Roadmap of GEA Chapter on Energy Access for Development

Chapter 2: Energy and Society
- Linkages between energy access, human wellbeing and the environment
- Importance of energy access to poverty reduction and development

Chapter 3: Energy and Environment

Chapter 4: Energy and Health
- Historical Trends in improving access and current status of access across regions for
  * Electricity
  * Clean Cooking/Heating

Africa
- Regional Efforts
  - Asia
  - Latin America

Conclusions (19.4)

Chapter 10: Energy End-Use: Buildings

Chapter 17: Energy Pathways for Sustainable Development

Chapter 18: Urban Energy Systems

Chapter 23: Policies for Energy Access

Chapter 25: Policies for Capacity Development

Chapter 19, #1

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Energy Access for Development

People Living in Poverty - Lack of Access to Electricity and Modern Fuels

<table>
<thead>
<tr>
<th>Category</th>
<th>Year</th>
<th>Millions of People</th>
</tr>
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<tbody>
<tr>
<td>&lt;$2 a day</td>
<td>1993</td>
<td>2900</td>
</tr>
<tr>
<td>No electricity</td>
<td>1990</td>
<td>2000</td>
</tr>
<tr>
<td>&lt;$1.25 a day</td>
<td>1993</td>
<td>1100</td>
</tr>
<tr>
<td>&lt;$2 a day</td>
<td>2002</td>
<td>2500</td>
</tr>
<tr>
<td>No modern fuels</td>
<td>2005</td>
<td>1500</td>
</tr>
<tr>
<td>No electricity</td>
<td>2005</td>
<td>1500</td>
</tr>
<tr>
<td>&lt;$1.25 a day</td>
<td>2002</td>
<td>1000</td>
</tr>
</tbody>
</table>
Energy Access for Development

Population without Access to Electricity in Households

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
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<th>Urban</th>
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<tbody>
<tr>
<td>1970</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1990</td>
<td></td>
<td></td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td>1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030 with no new policies</td>
<td>0.7</td>
<td>0.9</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Latin America
- Asia
- Africa
Population Dependent on Solid Fuels

- Africa
- India
- China
- Indonesia
- Rest of Asia
- Latin America

Population in billions relying on solid fuels:

- 2000: [Proportional bars]
- 2010: [Proportional bars]
- 2030 with no new policies: [Proportional bars]

Chapter 19, #4
Historical Experience with Household Electrification

- USA
- Mexico
- Mauritius
- China
- Brazil
- Thailand
- India
- UK
- Egypt
- South Africa

Percentage population with electricity access

- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

Year:
- 1910
- 1920
- 1930
- 1940
- 1950
- 1960
- 1970
- 1980
- 1990
- 2000
- 2010

Chapter 19, #5
Change in Population and Electrified Population by Region

- Latin America
- Middle East and North Africa
- Sub-Saharan Africa
- South Asia
- Pacific Asia + Centrally Planned Asia and China

- Total Population Increase 1970-1990
- Total Population Increase 1990-2008
- Rural Electrification Rate in 2008
- Incremental Population Electrified 1990-2008
Rural Population Density

The map illustrates the rural population density in units of people per square kilometer across different regions of the world. The colors and shades represent the population density ranges, from 1 to 1,000 people per square kilometer, with a special notation for areas without recorded data (N/A). Additionally, the map indicates the percentage of rural population without access to electricity in developing regions, sourced from the International Energy Agency (IEA).
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Changes in Residential Electricity Consumption and Access

- **World average 2004**
- **World average 1980**

Circle sizes represent total population

- North Africa
- Latin America
- Former USSR & Europe
- Sub-Saharan Africa
- East Asia/China
- OECD
- South Asia
- Middle East

Mean residential electricity consumption per electrified inhabitant in kWh

Range 1980

Range 2004

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Effective Costs for Lighting Services

- Kerosene, disposables
- Solar home systems
- Micro utility
- Traditional utility

High benefit/cost for user: 2
Attractive to utility: 50

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- Paraffin Candles
- Kerosene Wick
- Kerosene Pressure
- Incandescent 40 Watts
- Incandescent 100 Watts
- CFL Phillips 15 Watts
- Fluorescent 20 Watts
- Fluorescent 40 Watts

Kilolumen Hours per kWh
Energy Access for Development

Structure of Final Residential Fuels

Latin America
Middle East
North Africa
Sub-Saharan Africa
South Asia
East Asia & China
OECD & Transition

