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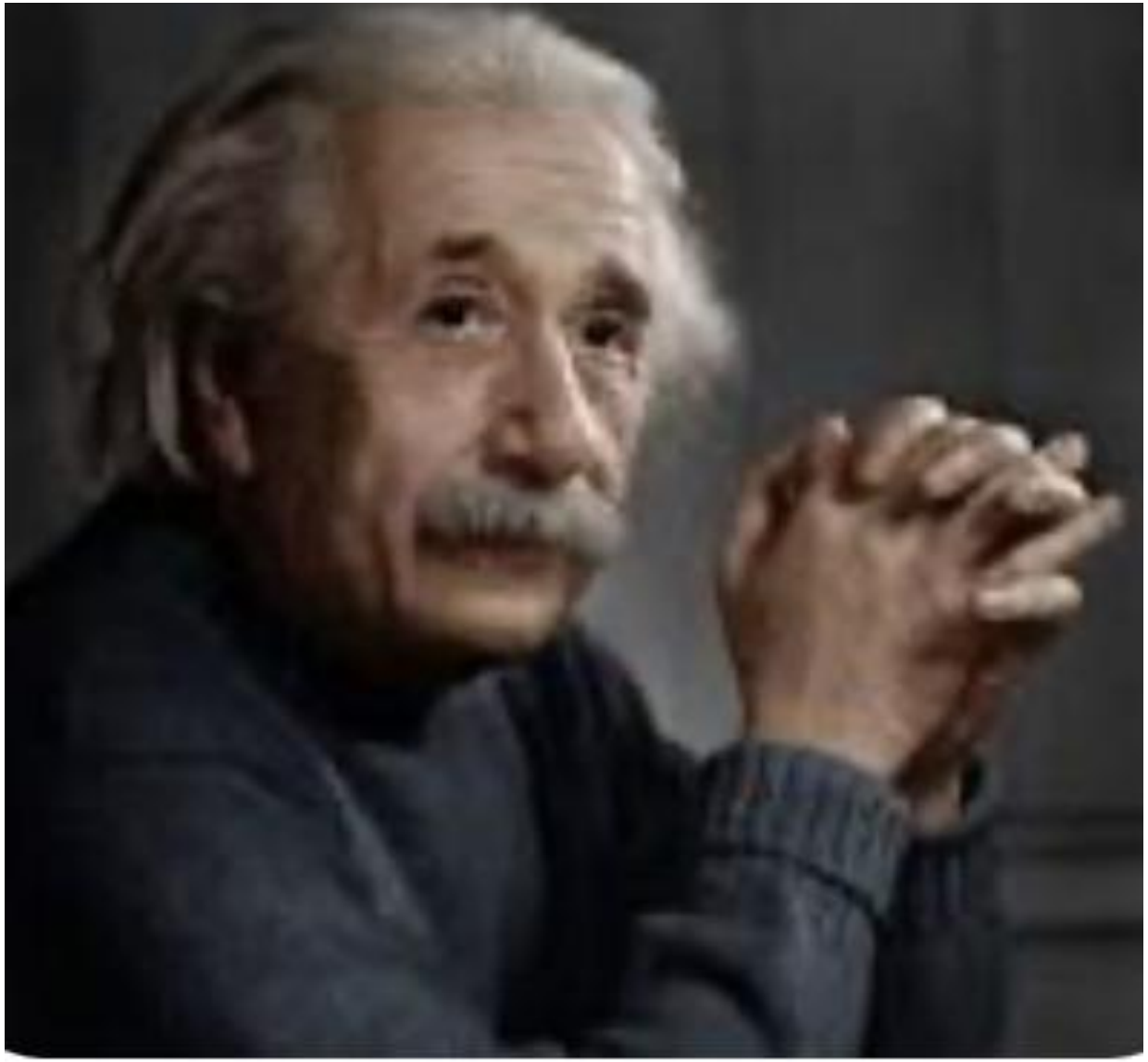
Electricity Regulatory Authority
Africa Electricity Symposium 2025 (AES2025)
Kampala, 25 June 2025

# The impact of regulation on smart, innovative and sustainable development of the energy sector in Africa

**Ignacio Pérez-Arriaga**
Interim Director of the African School of Regulation, ASR
Professor, Florence School of Regulation, EUI
Emeritus professor, IIT, Comillas University
Research Affiliate, Sloan School of Management, MITEI & CEEPR, MIT

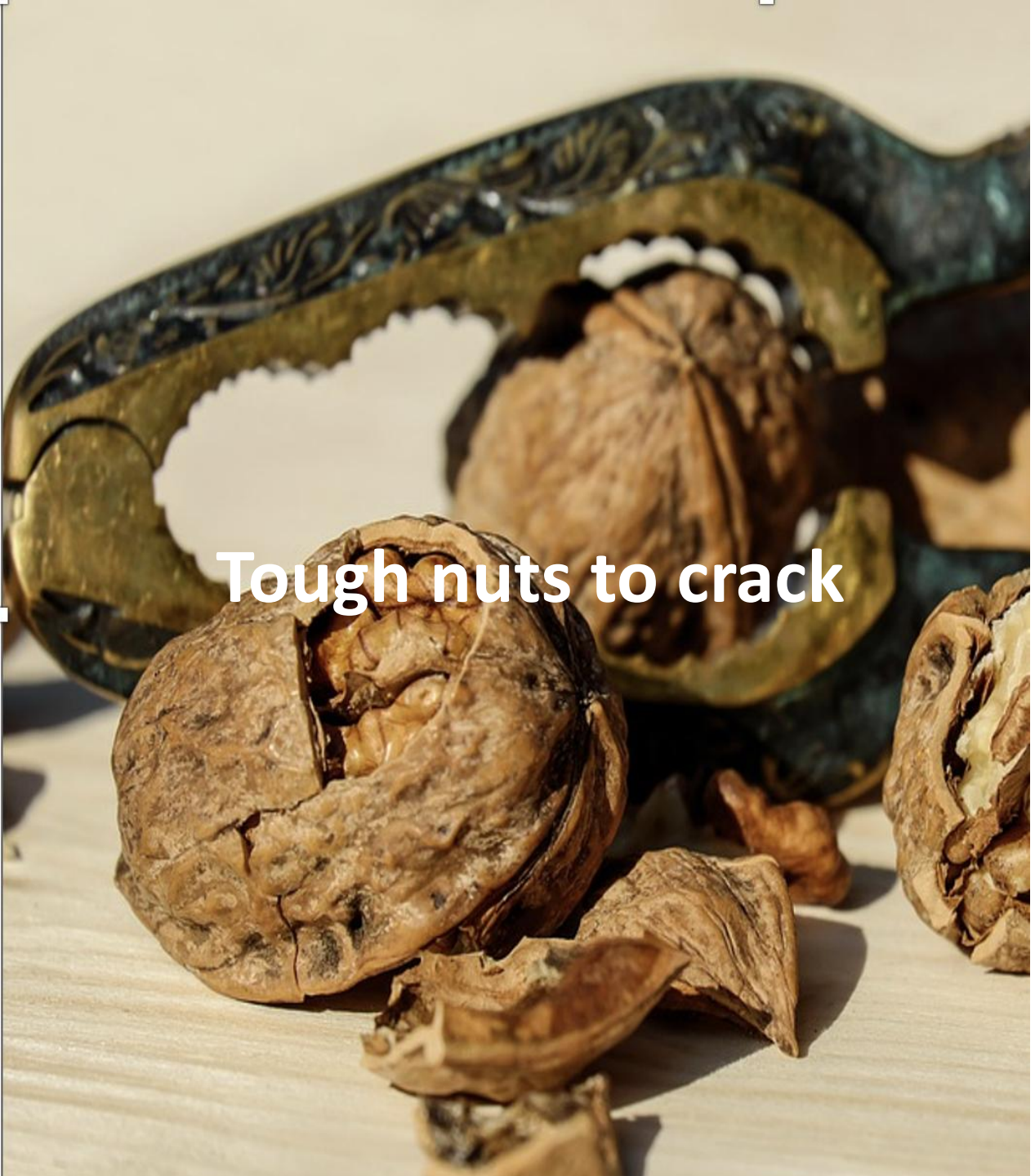


**“We cannot solve our problems with the same thinking we used when we created them.”**

Attributed to Albert Einstein

# My current selection of main challenges

(in all of them adequate regulation can make a substantial impact)



