Rethinking Renewables in the Mekong Basin

Opportunities and Challenges for a Transboundary Renewables-Based Power Grid in the Lancang-Mekong Region

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The Mekong region has an electricity problem

- Cambodia’s electricity situation is improving but still fragile
- Numerous isolated grid systems
- Rural-urban disparities persist
- Demand growth outpacing supply growth
- Prices high, reliability low
- Diesel’s share of electricity generation has drastically declined in recent years
Downstream electricity use low but growing

Comparison of Annual Electricity Generation & Consumption [TWh]

- **Generation**
- **Consumption**

- Yunnan
- Vietnam
- Thailand
- Myanmar
- Lao PDR
- Cambodia
Despite changes, fossil fuels still play key role
China’s energy companies have a solution

• China holds world’s greatest hydropower potential and abundant dam experience

• Southwestern China’s Yunnan Province already has more installed hydro than Russia, India, Norway and Switzerland
  • ~¼ of Lancang-Mekong lies in Yunnan

• Since 2000, Chinese energy SOEs have been encouraged to “go outward” and seek overseas development projects

• BRI/OBOR strengthens that trend
Yunnan Hydro: ~800% growth 2000-2014

Dams large and small have a mixed record

- Developers: flood control benefits, electricity
- Local officials: poverty alleviation
- Hydro’s fast ramp rate and ability to store renewable energy area its greatest asset
  - With smart grid, hydro can “firm” variable intermittent renewables like wind and solar
- Flood control capacity and power generation capacity vary inversely at any given time

Negative impacts of dams can be synergistic

- Negative socioeconomic, biophysical, and geopolitical impacts are well known (Tullos et al. 2009; Kibler & Tullos 2013)
  - Small is not always better
- Cascade impacts poorly understood
- High food security concerns in MSEA
- Institutions are manifold and weak
- Resettlement outcomes are often poor

Snapshot of Negative Impacts

• Biophysical
  • Reservoirs trap sediment, flatten the hydrograph, reduce water quality, disrupt ecosystems, waterlog soils, and encourage methane production from rotting submerged biomass

• Socioeconomic
  • Resettlement disrupts social networks and frequently involve inadequate compensation; migrants often lack skills to integrate into new communities; large reservoirs often disrupt local power systems (small hydro on tributaries)

• Geopolitical
  • Institutions for trans-boundary basin governance (even domestically) are limited, and of limited efficacy; regional distrust heightened by lack of transparency

• Impacts can be acute and far-reaching, upstream and downstream
### Assessing and Modeling Dam Impacts

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<th>Biophysical</th>
<th>Socioeconomic</th>
<th>Geopolitical</th>
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<td>SE2: Cultural Change</td>
<td>GP2: Political Complexity</td>
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<td>BP7: Impact Area</td>
<td>SE7: Macro Impacts</td>
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Integrated Dam Assessment and Modelling project (IDAM) captures positive and negative magnitude of each impact, as well as its salience, to facilitate comparing different scenarios and stakeholder perspectives. *(NSF Grant BCS-0826771)*
Cambodia: Strong solar potential, weak grid

• Population: 15 million
• Annual Electricity Consumption (2015): 5 Billion kWh
• Strong policy support for regional grid integration
• Low electrification rates, high tariffs
• High solar potential: 5 kWh/day/m²
  • 183 km² of solar panels could meet country’s current electrical needs (=1/15 Tonle Sap area in dry season)
• High economic growth rates in spite of electricity limitations and costs
Can northern Europe interlink be a model?

• Denmark (Pop. 5.7M)
  • Annual Electricity Consumption (2015): 32 Billion kWh
  • ~50% renewable electricity; 40% of total demand met by wind
  • Wind generation has exceeded demand in the past

• Germany (Pop. 82 M)
  • Annual Electricity Consumption (2015): 536 Billion kWh
  • Roughly 30% renewable electricity, commitment to phasing out nuclear power
  • Dispatch priority for renewables

• Norway (Pop. 5.3 M)
  • Annual Electricity Consumption (2015): 119 Billion kWh
  • 623-km 1400-MW HVDC cable to Germany will allow Norway’s hydropower to balance Germany’s intermittent renewables by 2020

• Norway and Yunnan can be the batteries for high-solar and high-wind neighbors
Challenges are Real but Manageable

• Limited transboundary transmission capacity at present
• Wholesale market undeveloped
• Generator scheduling and dispatch rules need to be more transparent
  • Prioritize lowest cost? Lowest carbon? Balancing vs base load?
  • Balancing w/ hydro may require re-regulation to meet downstream flow needs
• Regional mistrust among upstream-downstream countries is real
• Negative impacts of dams are often geographically concentrated
• Positive impacts are often geographically diffuse
Concluding Thoughts

• If we don’t measure the things we value, we end up valuing the things we measure
  • Food security, biodiversity, are geopolitical stability are hard to measure
  • Regulating capacity and generating capacity are easy to measure
  • Electricity output is a crude proxy for the actual services we value that are provided by electricity

• How might state and non-state actors best promote energy development scenarios that sustain ecosystems and livelihoods, while meeting key development indicators?
My favorite China electricity story

• Or, how many light bulbs does it take to change China?
• Incandescent bulb phase-out by 2020
  • LEDs ~12x more efficient
  • 5 W vs 60 W, same light output
  • 55 W saved at bulb = 5500 W at power plant
• Efficiency Power Plants (EPP, 能效电厂)
  • “Changing light bulbs” at utility-scale (MW)
  • Pumps, fans, lighting, transformers, HVAC
• China Energy Research Institute
  • LEDs could save 85 billion kWh/yr
  • Roughly equals annual output of Three Gorges Dam