POWERING ASEAN: CAN THE NORDIC MODEL WORK?

June 6 2016

Manila

NORD POOL

Acknowledgement

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Nord Pool Consulting
June 2016

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NORD POOL

The Nordic Electricity Exchange: What is it, how does it work, and where was it adopted around the world?

Mr. Hans-Arild Bredesen, CEO, Nord Pool Consulting

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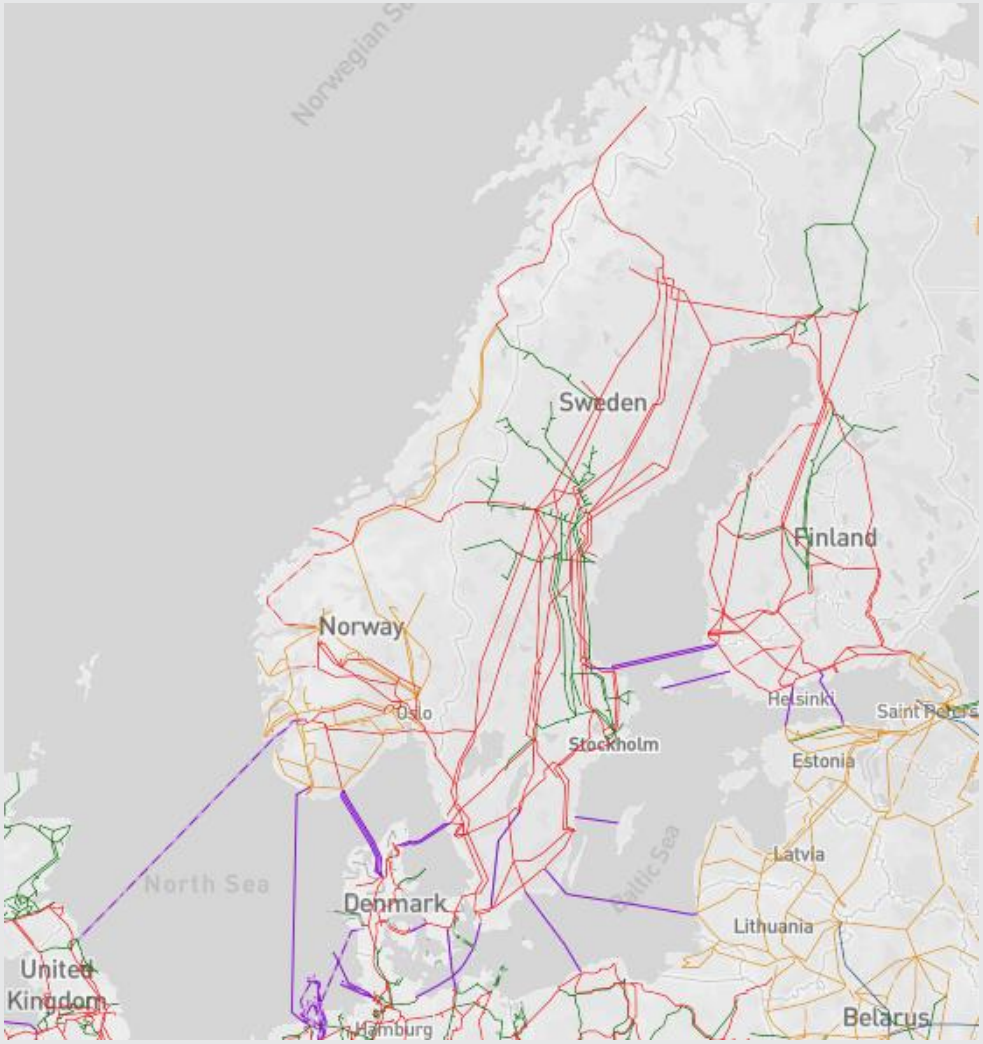
The Nordic power system



Norway:

• Population	5,5 mill
• Peak load:	24 000MW
• Installed capacity:	30 000MW
• Annual Consumption:	119 TWh
• Normal production:	125 TWh
• Variation.	60 TWh
• Hydro production:	99%

Nordic:

• Population >	24 mill
• Peak load:	69 000MW
• Installed capacity:	89 000MW
• Annual consumption:	412 TWh
• Production:	

• Hydro:	52%
• Nuclear:	14%
• Thermal:	32%
• Wind:	2%

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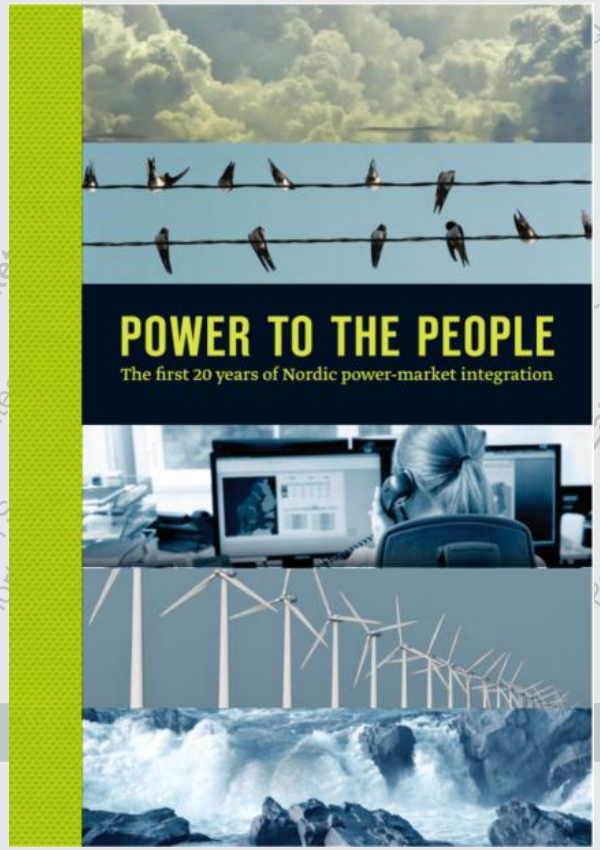
Our history



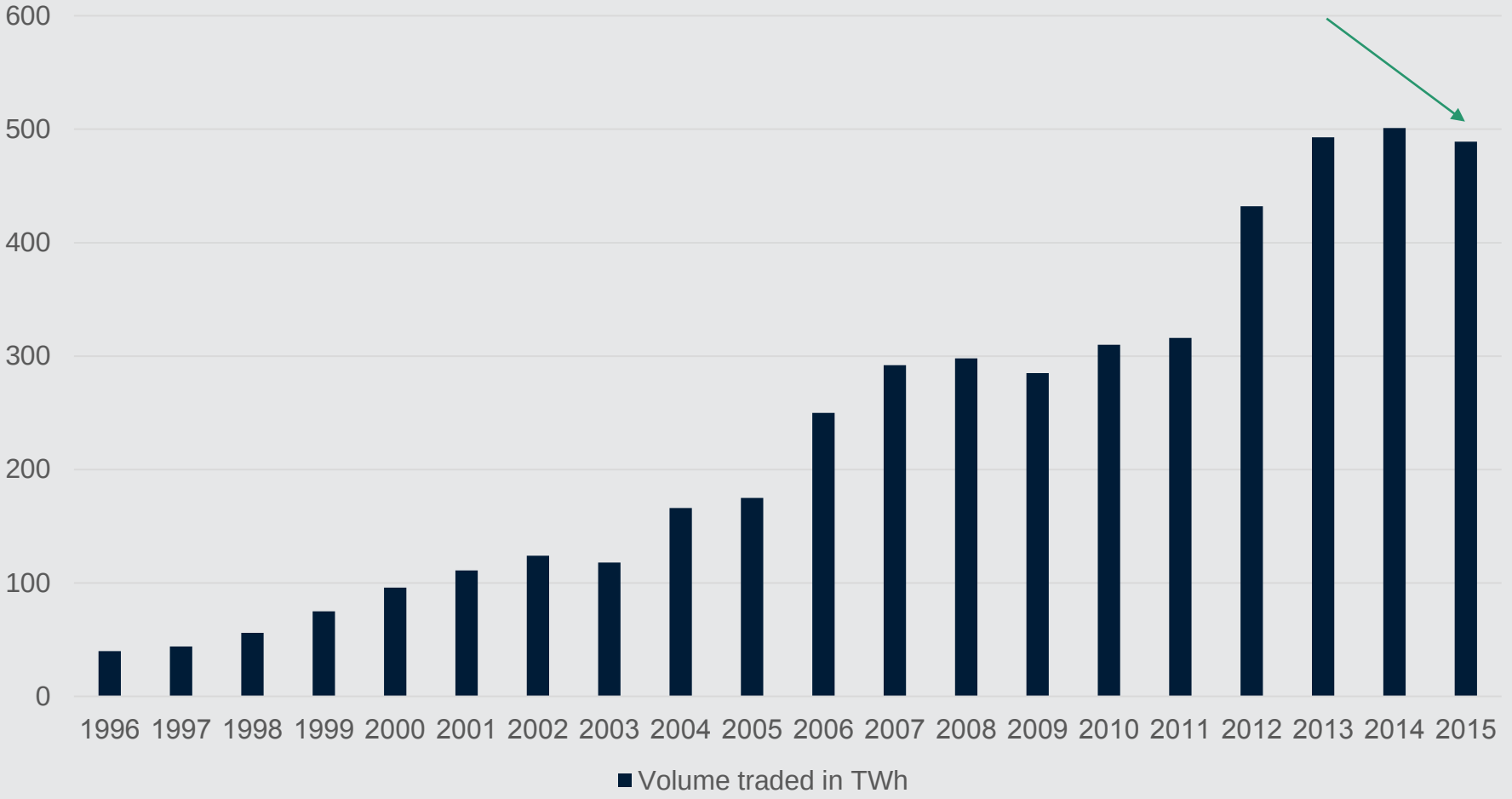
Norwegian power market deregulated
1991
A power market is established by the Norwegian TSO
1993
Nord Pool established as the **world's first**
1996
international power market
1998
Finland joins Nord Pool
1999
First international **intraday market**
2000
Nordic market fully inte
2002
Nord Pool S
for sho
Latvia opened as a marke
2014
North-Western European power markets coupled
2014
Nord Pool Consulting launched
2015
Nord Pool Spot designated NEMO within 11 markets
2016
Nord Pool Spot becomes Nord Pool

NORD POOL

Volume growth from 1996

A total of 489 TWh traded in 2015

- Day-ahead market Nordic/Baltic 374 TWh
- Day-ahead market UK 110 TWh
- Intraday market Nordic/Baltic/Germany 5 TWh



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Membership statistics

- Nord Pool has altogether approximately 380 members
- Majority of the members are Clients:
  - Participants: 40% (149)
  - Client representatives: 2% (6)
  - Client: 59% (222)
- Currently 19 different countries represented through members
- High level of versatility in terms of the type of market participants:
  - End consumers, producers, retailers, brokers
  - Starts ups and very large utilities
  - Industrial companies, municipalities, service providers, etc.

