RENEXPO® INTERHYDRO

Hydropower Solutions HYPOSO

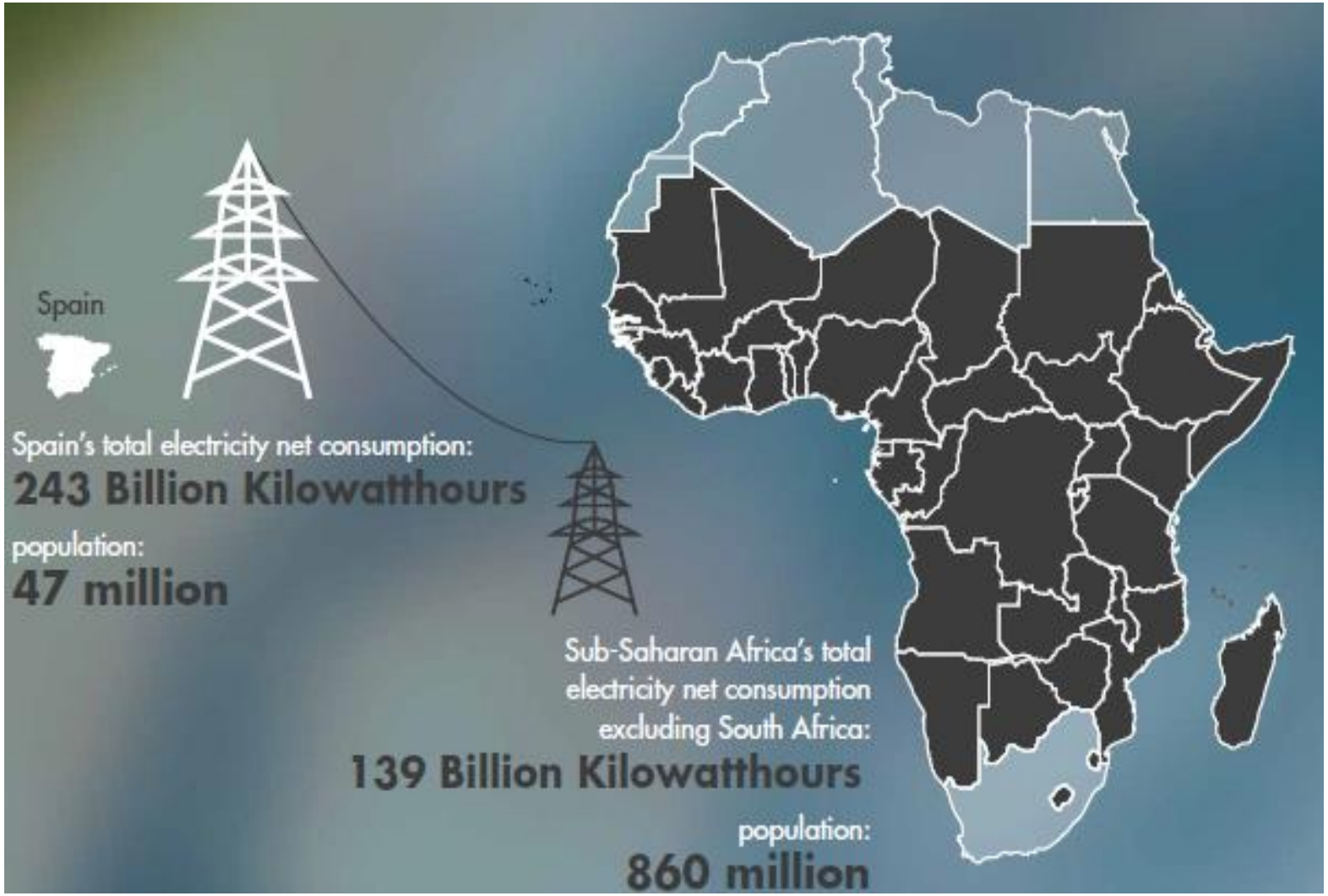
SOLARHYDROWATT

TARGET COUNTRY : CAMEROON

By Joseph KENFACK

INTRODUCTION – ENERGY CONSUMPTION IN AFRICA

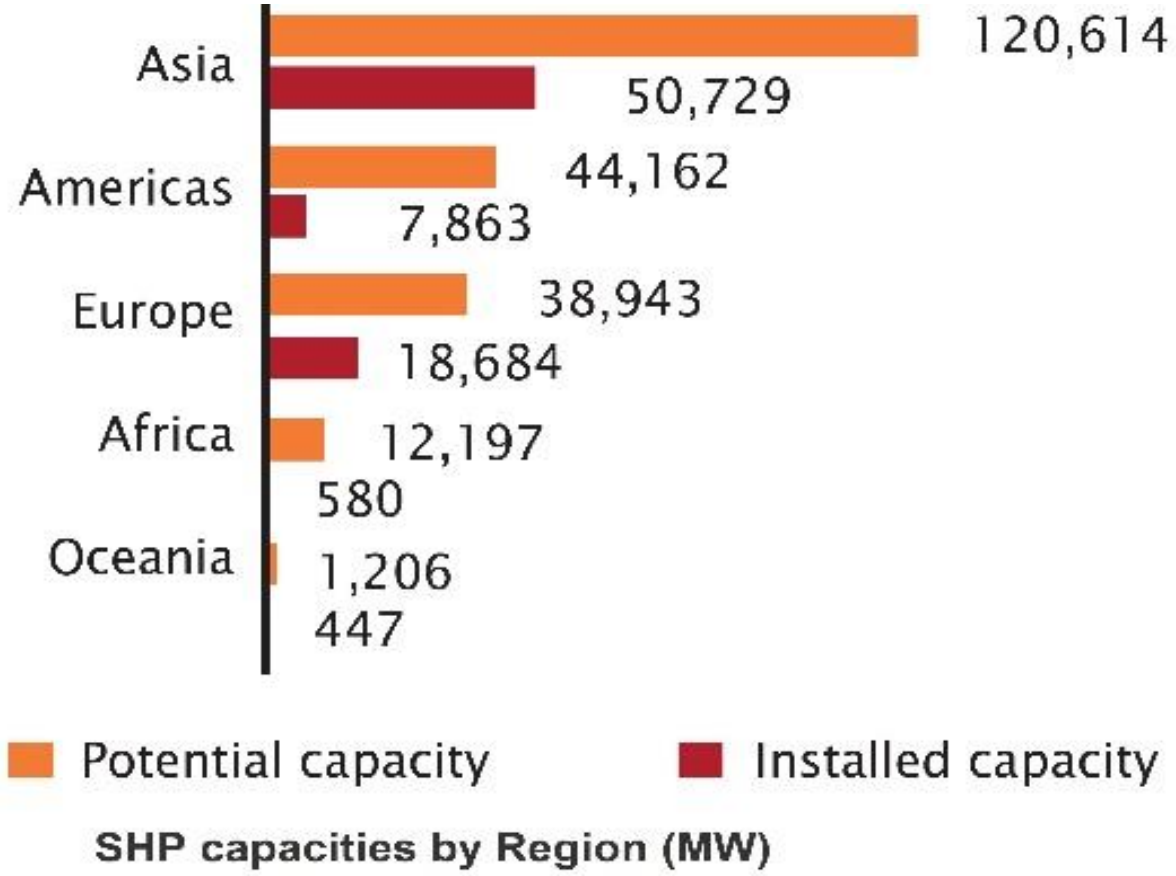
ENERGY GAP

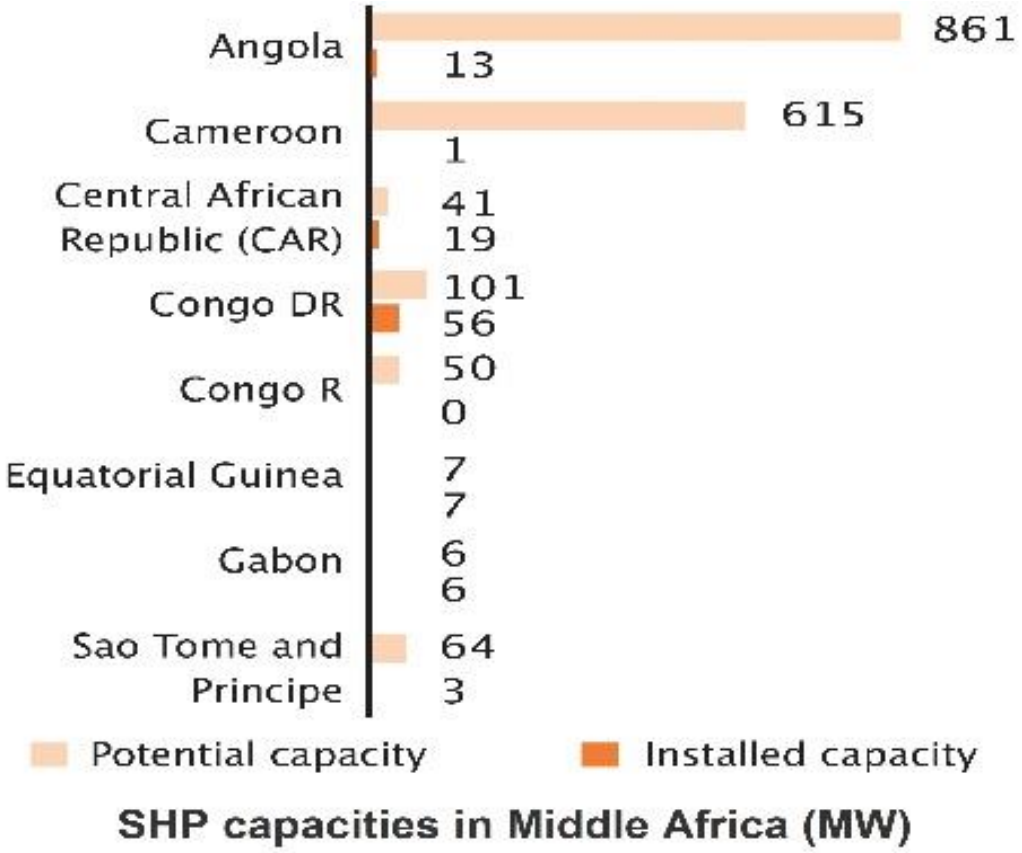


- Spain consumption per capita: 5.170 MWh
- Germany consumption per capita: 6.6 MWh (2016)
- Cameroon consumption par capita: 0.250 MWh (2016)
- Meaning 1 household in Germany = 26 households in Cameroon

