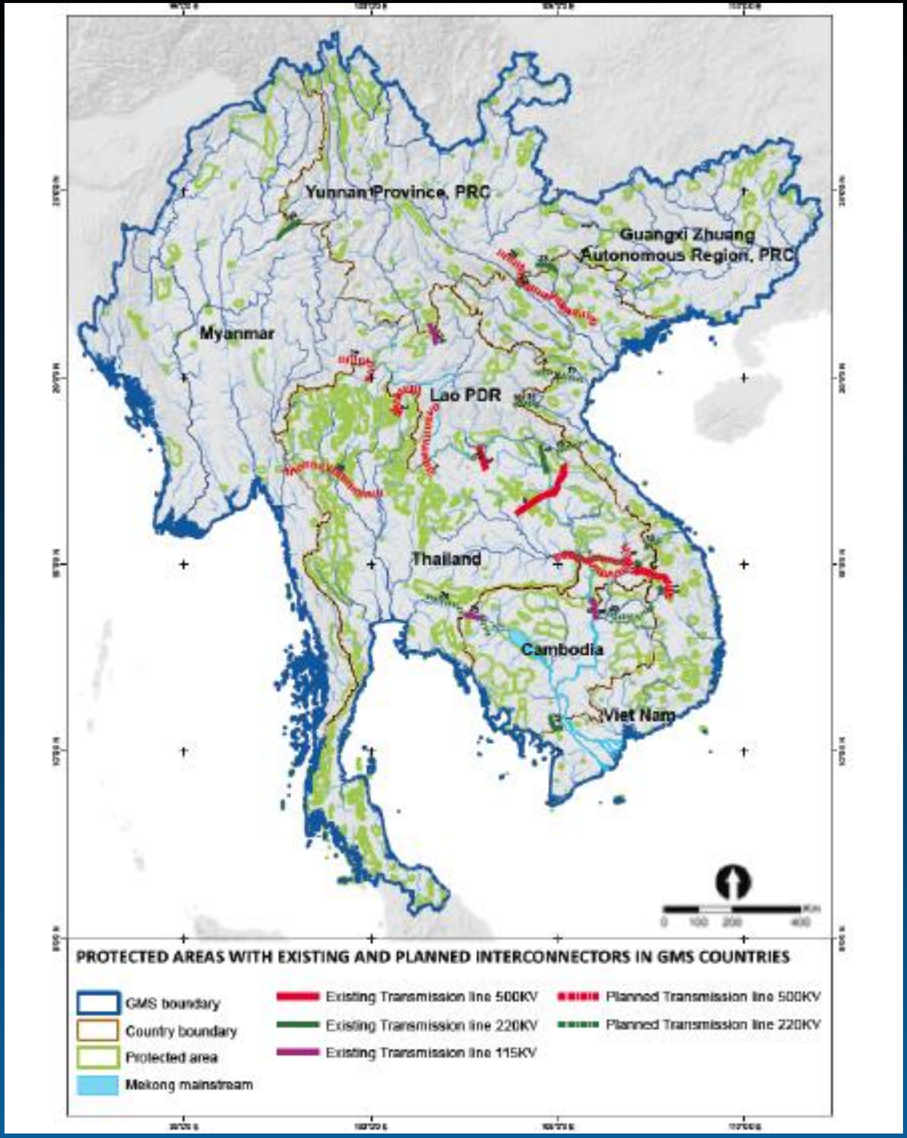
# USING STRATEGIC ENVIRONMENTAL ASSESSMENT TO INFLUENCE ALTERNATIVE POWER DEVELOPMENT PLANS IN THE GMS

Pradeep Tharakan
Southeast Asia Energy Division

ADB

# Overview

- *Ensuring Sustainability of the Greater Mekong Subregion Regional Power Development* (ADB TA 7764-REG) : 2012 - 2014
- Strategic environmental assessment (SEA) process for power planning.
- Incorporation of SEA into the PDPs in the Greater Mekong Sub region (GMS) to arrive at an optimal power development trajectory for the GMS as a whole.



