



Sectoral Burden of Rising Heat – Indian Railways

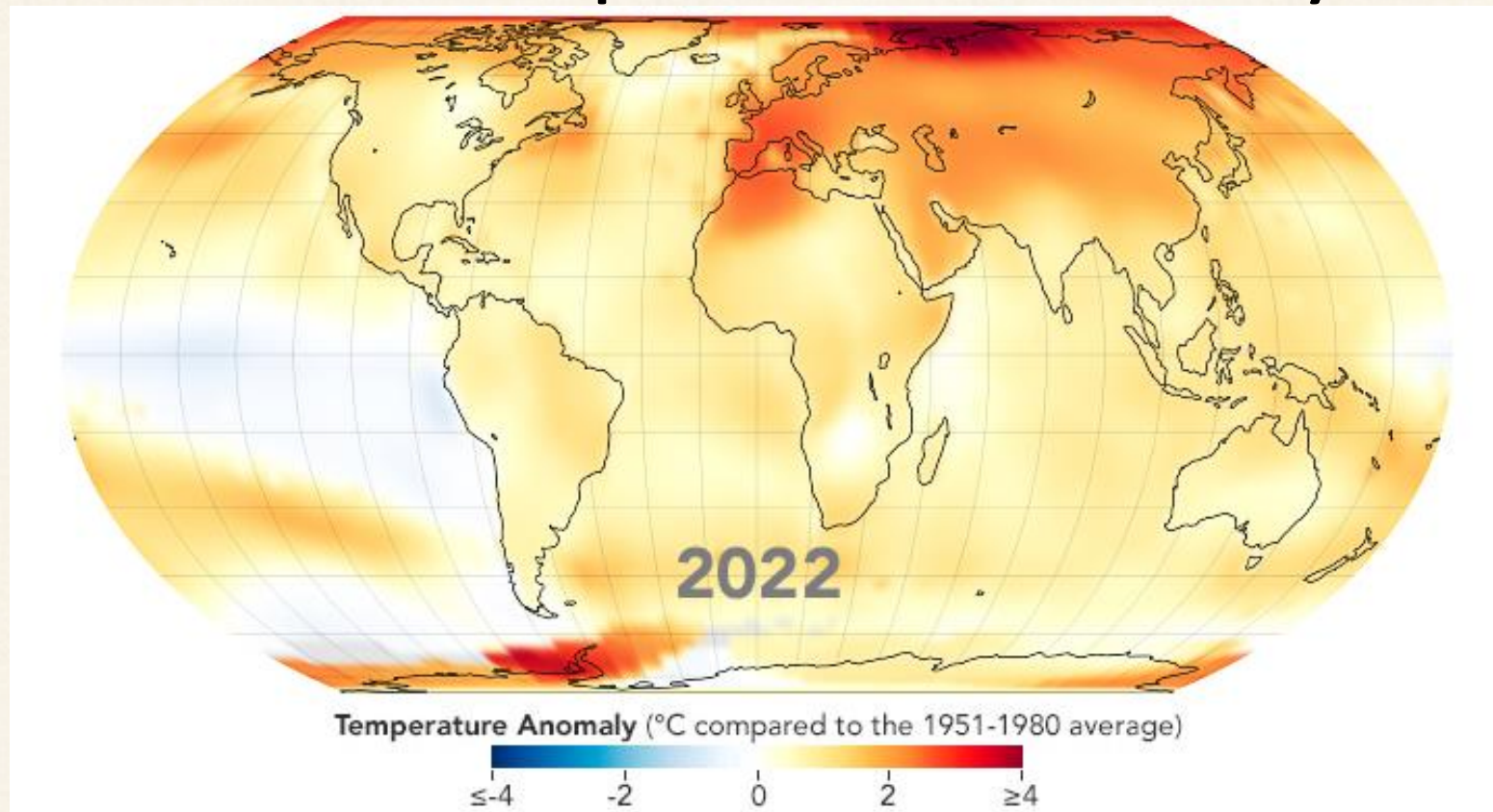


What we know?

- Global Warming is a fact
- Mean temperatures have been rising @ 0.2 °C per decade
- Reason is primarily anthropogenic
- Results in unpredictable temperatures – out of the normal
- Results in violent weather phenomena
- All these affect a critical sector like the Railways
- A resilient Railway needs to build mitigation into its infrastructure and maintenance



Global Temperature Anomaly



Source: <https://earthobservatory.nasa.gov/world-of-change/global-temperatures>



Direct Effects



Manpower-related Effects



- Reduced availability of maintenance window
- Higher manual patrolling requirements
- Worker fatigue
- Unhealthy working condition
- Higher drinking water requirement – 1940 l/coach



How Rising Temperatures Affect IR?

