

Supplementary Materials: Assessment of Environmental Performance of TiO₂ Nanoparticles Coated Self-Cleaning Float Glass

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S1. Uncoated Float Glass

The modeling of uncoated float glass considers the following criteria:

- “Flat glass, uncoated, at plant/RER” Ecoinvent v2 process was used to represent the glass manufacturing process.
- Cutting and lapping were taken into consideration.
- Installation of uncoated glass as windows to a private building, but contrary to nanoTiO₂ functionalized float glass no precautionary behaviors, such as special packaging and PPE, needed to be consider.
- Transportation by lorry from the company, where the uncoated glass was manufactured, to the installation site and the handling of glasses from lorry to private building was assessed.
- The phenomenon of radiation heat is the same as previously described for nanocoated glass, but in this case the sunlight radiation that passes through the uncoated glass is greater than on the nanocoated glass one, since the solar factor of uncoated glass (0.76) is greater than the nanocoated glass one (0.47). The solar factor is a parameter, which indicates the ability of a transparent material to let solar radiation through. It represents the fraction of solar energy that enters the environment, compared to the total incident.
- The cleaning of glass every four weeks using water and detergent has been assumed.
- The glass recycling process as end of life treatment has been adopted.

Table S1. LCIA comparison of 1 m² among uncoated flat glass (conventional material) and nanoTiO₂ functionalized coated float glasses (innovative materials).

Impact Category	Unit	Total	A	B	C
			Uncoated Flat Glass (30 Years Lifetime)	NanoTiO ₂ Coated Float Glass (10 Years Lifetime)	NanoTiO ₂ Coated Float Glass (30 Years Lifetime) re-Functionalization
Carcinogens	kg C ₂ H ₃ Cl eq	7.36	1.73	2.98	2.64
Non-carcinogens	kg C ₂ H ₃ Cl eq	4.23	5.53E-01	2.13	1.55
Respiratory inorganics	kg PM _{2.5} eq	2.55E-01	6.61E-02	1.24E-01	6.56E-02
Ionizing radiation	Bq C-14 eq	7.42E+03	1.55E+03	3.23E+03	2.64E+03
Ozone layer depletion	kg CFC-11 eq	1.07E-04	2.50E-05	4.30E-05	3.92E-05
Respiratory organics	kg C ₂ H ₄ eq	-1.10E+01	4.54E-02	-5.49E+00	-5.51

Table S1. Cont.

Impact Category	Unit	Total	A Uncoated Flat Glass (30 Years Lifetime)	B NanoTiO ₂ Coated Float Glass (10 Years Lifetime)	C NanoTiO ₂ Coated Float Glass (30 Years Lifetime) re-Functionalization
Aquatic ecotoxicity	kg TEG water	4.05E+04	3.55E+03	1.99E+04	1.71E+04
Terrestrial ecotoxicity	kg TEG soil	4.35E+03	3.09E+02	2.32E+03	1.72E+03
Terrestrial acid/nutri	kg SO ₂ eq	2.97	1.73	1.12	1.18E-01
Land occupation	m ² org.arable	3.31E+01	1.84E+01	9.81E+00	4.89
Aquatic acidification	kg SO ₂ eq	2.07	3.81E-01	9.82E-01	7.06E-01
Aquatic eutrophication	kg PO ₄ P-lim	8.19E-02	3.33E-02	2.73E-02	2.12E-02
Global warming	kg CO ₂ eq	6.34E+02	1.67E+02	2.56E+02	2.12E+02
Non-renewable energy	MJ primary	1.12E+04	3.10E+03	4.36E+03	3.72E+03
Mineral extraction	MJ surplus	1.87E+01	2.02	9.36	7.28
Radioactive waste	kg	9.80E-03	2.13E-03	4.23E-03	3.45E-03
Carcinogens inhaled	kg	3.45E-06	-	2.24E-06	1.21E-06

S2. Environmental Assessment by Single Score of NanoTiO₂ Functionalized Float Glasses and the Conventional Ones