- Hydropower potential of Africa:
  - 350 GW
  - Currently 28 GW installed and 14 GW under construction
  - Meaning only 12% developed so far
- Electricity grid:
  - Radial network ➔ Important end user voltage drop (75 kV instead of 90 kV in Bamenda - Cameroon from Douala for a 350 km power line; 17% voltage drop)
  - Low demand in the cities (MWs)
- Electrification rate:
  - Average of 15%
  - Below 5% in some rural areas (1% in rural Central African Republic)
- Meaning poor hydropower generation, slowing down the growth (estimated to cost Africa some 2-3% of GDP)
- Small hydropower is one option for power generation for standalone/grid connected generation and hence
- Mitigation of the energy access, energy security and energy shortage

Small hydro potential and installed capacities (world, Middle Africa)



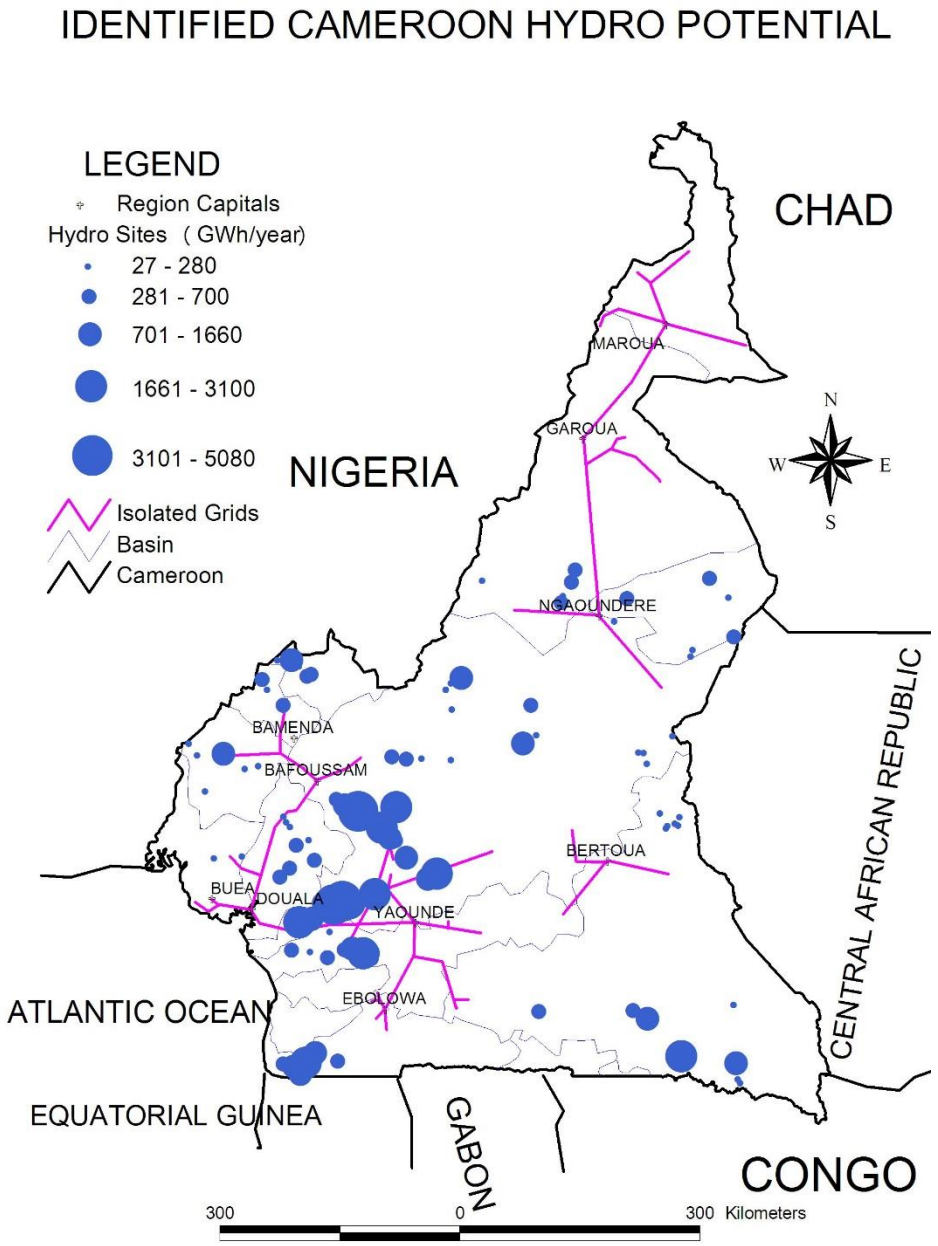


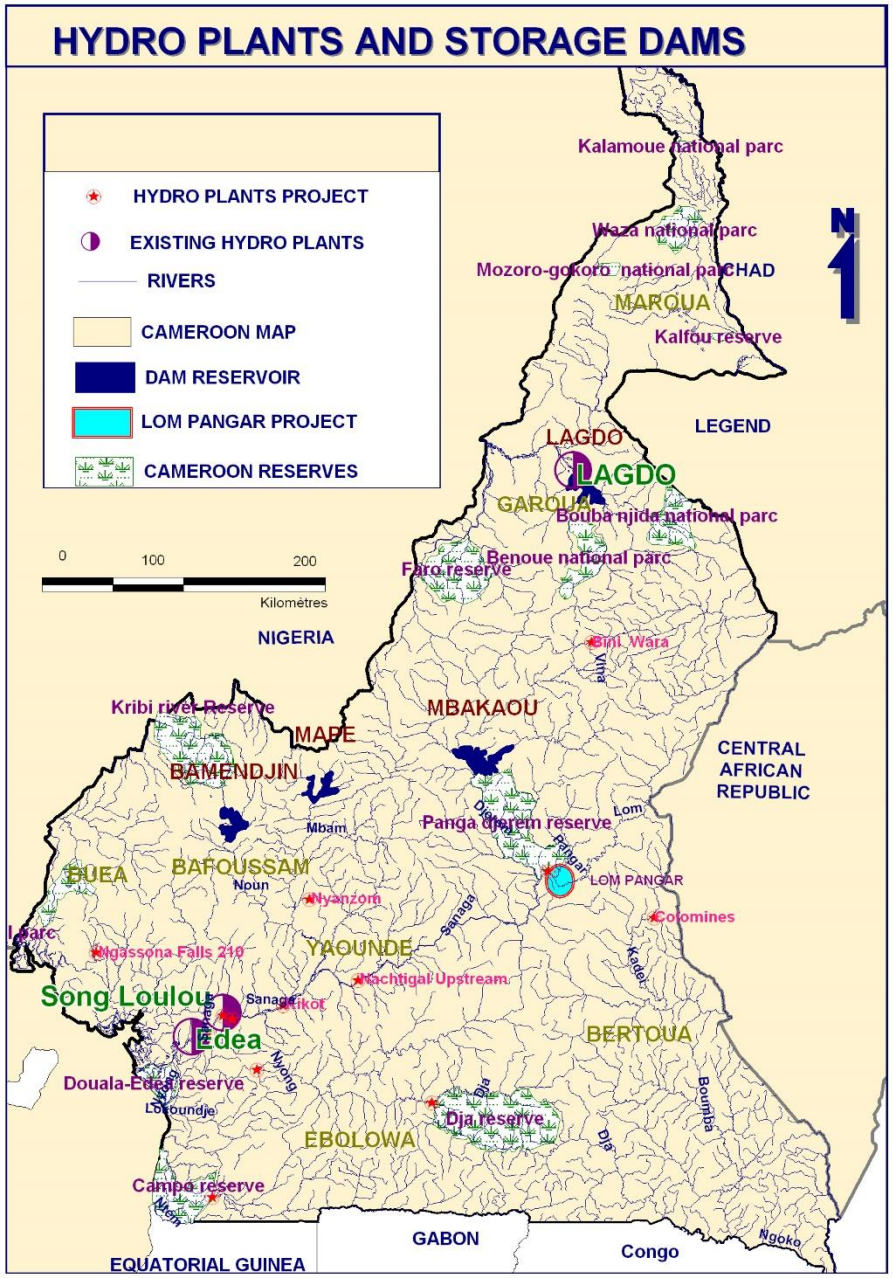
Data for known sites, detailed identification yet to come

NEED OF A BIG PUSH FOR HYDROPOWER DEVELOPMENT

Focus on Cameroon

- 25 million people
- 0,860 GW hydro installed capacity (6%)
- 19 GW hydropower potential (huge)
- About 615 MW small hydro potential
- Three isolated Grids (south, east, north)
- Three large hydro plants above 70 MW
- No small hydro plant in operation
- But 3 small plants under erection (2.9 MW, 1.4 MW, 15MW)
- 54% electrification rate in cities
- 17% electrification rate in rural area
- About 45% of population in rural area

