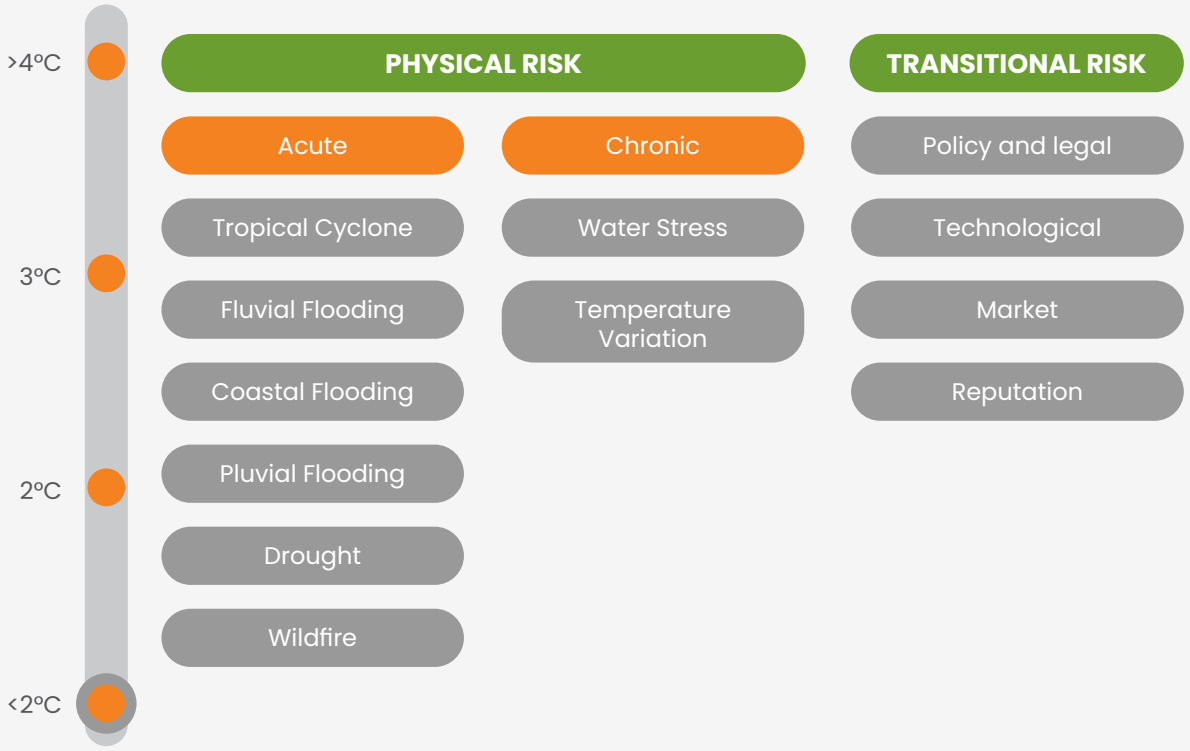
Climate Risk Assessment 2026

Climate Risk Assessment

In line with the IFRS S2 recommendations, HMEL has conducted a comprehensive risk assessment review to identify climate-related physical and transition risks across different time horizons The risk categorization has been done as per below:

- **Physical risks:** Risks resulting from event driven or longer-term change in climatic patterns causing damage to assets or supply chain disruption.
- **Transition Risks:** Risks associated with the transition to a low-carbon business model, which includes reputation, technological, and market reforms to address climate change mitigation and adaptation requirements.

Climate change scenarios and Classification of risks



Scenario analysis

The primary objective of conducting scenario analysis is to examine and better estimate how the business might perform under distinct future circumstances (i.e., its resiliency/robustness). Climate-related scenarios allow HMEL to investigate and advance a better understanding of how the physical and transition risks and opportunities of climate change might viably affect the company over time. Scenario analysis, in essence, assesses a spectrum of hypothetical results by contemplating diverse alternative future conditions (scenarios) that are both plausible and feasible within a given framework of assumptions and limitations. The application of scenario analysis has empowered the company to:

- Comprehend the array of risks linked to different scenarios of greenhouse gas (GHG) reduction.
- Examine and cultivate a comprehensive understanding of how the probable physical and transitional risks and opportunities of climate change could affect the business in long run.
- Evaluate the present collection of assets and investment prospects against scenarios.
- Assess the potential resilience of strategic plans against a range of scenarios.
- Identify options for increasing the strategic and business resiliency to plausible climate-related risks and opportunities through adjustments to strategic and financial plans.