# Tough nuts to crack

- Insufficient progress in achieving **universal electricity access**.
  - Poor performance & lack of financial viability of **distribution companies.**
  - Non-scalable & unsustainable **business models for off-grid** electrification.
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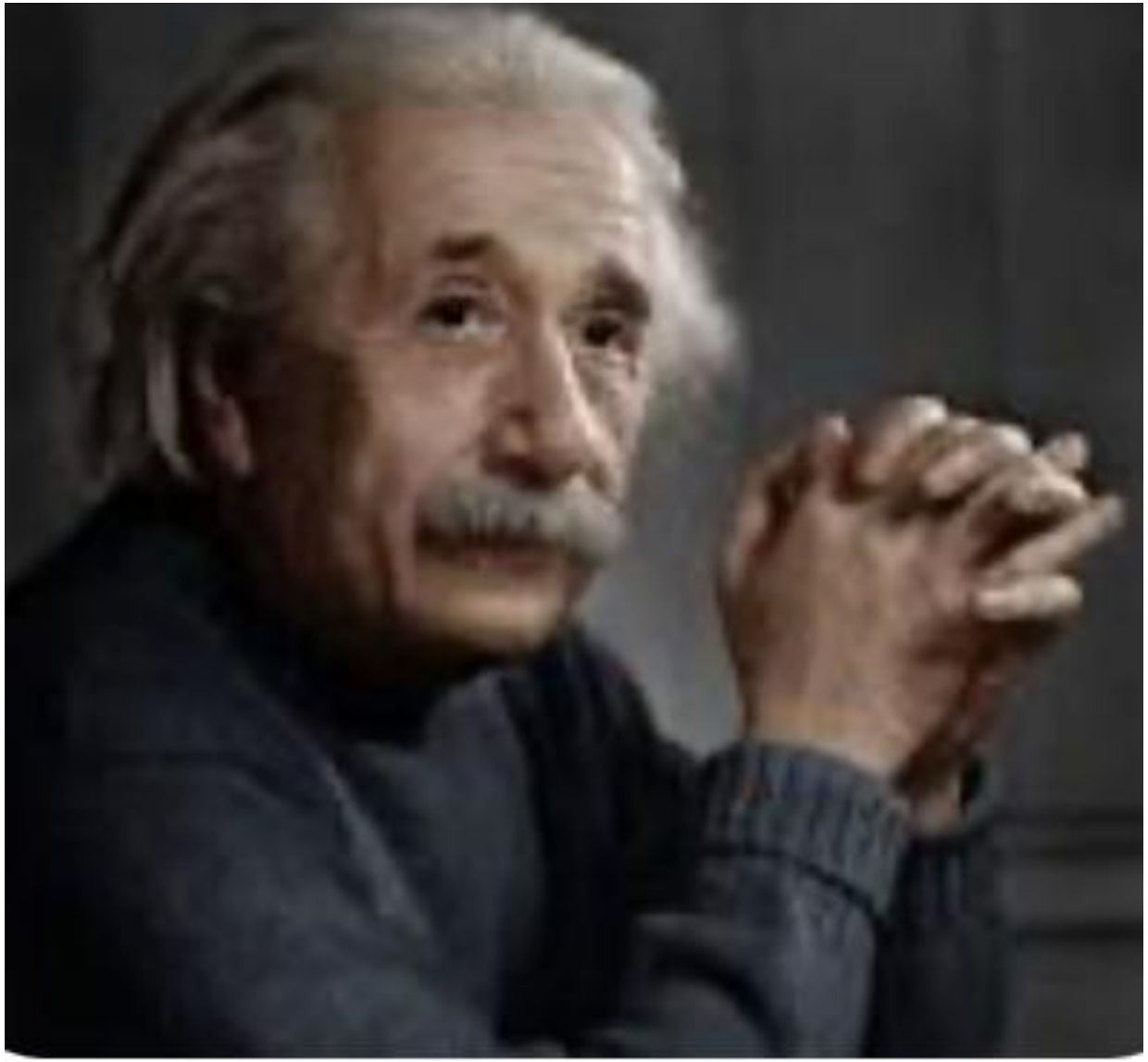
- Deficit in investment in electricity **transmission** networks.
- Low level of **cross-border trade**.

# Another insight…



**“We cannot solve our problems with the same thinking we used when we created them.”**

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**“We might solve our problems adapting the thinking that has worked elsewhere.”**

Attributed to me

# What has worked elsewhere?

- Remuneration of supply activities based on **efficient cost of service**, with adequate rate of return on investment & with performance incentives.
- Rural residential customer tariffs (on- & off-grid) designed with substantial & **permanent cross-subsidisations**, with an **integrated approach.**
- **Distribution concessions** with formats adapted to the specific country conditions & well-designed contracts.
- Tariff designs reflecting the **true costs & value** of distributed energy resources (**DERs**).
- Implement **wholesale markets** only when national &/or regional power sectors **meet some minimum conditions**.
- Approach regulation of  transmission investment with an ”**infrastructure mindset**”.
- Transmission charges must be independent on commercial transactions (**abolish wheeling!).**

