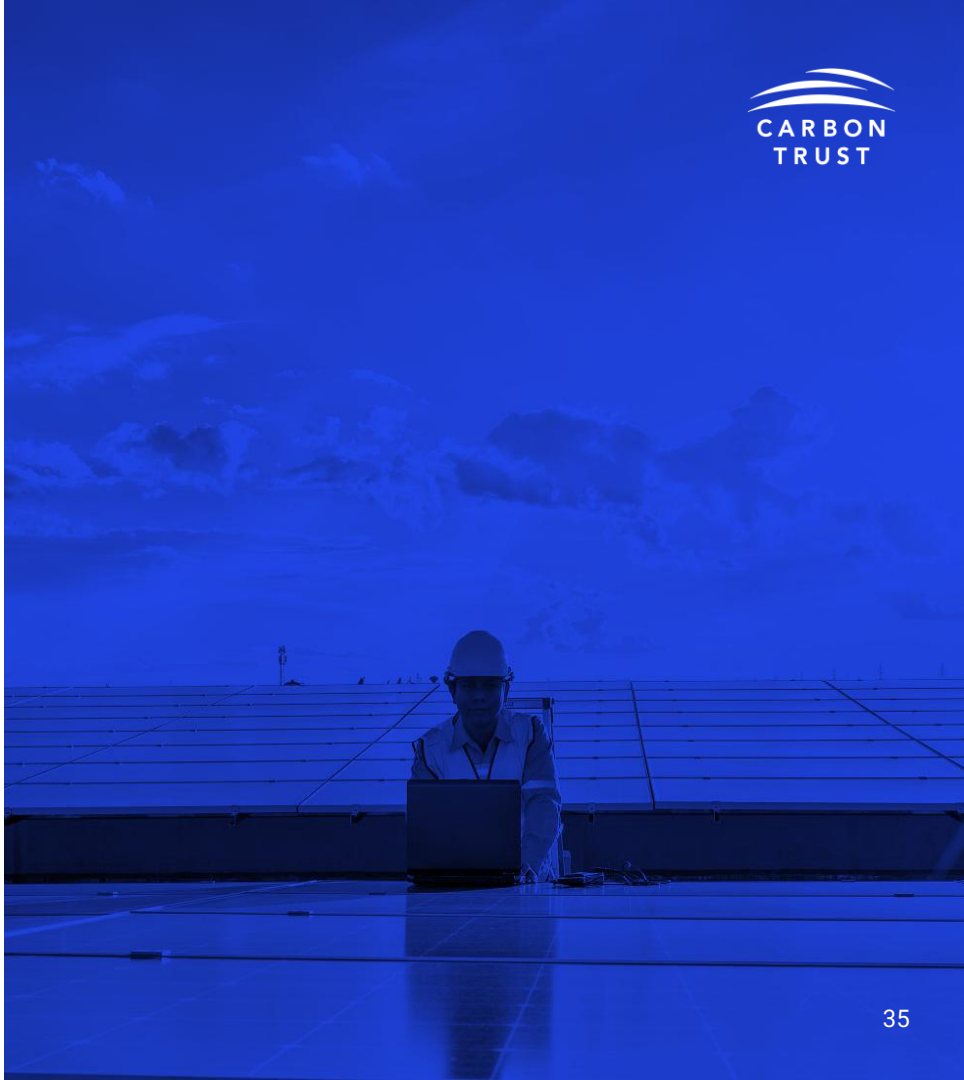
Australian states have autonomous control over their energy systems, with some states (NSW, Victoria and South Australia) having privately owned systems, while others (Northern Territory, Queensland, South Australia and Tasmania) are state run. All of the states participate in the National Energy Market (NEM) apart from the Northern Territory, which is also the only vertically integrated system.

Funding mechanism and sources of capital

Corporate financing is deployed widely across all states, with some employing project financing for large infrastructure projects. Stated owned systems are typically state funded, backed by government bonds, but also raise private debt/equity to assist in financing. Private systems have a larger reliance on commercial banks and funds for their capital.

