

**Integration Work Group  
Report to the Capacity Need  
Forum**

**September 29, 2005**

# Work Group Chairs

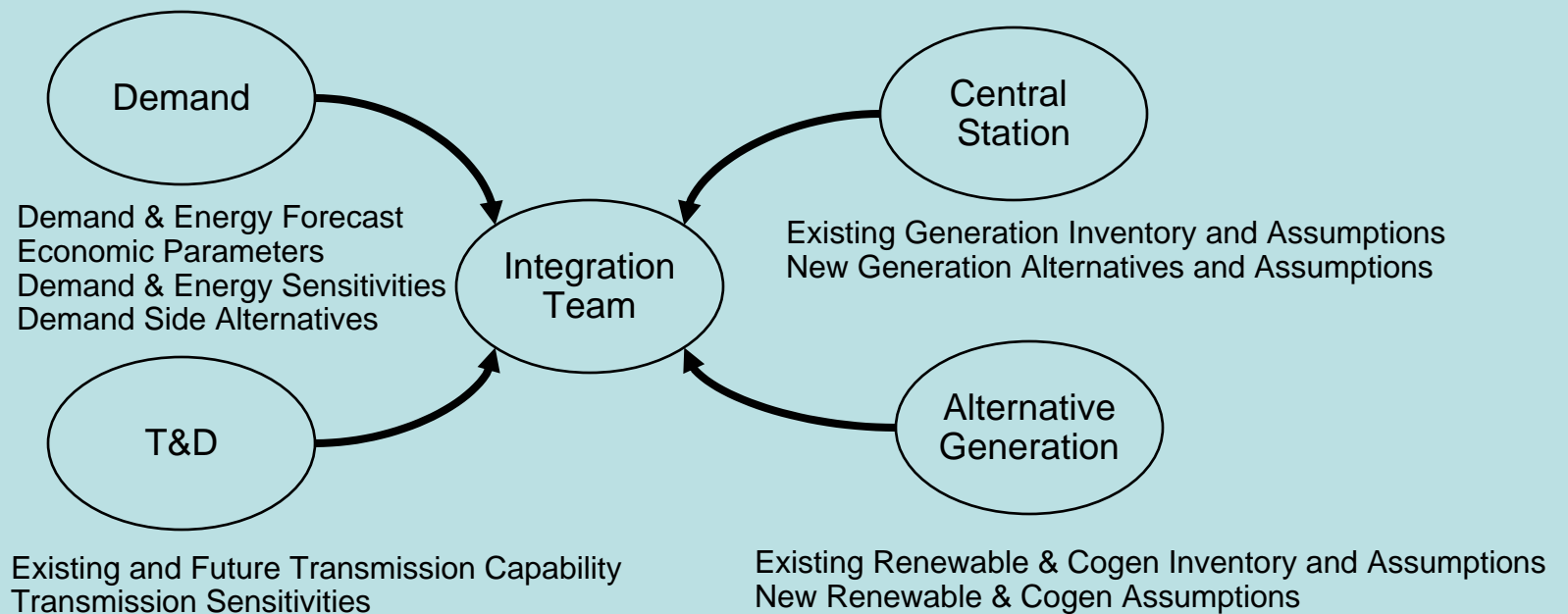
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# Presentation Points

- Define what the Integration Group was assigned to accomplish
- Describe how the Integration group accomplished its function
- Discuss the results of the integration process

## Process Overview

- The Capacity Need Forum (CNF) was created as a collaborative industry-wide process to assess the projected need for electrical generating capacity in Michigan over the short-, intermediate-, and long-term future.



# Proposed Integration Methodology

- Use MISO's modeling capability to quantify capacity needs.
- Use New Energy's Strategist to select a optimal resource addition plan.
- Use scenario based analysis to quantify Energy Conservation and Emissions issues.
- Regional modeling to reflect constraint issues.

# Scenarios

- Traditional power sources
- Emissions
- Energy Conservation
- Non-Traditional sources

## Capacity Need Forum Proposed Integration Scenarios

	Traditional Power	Emissions	Energy Conservation	Non-Traditional
	Assume Clean Air Interstate Rule and Clean Air Mercury Rule for environmental regulations.	Mercury removal requirements raised to 85% from 1999 baseline emissions in 2018. Carbon tax at \$30 per ton carbon by 2018.	Energy conservation portfolio wired in. CT's maybe assumed to be demand control options.	Mandated Renewable Portfolio Standard of 3% by 2008, 5% by 2010 and 7% by 2015.
<b>Resource Units</b>				
PC Unit	X	X	X	
CT Unit	X	X	X	X
GCC Unit	X	X	X	X
IGCC Unit	X		X	X
IGCC C Seq.		X		
Nuclear Unit	X	X	X	X
Waste Energy			X	X
Wind Generation		X	X	X
Cogeneration		X		X
Energy Conservation			X	
<b>Sensitivities</b>				
High Load	X	X	X	X
Low Load	X		X	X
High Gas Cost	X	X	X	X
Max Import <sup>1</sup>	X			
Restricted Import <sup>2</sup>	X			
Non-Traditional with PC				X
<b>Assumptions</b>				
Normal price driven energy conservation	X	X	X	
Carbon tax (\$10.00=2010-\$30.00=2018) <sup>3</sup>		X		
85% Mercury Emissions Removal		X		
IGCC has CO2 sequestering		X		
Max energy conservation options			X	
Maximum waste to energy				X
Maximum Cogeneration				X
Scale-up Renewables to Reflect RPS				X
Assumed Transfer Capability(Normal)	3,000-3,500	3,000-3,500	3,000-3,500	3,000-3,500

1) Teir 1 transmission upgrades  
 2) 1,500 MW transfer to OH  
 3) Nominal dollars

# New Energy's Strategist

- For each year of the optimization Strategist generates all possible combinations of alternatives
- Each combination is tested against the constraints for that year and only those combinations that meet all the constraints are passed; these are the feasible states
- Cumulative Capital and operations costs are calculated for each feasible state
- Feasible states from year X are the starting points for generating new combinations for year X+1
- Repeat to end of Optimization Horizon

# Integration Analysis Results

- Over 18 Unique runs
- Made up from the four scenarios and their associated sensitivities
- Today we will only be discussing a subset

# Base Case Overview

- Base Expansion Plan
- Plan Specifics
  - No Specialties in base expansion plan
- Alternatives Considered
  - Combustion Turbine
  - Combined Cycle
  - Pulverized Sub-Critical Coal
- Alternatives Screened Out
  - Pulverized Super-Critical Coal
  - Fluidized Bed Coal
  - IGCC
  - IGCC – PRB Coal
  - Nuclear

## Base Case Expansion Plan Results

- **2005 to 2014**

- **Capacity Additions**

– CT	1,280 MW
– CC	1,500 MW
– PC	4,000 MW
– Nuclear	0 MW
– IGCC-Seq	0 MW
– Other	0 MW

- **Total**                    **6,780 MW**

- **Demand Growth**                    **2.38 %**

- **Reserve Margin**                    **15.85 %**

- **Plan Costs**

– NPV Utility Cost	\$ 29,640.7 M
– NPV Emissions	\$ 4,089.0 M
– NPV CO2	\$ 0.0 M

- **2005 to 2024**

- **Capacity Additions**

– CT	2,880 MW
– CC	2,000 MW
– Nuclear	0 MW
– PC	12,000 MW
– IGCC-Seq	0 MW
– Other	0 MW

- **Total**                    **16,880 MW**

- **Demand Growth**                    **2.17 %**

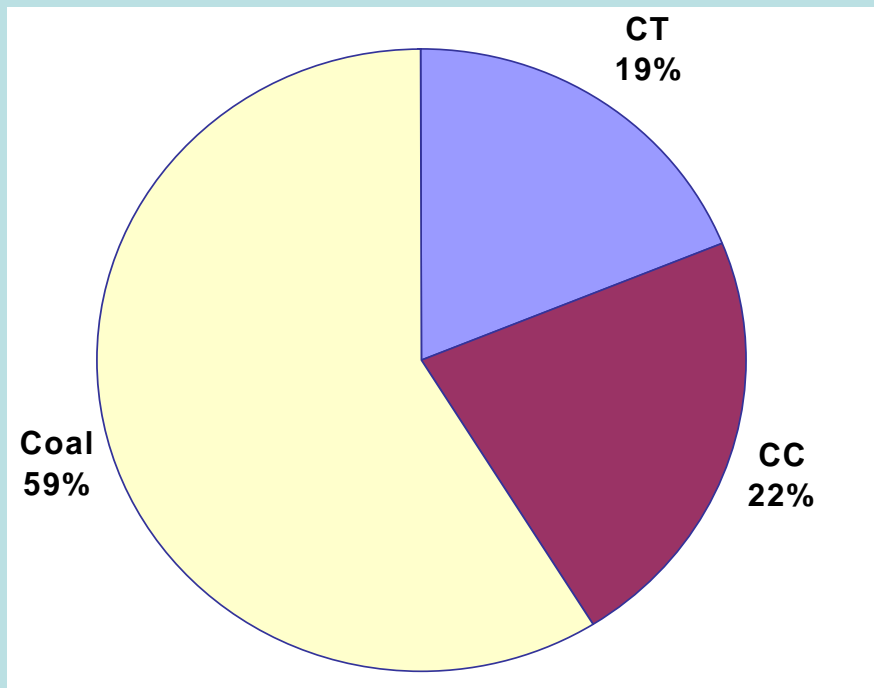
- **Reserve Margin**                    **15.03 %**

