

## **Greenhouse Gas (GHG) Emissions from New Fossil Fuel Projects**

### **Summary**

There are 12 new fossil fuel infrastructure projects in various stages of planning and implementation in New Jersey. Empower NJ conservatively estimates that the completion and operation of these projects will have the following impacts:

- Increase total CO<sub>2</sub>e GHG emissions by 20 to 40 percent over current levels;
- Increase total CO<sub>2</sub>e GHG emissions from in-state power plants by 76% over current levels;
- Preclude any possibility of reaching the clean energy objectives established by the Murphy Administration.

### **Methodology and Analysis**

The Empower NJ: Stop Fossil Fuel Projects Coalition has identified 12 new gas infrastructure projects in various states of proposal, planning, permitting and initial implementation in New Jersey. Eight of the 12 are new pipelines or compressor stations/upgrades. Four are new power plants. In an effort to assess the total impact these projects would have on New Jersey and on the Administration's commitment to eliminate fossil fuel usage to achieve 100% clean renewable energy by 2050, the coalition estimated the total GHG emissions these plants would add in New Jersey. (A fifth power plant, Sewaren 7, received its air quality permit from the Murphy DEP on 8/14/2018 and went into service in mid 2018 and is included in this analysis as its emissions should be part of the total view of additional GHGs from gas infrastructure projects under the current administration. The emissions from this plant are not in the latest (2017) EPA/DEP GHG report and must be considered as already putting NJ deeper into the GHG hole and, therefore, will require even more GHG reduction than may have been previously estimated.)

The tables below show the estimated annual CO<sub>2</sub> and Methane CO<sub>2</sub>e (CO<sub>2</sub> equivalent) GHG emissions from each of these projects, the total for each project and the cumulative total for the state based on both full lifecycle methane leakage (extraction to consumption, which includes leakage in Pennsylvania) and partial methane leakage (transportation to consumption which is primarily leakage in New Jersey).

This is a complex analysis due to several factors:

- There is clear overlap among some of the projects in terms of gas volume. A number of these projects expect to receive gas from the PennEast pipeline and the emissions from those projects needed to be excluded from the total as the total includes the PennEast emissions themselves.
- One of the projects, Northeast Supply Enhancement (aka NESE) will receive gas from PennEast and send it to NY for consumption. Thus, not only have its GHG emissions been excluded from the total but its gas volume was subtracted from that of PennEast since the PennEast emissions should only reflect consumption in New Jersey.
- Compressor projects include information on additional pumping capacity but in some cases it is not clear which, if any, pipelines among the new projects will receive this gas.
- In some cases it was not possible to determine the source of the gas for power plants or new compressor stations due to the lack of information on projects or the

need to analyze maps of the proposed network of gas pipelines. Those situations have been noted.

- Type of power plant technology and emissions data for some plants is not yet available.

The projects whose emissions are not included in the totals are shown in gray in the tables below and their emissions calculations are provided for education and informational purposes.

The methodology for estimating these emissions for the pipelines is based on the Oil Change International algorithm at <http://priceofoil.org/content/uploads/2017/02/Gas-Pipeline-Methodology-2017-Web-Final.pdf>. It assumes that all gas going into a pipeline is burned at some point whether by a power plant or home/business heating, cooking, etc. The algorithm uses gas capacity to compute both CO<sub>2</sub> emissions and CO<sub>2</sub>e emissions from methane leakage. Pipeline gas capacity is provided by all pipeline descriptions and is easily available. A summary of the calculations is listed below (for more details see the Oil Change document):

- Gas combustion converted to metric tons of CO<sub>2</sub>: 1Bcf = 69,726 Tons CO<sub>2</sub>
- Percent of methane leakage (volume): 2.6% (The Oil Change algorithm used 3.8% but the more recent PSE Healthy Energy 2017 report on Marcellus shale GHG emissions (<https://bit.ly/2jnt2Jq>), analyzed the national average of methane leakage for the entire gas production, processing, transportation and storage system taking into account atmospheric measurements published since 2014 and estimated the weighted national average to be 2.6% ±1.2%. It concluded that this is a good value for emissions in the Marcellus shale area. This includes total lifecycle methane leakage from extraction to consumption.)
- Percent of methane leakage associated with transportation and consumption: 17% (this was taken from a July 2018 article in Science magazine, <http://science.sciencemag.org/content/early/2018/06/20/science.aar7204>). It shows most of the methane leakage occurs as part of the extraction, gathering and processing activities and only 17% is associated with transportation and consumption. This analysis shows both the full lifecycle and transportation/consumption views separately for informational purposes.
- Methane leakage volume converted to metric tons: 1Tcf = 19.26 Million Metric Tons
- Methane mass (tons) converted to CO<sub>2</sub>e: 86 (the methane tonnage is multiplied by this factor since methane is 86 times more effective as a GHG than CO<sub>2</sub> over a 20 year span).
- Pipeline operational utilization: 90% (this is the percent of the time the pipeline will operate at full capacity). The Oil Change algorithm used 95% but it was lowered to 90% to be more conservative. Oil Change said that 95% was reasonable for new pipelines which should have relatively low maintenance needs and will work to maximize return by high utilization.