Key challenges

- **Coordination between states:** Australia's federal system means energy policy is often fragmented between states, which can hinder the coordinated development of national infrastructure and regulatory frameworks.
- **Environmental Regulations:** Gaining approval for new transmission projects can be slow, due to environmental assessments and negotiations with landowners. This is particularly problematic in rural areas.



Australian transmission system

A variety of operating and ownership models. Apart from the Northern Territory, all are unbundled and part of the National Energy Market (NEM).

Power and Water Corporation (Northern Territory)

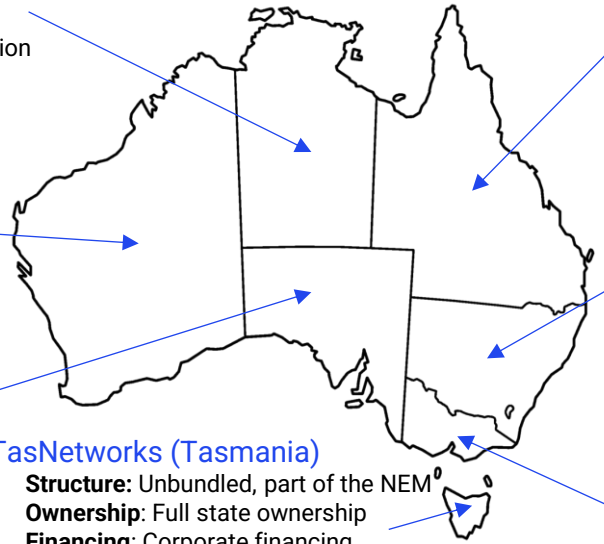
- **Structure:** Vertically integrated, not part of the NEM
- **Ownership**: Full state ownership
- **Financing**: Mainly corporate financing
- **Capital sources**: Mostly State funded
- **Number of customers**: ~245,000
- **Yearly revenues**: ~AUD 500-700 million
- **Renewable share**: 5-10%

Western Power (Western Australia)

- **Structure:** Unbundled, part of the NEM
- **Ownership**: Full state ownership
- **Financing**: Corporate financing
- **Capital sources**: State/commercial banks
- **Number of customers**: ~2.3 million
- **Yearly revenues**: ~AUD 1200 million
- **Renewable share**: 15-20%

ElectraNet (South Australia)

- **Structure:** Unbundled, part of the NEM
- **Ownership**: Full Private ownership
- **Financing**: Corporate/Project Financing
- **Capital sources**: Commercial banks
- **Number of customers**: ~1.7 million
  Yearly revenues: ~AUD 300-400 million
- **Renewable share**: 60-70%



TasNetworks (Tasmania)

- **Structure:** Unbundled, part of the NEM
- **Ownership**: Full state ownership
- **Financing**: Corporate financing
- **Capital sources**: Mainly state funding and debt
- **Number of customers**: ~540,000
- **Yearly revenues**: ~AUD 500-700 million
- **Renewable share**: Over 90%

Powerlink (Queensland)

- **Structure:** Unbundled, part of the NEM
- **Ownership**: Full state ownership
- **Financing**: Mainly corporate financing
- **Capital sources**: Government, bonds, banks
- **Number of customers**: ~5 million
- **Yearly revenues**: AUD 900-1100 million
- **Renewable share**: 20-25%

