Renewable energy sources and energy conservation

Renewable and nonrenewable energy can be converted into many different ...

In a world where the population swells up at an unprecedented scale, our focus ...

Institutional subscriptions

Published: 04 July 2019

Policies and ethics

Mining areas were mapped using a 50-cell radius around 62,381 pre-operational, operational, and closed mining properties. Mining areas with properties targeting materials critical for renewable energy technology and infrastructure are shown in blue, areas with properties targeting other materials are shown in orange, and those targeting both commodity types are shown in pink. Color shading (light to dark) indicates the density of mining areas--i.e. the number of mining properties within a 50-cell radius of each 1 km cell.

We identified the materials required for renewable energy production (Supplementary Table 1), using projected material demand under 2050 low-carbon energy scenarios6. These projections focused on two technologies (wind turbine manufacturing and solar photovoltaic installations; both expected to experience huge growth in future) and one energy-using technology (storage batteries for electric vehicles, which will address transportation emissions). However, we also included the minerals required for other technologies6 (including carbon capture and storage installations, nuclear electricity generation installations, LED manufacturing, electric vehicle manufacturing, and lithium-Ion batteries) to get a better split between renewable and non-renewable energies.

We obtained point locations for mining properties worldwide31, including pre-operational, operational, and closed sites (Supplementary Table 3). We used Mollweide equal area projection to analyze all data in ArcGIS 10.6. We mapped the global extent of areas potentially influenced by mining by summing the number of mining properties within a 50-cell radius of each 1 km2 grid cell containing a mining property and clipping resultant areas to the terrestrial land surface, to include both the direct and indirect impacts of mining on biodiversity. Counts represent mining density, and we converted density maps to binary values to indicate mining influenced areas when mining density was >0.

We repeated this process for subsets of mining areas by development status (pre-operational, operational, closed; Supplementary Table 3) and commodity type (critical areas only, other areas only, and areas targeting both commodity types; Supplementary Table 1). Note other mining areas included coal mines, some of which produce metallurgic coal used in steel production, which in 2018 represented 12% of world coal production43, and thus may also be influenced by increasing demand for renewable energy infrastructure. We mapped non-mining areas as any land (excluding Antarctica) outside mining influenced areas.

We overlaid the sampled data with PAs, Key Biodiversity Areas and Remaining Wilderness to determine differences in their proportional overlap (two-sided Chi-squared tests) and average mine density (Kolmogorov-Smirnov tests) for (1) mining vs. non-mining areas; (2) critical vs. other mining areas, and (3) pre-operational vs. operational vs. closed mining areas.

Finally, to test the robustness of our results to the 100-cell sampling interval, we sampled our datasets at 300-cell intervals (starting at a different cell to ensure an entirely different set of sample cells) and repeated all analyses. We found that the relative differences between mining and non-mining areas and between critical and other mining areas did not change, although the significance of these differences sometimes did (Supplementary Data 1-3).