The GHG emissions for power plants was based either on data from the DEP (for plants that have applied for permits or are operational) or was modeled based on the Meadowlands power plant data as this reflects new technology that is assumed for other new plants.

## **Findings**

The results in Table 1 below show the effect of the full life cycle leakage of methane. Total estimated CO<sub>2</sub> emissions from burning the gas in these pipelines and power plants are **24.35 million metric tons/year**. The estimated methane leakage from both adds another **13.65 million metric tons/year in CO<sub>2</sub>e GHGs** for a total of **43.2 million metric tons/year** of additional GHG emissions in New Jersey and in Pennsylvania where the bulk of the methane leakage will take place. (Note – the totals from CO<sub>2</sub> and methane above do not include the total CO<sub>2</sub>e emissions from Sewaren 7, as can be seen in the table. The total emissions are the sum of the CO<sub>2</sub> emissions, the methane CO<sub>2</sub>e emissions and the total CO<sub>2</sub>e emissions from Sewaren 7.)

Table 2 below shows the results by only considering the methane leakage associated with transportation and consumption. It has the same volume of CO<sub>2</sub> emissions but only 2.44 million metric tons/year from methane leakage for a total of **32.05 million metric tons/year** of additional estimated GHG CO<sub>2</sub>e emissions in New Jersey (including Sewaren 7).

It is also very illuminating to examine the emissions from power plants separate from the pipelines since pipeline gas will generally support both residential/business needs as well as power plants. The total CO<sub>2</sub>e emissions from these five power plants are estimated to be **14.2 million metric tons/year** (the methane leakage estimates for power plants is independent of the lifecycle considerations). Considering that New Jersey's 2017 in-state power emissions were **18.6 million metric tons of CO<sub>2</sub>e**, according to the U.S.

Environmental Protection Agency

(<https://www.njspotlight.com/stories/18/06/05/greens-urge-murphy-to-clamp-down-on-co2-emissions-from-power-plants/>), this is equivalent to **an increase of 76%**.

As described above there are some voids in the information needed to more precisely compute these GHG emissions. However, even if all the new projects use PennEast gas for 100% of their needs, the most by which this this could reduce the total in Table 2 would be about 11 million metric tons, leaving **a net CO<sub>2</sub>e increase of approximately 21 million metric tons**. Considering New Jersey's total GHG emissions per year are about 100 million metric tons (<https://www.state.nj.us/dep/aqes/climate/data.html>) this represents **a 21% increase in an era when the most urgent goal is to significantly reduce total GHGs**.

If readers of this report believe that it has errors or significant omissions the coalition urges them to perform their own estimates and review the algorithms and assumptions (such as overlaps in these projects) and come to their own conclusions. Empower NJ will provide all the details on its calculations and work with any other entities who wish to perform their own analysis.

