

# The greenhouse gas intensity of oil sands production

Appendix A: Data tables/results

September 2018

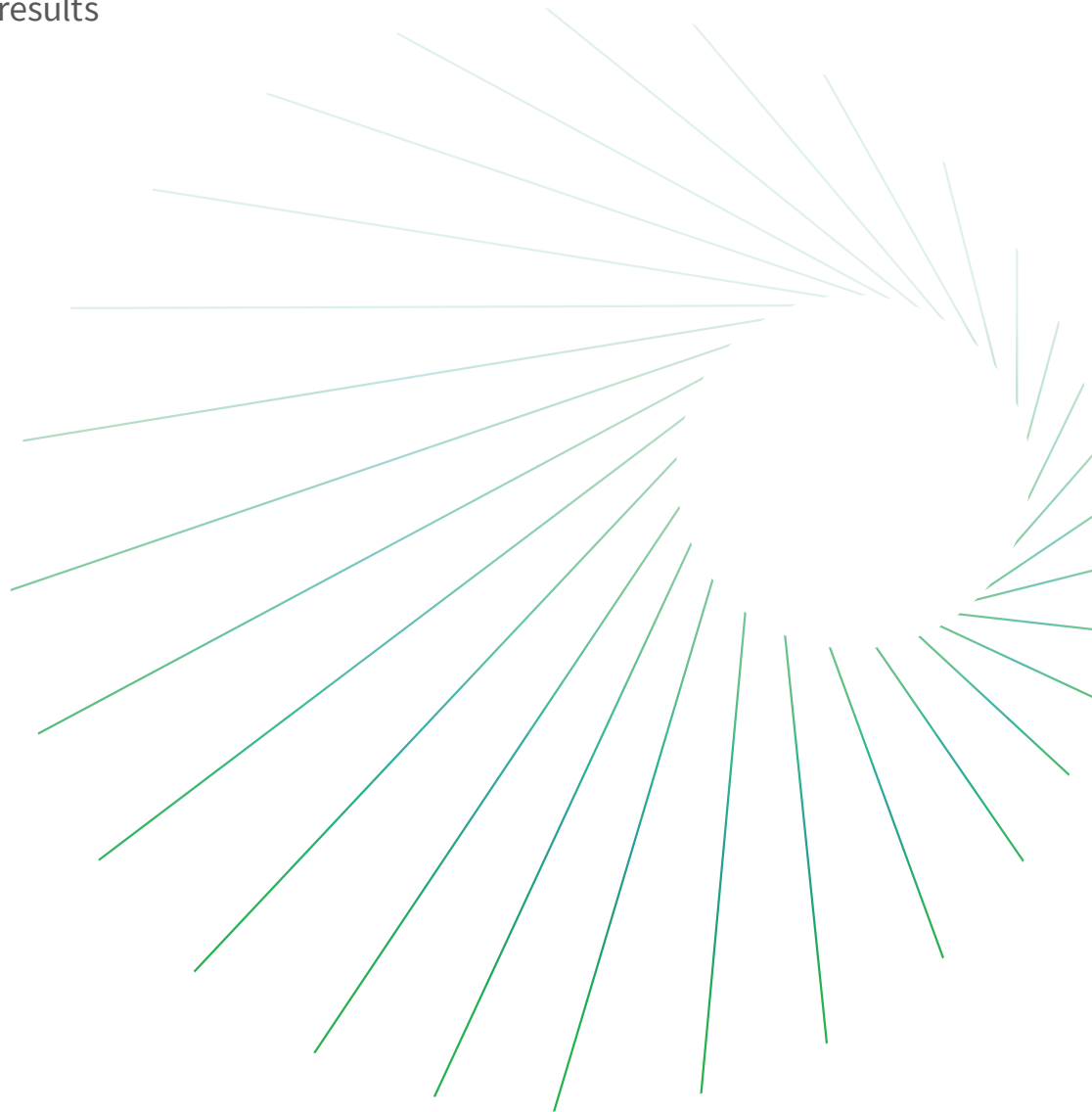




Table A-2

**Upper-bound (more conservative) mined oil sands by process and component, 2008-30**

| Mined SCO                          | Units                              | Historical |      |      |      |      |      |      |      |      |      | Forecast |      |      |      |      |      |      |      |      |      | Percent change, 2008/09-17 | Percent change, 2017-30 |      |      |      |       |
|------------------------------------|------------------------------------|------------|------|------|------|------|------|------|------|------|------|----------|------|------|------|------|------|------|------|------|------|----------------------------|-------------------------|------|------|------|-------|
|                                    |                                    | 2008       | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018     | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |                            |                         | 2028 | 2029 | 2030 |       |
| Natural gas                        | kgCO <sub>2</sub> e/bbl of SCO     | 41         | 41   | 38   | 35   | 45   | 38   | 40   | 38   | 38   | 38   | 38       | 39   | 38   | 38   | 46   | 45   | 45   | 45   | 45   | 44   | 44                         | 44                      | 44   | -7%  | 14%  |       |
| Produced gas                       | kgCO <sub>2</sub> e/bbl of SCO     | 29         | 32   | 31   | 31   | 25   | 34   | 33   | 27   | 24   | 23   | 23       | 23   | 23   | 23   | 23   | 23   | 23   | 23   | 23   | 23   | 23                         | 23                      | 23   | -19% | 0%   |       |
| Petroleum coke                     | kgCO <sub>2</sub> e/bbl of SCO     | 20         | 21   | 17   | 16   | 13   | 10   | 11   | 10   | 10   | 9    | 9        | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 8    | 8                          | 8                       | 8    | -5%  | -50% |       |
| Mobile mine fleet                  | kgCO <sub>2</sub> e/bbl of SCO     | 9          | 9    | 10   | 9    | 9    | 9    | 10   | 10   | 9    | 9    | 9        | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 8    | 8                          | 8                       | 8    | -5%  | -9%  |       |
| Fugitives, venting, and flaring    | kgCO <sub>2</sub> e/bbl of SCO     | 9          | 8    | 8    | 8    | 10   | 9    | 6    | 6    | 6    | 6    | 6        | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6                          | 6                       | 6    | -37% | -5%  |       |
| Carbon capture                     | kgCO <sub>2</sub> e/bbl of SCO     | -          | -    | -    | -    | -    | -    | -    | -1   | -3   | -2   | -2       | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2                         | -2                      | -2   | -2   | -4%  | -129% |
| Electrical balance (import/export) | kgCO <sub>2</sub> e/bbl of SCO     | -4         | -3   | -2   | -1   | 0    | -1   | 0    | 1    | 1    | 1    | 1        | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1                          | 1                       | 1    | 1    | -2%  | -518% |