# Approach and Methodology

- Sustainability is defined in terms of national and regional "security" – Eight aspects: ecological security, climate security, food security, social security, health and safety, good governance and state security, energy security, and economic security.
- Three alternative scenarios: (1) current PDP, (2) renewable energy (RE), and (3) energy efficiency (EE)
- With (2) and (3) two sub-scenarios: global and regional displacement
- The OptGen Power Dispatch Model
- Not detailed power plans, but a planning outlook.

# List of Indicators

| Security Aspect | Sustainability Assessment |
|---|---|
| 1. Ecological security<br>• Land<br>• Water<br>• Air | • Minimizing emissions, and ensuring the safe discharge and disposal of pollutants<br>• Maintaining and improving the quantity and quality of land, water, and air resources<br>• Maintaining and enhancing terrestrial, freshwater, and marine ecosystems throughout the GMS countries for conservation of biodiversity, connectivity, and ecosystem services and products |
| 2. Climate security | • Reducing emissions of greenhouse gases within the GMS countries to mitigate global climate change<br>• Maintaining and improving options and capacities of ecosystems and communities to adapt to climate change |
| 3. Food security | • Maintaining and enhancing the diversity and productivity of the agricultural systems in the GMS countries<br>• Maintaining and enhancing the diversity and productivity of the fisheries in the GMS countries<br>• Ensuring balanced nutrition for the people of the GMS countries, especially for the poor and vulnerable |
| 4. Social security | • Maintaining and enhancing employment and livelihoods for the people of the GMS<br>• Ensuring the well-being of vulnerable and minority groups of the population of the GMS who may be affected by development<br>• Maintaining the vital cultural diversity and heritage of importance to the GMS countries |
| 5. Health and safety security | • Minimizing the risks to human health and safety from the disposal of polluting, toxic, and radioactive wastes<br>• Minimizing the increased risks of flood and drought induced by development and climate change |
| 6. Good governance and state security | • Ensuring transparent and accountable development action throughout the GMS<br>• Preventing and resolving resource use conflicts within and between the countries of the GMS |
| 7. Energy security | • Ensuring the availability of energy at all times in various forms, in sufficient quantities, and at affordable prices, without unacceptable or irreversible impact on the environment for each of the GMS countries<br>• Increasing availability and access to electricity to communities in the GMS especially rural and urban poor |
| 8. Economic security | • Maintaining and enhancing contributions to the wealth and economic well-being of the GMS and its constituent nations<br>• Encouraging changes in the nature of production and consumption so that they can better satisfy human needs while using fewer raw materials and producing less waste<br>• Ensuring equitable distribution of economic benefits of development, including long-term support to vulnerable and affected groups |

| Security Aspect | Indicator | Units | Existing | Current PDP | Percent Change | Significance |
|---|---|---|---|---|---|---|
| Food security | Food production—loss of cropland or mixed agriculture | $km^2$ | | 146 | | C |
| | Irrigated area | million ha | 6.81 | 9.73 | 142.9 | C |
| | Food production—fisheries yield, Mekong (with mitigation) | million tons/yr | 2.034 | 2.295 | 112.8 | B |
| | Food production—fisheries yield, Mekong (without mitigation) | million tons/yr | 2.034 | 1.644 | 80.8 | B |
| | Riverine floodplain fisheries (LMB) | million tons/yr | 1.035 | 0.759 | 73.3 | C |
| | Food production—reservoir fisheries (LMB) | million tons/yr | 0.065 | 0.124 | 192.6 | C |
| | Balanced nutrition—supply/ demand balance with fisheries | tons/yr | 0 | 519,000 | | C |
| | Balanced nutrition—supply/ demand balance without fisheries | tons/yr | 0 | –132,000 | | C |
| Social security | Population within 50 km downstream of hydropower dams | # of people in GMS | 8,968,030 | 10,502,306 | 117.1 | C |
| | Potential resettlement thermal plants in GMS | # of people in GMS | | 140,662 | | B |
| | Potential resettlement requirement, HPP in GMS | # of people to be relocated | 750,487 | 1,062,789 | 141.6 | A |
| | Potential resettlement requirement, HPP in LMB countries | # of people to be relocated | 387,493 | 515,389 | 133.0 | A |
| Health and safety security | Health risks from power plants—people within 0.8 km of thermal plants | | 61,645 | 148,717 | 241.2 | A |
| | Health risks from power plants—people within 1.6 km of thermal plants | | 125,747 | 333,038 | 264.8 | B |
| | Flood control and safety risks | as per DOR | | | | C |
| | Seismic risk—installed capacity within seismic zone | GW installed capacity | 4.7 | 20 | 425.5 | C |
| | Nuclear safety—populations within 16 km of nuclear plants | # of people in GMS | 0 | 264,000 | | A |
| | Nuclear safety—populations within 80 km of nuclear plants | # of people in GMS | 0 | 4,448,000 | | A |
| Economic security | Investment needs (LMB) | $ billion/yr | 12.6 | 13.3 | | A |
| | Energy intensity | kWh/$000 GDP | 667 | 890 | 133.4 | A |
| | Jobs created—construction | # jobs/yr | 84,000 | 67,000 | 79.8 | C |
| | Jobs created—permanent | # jobs/yr | 14,000 | 29,000 | 207.1 | C |

