Hong Kong Electricity Market
A Review & The Way Forward

HK PolyU - School of Accounting & Finance
Background

- Ongoing public discussion on energy policy
- 2015 Policy Address: “…consult the public on the future development of the electricity market and the regulatory framework…announce the outcome of the fuel mix public consultation exercise and the way forward”
- Electricity market development is gaining importance in the policy agenda
Taking Stock

SCA
Scheme of Control Agreement (SCA)

**Environmental**
1. Emissions Performance Linkage Mechanism
2. Energy audit service
3. Energy efficiency loan
4. Smart Power Fund
5. Public education

**Tariff & Finance**
1. Fuel Clause Recovery Account
2. Higher transparency of annual Tariff Review
3. Tariff Stabilization Fund
4. Review of asset lives and permitted rate of return

**Operations**
1. Test for Excess Generating Capacity
2. Various incentives / penalties
3. Tightening of targets for incentives / penalties

**1979**

**Now**

**Source:** HK public library
Tariff Setting Under SCA

High Clarity

Permitted Return + Operating Costs + Tariff Stabilization Addition/Deduction = Forecasted Total Revenues

Average Net Fixed Assets

Actual Fuel Cost + Gen, T&D and Admin expenses + Depreciation = Forecasted Unit Volume

Rate of Permitted Return

Tariff = Actual Units Sold

Other Adjustments

Actual Revenues
**SCA Achievements**

**HEC Tariff**

- Expected tariff freeze from 2014-2018, accomplished in 2014 and 2015
- 10-year tariff increase from 2008 to 2018 is expected to be 5.9%
- HK’s 5-year cumulative inflation from 2009 to 2014 is about 23%

Comparison based on monthly domestic customer consumption of 275 units (3,300 units p.a.), ~40% of HK Electric’s domestic customers; tariffs and exchange rates are as at Nov 2014
### SCA Achievements

#### Supply Reliability

- Better than 99.999% since 1997; average power interruption < 1 min/year

<table>
<thead>
<tr>
<th>Supply Reliability</th>
<th>99.9%</th>
<th>99.99%</th>
<th>99.999%</th>
<th>99.9996%</th>
<th>99.9998%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Average</td>
<td>~ 9 hrs</td>
<td>~1 hr</td>
<td>~5 mins</td>
<td>~2 mins</td>
<td>~1 min</td>
</tr>
<tr>
<td>Outage Time Per Year</td>
<td></td>
<td></td>
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- World class electricity supply quality according to World Economic Forum

Among the highest rankings in “Quality of Electricity Supply” since 2012
(Hong Kong ranked 1\textsuperscript{st} in 2013-2014)

- Switzerland
- Hong Kong SAR
- Finland

(Top 3 in 2014-15)
SCA Achievements
HEC Environmental Performance

<table>
<thead>
<tr>
<th>Emissions</th>
<th>2014* vs 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Oxides (NOₓ)</td>
<td>↓ ~40%</td>
</tr>
<tr>
<td>Respirable Suspended Particulates (RSP)</td>
<td>↓ ~70%</td>
</tr>
<tr>
<td>Sulphur Dioxide (SO₂)</td>
<td>↓ ~90%</td>
</tr>
</tbody>
</table>

* Estimated year-end figures
SCA Contentions

Lack of environmental incentives

No Business Risk

High Rate of Return

Low Transparency

Prescription

- Competition
- Interconnection
- Grid access
- Powerful independent regulator
The Underlying Question: Regulate or Deregulate?

Guidance from economic theory

- Regulation always required for transmission and distribution (natural monopoly)
- Deregulating generation and retail sectors may bring beneficial competitions if necessary conditions are fulfilled

Hong Kong’s choice?
SCA

Regulation Issues
Permitted Rate of Return

- RoR Not Guaranteed
- Absolute Ceiling
- Regulatory Arrangements

Permitted Rate of Return

Considerations for Comparison
- Needs for New Investments?
- Regulatory Discontinuity?
- Economic Risk?
- Inflation Risk?
### RoR Comparison

