Beyond state policy: the personal carbon footprint, climate equity, and the bottom-up imperative in the African region and Nigeria

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State-centric, production-based climate governance has failed to deliver intergenerational justice, particularly for Africa. This paper reframes the debate around the personal carbon footprint (PerCF), arguing that consumption-based accounting more accurately locates moral responsibility and that the subsistence-luxury distinction is essential for equitable policy in developing economies. A Nigerian case study illustrates both the structural constraints inflating involuntary emissions and the rising luxury footprint of an urban elite. Three reforms are proposed: a progressive bifurcated carbon tax, a national clean energy access fund, and a digital PerCF tracker.

Keywords: *Personal carbon footprint; climate equity; intergenerational justice; carbon tax; Nigeria*

Introduction

The year 2024 stands as a historical marker, a point of no return in humanity's relationship with the environment. With global temperatures surpassing the critical 1.5 °C warming threshold relative to the 1850–1900 pre-industrial average (Copernicus 2024: 1), the international community has witnessed the failure of collective, state-centric climate action to prevent the breach of the limit deemed necessary to avert the most catastrophic climate tipping points (Esty/Moffa 2012: 777-791; Ötker-Robe 2014: 27). As CO_2 levels are further increasing at a quick pace, it becomes clear that there is a profound political failure, manifested in inadequate Nationally Determined Contributions (NDCs) and a global reliance on insufficient market mechanisms and offsets. This necessitates a radical re-evaluation of climate governance, moving beyond the current top-down paradigm of state-level emissions targets. The collective inaction of the current generation has critically consumed the finite global carbon budget, placing an existential and disproportionate burden of adaptation and constrained opportunity onto the future; a direct contravention of the principles of intergenerational justice (Shue 2014: 366; Gardiner 2013: 397-413).

This article addresses the widening gap between political commitment and climate reality by examining the personal carbon footprint (PerCF): the total greenhouse gas emissions (CO_2 and equivalents, CO_2e) caused directly and indirectly by an individual's activities. The argument is that the widely shared recognition that "more must be done" (World Meteorological Organisation 2025: 12) must be operationalised through a necessary integration of individual ethical responsibility and robust structural governmental incentives. The state's critical role in pricing emissions and guaranteeing dependable low-carbon infrastructure must be supplemented by a powerful bottom-up driver, namely the aggregated ethical decisions and market signals generated by informed consumers and responsible citizens. Emissions reduction is not solely a technical or policy challenge. It is fundamentally a question of moral accountability rooted in the consumer power of the present generation.

The objective of this analysis is threefold. First, it establishes the conceptual and ethical framework of the PerCF in a global context, highlighting the critical disparities inherent in a system dominated by historically high-emitting developed nations. Second, it analyses the unique emissions profile of the African region, where the PerCF is shaped more by acute energy poverty and the imperative for sustainable development than by discretionary luxury consumption, thereby requiring a distinct ethical lens (International Energy Agency 2022: 250). Finally, it conducts a focused case study on Nigeria, Africa's most populous nation and one of its leading economies, to develop concrete, innovative proposals for reform that integrate individual action with national policy (Federal Ministry of Environment of Nigeria 2025: 12). The article ultimately argues that a just and effective climate response, particularly within dynamic developing economies, requires a new social contract where structural support enables, and ethical duty drives, low-carbon individual choices, thereby fulfilling the vital mandate of intergenerational justice.

The ethics and methodological imperative of the personal carbon footprint

The PerCF is more than a simple accounting metric; it is the methodological nexus where global climate policy, economic activity, and individual ethical responsibility intersect. The PerCF serves as the necessary tool to translate the abstract political failure of states into the concrete moral duty of the consumer, thereby fulfilling the mandate of intergenerational justice (Gardiner 2013: 397-413). This section establishes the methodological basis of the PerCF, grounds it within the philosophy of climate equity, and argues for its indispensable role in reforming climate governance.

The ethical and practical utility of the PerCF relies entirely on adopting the correct accounting framework, one moving beyond national boundaries to capture individual demand's true environmental impact. The dominant paradigm in international climate reporting remains the production-based approach, under which emissions are assigned to the country where they physically occur (Tukker et al. 2020: 4). This creates a structural accountability gap that systematically flatters high-income, import-dependent economies while penalising developing ones whose industrial output largely serves foreign consumption, a distortion with direct implications for how Africa's emissions profile is read and judged internationally. The alternative, consumption-based accounting, reassigns those embodied emissions back to the individual whose final demand drove their creation, tracing them across global supply chains via multi-regional input-output modelling. This reallocation is ethically more defensible: it respects the polluter-pays principle at the level of actual causal agency rather than

geographic accident, and it situates responsibility where purchasing power and therefore meaningful choice reside.

Under production-based accounting, the high-income nation records a successful reduction in its national emissions while the actual environmental impact is merely externalised to the developing world.