Coal
Charcoal
Primary Solid Biomass
Kerosene
LPG
Natural Gas

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Selected Data on Time Spent in Wood Collection

- Tanzania
- Bangladesh
- Ethiopia
- Malawi
- Nepal
- Northern Kenya
- South Africa
- Zimbabwe

Maximum Hours/Day

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Chapter 19, #13
Changes in the Number of People Relying on Biomass

Population in Millions Dependent on Biomass

- Sub-Saharan Africa
- Rest of Developing Asia
- India
- China
- Indonesia
- Latin America & Caribbean
- North Africa & Middle East

Percentage

2000 vs. 2009

Energy Access for Development
Growth in Agricultural Mechanization

- **Agricultural Tractors per 1000 Hectares**
- **Arable Land**

- **Africa**
- **South America**
- **Eastern Asia**
- **Southern Asia**
- **South-Eastern Asia**

- **1961**
- **1971**
- **1981**
- **1991**
- **2001**
Mechanical Power Ladder

- Human Power
- Animal Power
- Renewable / Natural Power
- Mechanical Power from Fuels
- Electrical Power

Increasing flexibility, convenience and technical complexity

Increasing prosperity and development
Various costs per kW installed for rural hydro schemes

US$ / kW installed

Electrical Power

Mechanical Power

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Access to Electricity and Modern Cooking Fuels in North Africa

Chapter 19, #18

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Evolution of the Rural Electrification Rate in Morocco, 1995–2009
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Share of Population with Access to Modern Fuels, West and Central Africa

- Mali: 0%
- Central African Republic: 1%
- Guinea: 1%
- Guinea-Bissau: 1%
- Niger: 1%
- Sierra Leone: 1%
- Chad: 2%
- Togo: 2%
- Gambia: 5%
- Benin: 6%
- Burkina Faso: 7%
- Ghana: 12%
- Cote d'Ivoire: 14%
- Congo: 17%
- Cameroon: 21%
- Nigeria: 24%
- Senegal: 41%
- Cape Verde: 63%
Average Household Energy Demand by Energy Type in China

- Gas and Petroleum products
- Coal
- Electricity
- Crop residues
- Fuelwood

GJ/capita

<table>
<thead>
<tr>
<th>Year</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
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<tr>
<td>1990</td>
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</tr>
<tr>
<td>1995</td>
<td></td>
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</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Progress with Electrification in India According to Different Indicators

- % Villages electrified
- % Total households electrified
- % Urban population electrified
- % Rural population electrified
- No. of domestic connections

Energy Access for Development
Status of Electrification and Dependence on Solid Fuels

- Population Using Modern Fuels (Total)
- Urban Electricity Access
- Rural Electricity Access

Countries included:
- Viet Nam
- Thailand
- Sri Lanka
- Philippines
- Pakistan
- Nepal
- Myanmar
- Mongolia
- Maldives
- Malaysia
- Laos PDR
- Indonesia
- Cambodia
- Brunei Darussalam
- Bhutan
- Bangladesh
- Afghanistan
Relationship between Residential Energy Use and HDI

- Kgoe/person, residential sector, consumption excluding firewood
- HDI
- Log. (Kgoe/person residential excluding firewood)

Countries included: Guatemala, Bolivia (Plur. State of), Honduras, Nicaragua, El Salvador, Paraguay, Ecuador, Peru, Dominican Republic, Colombia, Brazil, Panama, Costa Rica, Uruguay, Chile, Argentina.

Graph shows a linear relationship between residential energy use (Kgoe/person) and HDI, with countries plotted according to their respective values.
Chapter 19, #27

Access to Electricity in Urban and Rural Areas
Differences in Access and Use across Income Quintiles

- Average difference in access to electrical equipment and communications
- Residential energy use per person (excluding firewood, in Kgoe/person)
- Expon. (Residential energy use per person (excluding firewood, in Kgoe/person))
- Expon. (Average difference in access to electrical equipment and communications)
Chapter 19, #29

Evolution of Firewood Consumption - South American Household Sector

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Population Without Access to Electricity in Rural Areas of Central America

- Costa Rica
- El Salvador
- Guatemala
- Honduras
- Nicaragua
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© Yu Nagai, Shonali Pachauri, Keywan Riahi (2011)

Cumulative financing required till 2030 to provide access to clean cooking fuels and devices and costs for rural electrification [in billion 2005US$]

Average annual premature deaths avoided from household air pollution [in million]