| Upstream natural gas production    | kgCO <sub>2</sub> e/bbl of SCO     | 7          | 6    | 6    | 6    | 7    | 6    | 6    | 6    | 6    | 6    | 6        | 6    | 6    | 6    | 7    | 7    | 7    | 7    | 7    | 7    | 7                          | 7                       | 7    | 7    | 7    | 8%    |
| Upstream diluent                   | kgCO <sub>2</sub> e/bbl of SCO     | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | -2%   |
| IHS Markit upstream GHG intensity  | kgCO <sub>2</sub> e/bbl of SCO     | 112        | 115  | 108  | 104  | 110  | 105  | 105  | 97   | 92   | 91   | 88       | 91   | 90   | 90   | 88   | 88   | 87   | 87   | 87   | 86   | 86                         | 86                      | 86   | 86   | 86   | -18%  |
| Mined dilbit (PFT)                 |                                    |            |      |      |      |      |      |      |      |      |      |          |      |      |      |      |      |      |      |      |      |                            |                         |      |      |      |       |
| Natural gas                        | kgCO <sub>2</sub> e/bbl of dilbit  | -          | -    | -    | -    | 50   | 28   | 25   | 24   | 24   | 27   | 22       | 22   | 22   | 22   | 22   | 22   | 22   | 22   | 21   | 21   | 21                         | 21                      | 21   | 21   | 21   | -13%  |
| Produced gas                       | kgCO <sub>2</sub> e/bbl of dilbit  | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A   |
| Petroleum coke                     | kgCO <sub>2</sub> e/bbl of dilbit  | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A   |
| Mobile mine fleet                  | kgCO <sub>2</sub> e/bbl of dilbit  | -          | -    | -    | -    | 10   | 5    | 5    | 5    | 5    | 5    | 5        | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5                          | 5                       | 5    | 5    | 5    | -5%   |
| Fugitives, venting, and flaring    | kgCO <sub>2</sub> e/bbl of dilbit  | -          | -    | -    | -    | 8    | 3    | 1    | 1    | 1    | 2    | 1        | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1                          | 1                       | 1    | 1    | 1    | 3%    |
| Carbon capture                     | kgCO <sub>2</sub> e/bbl of dilbit  | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A   |
| Electrical balance (import/export) | kgCO <sub>2</sub> e/bbl of dilbit  | 0          | 0    | 0    | 0    | 15   | 8    | 4    | 5    | 5    | 5    | 1        | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1                          | 1                       | 1    | 1    | 1    | -73%  |
| Upstream natural gas production    | kgCO <sub>2</sub> e/bbl of dilbit  | 0          | 0    | 0    | 0    | 0    | 8    | 4    | 4    | 4    | 4    | 4        | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4                          | 4                       | 4    | 4    | 4    | -13%  |
| Upstream diluent                   | kgCO <sub>2</sub> e/bbl of dilbit  | 0          | 0    | 0    | 0    | 0    | 7    | 7    | 7    | 7    | 7    | 7        | 7    | 7    | 7    | 7    | 7    | 7    | 7    | 7    | 7    | 7                          | 7                       | 7    | 7    | 7    | 3%    |
| IHS Markit upstream GHG intensity  | kgCO <sub>2</sub> e/bbl of dilbit  | 0          | 0    | 0    | 0    | 98   | 57   | 48   | 47   | 46   | 45   | 41       | 41   | 41   | 41   | 41   | 41   | 40   | 40   | 40   | 39   | 39                         | 39                      | 39   | 39   | 39   | -15%  |