That said, endorsing consumption-based accounting as the correct framework does not resolve the considerable methodological disputes arising within it. Any user who genuinely attempts to calculate their PerCF across existing tools will find they disagree, often substantially. The German Federal Environment Agency's UBA CO_2-calculator, the Conservation International calculator, and the WWF Switzerland tool each nominally adopt a consumption perspective, yet each encodes different answers to contested questions of scope, system boundary, and emission factors. Aviation illustrates this sharply: most calculators apply a radiative forcing index multiplier to account for the additional warming caused by contrails and nitrogen oxides at altitude, but the multipliers in active use range from 1.0 to 3.0, meaning the same flight can yield figures differing by a factor of three. Food categories diverge similarly; definitions of dietary patterns vary across platforms, calorie personalisation is applied by some tools and ignored by others, and the treatment of packaging, retail logistics, and food waste differs throughout. Some tools allocate a per-capita share of public infrastructure emissions to each user; others exclude government consumption entirely. These are not trivial discrepancies. The concept's credibility depends on greater methodological transparency and, eventually, convergence around common standards, particularly in contexts like Nigeria, where data scarcity already complicates any bottom-up accounting exercise (Birnik 2013: 281-285).

Refuting the production-based model: carbon leakage and moral hazard

National climate action, as reported under the United Nations Framework Convention on Climate Change, relies on production-based accounting, which attributes emissions to the country where the reenhouse gas (GHG) is physically released. This framework, while essential for national inventory, suffers from a critical ethical and economic flaw: the phenomenon of carbon leakage (Davis/Caldeira 2010: 5689). Carbon leakage occurs when industrialised nations, facing domestic emissions reduction mandates, relocate carbon-intensive manufacturing and production, such as cement, steel, and consumer electronics, to developing nations with lower environmental regulatory standards. Under production-based accounting, the high-income nation records a successful reduction in its emissions while the actual environmental impact is merely externalised to the developing world (Peters et al. 2012: 3247-3276). The high-income nation claims domestic success while its ultimate contribution to global warming, driven by its sustained demand, remains undiminished.

The consumption-based emissions accounting model on which the PerCF is built corrects this flaw. It attributes all emissions, both direct and indirect (embodied), to the final consumer of the product or service, regardless of where the GHG was emitted (Peters/Hertwich 2008: 1401-1407). This is a critical distinction: emissions may be produced in China, but they are demanded and therefore attributable to the consumer in New York, London, or Lagos. The PerCF is thus a metric of attributable responsibility.

The complexity of boundary setting: direct versus embodied emissions

Accurately calculating the PerCF requires methodological rigour, primarily involving precise boundary setting around the individual's sphere of influence. The total PerCF is typically divided into two categories which correspond to the Scope 1 and Scope 3 corporate framework. Scope 1 refers to direct emissions from sources under an individual's direct control, such as burning petrol in a personal vehicle, using a home generator, or consuming natural gas for heating. They are the most noticeable and easiest for individuals to monitor and influence (Hertwich/Peters 2009: 6414-6420). Scope 3 emissions, by contrast, are indirect or embodied and account for most of the PerCF for affluent consumers, usually representing 60–80% of the total. These emissions encompass the GHGs released throughout the entire life cycle of consumed goods and services, including the upstream extraction of raw materials, refining and manufacturing processes, complex international supply chains, and the eventual disposal or incineration of products. To accurately trace these complex flows, the PerCF relies on Environmentally Extended Input-Output models or hybrid Life Cycle Assessment models (Wiedmann/Minx 2008: 11). This complexity underscores a crucial point: individual responsibility extends far beyond what happens in one's own home or car, encompassing the entire global supply chain financed by one's purchasing decisions.

Ethical disparities: climate justice, inequality, and the 10% problem

The PerCF is not a uniform burden; its distribution reflects a profound crisis of global inequality that must be addressed before any mitigation policies can claim legitimacy. The ethical application of the PerCF must differentiate between necessary subsistence and discretionary luxury. To treat all emissions as morally equivalent, whether they arise from a Lagos smallholder burning charcoal to cook a meal or a frequent flyer crossing continents for leisure, is to collapse a morally decisive distinction into a single, indifferent metric. The scale of this asymmetry is well documented and will be examined in detail in the following section. This concentration of responsibility is not incidental; it is a direct expression of structural inequality embedded in global consumption patterns. Any climate framework that ignores this distribution and demands equivalent sacrifice from unequal actors does not advance justice – it entrenches injustice. The PerCF, properly applied, is therefore a tool of proportional accountability rather than universal austerity. Only on this ethical foundation can mitigation policy claim both legitimacy and lasting political support.

The exponential link between wealth and emissions

Empirical data reveals a stark relationship between income and GHG emissions, often referred to as the 'Global 10% Problem'. Studies by organisations like the Stockholm Environment Institute consistently demonstrate the extreme concentration of consumption responsibility. The top 10% of global income earners are collectively responsible for approximately 49% of lifestyle-related emissions worldwide. Within this group, ultra-high-net-worth individuals generate annual gross PerCFs reaching several thousand tonnes of CO_2, primarily through private aviation, multiple residences, and yachts (Gössling/Humpe 2023: 1-4). Some of these individuals have invested in carbon removal schemes that can reduce their net PerCF, but such efforts are the exception rather than the norm and do not eliminate the broader environmental

impacts of high-emission lifestyles (Joppa et al. 2021: 1-4). Conversely, the bottom 50% of the global population, which includes much of Africa and the world's poorest communities, accounts for only about 10% of these emissions (Stockholm Environment Institute 2020: 1). This stark disparity means the moral and practical responsibility for climate mitigation falls overwhelmingly on the affluent minority, defined by purchasing power rather than geography. Emphasising individual responsibility in this context addresses the structural consequences of excessive consumption rather than diverting attention from them.

