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**PROJECT ON ENHANCEMENT OF A SUSTAINABLE REGIONAL
ENERGY MARKET IN THE EASTERN AFRICA – SOUTHERN AFRICA – INDIAN OCEAN
(EA-SA-IO) REGION**

**REPORT ON THE COMESA, EAPP AND SAPP STUDY TOUR ON COMPREHENSIVE
POWER MARKET CONCEPTS
OSLO-NORWAY, COPENHAGEN AND DENMARK**

30TH OF MARCH – 13TH OF APRIL 2019

A. INTRODUCTION

1. The Common Market for Eastern and Southern Africa (COMESA), East African Power Pool (EAPP) together with Southern African Power Pool (SAPP) conducted a study tour on electricity markets in Norway and Denmark from the 30th of March to the 13th of April 2019. The training was conducted by Nord Pool Consulting in Oslo, Norway. The training was sponsored by COMESA through its RAERESA/ESREM Project. The delegation was comprised of 9 members; 1 from COMESA, 3 members from Eastern Africa Power Pool (EAPP), 4 from the Southern African Power Pool (SAPP) and 1 from the Independent Regulatory Board (IRB) of the EAPP. List of participants is attached as Annex1.



2. The training was structured in both presentations and site visits. Below are some of the key issues covered during the study.

B. PRESENTATIONS AND VISITS

3. Several presentations covering various topics were made and visits were undertaken to key institutions involved in electricity trading in the Nordic market. A summary is presented below;

The Nord Pool Market Model

4. Nord Pool is owned by Nordic Transmission System Operators (TSOs). The day ahead market (DAM) is the heart of the market where 93% of all consumption power is traded. The DAM Elspot market was formed in 1992 and is implicit auction based. It is the largest market place for trading power in Europe. Nord Pool receives around 2000 bids on daily basis. There are four basic currencies for trading namely Euro, Norwegian Krone (NOK), Swedish Krona (SEK) and Danish Krone (DKK).
5. The TSOs operate the balancing market. The intraday Elbas market was introduced in 1998 and is a secondary market to the DAM Elspot. In the Intraday market is usually used for balancing out a portfolio and a participant is usually a price taker. The prices are usually higher than those in the DAM and they are usually smaller volumes. The balancing market will always be expensive, the system is such that there is no room for speculation.

Financial Markets

6. The presentation on financial markets gave a background to financial markets, financial products and hedging, clearing and settlement of financial products, Electricity Price area differential (EPADs) and green products in the power markets.
7. Initially Nord Pool ran both the physical market and the financial markets up to the point when Nasdaq bought the financial market. The Nordic financial market separated from Nord Pool in 2002 and trading and hedging is purely financial.
8. There is a strong link between the financial and physical market. The financial market is an essential part of the electricity producer's and consumer's financial risk management. Financial markets allow for hedging of the risks in the power market such as price, weather, volume, credit risks to mention a few and both producers and consumers usually hedge the long-term power production and consumption for several years in advance. The elements of a well-functioning financial market are liquidity, transparency, secure clearing counterpart, equality and market surveillance.
9. Hedging of prices is done on exchanges such as Nasdaq or can be done over the counter. Financial markets only involve financial settlement and there is no physical delivery as in the case of the Elspot (day Ahead market) and Elbas (intraday) that are run by Nordpool and involve physical delivery. Contracts to buy or sell power are traded on the exchange but financial delivery happens in the future with a maximum period of 10 years ahead.

10. The financial delivery is the compensation for price differences between the system price of the physical market and the fixed contract price in the delivery period, and there is no physical delivery of power. In the Nordic model a player can buy or sell the physical electricity in the spot market and can combine with the spot deal with financial settled power derivatives in order to hedge and avoid future price risks.
11. Congestions between different areas can result in different area prices. Nordic futures contracts do not fully cover the price area risk (settled against the system price). EPADs are electricity price area differentials between different price areas and are contracts that secure the difference between the area prices and the system prices. Market players can therefore use the EPAD market to hedge against deviations between the area price and the Nordic system price or the deviations between two system prices.
12. The electricity Certificates system is a subsidy market where the certificates are tradable in the bilateral market or exchange. They are the most important green product system in the Scandinavia and are market-based support systems for the expansion of electricity production in Sweden and Norway from renewable resources. This is a very liquid and volatile market.