| <b>Table 1 - GHG Emissions (Full Lifecycle Methane Leakage - Extraction to Consumption)</b>           |                                       |   |   |
|---|---------------------------------------|---|---|
| <b>Pipeline Projects</b>  | <b>CO2 Emissions<br/>(MM* Tons/Y)</b> | <b>CO2e Methane<br/>Emissions<br/>(MM Tons/Y)</b> | <b>Total CO2e<br/>Emissions<br/>(MM Tons/Y)</b> |
| PennEast Pipeline (Central NJ) <sup>1</sup>   | 13.73                                 | 9.90  | <b>23.64</b>                                    |
| PennEast Pipeline (3 Compressors in PA) <sup>2</sup>  | 0.19                                  | 0.00  | <b>0.19</b>                                     |
| Northeast Supply Enhancement (NESE) (Somerset and Middlesex Counties, Raritan Bay) <sup>3</sup>       | 7.85                                  | 5.66  | <b>13.51</b>                                    |
| NESE Compressor #206 (Somerset NJ) <sup>4</sup>   | 0.14                                  | 0.003   | <b>0.14</b>                                     |
| Cape Atlantic Reliability Project (Pinelands Pipeline #1, aka South Jersey Gas pipeline) <sup>5</sup> | 1.13                                  | 0.82  | <b>1.95</b>                                     |
| Southern Reliability Link (Pinelands Pipeline #2) <sup>6</sup>  | 2.75                                  | 1.98  | <b>4.73</b>                                     |
| Garden State Expansion project <sup>7,8,17</sup>  | 3.53                                  | 2.55  | <b>6.12</b>                                     |
| Gateway Expansion (Roseland) <sup>7,8,9</sup>   | 1.28                                  | 0.92  | <b>2.19</b>                                     |
| Rivervale South to Market (Hudson, Mercer County and the NJ Meadowlands)                              | 3.73                                  | 2.69  | <b>6.42</b>                                     |
| Lambertville East Expansion <sup>10</sup>   | 1.18                                  | 0.85  | <b>2.03</b>                                     |
| Lambertville East Expansion Compressors <sup>11</sup>   | unk                                   | unk   | <b>0.10</b>                                     |
| <b>Net New Emissions from Pipeline Projects</b>   | <b>18.74</b>                          | <b>13.51</b>                                      | <b>32.35</b>                                    |
|   |                                       |   |   |
| <b>Power Plant Projects</b>   |                                       |   |   |
| Meadowlands Power Plant (North Bergen) <sup>12</sup>  | 3.50                                  | 0.09  | <b>3.59</b>                                     |
| Phoenix Energy Center (Holland Twp) <sup>13,14</sup>  | 1.93                                  | 0.04  | <b>1.98</b>                                     |
| BL England (Upper Twp) <sup>13</sup>  | 1.30                                  | 0.03  | <b>1.34</b>                                     |
| Keasbey Energy Center (Woodbridge) <sup>13,16</sup>   | 2.11                                  | 0.05  | <b>2.17</b>                                     |
| Sewaren 7 (Woodbridge) <sup>15</sup>  | unk                                   | unk   | <b>5.16</b>                                     |
| Total Power Plant Emissions (Informational)   | 8.85                                  | 0.21  | <b>14.23</b>                                    |
| <b>Net New Emissions from Power Plants</b>  | <b>5.61</b>                           | <b>0.14</b>                                       | <b>10.91</b>                                    |
| <b>Total Emissions</b>  | <b>24.35</b>                          | <b>13.65</b>                                      | <b>43.26</b>                                    |

\*Million Metric

| <b>Table 2 - GHG Emissions (Methane Leakage - Transportation and Consumption Only)</b>                |                                   |   |   |
|---|-----------------------------------|---|---|
| <b>Pipeline Projects</b>  | <b>CO2 Emissions (MM* Tons/Y)</b> | <b>CO2e Methane Emissions (MM Tons/Y)</b> | <b>Total CO2e Emissions (MM Tons/Y)</b> |
| PennEast Pipeline (Central NJ) <sup>1</sup>   | 13.73                             | 1.68                                      | <b>15.42</b>                            |
| PennEast Pipeline (3 Compressors in PA) <sup>2</sup>  | 0.19                              | 0.00                                      | <b>0.19</b>                             |
| Northeast Supply Enhancement (NESE) (Somerset and Middlesex Counties, Raritan Bay) <sup>3</sup>       | 7.85                              | 0.96                                      | <b>8.81</b>                             |
| NESE Compressor #206 (Somerset NJ) <sup>4</sup>   | 0.14                              | 0.003                                     | <b>0.14</b>                             |
| Cape Atlantic Reliability Project (Pinelands Pipeline #1, aka South Jersey Gas pipeline) <sup>5</sup> | 1.13                              | 0.14                                      | <b>1.27</b>                             |
| Southern Reliability Link (Pinelands Pipeline #2) <sup>6</sup>  | 2.75                              | 0.34                                      | <b>3.08</b>                             |
| Garden State Expansion project <sup>7,8,17</sup>  | 3.53                              | 0.43                                      | <b>4.00</b>                             |
| Gateway Expansion (Roseland) <sup>7,8,9</sup>   | 1.28                              | 0.16                                      | <b>1.43</b>                             |
| Rivervale South to Market (Hudson, Mercer County and the NJ Meadowlands)                              | 3.73                              | 0.46                                      | <b>4.18</b>                             |
| Lambertville East Expansion <sup>10</sup>   | 1.18                              | 0.14                                      | <b>1.32</b>                             |
| Lambertville East Expansion Compressors <sup>11</sup>   | unk                               | unk                                       | <b>0.10</b>                             |
| <b>Net Emissions from Pipeline Projects</b>   | <b>18.74</b>                      | <b>2.30</b>                               | <b>21.13</b>                            |
|   |                                   |   |   |
| <b>Power Plant Projects</b>   |                                   |   |   |
| Meadowlands Power Plant (North Bergen) <sup>12</sup>  | 3.5                               | 0.09                                      | <b>3.59</b>                             |
| Phoenix Energy Center (Holland Twp) <sup>13,14</sup>  | 1.93                              | 0.04                                      | <b>1.98</b>                             |
| BL England (Upper Twp) <sup>13</sup>  | 1.3                               | 0.03                                      | <b>1.34</b>                             |
| Keasbey Energy Center (Woodbridge) <sup>13,16</sup>   | 2.11                              | 0.05                                      | <b>2.17</b>                             |
| Sewaren 7 (Woodbridge) <sup>15</sup>  | unk                               | unk                                       | <b>5.16</b>                             |
| Total Power Plant Emissions (Informational)   | 8.85                              | 0.21                                      | 14.23                                   |
| <b>Net Emissions from Power Plants</b>  | <b>5.61</b>                       | <b>0.14</b>                               | <b>10.91</b>                            |
| <b>Total Emissions</b>  | <b>24.35</b>                      | <b>2.44</b>                               | <b>32.05</b>                            |