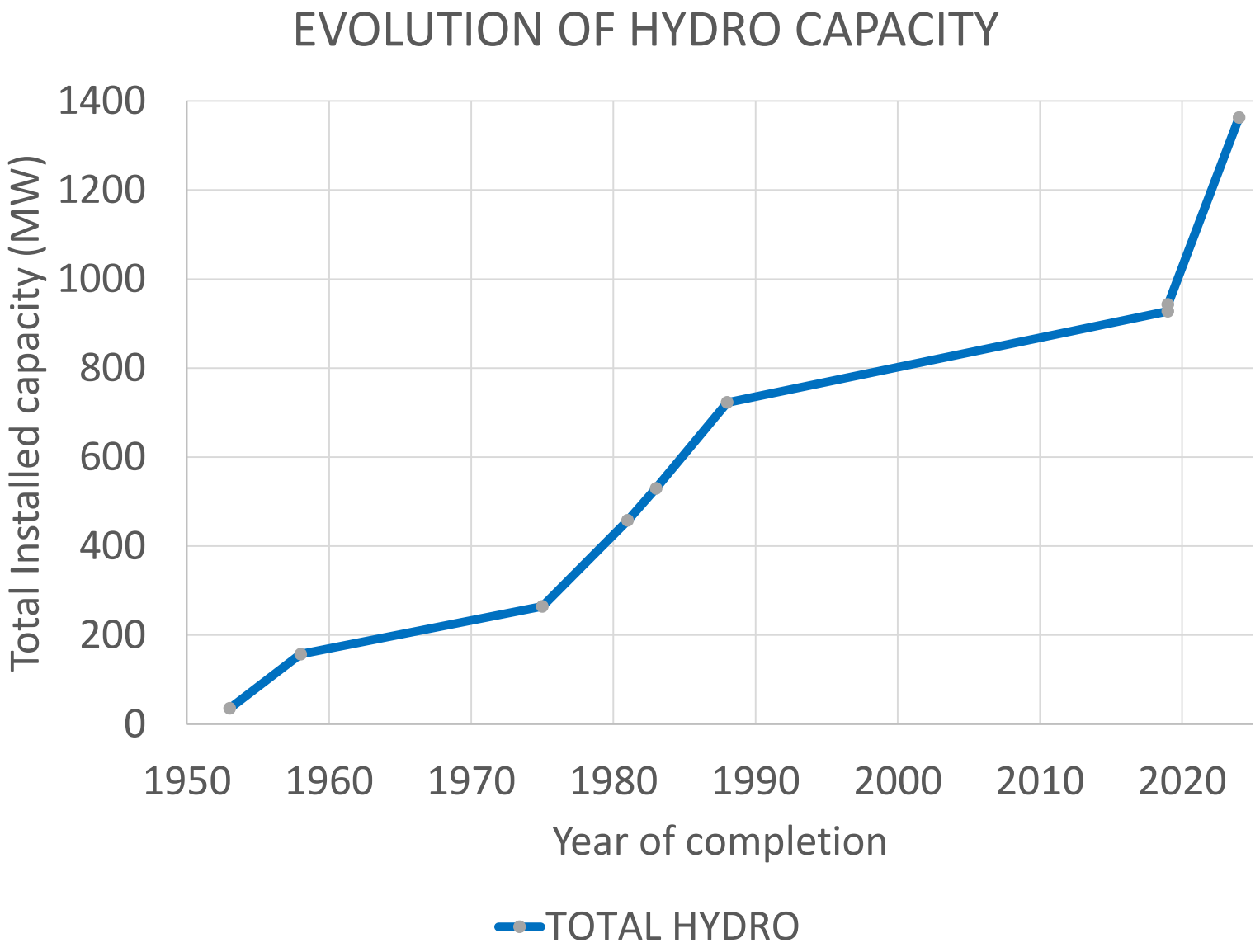


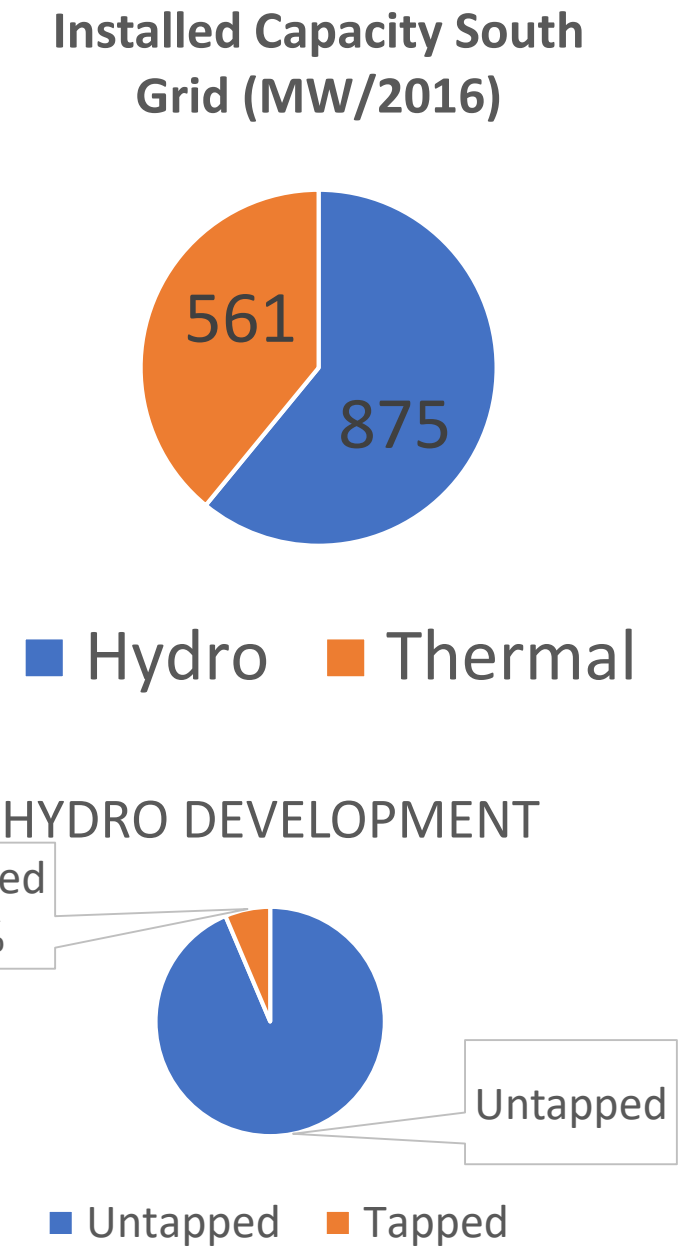


Existing HYDRO PLANTS plants (since 1952)

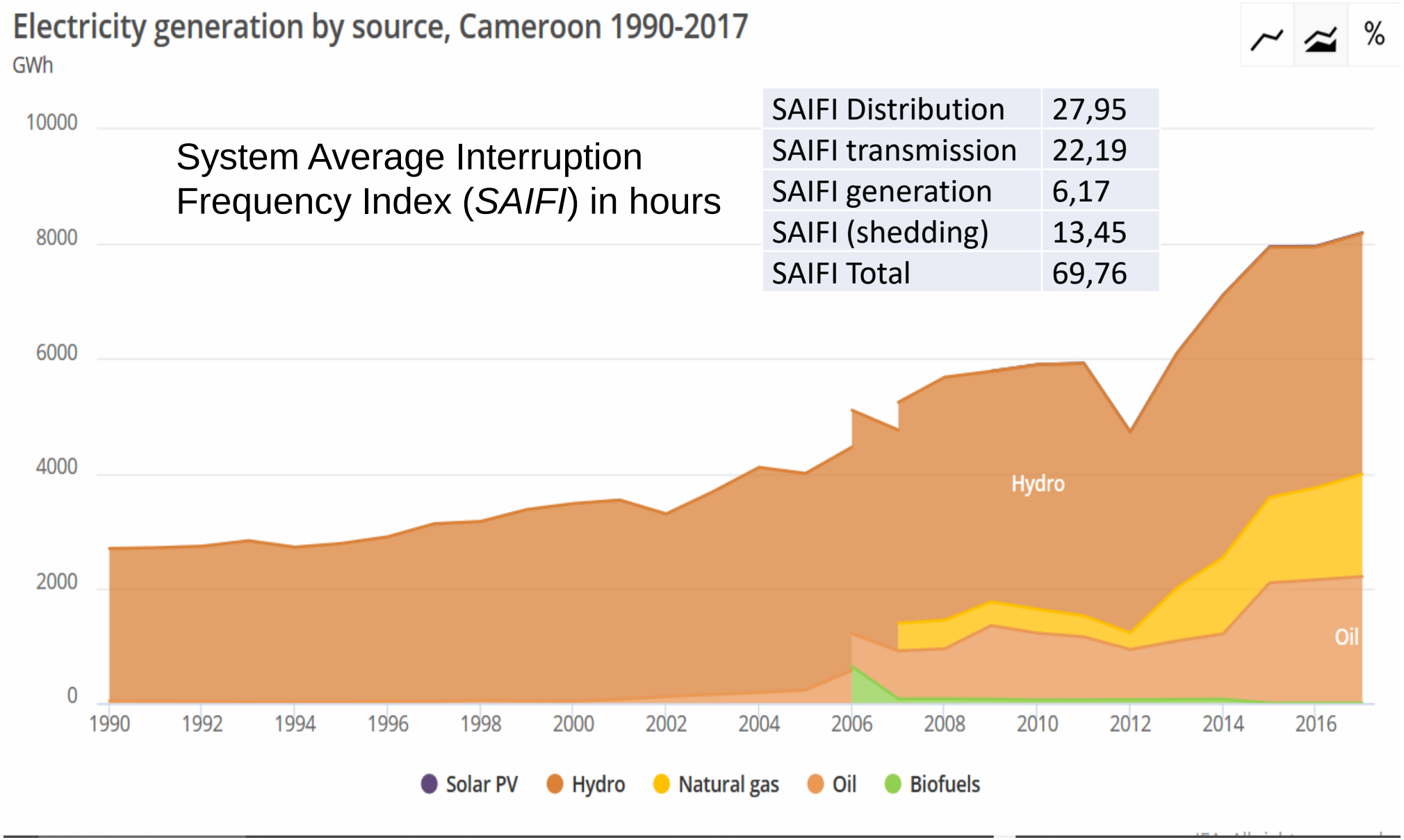
- 3 existing plants feeding two radial grids
  1. Edea hydro plant with 276 MW (since 1952)
  2. Song Loulou 384 MW (since 1987)
  3. Lagdo 72 MW (since 1986)
- 4 Storage dams
  1. Mape (3.3 km^3)
  2. Bamendjin (1.8 km^3)
  3. Mbakaou (2.6 $km^{3)}$
  4. Lom Pangar (6 km^3)
- plants under erection
  1. Nachtigal (420 MW ongoing)
  2. Mekin (15MW commisioning)
  3. Mbakaou carriere (1.4 MW ongoing)
  4. RUMPI (2.9 MW stopped for security reasons)