Market surveillance at Nord pool

13. Market surveillance is at the heart in creating trust and confidence for power markets in Nord Pool. Market Surveillance works to ensure confidence and prices that market participants can trust. Confidence in the market is essential for attracting market participants and creating liquidity in the market. Market surveillance reduces the risk of market participants becoming victims of market manipulation or to manipulate the market by negligence.
14. Regulation on wholesale Market Integrity and Transparency (REMIT) creates a market surveillance framework across Europe. REMIT is the first set of common rules for wholesale energy markets in Europe. On a European level REMIT aims to achieve; confidence in the market integrity, prices that represent a fair and competitive interplay between supply and demand and ensures that no profits are drawn from market abuse.
15. REMIT is enforced by the following organisations;
 - a) Agency for the Cooperation of Energy Regulators (ACER)
 - i. collects and analyses wholesale market data,
 - ii. Detects and prevents possible market abuse
 - iii. Creates guidance on application of REMIT
 - b) National Regulatory Authorities (NRA)
 - I. Responsible for carrying out investigations
 - II. Monitoring for proper disclosure of inside information
 - III. Monitoring for market manipulation

- c) Nord Pool as an Organised Market Place
 - i. Has arrangements in place to identify breaches
 - ii. Reports possible breaches to the national regulatory authority
 - iii. Implements prevention measures

16. The delegation also managed to visit Sentralem, a department that operates under Nord Pool. Sentralem carries out market surveillance and look at issues such a market manipulation and insider trading. It also investigates and sends reports of potential violations to the National Regulatory Authorities through ACER. The regulators which have powers to sanction then take up the cases for further prosecution.

The European target model

17. The European target model strives for a one common energy market. The European target model shall ensure the completion of the EU Internal Energy Market for electricity. The model provides guidance and standards for each timeframe: Day Ahead (DA), Intra-Day (ID), Balancing and Forward Market. A fair and transparent Day-ahead power price is a key factor for the target model's success.

18. The integrated European electricity market is expected to increase liquidity, efficiency, social welfare and transparency of prices and flows. The Price Coupling regions (PCR) which is an initiative of seven Power Exchanges to develop a single price coupling solution was launched in February 2014. An algorithm called EUPHEMIA is used. There is also Multi- regional coupling (MRC). This involves coupling of regions and efficient management of available transmission capacities between areas and countries. This has also resulted in the development of a common Intraday trading platform (XBID -Cross Border Intra-Day) with shared order book and capacity management module.

Dealing with Power Quality

19. A presentation was made by Metrum, a company that provides intelligent measurement systems for energy and power quality systems. It is of paramount importance to invest in power quality systems as bad power quality can result in huge financial impacts. Power quality losses in Europe are estimated to be 150 Billion Euro annually and the lifetime on electrical equipment can be reduced by 50% due to bad power quality. Metrum offers measurement instruments, applications, expertise and custom-made reporting tools. 70 out of 100 largest electric distribution and transmission companies in Sweden use Metrum. Metrum has also customers in Africa comprised of 5 distributors and 3 customers.

Visit to Statkraft

20. The delegation also visited Statkraft, a generator of renewable energy and is the biggest hydro-power producing company in Norway and Nordic region's third largest energy producer. Statkraft is 100% or fully owned by the state. The company has around 4200 employees and is headquartered in Oslo, Norway.

21. One of the key lessons learnt was on the efficient use of water reservoirs. There is a model for efficient use of water reservoirs. There are forecasting models that always utilise the cheapest resources at any time for production to make generation decisions. Generation is based on the water value and expected prices. The water is pumped back to the reservoirs when prices are low. Cheap wind power is used to pump the water back into the higher reservoir during summer when the snow has melted and stores the water for winter time when prices are a bit firm.

Visit to NVE

22. A visit was made to NVE, the Norwegian Water Resources and Energy Directorate (which is a Norwegian government agency established in 1921) on the 4th of April 2019. NVE is Norway Power Regulator and is under the Ministry of Petroleum and Energy and regulates the country's water resources and energy supply.

23. Norway has been running a market-based electricity sector since 1991 and 95% of generation is hydro power which constitutes 50% of reservoir capacity in Europe. Norway has a generation and consumption capacity of 141 TWh/yr and 133 TWh/yr respectively. There are 120 distribution grid companies and there is a high share of public ownership.

24. Generation is based on the water value. The water value is the expected value of power generated from the water stored in the reservoir. Bidding based on the opportunity cost of the water; the loss of future income by using the water today. The water value depends on several factors such as the reservoir level, expected inflow to the reservoir and Power market expectations such as the market price and marginal costs of thermal generation in interconnected markets. This can go a long way in ensuring efficient utilisation of water resources in Africa on the background of declining water levels in most reservoirs.