Scenario Analysis- Physical Risk As sessment and Transitional Risk Assessment

- For physical risks assessment, HMEL has considered the Shared Socioeconomic Pathways (SSP scenario). SSPs are plausible scenarios of projected socioeconomic global changes up to 2100. They are used to derive greenhouse gas emissions scenarios with different climate policies. These scenarios have been used in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6): the physical science basis. The AR 6 uses scenarios SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5. The details of SSP's across different time horizons are provided below

SSP scenarios

SSP	Scenario (Likelihood)	Estimated Warming (2021–2040) Near Term	Estimated Warming (2041–2060) Mid Term	Estimated Warming (2081–2100) Long Term	Very Likely Range In °C (2081–2100)
SSP1-2.6	Low GHG emissions: CO_2 emissions cut to net zero around 2075	1.5 °C	1.7 °C	1.8 °C	1.3 – 2.4
SSP2-4.5	Intermediate GHG emissions (likely): CO_2 emissions around current levels until 2050, then falling but not reaching net zero by 2100	1.5 °C	2.0 °C	2.7 °C	2.1 – 3.5
SSP3-7.0	High GHG emissions (unlikely): CO_2 emissions double by 2100	1.5 °C	2.1 °C	3.6 °C	2.8 – 4.6
SSP5-8.5	Very high GHG emissions (highly unlikely): CO_2 emissions triple by 2075	1.6 °C	2.4 °C	4.4 °C	3.3 – 5.7

HMEL has conducted geography wise assessment of its facilities for physical risk, both acute and chronic. The analysis indicates that the HMEL's facilities may face potential risks due to pluvial flooding, temperature extreme, tropical cyclone, and wildfire.

Mitigation measures of Acute Physical Risks

1. Flooding (Pluvial, Fluvial)

- Establish standard operating procedures (SOPs) and flood-specific emergency response plans
- Conduct flood risk assessments and mapping of vulnerable areas
- Build elevated infrastructure and install flood barriers (bunds, flood walls)
- Design and maintain efficient drainage and stormwater management systems
- Install water-level monitoring systems and integrate with early warning mechanisms
- Ensure adequate water pumping systems for rapid dewatering during inundation
- Ensure that storage tanks are not empty to avoid floating of tanks
- Maintain buffer storage capacity (e.g., raw materials, fuel) to handle supply disruptions
- Maintenance crew take shelter near the port and are provided with adequate fuel, water, and food.
- Implement safe shutdown procedures to avoid damage and environmental contamination
- Provide alternate access routes and logistics planning to ensure continuity
- Train personnel on evacuation, rescue, and emergency response protocols
- HMEL is exploring the feasibility of using bio-medical agents for combating oil spills
- HMEL is exploring the feasibility of adding power backup for the pumping stations at the port

2. Tropical Cyclones

- Establish standard operating procedures (SOPs) and cyclone-specific emergency response plans
- Implement early warning systems and real-time weather monitoring for timely action
- Strengthen infrastructure through wind-resistant design, secure roofing, and anchoring of critical equipment
- Ensure backup power systems (generators/UPS) to maintain critical operations
- Ensure that storage tanks are not empty to avoid floating of tanks
- Pre-position emergency supplies (fuel, food, water, medical kits) within facilities
- Enforce safe shelter protocols for employees within designated cyclone-resilient zones
- Secure loose materials and hazardous substances to prevent secondary damage or spills
- Maintain communication systems (satellite phones, radios) for uninterrupted coordination
- Conduct regular drills and workforce training on cyclone preparedness and evacuation
- HMEL is exploring the feasibility of adding power backup for the pumping stations at the port

3. Wildfire

- Wherever possible, maintaining defensible space around the facility by clearing weeds, tall grasses, dead vegetation, and trees within 10–30 meters of all structures, prune tree branches to a safe minimum height.
- Installing multi-layered fire detection (heat, smoke, flame sensors) for early alert, paired with automatic and manual fire suppression systems.
- Regularly inspect sprinkler systems and conduct maintenance on all infrastructure.
- Store flammable materials and hazardous substances in fire-rated, well-separated areas; keeping an updated list and ensuring proper labeling and signage for quick action.
- Implement comprehensive fire safety awareness, regular evacuation drills, and role-specific training for staff; including alarm activation, response coordination, and fire extinguisher use.