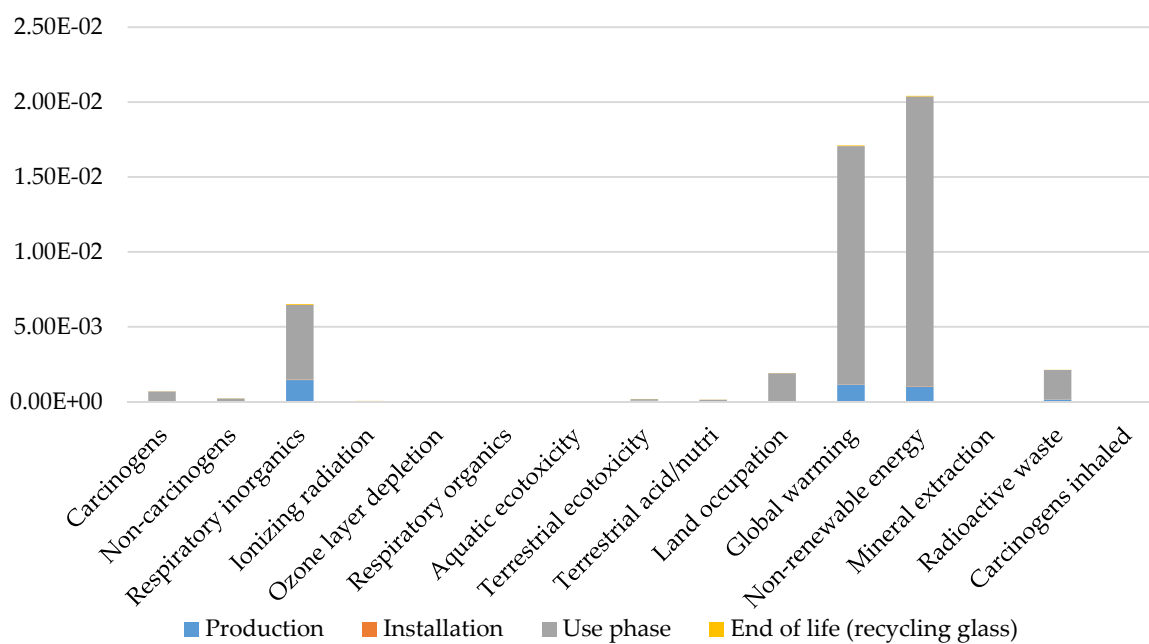


Figure S1. Evaluation by impact categories of 1 m² of uncoated flat glass (30 years life time).

