# Environmental Impact Comparison Between Natural / Mined Diamonds and Lab-Grown Diamonds

*Published industry benchmarks and data supported by sources*

| Category | Metric | Natural / Mined Diamond Benchmark | Published Lab-Grown Diamond Benchmark | The Sustainability Advantage of Lab-Grown Diamonds |
|---|---|---|---|---|
| **Resources** | Energy used per rough carat | 96–150 kWh/ct<br>**Source 1** | HPHT: approx. 20–36 kWh/ct<br>CVD: approx. 28–77 kWh/ct<br>**Sources A and B** | **HPHT: 76–79% less energy than the mined-diamond industry**<br>**CVD: 49–71% less energy than the mined-diamond industry** |
| **Resources** | Water use per rough carat | 0.48 $m^3$ (480 litres)<br>**Source 2** | 0.07 $m^3$ (70 litres)<br>**Source C** | **Approx. 85% less water than the mined-diamond industry** |
| **Gas Emissions** | GHG emissions per rough carat | 57 kg $CO_2e$ (published mined-diamond benchmark)<br>**Source 2** | 0.028 g $CO_2e$ (published clean-energy scenario)<br>**Source C** | **Significantly less — up to 99.9% lower GHG emissions than the mined-diamond benchmark under the published clean-energy scenario** |
| **Waste** | Mining and production-related material waste per rough carat | 2.63 tonnes<br>**Source 2** | 0.0006 tonnes (0.6 kg)<br>**Source C** | **Approx. 99.98% less mining and production-related material waste than the mined-diamond industry** |
| **Air Pollution** | $SO_2$ and $NO_x$ emissions | Emissions occur, but no robust directly comparable per-carat figure is available. | No direct $SO_2$ or $NO_x$ emissions from the diamond-growing process; indirect emissions depend on the electricity source. | |
| **Ecosystems** | Land, water and ecosystem impacts | Mining can disturb land, habitats and wildlife and create water-pollution risks. Serious failures have occurred, including the 2021 Catoca tailings leak, which polluted cross-border waterways.<br>**Sources 2 and 6** | No diamond mine: avoids mining-related land disturbance, deforestation, habitat disruption, wildlife displacement and mine-water pollution.<br>**Source C** | **Avoids diamond-mining-related disruption to land, water and ecosystems** |
| **Human Impact** | Employment, working conditions and community impact | Can deliver major economic benefits through jobs and public revenue, notably in Botswana. Mining can also involve occupational-safety and human-rights risks.<br>**Sources 3, 4 and 5** | Creates skilled manufacturing jobs in a controlled industrial setting; avoids mining-specific hazards, although factory safety and labour standards still depend on the producer. | **Avoids mining-specific occupational hazards; responsible factory oversight remains essential** |
| **Ethics** | Traceability | Chain of custody can involve multiple stages and jurisdictions. | Can be 100% traceable to a named producer and facility when supported by complete chain-of-custody records. | **Potentially simpler and more direct chain of custody** |

## Conclusion

The published benchmarks indicate that lab-grown diamonds can have a substantially lower environmental impact than mined diamonds. They still require energy, although approximately one-fifth of that used by the mined-diamond industry. As technology and reactor efficiency improve, we hope to reduce this even further, while clean-energy electricity makes production even more sustainable.

### Natural diamond sources


*1. Zhdanov, V. et al. (2021), Energies 14(21), 7062. Reports approximately 96 kWh per rough carat for ALROSA and 150 kWh per rough carat for De Beers. https://doi.org/10.3390/en14217062*

*2. Sun, Y., Jiang, S. and Wang, S. (2024), Humanities and Social Sciences Communications 11, 671, drawing on the earlier Frost & Sullivan dataset. Reports 57 kg $CO_2e$, 2.63 tonnes mineral waste and 0.48 $m^3$ water per rough carat. https://doi.org/10.1057/s41599-024-03195-y*

*3. Trucost / Diamond Producers Association (2019), Total Clarity. Documents employment and community benefits for participating natural-diamond producers. https://www.collectif-diamant.fr/uploads/5cd16066c55d7_2019-total-clarity-report.pdf*

*4. International Labour Organization, Safety and Health in Mines Convention, 1995 (No. 176). Establishes international requirements addressing occupational safety and health risks in mining. https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C176*

*5. Reuters (6 June 2025), Botswana's Debswana curbs diamond production as weak demand persists. Reports that diamonds account for approximately 30% of Botswana's government revenue and 75% of its foreign-currency earnings. https://www.reuters.com/world/africa/botswanas-debswana-curbs-diamond-production-weak-demand-persists-2025-06-06/*

*6. Reuters (3 September 2021), Congo says Angola tailings pollution kills 12, to seek compensation. Reports that pollution linked to the Catoca diamond-mine tailings leak affected the Kasai river system and downstream communities. https://www.reuters.com/business/environment/congo-says-angola-tailings-pollution-kills-12-seek-compensation-2021-09-02/*


### Lab-grown diamond sources


*A. Ali, S. H. (2011), University of Vermont working paper. Reports producer-supplied estimates of approximately 20 kWh per rough carat for Gemesis HPHT and 28 kWh per rough carat for Apollo CVD. These lower figures were not independently audited. https://www.uvm.edu/~shali/Synthetic_Diamonds_Mined_Diamonds.pdf*

*B. Zhdanov, V. et al. (2021), Energies 14(21), 7062. Reports approximately 36 kWh per rough carat for modern gem-quality HPHT and 77 kWh per rough carat for the cited commercial M-CVD process. https://doi.org/10.3390/en14217062*

*C. Sun, Y., Jiang, S. and Wang, S. (2024), Humanities and Social Sciences Communications 11, 671, drawing on the earlier Frost & Sullivan dataset. Under a clean-energy lab-grown scenario, reports 0.028 g $CO_2e$, 0.0006 tonnes production-related material waste and 0.07 $m^3$ water per rough carat. https://doi.org/10.1057/s41599-024-03195-y*