Cross-border market operations

Inputs from Nord Pool Consulting

Tokyo, September, 2016
Nordic market summary
Utilizing the Value of Differences in a Region

**Seasonally**
- Wet
- Dry
- Hydro
- Thermal/nuclear
- Thermal/wind

**Reserves**
- Hydro
- Thermal/nuclear
- RESERVES

**Situations**
- Hydro
- Thermal/nuclear
- Wind
- Less wind
- Much wind

- Complementary production
- Security of supply
- Cost synergies
- Climate challenge
Day Ahead price formation in practice

Factors affecting the **supply** for electricity:
- Fixed costs of production
- Variable costs of production
- Plant startup and shutdown costs
- CO2 allowance prices
- Weather
- Hydro situation

Factors affecting the **demand** for electricity:
- Retail volumes and delivery obligations:
  - Weather
  - Open deliveries, etc.
- Industrial consumers:
  - Fixed costs
  - Variable costs
  - Startup and shutdown costs
  - Flexibility of processes

**TRANSMISSION CAPACITY**

Available Transmission Capacity (ATC):
- Existing interconnectors
- Unavailability of interconnectors (faults, etc.)
The Southern African Power Pool: A Nordic Model in Africa
SAPP Market Area

SAPP consists of the following members:

- 12 SADC Member Countries
- 16 SAPP Members
- 280 Million people
- Installed Generation Capacity - 62 GW
- Available Generation Capacity - 47 GW
- Peak Demand - 55 GW
- Consumption - 400TWh
Regional Power Market Preconditions

The aim for SAPP was to enable national power capacity merging into regional market in order to further optimize social welfare and increase security of supply.

- More power resources will be more available in a large region than nationally
- The market will facilitate more efficient management of marginal available production and transmission resources
- A regional power market has proven to add value to the common interconnected power market
- The slogan for the market integration in SAPP can be summarized as

  “National control – regional cooperation”
Utilizing the Value of Differences in a Region

Seasonally
- Wet
- Dry

Reserves
- Hydro
- Thermal

Situations
- Less wind
- High Wind

- Complementary production
- Security of supply
- Cost synergies
- Climate challenge
SAPP Market concept

Southern African Power Pool

FPM
Forward Physical contracts
- auction trading -
  Week – peak load
  Week – off-peak
  Week – weekend
  Monthly baseload

DAM
Physical Contracts
Market equilibrium
- auction trade -
  one day ahead
  - cont. trade -
  114,25 (50)
  114,00 (20)
  113,75 (60)
  113,50 (45)
  113,00 (25)
  112,75 (55)
  112,50 (40)
  112,25 (15)

IDM
Physical contracts
- auction trade -
  hours ahead
  - cont. trade -

SAPP Settlement and financial management
Settlement of all physical contracts
Settlement of wheeling and losses
Market monitoring and reporting

National TSOs

Balancing Power
Single buyer
National markets
Balancing generation and consumption in realtime

System Operation
Real-Time Operation
Services during the Real-Time-Operation: Controlling frequency and voltage etc.
Role of Different Markets in Supply

Balancing on the Day – Hourly Contracts
SAPP Markets

Balance Responsibility
- Market Participants need a DAM and IDM in order to be able to balance their expected generation/consumption with contracts transparency

Market Information
- Distribution of all relevant information publicly that can have impact on the market prices available through the Market Operator – SAPP

Portfolio bidding & Self-dispatch
- The participants manages their own assets

The auction market manage both trading and transport of traded power by the implicit auctioning of Available Transmission Capacity between the market areas
SAPP Markets and Members Opportunity

Use own infrastructure flexibility
- In the production assets
- In the consumption
- In the interconnections transmission capacity

Buy in the market when prices is low and sell when price is high
- Utilize regional differences
- Save fuel for later production
- Reduce industrial consumption
The importance of interconnections – also for SAPP

Current

Planned

Transmission Interconnection Projects

2015: 2nd DRC – Zambia 220 kV
2018: ZIZABONA - 330 kV
2018: Mozambique – Malawi - 400 kV
2018: Zambia – Tanzania-Kenya - 400 kV
2018: Morupule – Maun – 400 kV
2020: MOZISA – 400 kV
2020: RSA –Botswana - 400 kV
2020: Namibia – Angola -400 kV
2020: Oropa – Pandamatenga -400 kV
2022: Grand Inga Transmission- HVDC/AC
2024: Mozambique STE – HVDC/AC
The Nordic/EU market model has proven to be a flexible tool to integrate national markets in regional setups
Market Participants

Bidding

Results/Settlement

National Market Operator 1

Bidding process
- Bid validation process
- Aggregated net purchase curve
- Market coupling
- Export of data
- NEC
- Block rates

Create NEC

2

Prices all areas
Flow all ICs

Scheduling
- Schedule process
- Control of ultra fast control
- Overloads
- Settlement and payment
- NEC
- ATC
- ATC all ICs

Create NEC

2

Regional Implicit Price Calculation

SAPP CC

3

Prices all areas
Flow all ICs

National Market Operator n

Single or central buyer (no national market)

Create NEC

2

Results/Settlement

National Market Operator 1

Bidding process
- Bid validation process
- Aggregated net purchase curve
- Market coupling
- Export of data
- NEC
- Block rates

Create NEC

2

Prices all areas
Flow all ICs

Regional Implicit Price Calculation

SAPP CC

3

Prices all areas
Flow all ICs

DAM Overview
National Control – Regional Cooperation

TSOs
Calculation of TC for all interconnections

ATC all

Flow all ICs

1

ATC all

Flow all ICs

1

NEC NM1

2

NEC NM2

+ NEC NM1

3

ATC all

Flow all ICs

3

NEC NM2

2

NEC NM1
Market Participants
Bidding

Results/Settlement

Power exchange 1
Bidding process
- Bid validation process
- Aggregated net purchase curve
Create NEC
- Market coupling
- Export of data
- NEC (block bids)

Scheduling
- Schedule prices
- Control of bids
- Yield volumes
- Distribution
- Transportation and substation

Common Price Calculation
SAPP CC
Nord Pool

Power exchange n
Bidding process
- Bid validation process
- Aggregated net purchase curve
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Scheduling
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Common Price Calculation
SAPP CC
Nord Pool

DAM Overview
National Control – Regional Cooperation

TSOs
Calculation of ATC for all interconnections

ATC_{all ICs}

Prices all areas
Flow_{all ICs}

ATC_{all ICs}

Prices all areas
Flow_{all ICs}

Nord Pool
Thank you!

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Profile Hans-Arild Bredesen

Hans-Arild has more than 20 years of experience from international projects in the energy sector based on his work with the Nord Pool model

- Implementation of the Southern African Power Pool
- Start of service power exchanges in Croatia and Bulgaria
- Setting up a national power exchange in India
- Implementing a Wholesale Market Opening for SEE (South East Europe)
- High level design for the Albanian Power Exchange
- Author of “Power to the People”

Hans-Arild Bredesen
CEO, Nord Pool Consulting

- BSc in Computer Science from Høgskolen I Østfold, Norway
- Involved in the electricity deregulation process since 1992.
- Technical project manager for the market systems at Nord Pool
- Product manager for wholesale energy market participant systems for the Nordic market.
- Wide international experience from key roles in the development of strategies for trading, scheduling and settlement systems for PXs and TSOs in California, Ireland, India, Romania, Turkey, Ukraine, Southern Africa and South-east Europe.

Consultant

Education and Experience

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Selected Project References