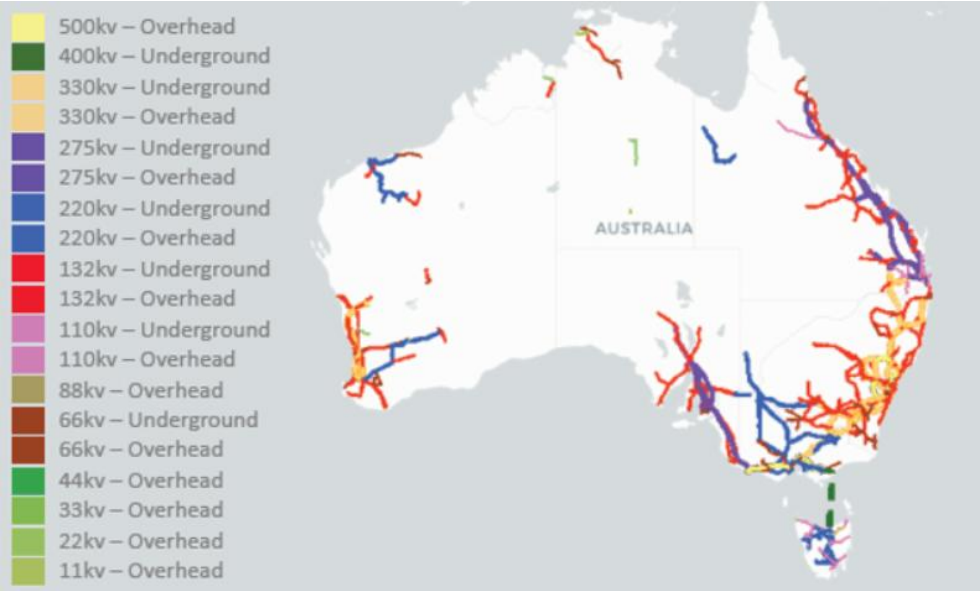
TransGrid (New South Wales and ACT)

- **Structure:** Unbundled, part of the NEM
- **Ownership**: Privately owned (long term lease)
- **Financing**: Mainly corporate but some project financing
- **Capital sources**: Private (commercial banks/funds)
- **Number of customers**: ~8 million
- **Yearly revenues**: AUD 800-1000 million
- **Renewable share**: 28-35%

AusNet Services (Victoria)

- **Structure:** Unbundled, part of the NEM
- **Ownership**: Full Private Ownership
- **Financing**: Mainly corporate financing
- **Capital sources**: Private (commercial banks/funds)
- **Number of customers**: ~6 million
- **Yearly revenues**: ~AUD 1800 million
- **Renewable share**: 30-40%

Australian Transmission System: Physical Network Characteristics



Metric	Status in Australia
% of population with grid connection	99%+
Geographical network configuration	~48,000 km of high voltage (HV) transmission lines and 850,000 km of lower voltage distribution lines.
Average age of grid	Ageing. Some parts of the system are more than 40 years old
Renewable deployment targets	82% of electricity from renewables by 2030.
Demand growth projections	Moderate. ~3% annually.
Network reliability	SAIDI = ~225 minutes/year. SAIFI = 2.
Level of interconnection	No international interconnections, but interconnection within the NEM.

Australian Transmission System: Financial Health factors

Transmission companies in Australia generally have strong balance sheets. The nation's favourable credit rating, low corruption, and stable political climate contribute to a lower cost of capital. Securing public or private investment for transmission infrastructure projects in Australia generally poses minimal challenges.

Metric	Status in Brazil
National credit rating	High. AAA (S&P)
Network company debt to equity ratio	Moderate. Varies by state with an average of around 1.49.
Energy theft rate	Low. While data is not published, theft rates are considered low due to strict regulatory frameworks and monitoring.
Consumer debt rate	High. Around 180%, one of the highest ratios among developed economies, driven largely by mortgage debt due to high property prices.
Energy bill caps	Yes. Australia has price regulation mechanisms like the Default Market Offer (DMO), which sets a price cap on electricity rates for small consumers in certain states to ensure fair pricing and prevent overcharging.
Exchange rates	~0.52 AUD to 1 GBP.
Corruption	Low. Ranks 18/180 in the Corruption Perceptions Index.
Political stability	High. Politically stable.

Case study: Brazil

Case Study: Brazil

Energy System Structure and Ownership

Brazil's energy system was unbundled following reforms in the 1990s.

