

Regional Power Integration:

Early Findings from an ESMAP Regional Power Study

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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

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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

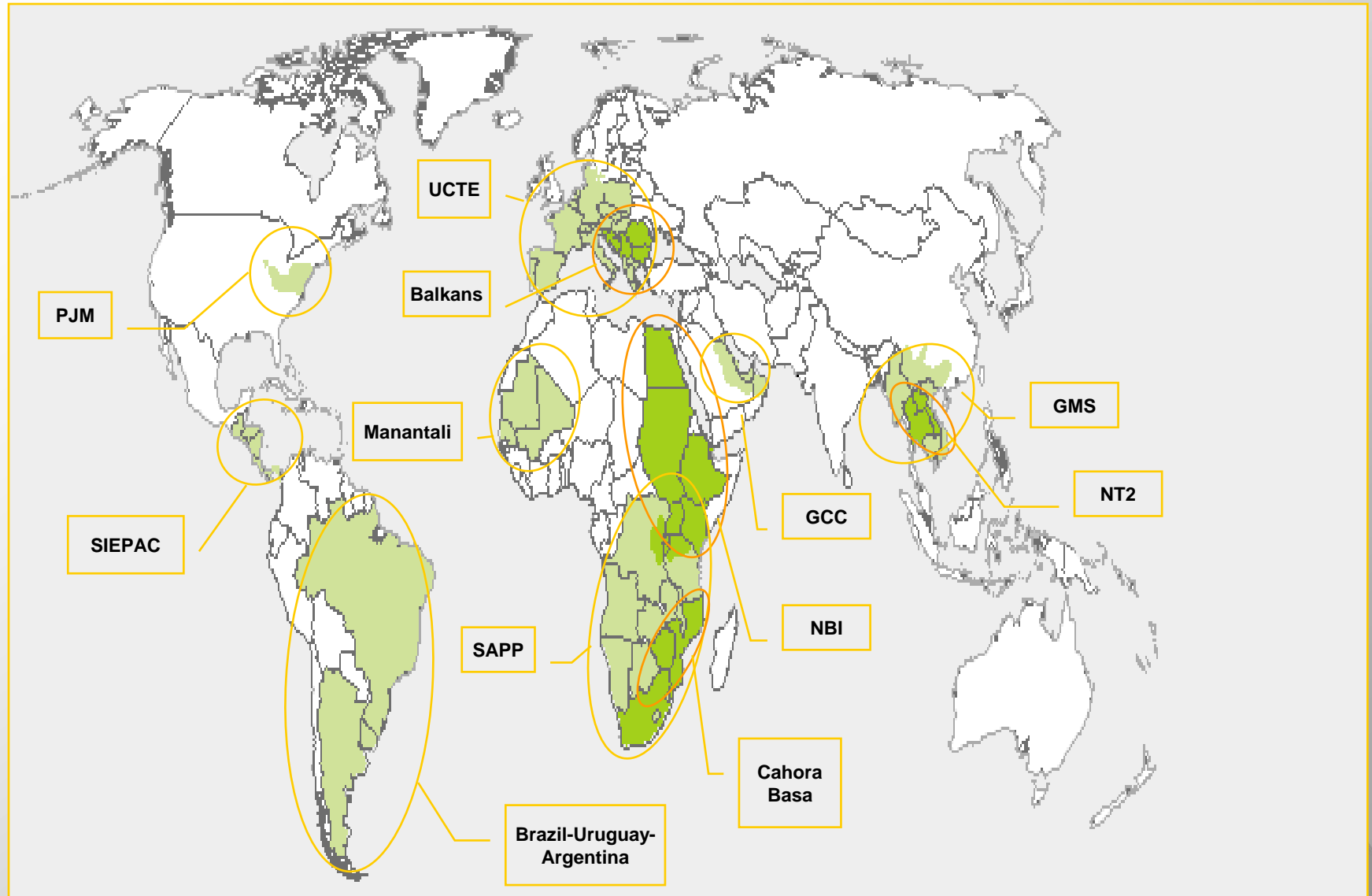
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Case studies

- **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**

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Location of the 12 case studies