Source: Nord Pool 14th March 2016

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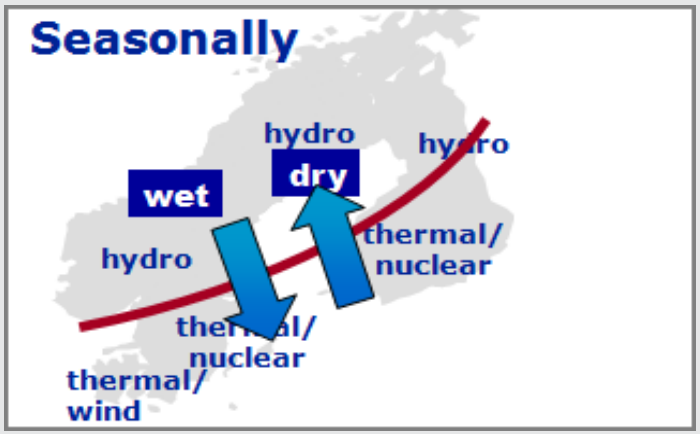
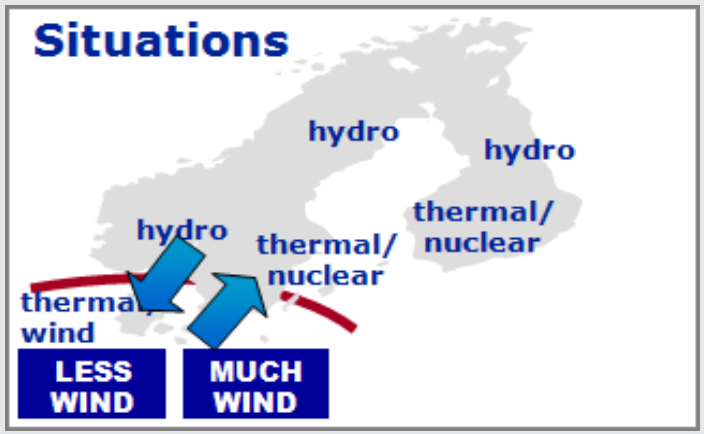
Utilizing the Value of Differences in a Region





- Complementary production
- Security of supply
- Cost synergies
- Climate challenge

Stakeholders

- Owned by Nordic and Baltic transmission system operators since the start
- Regulated by Norwegian Water Resources and Energy Directorate (NVE)
- Positives of TSO ownership:
  - All the markets for physical power will end up as a schedule that will be sent to the TSO for the ultimate balancing of the power system.
  - Ensure that the overall market concept be sharing common goals
  - In other words, all activities in the market are ultimately ***driven by planning***.
  - By having the TSO as an owner, connection and cooperation are ensured directly.

NORD POOL

Statnett – Norway – 28.2%

Svenska Kraftnät – Sweden – 28.2%

Energinet – Denmark – 18.8%

Fingrid – Finland – 18.8%

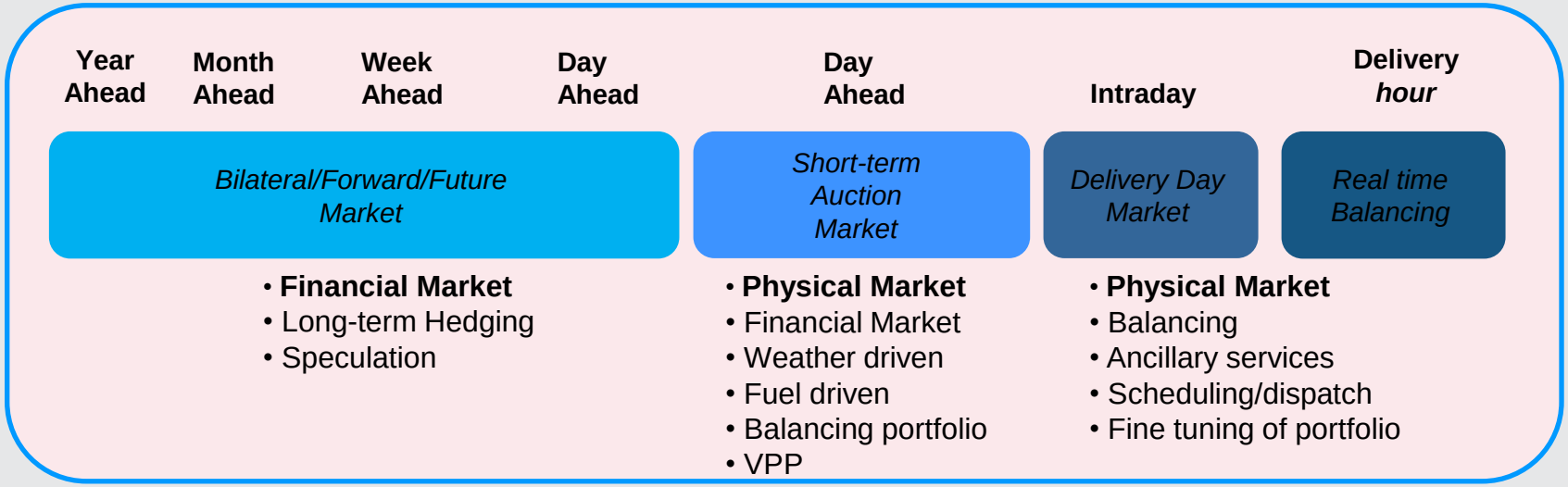
Elering – Estonia – 2%

Litgrid – Lithuania – 2%

AST – Latvia – 2%

The Reason for Establishing a Competitive Power Market

- The commodity power is characterized by high volatility and there is a potential need of long term risk management and the possibility to change position close to delivery.
- Efficient use of transmission capacity between areas and countries
- Cost-reflective power price in different timeframes



The Nordic market design

The Nordic Power Market

Organized and bilateral market

NASDAQ OMX

Financial Contracts

Hedging

1 day - 10 years ahead

- continuous trading -

Futures
Days Weeks

Forwards
Months Quarters Years CfDs

Carbon
EUA & CER

Options
European

Nord Pool AS

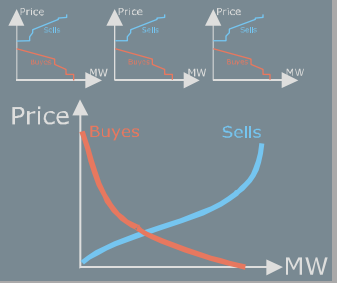
Elspot

Physical Contracts

Market equilibrium

one day ahead

- auction trade -



Elbas

Physical Contracts

hours 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)

NASDAQ OMX Commodities clearing

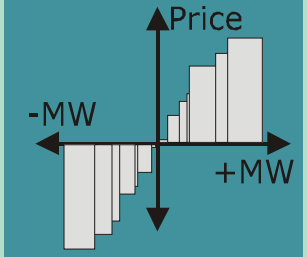
Derivatives	Security - Margins - Business reports Mark-to-Market, Risk Management
Additional Services	Clearing of Bilateral Derivatives

The TSOs

Statnett, Svenska Kraftnät, Fingrid, Energinet.dk

Balancing Power Market

Joint Nordic



Balancing generation and consumption in realtime

System Operation

Real-Time Operation

Services during the Real-Time-Operation: Controlling frequency and voltage etc.

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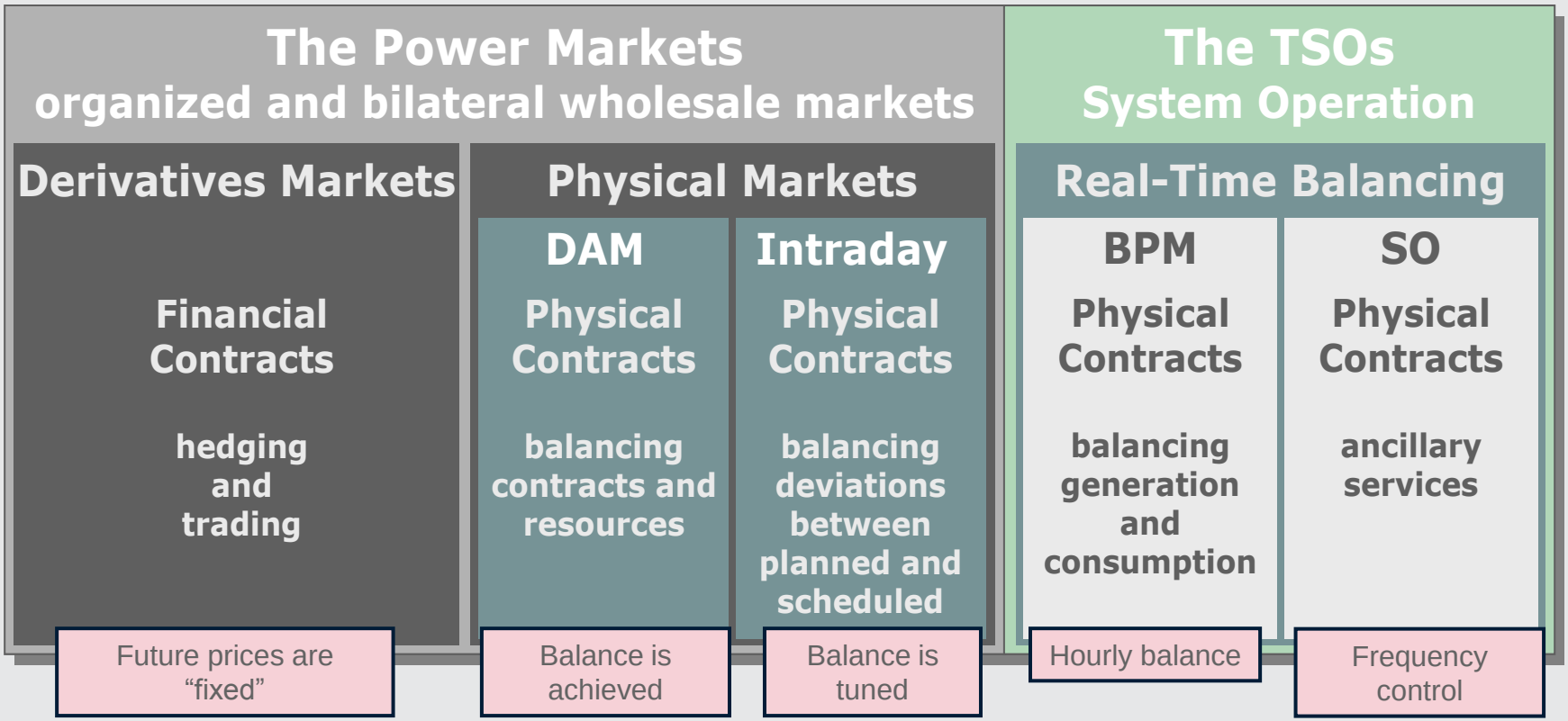
Integrated Markets



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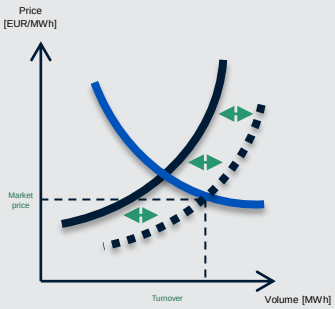
Day Ahead price formation in practice

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

SUPPLY



DEMAND

Factors affecting the **demand** for electricity:

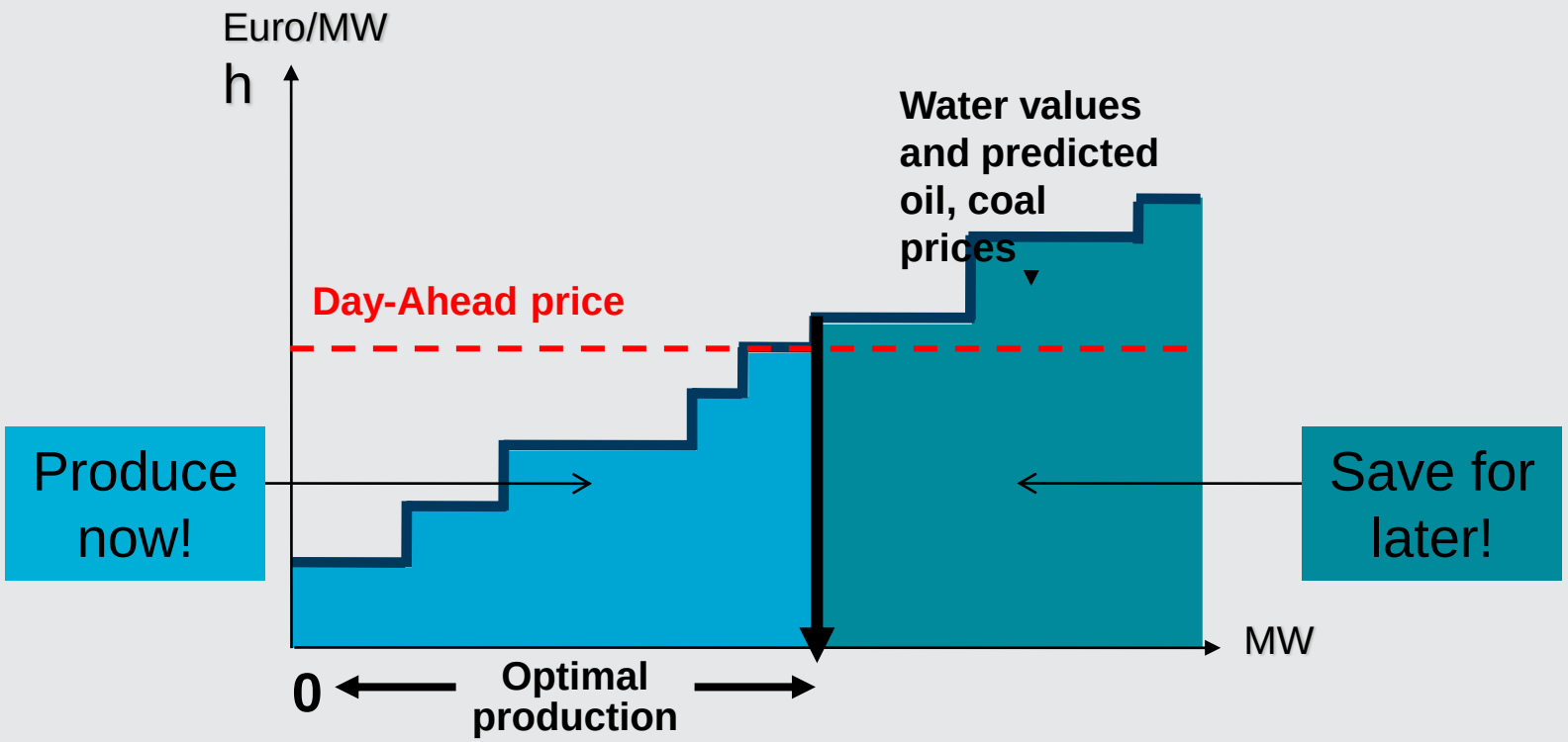
- Retail volumes and delivery obligations:
  - Weather
  - Open deliveries, etc.
- Industrial consumers:
  - Fixed costs
  - Variable costs
  - Startup and shutdown costs
  - Flexibility of processes

TRANSMISSION CAPACITY

Available Transmission Capacity (ATC):

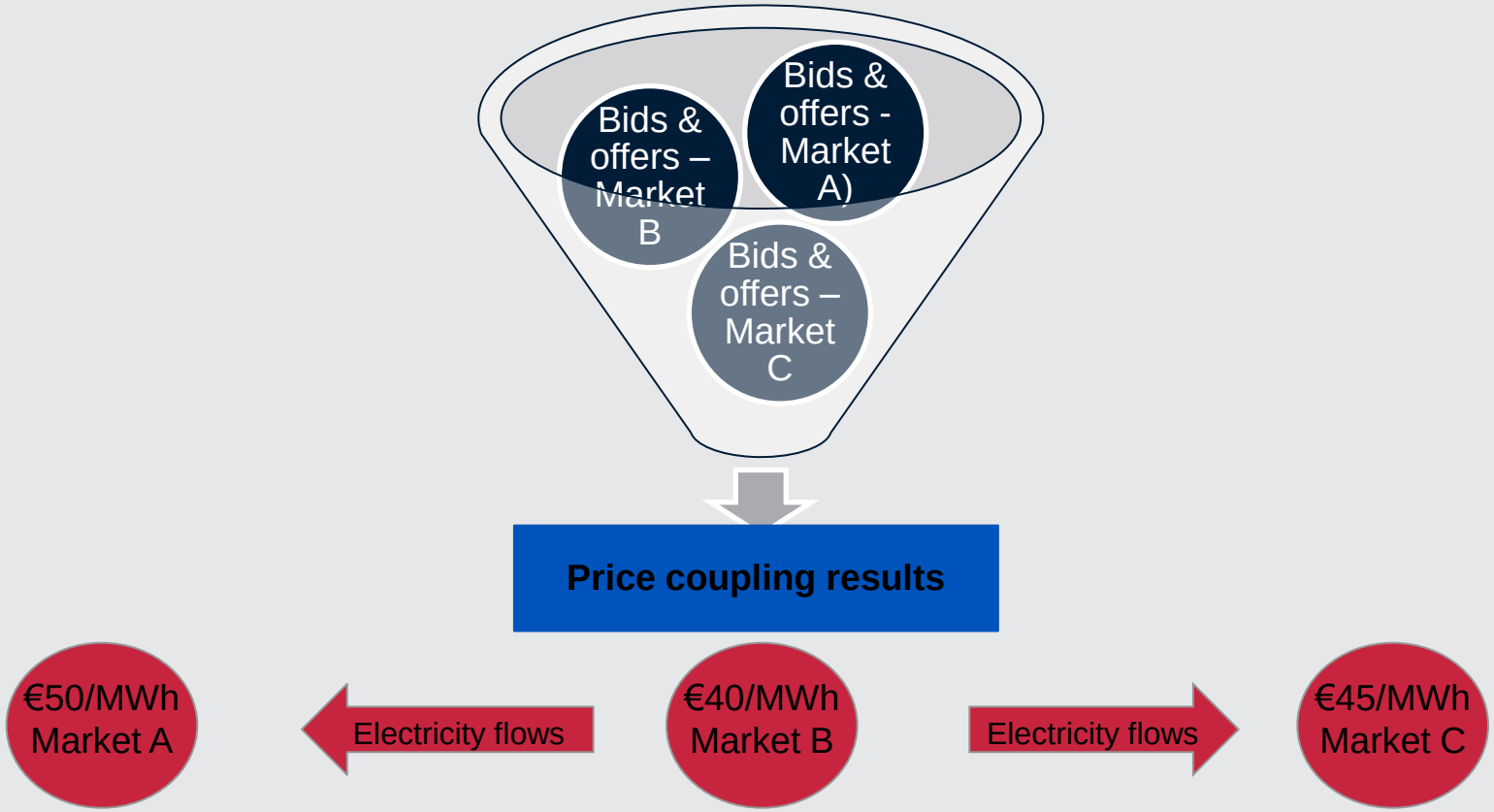
- Existing interconnectors
- Unavailability of interconnectors (faults, etc.)

To Produce or not to Produce



The fuel value is the opportunity cost of producing now compared with producing in the future?

Day-ahead: Prices and flows determined simultaneously in a one-shot auction



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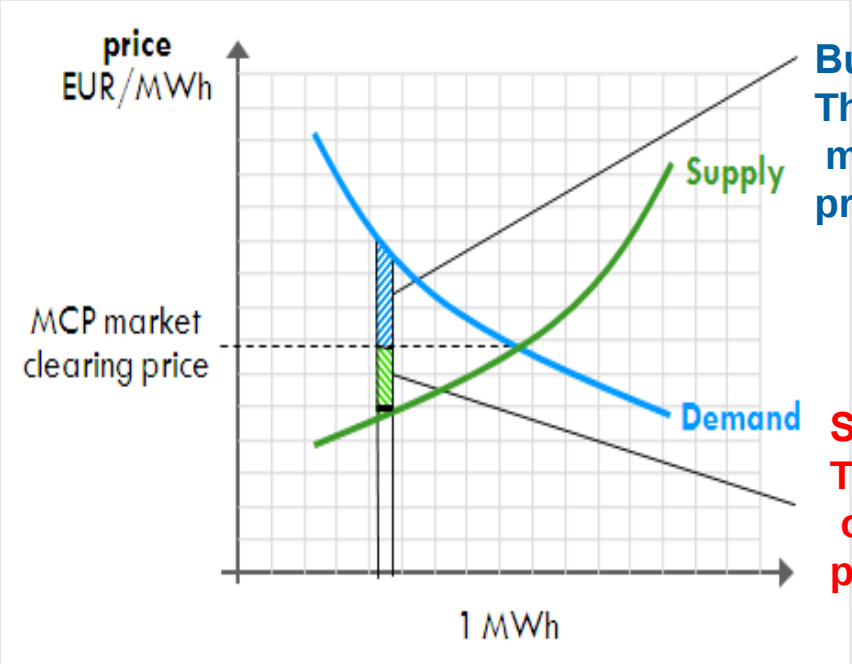
Market Sosioeconomic Welfare Aspect

Both the buyer and seller are settled by the balance price in the intersection between demand and supply
The price formation process is therefore economically effective for society.
The demand side will pay less than the bidding price and the seller will get paid more than the bidding price for the calculated contract volume



Buyers' gain for this MWh: The difference between the market price and the bid price

Sellers' gain for this MWh: The difference between the offer price and the market price

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Day Ahead prices are determined simultaneously across Europe

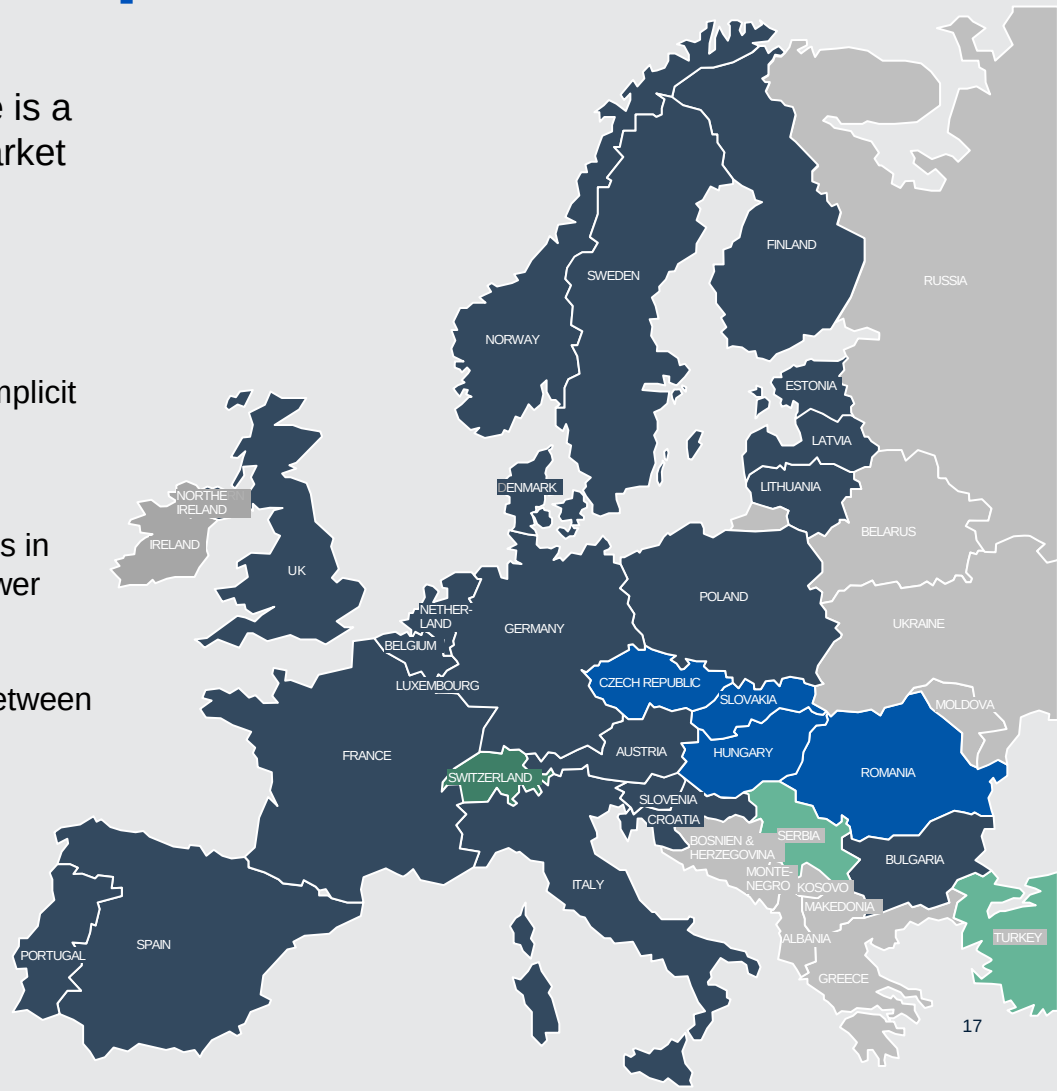
A fair and transparent day-ahead power price is a key factor for the successes of the Nordic market model.

