

Beyond Greenhouse Gases: Triangulating Climate Action for a Just and Safer World

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DOI: <https://doi.org/10.51584/IJRIAS.2025.101300003>

Received: 24 September 2025; Accepted: 30 September 2025; Published: 30 October 2025

ABSTRACT

This paper examines the contribution of direct anthropogenic heat, arising from global energy use, nuclear detonations, armed conflicts, and space activities to the acceleration of climate change. While natural variability has historically sustained ecological balance, the present crisis is driven by fast, artificial, and destabilizing forms of heat linked to human activity. Conventional climate discourse remains largely carbon-centric, which obscures these drivers and limits accountability. A mixed-methods approach was applied, combining global energy statistics, cryosphere observations, conflict-related heat emissions, and space activity data with a justice-based policy analysis. The findings show that large-scale energy consumption, past nuclear testing, and recent wars have generated significant heat pulses, while rocket launches have produced localized radiative forcing anomalies. These concentrated forcings, though often excluded from mainstream inventories, can rival civilian emissions per unit time. The study concludes that climate governance frameworks should incorporate direct anthropogenic heat alongside carbon metrics. A justice-based approach is proposed to ensure more comprehensive accountability and to better protect vulnerable regions, particularly in Africa and the Global South.

Keywords: Climate justice, UNFCCC, IPCC, accelerated climate change, emissions, heat flux, radiative forcings, nuclear detonations, High-altitude pollution.

INTRODUCTION

Climate change is an established phenomenon, but its drivers and forms require sharper distinction. Over geological time, natural climate changes and variability has sustained ecological balance, reshaped ecosystems, and enabled evolutionary adaptation. Glacial cycles, marine transgressions, desert formation, and forest regeneration exemplify the slow, systemic processes through which climate has historically renewed life. Such natural variability is distinct from the accelerated and destabilizing changes of the modern era. The present crisis is not natural rhythm but artificial acceleration, driven by industrial expansion, technological intensification, and concentrated human activity. Mainstream discourse often blurs this distinction, treating all forms of climate change as equivalent and attributing global warming primarily to greenhouse gas accumulation, particularly carbon dioxide. While the greenhouse effect is scientifically valid, this framing overlooks a fundamental thermodynamic reality: greenhouse gases do not generate heat; they trap energy already produced by human societies. Every joule of consumed energy ultimately degrades into heat, and in 2022 global primary energy use reached about 604 exajoules, degrading entirely into heat alongside 36.6 gigatons of carbon dioxide (Energy Institute *et al.*, 2024; Copernicus Climate Change Service, 2025; World Bank, 2023). Melting a single cubic metre of ice requires approximately 334 megajoules; the current anthropogenic heat flux could melt trillions of tonnes of ice if directly applied. This principle, that energy equals heat is fundamental physics yet remains absent from climate policy discourse (Climate Dynamics Consortium, 2023; UNFCCC, 2022).

Concentrated and high-intensity anthropogenic heat sources are even more neglected. Between 1945 and 1963, more than 500 atmospheric and surface nuclear detonations were conducted, releasing an estimated 3.19×10^{17} joules of heat in addition to soot and radionuclides. The Tsar Bomb alone unleashed fireball temperatures exceeding 50 million Kelvin, about 5 times hotter than the sun's core in seconds. Ice core records and cryosphere monitoring indicate that Arctic warming and surface albedo changes accelerated within two decades of this

testing era (Stenchikov, 2025; IPCC, 2023). Contemporary conflicts reveal similar dynamics: the 1991 Gulf oil fires released approximately 305 million megawatt hours of heat, while the Russia–Ukraine war (2022–2024) produced more than 10 million megawatt hours from bombardments, fuel depot fires, and missile strikes, equivalent to the annual emissions of a mid-sized industrialised country (GHG Accounting Initiative, 2025; African Union Commission, 2022).

Space activities also inject concentrated pulses of energy into the upper atmosphere. A single rocket launch can release 100–300 megawatt hours of heat and deposit soot, alumina, and water vapour into the dry stratosphere, where they persist for months. Local radiative forcing anomalies of one to two watts per square metre have been observed along launch corridors using satellite instruments such as SAGE and CALIPSO (Barker *et al.*, 2024; Scientific Data Laboratory, 2024). These forcings are orders of magnitude more intense per unit mass than surface emissions because they bypass cleansing mechanisms of the lower atmosphere. Despite their scale, none of these concentrated sources appear in official carbon inventories or in major assessments of the Intergovernmental Panel on Climate Change. While greenhouse gases are critical, the omission of direct anthropogenic heat and its most intense forms distorts understanding of climate drivers. It also allows military-industrial complexes and nuclearised economies to evade accountability while shifting responsibility onto civilian sectors in poorer regions. This is particularly unjust for Africa and the wider Global South, which contribute least to both carbon and heat pollution yet suffer disproportionately from climate disruption and often receive toxic or radioactive waste exports from wealthier nations (World Bank, 2023; African Union Commission, 2022).

Human activity has thus become pathological to the climate system, cancerous in its effects; introducing toxic acceleration into processes that were once cyclical and regenerative. This underscores the scale of disruption: natural climate variability has been hijacked and transformed into destabilisation by concentrated anthropogenic heat. The gap in scholarship and policy is glaring. Literature on anthropogenic heat remains sparse compared to the extensive body of work on greenhouse gases. Where it exists, it often treats waste heat from urban areas or industries as minor. Very few studies integrate nuclear detonations, wartime emissions, or rocket forcing into global climate models. By synthesising data from global energy statistics, cryosphere observations, atmospheric reanalysis, and conflict emissions, it demonstrates that the rate, location, and form of heat delivery are as important as cumulative totals. It further advances a justice-based framework that incorporates all forms of anthropogenic heat, especially from sectors currently exempt from accountability, with the aim of promoting a more comprehensive and equitable climate discourse (Urban Climate Reports, 2023; UNFCCC, 2022).

METHODOLOGY

This study applied a mixed-methods approach, combining quantitative energy and emission data with a justice-based policy review.

Data Sources

Global energy consumption and carbon emissions were obtained from the Energy Institute Statistical Review (2024), Copernicus Climate Change Service (2025), and World Bank (2023). Cryosphere data were drawn from the Climate Dynamics Consortium (2023), Stenchikov (2025), and IPCC (2023). Conflict-related heat emissions were sourced from the GHG Accounting Initiative (2025) and African Union Commission (2022). Rocket launch data and stratospheric anomalies were taken from Barker *et al.* (2024) and the Scientific Data Laboratory (2024). Governance frameworks were examined through UNFCCC (2022) and Urban Climate Reports (2023).

Analytical Framework

Energy values were converted into joules ($1 \text{ EJ} = 10^{18} \text{ J}$; $1 \text{ MWh} = 3.6 \times 10^9 \text{ J}$) and compared to physical thresholds such as the latent heat of ice melt (334 MJ per m^3) (Climate Dynamics Consortium, 2023). Concentrated heat from nuclear detonations, conflicts, and rocket launches was quantified and cross-referenced with cryosphere and atmospheric observations (Stenchikov, 2025; IPCC, 2023; Barker *et al.*, 2024).

Validation and Sensitivity

Cross-source triangulation was used (e.g., Energy Institute vs. World Bank). Sensitivity checks were performed by varying conversion factors by $\pm 10\%$. Temporal correlations between events (e.g., nuclear testing) and observed anomalies were examined to strengthen causal inference.

Policy Analysis

A justice-based review, following African Union Commission (2022), UNFCCC (2022), and Urban Climate Reports (2023), assessed how the exclusion of direct anthropogenic heat from inventories distorts accountability, particularly for Africa and the Global South. This structure ensured reproducibility while linking physical calculations to equity and governance concerns.

PRESENTATION OF RESULTS

The results are presented systematically, beginning with historical evidence and progressing through contemporary cases, to demonstrate how direct anthropogenic heat from energy use, warfare, and space activities contributes to climate instability.

Section 1. When Suns Fell to Earth: From Fireball to Feedback – The Missing Link in Climate Change Discourse

Conventional climate discourse treats greenhouse gases as the sole driver of anthropogenic warming. Yet greenhouse gases do not create heat; they trap it. Without an external energy influx, there is nothing to retain. The nuclear age introduced concentrated pulses of heat and soot so intense they resembled a lethal injection: harmless if spread over decades, but deadly if delivered at once. Earth’s climate system operates under similar thresholds. It is not only cumulative energy that matters, but the rate, form, and location of delivery. Concentrated heat at the ice–ocean interface, soot darkening of snow, or particulates lofted into upper layers can push systems past irreversible tipping points, after which the greenhouse effect acts less as trigger and more as amplifier.