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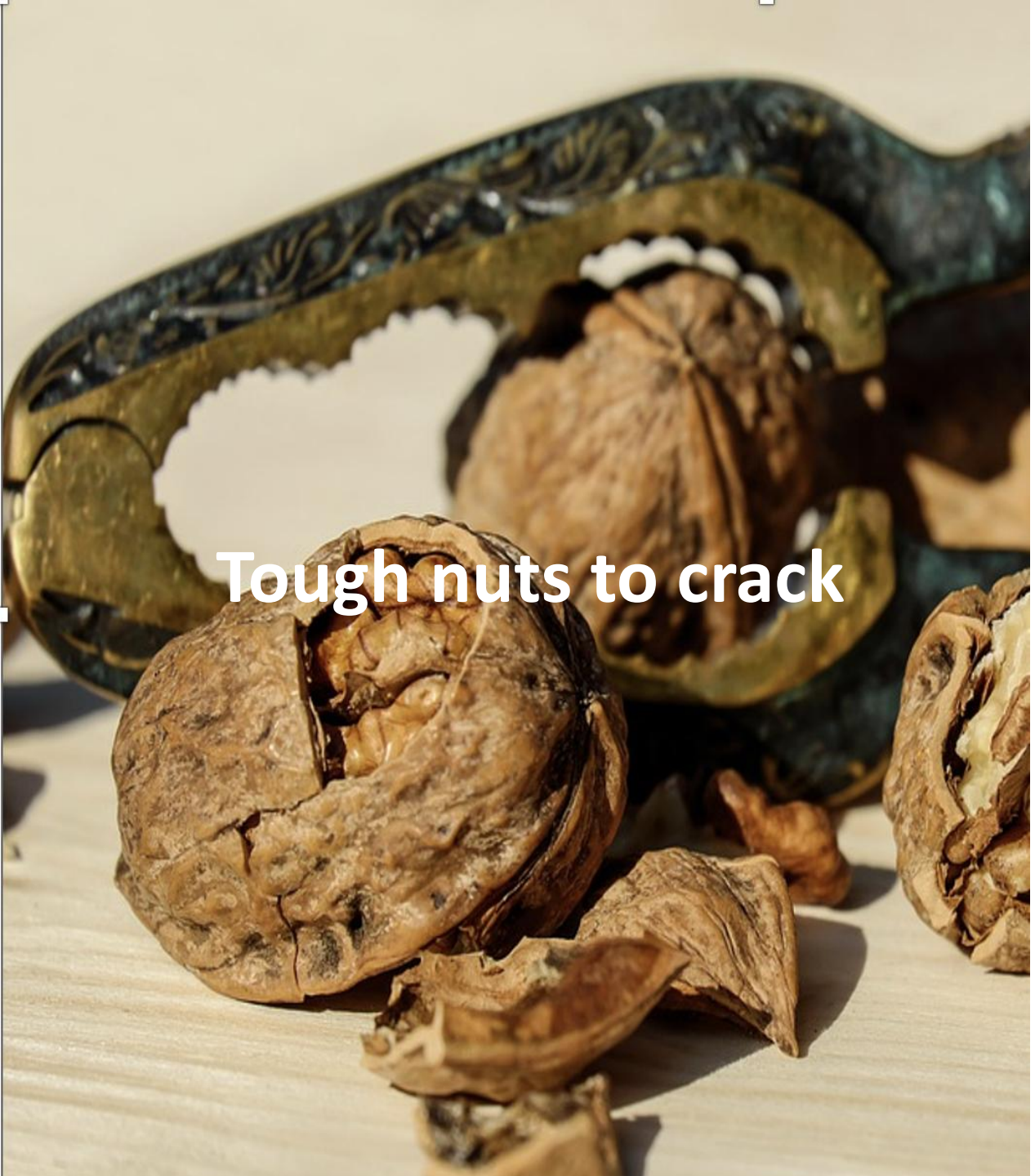
Let’s approach the big **challenges**
with well-proven **best practices**
and **smart, innovative and sustainable** solutions
adapted to the **specific conditions** of African countries.



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# Remember the costs of electricity supply

- **Network costs**
  - Distribution *(Capex & Opex)*
  - Transmission *(Capex & Opex)*
- **Generation costs**
  - If regulated under cost-of-service *(Capex & Opex)*
  - If under market conditions: price of energy
- **Retailing costs** *(small & typically merged with distribution costs)*
- **Regulated charges**
  - System Operator, Regulator, & any subsidized programs *(efficiency, renewables, domestic fuels, stranded costs, social tariffs, etc.)*
- **Taxes**

# Impacts of DERs when tariffs have the typical design

**Typical end-customer tariff** mostly consisting of a volumetric component ($/kWh)

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If there is **electricity generated behind the meter**…

- It partly cancels the volumetric component, therefore not only cancelling the energy cost, but also the network costs, the other regulated costs & the taxes.
  - **Who pays the cancelled network costs & other regulated costs & taxes?**

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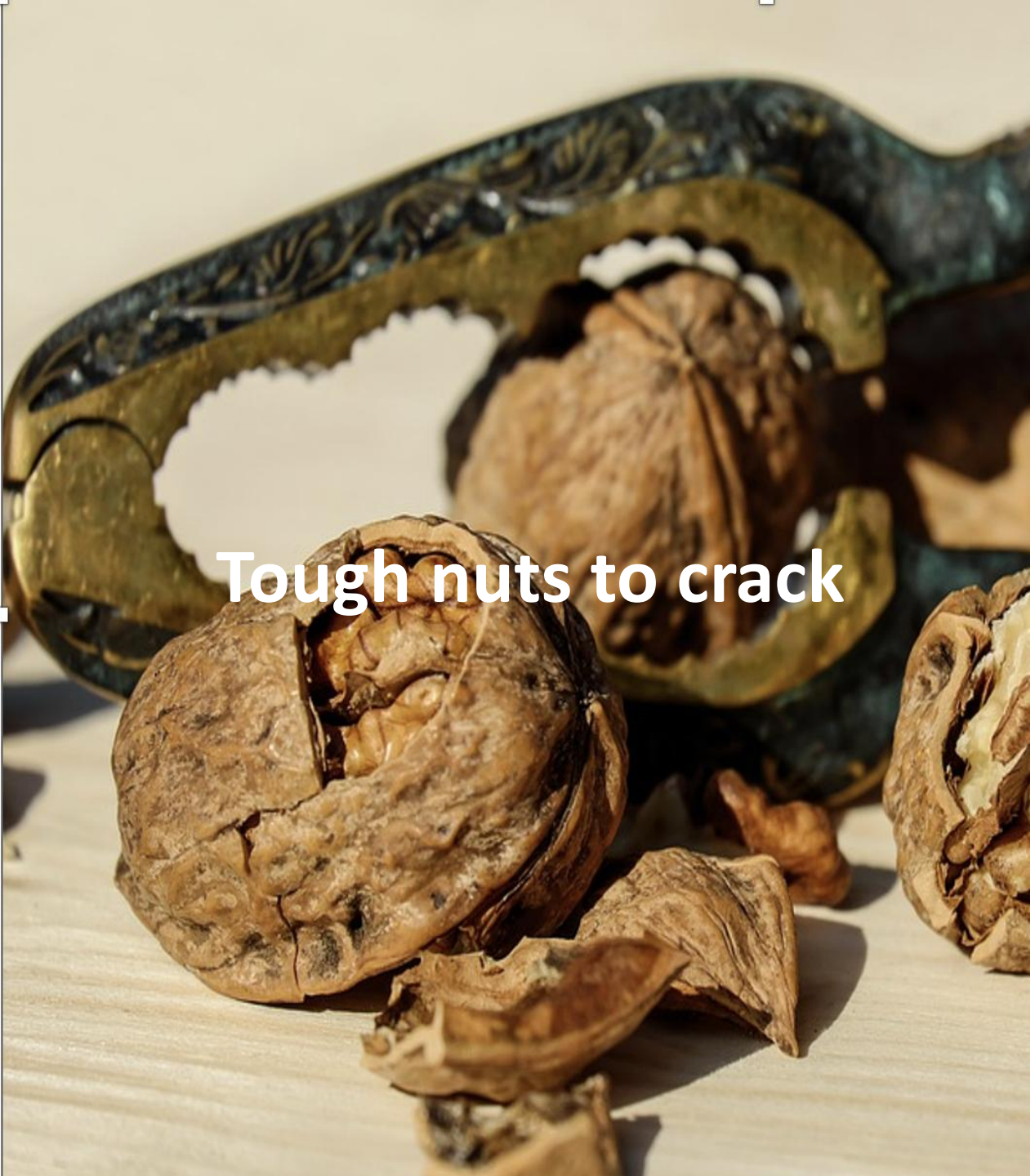
## CONCLUSIONS

- **Tariffs must be redesigned**, separating energy ($/kWh) from the rest in a fixed charge ($/month)
  - Still some issues adapting the fixed charge.
- **Hourly meters** equally charging or crediting energy at the connection point.
- Make sure that the **remuneration of distribution** is not affected negatively.