The ethical distinction: subsistence versus luxury emissions

To maintain legitimacy in developing economies like Nigeria, climate policy built on the PerCF must rigorously uphold the principle of common but differentiated responsibilities at the individual level. This requires establishing a moral floor for subsistence and a moral ceiling for luxury. Subsistence emissions are those tied to consumption necessary for securing a universally accepted, decent minimum standard of living, encompassing clean water, basic nutrition, education, reliable clean energy for lighting and cooking, and access to basic public infrastructure. For the energy-poor in Africa, these emissions are ethically protected by the human right to development (Shue 2014: 366). Luxury emissions, by contrast, result from purely discretionary consumption, which clearly exceeds the requirements for a decent minimum standard of living. Examples include frequent air travel, ownership of large high-emission vehicles, consumption of imported carbon-intensive goods, and excessive energy use for non-essential purposes. These emissions carry no ethical protection and are the morally appropriate and highest-leverage targets for progressive taxation and regulation.

It is important, however, to acknowledge the tension this distinction generates. Individual responsibility cannot be derived mechanically from a person's carbon footprint, even for non-subsistence emissions, because genuine moral accountability requires knowledge, decision-making capacity, and viable alternatives (Caney 2005: 319). A Nigerian middle-class household running a diesel generator is not making a 'luxury' choice in a morally culpable sense if no reliable grid power exists. This article, therefore, does not treat the subsistence-luxury boundary as a fixed technical threshold but as a *structural* one: luxury emissions are those arising where low-carbon alternatives genuinely exist and are reasonably accessible. This framing preserves the ethical force of the distinction while avoiding the injustice of holding individuals responsible for choices that structural failures effectively remove from their reach. The policy proposals in subsequent sections aim to broaden the scope of genuinely free, low-carbon choices.

Historical responsibility and climate debt

The analysis of the PerCF is incomplete without acknowledging historical responsibility. For much of modern history, industrialised nations in Europe, Asia, and North America have contributed the bulk of cumulative CO_2 emissions, shaping today's climate crisis. The United States remains the leading historical contributor, followed by China, whose cumulative CO_2 emissions recently surpassed those of the European Union, making it the second-largest historical emitter (Our World in Data 2025). This shift highlights that both the industrialised Global North and China carry substantial responsibility for climate mitigation.

The low PerCF of the African region today is not a choice of sustainable living but a consequence of historical underdevelopment and resource constraints (International Energy Agency 2022: 250). Conversely, the high PerCF of industrialised nations reflects the cumulative, uncompensated consumption of the global carbon budget since the industrial revolution. This dynamic creates a climate debt (Shue 2014: 366). The African continent's ethical claim for climate finance and technological transfer is strengthened by the PerCF data, which confirms that its current low emissions profile is the result of a crisis created elsewhere. The Global North and China bear a moral responsibility to provide the structural and financial assistance necessary for African nations to bypass the high-carbon, fossil-fuel-based phase of development. This responsibility is essential for effectively encouraging individual mitigation efforts within African states (Caney 2005: 319), as it enables these nations to invest in renewable energy and sustainable practices, which can reduce their carbon footprints.

Intergenerational justice, the carbon budget, and moral corruption

The fundamental justification for addressing the PerCF is rooted in the philosophy of intergenerational justice (Gardiner 2013: 397-413). This philosophy posits the current generation holds moral duties toward future, yet unborn, generations, primarily concerning the preservation of a stable global environment and the maintenance of conditions necessary for a just society. At its core, the argument is straightforward: those who are not yet born cannot negotiate, vote, or advocate for their interests, yet the consumption decisions of the present generation will determine the physical and ecological conditions they inherit. This temporal asymmetry, where the costs of today's emissions are borne by those who had no say in incurring them, is what gives the intergenerational justice framework its moral urgency in the climate context. In the Nigerian and broader African setting, this urgency is compounded by demographic reality: with the continent's population projected to double by 2050, the generation that will bear the heaviest burden of climate disruption is already being born into societies which contributed least to causing it.

The climate crisis is intrinsically an intergenerational equity problem because the carbon budget, which is the finite amount of CO_2 that can be emitted while limiting warming to an agreed-upon temperature target, is a scarce, non-renewable resource (Allen et al. 2018: 49-92). This budget must be understood as a fiduciary asset held in trust by the present generation. The current generation acts as a trustee, and its primary duty is one of prudence and preservation: every tonne of CO_2 emitted today is one tonne unavailable to the future. A high, discretionary PerCF is an act of intergenerational expropriation, actively stealing the future's right to a stable climate and clean energy choices. By depleting the budget, the present generation imposes massive and unjust burdens on the future, including forced adaptation costs, reduced economic opportunities, resource conflicts, and profoundly limited choices for energy transition.

The final ethical role of the PerCF is to overcome the problem of moral corruption and moral distance (Gardiner 2013: 397-413). Climate change is characterised by a "tyranny of the trivial" combined with vast, delayed consequences. Since the effect of any single person's flight or driving habit seems negligible on a global scale, and the catastrophic harm is temporally distant, individuals can easily rationalise inaction. The PerCF is the antidote: by quantifying an individual's climate impact, it transforms the vague, distant threat into an immediate, measurable ethical metric linked directly to daily life. It provides the moral salience

necessary to hold the individual accountable. The policy proposals in subsequent sections utilise this metric to harness behavioural science and nudge the individual toward ethical decisions, thereby formalising the bottom-up impetus that the 1.5 °C failure demonstrates is urgently needed.