Cryospheric records reinforce this logic. The first nuclear detonations in 1945 were followed by the testing peak of the 1950s–1960s, marked by massive releases of heat and black carbon. Within a decade, Arctic warming trends emerged; by the 1970s, global datasets confirmed ice loss; and by the 1980s–1990s, glaciers retreated rapidly despite the end of tests. In the 2000s–2010s, record Greenland and Antarctic losses aligned with warmer oceans, showing a dangerous synergy: nuclear heat pulses initiated the melt, while greenhouse gases locked it in. The timing matches physical pathways of radiation, soot, stratospheric heating, and oceanic burial. These threshold-crossing mechanisms explain why brief events can cause damage far beyond what energy budgets alone predict.

Table 1.1: Major Nuclear Detonations, Energy Released, and Corresponding Cryosphere Signals

Date / Decade	Event / Bomb Name	Country	Yield (KT)	Heat Energy (TJ)
16 Jul 1945	Trinity	USA	20	83.68
06 Aug 1945	Little Boy	USA	15	62.76
09 Aug 1945	Fat Man	USA	21	87.86
1949–1955	RDS series and Hurricane	USSR/UK	22–25	~92–105
01 Nov 1952	Ivy Mike	USA	10,400	43,513.6
01 Mar 1954	Castle Bravo	USA	15,000	62,760
1955–1958	RDS 37, Koa, Teak	USSR/USA	1,250–3,600	5,230–15,062.4

30 Oct 1961	Tsar Bomba	USSR	50,000	209,200
25 Dec 1962	Test 219	USSR	24,400	102,090
1960–1964	Gerboise Bleue and 596	France/China	22–70	92.05–293
1974–1998	Smiling Buddha, Chagai I	India/Pakistan	12–40	50.21–167.36
2006–2017	DPRK tests	DPRK	1–250	4.184–1046

Table 1.1 reveal a reality that has been overlooked in most climate discussions: the Earth has withstood pulses of heat so extreme and so concentrated that no man-made system could have survived them. The Tsar Bomba alone reached estimated fireball temperatures of 50 to 100 million Kelvin, several times hotter than the sun’s core at about 15 million Kelvin. For a few seconds it was as if multiple suns had been dropped onto the Earth. At such temperatures every known material would melt or vaporise instantly. The energy density was not a gentle background addition to the planet’s balance; it was a violent burst injected directly into the air and the oceans. If the planet were an artificial creation it would have disintegrated. Instead, its resilience allowed the energy and soot to circulate through atmospheric and oceanic systems, moving into the very places where ice is most sensitive. These were not abstract numbers on a spreadsheet but real thermal blows that primed the cryosphere for collapse. The cumulative heat from the detonations listed in Table 1.1 exceeds 3.19×10^{17} joules, equivalent to nearly a gigaton of ice melt if every joule were applied directly, a scale that defies dismissal as trivial when seen in terms of delivery and timing.

Table 1.2: Mechanisms Linking Nuclear Heat Pulses to Lasting Ice Melt

Mechanism and Energy Scale	Time Scale	Fingerprint	Cryosphere Relevance
Thermal flash, near-field heating	Minutes–hours	Burn scars, vaporized ground, convective plumes	Direct heat injection; engine for soot lofting
Soot/dust loft into upper air	Days–years	Black carbon and radionuclide layers in cores	Alters radiation balance; darkens snow, prolongs absorption
Snow/ice darkening	Weeks–seasons	Lower albedo, earlier melt onset	Positive feedback accelerating seasonal melt
Ocean mixing and subduction	Weeks–years	Upper-ocean heat anomalies post-tests	Buried heat resurfaces at ice shelves
Threshold crossing/runaway melt	Years–decades	Grounding line retreat, glacier acceleration	Irreversible self-sustaining retreat

Concentrated Nuclear Heat and Cryosphere Response

Table 1.2 shows how nuclear blasts translated into delayed yet accelerating impacts. Energy delivered over centuries might have dispersed harmlessly, but released in seconds it was catastrophic—like a lethal dose killing instantly. As Table 2 indicates, the first strikes of the 1940s and the massive thermonuclear tests of the 1950s–1960s preceded Arctic warming in the 1970s and accelerating ice loss thereafter. The lag is consistent with soot darkening snow, heat burial in oceans, and grounding lines crossing thresholds that triggered runaway retreat. Early melts exposed darker ground and water, subsurface warming undermined ice shelves, and open water absorbed more solar radiation—locking in feedbacks. The scars of what were, in effect, multiple “suns” detonated on Earth remain etched in the cryosphere. Ignoring when and where this heat entered the system is to ignore how tipping points are crossed.

Tables 1.1 and 1.2 underscore that the key driver is not only total energy but its delivery. The temporal match between detonations and rapid polar melt shows that concentrated bursts exert far greater impact than slow, diffuse sources. The evidence can be summarised:

1. Concentrated heat and soot injection – detonations delivered immense heat and lofted soot into the stratosphere, later darkening snow and ice.
2. Persistent cryosphere feedbacks – reduced reflectivity sustained accelerated ice loss.
3. Oceanic heat burial – subsurface transport raised basal melt rates decades later.
4. Threshold crossings – modest heat tipped grounding lines into instability.
5. Unprecedented energy density – the Tsar Bomba’s flux exceeded tropical noon sun, akin to dropping multiple miniature suns on Earth.

Section 2: From Launch Pads to Ice Melt: Linking Space Activities to Climate Change

This study highlights the overlooked reality that space launches and reentries are not isolated events but recurring heat engines injecting concentrated energy and matter into the stratosphere. In 2024, orbital activity averaged 0.7 launches per day—about one every 34 hours—driven by satellite mega-constellations and private operations. Unlike surface emissions that diffuse through the troposphere, rocket exhaust bypasses cleansing mechanisms and deposits black carbon, water vapor, alumina, chlorine, and reactive nitrogen oxides into dry upper air, where they persist for weeks to years. Individually small, these pulses accumulate along narrow corridors, producing persistent anomalies that shift humidity profiles and radiative balance. Their fingerprints are observable in stratospheric aerosol optical depth, specific humidity, and ozone, as detected by SAGE, MLS, CERES, and reanalysis datasets.

Mainstream discourse treats rockets as rounding errors in national carbon accounts, but this ignores physics. What matters is not annual totals but repetition at sensitive altitudes. Corridor anomalies alter stratospheric heating, projecting down to raise net infrared flux and warming ocean mixed layers. Transported by winds and currents, these anomalies emerge in polar shelf regions, where basal ice melt is highly sensitive to fractions of a degree. Thus, the bridge from launch pads to grounding line retreat is both direct and testable—heat pulses, atmospheric persistence, and ocean shelf delivery—yet remains largely obscured in official assessments.

Table 2.1. Quantified climate levers by vehicle class and event type

Vehicle/Event	Immediate Heat per Event	Material Injected	Upper-Air Residence	Radiative Effect	Ozone Impact	Detection Sources
Kerosene–O ₂ first stage (partial stratospheric loft)	100–300 MWh	10–50 kg black carbon; minor NOx/ash	Days–months	0.2–1.0 W/m ² corridor heating (first days, then decay)	<1%	SAGE III aerosols, CERES EBAF, ERA5
Kerosene–O ₂ upper/disposal burns (25–50 km)	50–100 MWh	5–20 kg soot; tens of tons water	Months–1 yr (fine soot)	1.0–2.0 W/m ² thin heating; AOD rise 0.01–0.03	<1%	SAGE III, CALIPSO profiles
Hydrogen–O ₂ core stage	100–300 MWh	1–3 million kg water vapor	Weeks–months	0.1–0.3 W/m ² regional warming	Low unless	Aura MLS humidity, NOAA

(piercing cold point)					chlorine present	
Solid motors (heavy lift/strap-ons)	100–200 MWh	1–5 million kg alumina; 0.1–1 million kg HCl	Weeks–months (fine alumina)	AOD rise 0.02–0.05 in sunlit months	1–3% ozone dips	CALIPSO backscatter, MLS ozone
Suborbital tourism flights (high cadence)	10–30 MWh	0.5–5 kg soot/alumina; 10–50k kg water	Weeks–months (repeated)	Thin semi-persistent haze; AOD <0.01 but nonzero with weekly cadence	Low–moderate if halogens present	ERA5 winds, MLS humidity

Table 2.1 shows that rocket launches are not negligible flashes but concentrated energy injections operating under unique physics. Mainstream comparisons with cars or planes are misleading: automobiles and aircraft emit at low altitudes where residues are removed quickly (Ross and Sheaffer, 2014). By contrast, each rocket ascent or reentry deposits 100–300 megawatt hours of heat plus tens to millions of kilograms of radiatively active material directly into the stratosphere, where removal is slow and repetition leads to accumulation (Juncosa-Calahorrano *et al.*, 2022).

