CANADA’S ALLIANCE FOR DECENTRALIZED ENERGY

DE Economic Analysis
Two Canadian Case Studies 2006

A Multi-Client Study Coordinated by NewERA

5TH ANNUAL
DECENTRALISED ENERGY
CONFERENCE
September 7, 2006

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Portfire Associates

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Emerging Energy Options
Two Canadian Case Studies

- **City of Calgary** – One of the fastest growing population centres in Canada, with a need to address generation capacity options and transmission upgrade requirements (growth rate of ~2.6% annually)

- **Province of Ontario** - The combination of demand growth (0.9% annually, peak growth at 1.3%) and generation retirements (coal and nuclear) could create a demand/supply gap of roughly 24,000 MW by 2025, equivalent to about 80% of Ontario’s current capacity.
WADE Economic Model

- Comparison of the performance of Central Generation (CG) and Decentralized Energy (DE) in meeting future electricity demand growth
- Outputs
  - Total capital costs
  - Delivered electricity costs
  - Environmental impact
- The WADE model has been applied in the UK, Ireland, Portugal, the European Union, China, Nigeria, Australia and the United States
Project Overview

- Calgary and Ontario
- Significant amount of data from many sources:
  - Electricity supply demand trends
  - Capital and operating costs
  - Transmission and distribution costs and line losses
  - Fuel costs
  - Heat rates
  - Air emissions and GHG factors
- Modifications to the computer model
# Alberta Internal Load - Technology

<table>
<thead>
<tr>
<th>2005</th>
<th>Maximum Capacity (MW)</th>
<th>Percent</th>
<th>Generation (GWh)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>5,840.0</td>
<td>51.2%</td>
<td>43,905.7</td>
<td>66.3%</td>
</tr>
<tr>
<td>Gas Cogen</td>
<td>3,214.0</td>
<td>28.2%</td>
<td>14,249.5</td>
<td>21.5%</td>
</tr>
<tr>
<td>Gas &amp; Oil</td>
<td>794.0</td>
<td>7.0%</td>
<td>3,520.3</td>
<td>5.3%</td>
</tr>
<tr>
<td>CCGT</td>
<td>250.0</td>
<td>2.2%</td>
<td>1,108.4</td>
<td>1.7%</td>
</tr>
<tr>
<td>Hydro</td>
<td>869.0</td>
<td>7.6%</td>
<td>2,323.4</td>
<td>3.5%</td>
</tr>
<tr>
<td>Wind</td>
<td>255.0</td>
<td>2.2%</td>
<td>764.0</td>
<td>1.2%</td>
</tr>
<tr>
<td>Biomass</td>
<td>177.5</td>
<td>1.6%</td>
<td>373.1</td>
<td>0.6%</td>
</tr>
<tr>
<td>Others</td>
<td>8.5</td>
<td>0.1%</td>
<td>21.7</td>
<td>0.0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11,408.0</td>
<td>100.0%</td>
<td>66,266.0</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Decentralized Energy Technologies

- 100 kW to 10 MW CHP gas turbines and internal combustion engines in local manufacturing plants and industrial locations
- Small CHP systems in the 30 to 100 kW range (microturbines, etc) for institutions such as hospitals, apartment buildings and grocery stores
- 1 to 30 kW units for residential buildings
- Substation peaker plants to provide peak power
Transmission

- Transmission losses: 5%
- Transmission costs:
  - New line between Edmonton and Calgary: $488/kW
  - New line between Alberta and Montana: $400/kW
  - IEA/WADE average for U.S. and Canada: $384/kW
  - Average used in the study: $436/kW
Distribution

- Distribution losses: 3%
- Distribution costs:
  - Average of ENMAX 2005 and 2006 capital expenditures for new distribution: $1,885/kW
Modelling Results