DOR = degree of regulation of rivers, GDP = gross domestic product, GMS = Greater Mekong Subregion, ha = hectare, HLW = high level nuclear waste, HPP = hydropower plant, km = kilometer , $km^2$ = square kilometer, kWh = kilowatt-hour, LLW = low level nuclear waste, LMB = Lower Mekong Basin, $m^3$ = cubic meter, MT = metric ton, PAs = protected areas, PDP = power development plan, PM10 = particulate matter of 10 microns, RCI = river connectivity index, yr = year.

Note: Significance is ranked from A (most important) to C (least important).

Source: ADB. 2013b.

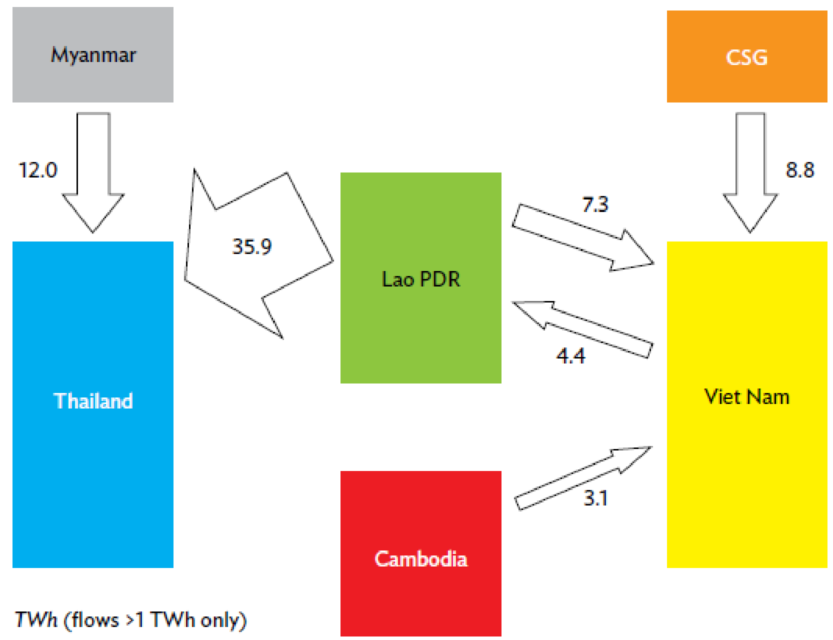
# Key Findings

- A tripling of power demand in the GMS by 2025, which is reduced by 15% if energy efficiency measures are incorporated.
- Depending on the scenario, 9-15 fewer coal-fired power plants, and between 22 fewer hydropower plants, and a few nuclear plants can be displaced and replaced.
- The EE scenario costs less because fewer plants need to be built to meet the reduced demand
- The RE scenario has slightly higher financial costs (approximately 5%) because of higher upfront costs and additional generational backup capacity, however social costs are very similar to the current PDP

# Projected Installed Capacity (PDP) and Cross Border Trade

- The current PDP scenario projects a tripling of capacity
- Major flow from hydropower export projects located in the Lao PDR to Thailand, as well as smaller imports from hydropower projects located in Myanmar
- Vietnam is importing from Northern Laos and exporting to Southern Laos

Figure 2. **Projected Cross-Border Flows in the Lower Mekong Basin, Current Power Development Plan Scenario, 2025**
(terawatt-hour)




CSG = China Southern Power Grid, Lao PDR = Lao People's Democratic Republic, TWh = terawatt-hour.
Note: Only flows greater than 1 TWh are presented.
Source: ADB. 2013c.

