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Energy Development Council, Nepal

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• Overview of energy sector
• Sectoral Interventions/Assumptions
• Scenario Results and Impacts
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Overview of energy sector
Per Capita Electricity Consumption in 2015

Norway: 23,656 kWh/capita

Key World Energy Statistics, IEA, 2017
Fuel mix 2015

- Biomass: 76%
- Petroleum products: 13%
- Coal: 5%
- Renewables: 3%
- Electricity: 3%

Total energy: 475 PJ


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Sectoral Energy 2015

- Residential: 80%
- Industry: 8%
- Agriculture: 1%
- Other: 0.30%
- Transport: 7%
- Commercial: 4%

Total: 475 PJ

Fuel Mix in the petroleum products

2004
- Kerosene: 36%
- Diesel: 34%
- Petrol: 8%
- LPG: 14%
- FO: 1%
- Av. Fuel: 7%
- Total: 876,000 kl

2016
- Diesel: 52%
- LP Gas: 26%
- Petrol: 16%
- Aviation: 5%
- Kerosene: 1%
- Total: 1,517,158 kl

Source: MOF, 2017
Primary data results in Kathmandu Households in 2014

Final Energy Share by Fueltype:
- Electricity: 30%
- LPG: 46%
- Solar: 3%
- Biomass: 19%
- Animal Waste: 0.32%
- Biogas: 0.21%
- Briquette: 0.11%
- Wax: 2%
- Kerosene: 0.26%

Final Energy Share by Enduse:
- Cooking: 69%
- Other Electric appl.: 17%
- Lighting: 6%
- Water Heating: 4%
- Room Heating: 4%
- Room Cooling: 0.24%

Total: 7,400 TJ

(Nakarmi and Rajbhandari, 2015)
Sales of Petroleum Products (kL)

Decade (2007-2017) long annual growth rate: Petrol 15%; Diesel 16%; Aviation fuel 10%; Kerosene -21%; Overall 11%
Penetration and Sales of LPG

Penetration of LPG in remote rural areas as well.

CAGR of LPG imports: 17%; Doubling every 5 years
Historical trend of Petro Imports vs. Goods Exports

(Source: MOF, 2017; NOC, 2017)
Fuel economics in urban/rural areas (cost of cooking/month for a household of 5 members) \textit{with electricity tariff increased by 20% since Aug 2016}

<table>
<thead>
<tr>
<th>Year</th>
<th>Kerosene stoves</th>
<th>LPG stoves</th>
<th>Electric hotplates</th>
<th>Biogas cook stoves*</th>
<th>Traditional fuel-wood stoves/rural</th>
<th>Traditional fuel stoves/KTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>270</td>
<td>430</td>
<td>680</td>
<td>320</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>340</td>
<td>535</td>
<td>790</td>
<td>320</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>1,760</td>
<td>1,082</td>
<td>960</td>
<td>1,120</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>1,354</td>
<td>1,212**</td>
<td>1,114</td>
<td>1,120</td>
<td>780</td>
<td>1,530</td>
</tr>
</tbody>
</table>

*: the cost is without subsidy for biogas plant of capacity 6 cu m

**: Household has 2 cylinders in use and it includes capital cost of them (loss of NR 208/cyl: 18/01/2018, NOC)

For induction heater NPR 990
Sectoral Policy Intervention

Policy Intervention in Energy Sector

Agriculture - Electrification
Commercial - Electrification
Industrial - Electrification
Residential - Electrification
Transportation - Mass Transportation