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Regulator, Period</th>
<th>Sector</th>
<th>Nominal Vanilla WACC&lt;sup&gt;a,b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>HKSARG, 2008/9-18</td>
<td>Electricity utility (SCA)</td>
<td>9.99%&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Australia</td>
<td>AER, 2012-17</td>
<td>Elect. transmission (Powerlink)</td>
<td>8.61%</td>
</tr>
<tr>
<td></td>
<td>AER, 2014-15</td>
<td>Elect. distribution (Aurora)</td>
<td>8.28%</td>
</tr>
<tr>
<td></td>
<td>ESC(Vic), 2008-12</td>
<td>Gas distribution</td>
<td>9.15%</td>
</tr>
<tr>
<td></td>
<td>QCA(Qld), 2010-13</td>
<td>Urban water business</td>
<td>9.35%</td>
</tr>
<tr>
<td>UK</td>
<td>Ofgem, 2013-21</td>
<td>Electricity transmission</td>
<td>7.95%</td>
</tr>
<tr>
<td>US</td>
<td>Florida, 2013-16</td>
<td>Electricity utility</td>
<td>8.39%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>CC, 2010-15</td>
<td>Electricity distribution</td>
<td>8.77%</td>
</tr>
<tr>
<td></td>
<td>CC, 2011-15</td>
<td>Electricity transmission</td>
<td>8.05%</td>
</tr>
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<sup>a</sup> The nominal vanilla WACC (weighted average cost of capital) is a kind of ROR estimated based on gearing-weighted average of pre-tax cost of debt and pos-tax cost of equity.

<sup>b</sup> Except the first three, the figures are from a consultancy report prepared by Economic Insights for the Commerce Commission (CC) of New Zealand. It is understood that adjustments to facilitate comparison have been made by the Economic Insights where necessary. The figures are however still not completely like-to-like since regulatory arrangements vary in different jurisdictions. Other local factors also affect reasonableness of a given ROR.

<sup>c</sup> Permitted rate of return for a insignificant portion of the fixed assets (renewables) is 11% but other fixed assets dominate. It should be noted that permitted rate of return under SCA is not completely like-to-like with other RoRs, again due to different regulatory arrangements and other local factors.
Fuel Price Risk

- Even in deregulated markets, higher fuel price unavoidably translates into higher price for electricity
  - Even worse, in case fuel price goes down, unregulated power companies usually lack the incentives to transfer extra earning to consumers.
- For regulated markets, fuel cost pass-through is practiced universally.
  - The lower profit volatility makes regulated power companies willing to accept relatively lower rate of return.

Investors demand high returns for high profit risks (volatility).
Environmental Regulation

- Various effective environmental initiatives emerge under the SCA:
  - Supply Side
    1. Emissions caps
    2. Environmental Performance Linkage Mechanism
    3. Renewable energy projects
  - Demand Side
    1. Energy audit service
    2. Energy efficiency loan
    3. Smart Power Fund
    4. Smart Power Campaign

- Environmental regulation will probably be tightened
- High certainty that new environmental initiatives can be implemented efficiently and effectively through the SCA
Accountability & Transparency

- Executive Council
- Environment Bureau
- Energy Advisory Committee
- Advisory Committee of Environment

PUBLIC

- Annual Report
- Sustainability Report

- Capital Projects
- Tariff Reviews
- Environmental Matters

Scrutiny

Enquires
Deregulation Issues
High Complexity

Government

SCA

Vertical Integrated Power Company

Info flows
Power flow

Deregulation Preparation

Unbundling
Grid Access
New Sources
Interconnection
Independent System Operator
Grid Access

Accessing Grid

Given the wide diversity and potentially large capacities of generators, a lot of complex technical requirements to be met for safety and security reasons, e.g.:

<table>
<thead>
<tr>
<th>Requirement</th>
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<tbody>
<tr>
<td>Voltage Regulation</td>
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<tr>
<td>Power Factor</td>
</tr>
<tr>
<td>Reactive Power Supply</td>
</tr>
<tr>
<td>Response to Faults</td>
</tr>
<tr>
<td>Response to Frequency Changes</td>
</tr>
<tr>
<td>Harmonics</td>
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</tbody>
</table>

Revised from time to time

The UK Grid Code (>600 pages)
New Generation Sources

Centralized

Benefits
- Better economies of scale
- Low or zero emission achievable (cogeneration or RE)

Hurdles (Local)
- High space requirement
- Lack of indigenous renewable resources
- Reliability (intermittent nature of RE)
- Affordability
- Lack of suitable users (cogeneration)

Hurdles (Mainland)
- Remote sources / high interconnection investments
- Uncertain environmental performance
- High transmission loss

Distributed

Benefits
- Low or zero emission achievable (cogeneration or RE)
- High fuel efficiency (cogeneration)
- Smaller space requirement and hopefully more feasible

Hurdles
- Affordability
- Reliability (intermittent nature of RE)
- Local pollution, noise and heat (cogeneration)
- Safety and technical requirements, O&M capability

HEC-CLP Interconnection

Issues

- Large substations (transformers on HK Island side) in urban areas
- Technical challenges due to constraints and traffics
- Construction period at least 8-10 years
- Cost of $1.6B (2x700MW, 2002 price)
- Benefits depend on actual mode of utilization (can be zero)
Mainland Interconnection

**Issues**

- Available coal and nuclear sources are far
- Transmission distance and scale dictates expensive & bulky equipment
- Complicated cross-border regulatory and technical issues
- Reliability concerns
- Sharing almost all issues for HEC-CLP interconnection at a larger scale

