

**Objective:**  
Evaluate the limitations of the EPA's landfill emissions estimation model. Alternative models are analyzed for improvements.

**Analysis and Conclusion:**  
The default values of k and L<sub>0</sub> used in LandGEM and IPCC are not representative of varying landfill waste compositions or climate. Therefore, a model that encompasses site-specific parameters will produce a more valid methane emission projection. To further improve the concepts introduced by CALMIM, a model should incorporate site-specific composition and waste depth.

# 2022 Solid Waste Competition: Evaluating Methods For Landfill Gas Emissions Estimation

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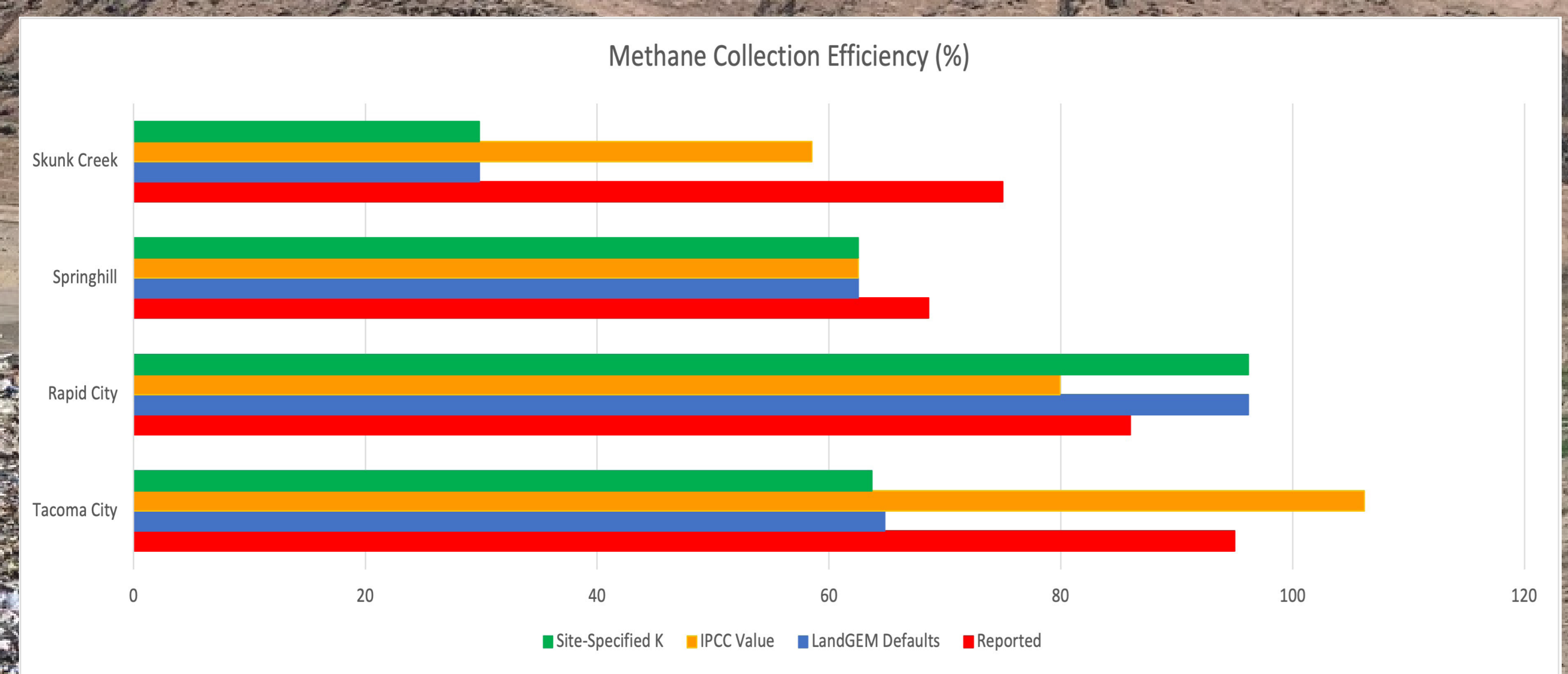
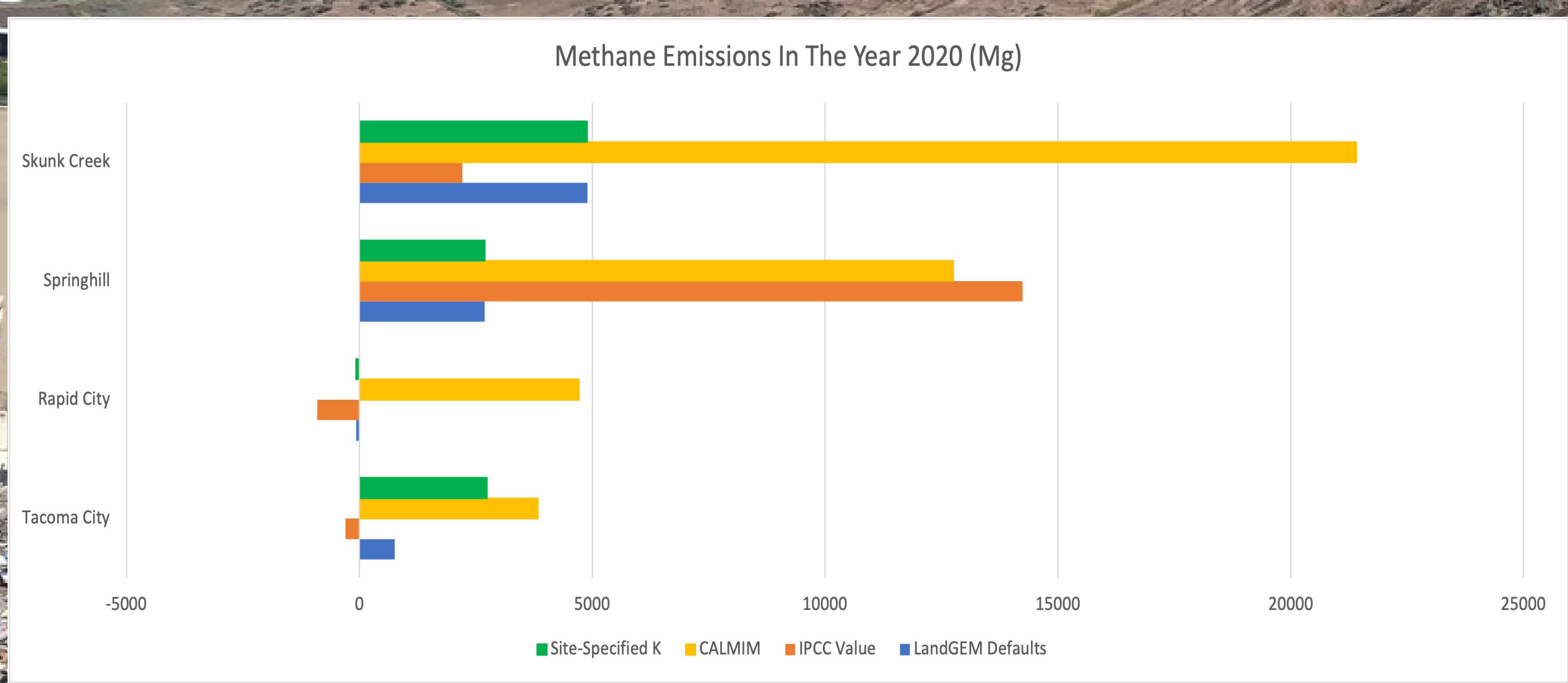