- Electricity demand increases from 8,286 GWh per year to 12,973 GWh in year 20 (2025) on the basis of an annual growth rate of 2.3% per year.
- Peak capacity in 2025 is calculated to be 2,710 MW based on a peak growth rate of 2.6% per year.
- Using 100% CG: 1,392 MW of new generation capacity is required.
- Using 100% DE: 1,302 MW of new capacity is needed.
## CG or DE Outcomes

<table>
<thead>
<tr>
<th></th>
<th>100% CG</th>
<th>75% CG 25% DE</th>
<th>50% CG 50% DE</th>
<th>25% CG 75% DE</th>
<th>100% DE</th>
<th>Max DE Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost (CA$ billion)</td>
<td>4.7</td>
<td>4.3</td>
<td>3.9</td>
<td>3.6</td>
<td>3.6</td>
<td>22%</td>
</tr>
<tr>
<td>Cost (CA¢ / kWh)</td>
<td>11.7</td>
<td>11.4</td>
<td>11.1</td>
<td>10.8</td>
<td>11.1</td>
<td>8%</td>
</tr>
<tr>
<td>NO(_x) (kT)</td>
<td>2.82</td>
<td>2.56</td>
<td>2.29</td>
<td>2.04</td>
<td>1.79</td>
<td>37%</td>
</tr>
<tr>
<td>SO(_2) (kT)</td>
<td>2.08</td>
<td>1.56</td>
<td>1.05</td>
<td>0.55</td>
<td>0.02</td>
<td>99%</td>
</tr>
<tr>
<td>PM10 (kT)</td>
<td>0.38</td>
<td>0.30</td>
<td>0.23</td>
<td>0.16</td>
<td>0.08</td>
<td>79%</td>
</tr>
<tr>
<td>CO(_2) (MT)</td>
<td>3.53</td>
<td>3.03</td>
<td>2.53</td>
<td>2.04</td>
<td>1.52</td>
<td>57%</td>
</tr>
</tbody>
</table>
Cost Analysis

- DE has higher unit capital costs than CG, but less DE capacity is required than CG because of the avoidance of line losses.
- However this is balanced by the higher cost of capital for DE.
- DE has less T&D costs than CG because DE is located closer to the load.
- DE has higher fuel costs because natural gas is more costly than coal.
- If DE requires 10% of the distribution infrastructure, the cost of delivered electricity could be reduced by $0.033/kw or 28%.
Capital Costs for Incremental 20 Year Demand

- **100% CG / 0% DE**
  - Investment in New Distribution: 2.31
  - Investment in New Transmission: 0.61
  - Investment in New Central Generation: 1.73

- **75% CG / 25% DE**
  - Investment in New Distribution: 2.24
  - Investment in New Transmission: 0.42
  - Investment in New Central Generation: 1.31

- **50% CG / 50% DE**
  - Investment in New Distribution: 2.14
  - Investment in New Transmission: 0.66
  - Investment in New Central Generation: 0.88

% of New Generation

- **100% CG / 0% DE:** 0.25
Delivered Costs per kWh for Incremental Year 20 Demand

- Operations & Maintenance
- Fuel
- Generation
- CO2 Cost
- Transmission
- Distribution

CA cents/kWh

100% CG / 0% DE
1.88
3.46
3.25
2.44
0.86

75% CG / 25% DE
1.90
3.64
3.15
2.51
0.59

50% CG / 50% DE
1.92
3.82
3.00
2.58
0.35

% of New Generation
Emissions

- In this study, DE is primarily based on natural gas and displaces CG that has an important coal component.
- Therefore, increased DE use results in reduced emissions of NO\textsubscript{x}, SO\textsubscript{x}, PM10 and CO\textsubscript{2}.
Conclusions

- DE technologies could reduce capital and delivered costs of electricity while reducing emissions.
- Most of the cost savings arise from less transmission and distribution infrastructure.
- Further studies should focus on:
  - Quantifying benefits of the best DE applications
  - Capturing the thermal side of CHP technologies
  - The potential for additional distribution capital cost savings.
DE Economic Analysis
Ontario Case Study