Mitigation measures of Chronic Physical Risks

1. Temperature Extreme

- Implement heat action plans with clear thresholds, alerts, and response protocols
- Reschedule high-exertion work to cooler hours (night shifts for construction- related activities, loading and unloading activities)
- Provide adequate hydration (water, electrolyte/ isotonic drinks) at all work locations
- Ensure rest breaks and shaded/cooling areas to prevent heat-related illnesses
- Supply climate-appropriate PPE and clothing (breathable, heat-resistant gear)
- Train workers to recognize and respond to high temperature symptoms (heatstroke, exhaustion)

- Maintain on-site medical support and emergency response readiness
- Optimize workforce planning to avoid overexertion and ensure sufficient manpower
- Incorporate engineering controls such as ventilation, cooling systems, and reflective surfaces
- HMEL is currently working on climate- adapted clothing for its workers

2. Water Stress

- Implement water efficiency programs to reduce freshwater consumption across operations
- Increase water recycling and reuse (zero liquid discharge, closed-loop systems)
- Develop adequate water storage capacity (14-16 days) to ensure operational continuity during shortage
- Explore and diversify alternative water sources (treated wastewater, rainwater harvesting, desalination where feasible)
- Install systems to minimize losses (leak detection, evaporation control measures like floating covers/solar panels)
- Optimize processes through water-efficient technologies and process redesign
- Conduct water risk assessments and integrate findings into business continuity planning
- Engage with local communities to ensure responsible water use and conflict avoidance
- Monitor and track water consumption metrics for continuous improvement
- Establish long-term resilience strategies (watershed management, partnerships, sustainable sourcing)
- HMEL is planning to install floating solar photovoltaic panels over water reservoirs to reduce evaporation losses.
- HMEL is exploring alternate sources of water.

To simulate a climate scenario and assess transitional risks across various time horizons, various external factors, such as regulatory frameworks, and evolving consumer behavior, were carefully analyzed. Acknowledging inherent uncertainties, scenario planning was employed to explore potential energy transition pathways up to 2050.

HMEL has assessed the evolving regulatory requirements and carbon pricing mechanisms. Additionally, the risk of increased cost of raw materials and unsuccessful investment in new technologies have also been analyzed. Market dynamics also pose a challenge, particularly due to shifting customer preferences and stakeholder expectations. HMEL has integrated International Energy Agency (IEA) scenarios - Current Policies Scenario (CPS), Stated Policies Scenario (STEPS), and Net Zero Emissions (NZE) to evaluate transitional risks in accordance with above 2-degree Celsius scenario and Well-Below 2-degree Celsius (WB2C) scenario.

Scenarios used for Transitional Risk Assessment

Scenario	Description	Estimated Temperature Rise by 2100	Net Zero Achievement
Net Zero Emissions by 2050 (NZE)	Global pathway aimed at achieving net zero CO_2 emissions by 2050, aligning with the 1.5°C global temperature goal. Emphasis on renewables, carbon capture, and reduced fossil fuels.	Up to 1.5°C	2050
Stated Policies Scenario (STEPS)	Projects energy demand and supply based on current policies. Assumes slower decarbonization, with emissions peaking later, leading to a higher temperature increase.	Above 2°C	No global net zero by 2050
Current Policies Scenario (CPS)	Maps a future energy system based solely on enacted legislation and regulations, disregarding announced but unimplemented pledges	Above 2°C	No global net zero by 2050

Transition risks identified for HMEL

HMEL recognizes that the transition to a low-carbon economy presents significant risks related to evolving regulations, technological shifts, and market dynamics that could impact its refining and petrochemical operations.

Transition risks identified for HMEL

Risk type	Risk description	Potential impacts on HMEL	Time horizon
Policy & Legal 	**Carbon pricing mechanisms** HMEL operates a large, energy-intensive refinery and faces policy risks from India's Net Zero goals, including the upcoming Carbon Credit Trading Scheme (CCTS) for GGSR starting FY25-26. The refinery has emission reduction targets, and evolving policies on ethanol blending, biofuels, and electric mobility could significantly impact demand for petrol and diesel, necessitating adjustments in product slate and infrastructure.	• Increased operational expenditure due to carbon costs and compliance expenses • Incremental capital expenditure for emission control systems, energy efficiency upgrades, and fuel switching	**Short term**
Market 	**Increased cost of raw materials** Tightening climate policies threaten to increase HMEL's supply chain and operational costs. Higher crude prices may result from carbon compliance pass-throughs, while supply constraints on high-emission grades could raise feedstock costs. The shift toward biofuels and SAF intensifies competition for expensive low-carbon inputs. Additionally, decarbonization of energy grids will drive up costs for power, natural gas, and hydrogen.	• Limited short-term flexibility to substitute crude grades • Rising demand and limited supply for transition-aligned feedstocks	**Medium term**
Technology 	**Unsuccessful investment in new technologies** HMEL's decarbonization strategy relies on capital-intensive, emerging technologies like green hydrogen, electrification, and CCUS. However, regulatory uncertainties, technical complexities, and unproven scalability pose significant risks. Although green hydrogen costs are expected to decline over time, current high expenses and performance uncertainties could slow adoption and lead to diminished returns on investment.	• High upfront transition capital expenditure with uncertain returns • Project execution delays and cost overruns • Risk of technological obsolescence of existing assets	**Long term**