# Renewable Energy Scenario

Renewable Energy Shares by Scenario in the Lower Mekong Basin Countries, 2025 (%)

| Security Aspect | Current PDP Scenario | | Renewable Energy Scenario | |
|---|---|---|---|---|
| | Capacity | Output | Capacity | Output |
| Cambodia | 1 | 1 | 25 | 20 |
| Lao PDR | 2 | 2 | 17 | 15 |
| Thailand | 15 | 12 | 27 | 20 |
| Viet Nam | 7 | 5 | 19 | 13 |
| **LMB** | **9** | **7** | **22** | **16** |

Lao PDR = Lao People's Democratic Republic, LMB = Lower Mekong Basin, PDP = power development plan.

Source: ADB. 2013c.

# Projected Demand by Scenario, 2025

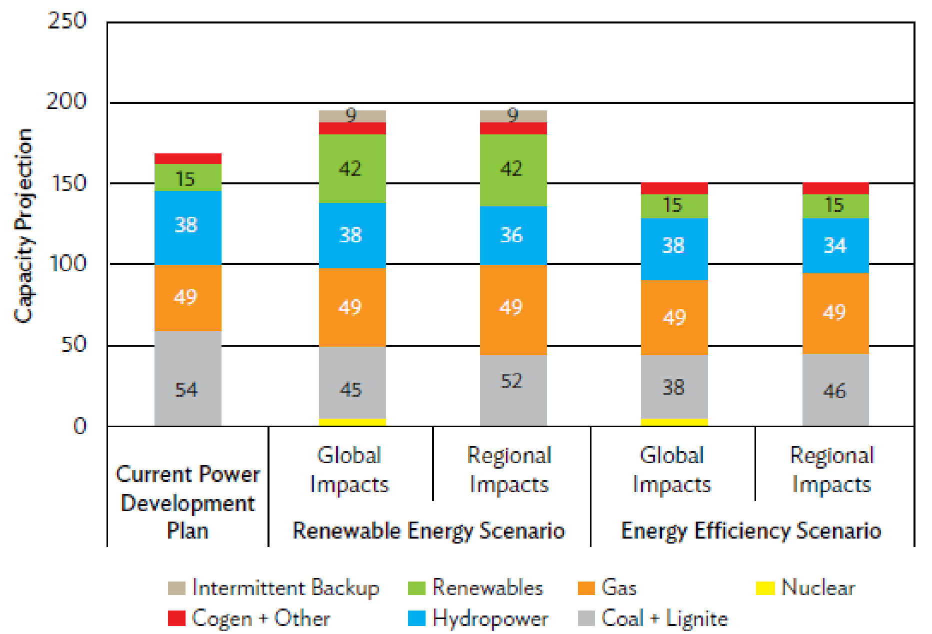
| Security Aspect | Current PDP Scenario and Renewable Energy Scenario (terawatt-hour) | Energy Efficiency Scenario (terawatt-hour) | Percent Change |
|---|---|---|---|
| Cambodia | 12.3 | 11.1 | (10.0) |
| Lao PDR | 18.2 | 16.4 | (10.0) |
| Thailand | 294.5 | 247.2 | (16.1) |
| Viet Nam | 489.6 | 413.6 | (15.5) |
| **LMB** | **814.7** | **688.3** | **(15.5)** |

( ) = negative, Lao PDR = Lao People's Democratic Republic, LMB = Lower Mekong Basin, PDP = power development plan.

Source: ADB. 2013c.

# Projected Installed Capacity (Alternative Scenarios)

Figure 4. **Projected Installed Capacity in the Lower Mekong Basin, Alternative Scenarios, 2025**
(gigawatt)




Cogen = cogeneration, GWh = gigawatt-hour, LMB = Lower Mekong Basin, PDP = power development plan.
Source: ADB. 2013c.

