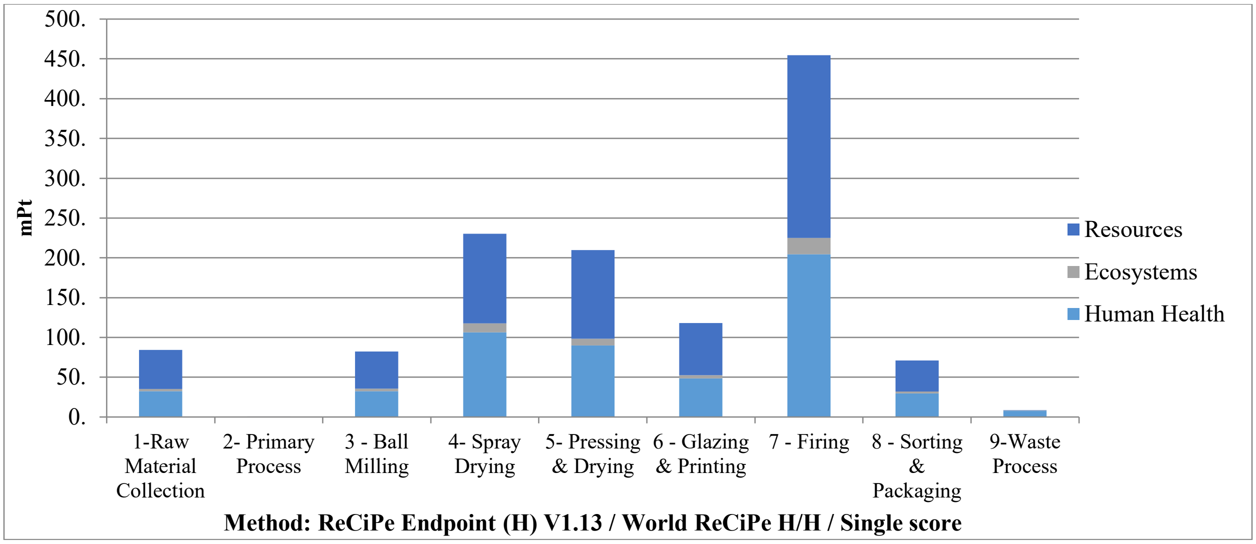

Figure 5. The section wise endpoint single score model with regard to the ReCiPe impact method

Table 3. Scenario analysis of global warming potential before and after 1% of error in inputs

Impact Category	Unit	State	Raw Material	Primary Process	Ball Milling	Spray Drying	Pressing& Drying	Glazing& Printing	Firing	Sorting& Packaging	Waste process
IPCC GWP 100a	Kg CO_2eq	Actual	0.684	0.0076	0.772	3.17	2.41	1.04	5.86	0.622	0.0949
		+1% Error	0.691	0.0077	0.779	3.20	2.43	1.05	5.92	0.629	0.0958

Table .3. shows a scenario analysis of global warming potential before and after 1% of error in inputs of 1m^2 ceramic floor tile which is defined as a functional unit (FU) of this study. The actual GWP value for the overall ceramic industry for FU was calculated by SimaPro 14.661 kg CO_2eq. Thereafter, GWP value was calculated after increase the inputs of all unit processes by 1% of existing inputs, the GWP value is 14.803 kg CO_2eq. Therefore, it is evident from the table value that the total increment of GWP by 1% of error for FU is 0.142 kg CO_2eq. Thus, from this scenario analysis, the way how the impact can be controlled by optimizing energy and resource consumption by 1% of its inputs is cleared.