Mark Tinkler
Emerging Energy Options
Ontario Case Study: Objectives

- Test the performance of the WADE Economic Model against the thorough Central Generation (CG) analysis provided by the Ontario Power Authority’s (OPA) Supply Mix Advice Report
  - “calibrate” the WADE Model against detailed modeling work done specifically for the Ontario situation

- Utilize the WADE Model to extend the OPA analysis to consider in greater detail the potential benefits of an energy supply scenario with significant amounts of DE
Ontario Case Study: Methodology

1. Input the current (2005) energy supply mix in Ontario: capacity (MW), energy (TWh), associated Load Factors.

2. Select an energy supply Portfolio from the OPA Report and adjust CG growth characteristics (Input data for the Model) until the generation supply mix for 2025 (Output data) resembles that of the selected Portfolio.

3. Incorporate all relevant assumptions of the OPA study, eg: load growth rates, capacity retirements, operating costs for new generation, financing assumptions, fuel costs, generation emissions characteristics.

4. Run the Model and compare the resulting CG output characteristics (eg capital costs, emissions) against similar Supply Mix results for the Portfolio selected.
Ontario Case Study: Methodology (2)

5. Develop a “DE Future” scenario that envisions a reasonable mix of distributed generation supply. Adjust the Model’s DE growth characteristics (Input data for the Model) until the generation supply mix for 2025 (Output data) resembles that of the proposed DE scenario.

6. Obtain from appropriate sources other needed information eg: typical T&D costs, average and peak T&D losses, as well as small-scale (DE) generation capital/operating costs and emissions characteristics.

7. Assess the Model’s output results - a detailed comparison of capital costs (capacity and T&D), electricity retail cost (c/kWh), and emissions characteristics for various levels of CG vs DE to 2025.
## Current Energy Supply Mix

**Ontario Generation Supply Mix, 2005**

<table>
<thead>
<tr>
<th>Source</th>
<th>Total Capacity (MW)</th>
<th>Percent of Capacity (%)</th>
<th>Generation (TWh)</th>
<th>Percent of Generation (%)</th>
<th>Avg. Load Factor (calc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>6,434</td>
<td>21</td>
<td>30</td>
<td>19</td>
<td>53.2%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>11,397</td>
<td>37</td>
<td>79</td>
<td>51</td>
<td>79.1%</td>
</tr>
<tr>
<td>Gas (&amp; Oil)</td>
<td>4,976</td>
<td>17</td>
<td>12</td>
<td>7.5</td>
<td>27.5%</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>7,756</td>
<td>25</td>
<td>34</td>
<td>22</td>
<td>50.0%</td>
</tr>
<tr>
<td>Wind, Biomass</td>
<td>68</td>
<td>&lt;&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>30,631</strong></td>
<td><strong>100</strong></td>
<td><strong>156</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

Selected OPA Supply Mix Portfolio

Portfolio 1A – Default Scenario, Nuclear Growth

Source: OPA Supply Mix Advice Report, Nov 2005
## Matching CG Growth Characteristics

<table>
<thead>
<tr>
<th>CG Type</th>
<th>OPA Portfolio 1A New Additions by 2025 (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas CC CHP &gt;50MW</td>
<td>1000</td>
</tr>
<tr>
<td>Gas CC (CCGT)</td>
<td>5000</td>
</tr>
<tr>
<td>Hydro Central</td>
<td>1200</td>
</tr>
<tr>
<td>Wind - Onshore</td>
<td>5000</td>
</tr>
<tr>
<td>Bioenergies</td>
<td>300</td>
</tr>
<tr>
<td>Nuclear</td>
<td>12382</td>
</tr>
<tr>
<td>Interconnector (Import)</td>
<td>1250</td>
</tr>
<tr>
<td>Coal Gasification</td>
<td>250</td>
</tr>
<tr>
<td>Gas CT (Peaker)</td>
<td>1520</td>
</tr>
<tr>
<td><strong>Total New Additions</strong></td>
<td><strong>27902</strong></td>
</tr>
</tbody>
</table>
### Matching CG Growth Characteristics