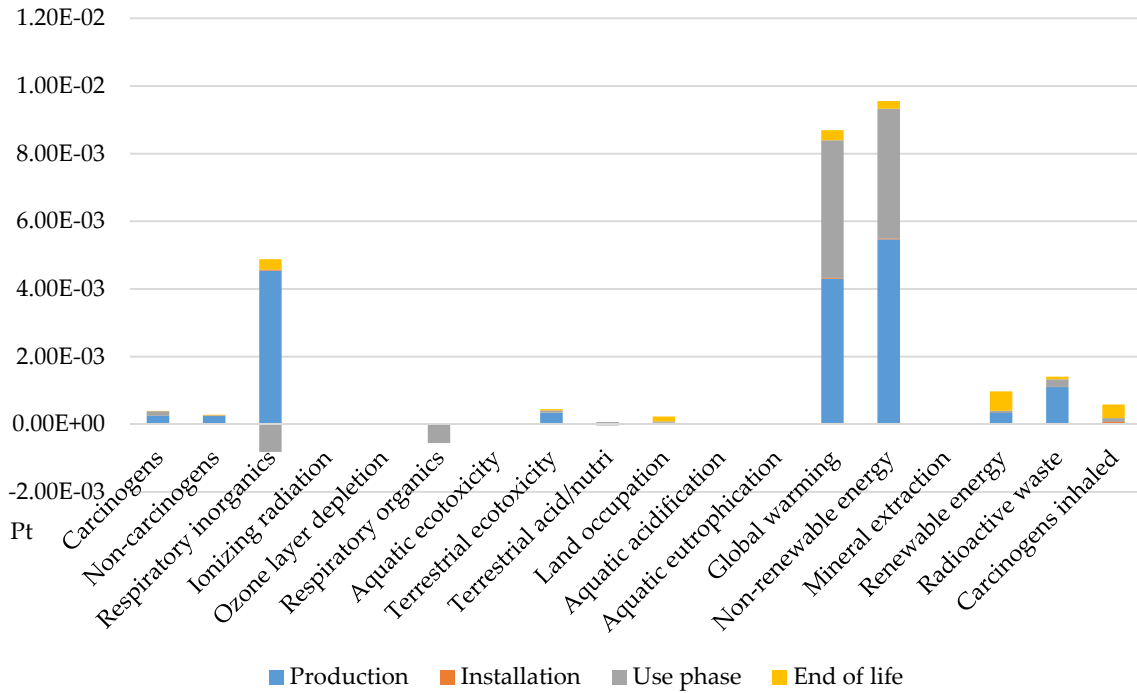


Figure S2. Evaluation by impact categories of 1 m² of nanoTiO₂ self-cleaning coated float glass (10 years life time).

The environmental analysis of 1 m² of nanoTiO₂ self-cleaning coated float glass (30 years life time) re-functionalized twice has been carried out considering 1 m² of nanoTiO₂ self-cleaning coated float glass (10 years life time) and the same process without end of life of glass and considering two functionalization treatments).

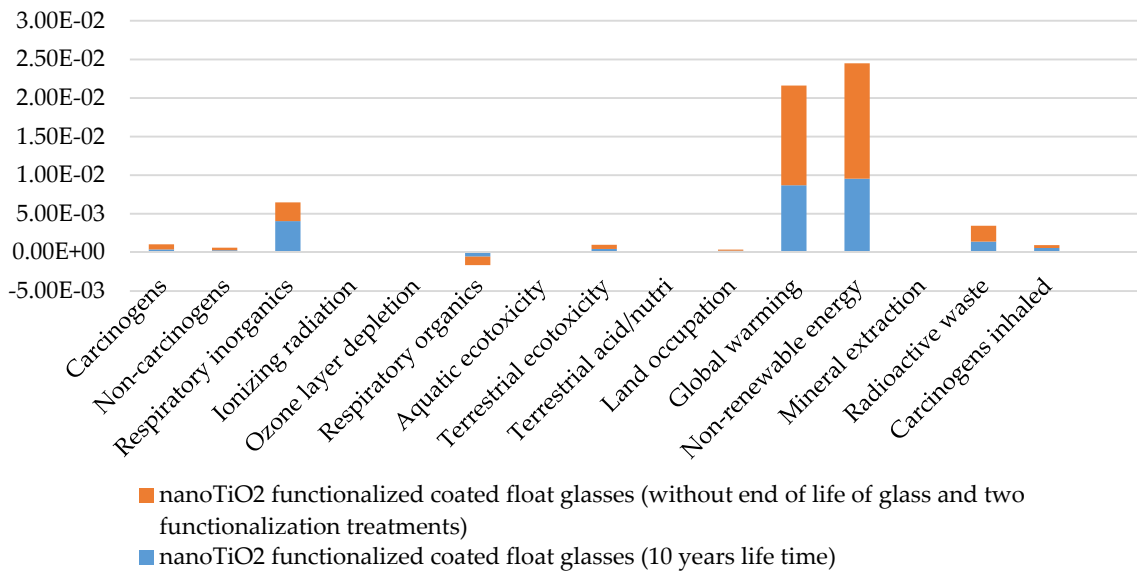


Figure S3. Evaluation by impact categories of 1 m² of nanoTiO₂ self-cleaning coated float glass (30 years life time) re-functionalized twice.