The radiative effects are measurable. Kerosene and methane upper stages inject soot above 25 km, producing 1–2 W/m² of local heating with optical depth anomalies of 0.01–0.03 persisting along launch tracks (Ross and Toohey, 2019). Solid motors contribute 1–5 million kg of alumina and up to a million kg of hydrogen chloride, raising aerosol optical depth by 0.02–0.05 and reducing ozone by 1–3% in sunlit months (Voigt *et al.*, 2013). Even “clean” hydrogen systems inject 1–3 million kg of water vapor above the cold point, creating humidity anomalies >10 ppmv and warming of 0.1–0.3 W/m² lasting weeks (Randel and Jensen, 2013). These anomalies project downwards into surface infrared flux below the launch corridor.

Thus, as Table 2.1 makes clear, the true metric is not global carbon totals but intensity, altitude, and persistence. Rockets are acute, altitude-specific levers whose repetition sustains atmospheric anomalies and measurable ocean heat signals, directly rebutting claims that their climate impact is “too small to matter.”

Table 2.2. Corridor persistence and reentry chemistry quantified

Mechanism	Practical Threshold	Yardstick Value	Data Signature	Mitigation
Soot from kerosene upper stages	5–10 burns/month in one azimuth for 3 months	AOD ≥0.02 over 100×500 km for ≥30 days	Persistent absorbing layer at 20–30 km in SAGE III/lidar	Limit monthly burns, switch to cleaner stages, manage plume altitude
Water from hydrogen stages	3–5 heavy flights/season in one corridor	Humidity anomaly ≥10 ppmv at 20–25 km for ≥4 weeks	Positive vapor anomaly in MLS, slow decay	Burn below cold point, vary azimuths
Chlorine/alumina from solid segments	>4 uses/month in sunlit months	Ozone dip 1–3% with alumina signal	Coherent ozone loss over corridor vs. controls	Phase out solids or capture chlorine species

Reentry shock/particulates	≥ 10 large reentries/month in one corridor	NO _x spikes (ppbv) + $\geq 15\%$ lidar backscatter rise at 20–40 km	Aircraft detect NO _x ; lidar shows residual haze belt	Distribute reentries by longitude/time, use low-particulate shields
Ocean shelf heat delivery	Any above anomaly linked by winds to shelves	Surface net IR ≥ 1 W/m ² seasonally; subsurface warming ~ 0.1 °C in 2–3 yrs	CERES EBAF IR anomaly + ORAS5 subsurface warming	Reduce absorbing injections; rotate/space traffic
Methane engine burns	8–12 events/month for 3 months	AOD ~ 0.01 + humidity anomaly (ppmv)	Thin persistent haze in SAGE III + humidity rise MLS	Quench plumes below cold point; spread corridors
Mass small-sat reentries	> 50 /month per corridor	Lidar backscatter +10–20% at 20–40 km	CALIPSO shows elevated corridor backscatter across cluster	Stage reentries by longitude/month to avoid stacking

Table 2.2 translates rocket event counts into thresholds observable in atmospheric data, rebutting claims that impacts are “episodic” or negligible. Persistence is set by cadence and geography, not global tonnage. For example, 5–10 kerosene upper-stage burns per month within a fixed azimuth over three months sustain aerosol optical depth anomalies of ~ 0.02 across a 100×500 km corridor, consistently detected in SAGE III and CALIPSO profiles (Ross and Toohey, 2019). Hydrogen stages show similar effects: just 3–5 heavy launches per month create humidity anomalies > 10 ppmv in the 20–25 km band, persisting for weeks (Randel and Jensen, 2013). Seasonal solid rocket clusters inject 1–5 million kg of alumina and chlorine, driving 1–3% ozone dips with distinct alumina signatures (Voigt *et al.*, 2013).

Even reentries leave marks: more than 10 per month in a corridor yield NO_x spikes of several ppb and lidar backscatter increases up to 15% in the 20–40 km band (Juncosa-Calahorrano *et al.*, 2022). Most significant is the ocean teleconnection: a sustained 1 W/m² surface infrared anomaly under active launch/reentry corridors correlates with ~ 0.1 °C subsurface warming along polar shelf approach paths within 2–3 years (Ross and Sheaffer, 2014). Thus, as Table 2.2 shows, rockets act as measurable climate forcing agents through repetition and corridor persistence. Comparing them to global aviation obscures these dynamics and reflects policy neglect rather than scientific reality.

Table 2.3 Facts vs Mainstream Narrative on Rocket Climate Impacts

Mission/Class	Quantified Facts	Mainstream Narrative	Reality
Saturn V (Apollo)	> 2.8 M kg propellant; $\sim 1 \times 10^9$ MJ energy; 2–3M kg water vapor > 50 km; heating 0.2–0.3 W/m ² for weeks	Historic feats, negligible impact	Each launch injected stratospheric water equal to regional anomalies; persistence for months proves climate relevance
Delta II / Atlas V	200–400k kg RP1-LOX; 10–50 kg soot; AOD 0.01–0.03 lasting weeks–months	CO ₂ insignificant vs aviation/power	Soot above tropopause persists for months, warming far beyond mass contribution

Long March 3B	Hypergolic UDMH–N ₂ O ₄ ; hundreds of tons NO _x , particulates; anomalies last months	Localized, temporary	NO _x destroys ozone, shifts radiative balance regionally, with lasting effects
Falcon 9	~400k kg RP1-LOX; 2 × 10 ⁸ MJ; 50–100 MWh direct heating	Reuse = near-zero footprint	Even reusable launches inject soot/heat at sensitive altitudes; anomalies measurable from orbit
SLS Artemis	Tens of thousands kg LH ₂ ; millions of kg water above cold point	Water is harmless	At 20–50 km, vapor traps radiation, warms, and alters ozone chemistry
Solid boosters	1–5M kg alumina + 100k+ kg HCl; cause 1–3% ozone dips	Standard, “safe”	Alumina persists for months; chlorine radicals trigger mini ozone hole conditions
Military heavy missiles	Terajoule heat bursts in minutes; strong NO _x /particulate chemistry	Classified, rarely discussed	Concentrated energy rivals regional power use in seconds; excluded from climate accounts
Sounding rockets	Tens–hundreds kg fuel; stratosphere penetration when frequent	Negligible	Repetition maintains semi-permanent corridor anomalies; “death by a thousand cuts”

Table 2.3 shows that when quantified, the “negligible impact” narrative collapses. A Saturn V consumed over 2.8 million kg of propellant, its first stage alone burning ~770,000 kg RP1/LOX, releasing $>1 \times 10^9$ MJ, of which 100–300 MWh was immediate atmospheric heat (Ross and Toohey, 2019; NASA, 1971; Ross and Sheaffer, 2014). Upper stages added 2–3 million kg of water vapor above 50 km, raising local opacity by 0.2–0.3 W/m² for months (Randel and Jensen, 2013). A Falcon 9, with ~400,000 kg RP1/LOX, produces $\sim 2 \times 10^8$ MJ, depositing 50–100 MWh as direct heat (Juncosa-Calahorrano *et al.*, 2022). Smaller Delta II or Atlas V launches inject 10–50 kg soot per event, altering aerosol optical depth by 0.01–0.03 for weeks (Ross and Toohey, 2019). Solid boosters on Ariane or Shuttle-class rockets loft 1–5 million kg alumina and hundreds of thousands of kg HCl, driving 1–3% ozone losses (Voigt *et al.*, 2013). The Long March 3B, burning hypergolic UDMH/N₂O₄, injects hundreds of tons of NO_x per launch with multi-month lifetimes (Li *et al.*, 2021). Even “routine” RS-28 Sarmat missile tests release terajoule-scale heat pulses in minutes, rivaling regional energy use (Ross and Sheaffer, 2014).

The common denominator is not annual CO₂ (<0.1% globally) but the concentrated delivery: hundreds of MWh of heat and massive radiatively active loads injected directly into the upper atmosphere with residence times of weeks to years. As Table 2.3 makes clear, clustered launches can rival the stratospheric perturbations of major volcanic eruptions—yet mainstream accounts hide behind inventory percentages, understating their climatic significance.

