During the past few decades it has been documented that the ultra-violet (UV) component of natural sunlight alone or in combination with visible light can instantaneously stimulate aerobic plant production of a range of important trace gases: CH$_4$, CO$_2$, CO, short-chain hydrocarbons/ non-methane volatile organic compounds (NMVOC), NOx and N$_2$O. This gas production, near or at the plant surface, is a new discovery and is normally not included in emission budgets (e.g. by the Intergovernmental Panel on Climate Change, IPCC) due to a lack of information with respect to validation and upscaling. For CH$_4$ it is known that the light dose controls emission under ambient and artificial light conditions, but the atmospheric gas composition and other environmental factors can influence gas production as well. Several plant components, including pectin and leaf wax, have been suggested as a precursor for CH$_4$ production, but underlying mechanisms are not fully known. For other gases such generating processes have not been established yet and mechanisms remain hypothetical. Field measurements of UV-induced emissions of the gases under natural light conditions are scarce. Therefore, realistic upscaling to the ecosystem level is uncertain for all gases. Nevertheless, based on empirical response curves, we propose the first global upscaling of UV-induced N$_2$O and CO to illustrate emission ranges from a global perspective and as a contribution to an ongoing quantification process. When scaled to the global level, the UV-induced emission of CO by vegetation surfaces amounts to up to 22 Tg yr$^{-1}$, which equals 11–44% of all the natural terrestrial plant sources accounted for so far. The total light-driven N$_2$O emissions amount to 0.65–0.78 Tg yr$^{-1}$, which equals 7–24% of the natural terrestrial source strength accounted for (range 3.3–9 Tg N yr$^{-1}$). In this review, we summarize current knowledge, based on experimental work with sunlight and artificial light, and estimate potential emission ranges and uncertainties, placing the available data into perspective. We discuss the state of the art in proposed mechanisms, precursors and environmental relationships, we consider the relevance of measured emission rates, and we also suggest a range of future research topics. Furthermore we propose and describe methods and techniques that can be used for future research.