LEVEL OF HYDRO DEVELOPMENT





Electricity generation by source (IEA)



System Average Interruption Frequency Index (*SAIFI*) in hours

SAIFI Distribution	27,95
SAIFI transmission	22,19
SAIFI generation	6,17
SAIFI (shedding)	13,45
SAIFI Total	69,76

IMPORTANT THERMAL PLANTS IN OPERATION (increase of tariffs)

Ongoing government policy

- In the framework of the long term development plan for the sector,
- several private actors have confirmed their intention to develop some hydro plants
- several memory of understandings have been signed with other potential developers at national and international levels
- Projects are designed to provide electricity in some remote areas and/or sustain the current generation capacity (grid connected)

EVOLUTION OF THE SECTOR

- Before 1974, many different companies in the country.
- Then all companies were nationalized and merged to form one national company.
- BUT monolithic organization showed its limits
- Sector liberalized since 1998 to overcome these limits.
- The National company was hence privatized,
- The sector was then opened to competition and new institutions were set up to manage this new competitive environment.
- Different regimes now apply, depending on the type of their activity and depending on the capacity or the activity (generation or sales).
- We distinguish the concession regime, the license regime, the authorization regime, the declaration regime and the liberty regime.

THE ACTORS OF THE SECTOR IN CAMEROON

- **The Ministry of Water and Energy,** is in charge of planning strategies, supervising the sector, preparing long-term investment plans, granting the main titles necessary to operate in the power sector (concession, licenses and authorizations).
- **Electricity Sector Regulatory Agency (ARSEL)**, the agency in charge of supervising, penalties, tariff, analyses of investments, studying applications for concessions, licenses and authorizations
- **ENEO** (formerly AES SONEL) is the utility (historical electricity operator)
- SONATREL is in charge of transmission (voltage above 30 kV)
- **Electricity Development Corporation (EDC),** is a state-owned entity in charge of managing the public assets in the electricity sector.
- **Rural Electrification Agency** for remote area electrification,
- **Independant Power Producers** are new actors coming into play since liberalization

Cameroun: institutional perspective (set in 1998)

- 1998: privatization of the national operator and liberalization of the production
- 2011: new electricity law (IPP, TSO, renewable energy obligations, etc.)
- Goals of this new law:
  - Double access rates by 2020 (we are missing the target)
  - 4.8 to 8.3 GW additional capacity by 2035
  - Interconnections with neighbouring countries (demand above 6 GW from Nigeria, but Chad demand also unmet)
- Constraints:
  - Limited grid capacity (aging)
  - Limited grid costs and off grid expansion
  - Should develop distributed generation
  - Lack of financial resources

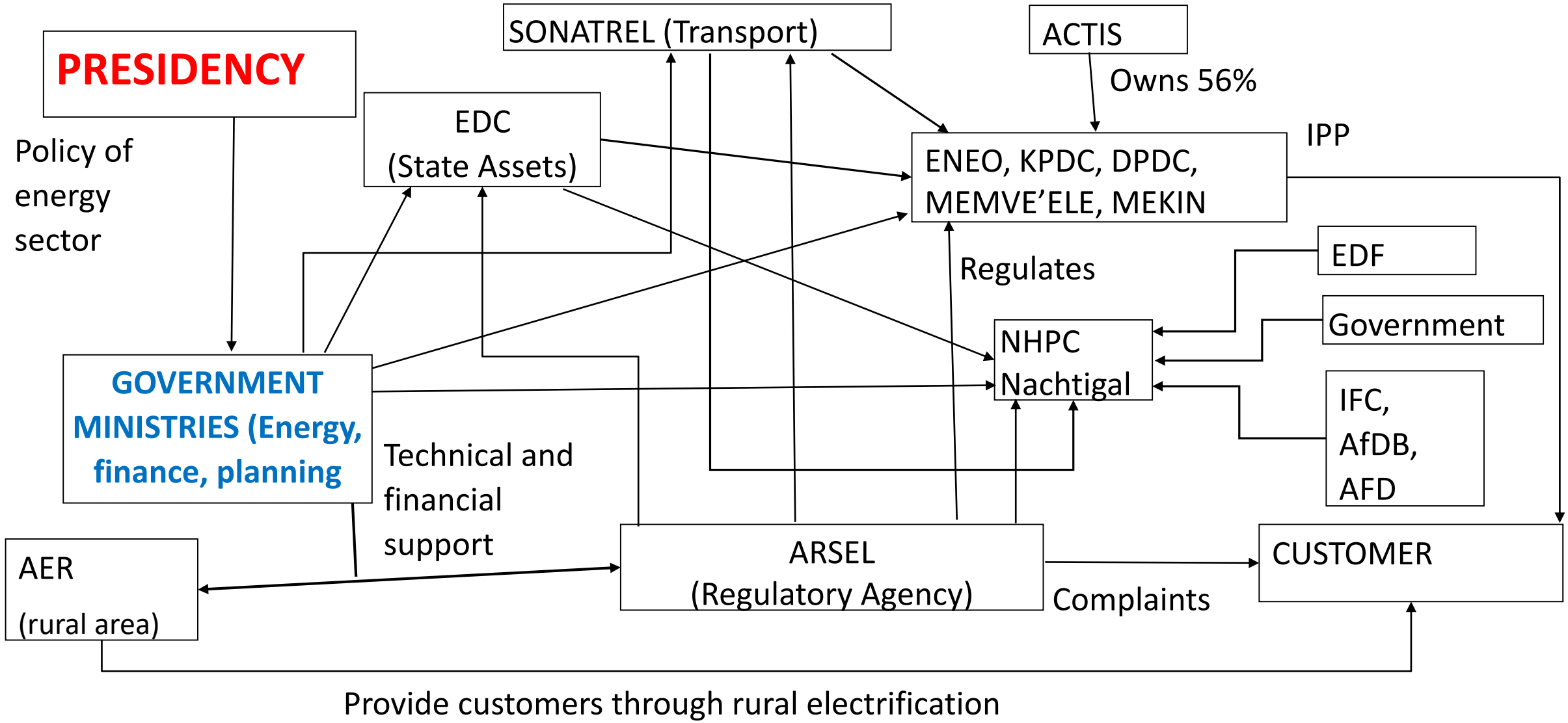
Regimes

- Concession for

  Generation, Transmission, Distribution,

- License for
  - IPP
  - Sales (high and medium voltage)
  - Importation and/or exportation of energy
- Authorization
  - Self generation > 1 MW
  - Exploitation less than 100 kW
  - Private lines
- Declaration
  - Self generation between 100kW and 1MW
- ~~Liberty~~
  - Self generation below 100 kW
  - Not for small hydro

