Regional Power Integration:

Early Findings from an ESMAP Regional Power Study

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World Bank BBL
I Building (I2-220), 10 November 2009
Presentation outline

- Study outline and case study overview
- Literature review
- Key themes
  - Financing interconnector projects
  - Regional power systems planning
  - Regulatory harmonisation
  - Integration and market reform
  - Regional institutions
  - Environmental concerns
Study Outline and Case Study Overview
Potential of Regional Power System Integration

Phase 1
- 12 Case Studies
- Literature Review
- Workshop

Phase 2
- ‘Guide’ to Power Sector Integration

Presentation objectives
- Feedback from Bank experts on work to date
- Discussion on Phase 2
Case studies

- This component of ESMAP’s Regional Energy Integration Strategies Program focuses on the power sector
- Broad view of power integration – not just power pools but a mix of ‘transmission and trading’ and ‘generation’ case studies
- PJM and UCTE from developed countries
  - Interesting lessons but even these sophisticated structures do not provide perfect solution for all RPSI issues eg suboptimal investment in cross-border transmission
- Remainder from Eastern Europe, Latin America, Africa and Asia
- Extremely diverse in terms of size and forms of trade
Location of the 12 case studies
Some characteristics of the case studies

<table>
<thead>
<tr>
<th>Transmission &amp; trade</th>
<th>Year</th>
<th># participants</th>
<th>MW</th>
<th>GWh pa</th>
<th>Max Trade %</th>
<th>PSP</th>
<th>Trade Arrangements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PJM</td>
<td>1927</td>
<td>14</td>
<td>163,500</td>
<td>700,000</td>
<td>100%</td>
<td>√</td>
<td>Multiple markets</td>
</tr>
<tr>
<td>2 UCTE</td>
<td>1951</td>
<td>24 (29)</td>
<td>672,000</td>
<td>2,300,000</td>
<td>10%</td>
<td>√</td>
<td>EU Single Market</td>
</tr>
<tr>
<td>3 GMS</td>
<td>1971 (1995)</td>
<td>6</td>
<td>88,000</td>
<td>366,000</td>
<td>1%</td>
<td>√</td>
<td>Bilateral</td>
</tr>
<tr>
<td>5 SAPP</td>
<td>1995</td>
<td>12 (9)</td>
<td>46,000</td>
<td>274,000</td>
<td>7%</td>
<td></td>
<td>STEM, now DAM</td>
</tr>
<tr>
<td>6 Argentina-Brazil</td>
<td>2000</td>
<td>2 (3)</td>
<td>125,000</td>
<td>480,000</td>
<td>13%</td>
<td>√</td>
<td>Bilateral</td>
</tr>
<tr>
<td>8 South East Europe</td>
<td>2005</td>
<td>9</td>
<td>48,200</td>
<td>179,000</td>
<td>14%</td>
<td>√</td>
<td>EU Single Market</td>
</tr>
<tr>
<td>10 SIEPAC</td>
<td>2010</td>
<td>6</td>
<td>9,700</td>
<td>32,000</td>
<td></td>
<td>√</td>
<td>MER regional market</td>
</tr>
<tr>
<td>11 GCC</td>
<td>2010</td>
<td>6</td>
<td>73,000</td>
<td>290,000</td>
<td></td>
<td></td>
<td>Spinning reserve</td>
</tr>
<tr>
<td>12 NBI</td>
<td>2010</td>
<td>9</td>
<td>27,400</td>
<td>142,000</td>
<td></td>
<td></td>
<td>Bilateral</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generation scheme</th>
<th>Year</th>
<th># participants</th>
<th>MW</th>
<th>GWh pa</th>
<th>Max Trade %</th>
<th>PSP</th>
<th>Trade Arrangements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Cahora Bassa</td>
<td>1977 (1997)</td>
<td>3</td>
<td>2,075</td>
<td>13,000</td>
<td>-</td>
<td></td>
<td>Bilateral</td>
</tr>
<tr>
<td>7 Manantali</td>
<td>2002</td>
<td>3</td>
<td>200</td>
<td>767</td>
<td>-</td>
<td></td>
<td>Fixed shares</td>
</tr>
<tr>
<td>9 Nam Theun 2</td>
<td>2009</td>
<td>2</td>
<td>1,070</td>
<td>5,636</td>
<td>-</td>
<td>√</td>
<td>Bilateral</td>
</tr>
</tbody>
</table>
Number of schemes per decade and per number of utilities