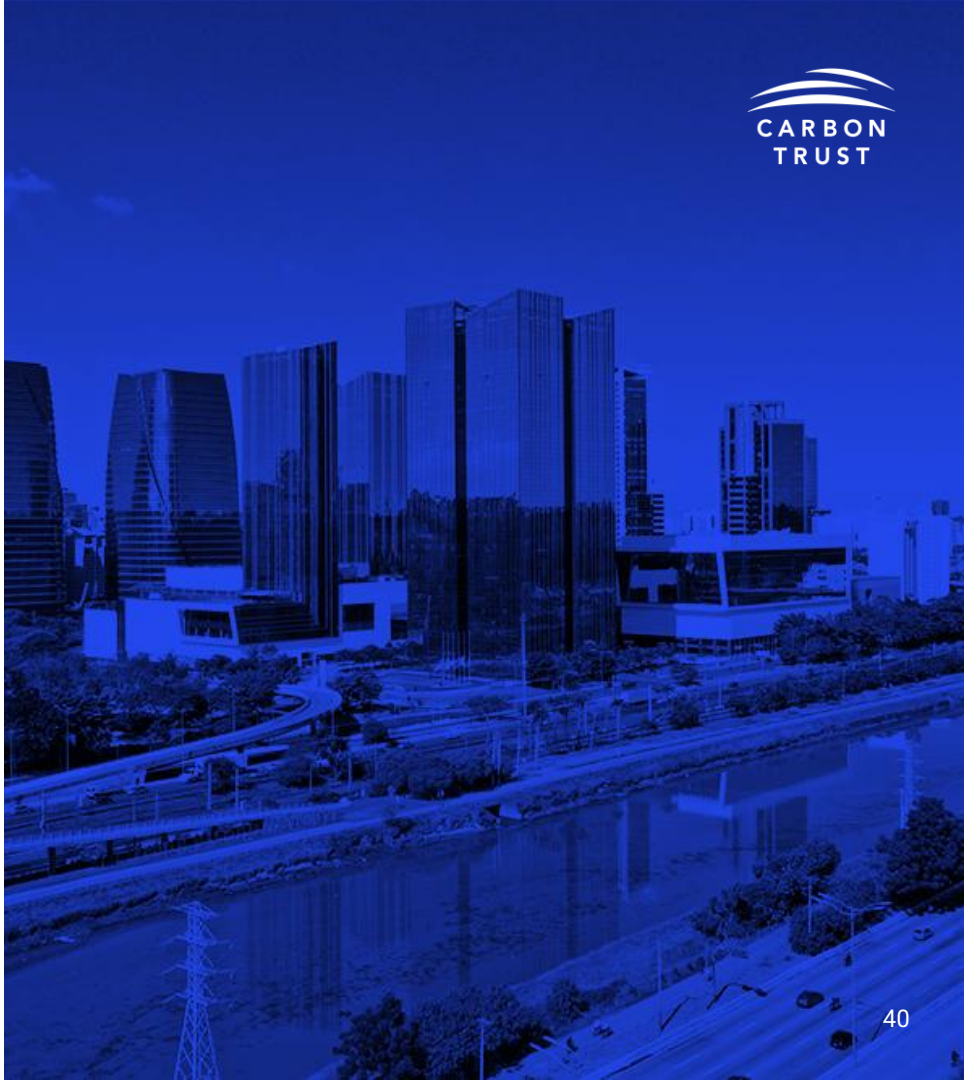
- Generation: Open to private and public entities.
- Transmission: Primarily independent operators through concession agreements.
- Distribution: Both private and state-owned.

Funding mechanism and sources of capital

Brazil typically employs project financing for large energy infrastructure projects, including transmission investments. Transmission investment in Brazil has been primarily funded through a **combination of development banks** (primarily the Brazilian Development Bank, but also the Inter-American Development Bank and World Bank) **and private capital (primarily through PPPs).** Recent years has seen significant levels of investment from China, particularly from State Grid.