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# Installed generation capacity (GW) in sub-Saharan African countries (data 2021)

Nigeria: Approximately 13.4 GW
Egypt: Approximately 59.4 GW
South Africa: Approximately 50.3 GW
Algeria: Approximately 20.3 GW
Ethiopia: Approximately 4.9 GW
Morocco: Approximately 10.6 GW
Kenya: Approximately 2.7 GW
Sudan: Approximately 3.3 GW
Ghana: Approximately 4.2 GW
Côte d'Ivoire: Approximately 2.4 GW
Angola: Approximately 3.1 GW
Tunisia: Approximately 5.4 GW
Libya: Approximately 6.2 GW
Cameroon: Approximately 2.3 GW
Uganda: Approximately 1.3 GW
Tanzania: Approximately 1.6 GW
Zimbabwe: Approximately 2.3 GW
Mozambique: Approximately 2.0 GW
Senegal: Approximately 0.8 GW
Zambia: Approximately 2.3 GW
Madagascar: Approximately 0.4 GW
Burkina Faso: Approximately 0.5 GW
Rwanda: Approximately 0.3 GW
Mali: Approximately 0.4 GW
Niger: Approximately 0.3 GW
Benin: Approximately 0.3 GW
Togo: Approximately 0.2 GW
Sierra Leone: Approximately 0.2 GW
Liberia: Approximately 0.1 GW
Mauritania: Approximately 0.1 GW
Eswatini (formerly Swaziland): Approximately 0.1 GW
Lesotho: Approximately 0.1 GW
Djibouti: Approximately 0.1 GW
The Gambia: Approximately 0.1 GW
Comoros: Approximately 0.1 GW
Equatorial Guinea: Approximately 0.2 GW
Seychelles: Approximately 0.1 GW
Cape Verde: Approximately 0.1 GW
São Tomé and Príncipe: Approximately 0.1 GW
Mauritius: Approximately 0.6 GW
Namibia: Approximately 1.3 GW
Eritrea: Approximately 0.2 GW
Burundi: Approximately 0.05 GW
Chad: Approximately 0.2 GW
Central African Republic: Approximately 0.05 GW
Guinea-Bissau: Approximately 0.07 GW
South Sudan: Approximately 0.1 GW
The Seychelles: Approximately 0.08 GW

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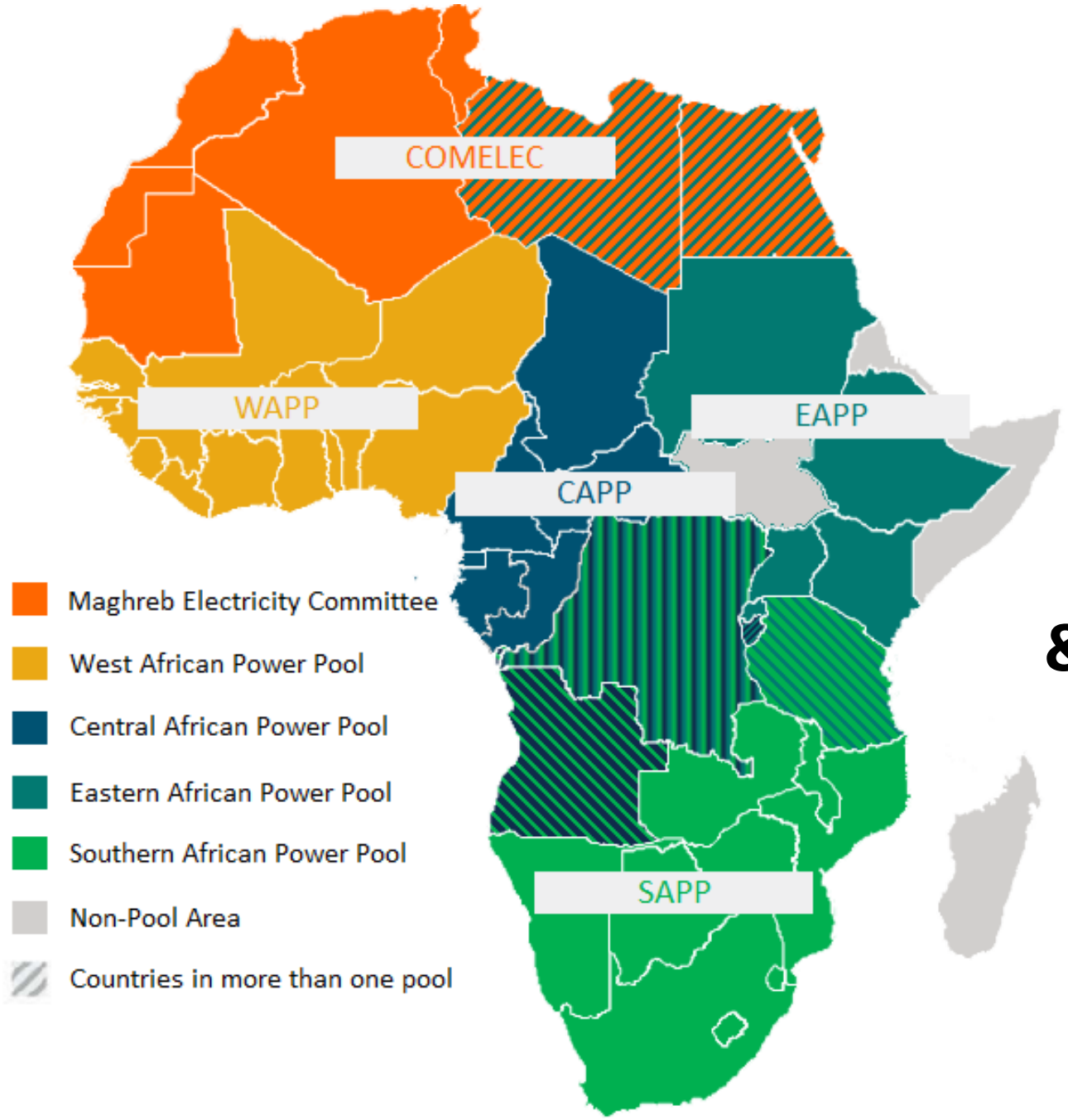
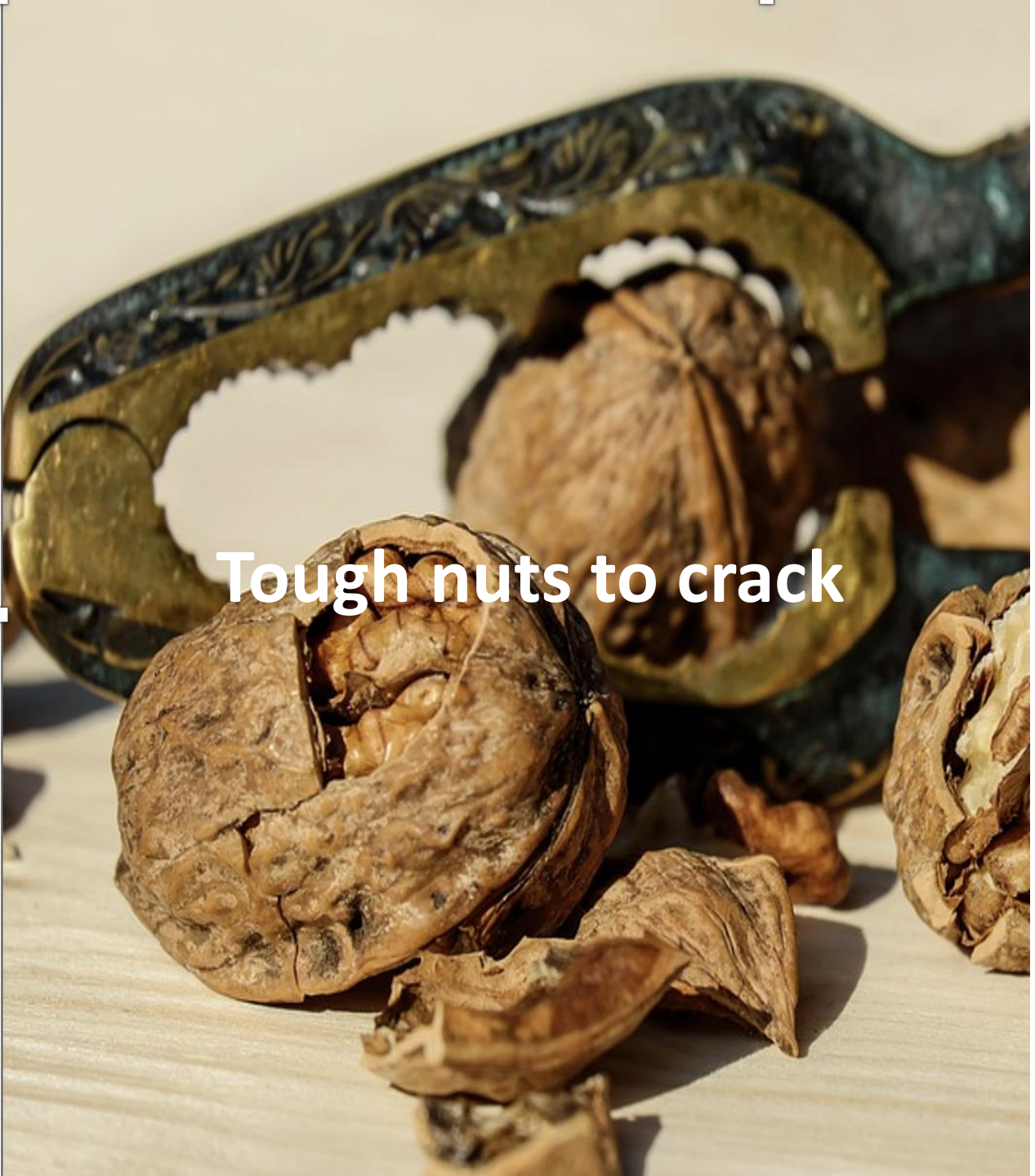
- Wholesale electricity markets **are difficult to implement** and require a **sufficiently large electrical size** of the potentially relevant market as well as an adequately **competitive structure** of the power sector.
- **Private investment** in generation capacity is **not guaranteed**.
- Potential abuses of **market power** must be under control.
- **Lack of understanding of these fundamental requirements** & constraints may result in ill-advised attempts & avoidable failures.