- **PJM, UCTE, SAPP**
- **GMS & Cahora Bassa**

- **NT2 & Cahora Bassa**
- **Arg & Br, Manantali**
- **SAPP, PJM, UCTE, SEE**

7 schemes
Literature Review
Format of literature review

- **Purpose**
  - document literature relevant to RPSI in Bank’s client countries

- **Introductory overview of main themes**
  - Motivations and barriers to integration
  - Outputs (market development, institutional and physical infrastructure)
  - Facilitating the process of integration (political will, coordination, sequencing)
  - Future research topics

- **Annotated bibliography**
  - Papers divided into 9 categories

- **Extended bibliographic entries**
  - Eg the E7/ESMAP RECI Guidelines
Findings

- Much of the literature on benefits of RPSI is advocacy rather than analysis, e.g.
  - ‘RPSI promotes access to electricity’ – little evidence of this
  - ‘RPSI gives rise to environmental benefits’ – in some cases, but by no means all
  - ‘RPSI means higher investment based on least cost projects’ – no assurance of this:
    - politicians equate energy security with having domestic generation capacity > max demand
    - bias towards national power development plans
    - regional aspect may or may not increase flow

- Dearth of serious academic work on RPSI
  - Empirical analysis of actual benefits of RPSI
  - Theoretical analysis of benefits distribution
  - Structuring and financing of RPSI projects
  - Political-economy analysis of institutions to promote RPSI
Key Themes

Financing interconnector projects
Regional power systems planning
Regulatory harmonisation
Integration and market reform
Regional institutions
Environmental concerns
Financing interconnection projects

- Approaches being used in developing countries predominantly bilateral donor, multilateral and DFI financing
  - **Problems**: soft budget constraints and moral hazard (Manantali)
  - **Response**: conditionalities (NT2) resulting in parallel projects funded by governments without social and environmental safeguards (GMS)

- Private sector funding is very limited
  - Garabi only example amongst case studies
  - CIEN took big knock when Argentina banned exports of power
Regional power sector planning

Regional generation and transmission optimization exercises show significant gains over sum of national plans

- SAPP’s latest 2025 Pool Plan requires US$89 b for 57,000 MW and associated transmission
- Savings compared to national power development plans of US$48 b

Yet national plans continue to prevail

- Countries unwilling to surrender sovereignty to regional bodies (from Austria to Zimbabwe)
- Little feeling of ownership, uncertainty and skepticism about regional arrangements
- ‘Optimal’ plans are not robust – subject to all sorts of technocrat-driven assumptions
Regulatory harmonisation

- Harmonisation most advanced in:
  - SEE (due to EU Directives)
  - SIEPAC – common rules, regional regulator, regional systems and market operator

- Harmonisation is not a pre-condition for RPSI, but in several schemes, greater regulatory harmonisation would give higher levels of certainty, improving the investment environment
  - GMS – national regulators in most but not all countries, no regional regulator
  - SAPP – regional electricity regulatory association exists but is a far cry from a regional regulator
Integration and market reform

- Presumption in earlier epoch was that national electricity sector reforms would gather momentum, in part due to RPSI

- Transmission operators would be the focal points for RPSI

- In practice, reforms have often stalled
  - SIEPAC shows that RPSI can go ahead even when countries are at very different stages of reform
  - However significant regional market development requires progressing from the single buyer model
  - Encouraging large customers to buy competitively important step in loosening grip of long-term bilateral contracts

- SEE - useful contrasting example where reforms and RPSI are moving together
Regional institutions

- SPVs obvious solution for standalones
  - **Generation**: Cahara Bassa, Manantali, NT2
  - **Transmission**: Garabi (Argentina-Brazil)

- In transmission and trade, a variety of institutional forms
  - Strong regional economic communities with power as a sub-component
    - SEE most extreme variant
    - SAPP, NBI, GCC
  - Power integration taking the lead
    - SIEPAC – Central American Electrification Council (1979), pre-cursor to PPP (2001) and Mesoamerican Project (2008)
  - Looser regional arrangement
    - GMS Economic Cooperation Program
    - Members also belong to ASEAN Mekong Basin Development Cooperation (AMBDC)
Environmental concerns