**Introduction:**  
Methane is among one of the worst greenhouse gasses for the atmosphere. A huge source of methane emissions can be traced to landfills. Over time, the waste decays and emits the gas at large volumes. Therefore, landfill emissions must be more strictly and accurately monitored.

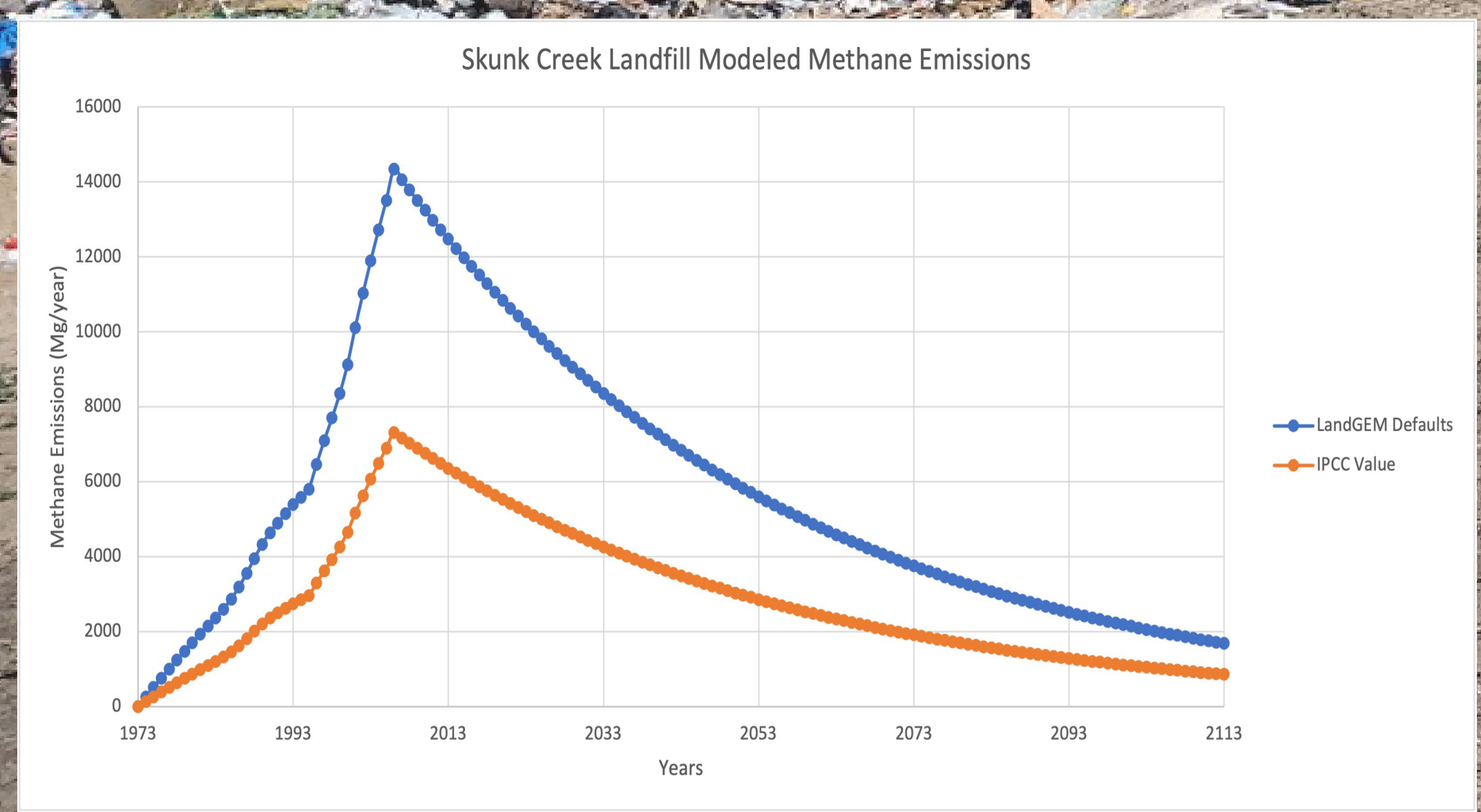
**Methodology:**  
Four landfills were selected using different climate criteria. After the landfills were selected, their reported data was used and ran through IPCC, LandGEM, and CALMIM. Using the software, each landfill's methane generation and emissions were calculated.



**Table of Methane Emissions and Collection Efficiencies:**



**Example Graph of Methane Generation Based on LandGEM and IPCC values:**



**Example CALMIM Calculation:**

CALMIM Version: 5.4  
SpringHill -- Simulated Weather Used  
03/02/2022

| *                       | A2    | A3    | A4           | A5    |
|-------------------------|-------|-------|--------------|-------|
| Gas Recovery            | 0 %   | 100 % | 100 %        | 100 % |
| Cover Type              | Daily | Daily | Intermediate | Final |
| Cover area %            | 15 %  | 2 %   | 57 %         | 26 %  |
| Vegetation Presence (%) | 0 %   | 0 %   | 0 %          | 50 %  |

| *        | A2      | A3      | A4      | A5      |
|----------|---------|---------|---------|---------|
| Layer 1  | CLAY 12 | CLAY 12 | CLAY 12 | LOAM 12 |
| Layer 2  |         |         |         |         |
| Layer 3  |         |         |         |         |
| Layer 4  |         |         |         |         |
| Layer 5  |         |         |         |         |
| Layer 6  |         |         |         |         |
| Layer 7  |         |         |         |         |
| Layer 8  |         |         |         |         |
| Layer 9  |         |         |         |         |
| Layer 10 |         |         |         |         |

| *  | A2       | A3      | A4            | A5        |
|--|----------|---------|---------------|-----------|
| Methane Concentration Base of Cover                        | 0.3      | 0.21    | 31.5          | 39.5      |
| Oxygen Concentration Base of Cover                         | 5.0      | 5.0     | 1.0           | 0.0       |
| Max. Methanotroph Oxidation Rate (ug/g/day)                | 400.0    | 400.0   | 400.0         | 400.0     |
| Emission Data  |          |         |               |           |
| Methane Emission without Oxidation (g/m <sup>2</sup> /day) | 0.92     | 0.64    | 94.58         | 12.62     |
| Methane Emission with Oxidation (g/m <sup>2</sup> /day)    | 0.89     | 0.63    | 12.84         | 0.0       |
| Remaining Oxidation Capacity(g/m <sup>2</sup> /day)        | 0.0      | 0.0     | 15.46         | 89.82     |
| % Oxidation  | 3.56     | 2.96    | 87.71         | 100.0     |
| Site Calculations  |          |         |               |           |
| Total Cover Emissions with Oxidation (kg/year)             | 29660.69 | 2787.88 | 1628414.57    | 0.0       |
| Total Cover Emissions without Oxidation (kg/year)          | 30620.45 | 2857.07 | 1.199267578E7 | 729811.63 |