The day-ahead market is an auction for delivery the following day, run every day of the year.

In Europe the Day-ahead price calculation is given implicit cross boarder capacity allocation.

The Price Coupling of Regions (PRC) initiative now enables the coupling of Day Ahead electricity markets in 23 countries representing over 90% of European power consumption.

Optimizes flows on the cross boarder connections between countries and areas.



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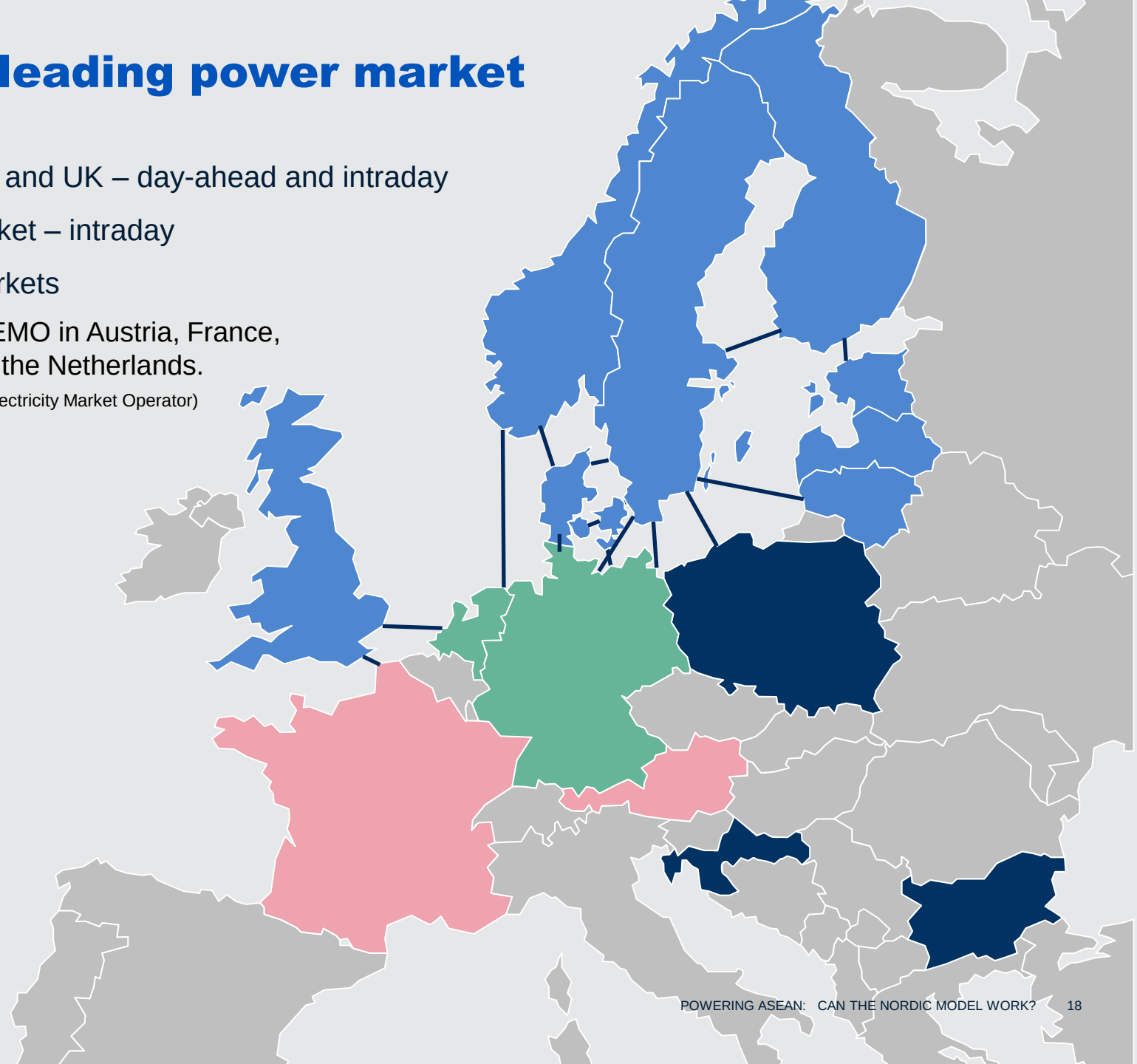
Europe’s leading power market

- Nordic/Baltic and UK – day-ahead and intraday
- German market – intraday
- Serviced markets
- Nominated NEMO in Austria, France, Germany and the Netherlands.

NEMO (Nominated Electricity Market Operator)



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Key success factors of the Nordic model (and some challenges and failures)

Success factors:

- Stepwise development
  - Both in geography and market/product offerings
- Involvement of the whole industry
  - Always had a strong Market Council
  - Adaptability – changing according to the need in the market and technological developments
- Transparency and neutrality
  - Market surveillance and access to data has always been public

Challenges (and one failure)

- European markets are being more and more regulated
  - Increases costs and complexity
- California Power Exchange (1997-2000)
  - Tried the “big-bang” implementation – and failed dramatically
  - Did not base its market on any of our success factors

NORD POOL

The Nordic Model beyond the Nordics: What have we learned from implementation of the Nordic model for Southern African States and in India?

Mr. Hans-Arild Bredesen, CEO, Nord Pool Consulting

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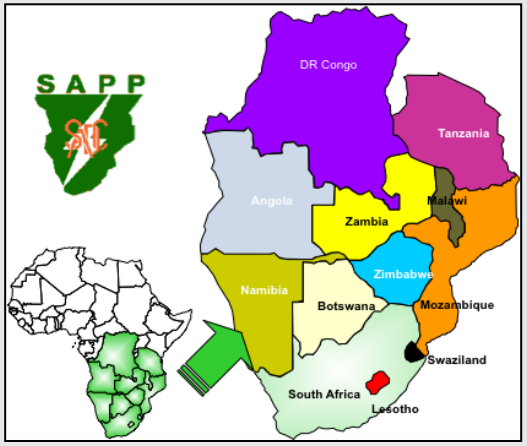
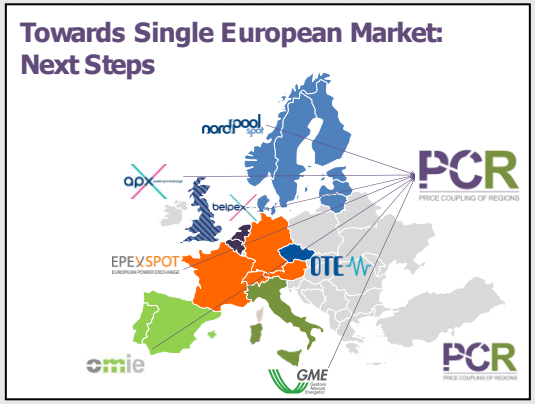
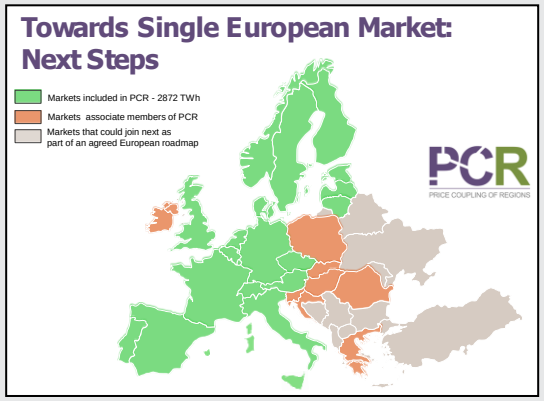
Nord Pool - Other international experiences

Southern African Power Pool



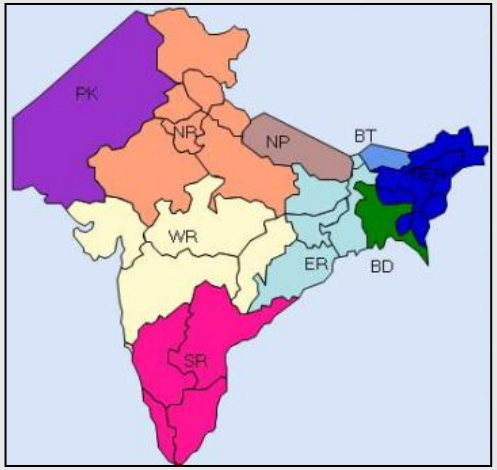
European target model





Central America

India



South-east Europe

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Southern African Power Pool - Power to the people

THE ADVENTURE IN AFRICA – ESTABLISHING A POWER MARKET FOR SOUTHERN AFRICAN POWER POOL

THE SOUTHERN AFRICAN POWER POOL (SAPP) was created on 28 August 1995, with the primary aim of providing reliable and economical electricity supply to consumers in each of the SAPP member countries, consistent with reasonable utilisation of natural resources and minimised negative impact on the environment.

Cooperation in the electricity sector is not a new phenomenon in the Southern African region; it has taken place at policy, planning and operational levels and involved governments, power utilities and financial agencies over a period of several decades. To formalise this cooperation, several of the utilities in the region came together to create SAPP. The members of SAPP have undertaken to create a common market for electricity in the Southern African region, the Southern African Development Community (SADC), and to let their customers benefit from the advantages associated with this market.

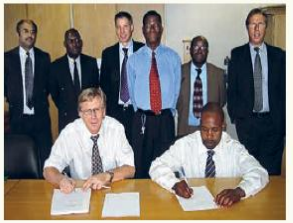
All utilities participating in SAPP have equal rights and obligations, and have agreed to act in solidarity without taking advantage of one another. Members have undertaken to share information and knowledge and to be politically neutral. The SAPP cooperation includes development, common planning and system operation.

The cooperation with the power industry in Southern Africa started with Nord Pool Consulting's involvement in 2004. Nordic authorities were involved in the project, with SAPP getting financial assistance from NORAD and SIDA.

Working in Africa involves other obstacles than the Nordics were accustomed to

FACTS

SAPP's Day-ahead market comprised the following countries: The Democratic Republic of Congo, Angola, Tanzania, Malawi, Mozambique, Zambia, Zimbabwe, Namibia, Botswana, Swaziland, Lesotho and South Africa – a total land area of 10 million square kilometres and a population of approx. 220 million people. Nine of the countries are electrically linked; only Angola, Tanzania and Malawi are not connected to the southern power network in Africa.



The signing of the IT supply contract with SAPP in Harare

With its experience from supplying similar systems in Europe, it was natural for Nord Pool to be interested in the project. The trading system Sapri was at the time being used in the Nordic, German and French power markets. The system was well tested, and SAPP's functional market requirements for the system supply were also based on the Nordic model. Nord Pool was accepted as a possible supplier in competition with a South African IT company, which had also shown an interest in the project.

