

**SKILLS FRAMEWORK FOR BIOPHARMACEUTICALS MANUFACTURING  
TECHNICAL SKILLS & COMPETENCIES (TSC) REFERENCE DOCUMENT**

<b>TSC Category</b>	Process Development/Manufacturing Science and Technology					
<b>TSC</b>	Green Manufacturing Design and Implementation					
<b>TSC Description</b>	Design and implement manufacturing processes that reduce waste, conserve energy and use replacements for hazardous substances					
<b>TSC Proficiency Description</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>	<b>Level 5</b>	<b>Level 6</b>
			<b>BPM-PST-3004-1.1</b>	<b>BPM-PST-4004-1.1</b>	<b>BPM-PST-5004-1.1</b>	<b>BPM-PST-6004-1.1</b>
			Analyse energy consumption, waste generation, emissions and other relevant data impacting green manufacturing initiatives and suggest improvements	Develop ways to reduce waste, conserve energy and discover alternatives to hazardous substances in line with green manufacturing strategies	Evaluate green manufacturing process designs for alignment with the manufacturing facilities' strategies and values	Establish the manufacturing facilities' green manufacturing strategies and values
<b>Knowledge</b>			<ul style="list-style-type: none"> <li>Types of biopharmaceuticals manufacturing waste</li> <li>Types of emissions generated through manufacturing processes</li> <li>Types of equipment used for measuring waste generation, emissions and other elements impacting the environments</li> <li>Procedures for operating equipment used for measuring waste, emissions and other elements impacting the environments</li> <li>Methods of collecting and analysing data</li> <li>Methods of conducting environmental modelling</li> <li>Manufacturing facilities' products and processes</li> <li>Manufacturing workflow processes</li> <li>Principles of green chemistry</li> <li>Principles of biocatalysis</li> </ul>	<ul style="list-style-type: none"> <li>Legislative green manufacturing codes, regulations and guidelines related to the biopharmaceuticals industry</li> <li>Methods to minimise biopharmaceuticals waste and conserve energy used for manufacturing processes</li> <li>New industry trends, technologies and innovations in green manufacturing</li> <li>Best practices and trends in biopharmaceuticals green manufacturing</li> <li>Pros, cons and applications of different environmental modelling software and techniques</li> </ul>	<ul style="list-style-type: none"> <li>Site management operating procedures</li> <li>Cost and operational implications of green manufacturing processes</li> <li>Business impact of different green manufacturing initiatives and technologies in the industry</li> <li>Business case formulation techniques</li> </ul>	<ul style="list-style-type: none"> <li>Organisation's vision, mission and values</li> <li>Macro factors impacting the demand or need for environmentally-friendly operating processes</li> <li>Methods of establishing clean energy initiatives</li> <li>Principles of change management</li> <li>Methods of ensuring long-term sustainability of new processes</li> <li>Processes involved in Research and Development (R&amp;D) in green manufacturing initiatives</li> </ul>

**SKILLS FRAMEWORK FOR BIOPHARMACEUTICALS MANUFACTURING  
TECHNICAL SKILLS & COMPETENCIES (TSC) REFERENCE DOCUMENT**

<p><b>Abilities</b></p>			<ul style="list-style-type: none"> <li>• Identify relevant data for calculating manufacturing waste and emissions</li> <li>• Collaborate with stakeholders to collect relevant data according to business priorities</li> <li>• Operate emissions, performance parameters and waste measuring equipment as per the specified procedures and guidance</li> <li>• Apply appropriate data analysis tools and software to conduct environmental modelling</li> <li>• Conduct research on alternatives to hazardous substances</li> <li>• Identify areas for improvements</li> </ul>	<ul style="list-style-type: none"> <li>• Propose interventions to reduce waste and emissions</li> <li>• Guide the development of manufacturing processes that reduce waste and environmental impact or conserve energy</li> <li>• Select appropriate environmental modelling tools and software</li> <li>• Conduct research and analysis of alternatives to hazardous substances</li> <li>• Collaborate with Research and Development (R&amp;D) department to identify natural or genetically engineered enzymes that can be used in lieu of synthetic chemicals</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate feasibility and impact of different types of green manufacturing initiatives against any cost or operational implications</li> <li>• Facilitate the review of procedures and processes to align with green manufacturing initiatives</li> <li>• Evaluate manufacturing process design parameters and suggest improvements to drive green manufacturing initiatives</li> <li>• Drive collaboration between Research and Development (R&amp;D) and manufacturing departments to find green solutions</li> <li>• Develop business cases for implementation of environmentally-friendly manufacturing practices</li> </ul>	<ul style="list-style-type: none"> <li>• Formulate green manufacturing initiatives aligned to the vision, mission and values of the organisation</li> <li>• Establish the manufacturing facilities' priorities in green manufacturing and environmental impact management</li> <li>• Drive innovation in areas aligned to reducing the negative environmental impact of manufacturing processes</li> </ul>
-------------------------	--	--	---	---	--	--