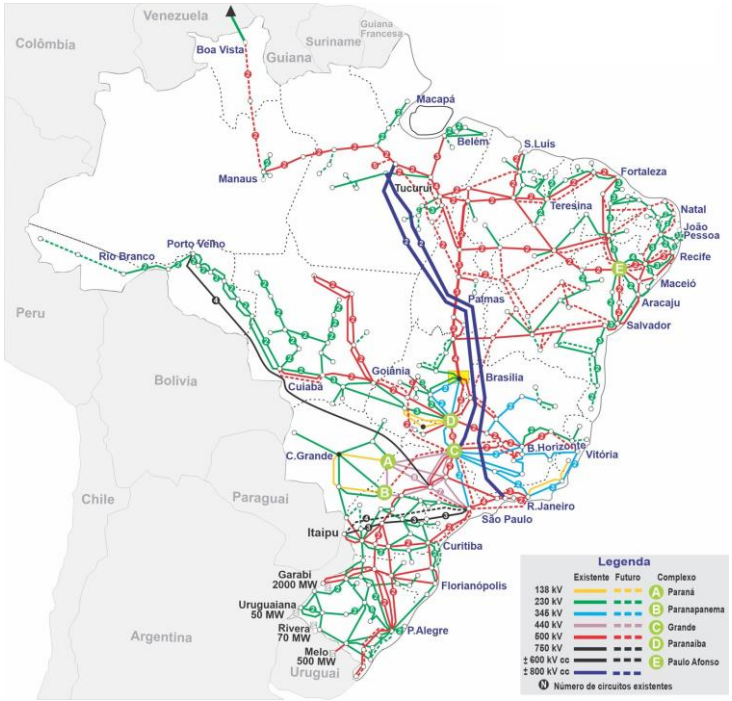
Key challenges

- **Economic conditions:** Currency, inflation and interest rate fluctuations can impact the cost of capital, materials and profitability of transmission projects.
- **Volatile political environment:** Periods of political instability or changes in government can lead to shifts in energy policy, creating additional uncertainty for long-term investments.



Brazilian Transmission System: Physical Network Characteristics

Since unbundling in the 1990s, Brazil's transmission system has seen significant investment, allowing the nation to integrate hydropower, which now accounts for over 60% of its generation capacity. Network reliability, while generally good, is still poor in rural areas.



Metric	Status in Brazil
% of population with grid connection	~99% have access to electricity.
Geographical network configuration	~160,000 km of HV transmission lines and over 1.4 million km of LV distribution lines.
Average age of grid	Moderate. Significant variation with an average of ~20-30 years.
Renewable deployment targets	45% of the energy matrix by 2030.
Demand growth projections	Moderate. ~4% annually.
Network reliability	SAIDI = ~15-20 hours/year. SAIFI = ~10-15.
Level of interconnection	Cross-border interconnections with neighbouring countries, such as Argentina, Paraguay, and Uruguay.

Brazilian Transmission System: Financial Health factors

Brazil's use of project financing and PPPs has attracted significant levels of investment in recent years. Many investors are international, such a China which has acquired over 12% of Brazil's transmission system in the last decade. PPPs are favoured in Brazil due to the significant investment required, which the government is unable to fund independently. Economic conditions, such as inflation and fluctuation of the Real increase risks for investors.

Metric	Status in Brazil
National credit rating	Stable. BB (Fitch/S&P)
Network company debt to equity ratio	Variable. Varies by company but typically falls within the range of 1.5 to 2.5
Energy theft rate	Moderate. Around 10-15%, with higher rates observed in urban and low-income areas.
Consumer debt rate	Moderate. ~40-50%. Lower than developed economies.
Energy bill caps	Yes. Brazil employs a system of tariff caps and regulates electricity prices to avoid sharp increases. This is particularly true for low income customers, who many pay lower rates through initiatives such as the “Tarifa Social”.
Exchange rates	1 Brazilian Real (BRL) = approximately 0.16 GBP
Corruption	Moderate. Ranks 94/180 in the Corruption Perceptions Index.
Political stability	Moderate. Political stability in Brazil has been relatively volatile, with significant political events, including elections and impeachment proceedings.

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