LAYOUT OF CAMEROON POWER SECTOR



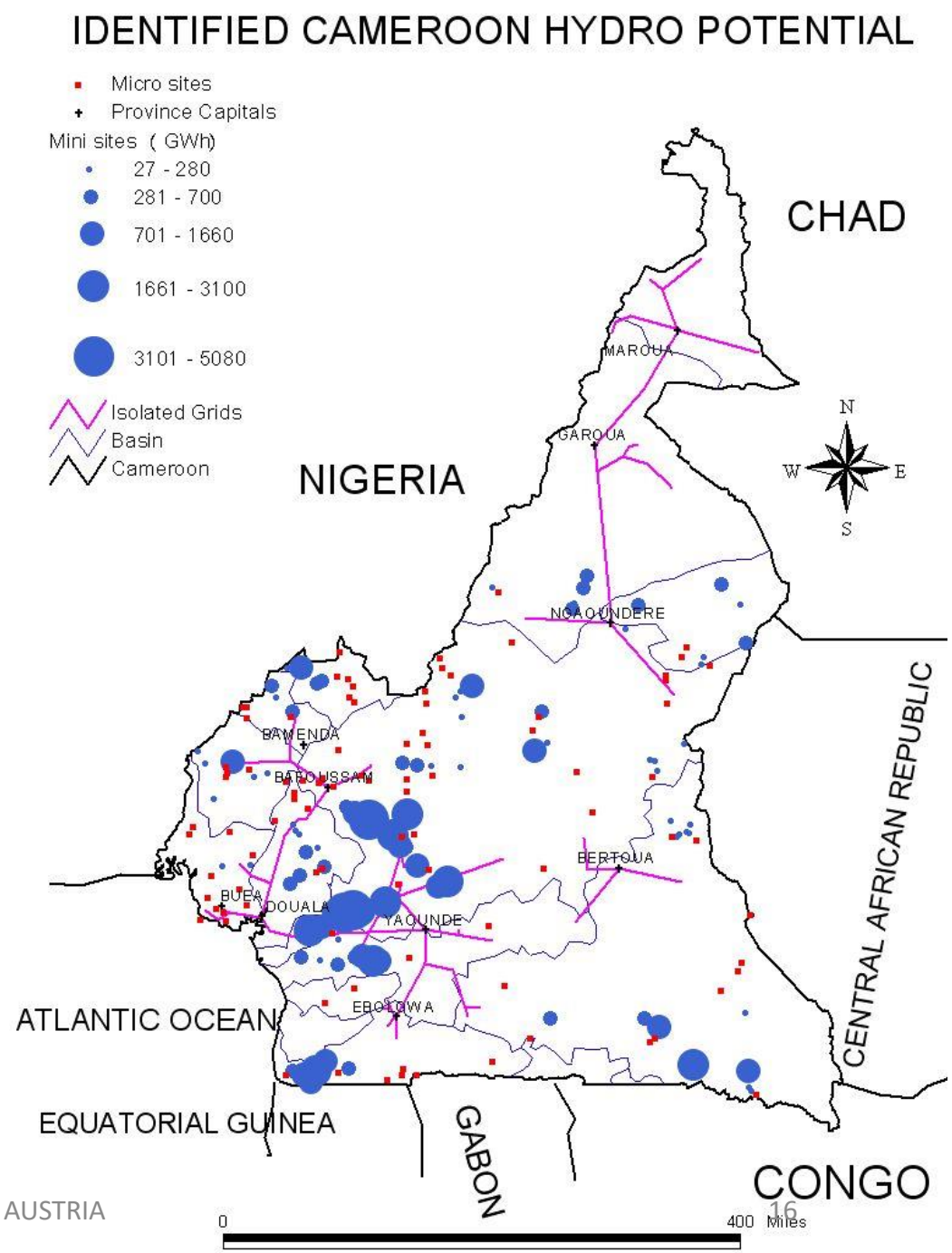
TITLES GRANTED BY THE REGULATORY AGENCY SINCE 1998

16 titles granted by the regulator

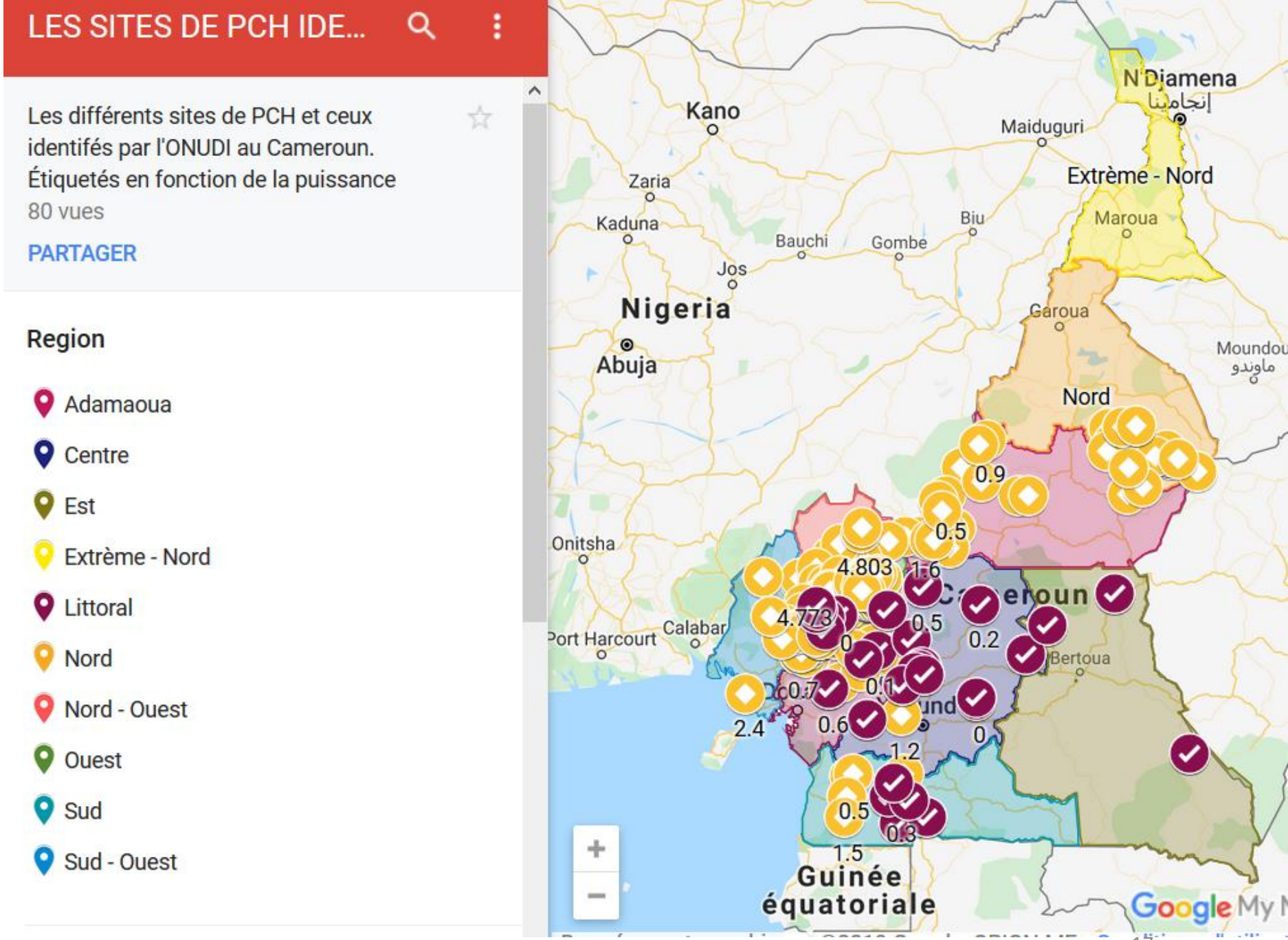
- 4 titles for hydropower
  - ENEO (utility 721 MW private - public)
  - IED Invest (1.4 MW private)
  - MBUROCADASS (75 kW?)
  - NACHTIGAL (420 MW private-public)
- 10 Titles for thermal plants
- 1 Tiltle for solar plant
- 1 Title for transport
- Titles for Mekin (15 MW public) and Memve'Ele (205 MW public) **yet to come**

Only one for small hydro Meaning we still have a huge gap to fill

2004 GIS map for hydro potential of Cameroon as research topic



Another raw data collection on small/ micro hydro potential to be consolidated UNIDO initiative (2019)



MEKIN SMALL HYDRO PLANT (15 MW, PUBLIC)

- Plant under completion
- ☞ Will feed 154 km - 30 kV power line
- Problems with turbine/generators and
- Power line not ready (should be reinforced)

RUMPI PROJECT (2.9 MW, PUBLIC)

- Abandoned for security reasons (civil war in that region of the country)

MEMVE ELE (205 MW, PUBLIC)

- Under completion

Other plants under erection

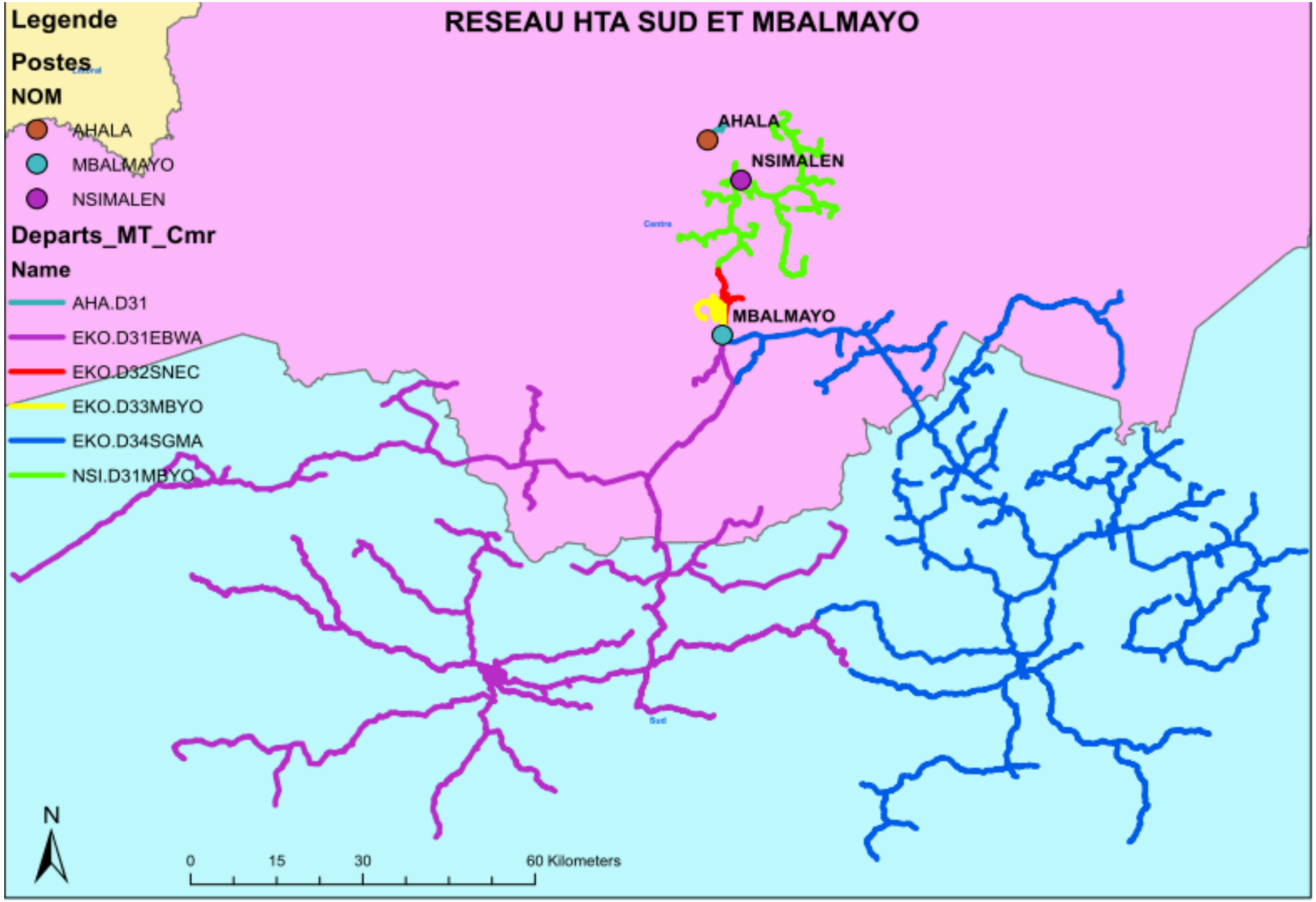
- Mbakaou Carriere (1.4 MW, Private)
- Lom Pangar (30 MW at the toe of the 6 km^3 storage dam, Public)
- Bini Warak (70 MW to feed Cameroon and Tchad, Public)