- **Plan Costs**

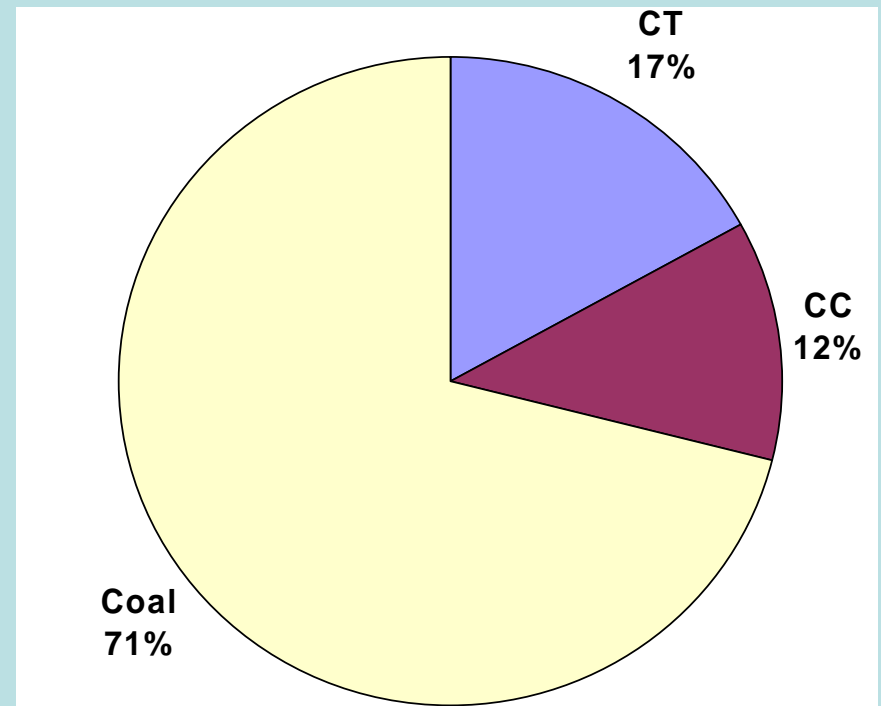
– NPV Utility Cost	\$ 54,605.6 M
– NPV Emissions	\$ 7,638.6 M
– NPV CO2	\$ 0.0 M

# Base Case

2005 to 2014



2005 to 2024



## High Load Case Overview

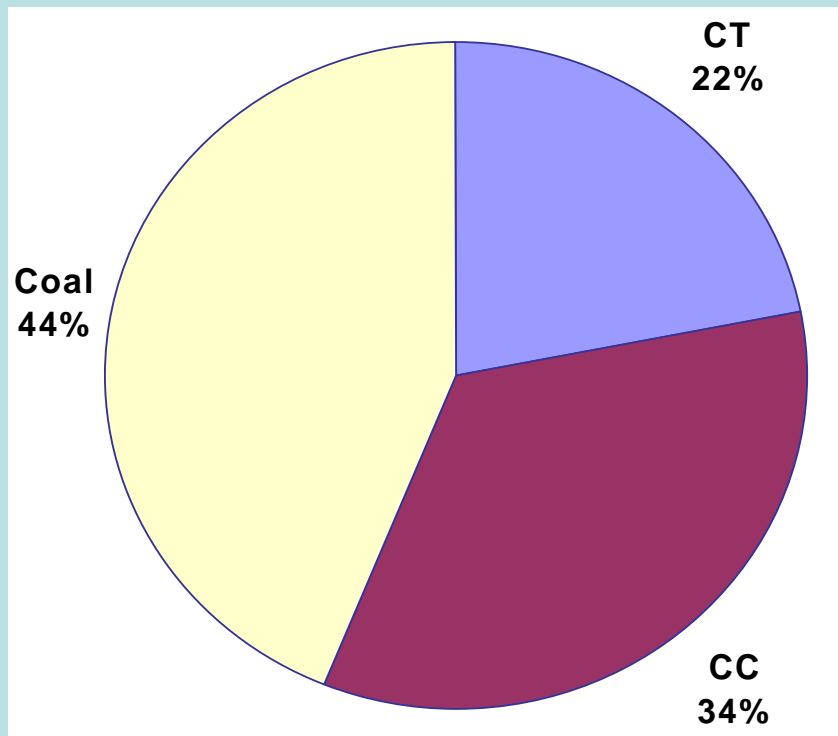
- **Base Expansion Plan**
  - High Load Sensitivity
- **Plan Specifics**
  - Base Expansion Plan with high load case consistent with the LOLP study.
- **Alternatives Considered**
  - Combustion Turbine
  - Combined Cycle
  - Pulverized Sub-Critical Coal
- **Alternatives Screened Out**
  - Pulverized Super-Critical Coal
  - Fluidized Bed Coal
  - IGCC
  - IGCC – PRB Coal
  - Nuclear

## High Load Case Expansion Plan Results

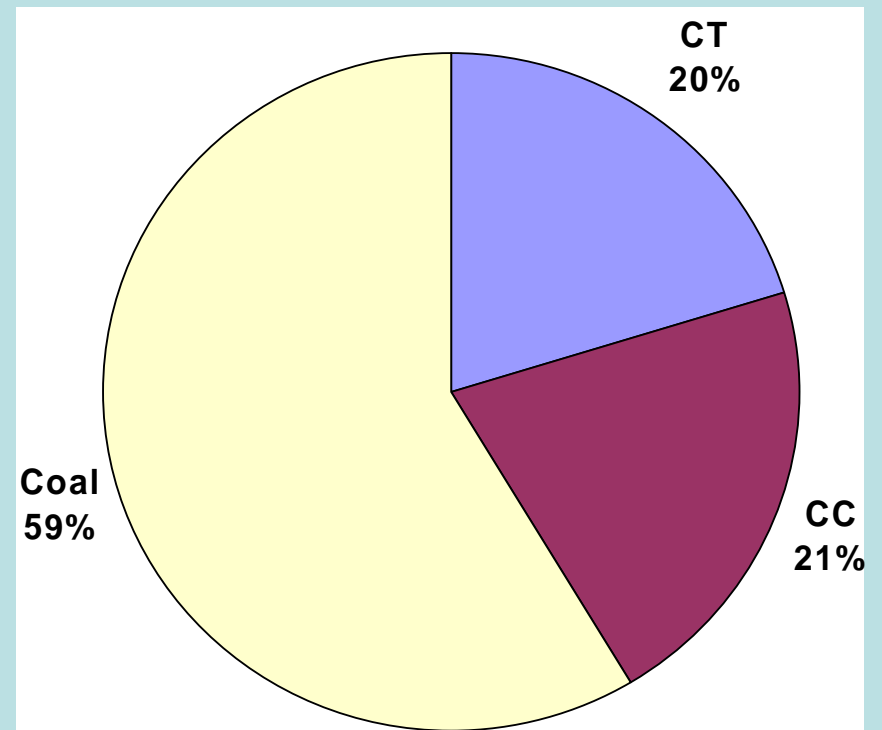
- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• <b>2005 to 2014</b></li> <li>• <b>Capacity Additions</b> <ul style="list-style-type: none"> <li>– CT            2,240 MW</li> <li>– CC            3,500 MW</li> <li>– PC            4,500 MW</li> <li>– Nuclear        0 MW</li> <li>– IGCC-Seq        0 MW</li> <li>– Other            0 MW</li> </ul> </li> <li>• <b>Total                    10,240 MW</b></li> </ul> | <ul style="list-style-type: none"> <li>• <b>2005 to 2024</b></li> <li>• <b>Capacity Additions</b> <ul style="list-style-type: none"> <li>– CT            4,320 MW</li> <li>– CC            4,500 MW</li> <li>– PC            12,500 MW</li> <li>– Nuclear        0 MW</li> <li>– IGCC-Seq        0 MW</li> <li>– Other            0 MW</li> </ul> </li> <li>• <b>Total                    21,320 MW</b></li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Demand Growth            3.35 %</b></li> <li>• <b>Reserve Margin            15.14 %</b></li> <li>• <b>Plan Costs</b> <ul style="list-style-type: none"> <li>– NPV Utility Cost        \$ 32,282.9 M</li> <li>– NPV Emissions        \$ 4,107.3 M</li> <li>– NPV CO2            \$ 0.0 M</li> </ul> </li> </ul>  | <ul style="list-style-type: none"> <li>• <b>Demand Growth            2.63 %</b></li> <li>• <b>Reserve Margin            15.00 %</b></li> <li>• <b>Plan Costs</b> <ul style="list-style-type: none"> <li>– NPV Utility Cost        \$ 60,895.9 M</li> <li>– NPV Emissions        \$ 7,771.3 M</li> <li>– NPV CO2            \$ 0.0 M</li> </ul> </li> </ul>   |