25. The Nordic system has four TSOs and one synchronous area. There is mutual benefit of a complimentary generation mix in the Nordics comprised of Hydro in Norway and Sweden, Nuclear and thermal in Finland, Wind and thermal in Denmark. Market based solutions are used to balance the system during operation.

26. Europe is moving towards a single European market through price coupling of regions. The TSOs of the Nordic synchronous area are responsible for maintaining the balance between production and consumption at all times. Power balance is maintained by supervising and controlling the frequency, making sure the system frequency is within the required frequency level of 50 +/-0,1 Hz. Norwegian Transmission System Operator (TSO), Statnett is responsible for maintaining the balance in the Norwegian power system. To handle energy imbalances, reserves for up- and down-regulation are purchased through market solutions.

27. The presentations at NVE also covered in detail market surveillance, capacity and financial markets. There is a Nordic agreement on the establishment of common Nordic balancing markets. There is also a common Nordic Imbalance Settlement.

A common operational unit, eSett, is responsible for imbalance settlement on behalf of the TSOs of Norway, Sweden and Finland. There are also harmonized Nordic processes for reporting, settlement management, invoicing and collateral management. There is transparent and equal treatment for all market participants. The goal is to move from the current fragmented Nordic balancing markets to the Pan European balancing platforms by December 2021.

Visit to the Nordic Energy Research

28. Nordic Energy Research is the platform for cooperative energy research and policy development under the auspices of Nordic Council of Ministers. It is based in Oslo, Norway. Nordic cooperation in energy research started in 1975, leading to common pot research funding since 1985 and the establishment of Nordic Energy Research as an institution under the Nordic Council of Ministers in 1999. The Nordic Energy Research funds research towards the Nordic region's ambitious goals to reduce carbon emissions and its dependence of fossil fuels, and at the same time create new growth industries based on green technology.

Danish experiences on market-based Integration of wind power

29. In Denmark, the delegation had the opportunity to visit Energinet in Fredericia and Nordic RSC in Copenhagen. A visit was made to Energinet headquarters in Fredericia. Energinet is an independent public enterprise that is owned by the Danish Ministry of Energy, Utilities and Climate and its vision is to create balance in a renewable energy system. Energinet owns and operates the overall electricity and natural gas transmission system in Denmark. Its task is to integrate renewable energy and ensure security of supply In Denmark.

30. The Danish power grid consists of 6913 km of transmission grid and has 5 international interconnectors. 926 Km gas pipes and a 6600-gas distribution network. The energy system in Denmark is changing. Denmark anticipates that by 2020, wind power will constitute 50% of the electricity consumption Denmark. Renewable energy will constitute 100% of electricity consumption and 55% of the energy consumption. Denmark is also anticipating that by 2050 it will be independent of fossil fuels.

31. The economic gains registered in the Nordic Electricity system through cooperation include but not limited to;

- i. Diversified generation system (high share of non-fossils and large storage capacity)
- ii. Strong interconnections
- iii. Integrated markets (Day-ahead, intraday and regulating)
- iv. Coordinated operation (Sharing of reserves)
- v. Coordinated planning (Nordic and regional grid planning)

32. Both the horizontal and vertical integration strategies are being used to move towards the independence of fossil fuels.

a) The toolbox for efficient large-scale RES integration – horizontal integration

- i. Strong transmission grids and interconnections
- ii. International electricity markets
- iii. Flexible generation system
- iv. Specialized forecasting and operational planning tools.

b) Long term enablers - Vertical perspective towards independence

- i. Flexibility in a coherent energy system – sector coupling
- ii. Demand side flexibility
- iii. New market players
- iv. Transformation of the energy value chain – data driven business models
- v. Temporal integration.

Balancing in Denmark and the Nordics

33. The Nordic Region encompasses 4 countries and 12 price zones. The Nordic power Markets have evolved through time since the introduction in 1996. The Nordic Balancing Model was proposed in 2017. The Balancing model involved cross-border activation of automatic reserves and common capacity markets for balancing capacity.

34. Small areas are risky and costly and provide a big incentive to increase market integration. Small areas are statistically more likely to have large imbalances (law of large numbers). More balancing capacity is needed in a small area as compared to a large area. All else equal there are relatively more socioeconomic costs to ensure a balanced system. All balancing bids are gathered in Common Merit Order List (CMOL). Operators are responsible for frequency and pick the cheapest bids for activation. Local operators activate national bids below or equal to the price of the marginal bid. Below are some of the key principles for an efficient balancing energy market;