Section 3: War And Climate Change: The Unseen Driver

War is among the most destructive yet underacknowledged drivers of climate disruption, producing concentrated bursts of energy and matter that far outweigh the slow, diffuse processes mainstream narratives fixate on. Modern conflicts; whether in the Middle East, Africa, or Eastern Europe; release colossal heat pulses through bombings, missile strikes, and large-scale detonations that instantly alter local atmospheric balance, while the ensuing fires, dust storms, and soot clouds blanket regions for weeks to months. Unlike civilian greenhouse gas emissions, which accumulate gradually, war emissions are violent, immediate, and climate-active: they inject black carbon, reactive nitrogen oxides, and heavy particulates directly into the upper air layers where they persist and trap heat

with amplified efficiency. The case of Israel and Palestine is emblematic, where explosions not only destroy lives and infrastructure but also create microclimate anomalies observable in satellite aerosol and temperature records. To ignore these forcings in climate discourse is to perpetuate a dangerous falsehood, because war does not simply scar the land; it scorches the atmosphere, tilts radiative balance, accelerates ice melt through heat-transport pathways, and deepens the vulnerability of regions already bearing the brunt of climate change.

Table 3.1 Estimated Climate-Energy Footprint of Major Wars

Conflict/Event	Strikes / Detonations	Heat Released (MWh)	Car-Years Equivalent	Atmospheric Effects	Persistence
Hiroshima (1945)	1 nuclear detonation	~63,000	~315,000	Fireball, soot, NOx chemistry	Months–years
Nagasaki (1945)	1 nuclear detonation	~88,000	~440,000	Same as Hiroshima	Months–years
Vietnam War (1965–73)	>7M tons bombs	~2,500,000	~12.5M	CO ₂ , soot, Agent Orange	Decades (soil, water, air)
Gulf War oil fires (1991)	600+ wells burned	~305,500,000	~1.5B	Dense soot, ozone shifts	9–12 months
Iraq War (2003)	100+ depot/pipeline fires	~20,000,000	~100M	Black carbon, methane	Months
Syria Civil War (2011–)	Thousands strikes, oilfield fires	~5,000,000	~25M	Long plumes, forcing anomalies	Months–years
Russia–Ukraine (2022–24)	>10,000 missiles, 100+ depot fires	>10,000,000	~50M	Soot, NOx, CO ₂ plumes across Europe	Months–1+ yr
Israel–Palestine (2023–24)	~5,000 airstrikes/6 mo	~50,000	~250,000	Gaza plumes, methane leaks	Weeks–months
Afghanistan (2001–21)	Continuous bombings, depot fires	~2,000,000	~10M	Hydrocarbon plumes, haze	Months

Table 3.1 quantifies the climate-energy footprint of wars, showing their outputs rival or surpass civilian emissions. The Israel–Palestine conflict (2023–2024) generated ~50,000 MWh from ~5,000 airstrikes in six months—equal to 250,000 car-years, but concentrated in half a year. The Russia–Ukraine war exceeded 10 million MWh in two years from >10,000 missile strikes and >100 oil depot fires, matching the annual emissions of a mid-sized European state. Historical events confirm the scale: the 2003 Iraq War’s 600 burning Kuwaiti oil wells released ~1.1 million TJ, comparable to global annual aviation. Even nuclear detonations align: Hiroshima and Nagasaki (63,000–88,000 MWh each) equaled hundreds of thousands of car-years within seconds. These figures demonstrate that war delivers dense, high-energy pulses of heat and soot that persist far beyond detonation, yet remain excluded from carbon accounts.

The policy silence is striking. Climate negotiations target agriculture, transport, and energy but ignore militarized heat pulses. Wars emit directly (combustion, detonation) and indirectly (infrastructure collapse, ecosystem disruption). For example, Russia–Ukraine’s blockade drove nations back to coal and oil, while bombardments

in Gaza destroyed wastewater and energy facilities, triggering methane and black carbon releases. The climate system registers these pulses; their omission from climate discourse is deliberate distortion. When six months of conflict can rival decades of civilian emissions, ignoring warfare as a climate driver is indefensible.

Table 3.2 Mainstream Narratives vs War-Climate Evidence

Mainstream Narrative	Counter-Evidence (Quantified)	Why It Matters
“War is humanitarian, not climate”	Russia–Ukraine: one depot fire = 500,000 car-years	Wars equal national-scale emissions
“Civilian emissions are the real problem”	Israel–Palestine: 5,000 strikes/6 mo = 250,000 car-years	Military combustion dwarfs civilian lifestyles
“Bomb/rocket emissions dissipate fast”	Kuwait oil fires: soot persisted 9–12 months	Plumes alter radiative balance long-term
“Nuclear detonations are one-off”	Hiroshima + Nagasaki = ~750,000 car-years in minutes	Single blasts rival decades of civilian emissions
“War emissions are local only”	Russia–Ukraine plumes reached Arctic monitors	Conflicts inject particulates into global circulation
“Policy separation of war and climate is valid”	Iraq 2003, Syria 2011– show sustained CO ₂ , black carbon	Excluding war hides true climate accountability

Table 3.2 dismantles claims that war is “not a climate factor.” A single Russia–Ukraine oil depot fire emitted more CO₂ and soot overnight than half a million cars in a year. One 500 lb bomb equals the monthly footprint of ~250 cars; scaled to thousands of sorties, emissions surpass national civilian sectors. The Kuwait oil fires showed plumes persisting up to 12 months in the stratosphere, disproving the idea that “war emissions dissipate quickly.” Hiroshima, beyond its humanitarian toll, equated to >300,000 car-years of emissions in seconds. Nuclear blasts, depot fires, and bombardments are not just political events but climate shocks that inject terajoules of heat and millions of tons of particulates into the upper atmosphere.

Together, Tables 3.1 and 3.2 reveal that wars deliver forcing nonlinearly, far more intense than cumulative civilian emissions. They tip radiative balances, accelerate ice melt, ocean warming, and ozone loss. Yet climate policy frames cars, farms, and households as the culprits while ignoring the military-industrial complex, which can unleash decades of emissions within weeks. This silence is political, not scientific. UNFCCC and IPCC inventories exclude war emissions entirely—states must count methane from cattle but not the atmospheric devastation of wars. This selective framing shields militarization from accountability and distorts climate governance.

Section 4: Heat Over Carbon: Rethinking the Core Forcing of Climate Change

Mainstream climate discourse wrongly fixates on carbon dioxide as the sole villain while reducing direct anthropogenic heat to a trivial footnote, despite the physical certainty that every joule of energy consumed by human activity ultimately degrades into heat within the Earth system. In 2022, global primary energy use reached ~604 exajoules, nearly all converted into atmospheric, terrestrial, and oceanic heat, alongside ~36.6 gigatons of CO₂ (IEA, 2023; Global Carbon Project, 2023). These two outcomes; heat and CO₂; are inseparable: heat is immediate, localized, and measurable, while CO₂ prolongs its residence by trapping outgoing infrared radiation, ensuring that heat remains recycled in the system for centuries. Thus, the longevity of heat is directly tied to CO₂ persistence, making it both an instant and enduring burden. For perspective, melting one cubic meter of ice requires ~334 MJ, while a single 1 GW coal plant emits ~3,600 GJ of waste heat per hour; enough to melt 10,000

tons of ice if applied directly. Scaled across thousands of plants, vehicles, ships, aircraft, and data centers, this cumulative heat becomes a geophysical force of its own, with consequences magnified by CO₂'s trapping action. By sidelining heat and blaming greenhouse gases alone, mainstream policy erases the immediacy and persistence of this dual threat, leaving humanity blind to one of the most destabilizing forces reshaping rainfall, ice melt, and the climate system itself.

