The Energy Access Dividend in Latin America

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Why does Energy Access Matter?

- Energy access recognized as a determinant in economic development and poverty alleviation

- Electricity access presents benefits and challenges at the extensive and intensive levels
- Benefits and costs that accrue at household, community, regional, and global levels
What is the Energy Access Dividend?

- Governments must decide how to balance power quality, quantity, reliability, and equitable access
  - Challenges of reaching rural populations
- Energy Access Dividend (EAD) quantifies the electrification benefits forgone over a country’s business-as-usual electrification transition
  - Expanding on idea from Sustainable Energy for All and Power for All’s Why Wait? report
  - Key factors in this calculation include benefits, time horizon, and population with different levels of electricity access
- Apply this concept to two case studies in Latin America: Haiti and Honduras
Research Questions

1. How does the EAD differ between Haiti and Honduras, two countries in Latin America experiencing different electrification transitions?
2. What are the implications of policies targeting different tiers of electricity access for the EAD?
1 Defining Energy Access

2 Data and Methods

3 Estimating the Basic EAD

4 Scenarios for Extending the EAD

5 Policy Applications
Tiers of Energy Access

Figure: Multi-tier framework for energy access (Source: Bhatia and Angelou, 2015)
Extensive and Intensive Margins of Energy Access

**Figure:** Households accruing the EAD

**Figure:** Households accruing the EAD by tier
Estimating the EAD

The EAD is calculated

\[
EAD = \sum_{t=0}^{T_s} \sum_{y=0}^{Y} (1 + \delta)^{-y} (B_{y,t_0,t_1=T_s}) \cdot f_{y,t_0,t_1=T_s} \cdot H_y
\]

(1)

where:

- \(t\): energy tier, with \(T_s\) being the highest attained tier
- \(y\): year
- \(\delta\): discount rate
- \(B_{y,t_0,t_1=T_s}\): benefits of electricity access
- \(f_{y,t_0,t_1=T_s}\): fraction of households that have not attained a given tier
- \(H_y\): total number of households

- Calculate the **basic** EAD \((T_s = 1)\) and the **extended** EAD \((T_s > 1)\)
# Benefits of Energy Access

## Table: Benefits included

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Tier 4</th>
<th>Tier 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Included</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Lighting savings</td>
<td>• Phone charging</td>
<td>• Study time</td>
<td>• Reliability</td>
<td></td>
</tr>
<tr>
<td>• Emissions reductions</td>
<td>• Fan ownership</td>
<td>• TV ownership</td>
<td></td>
<td></td>
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<tr>
<td>• Phone charging</td>
<td>• Refrigerator ownership</td>
<td></td>
<td></td>
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<tr>
<td>• Radio ownership</td>
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<tr>
<td><strong>Excluded</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>• Study time</td>
<td>• Changes in time allocation</td>
<td>• Reliability</td>
<td>• Productive use</td>
<td></td>
</tr>
<tr>
<td>• Health</td>
<td>• Safety</td>
<td>• Productive use</td>
<td>• Productive use</td>
<td>• Changes in time allocation</td>
</tr>
<tr>
<td>• Safety</td>
<td>• Land values</td>
<td>• Changes in time allocation</td>
<td>• Changes in time allocation</td>
<td>• Health</td>
</tr>
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</tbody>
</table>
Data

Haiti
- Projections of energy access and population growth by WB and IEA
- Academic literature
- Haiti-specific reports

Honduras
- Projections of energy access and population growth by WB and IEA
- Academic literature
- Honduras-specific reports
- Household-level surveys (Honduras MTF)
Calculating Benefits

- **Lighting expenditures**: Reduction in kerosene consumption multiplied by price of kerosene in Haiti or Honduras
- **Emissions**: Changes in emissions ($\text{CO}_2$, bc, $\text{CH}_4$, CO, $\text{N}_2\text{O}$, oc) converted to global warming potential (Jeuland et al., 2018)
- **Cell phone charging**: Changes in expenditures on cell phone charging outside the home
- **Study time**: Changes in time allocation for studying
- **Asset ownership**: Estimated consumer surplus associated with owning radios, fans, televisions, and refrigerators
Monetizing Benefits

- **Already in monetary terms**: lighting, cell phones, asset ownership
- **Emissions**: valued using the social cost of carbon
- **Study time**: valued using half the unskilled minimum wage rate
Haiti

Figure: Basic EAD for Haiti
Figure: Basic EAD for Honduras
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Process</th>
<th>Time Frame</th>
<th>Policy Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal tier 5 electrification</td>
<td>All households transition to tier 5 immediately</td>
<td>2016-2050</td>
<td>Universal grid coverage</td>
</tr>
<tr>
<td>Universal tier 3 electrification</td>
<td>All households transition to tier 3 immediately; households in tiers 3, 4, and 5 at baseline remain in original tiers</td>
<td>2016-2050</td>
<td>Microgrid and renewable expansion</td>
</tr>
<tr>
<td>Hybrid tier 3 or 5 electrification</td>
<td>All households in rural areas below tier 3 transition to tier 3 immediately; all households in urban areas below tier 5 transition to tier 5 immediately</td>
<td>2016-2050</td>
<td>Combination of grid, microgrid, and renewable expansion</td>
</tr>
</tbody>
</table>
EAD: Scenario 1

Figure: Extended EAD for Honduras: Scenario 1
EAD: Scenario 2

Figure: Extended EAD for Honduras: Scenario 2
Figure: Extended EAD for Honduras: Scenario 3
### Summary of results

**Table:** Summary of results

<table>
<thead>
<tr>
<th></th>
<th>Basic EAD</th>
<th></th>
<th>Extended EAD</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scenario 1</td>
<td>Scenario 2</td>
</tr>
<tr>
<td>Haiti</td>
<td>422.5 (1814, 781.7)</td>
<td></td>
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</tr>
<tr>
<td>Honduras</td>
<td>54.2 (112.5, 75)</td>
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</table>

Results reported as present value discounted at 12% (undiscounted, discounted at 5%).

All results in millions of US dollars.

**Key shortcomings:**

- Lack of inclusion of costs
- Additional benefits not valued
Policy Applications

- Electricity transition pathways should consider both the extensive and intensive margins of electricity access
  - Implications for technology options
  - Implications for hard-to-reach areas
- EAD provides guidance on the relative gains of extending basic access to more people versus enhancing the access of those already served
- EAD estimates can be incorporated into planning in other sectors and for development goals
The Energy Access Dividend in Latin America

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Global Energy Access

Haiti and Honduras

**Figure:** Global access to electricity