- Across the LMB, displacing conventional capacity with additional RE capacity increases total installed capacity by 27 GW.
- Under the EE scenario, installed capacity falls by 17 GW relative to the PDP (10% reduction).

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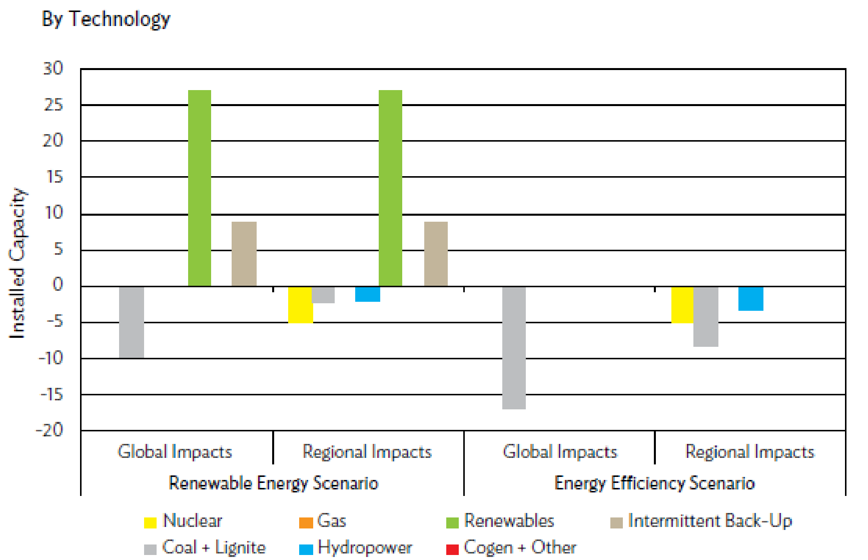
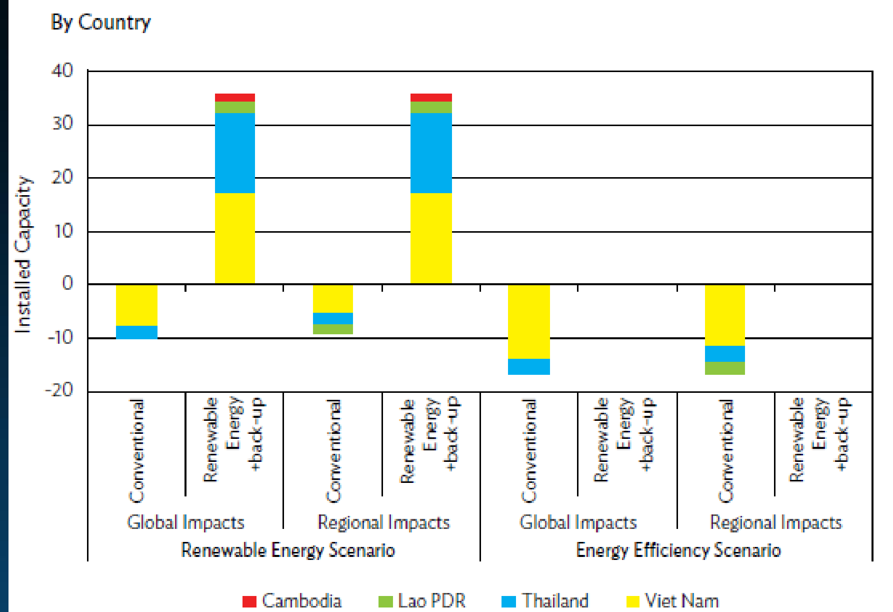
# Change in Installed Capacity

Figure 6. **Change in Installed Capacity from Current Power Development Plan Scenario, 2025**
(gigawatt)