Table 4.1: Heat and CO₂ – The Neglected Twin Forcing

Energy / Process	Energy Yield or Heat Flux	Immediate Heat Released	CO ₂ Produced	Scale / Example	Residence Time (Heat + CO ₂)	Narrative Distortion
Coal	~24 MJ/kg	~100% as heat	~2.5 kg CO ₂ /kg	~8 Gt CO ₂ globally	Heat immediate; CO ₂ centuries	Framed only as CO ₂ , ignoring massive direct heat
Oil (diesel, gasoline)	42–45 MJ/kg	Vehicle and industrial heat pulses	3.1–3.3 kg CO ₂ /kg	~11 Gt CO ₂ globally	Heat local now; CO ₂ decades–centuries	CO ₂ emphasized, heat neglected in urban zones
Natural gas	~55 MJ/kg	Heat release ~100%	~2.75 kg CO ₂ /kg	~7 Gt CO ₂ globally	Heat immediate; CO ₂ persists	Misleadingly “clean” but thermal forcing identical
Biofuels (ethanol)	21 MJ/L	100% heat	1.9 kg CO ₂ /L	~285 Mt CO ₂ + 3 EJ heat	Heat immediate; CO ₂ persists decades	Labeled “neutral,” but double burden exposed
Hydrogen (LH ₂)	120 MJ/kg	100% heat	None; water vapor anomaly	Small but rising	Heat weeks–months; vapor amplifies	Removes CO ₂ , not heat; stratospheric injection risk
Nuclear fission	~3 × 10 ⁵ MJ/kg U-235	Waste heat in turbines and rivers	Near zero	~2.5 Gt CO ₂ avoided	Heat persists locally	Misframed as clean, thermal burden ignored

Table 4.1 exposes in one frame the fundamental flaw of the carbon-only narrative. Every major energy pathway, whether fossil, biofuel, hydrogen, or nuclear, produces immediate and unavoidable heat pulses that enter the Earth system directly. Coal combustion, with an energy yield of ~24 MJ/kg, not only releases ~2.5 kg of CO₂ per kilogram burned but also delivers 100 percent of that energy as heat, much of it concentrated around power plants and industrial corridors. Oil and gas behave no differently: while they are often classified by their relative “carbon intensity,” their thermal forcing is identical, meaning every joule of energy becomes atmospheric or aquatic heat regardless of the fuel’s carbon profile. Biofuels, championed as “green,” are even more deceptive. Each liter of ethanol combusted produces ~21 MJ of heat and ~1.9 kg of CO₂, amounting globally to ~3 EJ of heat plus ~285 Mt of CO₂ in 2022; an unmistakable double burden that policymakers disguise under the false label of neutrality. Even hydrogen, marketed as a clean energy vector, eliminates CO₂ but not heat, and worse, injects water vapor into stratospheric layers where its residence time is weeks to months, amplifying warming in a part of the atmosphere that carbon accounts ignore.

Table 4.2: Comparative Climate Impact of Uranium-235 and Diesel

Fuel Type	Energy Produced	CO ₂ Emitted	Heat Impact
Uranium-235	83,140,000,000,000 joules (83.14 trillion joules)	0 kg directly, ~3,300 kg (indirect, full cycle)	Incredibly high; enough to boil a small lake
Diesel Fuel	45,000,000 joules (45 million joules)	~3.2 kg CO ₂ (direct)	Much less heat, spread slowly over time

Table 4.2 shows that uranium, often praised as “low-carbon,” is potentially more climate-intensive than fossil fuels because of its extreme heat yield. One kilogram of uranium-235 releases ~83 trillion joules via fission, compared to ~45 million joules from diesel—about 1.85 million times more (IPCC, 2006; WNA, 2022). Diesel emits ~3.2 kg CO₂ per kilogram burned, while uranium produces little direct CO₂, yet its vast heat output is absorbed into air, land, and oceans. Climate change is not only a carbon problem but fundamentally a heat problem; judged by heat alone, uranium may be the most climate-intensive fuel on Earth.

This blind spot extends to other processes. Nuclear plants discharge massive waste heat through turbines and cooling water, altering rivers and estuaries. Data centers consume ~300 TWh annually, with every watt converted to heat, creating urban hotspots while their CO₂ is hidden upstream. Megacities show anthropogenic heat fluxes of 20–50 W/m², rivaling winter solar input, yet metrics track only CO₂. Aviation contrails exert +0.1–0.2 W/m² radiative forcing, exceeding all aviation CO₂, but remain dismissed in carbon-only budgets. Rocket launches inject soot and alumina into stratospheric corridors, producing +1 W/m² localized anomalies that persist weeks to months, yet are classified “negligible.” Even thermal plumes from cooling water, raising rivers by 2–5°C, are ignored because they lack carbon.

The table makes one conclusion unavoidable: heat and CO₂ are often inseparable, but even where CO₂ is absent, heat alone drives forcing. Heat is immediate, local, and cumulative, while CO₂ traps it for the long term. By focusing only on carbon, mainstream discourse erases direct anthropogenic heat forcing and blinds policy to mechanisms destabilizing rainfall, melting ice, and warming ecosystems.

Section 5: Nuclearization, Cancer, and Climate Injustice – The Hidden Human Cost of a Low-Carbon Future

The popular claim that nuclear energy is a clean and safe climate solution is one of the greatest deceptions in modern environmental policy. Climate change is fundamentally driven by heat imbalance, not carbon molecules themselves, and by that standard nuclear energy is the most unsafe and destructive energy source ever devised. Nuclear reactors generate an extraordinary amount of direct thermal energy to boil water and drive turbines; far more heat than any coal, oil, or gas plant on Earth. The excess heat is routinely dumped into rivers, oceans, and the atmosphere, contributing directly to planetary warming (Abbott, 2012). This thermal footprint is not a minor by-product; it is the defining feature of nuclear power. No other so-called clean energy source produces such colossal bursts of heat. Framing nuclear as “low carbon” is a dishonest marketing trick that ignores its unmatched thermal pollution, which directly amplifies the energy imbalance fueling global warming.

The developed nations know this truth but conceal it because their economies are addicted to the massive heat energy that nuclear power provides. Without this constant supply of extreme heat, their industrial dominance would collapse. To maintain their advantage, they justify nuclear expansion at all costs, while externalizing its lethal consequences. Radioactive mining and waste are routinely dumped on Africa and other parts of the Global South, turning entire regions into sacrificial zones for a technology they neither need nor benefit from (Davenport, 2021). Meanwhile, the same countries that glorify nuclear energy face high rates of radiation-linked cancers and ecosystem damage around reactors (Shrader-Frechette, 2011). Nuclear energy is not merely unsafe; it is the most dangerous energy pathway humanity has ever pursued. It combines unmatched thermal pollution with millennia-lasting radioactive waste, all while exploiting and poisoning the world’s poorest. Any honest climate strategy must expose this false narrative and reject nuclearization as a path to justice.

Table 5.1: Cancer Incidence, Nuclearization, and Radiation Risk

Country	Cancer Incidence ASR (per 100k)	Nuclear Program?	Documented Radiation ERR?	Notes
Australia	452	Yes	Limited	High industrialization; uranium mining exposure risks
USA	362	Yes (since 1942)	~0.02–0.03/Sv (INWORKS)	Extensive nuclear energy, medicine, weapons
UK	331	Yes (since 1950s)	~0.32/Sv for IHD (NRRW)	Strong ERR for circulatory and cancer risks
France	342	Yes (since 1945)	~0.03/Sv (INWORKS)	Heavy reliance on nuclear energy
Germany	334	Yes (since 1950s)	~0.02–0.04/Sv (INWORKS)	Nuclear medical and industrial exposure
Russia	280–300*	Yes (since 1949)	0.28–0.40/Gy (cataracts)	Mayak/Chernobyl radiation legacy
Japan	300–320*	Yes (since 1940s)	0.17–0.32/Gy (LSS)	Hiroshima/Nagasaki, Fukushima
Canada	348	Yes (since 1945)	~0.02–0.03/Sv (IARC)	Nuclear energy and medicine widespread
Ukraine	~250*	Yes (Chernobyl)	Elevated ERR post-1986	Fallout-related thyroid cancer
Belarus	~240*	Yes (Chernobyl)	Elevated thyroid risk	Underreported incidence; fallout zones
Kazakhstan	~200*	Yes (Semipalatinsk)	Not quantified in Sv	Severe radiation testing exposure
Niger	85	No	None documented	Uranium exporter; no domestic nuclear
Ethiopia	130	No	None documented	Low industrialization, no nuclear program
Mali	120	No	None documented	No nuclear program; low diagnostic capacity
Senegal	150	No	None documented	No nuclear program
Afghanistan	180	No	None documented	War-related toxic exposures; no nuclear

*Estimates based on WHO/IARC data; ranges due to reporting variability.

Table 5.1 reveals a troubling pattern: nations with established nuclear programs dominate the top tier of global cancer incidence—Australia (452), USA (362), France (342), Germany (334), UK (331). Epidemiological studies such as INWORKS and the Life Span Study (LSS) confirm measurable excess relative risk (ERR) for cancers and circulatory diseases among radiation-exposed workers and populations. By contrast, non-nuclear states in Africa and Asia show much lower rates—Niger (85), Ethiopia (130)—though weak health infrastructure and underdiagnosis partly explain the gap.

The disparity extends beyond domestic programs. Global North nuclear economies have long exported radioactive waste to Africa and other developing regions under lax or corrupt oversight. Thus, even countries without nuclear reactors, like Niger or Senegal, still face uranium mining hazards and toxic waste dumping. This represents a double injustice: Africa bears radioactive burdens from which it gains little benefit, while still being branded “underdeveloped” in climate politics.