<table>
<thead>
<tr>
<th>CG Type</th>
<th>OPA Portfolio 1A New Additions by 2025 (MW)</th>
<th>WADE Model New Additions by 2025 (MW)</th>
<th>Differences (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas CC CHP &gt;50MW</td>
<td>1000</td>
<td>1032</td>
<td>+ 32</td>
</tr>
<tr>
<td>Gas CC (CCGT)</td>
<td>5000</td>
<td>5053</td>
<td>+ 53</td>
</tr>
<tr>
<td>Hydro Central</td>
<td>1200</td>
<td>1216</td>
<td>+16</td>
</tr>
<tr>
<td>Wind - Onshore</td>
<td>5000</td>
<td>5140</td>
<td>+140</td>
</tr>
<tr>
<td>Bioenergies</td>
<td>300</td>
<td>335</td>
<td>+ 35</td>
</tr>
<tr>
<td>Nuclear</td>
<td>12382</td>
<td>12087</td>
<td>-295</td>
</tr>
<tr>
<td>Interconnector (Import)</td>
<td>1250</td>
<td>1288</td>
<td>+ 38</td>
</tr>
<tr>
<td>Coal Gasification</td>
<td>250</td>
<td>286</td>
<td>+ 36</td>
</tr>
<tr>
<td>Gas CT (Peaker)</td>
<td>1520</td>
<td>1549</td>
<td>+ 29</td>
</tr>
<tr>
<td><strong>Total New Additions</strong></td>
<td><strong>27902</strong></td>
<td><strong>27986</strong></td>
<td><strong>+ 84</strong></td>
</tr>
</tbody>
</table>
Comparing CG Output Characteristics

<table>
<thead>
<tr>
<th>CG Category</th>
<th>OPA Portfolio 1A Electricity Supply in 2025 (TWh)</th>
<th>WADE Model Electricity Supply in 2025 (TWh)</th>
<th>Differences (TWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>89</td>
<td>90.6</td>
<td>+ 1.6</td>
</tr>
<tr>
<td>Gas-Fired</td>
<td>11</td>
<td>26.1</td>
<td>+ 15.1</td>
</tr>
<tr>
<td>Renewables</td>
<td>77</td>
<td>60.9</td>
<td>- 16.1</td>
</tr>
<tr>
<td>Total</td>
<td>179*</td>
<td>179.4*</td>
<td>+ 0.4</td>
</tr>
</tbody>
</table>

* Includes ~ 2 TWh from coal gasification, excludes CDM contribution
Comparing CG Output Characteristics (2)

Portfolio 1a Capital Expenditures, as Spent not Present Value ($billions, in 2006 dollars)

- Nuclear: 22.3
- Gas: 0.8
- Renewables: 0.2
- Gasification: 5.1
- CDM: 0.1
- Others: 10.3

$57.7 \text{ B}$

$68.3 - 5.1 \text{ (CDM)} = 63.2 \text{ B}$

WADE Model Result: Capital Investment for New CG
CO$_2$ Emissions for OPA Supply Mix Portfolios 1A and 1B

**Wade Model CO$_2$ Result**

11.4 Mt

Note: Greenhouse gases analyzed include carbon dioxide, methane and nitrous oxide