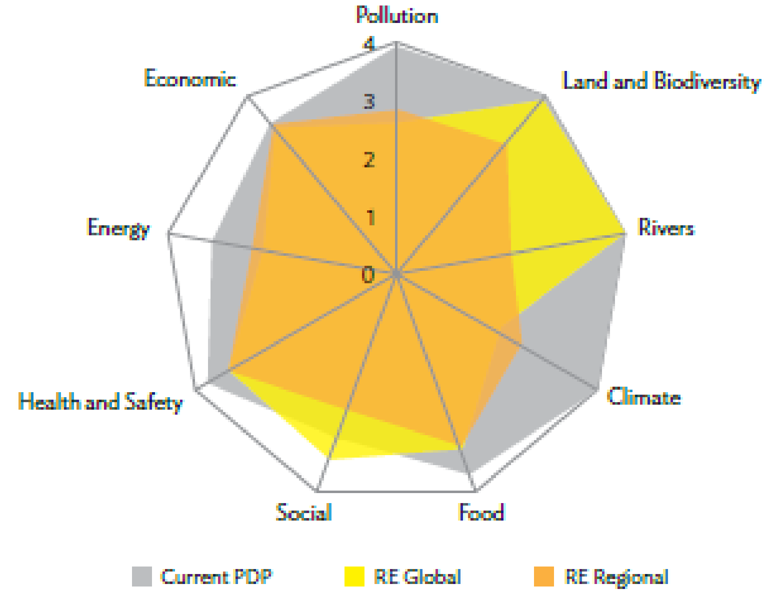




Cogen = cogeneration, Lao PDR = Lao People's Democratic Republic.
Source: ADB. 2013c.

# Qualitative Comparisons

- Both RE scenarios perform better than the PDP on pollution, climate, food, health and safety and energy security aspects

Figure 10. **Radar Diagram Comparing Security Aspect Scores of Global Renewable Energy and Regional Renewable Energy with Current Power Development Plan**



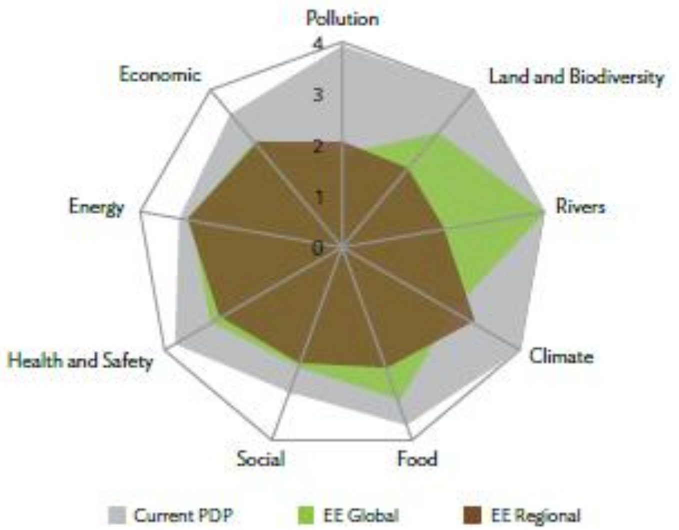

RE = renewable energy, PDP = power development plan.

Note: Pollution, land and biodiversity, and rivers are components under the ecological "security aspect." The aspect of good governance and state security is not included in the diagram, because no measurable indicators were found to compare the scenarios.

Source: ADB. 2013c.

# Qualitative Comparisons

Figure 11. **Radar Diagram Comparing Security Aspect Scores of Global Energy Efficiency and Regional Energy Efficiency with Current Power Development Plan**




EE = energy efficiency, PDP = power development plan.

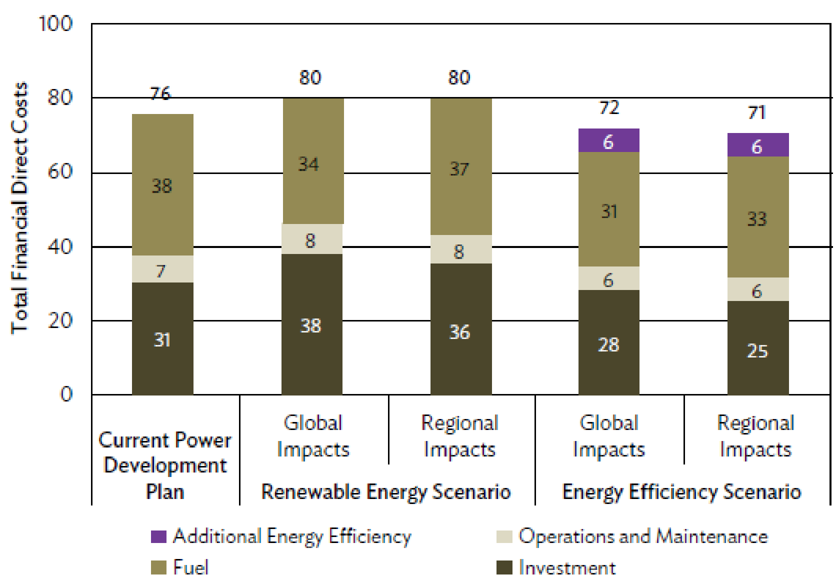
Note: Pollution, land and biodiversity, and rivers are components under the ecological "security aspect." The aspect of good governance and state security is not included in the diagram, because no measurable indicators were found to compare the scenarios.

