CIGRE Study Committee C5

Electricity Markets and Regulation

1. *Field of Activities*

In the worldwide process of restructuring the power supply industry, new structures, institutions, and actors appear. Efficiency improvements are expected from introducing various combinations of competition and regulation.

The scope of the SC is to analyze the different approaches and solutions and their impact on the electricity supply industry in support of the traditional approaches to power system economics, planning and operation as well as new market and regulatory structures and actors such as traders and independent power producers (IPP's) and the impact of new technology.
Close cooperation with C1 (System Development and Economics) and C2 (System Operation and Control) is expected.

In particular, areas covered are:

- Market structures and products such as physical and financial markets and the interaction between them, contracts, internationally integrated markets.
- Techniques and tools to support market actors such as demand and price forecasting, profit estimation, financial risk management etc
- Regulation and legislation such as regulation objectives, extension and limits, price regulation of transmission and ancillary services, international harmonization, environmental and reliability objectives etc

2. *Current Activities*

Currently there are six Working Groups and one Joint Working Group approved by Technical Committee as follows:

1. WG C5-3 *Investments & Financing of new Transmission and Generation Assets in a Deregulated Environment*

Disbanded in 2009

2. WG C5-7 *Market Design – Structure and Development of Electricity Markets*

Name of Convener: Andrew Ott, USA
The WG has a number of active work streams:

C5.7.1 *Investment Incentives in Various Market Designs.*
Name of Convener: Patrik BUIJS (Be)
A technical brochure has been published summarising the group's findings.

C5.7.2 *Gas- Electricity Interaction and Interdependency.*
Name of Convener: Luiz Augusto BARROSO
Work was completed 2008/9 but the recent developments in shale gas suggest that this topic would be worth of revisiting in the future either under this working group or as a new topic.

C5.7.4 *Wholesale / Retail Market Interdependencies*
Convener: Joao Mello (BR)
A Working Group report has been issued.

3. WG C5-8 *Renewables and energy efficiency in a deregulated market*
The most recent phase of work completed in 2010
Currently Inactive

4. **WG C5-9** *Retail Market Competition – Customer Switching, Metering and Load profiles*
Name of Convener: Ion Lungu (Romania)
During 2011 the draft final report has been developed and circulated. The results of the WG were presented at the Sydney Colloquium in November 2011. It is planned to issue a technical brochure in 2012.
The WG will continue to gather data and are investigating the use of a dedicated site for publication of main themes and use of other platforms for updating results

5. **WG C5-10** *Establishment of Effective and Sustainable Regulatory Incentives for Capital Investments in Electricity Networks and Generation*
Name of Convener: Konstantin Petrov, Germany
During 2011 the draft final report has been developed and circulated for final comment. The final draft of the paper was issued (Sept. 2011) and reviewed at the meeting of the Working Group (Sydney). The results of the WG were presented at the Sydney Colloquium and subject to final comments (by the end of 2012) it is planned to issue the final report in February 2012. A technical brochure and an article for Elektra are planned for the first half of 2012.
A separate summary of the various regulatory models and incentives for generating plant investment is being developed for publication.

6. WG C5-11 *Market design for large scale integration of renewable energy sources and demand side management*
Name of Convener: Olivier LAVOINE, France
During 2011 the final report and Technical Brochure were prepared. These were presented at the C5 Colloquium in Sydney (November 2011)

7. JWG C2/C5–5 *Development and Changes in the Business of System Operators*
Name of Convenor: Ole Gjerde, Norway
The Joint WG met in Sydney as part of the 2011 colloquim

C5 Colloquium, Sydney November 2011
A very successful colloquium was held in Sydney during November 2011. This provided for an opportunity for updates on the work of a number of the working groups as well as a "market Disturbance Workshop" which was well attended.

The first day of the colloquium considered new technology driving regulatory and market design changes. Francois Regairaz (Fr) reported on the work of C5-11. One of the interesting conclusions was that in markets with high penetration of intermittent generation while it might be expected that the uncertainty regarding generation output might tend to drive "gate closure" closer to real time, this was generally found not to be the case and frequently these "wind heavy" systems operated on a day ahead market. The work also concluded that storage and demand response would become increasingly important.