**Regional markets** are the solution…

**… if properly designed**

**& with sufficient interconnection**



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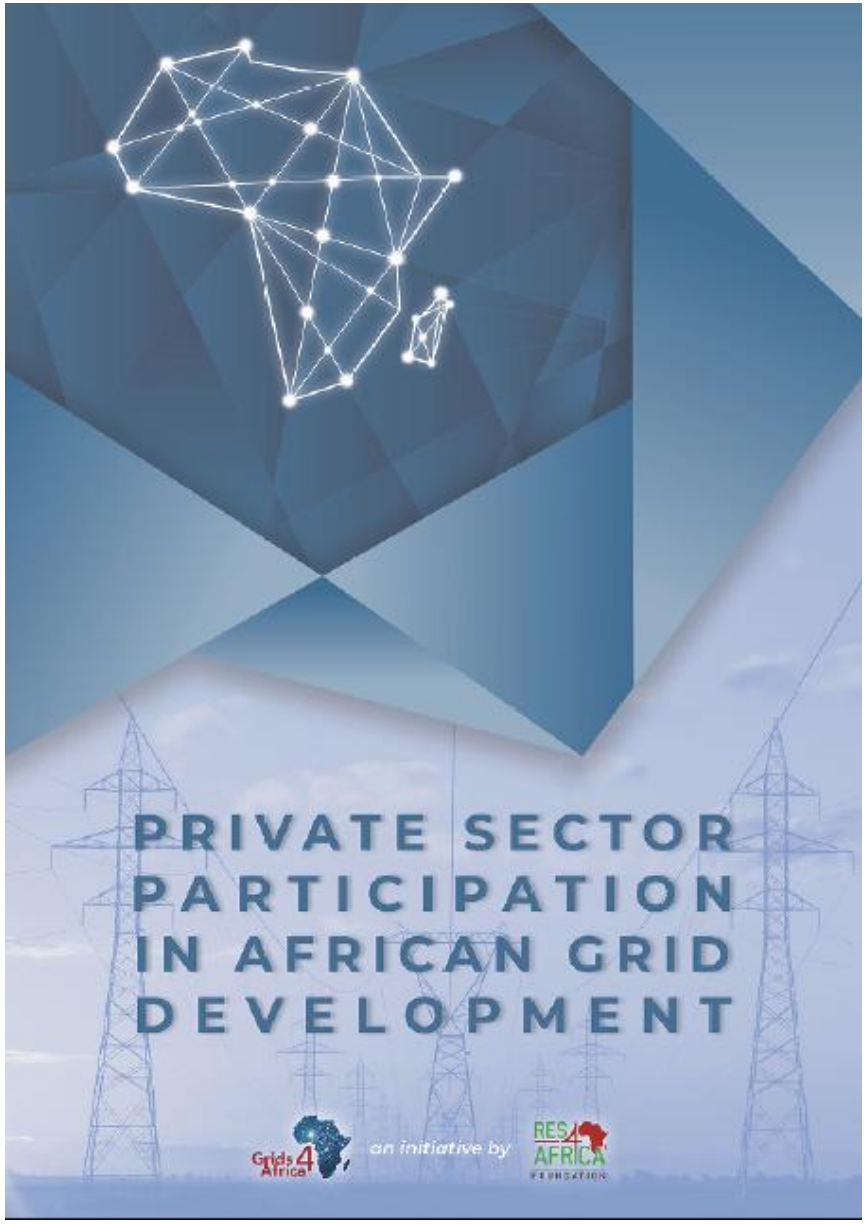
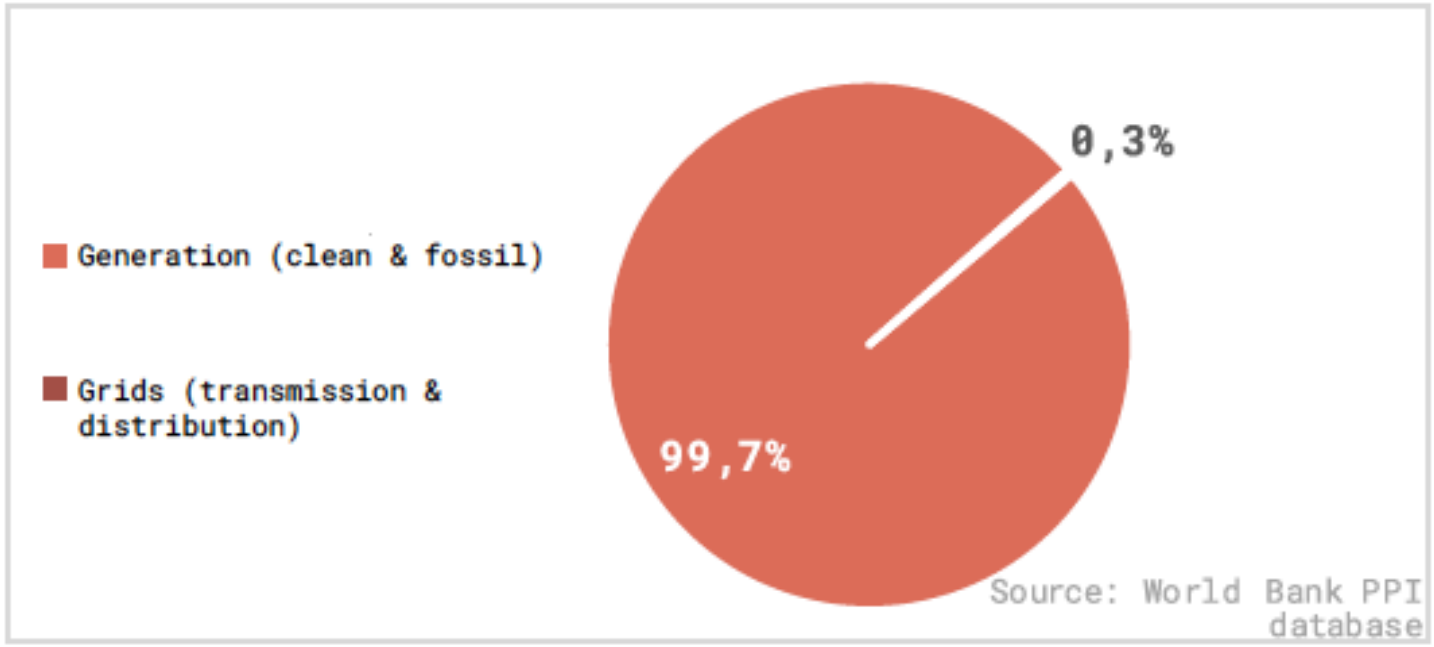