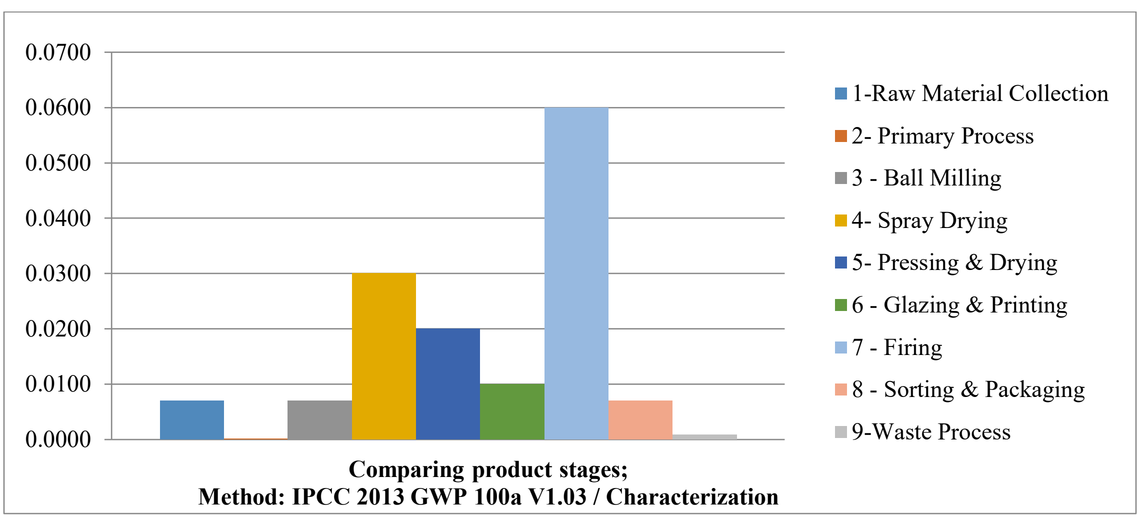

Figure 6. Section wise increment of global warming potential by 1% of error in inputs

Figure 6. shows a section wise increment of global warming potential by 1% of error in inputs. It can be seen that the firing process has the most significant potential impact (0.06 kg CO_2eq) on global warming by 1% of error in input. Afterward, spray drying is the second highest discharging process (0.03 kg CO_2eq) to the environment. This figure clearly states that the firing process plays a vital role in environmental impact due to the LPG combustion process.

4. Conclusions

Global warming is the biggest threat to the world in this current period. This is due to the illegitimate manufacturing practices and enterprises as well as excessive resources and energy utilities. Therefore, such a comprehensive LCA can bring hidden environmental hotspot to the surface which is acting as a major role in environmental impact. In that respect, the environmental hotspot was identified through this study by referring ISO 14040 and 14044 principles which provide a guideline for LCA. According to the IPCC GWP impact assessment method, the firing process was identified as the environmental hotspot which is discharging high amount of emission (5.86 kg CO_2eq) among the ceramic floor tile processes because the LP gas combustion processes rapidly increase the level of GHG emissions in the atmosphere and cause global warming and climate changes. As well as, when concentrating on the ReCiPe impact method, firing process acts as a major contributor to the environmental impact in all three endpoint impact categories such as resource, ecosystem and human health. Particularly, the resource category is affected significantly by the firing process among these three categories. Furthermore, the scenario analysis shows that the firing process discharges a significant amount of impact (0.06 kg CO_2eq) and overall factory emits 0.142 kg CO_2eq to the environment from the production of 1 m^2 floor tile by an increment of 1% of error in input. Therefore, it shows that a small amount of input reduction can also be avoided the environmental impact significantly. On the other hand, a minor error in the LCI may direct to identify incorrect environmental hotspot. Therefore, the accuracy and reliability of LCI is very essential. In such cases, the parametric modeling would be the best solution to compare the performance when making changes in the product or process frequently and it is very beneficial to identify the eco-design possibilities during the design stage. In essence, it is evident from this entire life cycle impact assessment results that the firing process is the stringent hotspot to the environment. Therefore, in order to enhance the sustainability of Sri Lankan ceramic floor tile industry, it is essential to ensure the eco-design possibility to the firing process as it causes serious problems towards the green world.

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