# High Load Case Expansion Plan Results

2005 to 2014



2005 to 2024



## Low Load Case Overview

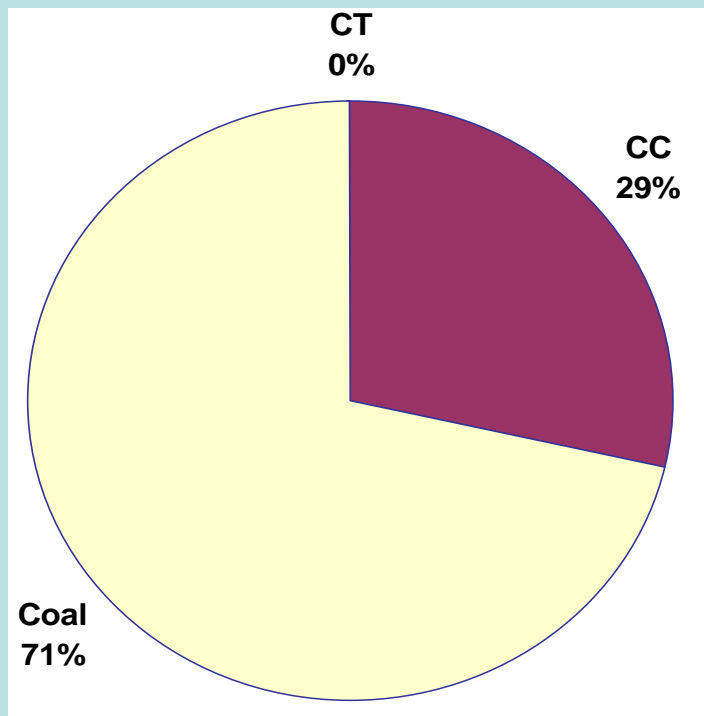
- **Base Expansion Plan**
  - **Low Load Sensitivity**
- **Plan Specifics**
  - **Base Expansion plan with low load case consistent with the LOLP Study**
- **Alternatives Considered**
  - **Combustion Turbine**
  - **Combined Cycle**
  - **Pulverized Sub-Critical Coal**
- **Alternatives Screened Out**
  - **Pulverized Super-Critical Coal**
  - **Fluidized Bed Coal**
  - **IGCC**
  - **IGCC – PRB Coal**
  - **Nuclear**

## Low Load Case Expansion Plan Results

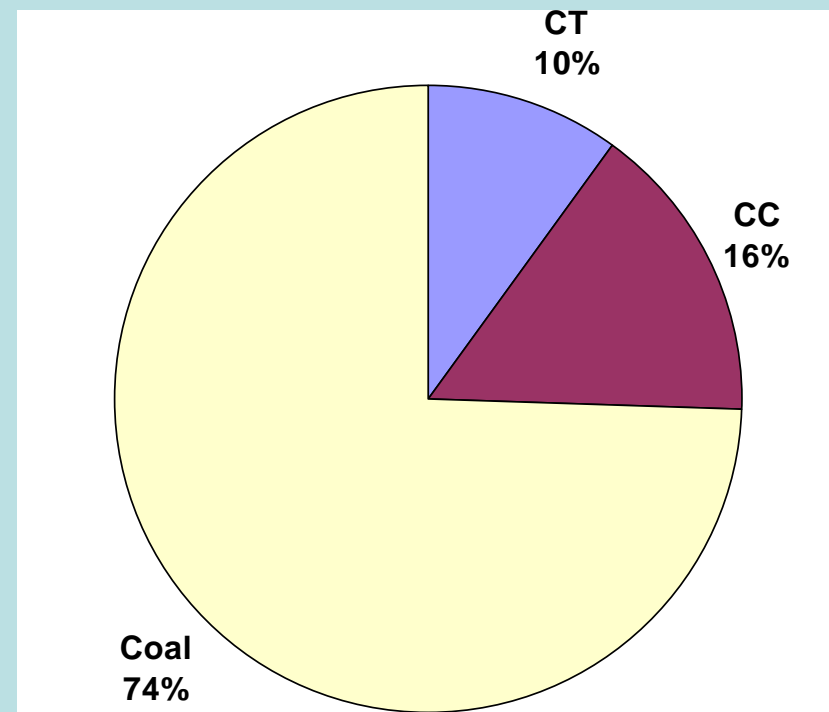
- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• <b>2005 to 2014</b></li> <li>• <b>Capacity Additions</b> <ul style="list-style-type: none"> <li>– CT                    0 MW</li> <li>– CC                  1,000 MW</li> <li>– PC                  2,500 MW</li> <li>– Nuclear            0 MW</li> <li>– IGCC-Seq            0 MW</li> <li>– Other                0 MW</li> </ul> </li> <li>• <b>Total                    3,500 MW</b></li> </ul><br><ul style="list-style-type: none"> <li>• <b>Demand Growth            1.30 %</b></li> <li>• <b>Reserve Margin            16.40 %</b></li> <li>• <b>Plan Costs</b> <ul style="list-style-type: none"> <li>– NPV Utility Cost    \$ 27,146.3 M</li> <li>– NPV Emissions     \$ 4,051.2 M</li> <li>– NPV CO2            \$ 0.0 M</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>2005 to 2024</b></li> <li>• <b>Capacity Additions</b> <ul style="list-style-type: none"> <li>– CT                    1,280 MW</li> <li>– CC                  2,000 MW</li> <li>– PC                  9,500 MW</li> <li>– Nuclear            0 MW</li> <li>– IGCC-Seq            0 MW</li> <li>– Other                0 MW</li> </ul> </li> <li>• <b>Total                    12,780 MW</b></li> </ul><br><ul style="list-style-type: none"> <li>• <b>Demand Growth            1.66 %</b></li> <li>• <b>Reserve Margin            15.42 %</b></li> <li>• <b>Plan Costs</b> <ul style="list-style-type: none"> <li>– NPV Utility Cost    \$ 48,710.8 M</li> <li>– NPV Emissions     \$ 7,536.0 M</li> <li>– NPV CO2            \$ 0.0 M</li> </ul> </li> </ul> |
|---|--|

# Low Load Case Expansion Plan Results

**2005 to 2014**



**2005 to 2024**



# High Gas Cost Case Overview

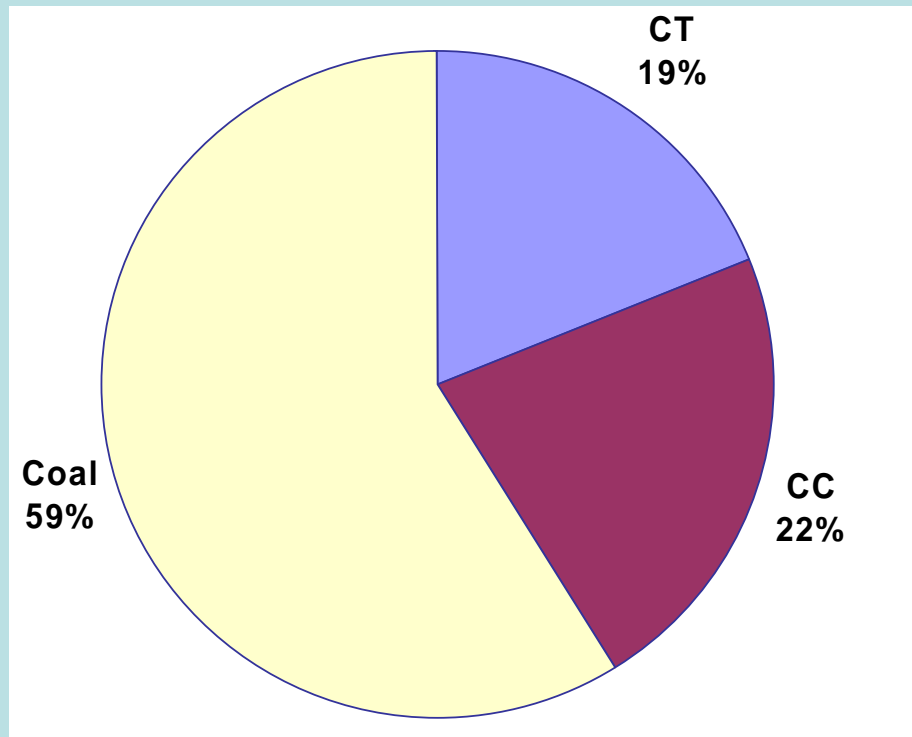
- **Base Expansion Plan**
  - High Gas Cost Sensitivity
- **Plan Specifics**
  - Base Expansion Plan with gas prices increased 20%.
- **Alternatives Considered**
  - Combustion Turbine
  - Combined Cycle
  - Pulverized Sub-Critical Coal
- **Alternatives Screened Out**
  - Pulverized Super-Critical Coal
  - Fluidized Bed Coal
  - IGCC
  - IGCC – PRB Coal
  - Nuclear