- Many of the schemes involve hydropower effectively displacing fossil fuels, leading to regional savings despite offsetting CH4
  - Net savings probably quite small: for GMS regional strategy saving estimated at 3%

- No scheme has yet obtained CDM financing
  - SIEPAC tried, was rejected and is re-submitting
  - 220 kV Vietnam-Cambodia interconnector project has applied (2008) and awaits decision

- GCC: economic rationale to trade in gas overtaken by inflated LNG price
  - More profitable to export LNG and import coal for electricity generation
  - Lack of global thinking in countries driving up the LNG price
Conclusions
## Case study scorecard

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<th>Successes</th>
<th>Problems</th>
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<td>1  PJM</td>
<td>DAM and real time markets, transmission auctions</td>
<td>Locational marginal pricing does not give expected investment signals.</td>
</tr>
<tr>
<td>2  UCTE</td>
<td>Legally binding agreement after 2003 supply failure</td>
<td>Lack of coordinated regional planning and investment</td>
</tr>
<tr>
<td>3  GMS</td>
<td>Bilateral trade a proven model</td>
<td>Imposition of social and environmental problems on poor countries</td>
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<td>STEM and DAM</td>
<td>Failure to implement Pool Plan; regional capacity shortfalls</td>
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<td>6  Argentina-Brazil</td>
<td>Regional transmission project promoted and owned by private sector</td>
<td>Banning of exports by Argentine government destroyed basis of Garabi project and set back market development in Southern Cone</td>
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<td>8  South East Europe</td>
<td>Progressive moves towards wholesale and retail competition</td>
<td>Next logical regional investment is located in region with uncertain status (Kosovo)</td>
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<tr>
<td>10 SIEPAC</td>
<td>Creation of market institutions ahead of physical infrastructure</td>
<td>Long process (23 years from feasibility study)</td>
</tr>
<tr>
<td>11 GCC</td>
<td>Power Exchange Trading Agreement</td>
<td>World LNG market distorting regional trade in gas, resulting in imports of coal for electricity generation</td>
</tr>
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<td>12 NBI</td>
<td>Investment projects underway</td>
<td>Lack of defined division of responsibilities between NBI and EAPP</td>
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<td>Consistent supply since 1997</td>
<td>Sabotage: 18 years out of service</td>
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<tr>
<td>7  Manantali</td>
<td>Operated satisfactorily since commissioning</td>
<td>Low tariffs and failure to repay loans</td>
</tr>
<tr>
<td>9  Nam Theun 2</td>
<td>Export revenues for Laos, clean power for Thailand</td>
<td>Controversy over share for private participants</td>
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# Case study scorecard – particular examples of mixed outcomes

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Has the potential of Regional Power Sector Integration been realised?

- Underlying economics extremely strong, yet RPSI achievements have been modest

- RPSI has proved difficult to achieve fundamentally because of lack of political will:
  - Countries have strong risk perceptions about regional schemes, gravitating towards autarchy
  - Regional institutions are not given the mandate to enforce cost-saving regional solutions

- Hopes that the power sector would drive a broad regional integration agenda amongst developing countries have not materialised
  - Instead RPSI has not infrequently been a follower rather than a leader
Have we been too ambitious?

- Bank and other agencies have given a lot of support to RPSI without necessarily appreciating the underlying realities.

  In particular, long-term bilateral contracts provide the basis for most of the electricity trade that takes place

  - this will necessarily continue because the financing of new projects requires long-term PPAs to be in place
  - Are complex institutional structures needed if trade is predominantly bilateral?

- Short-term competitive markets for residual requirements offer some (limited) benefits

- Coordinated regional investment would deliver much greater benefits

  - but NO regional institution has the mandate to enforce an optimal regional power development plan
Where to now?

- Have to conclude that strengthening institutions and aspiring to continuous reforms has not always succeeded

- Challenge going-forward is to identify specific approaches and interventions that would help build and/or sustain momentum for RPSI
  - Major lessons are that there is no linear progression and no ‘one size fits all’ solution
  - RPSI schemes go through cycles of development and have different needs at different times
  - Approach thus must be to offer a range of options grounded in theory and experience
Regional Power Integration:

Early Findings from an ESMAP Regional Power Study

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