| Mined average                      |                                    |            |      |      |      |      |      |      |      |      |      |          |      |      |      |      |      |      |      |      |      |                            |                         |      |      |      |       |
| Natural gas                        | kgCO <sub>2</sub> e/bbl of dilbit  | 41         | 41   | 38   | 35   | 45   | 39   | 39   | 36   | 36   | 36   | 35       | 33   | 33   | 33   | 38   | 38   | 37   | 37   | 37   | 37   | 37                         | 37                      | 37   | 36   | 36   | -13%  |
| Produced gas                       | kgCO <sub>2</sub> e/bbl of dilbit  | 29         | 32   | 31   | 31   | 25   | 33   | 30   | 23   | 19   | 19   | 16       | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16   | 16                         | 16                      | 16   | 16   | 16   | -34%  |
| Petroleum coke                     | kgCO <sub>2</sub> e/bbl of dilbit  | 20         | 21   | 17   | 16   | 13   | 10   | 9    | 8    | 8    | 8    | 8        | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8                          | 8                       | 8    | 8    | 8    | -62%  |
| Mobile mine fleet                  | kgCO <sub>2</sub> e/bbl of dilbit  | 9          | 9    | 10   | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9        | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9                          | 9                       | 9    | 9    | 9    | -14%  |
| Fugitives, venting, and flaring    | kgCO <sub>2</sub> e/bbl of dilbit  | 9          | 8    | 8    | 8    | 10   | 8    | 6    | 5    | 5    | 5    | 4        | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4                          | 4                       | 4    | 4    | 4    | -46%  |
| Carbon capture                     | kgCO <sub>2</sub> e/bbl of dilbit  | -          | -    | -    | -    | -    | -    | -    | -1   | -2   | -2   | -2       | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2                         | -2                      | -2   | -2   | -2   | -20%  |
| Electrical balance (import/export) | kgCO <sub>2</sub> e/bbl of product | -4         | -3   | -2   | -1   | 0    | 0    | 0    | 1    | 2    | 2    | 2        | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2                          | 2                       | 2    | 2    | 2    | -147% |
| Upstream natural gas production    | kgCO <sub>2</sub> e/bbl of product | 7          | 6    | 6    | 6    | 7    | 6    | 6    | 6    | 6    | 6    | 6        | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6                          | 6                       | 6    | 6    | 6    | -3%   |
| Upstream diluent                   | kgCO <sub>2</sub> e/bbl of product | -          | -    | -    | -    | 0    | 1    | 1    | 1    | 1    | 1    | 1        | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1                          | 1                       | 1    | 1    | 1    | -9%   |
| IHS Markit upstream GHG intensity  | kgCO <sub>2</sub> e/bbl of product | 112        | 115  | 108  | 104  | 110  | 105  | 101  | 89   | 83   | 83   | 75       | 75   | 74   | 74   | 73   | 73   | 72   | 72   | 72   | 71   | 71                         | 71                      | 71   | 71   | 71   | -26%  |