Personal carbon footprint drivers: mitigation pathways and behavioural ethics

A deeper ethical analysis of the key PerCF drivers reveals how individual choices can generate systemic market signals, moving beyond simple reduction to driving transformative change. This matters because the aggregate weight of individual consumption decisions shapes the investment priorities of firms, the product development strategies of industries, and ultimately the policy ambitions of governments. When sufficiently large numbers of consumers consistently choose low-carbon alternatives, they do not merely reduce their footprints in isolation; they restructure the economic incentives that determine what gets produced, how it gets produced, and at what scale. In this sense, the ethical individual is not simply a passive subject of climate governance but an active participant in reorienting the broader economy toward sustainability. The following section examines three domains: transportation, food, and consumer goods, where this dynamic is most pronounced and where the gap between current behaviour and what justice demands is widest.

Ethics of emissions in transportation, food systems, and consumer goods

The ethical weight of the transportation PerCF must be focused on frequency over mere distance. While a long-haul flight is a high-emissions event, it is the frequent flyer, including leisure travellers and highly mobile business executives, who consume a disproportionately large share of the carbon budget (Gössling/Higham 2021: 1167-1179). This high-frequency consumption, which serves largely discretionary and non-essential purposes, is a prime example of a luxury emission demanding immediate ethical curtailment. Furthermore, the individual's choice of electric vehicles must be viewed through a full life-cycle lens: while operational emissions are zero, the embodied emissions in the battery and manufacturing must be considered. The most ethical transportation decision is therefore the highest-impact, lowest-cost option: investing in and utilising low-carbon mass transit, such as electric rail or bus rapid transit, thereby supporting a collective, systemic solution over an individualised, resource-intensive one (International Energy Agency 2022: 250).

Dietary choice is a high-leverage personal carbon driver, particularly due to its impact on methane and nitrous oxide. Methane, primarily from ruminant agriculture (beef and dairy), has a warming potential roughly 80 times that of CO_2 over a 20-year period, making dietary shifts an immediate climate mitigation strategy. Recent evidence shows high-income households drive disproportionate emissions not only through mobility but also through food consumption, with higher meat and dairy intake contributing substantially to GHG emissions (Bohmann/Küçük 2024: 421-429). The ethical individual must recognise their role in the consumption-land use nexus: the demand for meat, particularly beef, drives deforestation and land-use change, converting carbon sinks into emission sources. Choosing plant-rich diets offers an immediate, often cost-neutral path to substantial emissions savings, simultaneously promoting land preservation and biodiversity (Poore/Nemecek 2018: 987-992).

Furthermore, the embodied carbon emissions in consumer goods represent the most challenging sector for the PerCF, as emissions are hidden within opaque global supply chains. The ethical duty here is to move from the linear 'take-make-dispose' model to the circular economy paradigm (Princen 2005: 401). The individual's moral responsibility is to prioritise durability and repairability by choosing products designed for longevity and demanding extended warranty and repair services, as well as to favour access over ownership by utilising sharing, leasing, or subscription models to reduce the overall material acquisition footprint. This collective shift in purchasing values is the primary bottom-up signal needed to force the industrial sector to decarbonise its manufacturing and supply chains.

The African region's personal carbon footprint and the climate paradox

The African continent presents the most challenging and ethically charged context for the application of the PerCF. The region is defined by a profound climate paradox: it holds the lowest average PerCF globally, reflecting persistent energy poverty and limited industrialisation, yet it faces the world's highest vulnerability to climate change impacts (African Development Bank 2021: 180). Addressing the PerCF here requires an inverted ethical approach: one prioritising sustainable transition and access for the majority over simple reduction and taxation. The following sections examine the unique drivers, structural constraints, and inherent dualism of the African PerCF, establishing the imperative for an equity-first policy design that honours both global mitigation goals and the right to development.

Africa's contribution to the cumulative global stock of GHGs is negligible, typically estimated at less than 4% of historical emissions (United Nations Environment Programme 2023: 108). The average per capita PerCF in sub-Saharan Africa hovers significantly below the global average of 4.7 tonnes of CO_2e, with many nations recording figures below 1.0 tonne CO_2e per capita (International Energy Agency 2022: 250). This low metric is not a badge of environmental virtue but rather an empirical marker of structural constraints, limited access to energy, and underdevelopment. The PerCF, in this instance, serves as a diagnosis of energy poverty rather than environmental excess. Despite this minimal contribution to the cause of the crisis, the continent experiences disproportionate harm. Extreme weather events, including prolonged droughts, devastating cyclones, and destructive coastal erosion, directly threaten livelihoods, drive internal migration, and undermine food security (African Development Bank 2021: 180). The ethical position is clear: any international or domestic climate framework applied to Africa must safeguard the right to development (Shue 2014: 366). The PerCF must not be utilised as a mechanism to constrain the energy consumption necessary to lift populations out of poverty and adapt to a climate crisis created elsewhere.

Drivers of the African personal carbon footprint: subsistence, health, and land use

Most of the African PerCF is driven by a search for basic energy access, creating emissions categorised as subsistence emissions tied to the fulfilment of basic needs. The most significant contributor to the African poor is the reliance on traditional, highly polluting fuels for cooking and heating. Approximately 600 million people in Africa lack access to grid electricity, and nearly 1 billion depend on solid biomass, including firewood and charcoal, for cooking

(International Energy Agency 2022: 250). The inefficient, incomplete combustion of biomass is a major source of black carbon, a short-lived climate pollutant with a warming potential thousands of times greater than CO_2 while it remains in the atmosphere (Sun et al. 2022: 564). This dependency also creates a massive public health crisis: indoor air pollution from inefficient cookstoves is responsible for over 600,000 premature deaths annually in Africa, primarily affecting women and children (Health Effects Institute 2022: 23). In this context, the individual's carbon footprint is inseparable from their health footprint. The imperative is therefore not to reduce biomass usage, which is often the only available energy source, but to mandate and subsidise an immediate clean transition to liquefied petroleum gas, biogas digesters, or modern electric cooking powered by solar systems – a policy pathway directly linking climate mitigation with health improvement and poverty alleviation.