OTHER INITIATIVES

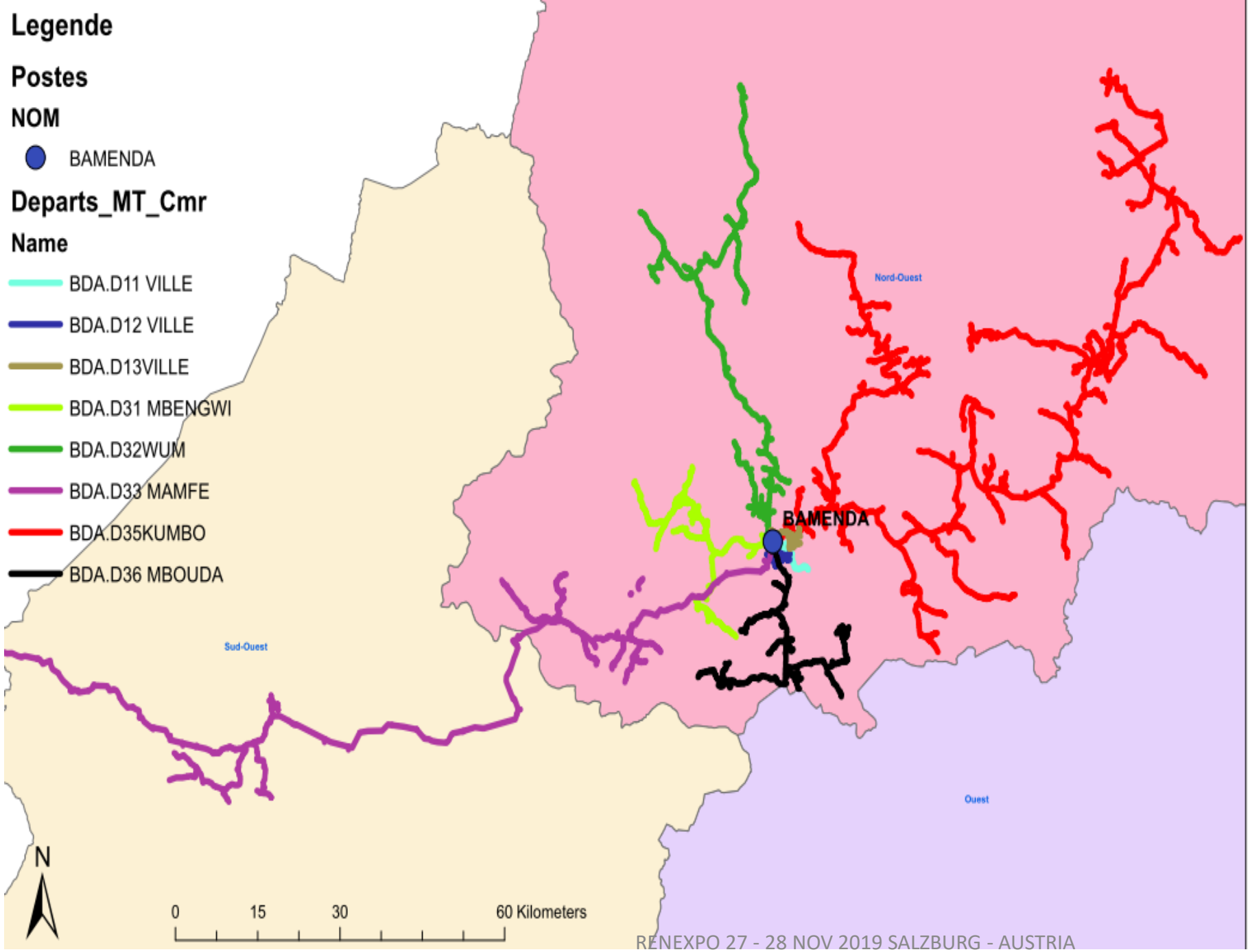
Tens of MoU from a few MW to hundreds of MW

Companies are from almost all parts of the world

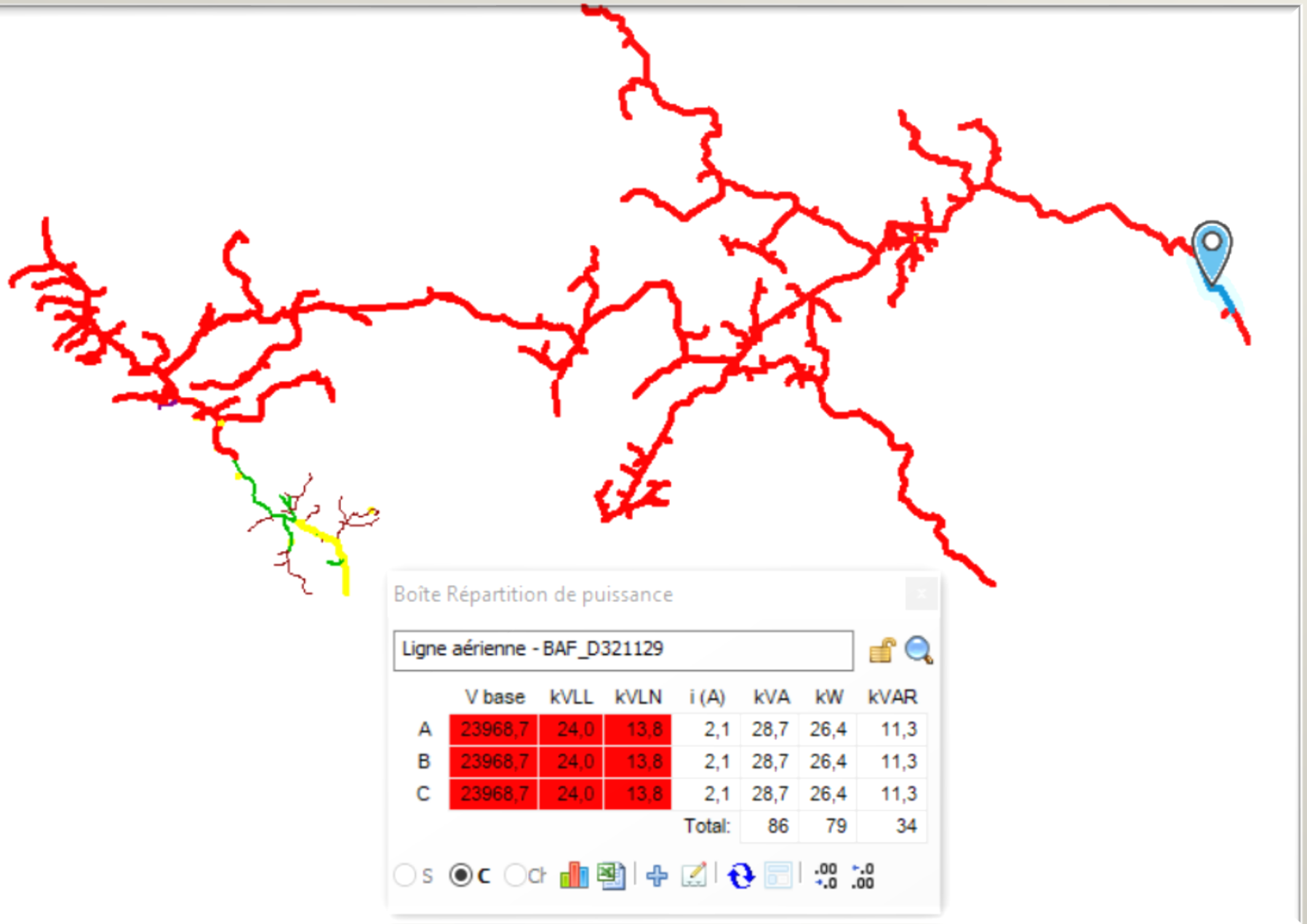
ABANDONED PLANTS SINCE LATE 70'S(20 kW to 3 MW)



RADIAL DISTRIBUTION OR ARCHITECTURE OF THE NETWORK IN CENTER REGION (Other regions are similar)