Risk type	Risk description	Potential impacts on HMEL	Time horizon
Market	**Reduced demand for products & services** HMEL's reliance on revenue streams from transport fuels exposes it to demand erosion from rising EV adoption, accelerated ethanol blending mandates, and improved fuel efficiency. As domestic fossil fuel consumption gradually declines, the company's revenues face sustained pressure. The refinery's large-scale, single-site configuration requires high throughput to cover fixed costs. If market shifts outpace HMEL's ability to pivot toward cleaner or higher-value products, lower utilization and market volatility could severely compress refining margins.	• Lower refinery utilisation and throughput risk • Margin compression and earnings volatility	**Long term**
Reputation	**Increased stakeholder concern** As a carbon-intensive joint venture, HMEL faces intense stakeholder scrutiny regarding its climate strategy and transition readiness. Stringent ESG expectations mean that delayed decarbonization or inadequate climate disclosures pose significant reputational risks. Consequently, poor ESG performance and perceived gaps in execution can lead to higher financing costs, as investors and creditors increasingly penalize weak climate risk management.	• Higher cost of capital or reduced financing options • Lower ESG ratings impacting investor appetite	**Long term**

The time horizon considered is: Short term (0- 5 years), Medium term (5- 10 years), Long term (>10 years)

Climate-related Opportunities identified for HMEL

HMEL has identified climate-related opportunities such as renewable energy adoption and implementing energy efficiency measures, reduced water usage and consumption, development of low emission goods and services, accessing new markets (Green Methanol, SAF, Green Ammonia), and supporting overall sustainable growth.

Climate-related opportunities identified for HMEL

Opportunity type	Opportunity description	Potential benefits for HMEL	Time horizon
Energy source 	**Use of renewable energy sources** HMEL's electricity-intensive operations offer a near-term opportunity to reduce Scope 2 emissions and hedge against power tariff volatility through renewable energy. Declining solar and wind tariffs enable cost-effective, long-term power procurement below grid rates. Reliance on grid electricity exposes HMEL to emissions liabilities and regulatory risks under transition scenarios. Early renewable adoption positions HMEL favourably for future CCTS compliance and ESG alignment. Currently, a 13.8 MW rooftop solar project is underway, with ~9 MW commissioned, expected to mitigate ~128 KT CO_2/ year, targeting 38% renewables in the energy mix by 2030.	• Operating cost savings from lower power tariffs • Lower earnings volatility from power price fluctuations.	**Short term**
Resource Efficiency 	**Energy Efficiency measures** Energy consumption is a major cost and emissions driver for HMEL. The company improved energy efficiency at the Petchem Plant, reducing Scope 1 GHG emissions by approximately 38.5% through optimized VHP steam use.	• Reduction in fuel and utility costs • Improvement in emissions and energy intensity indicators • Short payback periods and high internal rates of return compared to capital-intensive decarbonization technologies	**Short term**
Energy source 	**Use of low carbon sources of energy (Green hydrogen)** Transitioning to green hydrogen offers HMEL a powerful strategic opportunity to decarbonize its hydrogen-intensive refining processes and significantly reduce Scope 1 emissions. By proactively shifting away from natural gas, HMEL can stay ahead of emerging carbon pricing mechanisms like CCTS and stricter emission norms, gaining a strong competitive edge in the industry.	• Progressive reduction in Scope 1 GHG emissions • Improved cost predictability by partially decoupling hydrogen supply from fossil gas markets	**Medium term**