# The percentage of private investment in African electricity networks is negligible




Private investments in the electricity sector over 2010-20 (% share of total) for a sample of 10 African countries: Algeria, Ethiopia, Ghana, Kenya, Morocco, Senegal, South Africa, Tanzania, Uganda, Zambia

https://www.res4africa.org/calendar-news/79po1jnb8nbasjvf3s8x8bnogbhff4

# Current transmission regulation creates unnecessary risks in transmission remuneration

- Regulation must try to **avoid unnecessary financial risks** *(which have negative consequences on the cost of capital)* to a natural monopoly activity like transmission, subject to regulation
  - Frequent **flawed regulatory interventions** (see next slide) create **unnecessary risk** *(therefore perfectly avoidable)* in the **remuneration** of the transmission activity.

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REPUBLIC OF SOUTH AFRICA

# ELECTRICITY REGULATION AMENDMENT BILL

(4D) Transmission and distribution licensees shall procure the energy they use to cover energy losses and reserve capacity in their system according to transparent, non-discriminatory and market-based procedures.

# How to make transmission attractive to private investment?

- Transmission of electricity is an **infrastructure activity**, NOT a commercial activity which buys energy cheap & sells it expensive.
- Transmission of electricity is a **natural monopoly** that must be regulated as such, centrally planned & with remuneration based on its efficient **cost of service.**
  - Once transmission has been centrally planned and built, **the "viability" of the project is not questioned.**
- Secure and centralised **operation of the power system is the responsibility of the System Operator**, not of the network owners.
- There is **no reason to impede having multiple owners of transmission assets** in the same national transmission system.

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# How to make transmission attractive to private investment?

- Do not make transmission **remuneration** depend on the volume of flows or of wheeling charges, **just use cost-of-service** (or the outcome of a tender).
- The transmission cost is essentially a fixed cost. **Ring-fence the annuity** & recover it with **priority** from the regulated end customer tariffs.

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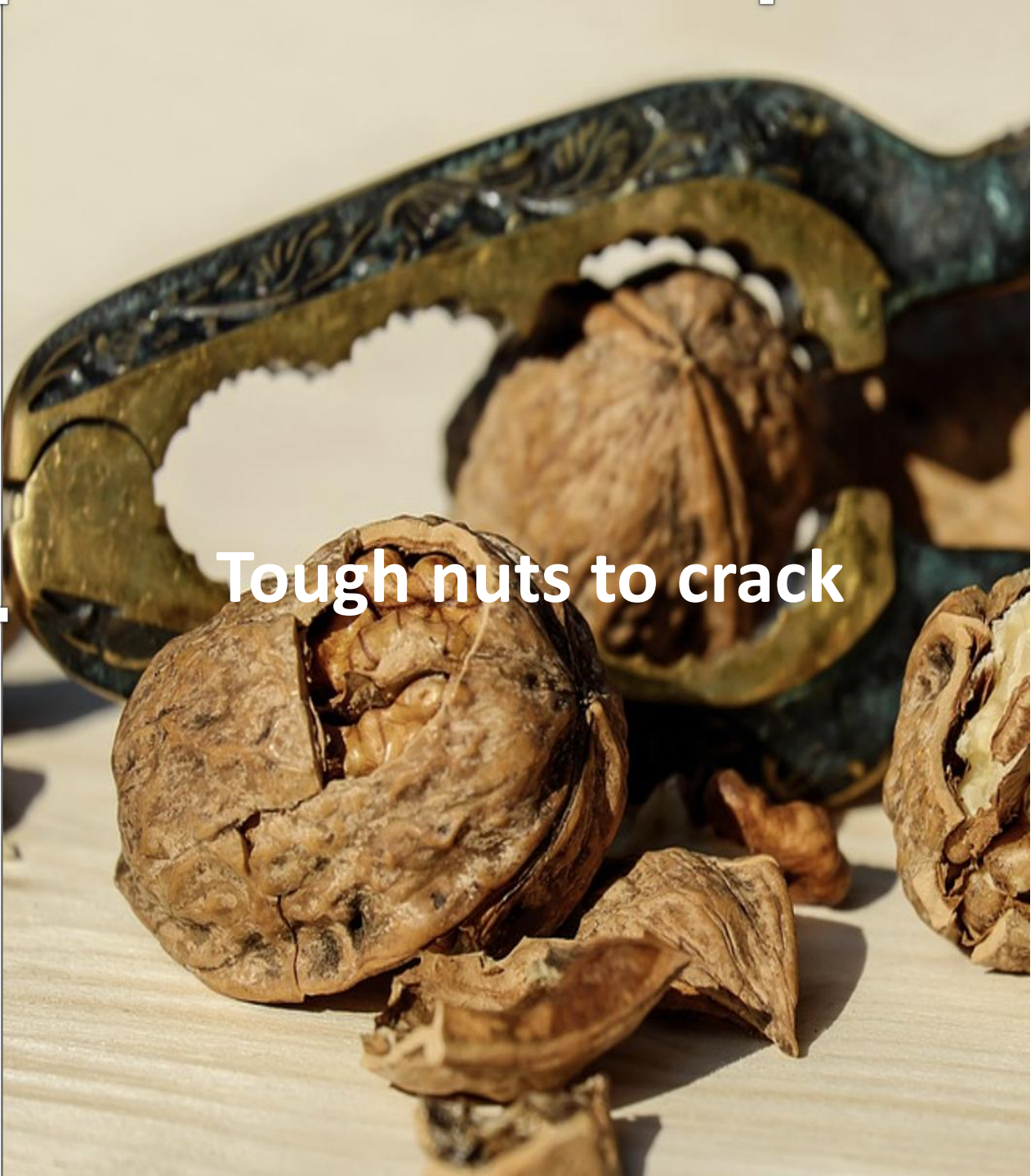
**The present situation of transmission in most African utilities does NOT suggest to privatise or concession the entire national networks, but to attract private investment to key transmission projects & to reinforce the networks piecemeal.**



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- **Low level of cross-border trade** in African regional markets – is **due to regulation** that
  - **discourages private investment** in transmission infrastructure,
  - allows **inefficient dispatch** of generation because of physical bilateral contracts,
  - and **penalises those who trade cross-border** applying excessive transmission charges.