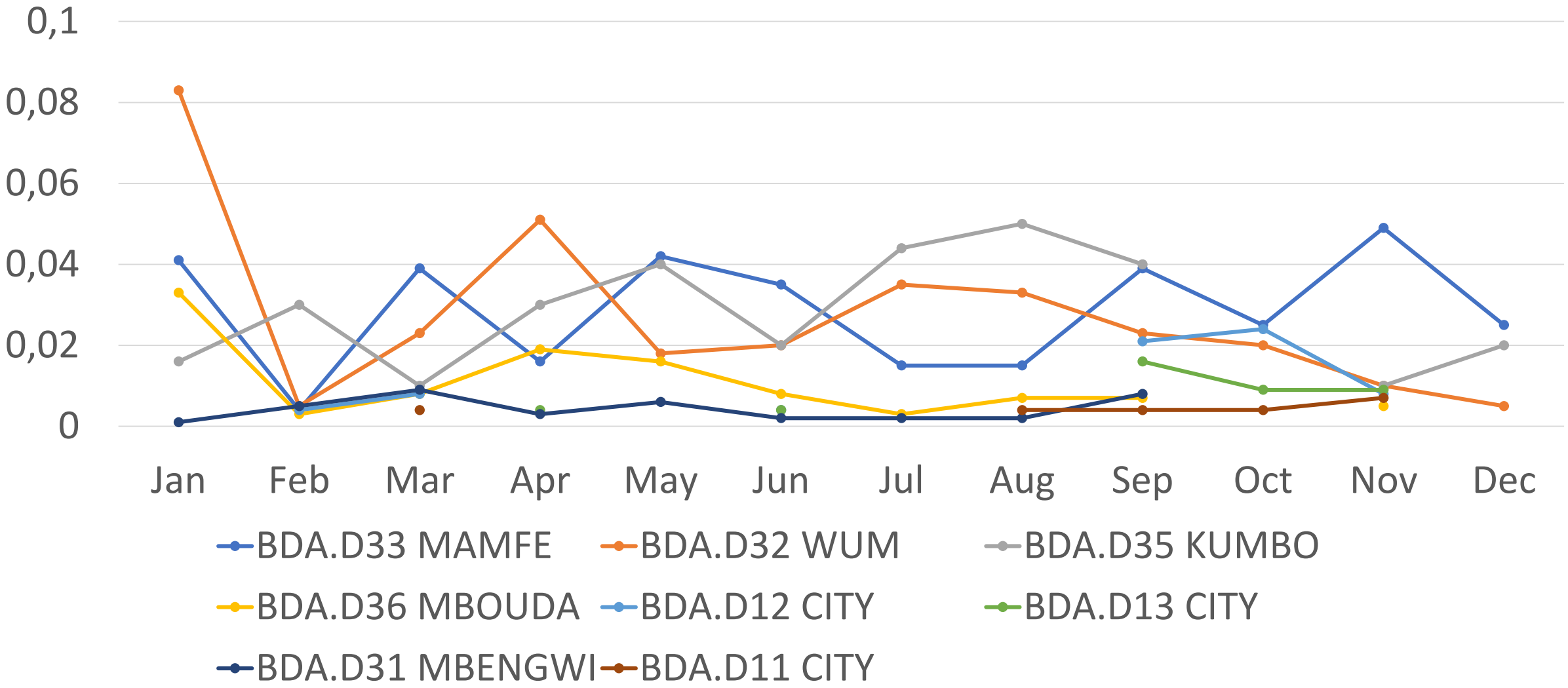


RADIAL DISTRIBUTION OR ARCHITECTURE OF THE NETWORK IN NORTH WEST REGION (Other regions are similar)

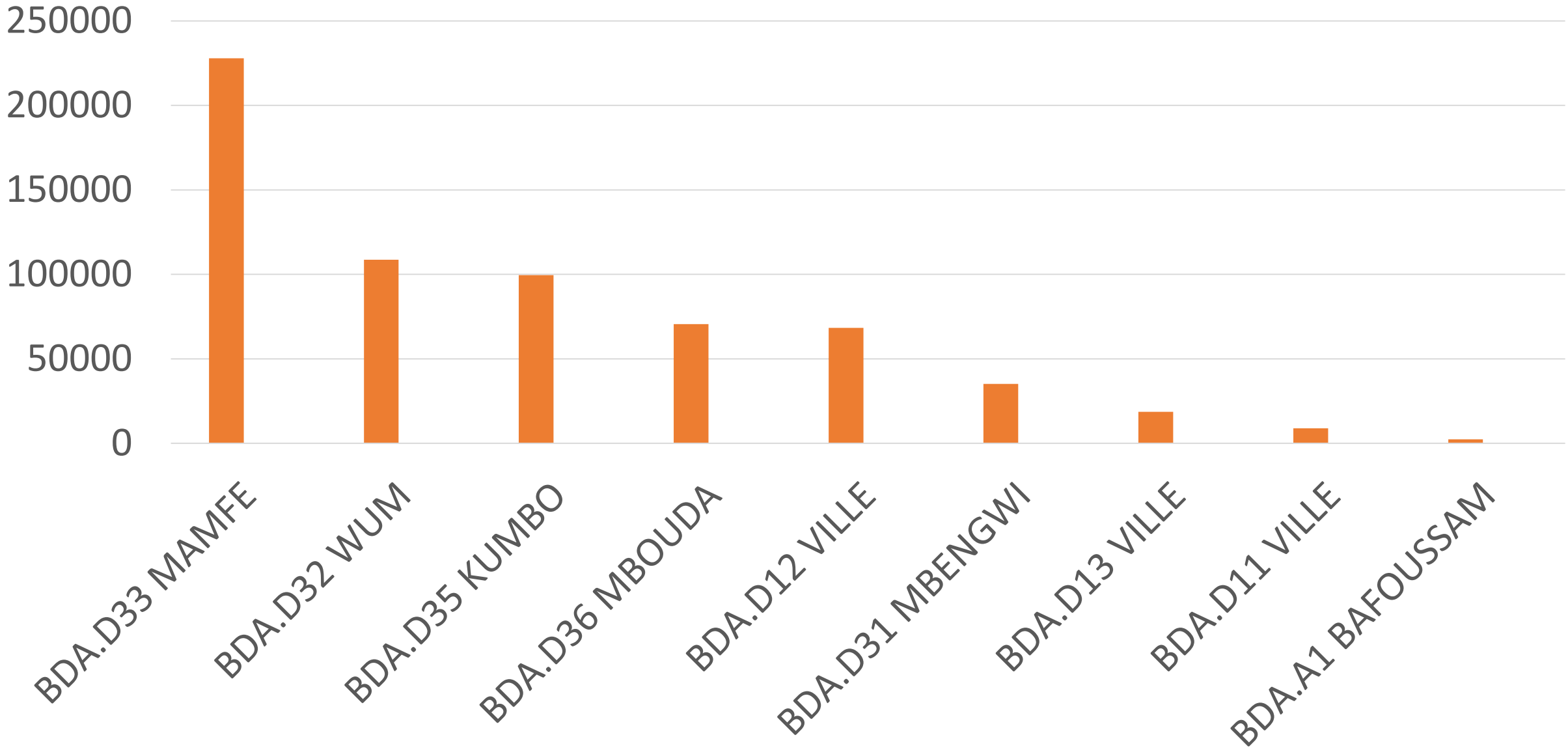


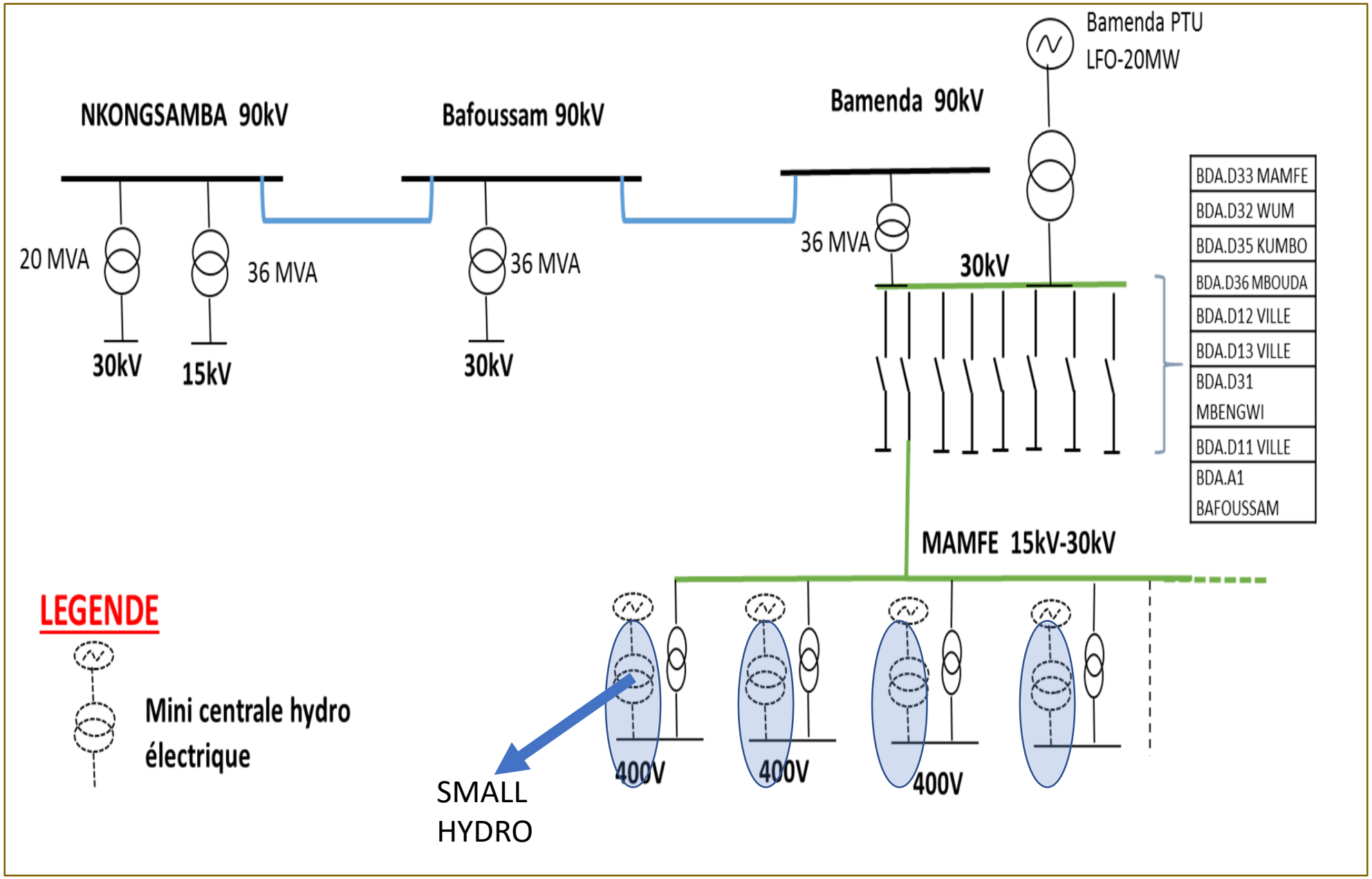
HIGH VOLTAGE DROP IN THE REMOTE NETWORK (24 kV INSTEAD of 30 kV IN THE NETWORK IN NORTH WEST REGION (Other regions are having similar problems)