Source: OPA
Develop a “DE Future” Scenario

<table>
<thead>
<tr>
<th>DE Type</th>
<th>Total Capacity (MW)</th>
<th>Portion of DE Capacity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill gas non-CHP</td>
<td>150</td>
<td>5.9</td>
</tr>
<tr>
<td>Hydro (Local)</td>
<td>175</td>
<td>6.8</td>
</tr>
<tr>
<td>Gas micro-CHP</td>
<td>150</td>
<td>5.9</td>
</tr>
<tr>
<td>Solar (Local)</td>
<td>80</td>
<td>3.1</td>
</tr>
<tr>
<td>Gas CHP (Indust. Cogen)</td>
<td>550</td>
<td>21.5</td>
</tr>
<tr>
<td>Biomass CHP</td>
<td>350</td>
<td>13.7</td>
</tr>
<tr>
<td>Other FF CHP: Fuel Cell</td>
<td>400</td>
<td>15.7</td>
</tr>
<tr>
<td>Gas CHP (Engine CHeP)</td>
<td>350</td>
<td>13.7</td>
</tr>
<tr>
<td>Substation Peakers</td>
<td>350</td>
<td>13.7</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>2555</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
Ontario Model Results: Energy Supply, 2025

Energy Supply by Source, 2025 - CG/DE Options

- 28,000 MW (New Generation)
- 25,250 MW

GWh/Year:
- Total Coal Generation
- Total Natural Gas Generation
- Total Nuclear Generation
- Total Oil Generation
- Total Bioenergy generation
- Total Renewable Generation

- 100% CG / 0% DE
- 90% CG / 10% DE
- 75% CG / 25% DE
- 50% CG / 50% DE
- 0% CG / 100% DE
Ontario Model Results: Capital Costs to 2025

Total Capital Costs for New Additions to 2025

- $4.75 B

New Capital Investment (Billion CAN$)

- 100% CG / 0% DE
  - Investment in new Distr: 57.7
  - Investment in new Transm: 14.8
  - Investment in new DE: 20.0

- 90% / 10%
  - Investment in new Distr: 50.1
  - Investment in new Transm: 4.0
  - Investment in new DE: 5.5

- 75% / 25%
  - Investment in new Distr: 45.4
  - Investment in new Transm: 3.6
  - Investment in new DE: 3.0

- 50% / 50%
  - Investment in new Distr: 40.6
  - Investment in new Transm: 2.1
  - Investment in new DE: 1.0

- 0% CG / 100% DE
  - Investment in new Distr: 21.0
  - Investment in new Transm: 5.5
  - Investment in new DE: 5.5

Legend:
- Investment in new Distr
- Investment in new Transm
- Investment in new DE
- Investment in new central generation
Ontario Model Results: Retail Costs, 2025

Retail Costs per kWh for Incremental Year 20 Load

- Distrib Amortization
- Transm Amortization
- CO2 cost of New Capacity
- Capital Amortization + Profit On New Capacity
- Fuel
- O&M of New Capacity
Ontario Model Results: Annual CO$_2$ Emissions

Annual CO2 Emissions From Total Year 20 Load

<table>
<thead>
<tr>
<th>% DE of Total Generation</th>
<th>CO2 emitted for total CG</th>
<th>CO2 emitted for total DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% CG / 0% DE</td>
<td>11.4</td>
<td></td>
</tr>
<tr>
<td>90% / 10%</td>
<td>10.4</td>
<td>1</td>
</tr>
<tr>
<td>75% / 25%</td>
<td>7.5</td>
<td>2.5</td>
</tr>
<tr>
<td>50% / 50%</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>0% CG / 100% DE</td>
<td>0</td>
<td>28.0</td>
</tr>
</tbody>
</table>

Million Metric Tonnes/Year
Ontario Model Results: Other Emissions

Added Annual Pollutant Emissions from Generating Incremental Year
20 Electric Load

- PM10 Emission from New Generation
- NOx Emissions from New Generation
- SO2 Emissions from New Generation
Ontario Case Study: Summary

1) The WADE Model appears to calibrate well against the Central Generation (CG) analysis provided by the OPA’s Supply Mix Advice Report

2) The Model can effectively be used to consider in greater detail the potential benefits of an energy supply scenario with significant amounts of DE

3) First-run results confirm significant potential economic benefit with increasing DE, because of avoided T&D losses and reduced T&D requirements

4) Because of the nature of Ontario’s CG supply mix, increased DE is likely to result in somewhat higher emissions
Conclusions