Enerweb was a small company closely linked to system supplies for Eskom, which is the system operator in South Africa with the largest influence on the power industry in the region. Nord Pool made a strategic decision that it would be a good idea to cooperate with Enerweb. A system supply to Africa with good local anchoring was important for all parties involved – also for NORAD (The Norwegian Agency for Development Cooperation) and SIDA (Swedish International Development Cooperation Agency) as sponsors of the project. In January 2005, two hopeful employees from Nord Pool travelled to Johannesburg to meet Enerweb's management. A solution that included cooperation and the use of local resources was accepted by SAPP, with Nord Pool and Enerweb being invited to give a 'live' demonstration of Sapri's system to the SAPP executive committee in Victoria Falls in February. This was a challenge, since the Sapri system was installed on the Unix operative system, and the smallest server was relatively large com-

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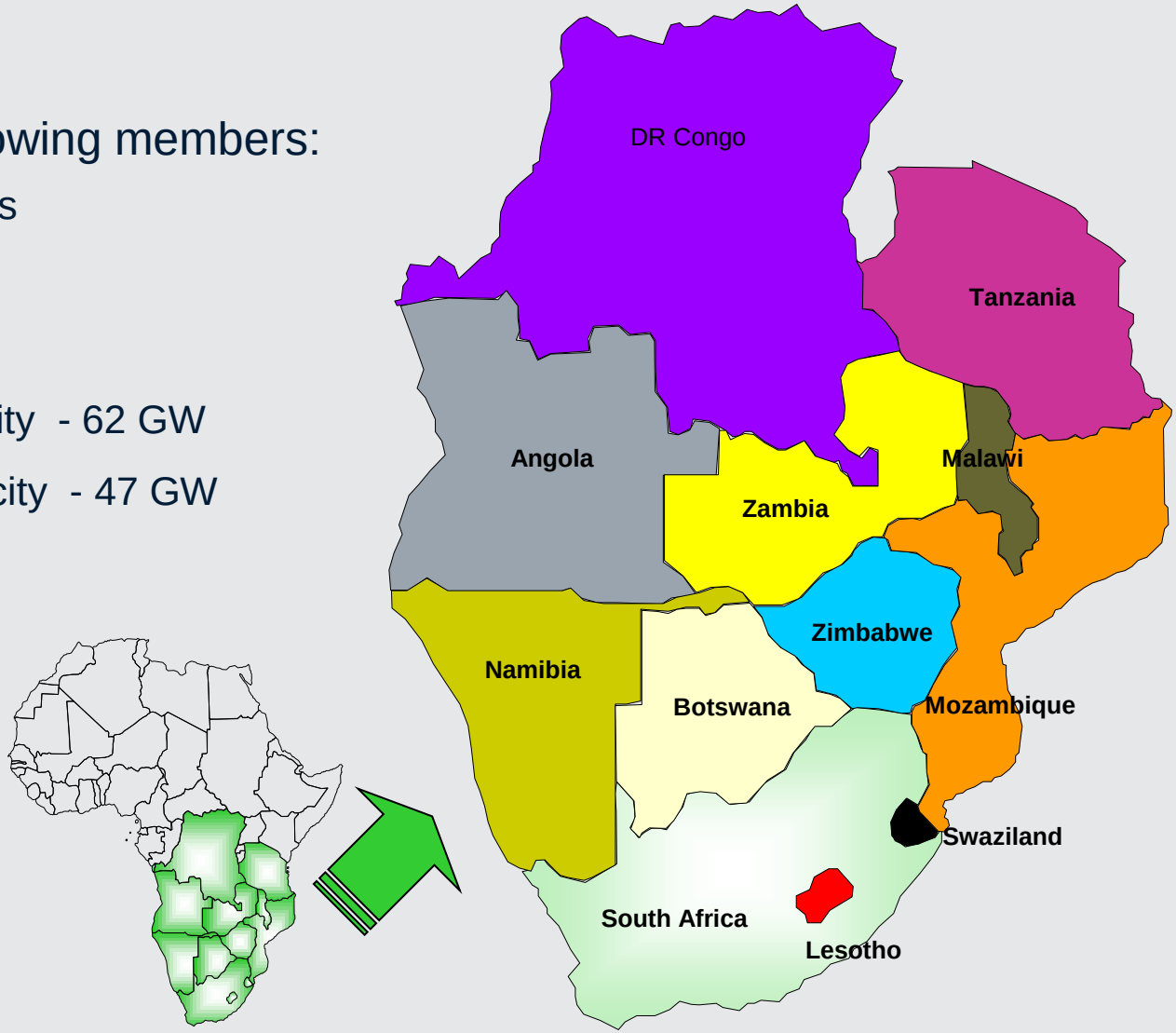
SAPP Market Area

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



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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”

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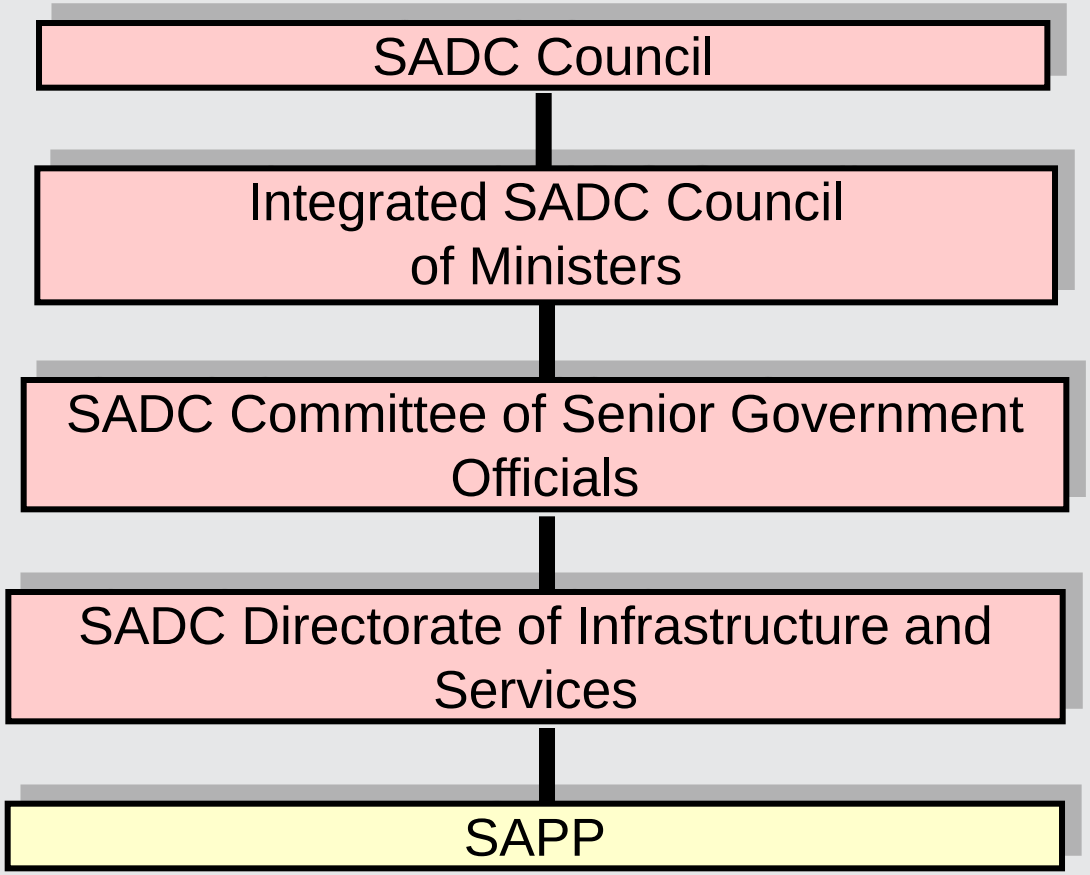
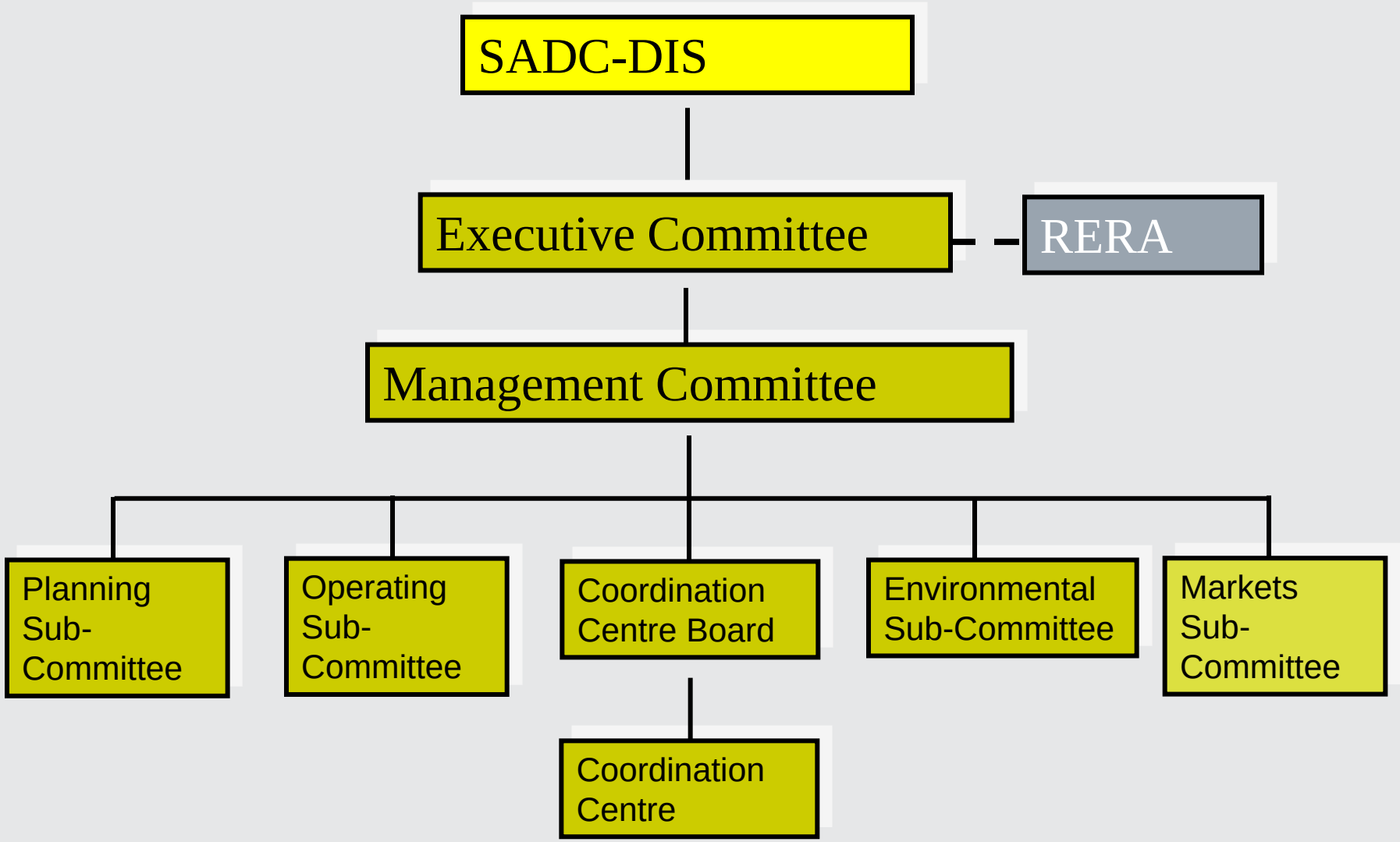
SAPP reporting structure



SAPP Governance structure



SAPP Main governing documents

Inter-Governmental MOU
- Established SAPP and was signed by SADC Member Countries in 1995.
- Revised document signed on 23 February 2006.