\*Million Metric

Notes: (Same for both tables)

1 Gas volume used in NESE was subtracted from total PennEast volume as PennEast is the source of gas for NESE and this will be burned in NY.

2 CO<sub>2</sub> emissions taken from FERC Final EIS for PennEast, Methane emissions computed based on NESE application for similar compressors.

3 All of the gas carried by the NESE pipeline is expected to be consumed in New York, other than that used to power the compressor.

4 CO<sub>2</sub> mass numbers are taken directly from the NESE FERC DEIS. Methane emission from NESE application.

5 GHG estimates based on the volume of gas capacity over the amount needed by BL England.

6 Assumes half of the capacity is used for reliability and the other half is used to support new customers. GHG calculation reflects half of the capacity.

7 Compressors are electric driven and do not burn methane as a power source.

8 Total GHG emissions include additional gas that will be carried by pipelines and compressor emissions.

9 Total additional horsepower is 33,000 to support additional 65K dekatherms/day (dt/d), while previous upgrade added 2,500 hp to support 115K dt/d. Total capacity of 33,000 hp is 1.5M dt/d but only used the stated increase of 65K dt/d.

10 Emissions estimated from burning and leakage of additional gas capacity.

Commissioner LeFleur stated that total additional CO<sub>2</sub>e emissions would be 1.16M metric tons.

11 Total CO<sub>2</sub>e emissions from new compressors as stated in FERC EA. Separate data on CO<sub>2</sub> and methane was not provided.

12 CO<sub>2</sub> emissions are based on applicant's submission to NJDEP. Methane emissions are based on F&WW estimate including leakage. Gas for this plant will come from Williams Transco but it is not clear how much will be provided by the additional capacity of the Rivervale project. The plant needs about 110M cf/d and Rivervale will only provide 50M cf/d to Transco's station in Hudson County.

13 Emissions are estimated based on those expected from the North Bergen plant as no information has been found on the gas power technology that will be used.

14 Methane burned by this plant would come from the PennEast pipeline whose emissions are shown in that pipeline section above. Emissions from the Phoenix plant are not included in the total emissions.

15 Emission data from NJDEP operating permit. Plant started operations in mid 2018 and emissions need to be counted as new. Since this plant is in operation it does not need gas from any new pipeline project. Sewaren 7 replaced four older peaker plants (Sewaren 1, 2, 3, 4) which were shut down, thus its emissions should be considered a combination of replacements and new (it is not a peaker plant).

16 It is not known which proposed pipeline project, if any, would supply gas to this power plant. There may be some overlap in the computation of emissions between pipelines and power plants.

17 Phase 1 of the Garden State Expansion project, which only contributes about 11% of that project's total capacity, was completed in September 2017. The second compressor was completed in 2018.