## High Gas Cost Case

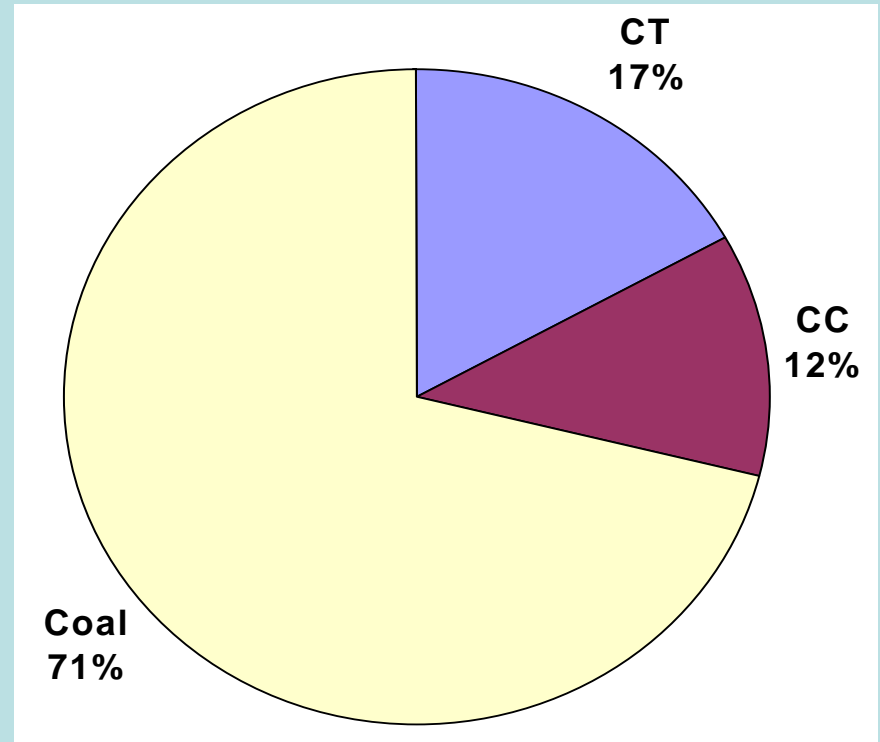
- 2005 to 2014
- Capacity Additions
  - CT 1,280 MW
  - CC 1,500 MW
  - PC 4,000 MW
  - Nuclear 0 MW
  - IGCC-Seq 0 MW
  - Other 0 MW
- Total 6,780 MW
- Demand Growth 2.38 %
- Reserve Margin 15.85 %
- Plan Costs
  - NPV Utility Cost \$ 30,794.9 M
  - NPV Emissions \$ 4,049.5 M
  - NPV CO2 \$ 0.0 M
- 2005 to 2024
- Capacity Additions
  - CT 2,880 MW
  - CC 2,000 MW
  - PC 12,000 MW
  - IGCC-Seq 0 MW
  - Nuclear 0 MW
  - Other 0 MW
- Total 16,880 MW
- Demand Growth 2.17 %
- Reserve Margin 15.03 %
- Plan Costs
  - NPV Utility Cost \$ 56,282.2 M
  - NPV Emissions \$ 7,568.1 M
  - NPV CO2 \$ 0.0 M

# High Gas Cost Case

2005 to 2014



2005 to 2024



# High Import Case Overview

- **Base Expansion Plan**
  - **High Import Sensitivity**
- **Plan Specifics**
  - **Base Expansion Plan with increased import capability**
  - **Tier I improvements are made to the system**
  - **Limits**
    - **into METC 4750**
    - **into ITC 1150**
    - **METC to ITC 3950**
    - **ITC to Ontario 0**
    - **All to MECS 4250**
- **Alternatives Considered**
  - **Combustion Turbine**
  - **Combined Cycle**
  - **Pulverized Sub-Critical Coal**
- **Alternatives Screened Out**
  - **Pulverized Super-Critical Coal**
  - **Fluidized Bed Coal**
  - **IGCC**
  - **IGCC – PRB Coal**
  - **Nuclear**

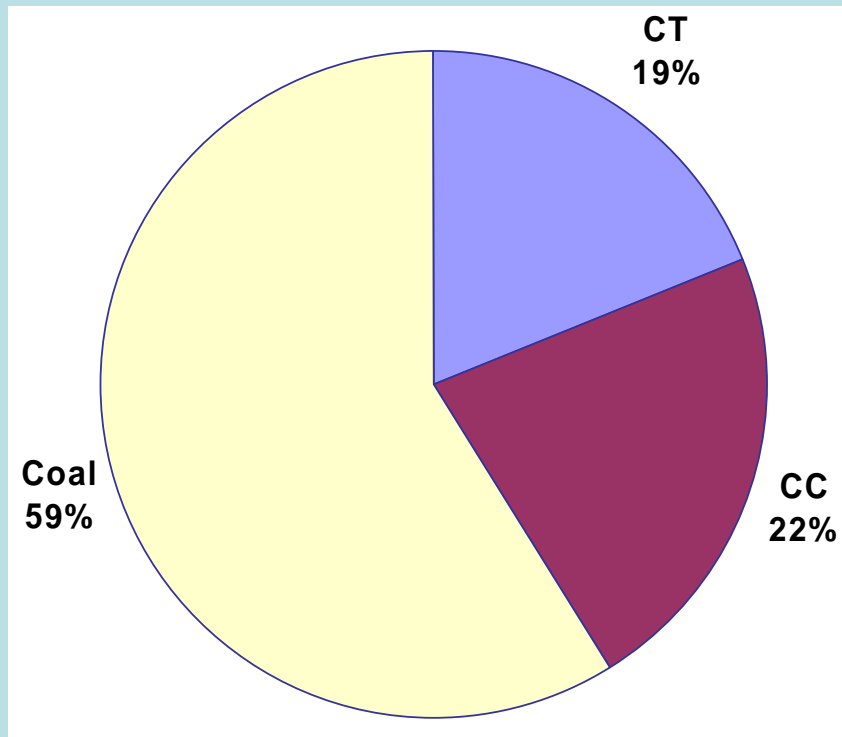
# High Import Case

- |                                 |               |                                 |               |
|---------------------------------|---------------|---------------------------------|---------------|
| • 2005 to 2014                  |               | • 2005 to 2024                  |               |
| • Capacity Additions            |               | • Capacity Additions            |               |
| – CT                            | 1,280 MW      | – CT                            | 2,400 MW      |
| – CC                            | 1,500 MW      | – CC                            | 1,500 MW      |
| – PC                            | 4,000 MW      | – PC                            | 13,000 MW     |
| – Nuclear                       | 0 MW          | – Nuclear                       | 0 MW          |
| – IGCC-Seq                      | 0 MW          | – IGCC-Seq                      | 0 MW          |
| – Other                         | 0 MW          | – Other                         | 0 MW          |
| • Total                         | 6,780 MW      | • Total                         | 16,900 MW     |
| • Demand Growth                 | 2.38 %        | • Demand Growth                 | 2.17 %        |
| • Reserve Margin                | 16.85 %       | • Reserve Margin                | 15.38 %       |
| • Plan Costs                    |               | • Plan Costs                    |               |
| – NPV Utility Cost <sup>1</sup> | \$ 29,608.1 M | – NPV Utility Cost <sup>1</sup> | \$ 54,242.0 M |
| – NPV Emissions                 | \$ 4,091.3 M  | – NPV Emissions                 | \$ 7,746.7 M  |
| – NPV CO2                       | \$ 0 M        | – NPV CO2                       | \$ 0 M        |

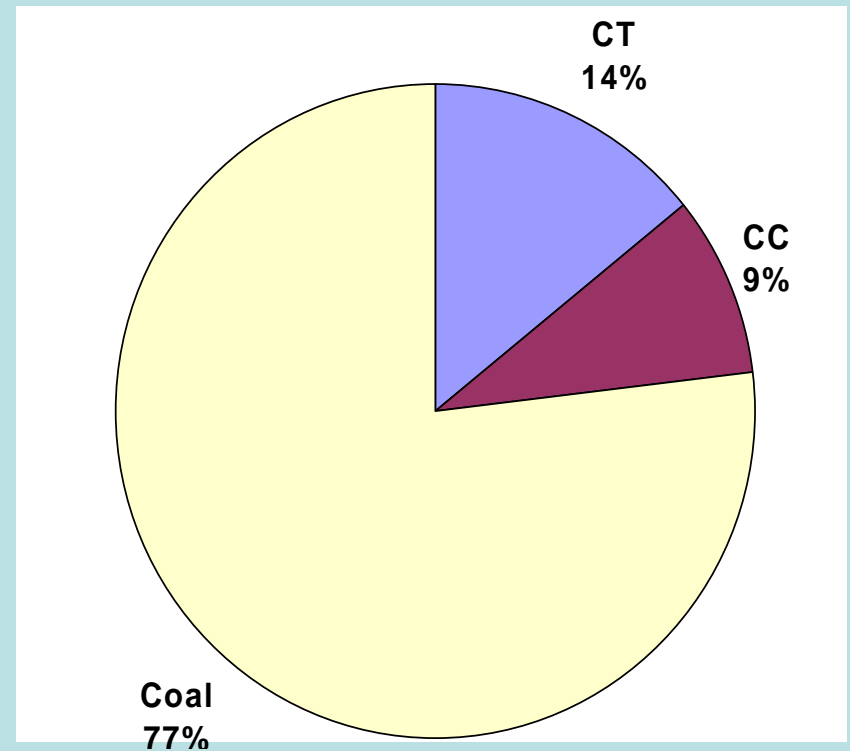
<sup>1</sup> Does not include investment for Tier I improvements

# High Import Case

2005 to 2014



2005 to 2024



# Low Import Case Overview

- **Base Expansion Plan**
  - **Low Import case**
- **Plan Specifics**
  - **Base Expansion Plan with limited import capability**
  - **1500 MW of flow across the Michigan system going into Ontario Hydro reduces import capabilities for the Michigan System.**
  - **Michigan is not making sales to Ontario Hydro. The sales source is external to Michigan**
  - **Limits**
    - **into METC 1450**
    - **into ITC 200**
    - **METC to ITC 1800**
    - **ITC to Ontario 1500 unidirectional**
    - **All to MECS 1650**
- **Alternatives Considered**
  - **Combustion Turbine**
  - **Combined Cycle**
  - **Pulverized Sub-Critical Coal**
- **Alternatives Screened Out**
  - **Pulverized Super-Critical Coal**
  - **Fluidized Bed Coal**
  - **IGCC**
  - **IGCC – PRB Coal**
  - **Nuclear**