A substantial portion of African emissions is driven by the land use, land-use change, and forestry sector, particularly deforestation caused by clearing land for subsistence agriculture and charcoal production. The smallholder farmer's PerCF is intertwined with decisions regarding fertiliser use, irrigation methods, and forest clearing. These decisions are often constrained by poverty, insecure land tenure, and lack of access to climate-smart agricultural knowledge and technology. Mitigation here must focus on capacity building and resource provision, supporting the individual's transition to regenerative and high-yield farming, which minimises forest clearing (World Bank 2023a: 463).

The emerging threat: personal carbon footprint dualism and the urban affluent

While the average PerCF remains low, rapid urbanisation and widening wealth gaps across Africa, particularly in economic hubs such as Lagos, Nairobi, and Johannesburg, are creating a growing pattern of carbon footprint dualism. The urban affluent minority represents the African 'Global 10%', whose consumption patterns increasingly mirror those of high-income nations (Stockholm Environment Institute 2020: 1). This segment's PerCF is disproportionately driven by high-carbon mobility: the purchase of large, imported internal combustion engine vehicles, reliance on high-frequency domestic and regional air travel, and a lack of investment in public transport. Energy-intensive lifestyles, including the consumption of imported goods with high embedded energy, elevated levels of meat consumption, and reliance on private high-capacity diesel generators, compound this further. This dualism creates an acute ethical problem: the rising emissions of the few risks consuming the limited remaining carbon budget required by the energy-poor majority for basic developmental needs. The policy objective is thus to isolate and target the luxury emissions of this affluent minority, generating revenue that can be recycled to subsidise the subsistence transition of the poor, thereby honouring the principle of both intragenerational and intergenerational justice.

Structural barriers constraining individual action

In the African context, high PerCFs are often the result of systemic, structural failures which actively discourage low-carbon individual choices. The persistent failure of national electricity grids compels businesses and households to rely on personal petrol and diesel generators. This is not a luxury choice; it is a necessity for preserving food, powering businesses, and maintaining basic security. The individual's decision to run a generator is an unavoidable emission that adds a significant burden to their PerCF, often doubling estimated national averages. This structural failure also imposes a significant economic opportunity cost: expenditure on imported fossil fuels drains foreign exchange reserves, stifles small business growth due to high energy overheads, and prevents investment in productive infrastructure.

Rapid, often unplanned urbanisation has similarly outpaced the development of transport and waste management infrastructure, serving as a physical constraint on ethical individual choice. In many African cities, urban travel relies heavily on motorcycles, buses, and cars, with limited safe and reliable mass transit generating high emissions. A notable exception is the rapid growth of electric motorcycles across East and West Africa: companies operating in Kenya, Uganda, Nigeria, Rwanda, and Benin have already deployed tens of thousands of electric motorcycles, which are particularly significant because motorcycles are the dominant mode for taxis and deliveries, and switching to electric has been shown to increase driver incomes substantially (Ndhlovu et al. 2025). This trend remains early-stage and geographically uneven, constrained by high upfront costs and insufficient charging infrastructure, but it demonstrates that leapfrogging to low-carbon mobility is viable where targeted investment and enabling conditions exist. For the individual who wants to utilise low-carbon transport beyond this, lack of safe cycling infrastructure, time inefficiency, and the non-existence of dedicated low-carbon corridors remain binding constraints. The primary policy lever must therefore be state infrastructure guarantees, without which the individual citizen remains trapped in a system that forces high-carbon consumption as the only viable choice for daily survival.

Policy implications: the mandate for equitable leapfrogging

The African PerCF profile dictates a radical departure from Western-centric climate policy. The ethical mandate is one of equitable leapfrogging: using the current lack of entrenched, fossil-fuel-based infrastructure as a strategic opportunity to jump straight to decentralised, low-carbon solutions, thereby avoiding the costly, carbon-intensive development paths of industrialised nations (United Nations Development Programme 2016: 50). Policy must integrate three priorities. First, dedicated financing mechanisms, such as a proposed national clean energy access fund, must be established and funded through external climate finance and internal luxury carbon taxation to subsidise the clean energy transition for low-income households. Second, mitigation efforts must prioritise the swift reduction of short-lived climate pollutants (black carbon and methane) through clean cooking and waste management reforms, as these provide immediate health benefits and short-term cooling, demonstrating tangible returns to the current generation while securing the future (Shindell et al. 2012: 183–189). Third, the PerCF must be used as a political and ethical tool to expose and regulate the rapidly growing, high-impact consumption of the affluent minority, ensuring their discretionary emissions fund the developmental needs of the majority. Structural support and individual duty are not strictly sequential here; they must advance in parallel, with each enabling the other.