-Efficient Technology
-Efficiency Improvement
-Efficiency Improvement

-Biofuels

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## Strategy Matrix

<table>
<thead>
<tr>
<th>Agricultural Sector</th>
<th>Strategic Options</th>
<th>2015 status</th>
<th>Target by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non emissive devices for agricultural activities</td>
<td>• 20% water pumping by electricity</td>
<td>• 50% water pumping by electricity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1% electricity operated farm machineries</td>
<td>• 25% electricity operated farm machineries</td>
</tr>
<tr>
<td></td>
<td>Commercial Sector</td>
<td>• 5% electricity penetration</td>
<td>• 100% penetration of electrical technologies in all end-uses.</td>
</tr>
<tr>
<td></td>
<td>Industrial Sector</td>
<td>• 50% electrification in other uses in mechanical engineering and manufacturing industries.</td>
<td>• 100% electric motive power devices.</td>
</tr>
<tr>
<td></td>
<td>Replace non-electric devices with electric devices</td>
<td>• 0% Electric boilers</td>
<td>• 50% electrification in other uses in mechanical engineering and manufacturing industries.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 100% electric lighting.</td>
<td>• 50% Electric boilers</td>
</tr>
<tr>
<td></td>
<td>Efficiency</td>
<td></td>
<td>• 100% electric lighting by CFL and LED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 50% Electric boilers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 100% electric lighting by CFL and LED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 35-40% efficiency improvement of current efficiency in process heat technology</td>
</tr>
</tbody>
</table>

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### Residential Sector

<table>
<thead>
<tr>
<th>Strategic Options</th>
<th>2015 status</th>
<th>Target by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Electrification in urban Area</td>
<td>• 12.8% cooking by electricity in urban</td>
<td>• 100% electrical cooking technology</td>
</tr>
<tr>
<td>• Increase access to modern fuel cooking technology in rural area</td>
<td>• 18.3% improved cooking stoves and 27% biogas</td>
<td>• 70% improved cooking stoves in rural area, 15% electric cooking devices, 5% LPG stoves, 10% biogas source for cooking purpose</td>
</tr>
<tr>
<td>• Phase out non-electric lighting sources.</td>
<td>• 3.6% LPG and 1% Electric cooking devices in rural</td>
<td>• 100% lighting by electricity (LED)</td>
</tr>
</tbody>
</table>

### Transport Sector

<table>
<thead>
<tr>
<th>Intracity</th>
<th>30% intracity share by bus</th>
<th>39% intracity electric bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Efficient means of transportation</td>
<td>• 19% transportation share by bus</td>
<td>• 5% share of electric car</td>
</tr>
<tr>
<td>• Electrify transport sector.</td>
<td>• 48% share by motorcycle</td>
<td>• 20% share of Ethanol mix in gasoline.</td>
</tr>
<tr>
<td>• Introduce bio-fuels (Ethanol and Bio-diesel) .</td>
<td>• 9% share by car/jeep/Van</td>
<td>10% share of Bio-diesel in total diesel mix.</td>
</tr>
<tr>
<td></td>
<td>• 15% Mini-bus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 3% micro bus</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Transport Modal Mix (Intracity Passenger-km)

Reference Case in 2015
- Motorcycle: 48%
- Bus: 19%
- Mini bus: 15%
- Micro Bus: 3%
- Three Wheeler: 5%
- Car Gasoline: 8%
- Car Diesel: 2%

Policy case 2030
- Electric Bus: 37%
- Electric Car: 5%
- Car Gasoline: 5%
- Car Diesel: 2%
- Ropeway: 1%
- Mono Rail: 2%
- Bus: 30%
- Motorcycle: 10%
- Mini bus: 5%
Overall Scenario Result

Energy Mix
GHG emissions
Power Plant Requirements
Sectoral Energy Mix in 2030

Reference scenario:
- Residential: 59% (646 PJ)
- Industrial: 17% (17% of Residential)
- Transport: 14% (14% of Residential)
- Agriculture: 2% (2% of Residential)
- Commercial: 8% (8% of Residential)

Policy scenario:
- Residential: 53% (376 PJ)
- Industrial: 23% (23% of Residential)
- Transport: 17% (17% of Residential)
- Agriculture: 3% (3% of Residential)
- Commercial: 4% (4% of Residential)

• 42% reduction of energy consumption in policy scenario
Energy Balance in Reference Scenario in 2030
(E- Sankey Diagram)