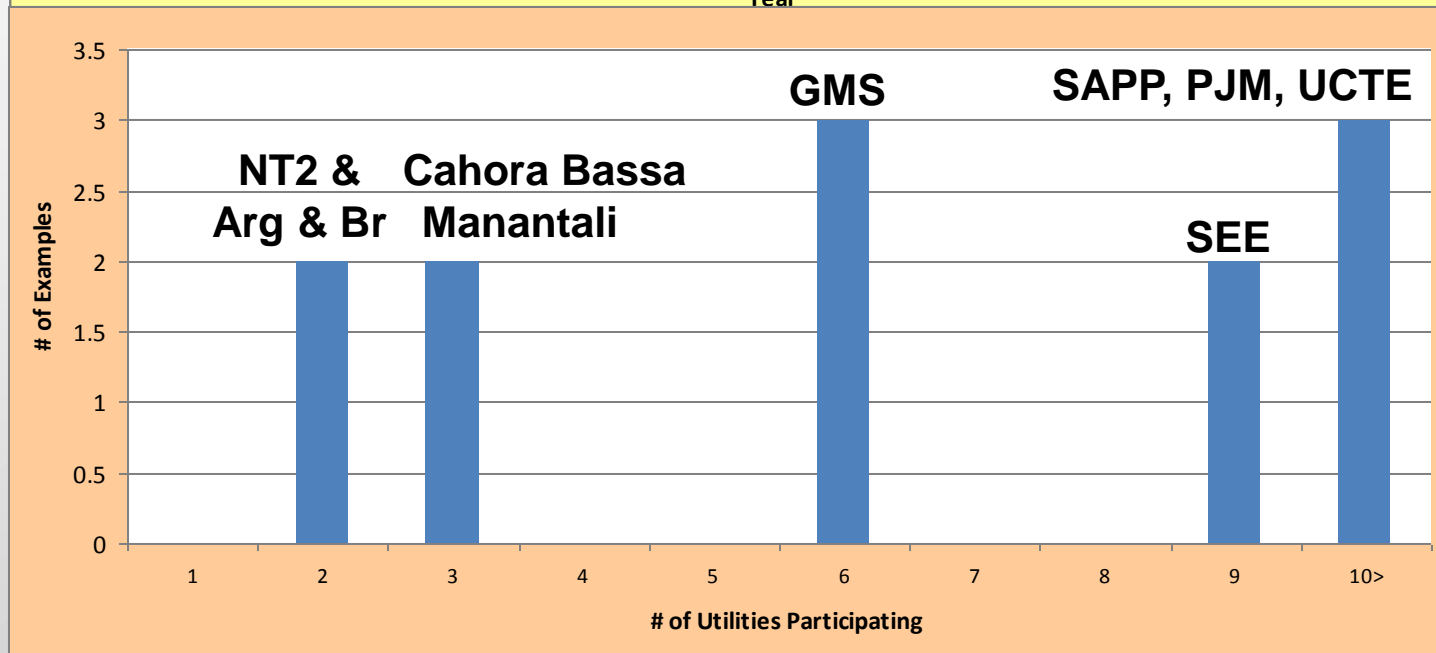
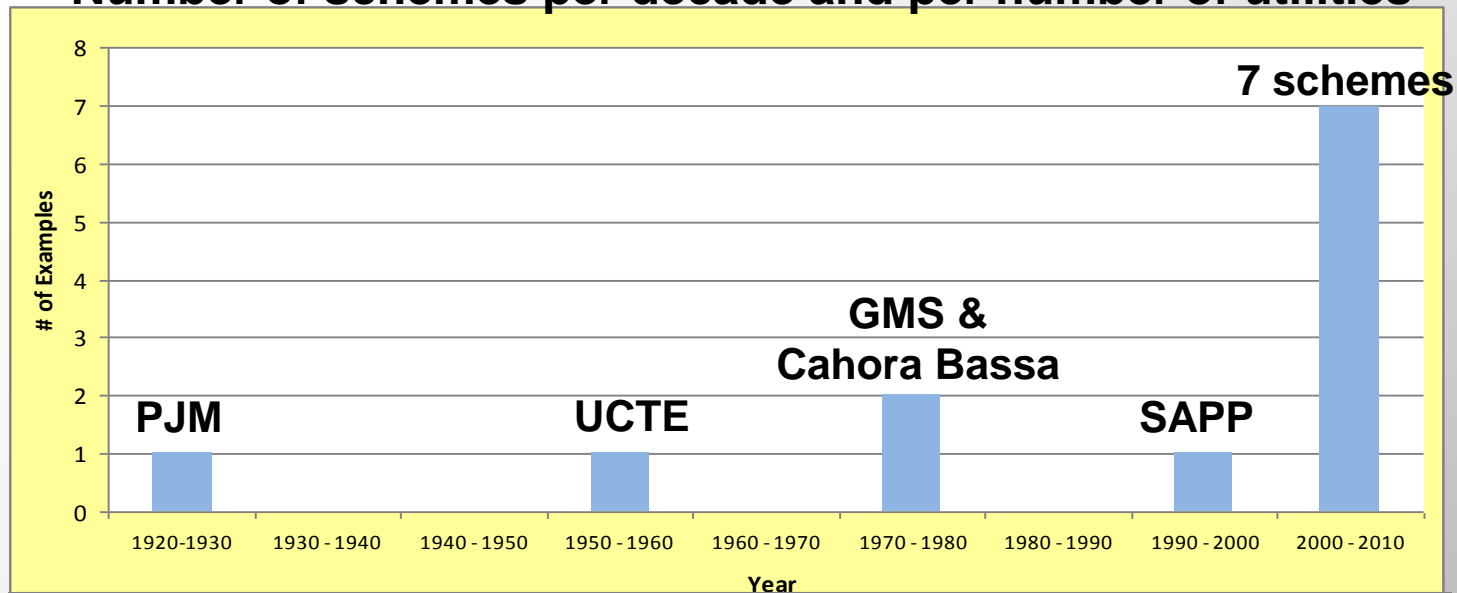