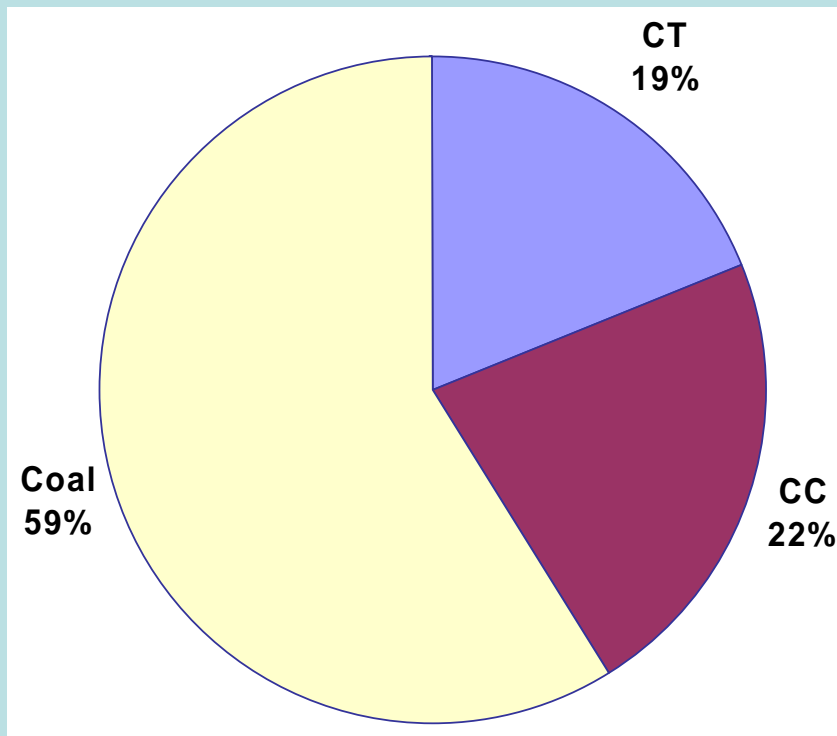
# Low Import Case

- 2005 to 2014
- Capacity Additions
  - CT 1,280 MW
  - CC 1,500 MW
  - PC 4,000 MW
  - Nuclear 0 MW
  - IGCC-Seq 0 MW
  - Other 0 MW
- Total 6,780 MW
  
- Demand Growth 2.38 %
- Reserve Margin 15.85 %
- Plan Costs
  - NPV Utility Cost \$ 29,740.6 M
  - NPV Emissions \$ 4,074.7 M
  - NPV CO2 \$ 0 M

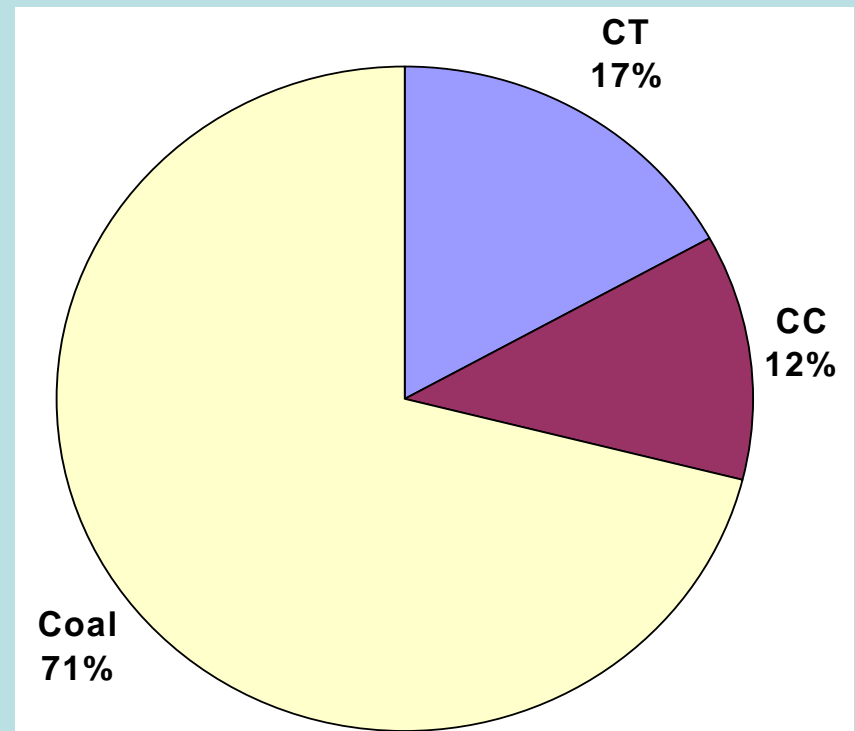
- 2005 to 2024
- Capacity Additions
  - CT 2,880 MW
  - CC 2,000 MW
  - PC 12,000 MW
  - Nuclear 0 MW
  - IGCC-Seq 0 MW
  - Other 0 MW
- Total 16,880 MW
  
- Demand Growth 2.17 %
- Reserve Margin 15.03 %
- Plan Costs
  - NPV Utility Cost \$ 54,873.1 M
  - NPV Emissions \$ 7,410.1 M
  - NPV CO2 \$ 0 M

# Low Import Case

2005 to 2014



2005 to 2024



# Emissions Case Overview

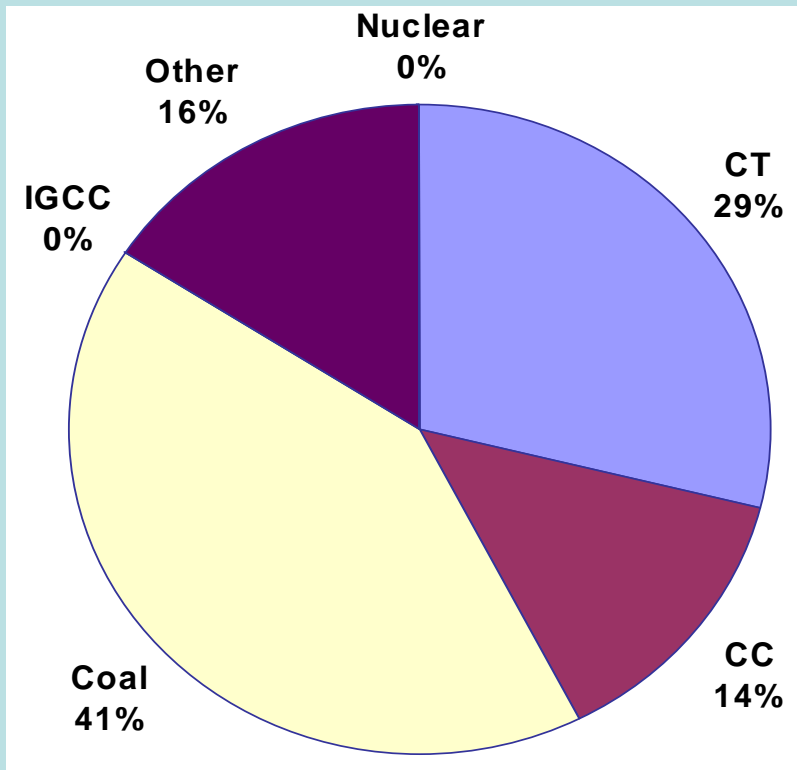
- **Plan Specifics**
  - Hg emission allowance prices increased by 15%.
  - CO2 tax of 10 \$/ton starting in 2010 and escalating to 30 \$/ton in 2018 and constant thereafter.
  - IGCC has CO2 sequestering
  - IGCC without sequestration is not considered
  - Wind and Cogeneration capability is scheduled in
- **Alternatives Considered**
  - Combustion Turbine
  - Combined Cycle
  - Pulverized Super-Critical Coal
  - IGCC – CO2 Sequestered
  - Nuclear
- **Alternatives Screened Out**
  - Pulverized Sub-Critical Coal
  - Fluidized Bed Coal

# Emissions Case

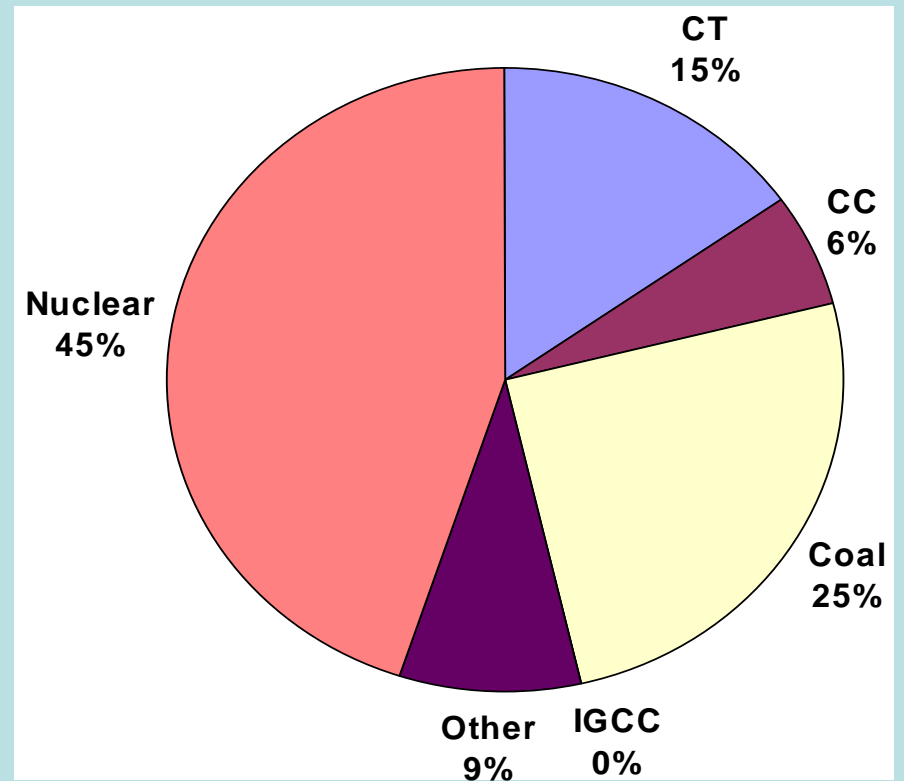
- **2005 to 2015**
  - **Capacity Additions (Firm MW)**
    - CT 2,080 MW
    - CC 1,000 MW
    - PC 3,000 MW
    - Nuclear 0 MW
    - IGCC-Seq 0 MW
    - Other 600 MW
  - **Total 6,680 MW**
  