Personal carbon footprint in Nigeria: a case study

Nigeria, as Africa's most populous nation and one of its leading economies, serves as a quintessential case study for understanding the paradoxes of the African PerCF. Its high population density,

rapid urbanisation, chronic energy deficits, and dependence on hydrocarbon exports create an environment where the individual's ethical capacity for low-carbon choice is severely constrained by systemic failures. The following sections analyse the key drivers of the PerCF in Nigeria, demonstrating how structural impediments translate into unavoidable high-carbon emissions for the majority, and shows how a small affluent class drives consumption-based emissions, which demand targeted policy intervention. It also presents sample footprint estimates to ground the ethical and policy argument in concrete numbers.

Nigeria's CO_2 emissions profile is dominated by the energy sector, but its climate complexity is rooted in two concurrent pressures: a vast, unfulfilled energy demand and a rapidly growing, young population. Despite its oil wealth, Nigeria faces one of the world's largest energy access deficits, with over 80 million people lacking reliable electricity (World Bank 2023b: 64). This deficit, combined with the removal of the petrol subsidy in 2023, profoundly reshaped the economic and environmental landscape, making low-carbon alternatives both expensive and inaccessible for many (Evans et al. 2023: 12). The average PerCF in Nigeria remains relatively low by global standards, but the rate of growth in consumption-driven sectors, particularly among the urban elite, poses a substantial long-term threat to the national carbon budget.

Estimating the personal carbon footprint in Nigeria across income tiers

A critical gap in the existing analysis is the absence of empirical PerCF estimates disaggregated by income group. Using publicly available consumption-based carbon calculators, notably the German Federal Environment Agency's UBA CO_2-calculator, the Conservation International calculator, and the WWF footprint tool, and calibrating inputs to Nigerian consumption patterns, it is possible to construct indicative estimates for three distinct income tiers.

For a *low-income household* in a peri-urban or rural setting, where solid biomass cookstoves, kerosene lamps, and occasional generator use meet most energy needs, the estimated PerCF is between 0.6 and 1.2 tonnes of CO_2e per year. This figure is predominantly influenced by black carbon and methane from biomass combustion and is structurally involuntary; the individual lacks realistic low-carbon alternatives. Notably, this footprint remains well below the widely cited 2.0 tonne per capita global sustainability threshold for a 1.5 °C-compatible pathway (TU Delft 2025).

For a *middle-income urban household* in Lagos or Abuja that relies on grid electricity supplemented by a small to medium generator (3–5 kVA), a fuel-powered car, and a mixed diet including some animal protein, the estimated resulting PerCF rises to approximately 2.5 to 4.5 tonnes of CO_2e per annum. The generator alone may contribute between 0.8 and 1.5 tonnes of CO_2e annually, depending on daily usage hours; this addition is necessitated by infrastructure failure rather than lifestyle choice. This figure sits at or above the global sustainability threshold, not due to luxury consumption, but because structural deficits compel ordinary citizens to adopt carbon-intensive coping strategies.

For a *high-income household* in the top income decile, characterised by ownership of multiple large-engine imported vehicles, a high-capacity diesel generator above 10 kVA, regular domestic and international air travel, imported consumer goods, and high-protein dietary patterns, the estimated resulting PerCF rises to between 10 and 25 tonnes of CO_2e per annum or higher. International business-class air travel alone can account for 5 to 8 tonnes of CO_2e per long-haul return flight. This group represents Nigeria's functional equivalent of the 'Global 10%' and is the appropriate primary target of progressive carbon policy.

These estimates, while indicative given the absence of Nigeria-specific household carbon accounting infrastructure, highlight several important policy realities. First, the structural constraint argument has empirical weight: the middle-income Nigerian's footprint is inflated by several tonnes relative to what it would be under reliable grid provision, making generator emissions a matter of state failure rather than individual choice. Second, the gulf between the low-income and high-income tiers, at roughly a factor of 15 to 25, confirms the subsistence-luxury distinction as reflective of a concrete and measurable division in consumption responsibility. Third, meaningful policy cannot adopt a uniform approach: targeting low-income Nigerians with any form of carbon pricing would be both unjust and politically counterproductive, whereas targeting the high-income tier would address the fastest-growing source of Nigeria's consumption-based emissions.

The three calculators used for these indicative estimates do not produce identical results for the same inputs. The UBA CO_2-Rechner, grounded in the German Federal Environment Agency's methodology and calibrated primarily to European consumption, requires manual adjustment of emission factors for generator use and biomass combustion in sub-Saharan Africa. The Conservation International and WWF tools offer broader geographic adaptability but make different assumptions about food emission factors and the treatment of shared public infrastructure emissions. This divergence is itself an argument for the development of a Nigeria-specific PerCF methodology and calculator, a tool that would be an essential complement to the digital PerCF tracker.

Personal carbon footprint in Nigeria: generators, urbanisation, transportation, waste management, and agriculture

The single most consequential failure in Nigeria's infrastructure is the persistent collapse of the national power grid, necessitating the widespread adoption of private, standalone power generators. Millions of small petrol generators (known locally as 'I-pass-my-neighbour') and large diesel generators power homes, shops, and businesses for many hours daily. For the small business owner or household trying to preserve food and maintain security, running a generator is a necessity, not a discretionary luxury; it is a direct result of the state's failure to provide reliable power. The ethical mandate is therefore clear: the state must aggressively deploy decentralised renewable energy solutions, such as solar mini-grids, to eliminate this involuntary high-carbon footprint and restore the individual's ability to choose a low-carbon lifestyle. The incomplete combustion of diesel and petrol in these generators also releases high levels of black carbon and methane, short-lived climate pollutants which contribute to severe regional warming and other negative health effects.