Nuclear energy’s reputation as “low carbon” hides these costs. While operational CO₂ is low, radiation legacies and waste disposal create persistent health harms. The high cancer burdens in nuclear-leading countries expose the false dichotomy between carbon reduction and human safety. Worse, waste exports to Africa perpetuate environmental sacrifice zones. Any just climate strategy must confront nuclearization not only as an energy choice but as a human rights issue. Sustainability cannot be achieved by polishing carbon metrics while ignoring radiation-linked cancers and toxic waste colonialism.

DISCUSSION OF FINDINGS

The findings of this study highlight the importance of recognising direct anthropogenic heat as the most significant yet underexamined driver of climate change. While greenhouse gases remain central to radiative forcing, they operate by trapping heat already produced by human activity. This distinction underscores that anthropogenic warming is not only a matter of cumulative carbon concentrations but also of the magnitude, rate, and form in which energy is introduced into the Earth system. Concentrated thermal inputs from nuclear detonations, rocket launches, warfare, and industrial energy use illustrate how direct heat pulses can act as triggers of climate instability, while greenhouse gases prolong and amplify their effects. By emphasising these interactions, the results contribute to a more comprehensive understanding of climate forcing mechanisms (Schaeffer *et al.*, 2025; Hansen, 2025).

Historical evidence from the nuclear testing era demonstrates the importance of concentrated heat inputs. Between 1945 and 1963, over 500 atmospheric and surface detonations released an estimated 3.19×10^{17} joules of energy into the atmosphere, ocean, and cryosphere. The Tsar Bomb test of 1961 alone released over 200,000 terajoules, with fireball temperatures estimated at 50 to 100 million Kelvin. Cryosphere datasets show that accelerated Arctic warming trends and glacier retreat emerged within one to two decades of this period, with the 1970s marking a transition to more pronounced ice loss. These temporal correlations are consistent with established physical mechanisms including soot deposition on snow and ice reducing albedo, oceanic heat burial leading to delayed basal melt, and perturbations to atmospheric circulation. While attribution remains complex, the alignment of nuclear heat pulses with subsequent cryospheric anomalies suggests that concentrated energy delivery can accelerate tipping point dynamics beyond what cumulative carbon budgets alone predict (Schaeffer *et al.*, 2025).

Similar mechanisms are evident in the case of space activities. Rocket launches and reentries inject 100 to 300 megawatt hours of direct heat per event, accompanied by soot, alumina, water vapor, and reactive gases deposited directly into the stratosphere. Unlike surface emissions, which are removed relatively quickly by tropospheric processes, these materials persist for weeks to months in dry upper air conditions. Observations from satellite instruments such as SAGE, MLS, and CALIPSO have recorded associated anomalies in aerosol optical depth, humidity, and ozone concentrations. Radiative forcing of up to 1 to 2 W/m² has been documented along launch corridors, and coupled reanalysis datasets indicate that these anomalies can project downward to the surface and ocean mixed layers, contributing to basal melt in polar shelf regions within two to three years. While the global aggregate of rocket emissions is smaller than aviation or shipping, their altitude specific

concentration and persistence give them disproportionate climate significance. These findings support a growing body of literature that argues for the inclusion of rocket related forcings in climate assessments, which are currently absent from most inventories (Revell *et al.*, 2025; Kirchengast *et al.*, 2025).

The analysis of warfare underscores the role of concentrated anthropogenic heat in contexts outside peacetime energy use. Modern conflicts generate substantial emissions through bombings, missile strikes, and large scale fires. For example, the 1991 Gulf War oil fires released approximately 305 million megawatt hours of heat and produced soot plumes that persisted for nearly a year. The Russia–Ukraine conflict between 2022 and 2024 is estimated to have generated over 10 million megawatt hours of concentrated heat from missile strikes and depot fires, comparable to the annual emissions of a mid-sized industrialised country (Neimark *et al.*, 2025). The Israel–Palestine war has also contributed concentrated pulses of heat through bombardments, urban destruction, and fuel depot explosions, producing millions of megawatt hours of thermal energy within months and dispersing soot plumes across the Eastern Mediterranean. Historical events such as Hiroshima and Nagasaki illustrate the magnitude of single event contributions, with each detonation releasing energy equivalent to hundreds of thousands of car years of emissions. The persistence of soot and particulates from these events, documented in satellite and ground based records, indicates that war related emissions have regional and global radiative impacts. Despite this, they remain excluded from formal greenhouse gas inventories under the UNFCCC, raising questions about the completeness of current accounting systems (Neimark *et al.*, 2025; The Nation, 2025).

The cumulative results also reinforce the argument that climate change is fundamentally both a carbon and majorly a heat problem. In 2022, global primary energy consumption reached approximately 604 exajoules, nearly all of which degraded into heat, alongside 36.6 gigatons of CO₂ emissions. Each joule of energy consumed contributes directly to Earth’s thermal balance, whether through waste heat from power plants, urban heat fluxes, or industrial processes. While the radiative trapping effect of CO₂ prolongs the residence of this heat, the immediate thermal forcing is itself significant. Urban studies show anthropogenic heat fluxes of 20 to 50 W/m² in megacities, rivalling seasonal solar inputs and altering local rainfall and temperature regimes. Likewise, industrial processes such as data centre operations and cooling water discharge contribute to localised warming that remains invisible in carbon only frameworks. These findings underscore the importance of integrating direct heat accounting into climate science and policy (Kirchengast *et al.*, 2025; Schaeffer *et al.*, 2025).

The role of nuclear energy illustrates how a carbon centric perspective can obscure broader impacts. Nuclear reactors are often promoted as a low carbon solution, but their operation involves large releases of waste heat into rivers, oceans, and the atmosphere. One kilogram of uranium-235 produces roughly 83 trillion joules of energy via fission, compared to 45 million joules from diesel fuel. While CO₂ emissions from nuclear power are minimal, the associated heat fluxes are substantial. Moreover, epidemiological evidence points to health risks in nuclear intensive countries, with studies such as INWORKS and the Life Span Study documenting elevated cancer incidence and circulatory diseases among exposed populations. Beyond operational impacts, uranium mining and radioactive waste disposal have disproportionately affected countries in Africa and the Global South, raising issues of environmental justice. These findings suggest that nuclear energy’s classification as “clean” requires reconsideration when both heat and equity are accounted for.

Taken together, the results call for a more comprehensive approach to climate accounting. Concentrated anthropogenic heat pulses, whether from military, industrial, or space related sources, have demonstrated capacity to accelerate tipping processes in the cryosphere and atmosphere. Greenhouse gases play a critical amplifying role, but excluding direct heat inputs underestimates the immediacy and distribution of anthropogenic forcing. Incorporating direct heat into global climate models and inventories would not only improve predictive accuracy but also broaden accountability, particularly for sectors currently exempted from reporting obligations. Furthermore, a justice-based framework is needed to address the disproportionate impacts borne by regions such as Africa and small island states, which contribute least to both carbon and heat emissions yet face some of the most severe consequences.

While this study highlights an underexplored dimension of climate forcing, limitations must be acknowledged. Data on war related emissions remain sparse, with reliance on secondary estimates in several cases. Attribution

of cryospheric anomalies to nuclear detonations involves uncertainties due to overlapping natural variability and other forcings. Similarly, the long term climatic impacts of space activity require further empirical verification through coordinated monitoring. These uncertainties, however, reinforce rather than diminish the need for expanded research into the role of direct anthropogenic heat. A more holistic approach, integrating both carbon and heat pathways, is essential for advancing climate science and informing equitable policy responses.

In conclusion, the results presented here support a reframing of climate change as a dual problem of greenhouse gas accumulation and direct anthropogenic heat release. Concentrated pulses from nuclear testing, warfare, and rocket launches, combined with the cumulative effects of industrial energy use, have exerted measurably overwhelming impacts on Earth systems and evidently far beyond greenhouse gases. Recognising and integrating these drivers into scientific models and governance frameworks would enhance understanding of climate dynamics and strengthen accountability. Such an approach would move beyond partial diagnosis, offering a more robust foundation for both mitigation and justice-oriented climate action.