646 PJ
Energy Balance in Policy Scenario in 2030 (E-Sankey Diagram)

376 PJ
Energy Demand and Fuel Mix

<table>
<thead>
<tr>
<th>Fuels mix in policy scenario</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>3%</td>
<td>10%</td>
<td>20%</td>
<td>37%</td>
<td>49%</td>
<td>58%</td>
</tr>
<tr>
<td>Biomass</td>
<td>76%</td>
<td>66%</td>
<td>53%</td>
<td>35%</td>
<td>19%</td>
<td>8%</td>
</tr>
<tr>
<td>Petroleum products</td>
<td>13%</td>
<td>17%</td>
<td>19%</td>
<td>20%</td>
<td>24%</td>
<td>26%</td>
</tr>
<tr>
<td>Coal</td>
<td>5%</td>
<td>5%</td>
<td>6%</td>
<td>7%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Renewables</td>
<td>3%</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

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# Fuel Mix in Policy scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>Traditional solid fuels (%)</th>
<th>Modern energy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>77</td>
<td>23</td>
</tr>
<tr>
<td>2020</td>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>2025</td>
<td>53</td>
<td>47</td>
</tr>
<tr>
<td>2030</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>2040</td>
<td>19</td>
<td>81</td>
</tr>
<tr>
<td>2050</td>
<td>8</td>
<td>92</td>
</tr>
</tbody>
</table>

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GHGs emission (100 year GWP)

- Policy Scenario:
  - 2015: 11
  - 2020: 11
  - 2025: 10
  - 2030: 9
  - 2040: 12
  - 2050: 17

- Reference Scenario:
  - 2015: 11
  - 2020: 13
  - 2025: 16
  - 2030: 20
  - 2040: 32
  - 2050: 54

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Capacity Requirement in MW

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Scenario</td>
<td>856</td>
<td>4,526</td>
<td>8,056</td>
<td>12,736</td>
<td>20,076</td>
<td>32,516</td>
</tr>
<tr>
<td>Reference Scenario</td>
<td>856</td>
<td>2,186</td>
<td>2,876</td>
<td>4,476</td>
<td>6,736</td>
<td>12,056</td>
</tr>
</tbody>
</table>
Capacity Requirement in MW

- Grid electricity includes solar PV system of 2,100 MW from 2030
- Off Grid electricity includes solar home system and micro-hydro
Per capita Electricity Consumption

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Capacity Requirement in MW

<table>
<thead>
<tr>
<th>Branches</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower</td>
<td>802</td>
<td>4,222</td>
<td>7,502</td>
<td>10,582</td>
<td>17,922</td>
<td>30,362</td>
</tr>
<tr>
<td>Solar PV System</td>
<td>0</td>
<td>250</td>
<td>500</td>
<td>2,100</td>
<td>2,100</td>
<td>2,100</td>
</tr>
<tr>
<td>Thermal plant</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>856</strong></td>
<td><strong>4,526</strong></td>
<td><strong>8,056</strong></td>
<td><strong>12,736</strong></td>
<td><strong>20,076</strong></td>
<td><strong>32,516</strong></td>
</tr>
</tbody>
</table>

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## Benefit –Cost Analysis

<table>
<thead>
<tr>
<th></th>
<th>Benefit (Million NRs.)</th>
<th>Cost (Million NRs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Sector</td>
<td>-</td>
<td>35,540</td>
</tr>
<tr>
<td>Electricity Generation</td>
<td>-</td>
<td>973,303</td>
</tr>
<tr>
<td>Fuel/resources</td>
<td>2,937,733</td>
<td>-</td>
</tr>
<tr>
<td>Carbon Trade</td>
<td>38,955</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,976,688</strong></td>
<td><strong>1,008,843</strong></td>
</tr>
</tbody>
</table>

### Benefit-Cost

<table>
<thead>
<tr>
<th></th>
<th>B-C</th>
<th>1,967,845 million NPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/C</td>
<td></td>
<td>2.95</td>
</tr>
</tbody>
</table>

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Conclusion

- Nepal’s Energy Policy should focus on
  - Electrification in all economic sectors through harnessing renewable energy
  - Substituting use of fossil fuels by electricity and electricity market development
  - Modern Energy Access to all by 2030
  - Strong institutional set-up for development of renewable energy in an integrated way
  - Development of financial mechanism/incentives for investment in power sector

- Nepal’s economy will be strengthened only through sustainable energy development and energy security

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THANK YOU !!!

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