Source: IHS Markit

Table A-3

**Lower-bound (more aggressive) mined oil sands by process and component, 2008-30**

| Mined SCO                          | Units                             | Historical |      |      |      |      |      |      |      |      |      | Forecast |      |      |      |      |      |      |      |      |      | Percent change, 2008/09-17 | Percent change, 2017-30 |      |      |      |     |       |       |
|------------------------------------|-----------------------------------|------------|------|------|------|------|------|------|------|------|------|----------|------|------|------|------|------|------|------|------|------|----------------------------|-------------------------|------|------|------|-----|-------|-------|
|                                    |                                   | 2008       | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018     | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |                            |                         | 2028 | 2029 | 2030 |     |       |       |
| Natural gas                        | kgCO <sub>2</sub> e/bbl of SCO    | 41         | 41   | 38   | 35   | 45   | 38   | 40   | 38   | 38   | 38   | 38       | 38   | 38   | 38   | 45   | 46   | 45   | 47   | 44   | 44   | 44                         | 44                      | 44   | 44   | 44   | -7% | 13%   |       |
| Produced gas                       | kgCO <sub>2</sub> e/bbl of SCO    | 29         | 32   | 31   | 31   | 25   | 34   | 33   | 27   | 24   | 23   | 23       | 23   | 23   | 23   | 23   | 23   | 23   | 23   | 23   | 23   | 23                         | 23                      | 23   | 23   | 23   | 23  | -19%  | 0%    |
| Petroleum coke                     | kgCO <sub>2</sub> e/bbl of SCO    | 20         | 21   | 17   | 16   | 13   | 10   | 11   | 10   | 10   | 10   | 10       | 10   | 10   | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9                          | 9                       | 9    | 9    | 9    | 9   | -53%  | -50%  |
| Mobile mine fleet                  | kgCO <sub>2</sub> e/bbl of SCO    | 9          | 9    | 10   | 9    | 9    | 9    | 10   | 10   | 9    | 9    | 9        | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9    | 9                          | 9                       | 9    | 9    | 9    | 9   | -16%  | -5%   |
| Fugitives, venting, and flaring    | kgCO <sub>2</sub> e/bbl of SCO    | 9          | 8    | 8    | 8    | 10   | 9    | 6    | 6    | 6    | 6    | 6        | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6    | 6                          | 6                       | 6    | 6    | 6    | 6   | -37%  | -5%   |
| Carbon capture                     | kgCO <sub>2</sub> e/bbl of SCO    | -          | -    | -    | -    | -    | -    | -    | -1   | -3   | -2   | -2       | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2   | -2                         | -2                      | -2   | -2   | -2   | -2  | -4%   | -129% |
| Electrical balance (import/export) | kgCO <sub>2</sub> e/bbl of SCO    | -4         | -3   | -2   | -1   | 0    | -1   | 0    | 1    | 1    | 1    | 1        | 1    | 1    | 1    | 2    | -5   | -5   | -7   | -7   | -7   | -7                         | -7                      | -7   | -7   | -7   | -7  | -128% | -756% |
| Upstream natural gas production    | kgCO <sub>2</sub> e/bbl of SCO    | 7          | 6    | 6    | 6    | 7    | 6    | 6    | 6    | 6    | 6    | 6        | 6    | 6    | 6    | 7    | 7    | 7    | 7    | 7    | 7    | 7                          | 7                       | 7    | 7    | 7    | 7   | -2%   | 7%    |
| Upstream diluent                   | kgCO <sub>2</sub> e/bbl of SCO    | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A | N/A   |       |
| IHS Markit upstream GHG intensity  | kgCO <sub>2</sub> e/bbl of SCO    | 112        | 115  | 108  | 104  | 110  | 105  | 105  | 97   | 92   | 91   | 88       | 90   | 90   | 89   | 87   | 87   | 87   | 86   | 83   | 83   | 82                         | 82                      | 82   | 82   | 82   | 82  | -18%  |       |
| Mined dilbit (PFT)                 |                                   |            |      |      |      |      |      |      |      |      |      |          |      |      |      |      |      |      |      |      |      |                            |                         |      |      |      |     |       |       |
| Natural gas                        | kgCO <sub>2</sub> e/bbl of dilbit | -          | -    | -    | -    | 50   | 28   | 25   | 24   | 24   | 27   | 22       | 22   | 22   | 22   | 21   | 21   | 21   | 21   | 20   | 20   | 18                         | 18                      | 17   | 17   | 17   | 17  | -27%  |       |
| Produced gas                       | kgCO <sub>2</sub> e/bbl of dilbit | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A | N/A   |       |
| Petroleum coke                     | kgCO <sub>2</sub> e/bbl of dilbit | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A | N/A   |       |
| Mobile mine fleet                  | kgCO <sub>2</sub> e/bbl of dilbit | -          | -    | -    | -    | 10   | 5    | 5    | 5    | 5    | 5    | 5        | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5    | 5                          | 5                       | 5    | 5    | 5    | 5   | -13%  |       |
| Fugitives, venting, and flaring    | kgCO <sub>2</sub> e/bbl of dilbit | -          | -    | -    | -    | 8    | 3    | 1    | 1    | 1    | 2    | 1        | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1                          | 1                       | 1    | 1    | 1    | 1   | 3%    |       |
| Carbon capture                     | kgCO <sub>2</sub> e/bbl of dilbit | N/A        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A                        | N/A                     | N/A  | N/A  | N/A  | N/A | N/A   |       |
| Electrical balance (import/export) | kgCO <sub>2</sub> e/bbl of dilbit | -          | -    | -    | -    | 15   | 8    | 5    | 5    | 5    | 5    | -1       | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1                          | 1                       | 1    | 1    | 1    | 1   | -73%  |       |
| Upstream natural gas production    | kgCO <sub>2</sub> e/bbl of dilbit | -          | -    | -    | -    | 6    | 4    | 4    | 4    | 4    | 4    | 4        | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4    | 4                          | 4                       | 4    | 4    | 4    | 4   | -27%  |       |
| Upstream diluent                   | kgCO <sub>2</sub> e/bbl of dilbit |            |      |      |      |      |      |      |      |      |      |          |      |      |      |      |      |      |      |      |      |                            |                         |      |      |      |     |       |       |