  - **Demand Growth 2.38 %**
  - **Reserve Margin 15.19 %**
  - **Plan Costs (2005 \$)**
    - NPV Utility Cost \$ 33,543.9 M
    - NPV Emissions \$ 7,851.0 M
    - NPV CO2 \$ 3,724.5 M
- **2005 to 2024**
  - **Capacity Additions (Firm MW)**
    - CT 2,720 MW
    - CC 1,000 MW
    - PC 4,500 MW
    - Nuclear 8,000 MW
    - IGCC-Seq 0 MW
    - Other 600 MW
  - **Total 16,820 MW**
  
  - **Demand Growth 2,17 %**
  - **Reserve Margin 15.03 %**
  - **Plan Costs (2005 \$)**
    - NPV Utility Cost \$ 66,002.9 M
    - NPV Emissions \$ 20,195.6 M
    - NPV CO2 \$ 12,751.3 M

# Emissions Case

2005 to 2015



2005 to 2024



# Conservation Case Overview

- **Energy Conservation Plan**
- **Plan Specifics**
  - Energy Conservation is scheduled in.
  - No direct load control
  - Landfill Gas, Digestion, and Wind technologies are scheduled in.
  - Cogeneration is not scheduled in
  - Gas Combined Cycles were considered
- **Alternatives Considered**
  - Combustion Turbine
  - Combined Cycle
  - Pulverized Sub-Critical Coal
- **Alternatives Screened Out**
  - Pulverized Super-Critical Coal
  - Fluidized Bed Coal
  - IGCC
  - IGCC – PRB Coal
  - Nuclear

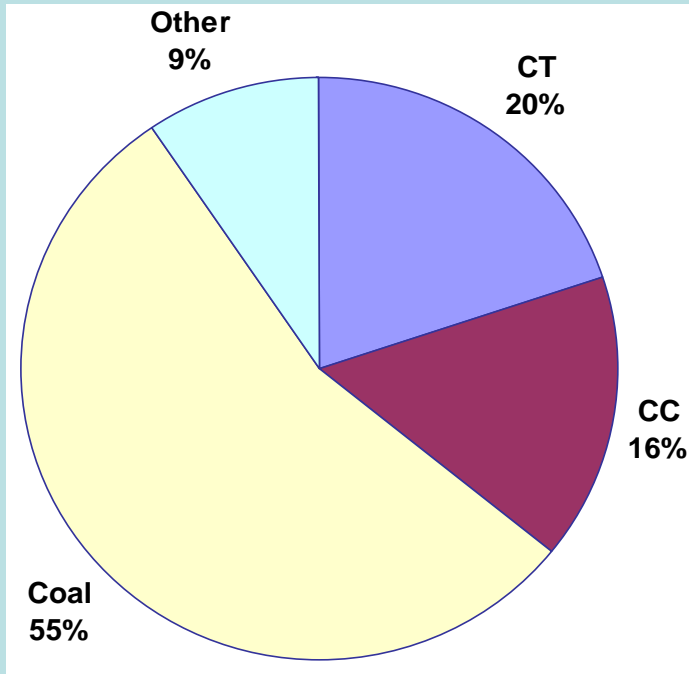
# Conservation Expansion Plan

- 2005 to 2014
  - Capacity Additions
    - CT 1,280 MW
    - CC 1,000 MW
    - PC 3,500 MW
    - Nuclear 0 MW
    - IGCC-Seq 0 MW
    - Other 599 MW
  - Total 6,379 MW
  - Demand Growth 2.38 %
  - Reserve Margin 15.34 %
  - Plan Costs
    - NPV Utility Cost<sup>2</sup> \$ 29,802.9 M
    - NPV Emissions \$ 4,054.5 M
    - NPV CO2 \$ 0.0 M
- 2005 to 2024
  - Capacity Additions
    - CT 3,040 MW
    - CC 2,500 MW
    - PC 10,000 MW
    - Nuclear 0 MW
    - IGCC-Seq 0 MW
    - Other 626 MW
  - Total 16,166 MW
  - Demand Growth 2.17 %
  - Reserve Margin 15.07 %
  - Plan Costs
    - NPV Utility Cost<sup>2</sup> \$ 54,066.4 M
    - NPV Emissions \$ 7,509.6 M
    - NPV CO2 \$ 0.0 M

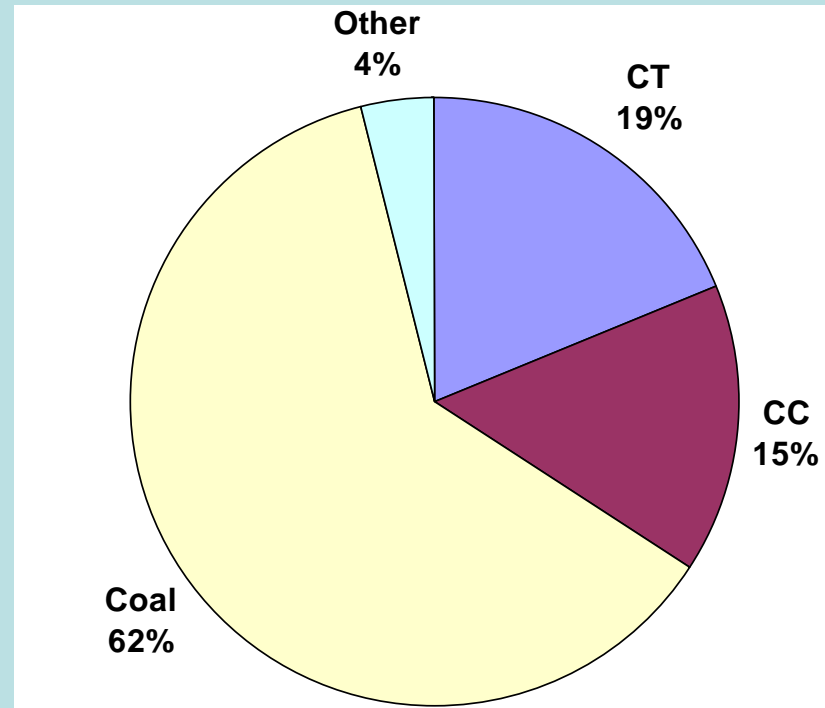
<sup>2</sup> Fixed costs for Energy Conservation are included.

# Conservation Expansion Plan

2005 to 2014



2005 to 2024



# Non –Traditional Case Overview

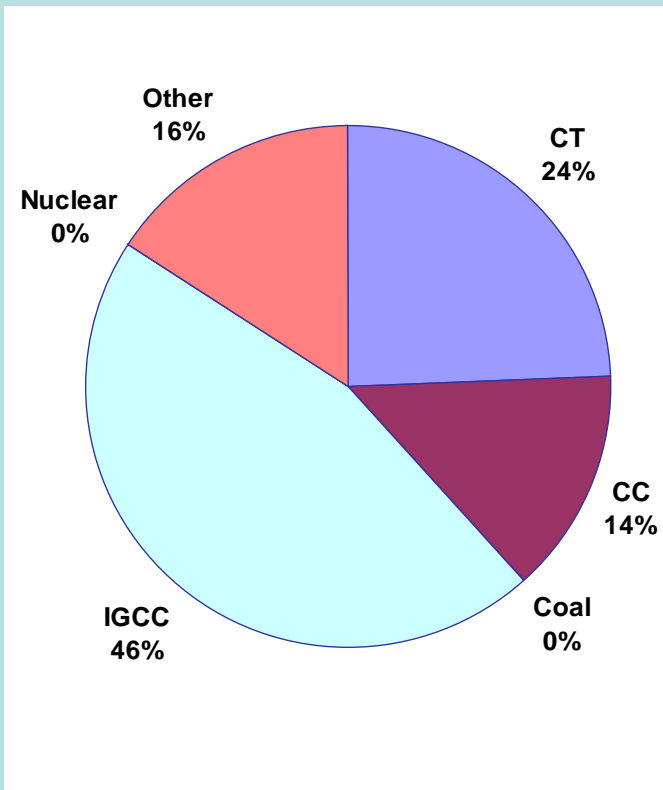
- **Non-Traditional Plan**
- **Plan Specifics**
  - **Mandated renewable portfolio standard of 3% by 2008, 5% by 2010, and 7% by 2015 – Energy Based**
  - **Energy Conservation is not scheduled in.**
  - **Landfill Gas, Digestion, Wind, and Cogeneration technologies are scheduled in.**
  - **Renewable capabilities are scaled up to meet portfolio standards**
  - **No Coal Units nor Gas Combined Cycle units are allowed**
- **Alternatives Considered**
  - **Combustion Turbine**
  - **IGCC – PRB Coal**
- **Alternatives Screened Out**
  - **Fluidized Bed Coal**
  - **IGCC**
  - **Nuclear**