- i. No discrimination, “all players” should be allowed to participate with voluntary bids.
- ii. Easy to submit bids and update price close to real-time
- iii. Price shall always be attractive for all BSPs (cross border marginal pricing)
- iv. The imbalance price is in general, the penalty for not delivering according to requested.
- v. Imbalance price shall in general not be artificially increased above the balancing energy price (otherwise BSP/BRP’s may withhold flexibility to protect themselves against imbalance costs reducing balancing capacity available to the TSOs)

Regional and European TSO-cooperation

35. There is over 50 years of common grid planning. Nordel was founded in 1963 by Nordic transmission system operators to create preconditions for an effective and harmonized Nordic electricity market. ENTSO-E was established as a result of the EU 3rd Energy Package in 2011 to promote the completion and functioning of the internal market in electricity and cross-border trade. Some of the blueprints in place are Nordic Grid Master Plan 2008 and Entso-e's Regional Investment Plan- Baltic Sea. Network codes enable safe and efficient system operation and market functioning. Entso-e has a ten-year Network Development plan 2018 (TYNDP18). Europe is divided into 6 Planning Regions namely North Sea, Baltic Sea, Continental CE, Continental CS, Continental SE and Continental SW.

Visit to Nordic regional Security Coordinator (RSC) in Copenhagen

36. The delegation visited the Nordic Regional Security Coordinator (RSC) in Copenhagen. The Nordic Regional Security Coordinator (RSC) is the joint office for the four electricity Transmission System Operators (TSOs) in the Nordic region. The RSC supports the national TSOs in maintaining the operational security of the power systems across Finland, Norway, Sweden and Denmark. The power systems in the Nordic area and in Europe in general are becoming increasingly integrated and are going through massive changes in meeting ambitious climate goals. This calls for greater cooperation between national TSOs. The Copenhagen-based Nordic RSC embodies the strong Nordic cooperation needed to maintain reliable power supply now and in the future.

37. Nordic RSC has made greater efforts to enhance Information sharing. Greater efforts have been made in terms of information security to ensure information sharing by TSOs. The system gives comfort to members and they can share information knowing that their information is secure. Nordic RSC also engages ethical hackers to proof test the system.

C. KEY LESSONS LEARNT

38. The following key lessons were learnt;

- i. Regional integration is key in penetration of renewables and ensuring security of supply. It ensures well-functioning and liquid markets that are key to balancing of renewable resources.
- ii. The EU Commission has developed common rules for wholesale energy markets called Regulation on wholesale Market Integrity and Transparency (REMIT). Regulatory authorities and power exchange markets are required to base their regulations on the REMIT. A similar model could be a positive step for Africa.
- iii. Market surveillance is at the heart in creating trust and confidence for power markets in Nord Pool. Rules and regulations ensure the benefits of a

liberalized market. Market Surveillance works to ensure prices that market participants can trust. It also reduces risk of market participants becoming victims of market manipulation.

- iv. Decisions to generate power from hydro resources are predominantly based on the water value. The water value is the expected value of power generated from the water stored in the reservoir. Bidding based on the opportunity cost of the water; the loss of future income by using the water today. The water value depends on several factors such as the reservoir level, expected inflow to the reservoir and Power market expectations such as the market price and marginal costs of thermal generation in interconnected markets. This can go a long way in ensuring efficient utilisation of water resources in Africa on the background of declining water levels in most reservoirs. water has a higher value and it must not be wasted when there are other means.
- v. Europe is moving towards a single European market through price coupling of regions. Cooperation has resulted in better security of supply, ability to invest in new generation, flexibility and optimum usage of resources. The Nordic region is now working towards load flow-based capacity allocation in coupling markets.
- vi. Nordic RSC has made great strides to ensure security of information that is shared by utilities. More investment can be made to ensure security of information that is shared by utilities by both SAPP and EAPP.
- vii. It is of paramount importance to invest in power quality systems as bad power quality can result in huge financial impacts.
- viii. When handling energy imbalances, reserves for up and down regulation are purchased through market solutions.
- ix. There is a Nordic agreement on the establishment of common Nordic balancing markets. There is also a common Nordic Imbalance Settlement.
- x. Nordpool is able to operate other markets without being physically located in other areas
- xi. There is multi regional coupling and price calculation is done at PCR that is co-owned by seven Power Exchanges. The coordinator changes every two weeks.
- xii. Energinet is working towards ensuring that all developments are timely coordinated with development in renewable energy and to also ensure that the systems are able to handle the renewables.
- xiii. Strong transmission grids and interconnectors, International electricity markets, Flexible and controllable generations, Specialised forecasting and operational planning tools ensures security of supply in the Nordic region.
- xiv. Successful energy regional integration requires decisions and commitment from the top political level.

ANNEX 1: LIST OF PARTICIPANTS

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