Konstantin Petrov provided a summary of the results from C5-10 on the regulatory incentives for network investments. This compared and contrasted the differing approached. No obvious "best solution" was identified – there are many different approaches and they all work to a greater or lesser extent.

On the same topic of regulatory incentives for network investments Bess Clark (Australia) described a current debate in Australia regarding the development of network infrastructure to support large scale renewable projects and whether these should be on a piecemeal basis or integrated in order to attempt to capture economies of scale.

Angela Chuang (USA) described the work she has been undertaking with EPRI on some of the potential impacts of renewable generation integration on market design..

Andrew Ott (USA) described developments in the USA driven by increasing penetration of renewable (driven by clean air targets rather than climate change / CO2 reduction objectives) and the development of a very strong demand side response within the PJM region. This region operates a capacity mechanism and the latest round of auctions has provided 9% of capacity through demand response. He reported that actual events have subsequently demonstrated that this response is reliable and deliverable.

Andrew Ott (USA) then went on to provide an update from Task Force C5-7.1 on the Impact of Market Designs on Generation Adequacy. Once again the overall conclusion was that there was no single recipe for success – there are a number of different designs all performing quite well, the key is tailoring the design to the market concerned.

The second day of the colloquium was devoted to the "Market Disturbance Workshop". This provided an opportunity to consider a range of events that had led to market failures and disruptions due to: market designs, poor market signals to generation to respond, market participants failing to understand the market and adopting inappropriate contracting strategies, political interference in the market leading to inadequate investment signals, the interface between markets with different designs / timescales, the transition from one market design to another and the risks associate with using dynamic circuit ratings where transmission rights are non-firm.

The session was very interesting (not least because of the wide range of event s that were included within the topic) with lively questions and debate.

C5 Study Committee Meeting (11 November 2011)
The C5 Study Committee Meeting followed the Sydney Colloquium and identified a number of areas where work was to be progressed in preparation for the meeting in Paris in August 2012. A number of technical brochures are to be produced as well as articles fro Electra. The C5 WG had been awarded a "poster session" to provide an opportunity to expose its work to a wider audience at the Paris meeting.

Possible new study topics
Consideration was given to a number of new topics that might be worthy of investigation. The possible tiles and key areas to explore are summarized below:

<u>Regulatory aspects of introducing SMART energy systems</u>

The widespread introduction of smart energy systems raises many questions about risk, benefit, and cost. This WG would explore:

- Who pays - Fair allocation of costs in terms of benefits
- How does a regulator assess costs and benefits
- Who wears the investment risk
- Defining Regulated and competitive services (eg is communication services to the smart device a contestable service?)
- Widespread rollout versus trial

Markets role in the coming Smart grids environment

The development of power technology and communication (internet) systems may provide the ability for smart technologies to technically deliver a distributed power system. That distributed system may include local renewable generation, storage devices, electric vehicles and controllable loads. Work is likely to be

Interaction of Market Pricing and Regulation with Emerging Technologies

- Outline the economics of wholesale and retail market pricing with the introduction and growth in participation of intermittent renewables resources, demand side management, emerging technologies and storage systems;
- estimate the impact on market pricing (and tariffs) caused by the new technologies;
- analyze the distortions introduced by subsidies, incentives, government policies;
- identify the roles and responsibilities of market stakeholders;
- map funding alternatives for the development and implementation of new technologies;

Risk Management (how market players should handle risk management versus profit: the product is the preparation of a handbook or a tutorial)

- outline the economics and financing procedures of wholesale and retail market in relation to risk management: risk versus probability, threat, negative results, innovation;
- Risk analysis: interactions of risk and utility and wealth, risk averse theories applied to electrical energy market, forward curve, volatility, energy derivatives, etc.;
- The choice of investments: in which way decision investments are taken in different time frames; asset valuation; risk-return trade-off definitions of the conditions of entrance, exit, warranty, collateral effects and arbitrage in every new electrical market opportunity, contracts ;
- models and techniques for risk measuring (Markowitz, Benoit Mandelbrot, CAPM, asymmetrical distributions, proxies, value at risk, Monte Carlo, etc.)
- Country risk: spread, premium, approaches, risk classification, liquidity and illiquidity, etc.;
- risk scenarios and the constitution of portfolios, e-commerce;
- risk handling in electrical energy market: securitisation (bonds, certificates, funds), futures and options – hedge, swap, options and cross market derivatives.