# Non –Traditional Case Expansion Plan Results

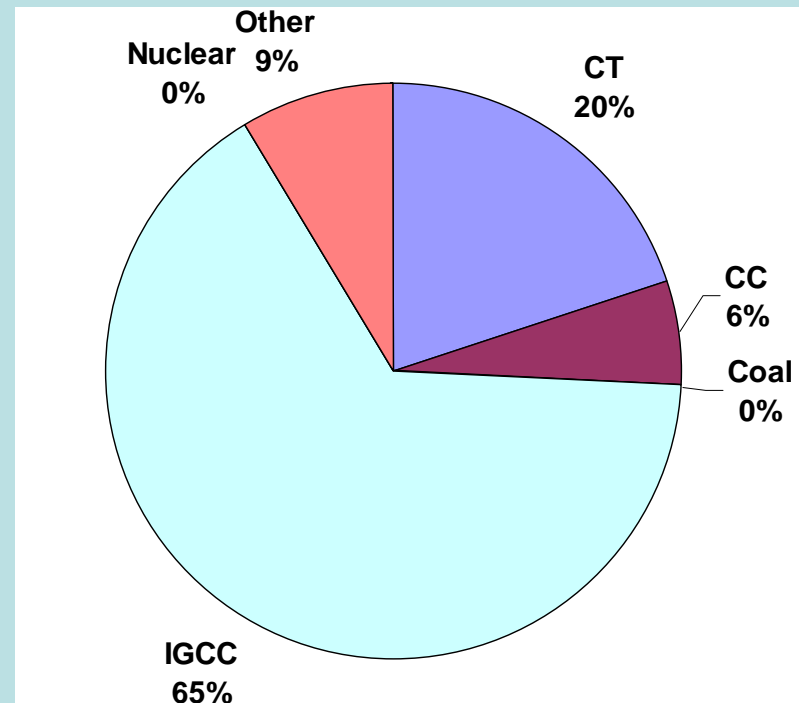
- 2005 to 2014
- Capacity Additions
  - CT 1,760 MW
  - CC 1,000 MW
  - PC 0 MW
  - Nuclear 0 MW
  - IGCC-PRB 3,300 MW
  - Other 1,146 MW
- Total 7,206 MW
  
- Demand Growth 2.38 %
- Reserve Margin 15.86 %
- Plan Costs
  - NPV Utility Cost \$ 30,404.2 M
  - NPV Emissions \$ 4,045.2 M
  - NPV CO2 \$ 0.0 M
  
- 2005 to 2024
- Capacity Additions
  - CT 3,520 MW
  - CC 1,000 MW
  - PC 0 MW
  - Nuclear 0 MW
  - IGCC-PRB 11,550 MW
  - Other 1,507 MW
- Total 17,577 MW
  
- Demand Growth 2.17 %
- Reserve Margin 15.57 %
- Plan Costs
  - NPV Utility Cost \$ 57,480.9 M
  - NPV Emissions \$ 7,451.2 M
  - NPV CO2 \$ 0.0 M

# Non –Traditional Case

2005 to 2014



2005 to 2024



# Non-Traditional with PC Case Overview

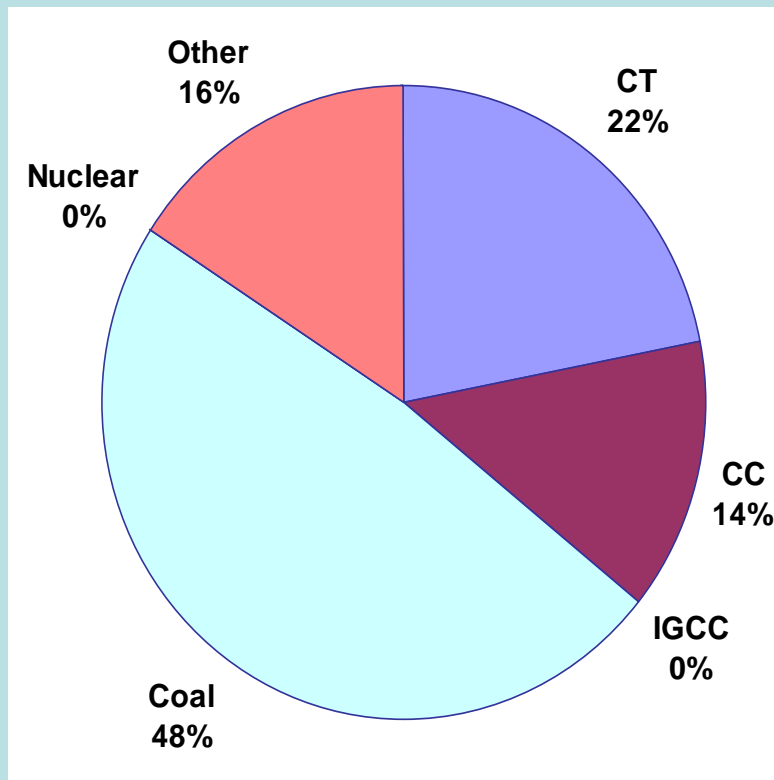
- **Non-Traditional Plan**
  - **Coal Resource Sensitivity**
- **Plan Specifics**
  - **Mandated renewable portfolio standard of 3% by 2008, 5% by 2010, and 7% by 2015 – Energy Based**
  - **Energy Conservation is not scheduled in.**
  - **Landfill Gas, Digestion, Wind, and Cogeneration technologies are scheduled in.**
  - **Renewable capabilities are scaled up to meet portfolio standards**
  - **No Gas Combined Cycle units are allowed**
  - **Pulverized Coal is allowed**
- **Alternatives Considered**
  - **Combustion Turbine**
  - **Pulverized Sub-Critical Coal**
- **Alternatives Screened Out**
  - **Pulverized Super-Critical Coal**
  - **Fluidized Bed Coal**
  - **IGCC**
  - **IGCC – PRB Coal**
  - **Nuclear**

# Non-Traditional with PC Case

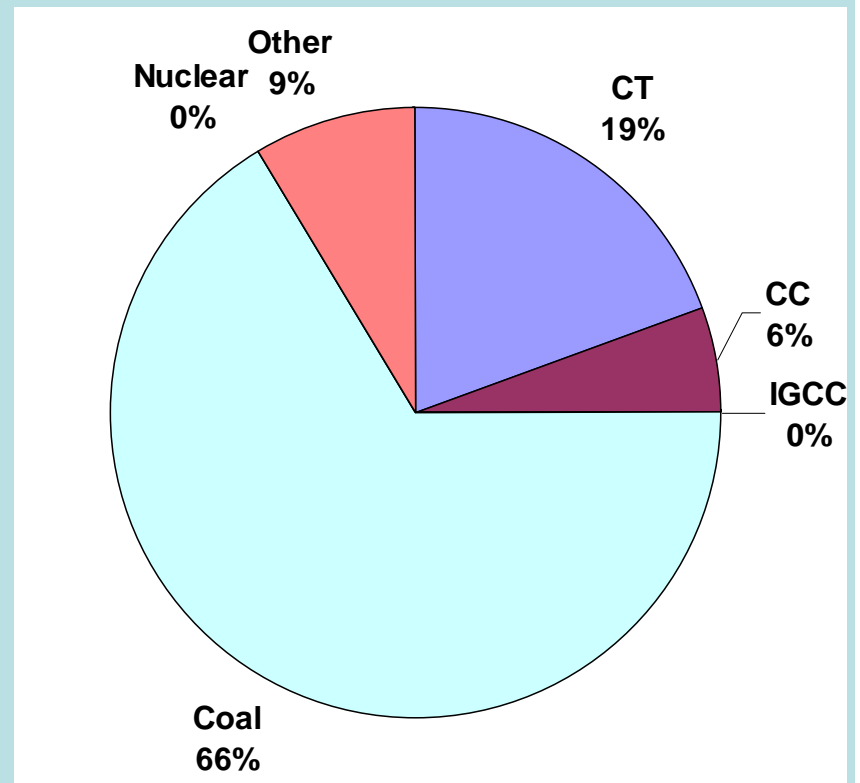
- **2005 to 2014**
  - **Capacity Additions**
    - CT 1,600 MW
    - CC 1,000 MW
    - PC 3,500 MW
    - Nuclear 0 MW
    - IGCC-PRB 0 MW
    - Other 1,146 MW
  - **Total 7,246 MW**
  
  - **Demand Growth 2.38 %**
  - **Reserve Margin 16.06 %**
  - **Plan Costs**
    - NPV Utility Cost \$ 30,106.3 M
    - NPV Emissions \$ 4,064.2 M
    - NPV CO2 \$ 0.0 M
- **2005 to 2024**
  - **Capacity Additions**
    - CT 3,360 MW
    - CC 1,000 MW
    - PC 11,500 MW
    - Nuclear 0 MW
    - IGCC-PRB 0 MW
    - Other 1,507 MW
  - **Total 17,367 MW**
  
  - **Demand Growth 2.17 %**
  - **Reserve Margin 15.00 %**
  - **Plan Costs**
    - NPV Utility Cost \$ 55,874.4 M
    - NPV Emissions \$ 7,557.1 M
    - NPV CO2 \$ 0.0 M