Some characteristics of the case studies

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

| Generation scheme | | Year | # participants | MW | GWh pa | Max Trade % | PSP | Trade Arrangements |
|-------------------|--------------|-------------|----------------|-------|--------|-------------|-----|--------------------|
| 4 | Cahora Bassa | 1977 (1997) | 3 | 2,075 | 13,000 | - | | Bilateral |
| 7 | Manantali | 2002 | 3 | 200 | 767 | - | | Fixed shares |
| 9 | Nam Theun 2 | 2009 | 2 | 1,070 | 5,636 | - | √ | Bilateral |

Number of schemes per decade and per number of utilities



Literature Review

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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

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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**

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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**

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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

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Case study scorecard

| Transmission & trade | | Successes | Problems |
|----------------------|-------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1 | PJM | DAM and real time markets, transmission auctions | Locational marginal pricing does not give expected investment signals. |
| 2 | UCTE | Legally binding agreement after 2003 supply failure | Lack of coordinated regional planning and investment |
| 3 | GMS | Bilateral trade a proven model | Imposition of social and environmental problems on poor countries |
| 5 | SAPP | STEM and DAM | Failure to implement Pool Plan; regional capacity shortfalls |
| 6 | Argentina-Brazil | Regional transmission project promoted and owned by private sector | Banning of exports by Argentine government destroyed basis of Garabi project and set back market development in Southern Cone |
| 8 | South East Europe | Progressive moves towards wholesale and retail competition | Next logical regional investment is located in region with uncertain status (Kosovo) |
| 10 | SIEPAC | Creation of market institutions ahead of physical infrastructure | Long process (23 years from feasibility study) |
| 11 | GCC | Power Exchange Trading Agreement | World LNG market distorting regional trade in gas, resulting in imports of coal for electricity generation |
| 12 | NBI | Investment projects underway | Lack of defined division of responsibilities between NBI and EAPP |

| Generation schemes | | Successes | Problems |
|--------------------|--------------|----------------------------------------------------|-------------------------------------------------|
| 4 | Cahora Bassa | Consistent supply since 1997 | Sabotage: 18 years out of service |
| 7 | Manantali | Operated satisfactorily since commissioning | Low tariffs and failure to repay loans |
| 9 | Nam Theun 2 | Export revenues for Laos, clean power for Thailand | Controversy over share for private participants |

Case study scorecard – particular examples of mixed outcomes

| Transmission & trade | | Successes | Problems |
|----------------------|------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 5 | SAPP | STEM and DAM | Failure to implement Pool Plan; regional capacity shortfalls |
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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**

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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

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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

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