WG 5-7 proposed a topic for a new Working Group along with some draft terms of reference

The Interaction of Market Designs, Regulatory Initiatives, and Emerging Technologies and Applications

Market designs incentivise innovations that in turn benefit or challenge the Market designs. The Working Group will provide insight into those innovations and challenges by:

- identifying new technology types that are being introduced in various markets
- identifying the capabilities and limits of current Market Designs to meet those challenges or maximize benefits of emerging technologies
- Evaluating current market design changes being considered or implemented.

The Working Group should review:
1 the market functions being impacted or imposed by new actors
2 the market design elements that are facilitating the introduction of new technologies
3 solutions being applied and proposed
4 alternative market concepts

Deliverables should include a survey and summary of market functions impacted by new actors. Description of current market design elements and how they facilitate new technologies. Description of pending and potential market solutions. Forecast of alternative market designs in future.

Annex

C-5 Strategic PLAN 2009 - 2018.
Areas of interest include:

- Changing market structures and new products (Both physical and financial as well as the interactions between them)
- Market Approaches and Tools (Forecasting of demand and price; Profit estimation and Financial Risk Management)
- Market designs impact on reliability, economy as well as environmental aspects
- Regulations on transmission and generation (objectives, incentives and approaches)
- Transmission issues from an economic perspective (pricing, ancillary services)

SC C-5 Strategic Goals
A generalized scope statement of C-5 is *"to analyze alternative market models and solutions and their impacts."* Based on actual and pending national and regulatory activities, the following strategic directions are identified for C-5:

Strategic direction 1: "Development and changes in the Business of System Operations"
Expanding markets, penetration of renewable and often intermittent generation sources will challenge the traditional principles of system operation in the future. Enhanced flexibility due to reduced firmness and need for shorter time horizons between market clearing and operation will be the trend. It is also challenging and time consuming to get permission to expand the transmission system so the margins are likely to become smaller and the overall operation becomes tighter. In some cases the renewable energy sources will have significant capacity and a location where untraditional system designs are needed. With expanding markets, multi-regional markets will normally be the case and this will raise issues around market coupling, harmonization, reliability of interconnected systems as well as regulation.

Strategic direction 2: "Market Entities"
As the electricity markets develop, the number and variety of market participants increase. There will be classical participants related to generation, transmission and distribution but also new as traders, market operators and special entities representing large groups of producers or consumers. The development of the "SmartGrid"-concept will probably to some extent remove the classical separation between the transmission and distribution and give rise for new entities acting directly into the markets.

An activity of C5 should be to identify the various types of organizations that can operate in electric markets and:

- *define* the appropriate roles that must be served and how these may be changed as the system develops
- *identify* the drivers (financial, regulatory) that affect those roles
- *define* principles for connection (infrastructure development and responsibilities)
- *determine* compliance measures related to those roles.

The variety of new market entities will be a challenge for the future operation of the system in terms of reliability and firmness. The balance between the flexibility to

participate in a free market and the responsibility for system services needed to operate the system is important.

Strategic direction 3: "Market Activities and Market Design"

Identify the proper roles of markets, of regulated organizations. Determine coordination function served by the Reliability Authority in an interconnection. Consideration will include:

- Congestion Management alternatives
- Congestion Revenue Rights
- Locational Marginal Pricing
- Interaction between Gas and Electric Markets

The market activities and the market design are important for the continued integration of intermittent and renewable generation. The continued development of the existing market to add flexibility for intermittent generation while preserving the reliability should be an important focus of the C5.

Strategic direction 4: "Market Regulations"

The focus of market regulation should be strengthened within C5. The membership with background from regulation has been limited but will to some extent change from 2010. It is important to make it attractive for regulators to participate.

In the restructured electricity markets, networks remain regulated while generation is exposed to competition. This has implications for investment in new generation and transmission facilities and possibly has implications for reliability, operation and system performance.