# Non-Traditional with PC Case

2005 to 2014



2005 to 2024



Plan Name	Total Capacity Added MW (Firm)	CT Capacity MW	CC Capacity MW	PC Capacity MW	Nuclear Capacity MW	IGCC Capacity MW	Other Capacity MW (Firm)	Ending Reserve Margin %	Ending Peak Demand MW	PVRR 2005 \$M
Base	17,040	3,040	3,000	11,000	0	0	0	15.16%	34,880	\$ 54,596.8
Base High Load	21,320	4,320	4,500	12,500	0	0	0	15.00%	38,368	\$ 60,895.9
Base Low Load	12,780	1,280	2,000	9,500	0	0	0	15.42%	31,392	\$ 48,707.3
Base High Gas	16,880	2,880	2000	12,000	0	0	0	15.03%	34,880	\$ 56,282.2
Base High Import	16,900	2,400	1,500	13,000	0	0	0	15.38%	34,880	\$ 54,238.5
Base Low Import	16,880	2,880	2,000	12,000	0	0	0	15.03%	34,880	\$ 54,870.9
Emissions	16,820	2,720	1,000	4,500	8,000	0	600	15.03%	34,880	\$ 66,002.9
Emissions High Load	21,320	2,720	3,000	6,000	9,000	0	600	15.87%	38,368	\$ 77,407.4
Emissions High Gas	17,660	2,560	1,000	4,500	9,000	0	600	17.55%	34,880	\$ 67,779.9
Energy Conservation	15,799	3,040	2,500	10,000	0	0	259	15.07%	33,722	\$ 54,066.4
Energy Conservation High Load	20,139	2,880	4,500	12,500	0	0	259	15.34%	37,210	\$ 60,335.7
Energy Conservation Low Load	11,539	1,280	1,500	8,500	0	0	259	15.33%	30,234	\$ 48,156.2
Energy Conservation High Gas	15,799	3,040	2,000	10,500	0	0	259	15.22%	33,722	\$ 55,639.9
Non-Traditional	17,105	3,520	1,000	0	0	11,550	1,035	15.57%	34,880	\$ 57,477.8
Non-Traditional High Load	21,395	4,160	3,000	0	0	13,200	1,035	15.28%	38,368	\$ 67,023.5
Non-Traditional Low Load	12,535	1,600	0	0	0	9,990	1,035	15.51%	31,392	\$ 53,523.5
Non-Traditional High Gas	17,105	3,520	1,000	0	0	11,550	1,035	15.57%	34,880	\$ 59,149.8
Non-Traditional with PC as an option	16,895	3,360	1,000	11,500	0	0	1,035	15.00%	34,880	\$ 55,864.4

Review of what was learned

- Substantial additions of new capacity are required to maintain the planning reserve margin and the associated LOL probability over the planning period.
- Capacity additions are required in the short term to maintain reserve margin targets.

- All scenarios add capacity during the planning period.
- The low growth sensitivity of the Energy Conservation Scenario adds 3,000 MWs of new capacity during the initial phase of the planning period (2005-2014).

- Additional base load capacity is part of the optimal resource plan and should be acquired in a timely manner.

- Optimal expansion plans were developed for four unique possible futures.
- These Scenarios were further analyzed with sensitivities analysis.
- All plans add base load capacity as soon as it is available.

- Resource plans that include energy conservation components and renewable options are comparable in cost to plans containing conventional resources.

- **The Energy Conservation Scenario is only slightly more costly than the Base Case Scenario in the 2005-2015 period and is actually cheaper than the Base Case Scenario over the study period.**
- **2005-2014**
  - **Conservation \$ 29,802.9M**
  - **Base Case \$ 29,640.7M**
- **2005-2024**
  - **Conservation \$ 54,066.4M**
  - **Base Case \$ 54,605.6M**

- **The Non-Traditional with PC Scenario is only slightly more costly than the Base Case Scenario in the 2005-2015 period and is only 2% more costly than the Base Case Scenario over the study period.**
- **2005-2014**
  - **Non-Traditional with PC \$ 30,106.3M**
  - **Base Case \$ 29,640.7M**
- **2005-2024**
  - **Non-Traditional with PC \$ 55,874.4M**
  - **Base Case \$ 54,605.6M**

- The cost of emissions control systems while significant are not the driving force for resource selection.
- Even a moderate tax on carbon will substantially increase the cost of electricity.

## Base Case

### Effluent Expense

	<b>NOX</b>	<b>SOx</b>	<b>CO2</b>	<b>Hg</b>	<b>Annual Total</b>
<b>2005</b>	\$ 134,901	\$ 227,876	\$ -	\$ -	\$ 362,777
<b>2006</b>	\$ 122,199	\$ 246,143	\$ -	\$ -	\$ 368,342
<b>2007</b>	\$ 123,088	\$ 267,581	\$ -	\$ -	\$ 390,669
<b>2008</b>	\$ 126,756	\$ 291,232	\$ -	\$ -	\$ 417,987
<b>2009</b>	\$ 114,280	\$ 317,870	\$ -	\$ -	\$ 432,150
<b>2010</b>	\$ 240,430	\$ 340,821	\$ -	\$ 125,350	\$ 706,601
<b>2011</b>	\$ 262,604	\$ 366,247	\$ -	\$ 130,224	\$ 759,075
<b>2012</b>	\$ 295,503	\$ 395,470	\$ -	\$ 136,486	\$ 827,458
<b>2013</b>	\$ 328,500	\$ 423,855	\$ -	\$ 141,991	\$ 894,345
<b>2014</b>	\$ 363,460	\$ 454,359	\$ -	\$ 147,676	\$ 965,494
<b>2015</b>	\$ 396,790	\$ 487,130	\$ -	\$ 152,505	\$ 1,036,425
<b>2016</b>	\$ 382,056	\$ 517,255	\$ -	\$ 155,737	\$ 1,055,048
<b>2017</b>	\$ 378,438	\$ 543,894	\$ -	\$ 158,972	\$ 1,081,304
<b>2018</b>	\$ 370,653	\$ 570,419	\$ -	\$ 225,393	\$ 1,166,465
<b>2019</b>	\$ 357,042	\$ 579,403	\$ -	\$ 224,786	\$ 1,161,231
<b>2020</b>	\$ 343,220	\$ 582,718	\$ -	\$ 222,222	\$ 1,148,160
<b>2021</b>	\$ 336,319	\$ 614,563	\$ -	\$ 225,760	\$ 1,176,642
<b>2022</b>	\$ 327,335	\$ 637,994	\$ -	\$ 227,558	\$ 1,192,887
<b>2023</b>	\$ 311,733	\$ 637,780	\$ -	\$ 219,653	\$ 1,169,166
<b>2024</b>	\$ 301,470	\$ 671,634	\$ -	\$ 221,005	\$ 1,194,109

**Emissions Case  
Effluent Expense**

	<b>NOX</b>	<b>SOx</b>	<b>CO2</b>	<b>Hg</b>	<b>Annual Total</b>
<b>2005</b>	\$ 134,901	\$ 227,876	\$ -	\$ -	\$ 362,777
<b>2006</b>	\$ 122,168	\$ 246,127	\$ -	\$ -	\$ 368,295
<b>2007</b>	\$ 122,963	\$ 267,496	\$ -	\$ -	\$ 390,459
<b>2008</b>	\$ 125,070	\$ 289,479	\$ -	\$ -	\$ 414,549
<b>2009</b>	\$ 113,652	\$ 316,665	\$ -	\$ -	\$ 430,316
<b>2010</b>	\$ 239,843	\$ 338,358	\$ 849,861	\$ 143,823	\$ 1,571,886
<b>2011</b>	\$ 263,735	\$ 364,619	\$ 1,046,193	\$ 150,137	\$ 1,824,684
<b>2012</b>	\$ 291,216	\$ 391,617	\$ 1,262,056	\$ 155,443	\$ 2,100,331
<b>2013</b>	\$ 324,948	\$ 421,729	\$ 1,549,178	\$ 162,409	\$ 2,458,264
<b>2014</b>	\$ 355,703	\$ 451,715	\$ 1,846,042	\$ 167,710	\$ 2,821,171
<b>2015</b>	\$ 389,498	\$ 483,143	\$ 2,225,541	\$ 173,568	\$ 3,271,751
<b>2016</b>	\$ 375,850	\$ 514,763	\$ 2,637,039	\$ 177,322	\$ 3,704,973
<b>2017</b>	\$ 361,314	\$ 539,262	\$ 2,989,966	\$ 177,824	\$ 4,068,367
<b>2018</b>	\$ 340,253	\$ 553,176	\$ 3,329,216	\$ 242,894	\$ 4,465,539
<b>2019</b>	\$ 308,705	\$ 540,159	\$ 3,108,114	\$ 228,484	\$ 4,185,463
<b>2020</b>	\$ 289,768	\$ 552,074	\$ 3,017,380	\$ 224,493	\$ 4,083,715
<b>2021</b>	\$ 276,696	\$ 576,938	\$ 2,947,589	\$ 222,759	\$ 4,023,981
<b>2022</b>	\$ 258,436	\$ 592,226	\$ 2,849,269	\$ 217,432	\$ 3,917,363
<b>2023</b>	\$ 224,933	\$ 564,858	\$ 2,545,184	\$ 191,727	\$ 3,526,702
<b>2024</b>	\$ 212,559	\$ 597,821	\$ 2,504,945	\$ 190,513	\$ 3,505,838

# Where do we go from here?

- Continue to analyze the results
- Complete the Integration Work Group's Final Report
- Provide assistance and recommendations to the Capacity Need Forum as the Forum moves forward to complete its tasks