Huizhou 500kV 3000MW HVDC Converter Station has a site footprint > 17 hectares
Major Phenomena Under Competition

UK experience –
Reconsolidation of market players

14 regional independent retail companies

Market rebundle

Favour commercial consumers

• 2012 UK Government commissioned report on fuel poverty:
50% of poor households ended up with ‘wrong’ deal

Doorstep selling malpractice

Source: Consumer Council
Environmental Issues

- Environmental issues are the main future challenges but market deregulation is seeking economic efficiency
- In deregulated markets, less conventional and more controversial measures are adopted to address environmental issues

Market instruments have positive effects on environmental issues, but not without issues

European Union Emission Trading Scheme
- Complexities
- Company gaming

Renewable Obligations
- Controversies surrounding the fines

Feed-in-Tariff (FiT)
- Criticized as economically inefficient
Regulatory Bodies

Characteristics of an efficient regulator

- Unbundled & new players
- New responsibilities (e.g. electricity trading & increased complaints)

- Mirror the scale and structure of the sector
- Consolidation of electricity-related public services

- Disclosure of policy
- Stakeholders participation
- Report on performance

- Collective voice on policy setting, e.g. limits on tariff or RoR
- Individual complaints and dispute settlement

Source: Consumer Council
### Needs for Independent Bodies

**Regulator and Independent System Operators**

#### Now

- 2 power companies participate HK’s electricity market.

#### Deregulated Market

- A dozen of power companies (Gen., T&D and/or Retails) participate the market.

  - Due to the complicated system, more disputes and higher needs for coordination and resolution; long-term planning may be missing.

  - A fair operator and trading platform is essential for running the market and long-term planning.

  - Big independent regulator to oversee players.

### Challenges

- Low economies of scale given small market size
- Human resource challenges (small no. of competent persons in HK)
- The connection with aims (e.g. lower tariff and better environment) is indirectly and can be remote
## Existing Regulated Assets

<table>
<thead>
<tr>
<th>Asset Category</th>
<th>Years</th>
</tr>
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<tbody>
<tr>
<td>Cable tunnels</td>
<td>100</td>
</tr>
<tr>
<td>Buildings</td>
<td>60</td>
</tr>
<tr>
<td>Ash lagoon and gas pipeline</td>
<td>60</td>
</tr>
<tr>
<td>Transmission and distribution equipment, overhead lines and cables</td>
<td>60</td>
</tr>
<tr>
<td>Generating plant and machinery</td>
<td>35</td>
</tr>
<tr>
<td>Gas turbines and gas turbine combined cycle</td>
<td>30</td>
</tr>
<tr>
<td>Mechanical meters</td>
<td>30</td>
</tr>
<tr>
<td>Photovoltaic systems</td>
<td>25</td>
</tr>
<tr>
<td>Wind turbines</td>
<td>20</td>
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</tbody>
</table>

- SCA acknowledges that fixed assets for electricity supply have long asset lives
- Investment decisions were made under SCA
- Major changes of the regulatory regime can create big problems (2013 fixed assets: HEC $43B / CLP & CAPCO $98B)
Telecom: A Good Reference? A Board Brush Comparison

Telecommunications

<table>
<thead>
<tr>
<th>Market Objectives</th>
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<tr>
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<tr>
<th>Necessity</th>
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<tr>
<th>Environmental Challenges</th>
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<td><img src="image4.png" alt="Image" /></td>
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Electricity

Telecommunications vs Electricity Comparison:

- Market Objectives
- Infrastructure
- Necessity
- Environmental Challenges
There is simply no silver bullet for electricity market development. Stakeholders must together make an informed decision on whether the SCA is to be replaced and, if yes, by what.
Judgments to Be Made...

“… a need to change the regulatory system of the Hong Kong electricity market”

Stakeholders should judge on the below views behind the conclusion:

• SCA does not flexibly adapt to the new environmental policies
• The power companies is enjoying high permitted rate of return
• The power companies is transferring business risks to consumers
• SCA may not provide adequate incentives to apply renewable energy

Even if it is concluded that change is to be introduced, does it mean the abolishment of the SCA?
Questions to Be Answered...

- SCA has been functioning reliably with good performance. Why can’t it be used as the blueprint regulatory framework for meeting future challenges?

- What are the opportunities opened by market deregulation? How big? At what costs?

- As Consumer Council points out: “the results of liberalisation were commonly disappointing as compared with the theory”. Does Hong Kong have the conditions for enabling meaningful competition?
Consumer Council’s Approach

“…should be carried out in a gradual and incremental way ensuring the strengths of the old system are not lost and new objectives are met”.

“…has to be viewed as a whole and should not be compartmentalized into discrete issues”.
Thank You