# Regulation for regional trade must be guided by the "Single system paradigm"

## The "Single system paradigm"

Design regional regulation so that the expected outcome is as close as possible to that of a sound regulation for *a single system of regional dimension*.

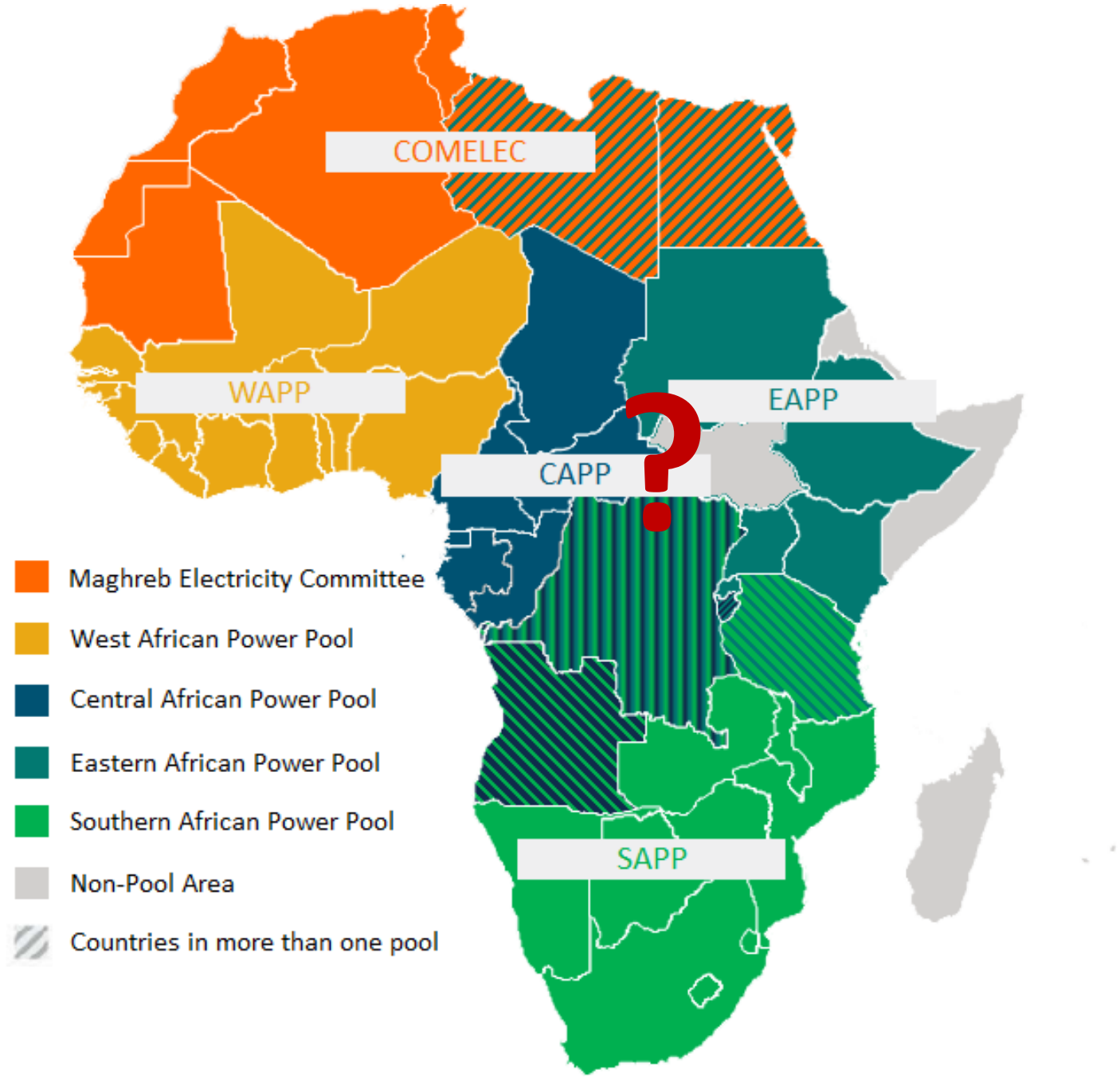
# EUROPE

F.Y.R.O.M. - The Former Yugoslav Republic of Macedonia
Greenland (DENMARK)
Jan Mayen (NORWAY)
Greenland Sea
Denmark Strait
Norwegian Sea
Barents Sea
White Sea
Arctic Circle
Hammerfest
Tromsø
Murmansk
Arkhangel'sk
Kiruna
Luleå
Oulu
Umeå
Trondheim
NORWAY
SWEDEN
FINLAND
Lake Onega
Lake Ladoga
Gulf of Bothnia
Tampere
Helsinki
Turku
Gävle
Tórshavn
Faroe Islands (DENMARK)
Reykjavík
ICELAND
SHETLAND ISLANDS
ORKNEY ISLANDS
HEBRIDES
Rockall (U.K.)
Bergen
Oslo
Stockholm
Stavanger
ÅLAND ISLANDS
Gulf of Finland
Tallinn
ESTONIA
St. Petersburg
RUSSIA
Moscow
North Atlantic Ocean
Aberdeen
Glasgow
Edinburgh
Belfast
UNITED KINGDOM
Isle of Man (U.K.)
Dublin
IRELAND
Irish Sea
Leeds
Manchester
Liverpool
Birmingham
Cardiff
London
Celtic Sea
North Sea
Skagerrak
Kattegat
Göteborg
Gotland
Baltic Sea
Öland
Rīga
LATVIA
LITHUANIA
Vilnius
Vitsyebsk
Smolensk
Mahilyow
Minsk
BELARUS
Hrodna
Homyel'
DENMARK
Copenhagen
Malmö
Kaliningrad
RUSSIA
Bornholm
Gdańsk
Hamburg
Bremen
Berlin
Poznań
Warsaw
POLAND
Łódź
Wrocław
Brest
Kiev
Rivne
Amsterdam
NETH.
Rotterdam
Essen
Cologne
Leipzig
Brussels
Lille
BEL.
Bonn
GERMANY
Frankfurt am Main
Prague
CZECH REPUBLIC
Brno
Kraków
L'viv
UKRAINE
Chernivtsi
English Channel
Guernsey (U.K.)
Jersey (U.K.)
Luxembourg
LUX.
Paris
Strasbourg
Stuttgart
Munich
SLOVAKIA
Bratislava
Mykolayiv
Chişinău
Iaşi
MOLDOVA
Odesa
Nantes
Vienna
AUSTRIA
Budapest
HUNGARY
Cluj-Napoca
ROMANIA
LIECH.
Vaduz
Zürich
Bern
SWITZ.
Geneva
FRANCE
Bay of Biscay
Ljubljana
SLOVENIA
Zagreb
Bucharest
Constanța
Black Sea
Lyon
Turin
Milan
Venice
Bordeaux
CROATIA
BOSNIA AND HERZEGOVINA
Belgrade
Varna
Genoa
SAN MARINO
Sarajevo
YUGOSLAVIA
BULGARIA
Sofia
Bilbao
Toulouse
MONACO
Andorra la Vella
Marseille
Florence
Ligurian Sea
Adriatic Sea
ITALY
Skopje
F.Y.R.O.M.
İstanbul
Porto
ANDORRA
Zaragoza
Corsica
Rome
VATICAN CITY
Tirana
ALB.
Thessaloniki
Bursa
PORTUGAL
Madrid
Barcelona
Naples
TURKEY
Lisbon
Tagus
SPAIN
Valencia
Balearic Sea
Sardinia
Tyrrhenian Sea
GREECE
Aegean Sea
İzmir
Athens
Sevilla
BALEARIC ISLANDS
Cagliari
Ionian Sea
Mediterranean Sea
Palermo
Sicily
Rhodes
Gibraltar (U.K.)
Málaga
Strait of Gibraltar
Ceuta (SPAIN)
Alborán Sea
Melilla (SPAIN)
Oran
Algiers
Tunis
Crete
Rabat
Casablanca
MOROCCO
ALGERIA
TUNISIA
Valletta
MALTA
Scale 1: 19,500,000
Lambert Conformal Conic Projection, standard parallels 40°N and 56°N
0 300 Kilometers
0 20 300 Miles