SYSTEM AVERAGE INTERRUPTION DURATION INDEX (SAIFI) FOR NORTH WEST REGION



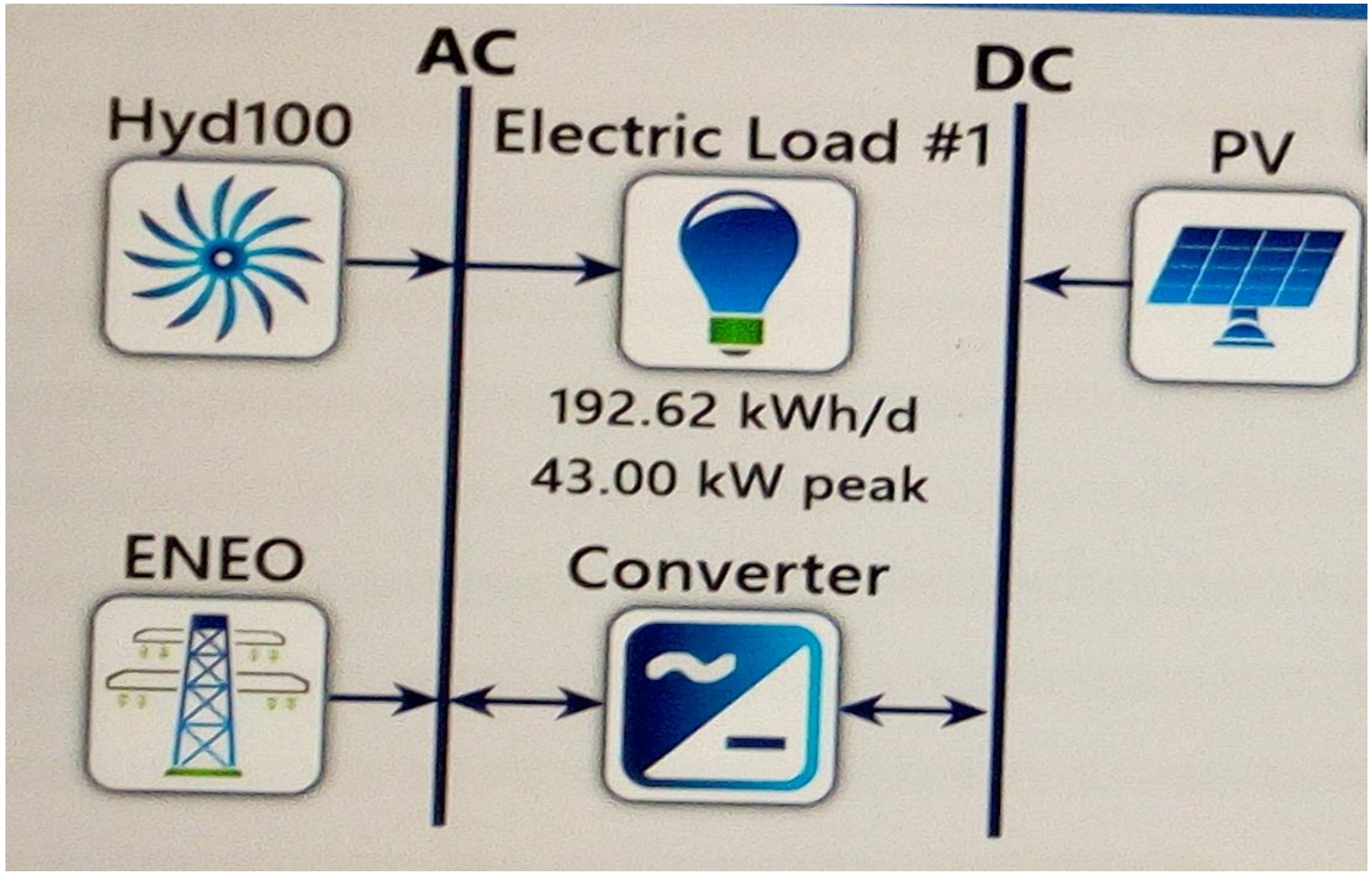
TOTAL ENERGY NON DISTRIBUTED BY MEDIUM VOLTAGE CIRCUIT





CURRENT ARCHITECTURE AND UPCOMING CONTRIBUTION OF SMALL HYDRO

GRID & OFF GRID ISSUES



- Low demand in remote area,
- high capacity for small hydro,
- Long distance medium voltage network,
- Huge voltage drop
- Should envisage grid connected
- To sustain the grid
- For cost effectiveness

COMPANIES WITH MEMORY OF UNDERSTANDING FOR PROJECTS ABOVE 5 MW

1. ASIAN PACIFIC
2. HYDROCHINA CORPORATION
3. GRENOR CAMEROON SA
4. A2Z MAINTENANCE & ENGINEERING SERVICES LIMITED ET EUROFINA S.A.,
5. CLUB MILLENIUM
6. African Energy Company
7. Hydromine Inc
8. TBEA
9. Kedjom PowerProject (KPP)
10. TBEA

11. XINJIANG BEIXIN CONSTRUCTION AND ENGINEERING
12. CWE
13. CWE
14. SINO HYDRO
15. JOULE AFRICA
16. Ximcor (USA)
17. SUHN
18. China National Electric Equipment Corporation
19. APICA
20. Alpha Technology

21. ALUCAM
22. RIO TINTO ALCAN
23. CHINA GEZHOUBA GROUP CO
24. CGC OVERSEAS CONSTRUCTION GROUP CO. ;Ltd
25. HYOSUNG CORPORATION
26. POWER CONSTRUCTION CORPORATION OF CHINA
27. DEFEX et son partenaire Technique –ELECNOR
28. SINOHYDRO CORPORATION LIMITED
29. BOUYGUES ENERGIES & SERVICES
30. FABIEN M.ASSIGANA &ASSOCIATES INTERNATIONAL CONSULTING

31. KALPATARU POWER TRANSMISSION LTD,UNE SOCIETE INDIENNE
32. XUAN THIEN AFRICA INVESTMENT S.A
33. ENVIRONMENTAL CHEMICAL CORPORATION
34. CHINA NATIONAL AERO-TECHNOLOGY INTERNATIONAL ENGINEERING CORPORATION
35. CHINA NATIONAL AERO-TECHNOLOGY INTERNATIONAL ENGINEERING CORPORATION
36. FINAGESTION S.Adevenue
37. ERANOVE S.A
38. A2Z MAINTENANCE & ENGINEERING SERVICES LIMITED ET EUROFINSA S.A
39. ERG Construction and Trade Co
40. Nurol

41. OZTURK
42. Platinuim
43. **c**hina Railway Construction Corporation
44. NPPC
45. CMEC/PBEC
46. TBEA Hengyand Transformer
47. KALPATARU
48. DOUBLE KINGDOM LTD

MoU for Small hydro 1/2

1. **GREEN WATT**
2. BAMUSSO CITY COUNCIL
3. Fabien M. ASSIGANA & Associates International Consulting
4. FOKOUÉ CITY COUNCIL
5. BERKELEY ENERGY
6. **ADEID**
7. SOLARHYDROWATT
8. BILL

MoU for Small hydro 1/2

9. HYDROMEKIN
10. ALPHA TECHNOLOGY
11. Kedjom Power Project
12. MINEE/AER/UNIDO
13. AER / Plan VER
14. AER / ERD RUMPI
15. AER / Projet FED

ONGOING INITIATIVE FOR SMALL HYDRO

The government intends to develop 50 small hydro projects. It is under prefeasibility studies (but lacking funds)

ABOUT MoUs & OTHER GOVERMENT INITIATIVES

- Almost all projects are behind schedule,
- Lack of experience (30 years since last plant commissioned),
- Lack of funding,
- Projects initiated by local start up companies,
- Lack of investment banks (poor or no support),
- High interest rate (above 5%)
- But funds available abroad

HOW CAN WE ADDRESS THE ISSUE WITH RESPECT TO THE LOCAL CONSTRAINTS

THANK YOU FOR YOUR ATTENTION

Joseph KENFACK