Inter-Utility MOU
- Established the Management of SAPP.
- Revised document signed on 25 April 2007.

Agreement Between Operating Members
- Signed by Operating Members.
- Revised document signed May 2008

Operating Guidelines
- Reviewed and approved in 2014.

Market Guidelines (New in the SAPP Hierarchy)
- Developed and approved in 2014

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SAPP supply situation

Demand and Supply Balance with Current Peak Demand - 2015						
No. Country	Utility	Installed capacity (MW)	Operating Capacity (MW)	Current Peak Demand (MW)	Peak Demand Plus Reserves	Capacity excess/ shortfall including Reserves
Angola	ENE	2,210	1,772	1,599	1,829	(57)
Botswana	BPC	892	410	610	698	(288)
DRC	SNEL	2,442	1,066	1,381	1,580	(514)
Lesotho	LEC	74	70	150	172	(102)
Malawi	ESCOM	352	351	326	373	(22)
Mozambique	EDM/HCB	2,724	2,279	830	949	1,330
Namibia	Nampower	501	354	629	720	(366)
South Africa	Eskom	46,963	36,000	37,661	43,080	(7,080)
Swaziland	SEC	70	55	219	251	(196)
Tanzania	TANESCO	1,380	823	935	1,070	(247)
Zambia	ZESCO/CEC/ LHPC	2,206	2,175	2,287	2,616	(441)
Zimbabwe	ZESA	2,045	1,555	1,589	1,818	(263)
TOTAL ALL		61,859	46,910	48,216	55,157	(8,247)
TOTAL Operating Members Only		57,917	43,964	45,356	51,885	(7,921)

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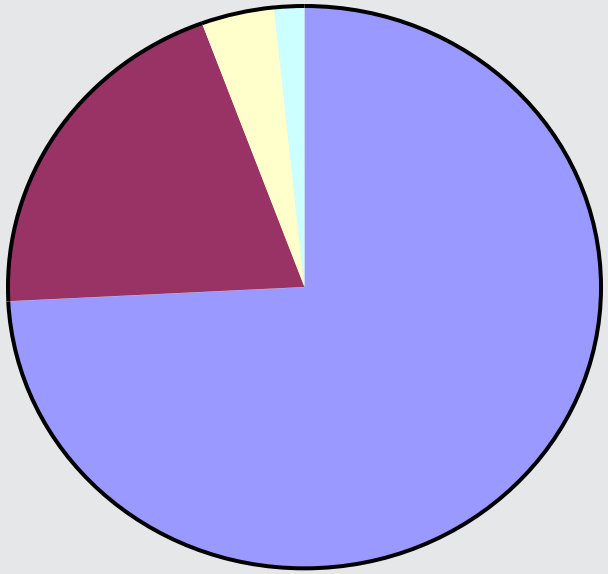
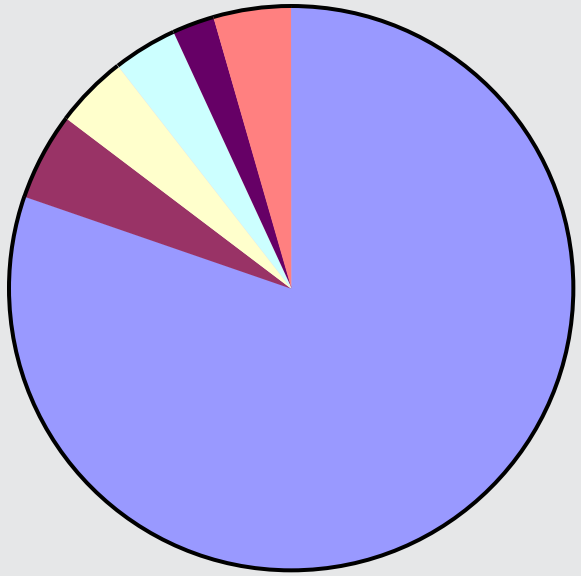
SAPP Generation mix – is this dominated by S-A?



- 74.3% Coal
- 20.1% Hydro
- 4.0% Nuclear
- 1.6% Gas/Diesel



- 80.4% South Africa
- 5.0% Mozambique
- 4.1% Zimbabwe
- 3.6% Zambia
- 2.6% DRC
- 4.4% Rest

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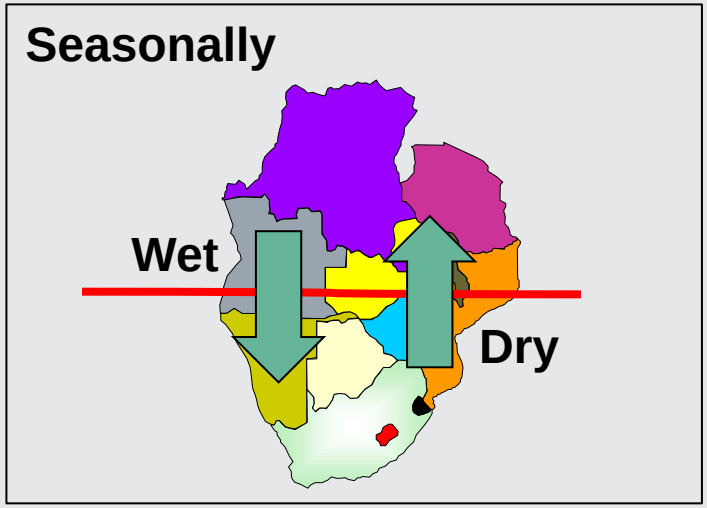
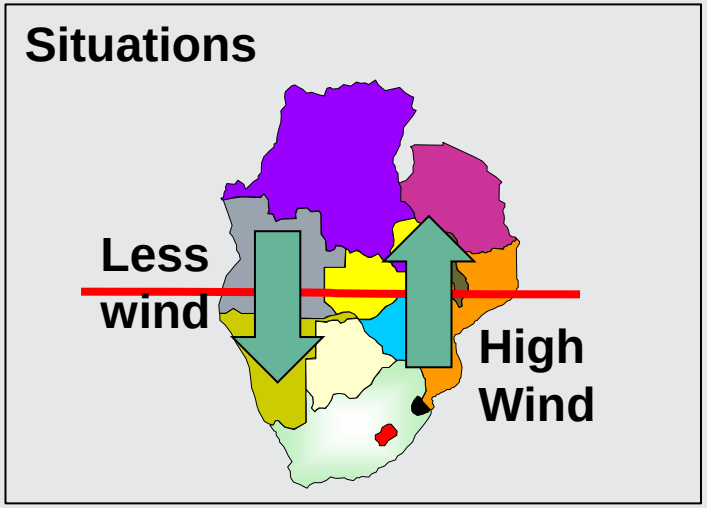
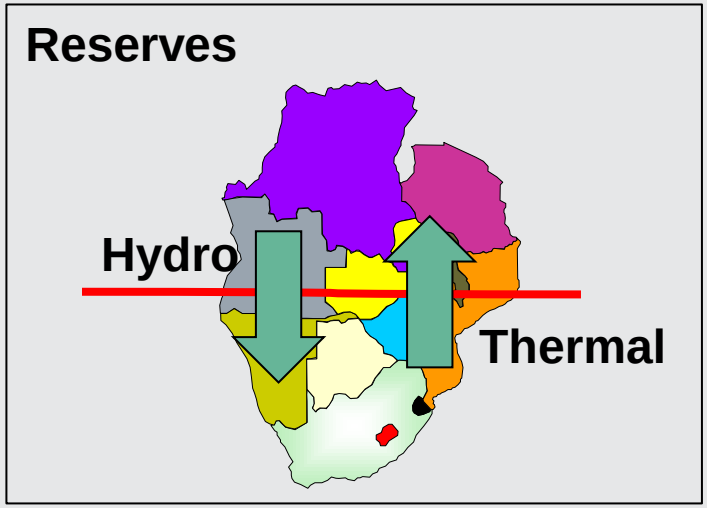
Utilizing the Value of Differences in a Region







- Complementary production
- Security of supply
- Cost synergies
- Climate challenge

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The African power market development

Based on **evolution**, not revolution

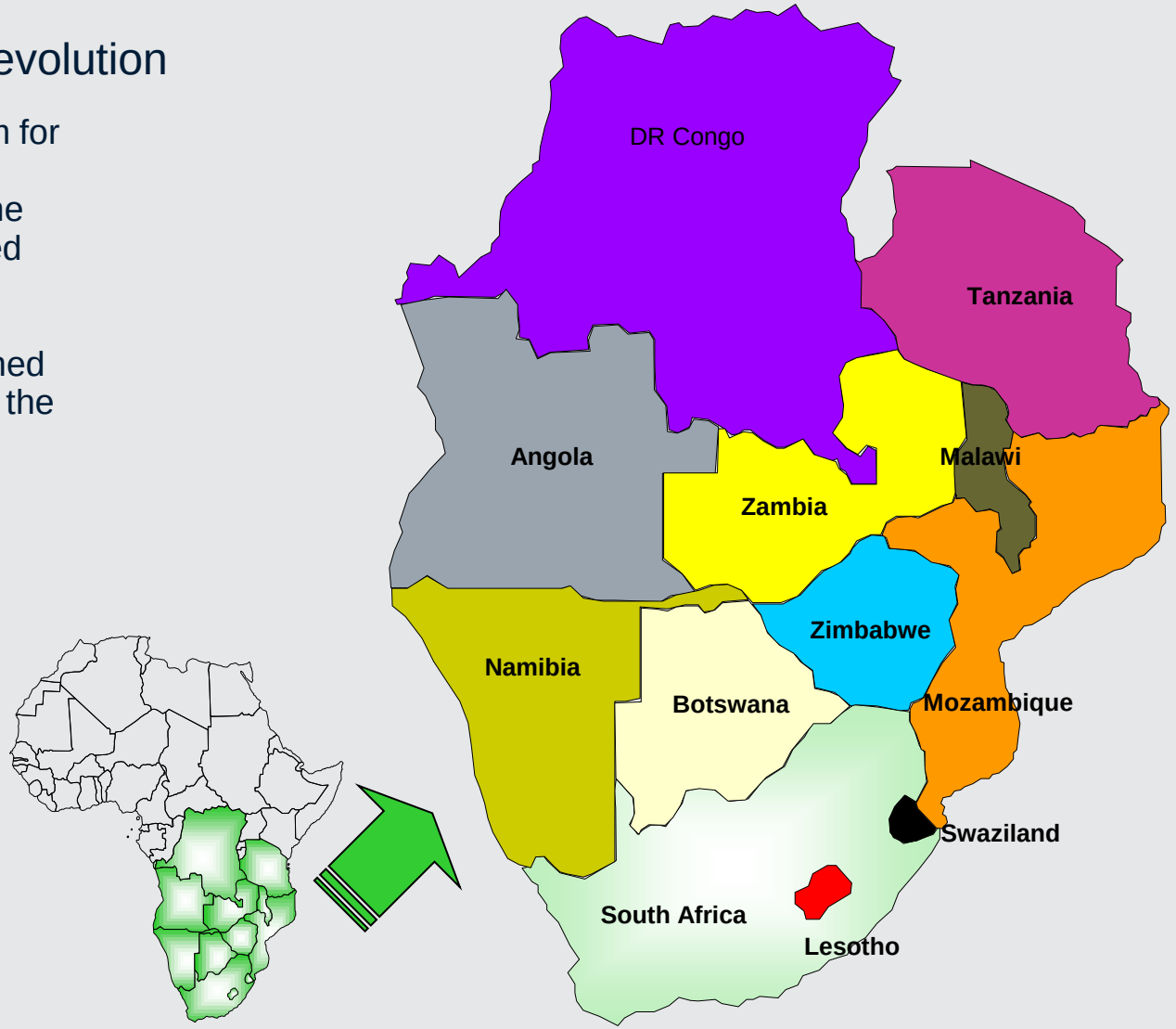
The auction market price algorithm for FPM and DAM is determine the unconstrained system price and the constrained area price for a defined market area.