Table A-4

**Oil sands SAGD dilbit GHG emission intensity cases by component, 2009–30**

| Upper-bound case (more conservative)                   | Units                                  | Historical |           |           |           |           |           |           |           |           |           | Forecast  |           |           |           |           |           |           |           |           |           | Percent change, 2017–30 |            |
|--|--|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------------------|------------|
|  |  | 2009       | 2010      | 2011      | 2012      | 2013      | 2014      | 2015      | 2016      | 2017      | 2018      | 2019      | 2020      | 2021      | 2022      | 2023      | 2024      | 2025      | 2026      | 2027      | 2028      |                         | 2029       |
| Natural gas  | kgCO <sub>2</sub> e/bbl of dilbit      | 62         | 57        | 56        | 55        | 56        | 51        | 50        | 50        | 49        | 47        | 47        | 47        | 47        | 46        | 45        | 43        | 42        | 40        | 39        | 39        | 38                      | -22%       |
| Flaring and fugitives                                  | kgCO <sub>2</sub> e/bbl of dilbit      | 0          | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0                       | 0%         |
| Electrical import/export                               | kgCO <sub>2</sub> e/bbl of dilbit      | -19        | -15       | -13       | -11       | -12       | -9        | -8        | -6        | -6        | -5        | -4        | -4        | -4        | -4        | -4        | -4        | -4        | -4        | -4        | -4        | -4                      | -70%       |
| Upstream natural gas production                        | kgCO <sub>2</sub> e/bbl of dilbit      | 12         | 11        | 10        | 10        | 10        | 10        | 9         | 9         | 9         | 9         | 9         | 9         | 9         | 8         | 8         | 8         | 8         | 8         | 8         | 7         | 7                       | -22%       |
| Upstream diluent production                            | kgCO <sub>2</sub> e/bbl of dilbit      | 10         | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10                      | 0%         |
| Upstream solvent/natural gas production for confection | kgCO <sub>2</sub> e/bbl of dilbit      | -          | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -                       | 0%         |
| <b>IHS Markit upstream GHG intensity</b>               | <b>kgCO<sub>2</sub>e/bbl of dilbit</b> | <b>66</b>  | <b>63</b> | <b>64</b> | <b>65</b> | <b>62</b> | <b>62</b> | <b>62</b> | <b>64</b> | <b>63</b> | <b>62</b> | <b>62</b> | <b>63</b> | <b>62</b> | <b>61</b> | <b>60</b> | <b>58</b> | <b>57</b> | <b>56</b> | <b>54</b> | <b>53</b> | <b>52</b>               | <b>-4%</b> |
| <b>Lower-bound case (more aggressive)</b>              |  |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |                         |            |
| Natural gas combustion                                 | kgCO <sub>2</sub> e/bbl of dilbit      | 62         | 57        | 56        | 55        | 56        | 51        | 50        | 50        | 49        | 47        | 46        | 46        | 46        | 45        | 44        | 42        | 41        | 40        | 38        | 36        | 35                      | -22%       |
| Flaring and fugitives                                  | kgCO <sub>2</sub> e/bbl of dilbit      | 0          | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0         | 0                       | 0%         |