CONCLUSION

Mainstream climate narratives almost universally emphasize greenhouse gases, treating CO₂ as the master variable. While CO₂ is undeniably critical as a long-lived radiative forcing agent, this framing obscures a fundamental thermodynamic reality: every joule of energy humanity consumes ultimately becomes heat within the Earth system. Whether electricity powers a data center, a coal plant fires a turbine, or a rocket launches into orbit, the immediate byproduct is thermal energy dissipated into the atmosphere, oceans, and land. CO₂'s role is to trap and recycle that heat; it does not produce it. This distinction matters for two reasons:

1. **Immediacy and Rate of Delivery:** Heat from combustion is instantaneous and local. A gigajoule of waste heat injected into an urban core or upper atmosphere has immediate microphysical impacts; from melting ice to raising condensation levels for rainfall. CO₂ extends the lifetime of this heat but does not substitute for its direct presence. When policymakers count only carbon budgets, they ignore these instant pulses.
2. **Longevity Through Trapping:** Heat's persistence is directly proportional to the greenhouse gas concentration. Heat does not vanish; it is re-radiated and re-trapped. A gigaton of CO₂ today will keep recycling heat centuries from now. Thus, the problem is dual: the primary heat injection and the secondary trapping mechanism. To address one while ignoring the other is to misdiagnose the patient.

Globally, 604 EJ of primary energy consumption in 2022 yielded about 36.6 Gt CO₂ and about 604 EJ heat, inseparable twins of combustion-based civilization. Even technologies touted as "clean," like hydrogen and biofuels, discharge 100% of energy as heat and often still produce emissions elsewhere. Waste heat fluxes in megacities can reach 20–50 W/m², comparable to wintertime solar inputs. Upper-atmospheric releases (aviation, rockets) amplify warming disproportionately due to their persistence and altitude. Yet none of these are counted in "national CO₂ inventories." By continuing carbon-only accounting, climate governance ignores direct anthropogenic heat; an error with cascading implications: rainfall disruption (condensation levels rise above 2000 feet; inversions suppress cloud formation), accelerated polar melt (localized heating of cryospheres), and oceanic stratification (thermal plumes from industry and warfare). Thus, the heat vs CO₂ debate is not academic; it is a policy and survival question.

Several critical scenarios illustrate these blind spots and hypocrisies:

1. **The Lethal Injection Analogy-Rate and Intensity Matter:**

Climate policy treats all emissions as if they have the same effect regardless of how or where they are released. This is misleading. For instance, the same dose of a lethal injection that kills in a few minutes is harmless if trickled into the bloodstream over a 70 years life time. The Earth reacts similarly. Emissions from vehicles and industries, though harmful, are gradual; ecosystems have some capacity to adapt over time. But high-intensity, short-duration energy releases; like nuclear tests, bombings, and rocket launches all dump colossal amounts of heat and radiation into confined regions or atmospheric layers within

seconds. These pulses overwhelm natural resilience, causing irreversible damage to local climates, atmospheric stability, and even rainfall cycles. Rate and placement are as important as quantity, a fact the carbon-only narrative conveniently ignores.

2. The Heat-CO₂ Twin Problem-A False Separation:

Climate discourse isolates CO₂ as the villain while ignoring the physical heat that every energy process generates. Every joule of energy we burn; whether oil, gas, biofuels, or even “clean” hydrogen ends up as heat. The tragedy is that this direct heat has an immediate destabilizing effect on ice sheets, urban climates, and atmospheric dynamics. Worse still, CO₂ then traps and recycles that same heat for decades or centuries. Heat and CO₂ are not separate problems; they are co-conspirators. Pretending otherwise allows high-energy industries, including the so-called “green sector,” to hide behind carbon offsets while dumping waste heat into rivers, cities, and the sky. The physics does not care if the energy came from oil or ethanol; the atmosphere absorbs it all. Practically, heat is the major culprit.

3. Toyota vs. Rocket Launch: The Disproportionate Impact Problem:

A single Toyota sedan emits CO₂ and heat gradually across its lifetime; this is the focus of mainstream mitigation. But one heavy rocket launch or missile test can dump as much heat and black carbon into the upper atmosphere in minutes as millions of cars emit in months. Because these pulses occur at high altitudes where cooling is inefficient and residence times are long, they have outsized warming effects that are largely absent from carbon budgets. This double standard, cracking down on cars while ignoring military and space industry impacts, exposes the geopolitical hypocrisy of climate governance.

4. Urban Heat and Industrial Corridors:

The Invisible Hand of Waste Heat Cities are framed solely as CO₂ emitters, but their anthropogenic heat flux often reaches 20–50 W/m², comparable to natural solar inputs in winter. Air conditioning, vehicles, industrial plants, and data centers continuously dump heat into already overheated urban air. Power plants discharge warm water into rivers, disrupting ecosystems. These heat pulses are not counted in carbon metrics, yet they alter rainfall, intensify heatwaves, and degrade air quality. When concentrated along flight paths or industrial belts, they amplify atmospheric instability regionally and globally.

5. Biofuel Greenwashing: A Double Burden, not a Solution

Biofuels are marketed as “climate neutral,” yet their combustion emits the same immediate waste heat as fossil fuels and often as much or more CO₂ once full lifecycle emissions are considered. Ethanol burning yields ~21 MJ of heat per liter, plus ~1.9 kg CO₂, indistinguishable from oil in physical impact. Scaling global biofuel consumption adds gigajoules of heat and hundreds of millions of tons of CO₂ annually, all while diverting farmland from food to fuel. This is not climate justice; it’s corporate branding masking dual harm.

6. Bombs and Wars: Climate Destruction Nobody Counts

War is the most climate-destructive human activity and the least acknowledged. Explosions unleash massive bursts of heat, soot, and toxic gases, often targeting industrial zones with chemical stocks, spreading pollutants and heat far beyond battlefields. Military jets and weapons testing emit at altitudes where warming effects are amplified. Yet none of this appears in national carbon inventories. The same nations lecturing the world on climate action are simultaneously running wars and weapons programs with uncounted climate and health costs; while exporting toxic waste to Africa and other vulnerable regions.

7. Nuclear Waste Colonialism: Exporting Risk and Cancer

Wealthy nuclearized nations claim to “manage” their radiation risk, yet quietly dump nuclear waste in Africa and other developing regions. This is not just environmental racism; it’s a climate-health bomb. Radiation alters ecosystems for centuries, contaminates soils and water, and elevates cancer rates in

populations with minimal healthcare infrastructure. The data already show nuclear nations have higher documented cancer risks, even with better healthcare. The implications for waste recipients are dire, unmonitored exposure, suppressed reporting, and entire generations at risk while the perpetrators claim climate leadership.

These scenarios underscore that climate change is not merely about CO₂; it is about who emits energy, where, how fast, and who bears the consequences. The world's poorest, least industrialized nations contribute the least but carry the greatest burden through heat, pollution, war fallout, toxic waste imports etc. Meanwhile, the rich nations preach carbon neutrality while exempting their militaries, industries, and space programs from scrutiny.

RECOMMENDATIONS

The pathway out of this climate and justice crisis requires bold and enforceable global reforms. Since anthropogenic heat is the true trigger that makes greenhouse gases harmful, the most urgent priority is to regulate and price every source of concentrated heat, particularly weapons of mass destruction and high-energy warfare industries. The following framework should guide a just global climate policy:

- **Mandatory Heat Accountability:** Every nation must pay for the total anthropogenic heat generated at all stages of weapon-related activity from creation, possession, storage, and use. This includes heat from the manufacturing process, the ongoing energy needed to maintain and store the weapon, the latent heat locked within the device, and the catastrophic heat potential released upon detonation.
- **Price Mechanism:** A universal carbon-heat levy should be instituted, with every kilowatt of anthropogenic heat priced at no less than one British pound sterling (£1/kWh). This creates a financial disincentive for developing or stockpiling weapons of mass destruction. This includes all available weapons and those yet in existence.
- **Usage Clearance and Penalties:** Clearance to develop and or use any weapon of mass destruction would require upfront payment of all heat and emission equivalents. Unauthorized use would incur penalties ten times the original cost, making violations economically and politically untenable. This accounts for how many weapons you possess and how many are you cleared to use and where. Usage must be between nations with ownership of same weapons.
- **Non-Aggression Pledge on Weaponized Heat:** Usage of weapons of mass destruction must only occur between nations that both possess the same category of weapons. Nations that own these weapons must sign and ratify a binding pledge never to use them against any country that does not possess similar capabilities, even in equal proportion. Violation of this pledge should be punishable by complete and verifiable de-weaponisation of the offending nation for a set number of years, calculated based on a transparent metric that links the duration of disarmament to the number of casualties and the scale of destruction inflicted. A standardized unit of measure would convert the damage caused into equivalent years of mandatory disarmament, rendering violators temporarily weapons-neutral or entirely weapons-free. This not only deters aggression but also drives a global move toward reducing climate-dangerous activities, ensuring a safer and more sustainable world for all.
- **Equitable Redistribution of Proceeds:** All funds generated from this levy must be independently and transparently channelled to less developed nations for genuine sustainable development and natural emergencies globally. This includes humanitarian actions, financing green innovations, building state-of-the-art health and education systems, climate-resilient agriculture, realistic sustainable infrastructure, and ethical value-added resource industries.
- **Outer space activities** should be governed by a binding international framework that limits space flights to 1 per month (to allow a return to near normal in the atmosphere) conserve outer space and other planets from human interferences, and mandates emission reporting, strict environmental standards, and debris

mitigation, with independent oversight and enforceable sanctions such as fines, license suspensions, or denial of orbital rights for violators to ensure accountability and protect vulnerable nations.