The IDM market price is the matched price between buyer and seller on the market

Based on international experience applied for the SADC region

Stepwise implementation

- Develop new markets when ready



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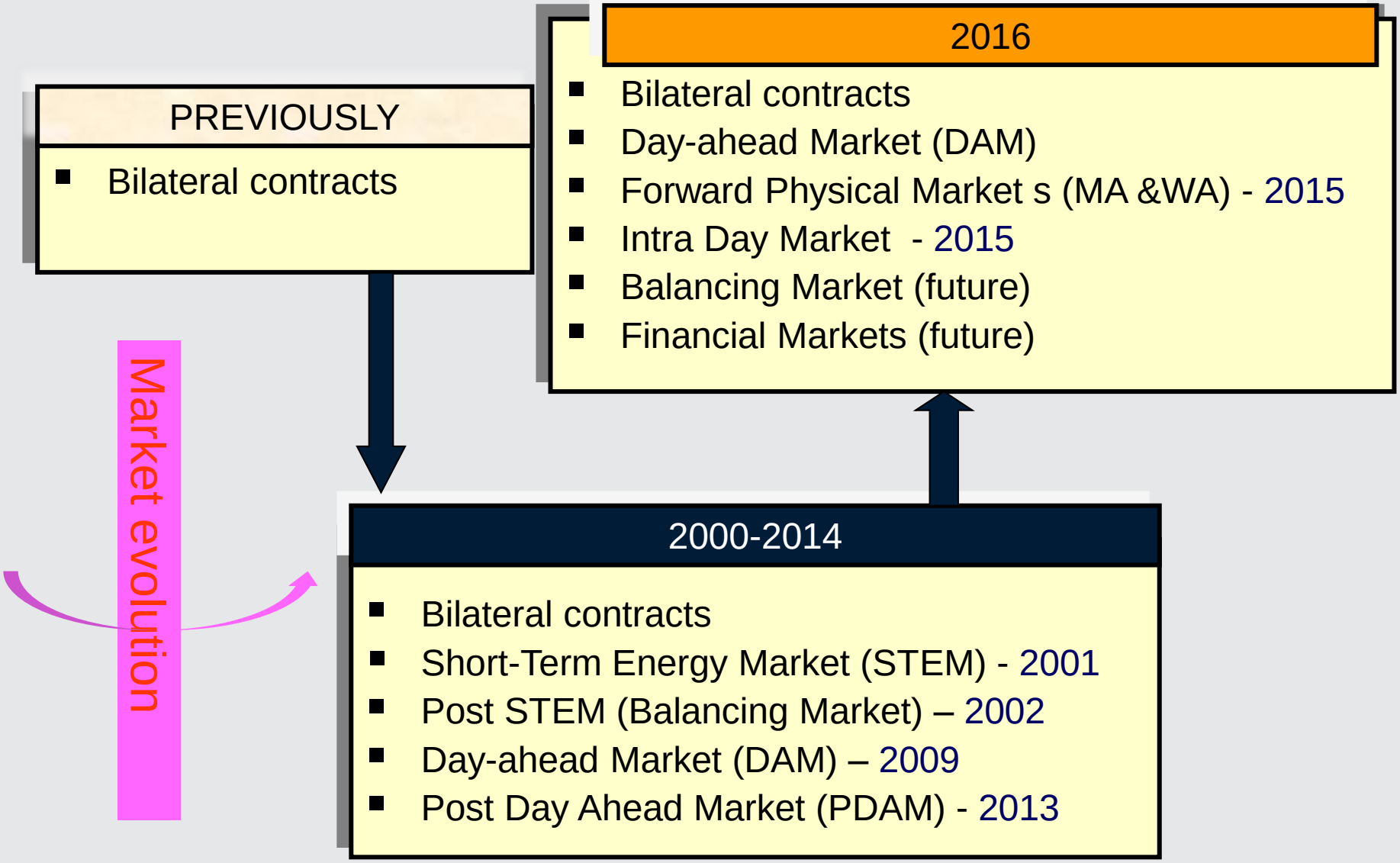
SAPP Market evolution



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SAPP Market concept

Southern African Power Pool

FPM

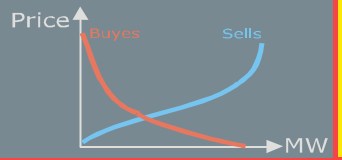
Forward Physical contracts

Weekly and monthly
- auction trading -
Forwards
Week – peak load
Week – off-peak
Week – weekend

Monthly baseload

DAM

Physical Contracts
Market equilibrium
one day ahead
- auction trade -



IDM

Physical contracts
hours 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)

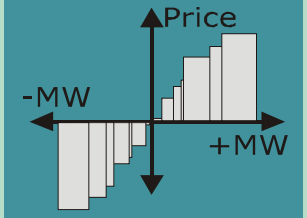
SAPP Settlement and financial management

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.

NORD POOL

CHALLENGES FOR SADC IN 2012

SAPPs main objective is to build a sustainable short term market model based on African power industry needs and requirements

Long term (Bilaterals & Forwards)	Short term (DAM)	Intraday/ PDAM	Operations
Challenge: - Bilateral contracts - Transmission capacity management	Challenge: - Liquidity - Transmission capacity management	Challenge: - New requirement - How to attract participation?	- Managed by TSOs - New opportunities?

How can these challenges be addressed?
Who shall be allowed to participate?
How shall this be regulated?

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What did SAPP do to answer these challenges?

Their question was: Is the low liquidity a signal to shut down the market all together?

No - SAPP answer was to reinforce the SAPP vision on the market:

"Facilitate the development of a competitive electricity market in the Southern African region."

The follow-up question was then: How can we then enhance trading?

Create the Southern African power market model with integrated markets and services through a central marketplace.

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SAPP Market concept

Southern African Power Pool

FPM

Forward Physical contracts

Weekly and monthly
- auction trading -
Forwards
Week – peak load
Week – off-peak
Week – weekend

Monthly baseload

DAM

Physical Contracts
Market equilibrium
one day ahead
- auction trade -

IDM

Physical contracts
hours ahead
- cont. trade -

114,25 (50)
114,00 (20)
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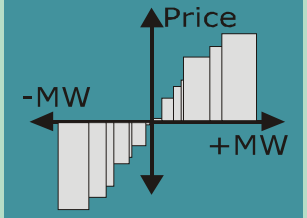

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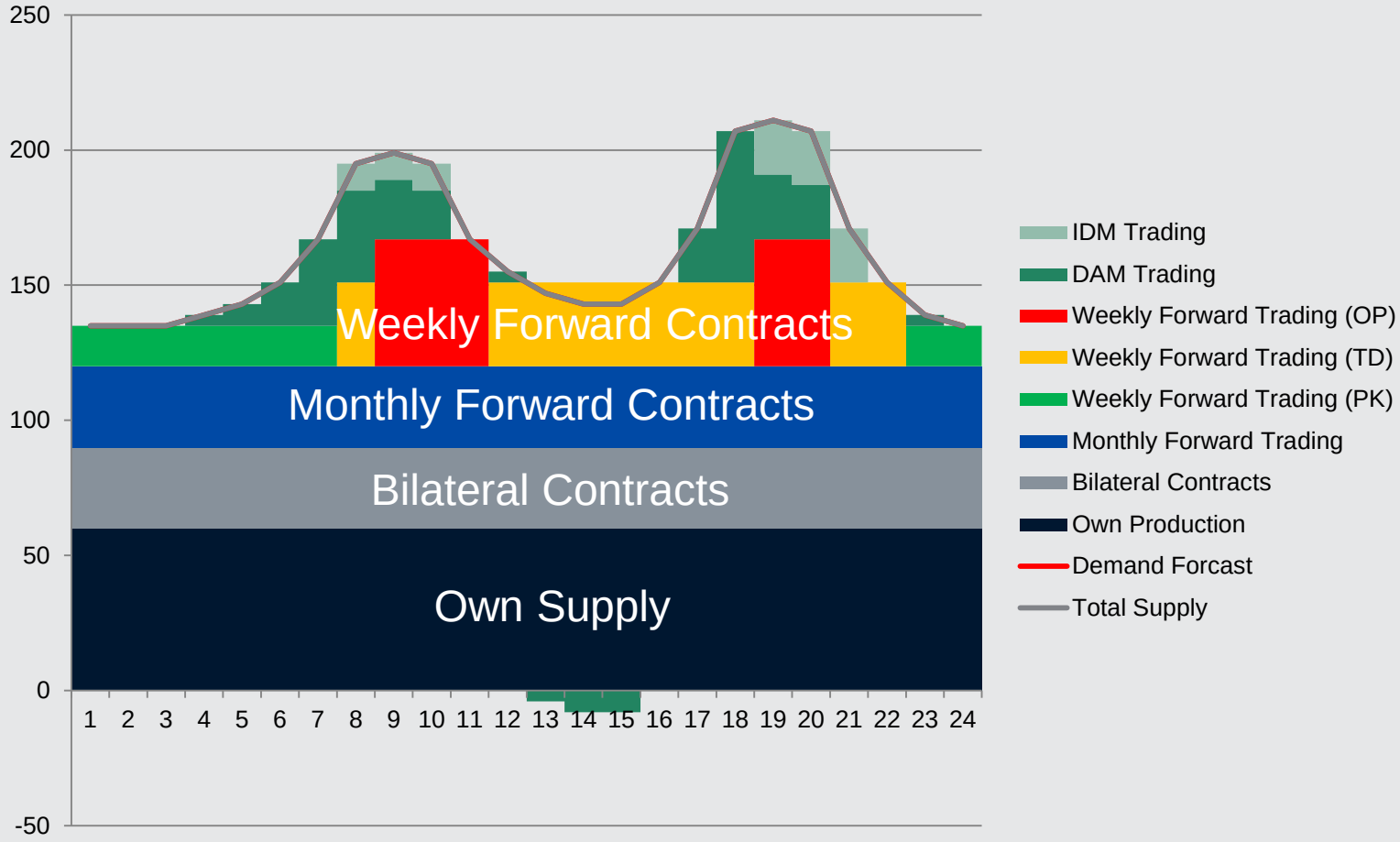
Role of Different Markets in Supply