Interconnected
network of
ENTSO-E
ATLANTIC OCEAN
NORTH SEA
BALTIC SEA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA

Unclassified

SOURCE: WORLD BANK
RETRADE-EAPP-2024


COMELEC
WAPP
EAPP
CAPP
SAPP
?
Maghreb Electricity Committee
West African Power Pool
Central African Power Pool
Eastern African Power Pool
Southern African Power Pool
Non-Pool Area
Countries in more than one pool

# Cost allocation of regional transmission projects
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# It seems that Africa is in the process of abandoning the “common sense” (but flawed) transmission regulation…

AUTHORIDADE REGIONAL
REGULADORA DE ELETRICIDADE DA CEDEAO

ECOWAS REGIONAL
ELECTRICITY
REGULATORY AUTHORITY

AUTORITÉ DE RÉGULATION
RÉGIONALE DU SECTEUR DE
L'ÉLECTRICITÉ DE LA CEDEAO

ENERGY COMMISSION BUILDING, GHANA AIRWAYS AVENUE, PMB 76 MINISTRIES POST OFFICE, ACCRA – GHANA
TEL: (+233) 0302 817 047 (+233) 0302 817 049 FAX: (+233) 0302 817 050 WEBSITE: www.erera.arrec.org EMAIL: info@erera.arrec.org

# RESOLUTION N°006/ERERA/15

## Adoption of the Tariff Methodology for Regional Transmission Cost and Tariff

The Regulatory Council,

Mindful of Article 18.5 of Regulation C/REG.27.12/07 of 15 December 2007, as amended, on the composition, organisation, functions and operations of ERERA, and

After the review of the Tariff Methodology for Regional Transmission Cost and Tariff for the West African Power Pool (WAPP) by ERERA's Consultative Committees,

**RESOLVE THAT:**

1. The Tariff Methodology for Regional Transmission Cost and Tariff for the West African Power Pool, hereby attached, is approved.
2. The Tariff Methodology for Regional Transmission Cost and Tariff for the West African Power Pool shall be published in the ERERA official Bulletin and Website.

**Done in Accra, GHANA, on August 18, 2015**

Mr. Alagi Basiru GAYE
Council Member

Mrs. Ifeyinwa IKEONU
Acting Chairperson

WAPP

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IE24288

**THE FIRST ORDINARY SESSION OF THE AFRICAN UNION SPECIALIZED TECHNICAL COMMITTEE ON TRANSPORT, TRANSCONTINENTAL AND INTERREGIONAL INFRASTRUCTURES, ENERGY AND TOURISM (STC-TTIET)**
**14 – 18 April 2019**
**Cairo, Egypt**

CMP

# CONTINENTAL TRANSMISSION TARIFF METHODOLOGY FOR INTERNATIONAL BILATERAL TRANSACTIONS

**THEME: → DEVELOPING SMART INFRASTRUCTURE TO BOOST AFRICA'S CONTINENTAL TRANSFORMATION AND INTEGRATION**

**TECHNICAL PAPER**

# … to adopt the best regulatory practices that will facilitate transmission investment & power trade

Unclassified

| Economic Community of West African States | WEST AFRICAN POWER POOL<br>WEST AFRICAN POWER EXCHANGE SYSTEM<br>General Secretariat / Secrétariat Général | Communauté Economiques des Etats de l'Afrique de l'Ouest |
|---|---|---|

# FINALIZATION OF THE WAPP TARIFF COMPARATIVE ANALYSIS

# FINAL MEETING

**Lomé, 13-15 May 2024**

WAPP

- ERERA and WAPP to develop the necessary Regulation and Procedures for the application of the customized APM to the WAPP Region. The Regulation should set the rules for the transitional period for the application of the APM.

- ERERA to collaborate with the National Regulators to facilitate the necessary legal measures for the approval of the APM.

## XI. VOTE OF THANKS

35. The WAPP Secretariat expressed its sincere gratitude to the participants for their availability and collaboration.

36. The Participants expressed their utmost gratitude to the WAPP Secretariat and World Bank for the organization of the meeting as well as for the provision of adequate resources which contributed enormously to the success of the meeting.

37. The participants in the meeting also expressed their deep gratitude to the people and Government of Togo, in particular His Excellency Faure Essozimna GNASSINGBÉ, President of the Republic of Togo for the warm hospitality they enjoyed throughout their stay in the country.

**SIGNATURE**

**For WAPP Secretariat**

**Mr. Abdulkadir NAZIF** .....

**The Chairman of the Taskforce**

**Mr. Etienne BAILLY** .....

**For CESI-S. P.A**

**Mr. Fabio RIVA** .....

- Insufficient progress in achieving **universal electricity access**.
  - Poor performance & lack of financial viability of **distribution companies.**
  - Non-scalable & unsustainable **business models for off-grid** electrification.
- Inadequate regulation of **distributed energy resources** (DERs)
- Inadequate conditions at national scale to implement **wholesale electricity markets**.
- Deficit in investment in electricity **transmission** networks.
- Low level of **cross-border trade**.

Unclassified

AFRICAN SCHOOL OF REGULATION

# Building the human capacity in energy regulation that Africa needs to tackle the critical challenges of the energy sector

https://africanschoolregulation.org

# The ASR mission

- Africa socio-economic development, technology evolution and environmental threats pose **new challenges** to the energy sector and increase the **demand for electricity infrastructure**.
- The **regulation** currently adopted in most areas **is not responding** to those challenges and **does not attract** the necessary private investment.
- **ASR will contribute** to enhance energy regulation adapting global **best practices** in regulation to Africa's energy sector or designing new ones.

Unclassified

Electricity Regulatory Authority
Africa Electricity Symposium 2025 (AES2025)
Kampala, 25 June 2025

# The impact of regulation on smart, innovative and sustainable development of the energy sector in Africa

**Ignacio Pérez-Arriaga**
Interim Director of the African School of Regulation, ASR
Professor, Florence School of Regulation, EUI
Emeritus professor, IIT, Comillas University
Research Affiliate, Sloan School of Management, MITEI & CEEPR, MIT