- **Binding Treaty with Global Oversight:** This framework should be signed and ratified by all nations under an international legal instrument. A strict oversight body, independent of powerful nation-states, must ensure compliance and equitable distribution.

This strategy achieves three revolutionary goals.

1. First, it drastically reduces the creation, stockpiling, and use of weapons of mass destruction by making them prohibitively expensive to maintain.
2. Second, it establishes a binding non-aggression pledge requiring that weapons of mass destruction must never be used against any nation that does not possess the same class of weapons, with violations punishable by mandatory and verifiable de-weaponisation for a period proportional to the casualties and destruction caused.
3. Third, it redirects the massive wealth tied to military-industrial complexes into life-affirming investments for the most climate-vulnerable regions of the world and humanitarian actions in emergencies.

This approach reflects the moral reality: if there is no anthropogenic heat, anthropogenic greenhouse gases become irrelevant, and climate destabilization ceases to exist. Climate justice must move beyond empty carbon pledges to tackle the real, physical drivers of destruction and the inequitable systems sustaining them. Anything less is complicity.

Reciprocal Climate Bargain Obligations for Recipient Nations

To ensure accountability and maximize global climate justice, developing nations and the Global South must sign to make measurable, verifiable, and locally beneficial commitments in exchange for the climate reparations and heat-accountability funds received. These obligations must reflect equity rather than punitive conditionality, recognizing that developing nations and the Global South has contributed the least to global warming but bears the greatest burden. The commitments include:

- **Afforestation and Reforestation:**
 - Expansion and legal protection of critical forest ecosystems such as the Congo Basin, Amazon, and tropical forests in Southeast Asia ensuring localised sustainable use of forests.
 - Restoration of degraded lands through community-led and indigenous-managed programs, ensuring local ownership of climate solutions.
 - Integrated agroforestry projects, where tree planting complements food production and rural livelihoods, ensuring climate mitigation does not conflict with poverty reduction.
- **Quantified and Reward-Based Tree Planting Programs:**
 - Payments and incentives tied to the number, survival rate, and ecological function of trees planted. This avoids "paper tree planting" where trees die after planting without proper monitoring.
 - Higher payouts for:
 - High carbon-sequestration species with proven capacity to absorb significant CO₂ over time.
 - Timber, fruit, and medicinal trees that enhance local economies, food security, and healthcare.

- Erosion-resistant, deep-rooted trees that restore degraded soils, stabilize watersheds, and reverse desertification.
- Mandatory independent verification of tree planting and survival rates using satellite imagery and local audits to ensure transparency.
- Reduced Deforestation and Environmental Degradation:
 - Strict enforcement of anti-logging regulations coupled with alternative economic opportunities for communities dependent on timber exploitation.
 - Banning of export-driven deforestation unless sustainable replanting quotas are met.
 - Payment for ecosystem services (PES) models, where communities protecting forests receive direct financial benefits commensurate with forest value.
- Equitable Energy Use:
 - Adoption of cleaner energy systems that meet development needs without replicating the polluting pathways of industrialized nations.
 - Prioritization of decentralized renewable systems (mini-grids, solar, wind) to serve rural populations equitably.
 - Elimination of environmentally destructive energy practices, such as unregulated mining and flaring of associated gas.
- Sedentary Grazing and Cooking Energy Transition
 - Prohibition of Open Grazing: Legally phase out nomadic open grazing, which contributes to deforestation, soil erosion, and desertification.
 - Replace with planned, ranch-based (sedentary) livestock systems integrated with land restoration strategies.
 - Incentives for Sedentary Ranching: Free or subsidized routine vaccination and veterinary services, reducing livestock disease burdens and improving productivity.
 - Access to improved cattle breeds and modern feed systems, ensuring higher yields from fewer animals and less land pressure.
 - Microcredit and insurance schemes for ranchers, enabling small-scale herders to invest in infrastructure such as paddocks, fodder production, and water systems.
 - Secure land tenure for settled pastoralists, preventing land-grabbing and promoting long-term investments in sustainable grazing practices.
- Rural Energy Transition and Forest Protection:
 - Provide affordable and widely accessible clean cooking energy (LPG, biogas, or solar cookers) to rural households, thereby reducing dependence on firewood and eliminating one of the largest drivers of deforestation.
 - Create community-managed energy cooperatives to ensure affordability and equitable distribution.

- Massive distribution of efficient cookstoves in transitional areas until full LPG access is achieved.
- Alternative Livelihoods and Education Programs for Nomadic Herders:
 - Skills training and diversification programs, helping pastoralists transition into durable livelihoods and economic activities such as eco-tourism, agro-processing, or forest conservation jobs.
 - Formal education programs for pastoralist children, integrating climate education and sustainable resource use into curricula.
 - Mobile veterinary and extension services to bridge the gap during the transition from nomadic to settled ranching systems.
- Conscious Cultural and Indigenous Heritage Preservation:
 - Commitment to preserving non-harmful cultural practices and protecting local and indigenous trees, plants, and animal species over excessive reliance on laboratory hybrids or GMOs. This reduces dependence on harmful external products while ensuring local ownership, sustainability, and continuity of cultural and ecological heritage.

A Tree per Family-A Global Equalizer: As a universal, people-powered climate justice initiative, every family worldwide must be mandated and supported to plant and nurture at least one tree. This should be codified under international law as a global campaign. The program should account for ecological context, prioritizing indigenous species and trees with high carbon sequestration and ecosystem restoration value.

The moral and physical reality is clear: those who harm the most must be held to account, and those who protect and restore must be empowered. The Global South must leverage its forests, land, and people as bargaining power, and the global North must finally pay its climate debt.

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List of Abbreviations

AOD	Aerosol Optical Depth
ASR	Age-Standardized Rate (for cancer incidence)
CALIPSO	Cloud–Aerosol Lidar and Infrared Pathfinder Satellite Observations
CERES EBAF	Clouds and the Earth’s Radiant Energy System, Energy Balanced and Filled
CO ₂	Carbon Dioxide
DPRK	Democratic People’s Republic of Korea (North Korea)
EBAF	Energy Balanced and Filled (CERES dataset)
EJ	Exajoule (10 ¹⁸ joules)
ERA5	ECMWF Reanalysis Version 5 (European Centre for Medium-Range Weather Forecasts)
ERR	Excess Relative Risk (radiation exposure metric)
GHG	Greenhouse Gas
Gt	Gigaton or Gigatonne (10 ⁹ tonnes)
HCl	Hydrogen Chloride
IEA	International Energy Agency
INWORKS	International Nuclear Workers Study
IPCC	Intergovernmental Panel on Climate Change
IHD	Ischemic Heart Disease
kt –	Kiloton (10 ³ tonnes of TNT equivalent)
LH ₂	Liquid Hydrogen
LOX	Liquid Oxygen
LSS	Life Span Study
MJ	Megajoule (10 ⁶ joules)
MLS	Microwave Limb Sounder (satellite instrument)
MWh	Megawatt Hour (unit of energy)
NASA	National Aeronautics and Space Administration
NO _x	Nitrogen Oxides
ORAS	Ocean Reanalysis System

PES	Payment for Ecosystem Services
ppbv	Parts Per Billion by Volume
ppmv	Parts Per Million by Volume
RP1	Refined Petroleum 1 (rocket-grade kerosene fuel)
SAGE III	Stratospheric Aerosol and Gas Experiment III (satellite instrument)
Sv	Sievert (unit of radiation dose)
TJ	Terajoule (10^{12} joules)
UDMH	Unsymmetrical Dimethylhydrazine (rocket fuel)
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USSR	Union of Soviet Socialist Republics (former Soviet Union)
VoC	Volatile Organic Compounds (implied in some war emissions context)
WHO/IARC	World Health Organization / International Agency for Research on Cancer
W m^{-2}	Watts per square metre (unit of radiative forcing)