Balancing on the Day – Hourly Contracts



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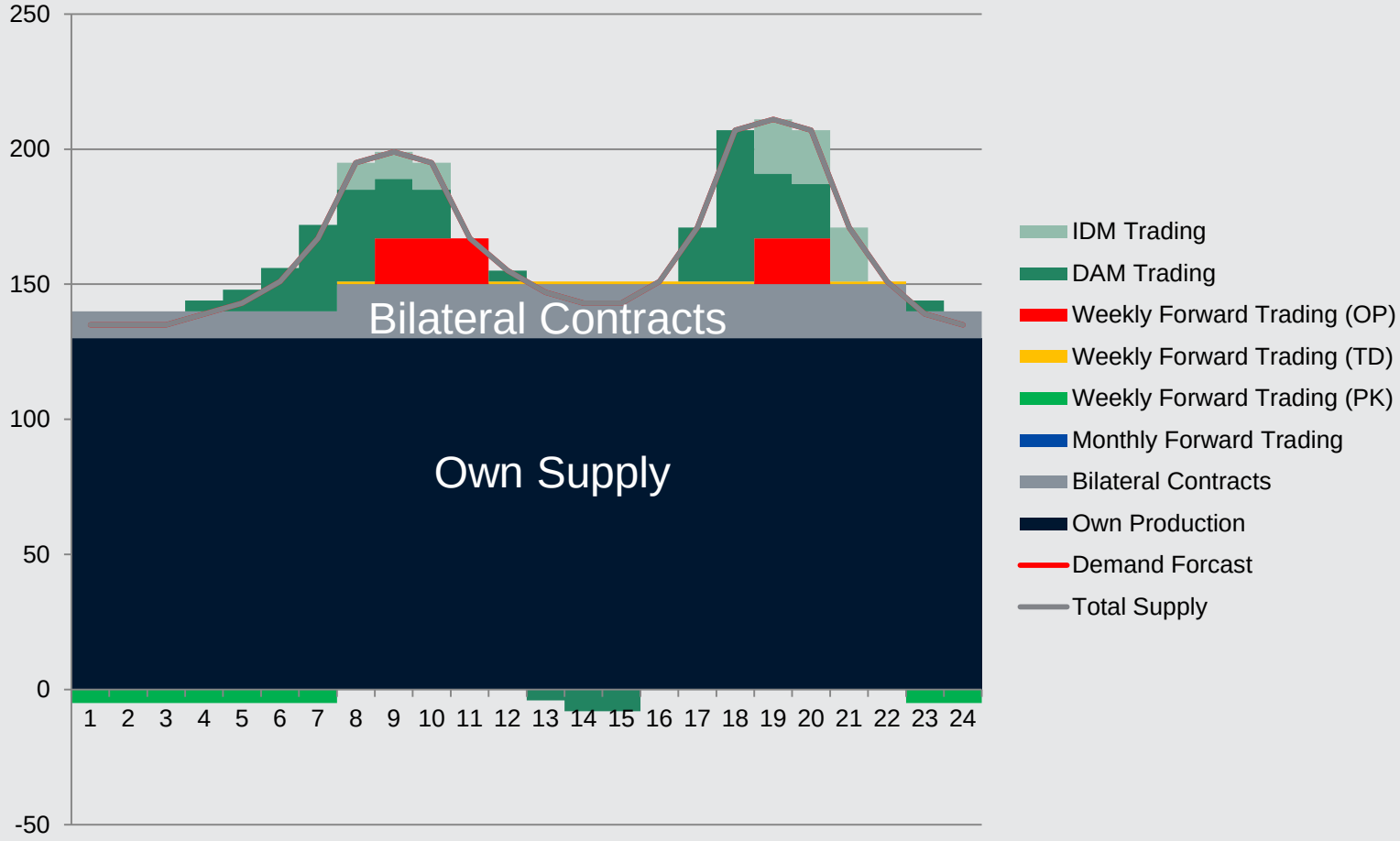
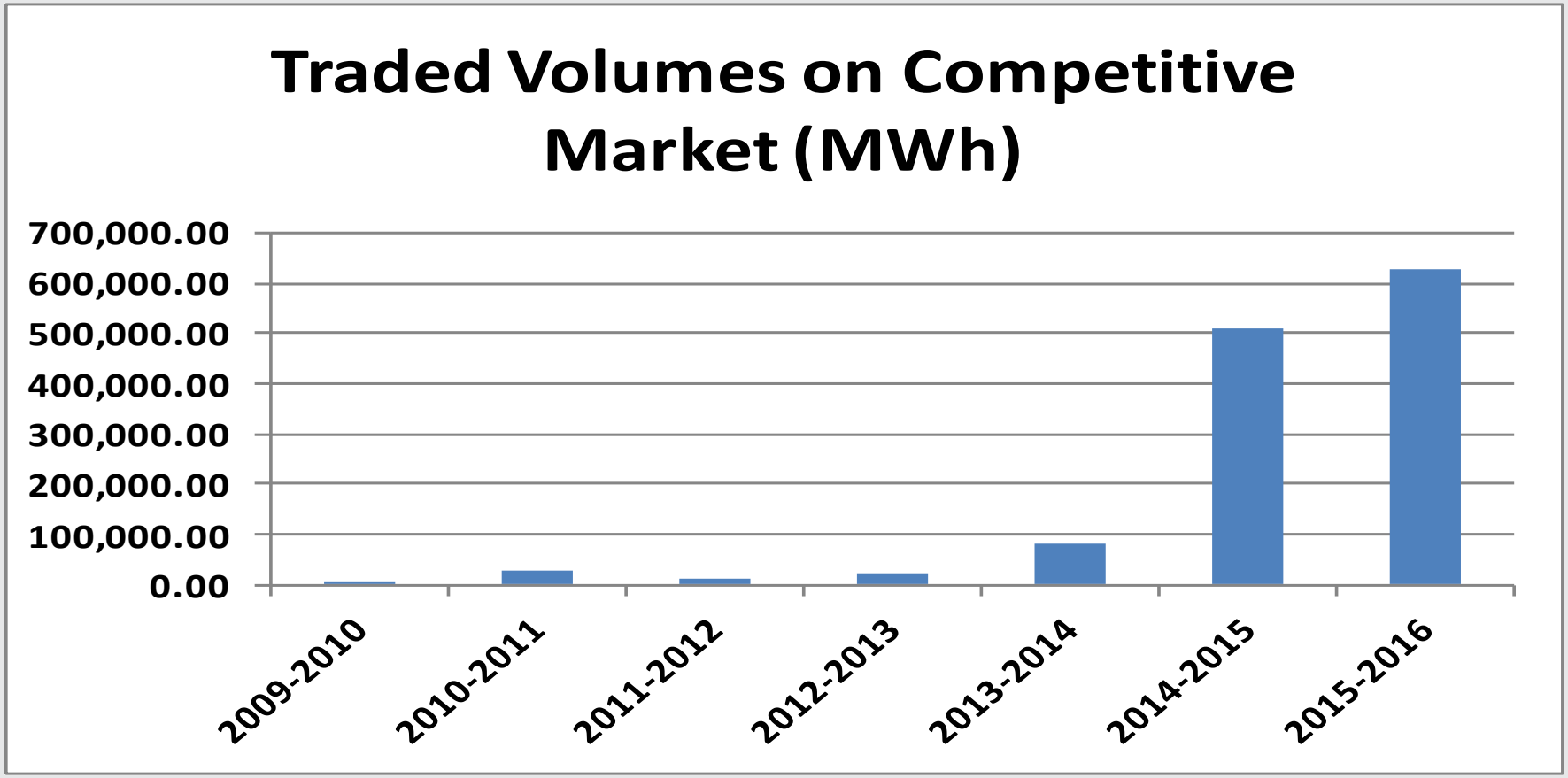
A real example –with regulatory limitation



Market Performance – Competitive Market



- Significant increases in trade volumes were recorded in 2014/15 (508,526 MWh) & 2015/16 (627,796 MWh for the period Apr to Oct.) when compared to previous years of less than 100,000MWh annually

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Does it really work?

Is the market dominance of South Africa a problem?

- One could think that based on the installed capacity that the market would be totally dominated by South Africa
- However – the trading is based on ***cross-border capacities***
- The trading pattern has changed over time:
  - Initially (2009-2011) buying in South-Africa from the others
  - Changed with new interconnection – and increased understanding of the market
  - Now flow of base-load capacity in off-peak hours from South-Africa all the way to Zambia (+ Zimbabwe) and Mozambique
  - Trading more expensive (but flexible) hydropower in the opposite direction during standard and peak time
  - The focus on capacity building has improved the trading patterns to follow economic principles

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Does it really work?

How can a market work in an under-supplied region?

- In a shortage situation, the use of the scarce resources should be based on economics
- There are hours/periods of the day where there is little trading – but trading small volumes “on the margin” also help.
- The same objections was made in India – but has proved to be wrong

But the national markets are not deregulated?

- True – but still the region benefits of regional cooperation and integration
- The market model is flexible so that when the underlying national markets opens, they will have access to the larger market from day one.

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Other relevant experiences

Turkey – introduction of Day-Ahead Market in a constrained situation

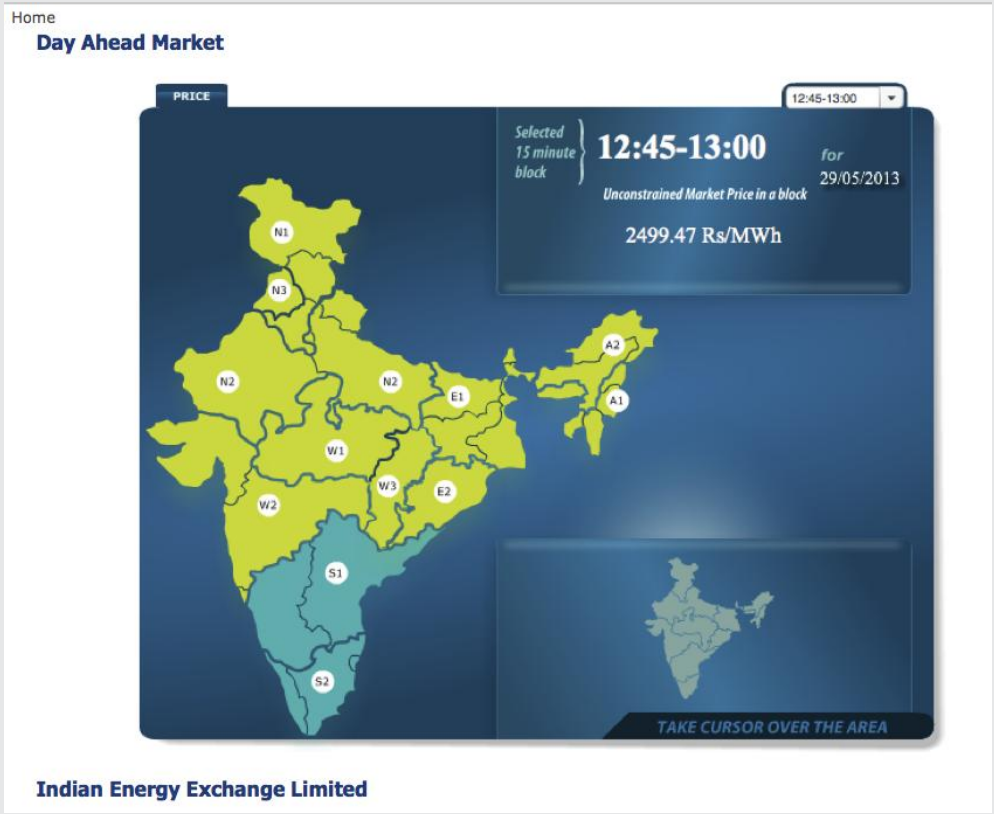
- Started in a deficit situation
- Faced a future with high demand growth and low investments in new power generation
- The market has helped to attract new investors
- Turkey has done a step-wise market opening – with success
  - Plan to open a Financial market
  - Reorganization of the market place
  - Further liberalization

- Key success factor was a long term stratgy
- Key obstacle is missing transparency – a key focus now.

Indian Energy Exchange (IEX India)

Main components of the Indian market

- Competing PXs in the same market areas
- 15 min trading intervals
- Regional optimisation and use of power resources
- 28 states – 12 bidding zones
- Complex framework – more like a continent
- 1 national Regulator (CERC), one national regulatory agency (CEA), one national TSO, 5 regional TSOs with individual LDCs, 28 state regulators
- Common transmission structure
- Day-Ahead Market covers for app 5% of consumption, the rest are bilateral contracts
- Based on the Nordic market concept
- India has a high demand growth, regularly load shedding and are in a deficit
- DAM is considered the most optimum ***marginal trading tool*** by CERC
    - Market monitoring shows more efficient (lower) prices through PXs
- Main barrier is the long term bilateral contracts as well as no international trading license



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