Nigeria is undergoing rapid urbanisation, with cities like Lagos becoming megacities without commensurate infrastructure development, which forces a high-carbon mobility profile especially among the affluent and middle classes. High reliance on imported, often old and poorly maintained, internal combustion engine vehicles dominate urban travel, compounded by the lack of reliable, safe, and efficient mass transit. The sudden removal of the petrol subsidy in 2023 dramatically increased the cost of transport, disproportionately impacting low-income individuals and making the transition to costlier alternatives completely unviable

(Evans et al. 2023: 12). The infrastructure gap is equally acute at the individual level: choosing to walk or cycle is often made impossible by unsafe roads, the absence of non-motorised transport lanes, and general urban insecurity. The individual is thus structurally constrained from adopting low-carbon mobility even when they might otherwise wish to.

The introduction of mechanisms which financially reward low-carbon behaviour, such as the proposed digital PerCF tracker, and that target luxury high-carbon consumption, such as the bifurcated carbon tax, is essential for activating the bottom-up ethical duty required to meet NDC goals and secure intergenerational justice.

Waste management and agriculture contribute significantly to the national emissions profile through the individual's indirect influence. Lagos and other major cities generate vast quantities of solid waste; the absence of comprehensive formalised municipal waste management, recycling, and sanitary landfill infrastructure forces citizens to rely on illegal dumping or open burning, generating substantial collective methane and black carbon emissions that the individual cannot avoid. In agriculture, subsistence practices including the use of chemical fertilisers and traditional livestock management are a primary source of nitrous oxide and methane. Here, the individual farmer's PerCF is a function of necessity linked directly to food security; intervention must focus on providing subsidised access to climate-smart agriculture techniques and low-carbon inputs.

Government policies and initiatives on climate change in Nigeria

Nigeria's policy framework, while increasingly ambitious, still struggles to translate top-down commitments into bottom-up structural support for the individual. Nigeria's third NDC emphasises a 20% unconditional and 47% conditional emissions reduction target by 2030. Crucially, it explicitly focuses on "just transition measures" and developing a comprehensive "climate investment plan" (Federal Ministry of Environment of Nigeria 2025). These policies acknowledge the need to address energy poverty and socio-economic equity, providing a strong anchor for policy proposals that integrate PerCF reduction with developmental goals. The Climate Change Act of 2021 institutionalised the commitment to achieve net-zero by 2060 and established the National Council on Climate Change; however, the policy mechanisms for incentivising individual action beyond broad mandates for industry and state agencies remain largely underdeveloped, creating a vacuum which must be filled with targeted, PerCF-centric policy.

Public awareness and integrating the personal carbon footprint in Nigeria's development strategy

Public awareness of climate change, while growing, often remains disconnected from the concept of the individual's PerCF. The prevailing narrative correctly emphasises industrial emissions, gas flares, and government corruption. For the average citizen whose primary emissions are driven by the necessity of generating electricity or using high-carbon transport, the moral imperative to reduce their footprint is diluted by the perception that the problem is solely structural and corporate. To bridge this gap, policy must move beyond simple awareness campaigns to establish a tangible link between individual choice and national progress. The introduction of mechanisms which financially reward low-carbon behaviour, such as the proposed digital PerCF tracker, and that target luxury high-carbon consumption, such as the bifurcated carbon tax, is essential for activating the bottom-up ethical duty required to meet NDC goals and secure intergenerational justice. The analysis of the PerCF in Nigeria confirms the failure to meet climate targets is not merely a political or corporate issue but a structural impediment trapping individuals in high-carbon choices. Consequently, fulfilling the mandate of intergenerational justice requires moving beyond passive state commitments to implementing innovative, equity-driven policies that activate the individual's ethical duty while simultaneously guaranteeing a viable low-carbon pathway. The following sections detail three interconnected, high-impact reforms designed specifically for a dual economy like Nigeria: the progressive bifurcated carbon tax, the national clean energy access fund, and the digital PerCF tracker.

The progressive bifurcated carbon tax

Traditional, uniform carbon taxes fail in high-inequality developing nations because they disproportionately burden the poor, who rely on basic, often high-carbon, necessities. The solution is a bifurcated carbon tax which explicitly distinguishes between essential energy consumption and discretionary luxury consumption, operating on two tiers that generate revenue while preserving equity. The first tier is a subsistence tax shield: all emissions related to basic needs, including liquefied petroleum gas for clean cooking, small-scale transport such as motorbikes used for public transport or delivery, and grid electricity below a minimum consumption threshold of approximately 50 kWh per month (International Energy Agency 2021: 386) are either exempted or minimally taxed. This safeguards the human right to energy access and shields the poor from regressive taxation, addressing justice within the currently living generation. The second tier is a luxury carbon surcharge: a steep, progressive tax levied exclusively on high-impact luxury goods and activities that constitute discretionary consumption by the affluent minority. This covers a CO_2-based tax on imported luxury vehicles, diesel used in large, high-capacity generators above 5 kVA, and a carbon surcharge on business class and first-class international air travel.

This bifurcation ensures the tax is not a punitive measure on the struggling majority but an accountability mechanism for the wealthy minority, forcing high emitters to internalise the external costs of their luxury PerCF on future generations. The feasibility of this structure depends on the ongoing development of Nigeria's administrative capacity. However, the bifurcated approach has precedent in existing fuel subsidy architecture and excise tax frameworks; it extends rather than replaces mechanisms already present in the Nigerian fiscal system, making implementation more tractable than a wholesale carbon pricing reform.