Opportunity type	Opportunity description	Potential benefits for HMEL	Time horizon
Resource Efficiency 	**Reduced water usage & consumption** HMEL is proactively transforming regional water scarcity challenges into opportunities for operational resilience and sustainability. To safeguard against climate-driven water stress and regulatory risks, the company has implemented highly efficient water management strategies, successfully achieving 100% wastewater recycling. The company is driving towards a 20% reduction in freshwater withdrawal per unit of crude processed by 2027, securing a highly sustainable, cost-effective, and future-proof operation.	• Reduced dependence on freshwater abstraction, lowering exposure to water scarcity and regulatory curtailment • Long-term reduction in water procurement, treatment and discharge costs • Improved operational resilience during drought or water stress periods	**Medium term**
Markets 	**Access to new markets Biofuels, Green Methanol, SAF, Green Ammonia)** By leveraging its existing world-scale hydrogen production, blending infrastructure, and methanol-to-olefins (MTO) capabilities, the company can seamlessly pivot from grey to green molecules with minimal new capital expenditure. Embracing validated solutions like biofuels (ethanol/CBG), green methanol, SAF, and green ammonia aligns with the 2022 National Policy on Biofuels, National Green Hydrogen Mission (NGHM), and global targets (IEA NZE, IATA/ IMO).	• Diversification of product portfolio into transition-aligned fuels, reducing long-term demand risk • Creation of additional revenue streams linked to emerging green fuel markets	**Long Term**
Energy source 	**Use of carbon capture and storage** HMEL's large, single-site refinery and petrochemical complex is well-positioned to benefit from early CCUS adoption, which can significantly cut Scope 1 emissions while maintaining high throughput. Recognized in India's draft 2030 CCUS Roadmap and aligned with global decarbonization pathways, CCUS offers a strategic opportunity to future-proof the Bathinda asset.	• Hedging against future carbon costs by abating a material share of direct emissions	**Long term**
Markets 	**Access to new markets (Electric Mobility and Downstream Energy Services)** India's rapid EV adoption, with an expected 30% market share and 10 million annual sales by 2030, offers HMEL a prime opportunity to transform its retail network into high-tech EV charging hubs. HMEL Retail's AI-enabled fast-charging stations, starting in Noida, will integrate seamlessly with convenience retail and CNG services. By leveraging dwell times of 40–60 minutes, HMEL can significantly boost customer lifetime value, increase site profitability, and establish long-term leadership in the evolving forecourt landscape.	• High-margin revenue stream from fast-charging fees, enhanced by subsidies and operational efficiencies for strong profitability at scale	**Medium-long term**

Mitigation measures for transition risks

1. Policy & Legal- Carbon pricing mechanisms

- Investment in low carbon technologies such as carbon capture utilization and storage
- Purchase of carbon offsets
- Transition from traditional "grey" hydrogen (produced via steam methane reforming) to "green" hydrogen produced via low-emissions electrolysis
- HMEL is exploring to replace gas-fired turbines, compressors, and pumps with high-efficiency electric motor drives.
- HMEL is investigating specific, cost-effective direct CO_2 capture technologies tailored to different refinery exhaust streams
- HMEL is actively participating in emissions trading schemes to manage carbon costs effectively and potentially generate revenue from emission reductions.

2. Market- Increased cost of raw materials

- Reduce exposure to carbon cost pass-through through diversified crude sourcing and logistics optimization
- Secure low-carbon feedstock supply via vertical integration and circular economy approaches
- Stabilize energy costs through renewable energy adoption, efficiency gains, and phased hydrogen transition
- Maintain competitiveness by leveraging policy incentives, carbon markets, and strategic portfolio shifts

3. Technology- Unsuccessful investment in new technologies

- HMEL is reducing technical risk through phased deployment, digital modeling, and pilot programs
- Improve commercial viability via strategic financing, government incentives, and long-term offtake agreements
- Navigate regulatory uncertainty through proactive policy engagement and scenario planning
- Minimize financial exposure by diversifying technology portfolios and sharing risks with partners
- Build organizational capability through workforce development and continuous performance monitoring

4. Market- Reduced demand for products & services

- Diversification of product portfolio through investments in production of biofuels and green hydrogen
- Invest in bioethanol, biodiesel, and renewable diesel to meet blending mandates and future demand.
- Optimize crude sourcing (heavy, sour crudes), improve energy efficiency, and reduce operational costs to maintain competitiveness.

5. Reputation- Increased stakeholder concern

- Embed climate-related ESG targets into the ERM framework, linking them to overall business risk profiles.
- Report and disclose quarterly or half-yearly ESG progress, with clear expectations for any shortfalls, revised timelines, and corrective actions, hence building stakeholder trust
- Utilize advanced ESG dashboards with predictive analytics, to provide stakeholders with real-time insights into ESG target performance.
- Incorporate feedback from stakeholders such as institutional investors, sustainability rating agencies, and employees, which can inform corrective actions and recalibrate strategies, ensuring that ESG targets are aligned with stakeholder expectations.