- DE technologies could reduce capital and delivered costs of electricity and may reduce emissions.
- Most of the cost savings arise from less transmission and distribution infrastructure.
- Further studies should focus on:
  - Best DE applications
  - Thermal side of CHP technologies
  - Additional distribution capital cost savings.
Thank You

- Natural Resources Canada
- Ontario Power Generation
- Alberta Economic Development
- Government of the Northwest Territories
- Enbridge
- Fortis Alberta

- Alberta Electric System Operator
- Enmax
- Renewable Energy Solutions

Project Team:
- Bert Dreyer
- Marc Godin
- Anouk Kendall
- Mark Tinkler
Additional Slides
WADE Economic Model:
Inputs & Outputs

- Existing capacity and generation technology
- Current and future pollutant emissions by technology
- Current and future heat rates, fuel consumption and load factor by technology
- Current and future capital investment costs by technology and for T&D
- Current and future operations and maintenance (O&M) and fuel expenses by technology
- System growth properties
- Existing yearly capacity retirement by technology
- Future growth in capacity by technology

WADE Economic Model

- Capital Costs
- Retail Costs
- Fossil Fuel Use
- CO$_2$ and Pollutant Emissions
Alberta Internal Load Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Consumption (GWh)</th>
<th>Peak Demand (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>54,052</td>
<td>8,185</td>
</tr>
<tr>
<td>2002</td>
<td>59,428</td>
<td>8,570</td>
</tr>
<tr>
<td>2004</td>
<td>65,259</td>
<td>9,236</td>
</tr>
<tr>
<td>2006</td>
<td>69,453</td>
<td>9,974</td>
</tr>
<tr>
<td>2008</td>
<td>74,468</td>
<td>10,597</td>
</tr>
<tr>
<td>2010</td>
<td>77,136</td>
<td>11,002</td>
</tr>
<tr>
<td>2012</td>
<td>81,324</td>
<td>11,493</td>
</tr>
<tr>
<td>2014</td>
<td>84,059</td>
<td>11,946</td>
</tr>
<tr>
<td>Growth</td>
<td>3.4 %</td>
<td>2.9 %</td>
</tr>
</tbody>
</table>
# Calgary Electricity Demand Statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Delivered (GWh)</th>
<th>Peak Demand (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>7,747</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>8,044</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>8,479</td>
<td>1,527</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td>1,612</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td>1,700</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td>1,788</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td>1,868</td>
</tr>
<tr>
<td>Growth</td>
<td>2.3 %</td>
<td>2.6 %</td>
</tr>
</tbody>
</table>
Transmission and Distribution

- Full transmission costs were attributed to CG but none to DE.
- Full distribution costs were attributed to CG and DE.
- The likelihood that DE would have lower distribution costs than CG was explored, but facts were not available to perform a definite analysis.
Central Generation Technologies

- Three new 450 MW coal generation plants by 2015, similar to Genesee 3
- A total of 3,151 MW of oil sands related cogeneration facilities by 2015, of which 750 MW would be available for exports to the Alberta grid
- Increases in wind power, but at a slower pace; 400 MW of new capacity by 2015
- Balance of power requirement provided by natural gas simple and combined cycle turbines
Added Annual CO₂ Emissions for Incremental Year 20 Load

- CO₂ Emitted from Added CG
- CO₂ Emitted from Added DE

<table>
<thead>
<tr>
<th>% of New Generation</th>
<th>Million Metric Tonnes / Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% CG / 0% DE</td>
<td>3.5</td>
</tr>
<tr>
<td>75% CG / 25% DE</td>
<td>2.5</td>
</tr>
<tr>
<td>50% CG / 50% DE</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Added Annual Pollutant Emissions from Generating Incremental Year 20 Electric Load

- PM10 Emission from New Generation
- NOx Emissions from New Generation
- SO2 Emissions from New Generation

% of New Generation

100% CG / 0% DE

75% CG / 25% DE

50% CG / 50% DE

Thousand Metric Tonnes / Year