DIRECT EFFECTS

- Effects on infrastructure
 - Tracks
 - Overhead Equipment
 - Signaling
 - Locomotives
 - Coaches
- Effects on people
 - Passengers
 - Workers
- Effects on resources
- Effects on working processes

INDIRECT EFFECTS

- Sudden violent weather
 - Cyclones
 - Mudslides/ boulder falls
 - Cloud bursts & Flash-floods
 - Accidents and Traffic Disruptions

Tracks



- **Stored stresses**
 - Buckling: De-stressing required
 - Enhanced patrolling
 - Enhanced fittings renewal
 - More and better ballast cushioning requirements
 - SEJ Maintenance

- **Effects**
 - Higher maintenance
 - Higher material inputs
 - Enhanced vigil
 - Maintenance Blocks & Speed restrictions affect throughput

- **Mitigation**
 - Better quality track fittings, rails and sleepers
 - Mechanized maintenance
 - More efficient hand tools for staff



Overhead Equipment



- Overhead wires undergo thermal expansion in high heat
- They need to be maintained at a specified tension
- Auto tensioning device is used for the purpose
- Resistance of Copper rises by 0.393% per degree C rise in temperature
- Higher resistance means more Ohmic Losses in OHE
- Ohmic losses in transformers also increase with temperature

Signaling Systems



- Some high-tech electronics area at the core of train operations in the form of EI and Relay Rooms
- Requires fail-safe 24*7 working
- Very high cooling requirement even at remote stations
- Battery-based power supply to field equipment – Capacity can degrade at higher temperatures – Higher design load factors incorporated
- Higher maintenance needs

Locomotives



- Reduced efficiency in diesel locomotives
- Reduced energy content per litre of fuel – loss of density
- Higher engine as well as electrical equipment and systems cooling requirements
- Cab cooling requirements
- Higher ohmic losses – small components failure
- Higher maintenance requirement



Passenger Coaches



- Increased Comfort cooling requirement – higher energy consumption
- Increased water consumption – Over 1.9 kl water to be charged in every LHB Coach
- For 22 coach train – over 40 kl watering at starting station and replenishment en-route
 - Water saving taps, bio-vacuum toilets
- Reduced EOG DG Set Efficiency
 - HOG Enablement



People - Passengers

- Enhanced cooling requirements in passenger spaces – trains and stations
 - 3 AC Coaches in trains – also required for higher speed trains beyond 130 kmph
- Increased watering facilities at stations
- Higher catering requirement - cold water, cool drinks hygienic food
- Cooled waiting rooms
- Drinking water supply at wayside stations
- Shaded passenger circulation/ refuge areas at stations
- Air circulators and fans
- Functional hand pumps at remote stations
- Enhanced facilities like elevators and escalators for passengers – prevents fatigue, helps curb the dangerous behaviour of crossing tracks on stations

People – Employees and Staff

- Reduced employee efficiency due to heat
- Hazardous working condition in heat wave for field staff
- Narrower work windows availability
 - Refuge for field workers – Coaches for ART
 - Air-conditioned cabs for locomotives – prevents driver fatigue
 - Air-conditioned guard areas – prevents fatigue
 - Fully air-conditioned crew lobbies for outstation rest
 - Working on improved amenities for freight train managers
 - Better cabins at level crossings
 - Old closed LC gate cabins converted as resting places for gang-men





Effect on Resources

- Reduced equipment efficiency due to high ambient temperatures
- Higher energy requirement due to this reduction in efficiency
- High energy consumption due to cooling load
- Heightened water consumption due to body requirements
- Higher evaporative loss from Railway's reservoirs

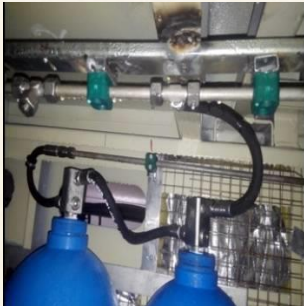


Working Systems

- More frequent equipment maintenance
- Increased Hot weather patrolling requirements
- Reduced human efficiency in extreme heat – less efficient working
- Requirement of maintenance blocks and imposing speed restrictions – reduces throughput
 - 26 week rolling-block programme
- Hot-weather-related equipment failure – affects throughput
- Can affect personal safety of workers – due to cumbersome nature of Personal Protective Equipment

Protection from Fires

- High heat load, reduced equipment efficiency, high ambient temperatures increase the risk of fire in trains
- Mitigation measures
 - EN 45545 standards for coach furnishing
 - Code of good practice for electrical equipment is followed
 - All coaches, including non AC coaches, equipped with fire extinguishers
 - Automatic FSDS being provided in all new AC coaches, older coaches also being retrofitted. 61% AC coach holding already covered
 - Automatic FDSS being progressively provided in all pantry and power cars. 75 % of the holding already covered
 - Mock drills and training to IR as well as NDRF and Civilian rescue personnel
 - Additional features in new trains – Vande Bharat Train Sets





Indirect Effects



Infrastructure Damages

- Global temperature rise has caused freak and unpredictable weather phenomena like super cyclones, cloudbursts, flash floods, land slides and boulder falls
 - These damage railway infrastructure on a large scale
 - Affects traffic in a big way
 - Sometimes accidents due to landslides and boulder fall
- Mitigation
 - Constant monitoring
 - Detailed SOP for handling bad weather predictions
 - Stopping traffic and evacuating sections
 - All protection measures for infrastructure, trains, staff and passengers
 - Resilient systems for restoration with Railway's own resources as well as hired resources.



Thank You!