Source: ADB. 2013c.

- Both EE scenarios perform better than the PDP almost all aspects.
- The EE-G scores lower on rivers parameter owing to a reliance on hydropower

# Financial Direct Costs

Figure 13. **Financial Costs of Electricity Supply by Scenario, 2025**
($ billion/year)




Source: ADB. 2013c.

- Total annual financial costs under the current PDP is estimated at $76 billion in 2025.
- In the RE scenario, these costs rise to $80 billion, an increase of 5.5%.
- Under the EE scenario, total costs including investments in additional energy efficiency measures fall to around $72 billion

  or by 5-7%

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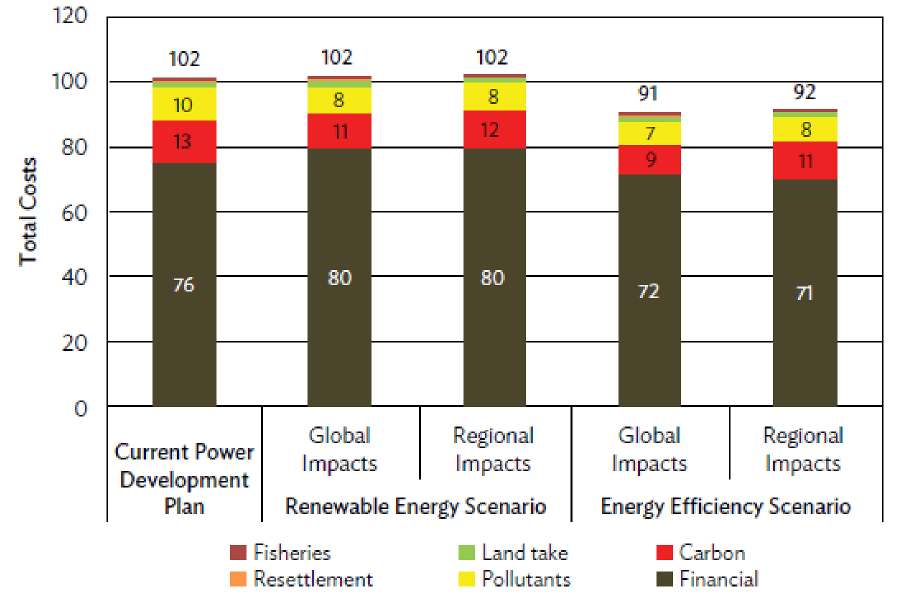
# Total Cost Comparisons

- The costs of major impacts of power generation were added to the direct costs of electricity generation to obtain estimates of the total costs of alternative PDPs
- These include health impacts, resettlement impacts and costs of GHG emissions.
- The externalities are dominated by GHG emissions and local pollutants

Figure 14. **Total Costs of Electricity Supply in the Lower Mekong Basin by Scenario, 2025**
($ billion/year)




Note: For clarity, interconnector costs are not separately shown given their small size relative to total costs.
Source: ADB. 2013c.

# Conclusions

- More accurate and realistic demand forecasting is an essential part of making the power sector development more sustainable
- Sustainability of the power sector would be improved with a greater emphasis on combining energy efficiency measures and renewable energy technologies
- In making choices about the type of technologies for power generation, governments should be aware of the need to address greater regional and local impacts in addition to addressing global impacts