The national clean energy access fund

For the progressive bifurcated carbon tax to be ethically and politically tenable, the revenue generated from taxing luxury emissions must be demonstrably recycled back into subsidising the low-carbon transition for the energy-poor majority. This is the core function of the proposed national clean energy access fund. The fund would be capitalised by 70% of the progressive bifurcated carbon tax revenue, 100% of the fees from auctioned carbon capture and storage licences to the oil and gas sector, and international conditional climate finance. Its primary mandate is the mass subsidisation of essential clean energy technologies for the poor, delivered through three channels: decentralised renewables

(grants and extremely low-interest loans for solar mini-grids and subsidised solar home systems targeting displacement of petrol generators); the clean cooking transition (subsidies of 50–75% on electric cookstoves to eliminate reliance on firewood and charcoal); and urban mass transit investment (co-financing dedicated bus rapid transit lanes, electric commuter buses, and safe non-motorised transport corridors in congested cities like Lagos and Abuja). The national clean energy access fund translates the ethical duty of the affluent present generation into a tangible investment in the health and energy future of the entire population, fulfilling the core principle of intergenerational justice through wealth redistribution.

The digital personal carbon footprint tracker and gamified responsibility

To link the individual's ethical duty directly to the national climate effort, the digital PerCF tracker is proposed as a technologically innovative tool: a secure, government-backed application designed to deliver behavioural change through gamification and financial reward. The tracker would integrate with national identity verification systems and with the banking sector via a secure application programming interface to anonymously track major consumption categories for high-income earners, including monthly fuel purchases, electricity consumption above the subsistence shield threshold, and spending on high-carbon imported items based on customs data. All personal consumption data would be stored exclusively on domestic servers under the jurisdiction of the Nigeria Data Protection Commission, processed under end-to-end encryption, and made accessible to government agencies only in anonymised, aggregated form, ensuring full compliance with the Nigeria Data Protection Act 2023 and precluding any cross-purpose surveillance use.

The tracker's functionality moves beyond simple reporting to actively encourage individual ethical action through three mechanisms. PerCF benchmarking provides users with personalised weekly reports compared against similar income and location demographics, utilising social comparison to drive reduction (Allcott/Rogers 2014: 3003-3037). Carbon dividends reward users who successfully reduce their footprint below a national or demographic baseline with small, immediate financial rewards or vouchers redeemable for subsidised clean energy technologies. Transparency mechanisms require the platform to publish the performance metrics of government ministries and parastatals, ensuring the public sees the state is also held accountable, and thereby building the trust necessary for wide-scale compliance. The tracker is best understood as a medium-term policy objective, contingent on prior investments in digital public infrastructure, and the architecture proposed is deliberately modular: even a stripped-down version tracking only fuel purchases and utility consumption for households above a defined income threshold would generate meaningful behavioural data and demonstrate the principle at scale. The relevant precedent is not sophisticated Western emissions accounting systems, but Nigeria's own mobile payment infrastructure – bank verification number systems and mobile money platforms already demonstrate how complex digital financial tools can achieve mass adoption with appropriate institutional backing, and the path to a fully functional digital PerCF tracker runs through the same governance investments that Nigeria's broader digital economy agenda already demands.

Conclusion

The year 2024, marked by the definitive breach of the 1.5 °C warming threshold, stands as a crucial indictment of the sufficiency of state-centric climate governance. This paper has argued that protecting the environment, and specifically fulfilling intergenerational justice, must be powered by a complementary, bottom-up dimension: the PerCF and the ethical duty it represents. For a developing economy like Nigeria, this ethical duty is structurally constrained: most of the population is forced into high-carbon subsistence not through choice, but through the state's failure to provide reliable, low-carbon infrastructure. Indicative footprint estimates across income tiers make this concrete: the middle-income Nigerian's footprint is inflated by several tonnes relative to what responsible grid provision would allow, while the high-income tier generates footprints ten to twenty times larger, driven by genuinely discretionary consumption.

The key ethical conflict lies in the PerCF dualism, where the rising luxury emissions of a small affluent minority threaten to consume the carbon space desperately needed for the developmental trajectory of the energy-poor majority. To resolve this injustice, the paper has proposed an integrated three-part strategy. The progressive bifurcated carbon tax enforces proportional accountability by steeply taxing luxury emissions while entirely shielding essential subsistence emissions. The revenue generated is recycled into mass subsidies via the national clean energy access fund, funding solutions like solar mini-grids and clean cooking stoves and thereby eliminating the involuntary high-carbon footprint of the poor. The digital PerCF tracker provides the necessary feedback loop, utilising gamification and carbon dividends to reward low-carbon behaviour among high-income earners and effectively transforming abstract ethical responsibility into measurable, financially beneficial individual action.

These three reforms offer a model which developing nations more broadly may adapt. They prove the individual duty to protect the environment for future generations is only legitimate, effective, and sustainable when it is rooted in the current generation's structural freedom to choose a low-carbon life. By guaranteeing that structural support enables ethical duty, advancing in parallel rather than in strict sequence, this framework ensures the burden of climate action is borne justly, securing a viable future for all Nigerians, present and future.

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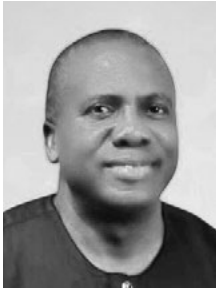

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