| Electrical import/export                               | kgCO <sub>2</sub> e/bbl of dilbit      | -19        | -15       | -13       | -11       | -12       | -9        | -8        | -6        | -6        | -5        | -4        | -4        | -4        | -5        | -5        | -5        | -5        | -5        | -5        | -5        | -5                      | -70%       |
| Upstream natural gas production                        | kgCO <sub>2</sub> e/bbl of dilbit      | 12         | 11        | 10        | 10        | 10        | 10        | 9         | 9         | 9         | 9         | 9         | 9         | 9         | 8         | 8         | 8         | 8         | 8         | 7         | 7         | 7                       | -22%       |
| Upstream diluent production                            | kgCO <sub>2</sub> e/bbl of dilbit      | 10         | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10        | 10                      | 0%         |
| Upstream solvent/natural gas production for confection | kgCO <sub>2</sub> e/bbl of dilbit      | -          | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -         | -                       | 0%         |
| <b>IHS Markit upstream GHG intensity</b>               | <b>kgCO<sub>2</sub>e/bbl of dilbit</b> | <b>66</b>  | <b>63</b> | <b>64</b> | <b>65</b> | <b>62</b> | <b>62</b> | <b>62</b> | <b>64</b> | <b>63</b> | <b>62</b> | <b>61</b> | <b>62</b> | <b>60</b> | <b>59</b> | <b>58</b> | <b>56</b> | <b>54</b> | <b>53</b> | <b>50</b> | <b>48</b> | <b>46</b>               | <b>-4%</b> |

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Table A-5

**Oil sands CSS dilbit historical GHG emission intensity, 2009–17**

| Component                                | Units                                  | Historical |           |           |           |           |           |           |           |           |            | Percent change, 2008/09–17 |
|--|--|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|----------------------------|
|  |  | 2009       | 2010      | 2011      | 2012      | 2013      | 2014      | 2015      | 2016      | 2017      |            |                            |
| Natural gas                              | kgCO <sub>2</sub> e/bbl of dilbit      | 77         | 61        | 61        | 54        | 53        | 56        | 58        | 61        | 75        | 76         | -2%                        |
| Flaring and fugitives                    | kgCO <sub>2</sub> e/bbl of dilbit      | -          | -         | -         | -         | -         | -         | -         | -         | -         | -          | 0%                         |
| Electrical import/export                 | kgCO <sub>2</sub> e/bbl of dilbit      | -5         | -5        | -5        | -5        | -5        | -5        | -7        | -10       | -9        | 83%        |                            |
| Upstream natural gas production          | kgCO <sub>2</sub> e/bbl of dilbit      | 15         | 11        | 10        | 10        | 10        | 11        | 11        | 14        | 14        | -2%        |                            |
| Upstream diluent production              | kgCO <sub>2</sub> e/bbl of dilbit      | 9          | 9         | 9         | 9         | 9         | 9         | 9         | 9         | 9         | 0%         |                            |
| <b>IHS Markit upstream GHG intensity</b> | <b>kgCO<sub>2</sub>e/bbl of dilbit</b> | <b>96</b>  | <b>77</b> | <b>69</b> | <b>68</b> | <b>71</b> | <b>73</b> | <b>76</b> | <b>89</b> | <b>90</b> | <b>-7%</b> |                            |

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