



Innovative Tech Transformations: Shaping Green and Eco-Friendly Products *Technology, Sustainability and the Limits of Technological Solutions in Developed and Developing Economies*

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ABSTRACT :

Technology has been the engine of human progress and, at the same time, the principal driver of the ecological crisis that now threatens it. This paper asks whether technological transformation alone can deliver sustainable development, focusing on green and eco-friendly products. It traces the history of green technology, distinguishes end-of-pipe from clean technologies through the Bhopal Gas Disaster, and analyses the technology-transfer obligations in the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. Using the economics of demand and supply, it explains why electric vehicles have spread rapidly in Norway and California but slowly in developing countries, drawing on India's policy experience and Sri Lanka's organic-farming crisis of 2021–22. A section on recent developments surveys legislative, judicial and treaty changes, including the International Court of Justice's 2025 advisory opinion on climate change, the outcomes of COP28 to COP30, India's Carbon Credit Trading Scheme, the Supreme Court of India's recognition of a right against the adverse effects of climate change, and the retreat from electric-vehicle subsidies in parts of the developed world. The paper concludes that technological change is necessary but not sufficient: sustainability also requires social change, well-designed policy and predictable international finance.

Keywords: green technology; sustainable development; electric vehicles; technology transfer; climate law; developing countries; India

1. Introduction

Technology is among the defining characteristics of the human species. The word derives from the Greek *techne*, meaning skill or art, and *logos*, meaning study, and the history of civilisation can be read as the history of its application. Technology has lengthened lives, compressed distances and relieved people of drudgery. Yet the benefits of technology have not been shared equally, and the resulting technological divide has widened the gap between the fortunate and the disadvantaged.

The same technologies have also transformed the planet. Industrial production, fossil-fuel combustion and the conversion of land to agriculture have altered the climate and degraded ecosystems on a scale earlier generations could not have imagined. Technological development, in short, has not followed a sustainable path. At the same time, a counter-movement has emerged. Citizens, firms and governments increasingly recognise the environmental costs of technological progress and seek remedies of two broad kinds. The first is a change in social behaviour, through awareness-raising and the adoption of sustainable lifestyles. The second is a change in technology itself, by replacing environmentally harmful processes with cleaner alternatives and by expanding the capacity to manufacture eco-friendly products.

This paper is concerned with the second remedy and asks whether it can succeed on its own. Its central research question is whether technological transformation alone can deliver sustainable development, or whether it must be accompanied by social and policy change. The hypothesis advanced is that technological change is necessary but not sufficient. It draws on international instruments, statutes and judicial decisions; on basic economic reasoning about demand and supply; and on two comparative case studies, namely electric vehicles across developed and developing economies and Sri Lanka's abrupt shift to organic agriculture.

Parts 2 to 4 trace the history of green technology, distinguish end-of-pipe from clean technology and examine the international law of technology transfer. Parts 5 to 10 analyse green products, their economics, electric vehicles, India and Sri Lanka. Part 11 surveys recent developments in legislation, case law and treaty practice, and Part 12 concludes.

2. A Brief History of Green Technology

The adoption of green technology has been proposed as a solution to pollution, but any assessment of that proposal must begin with the root causes of

pollution. Before the Industrial Revolution, people lived relatively simple lives, free from modern technology and, consequently, from industrial pollution. The sun was the principal source of warmth and illumination, and animal power supplied transport and traction. Because nature provided food, clean air, sunlight and water without asking anything in return, it was widely revered in pre-modern societies.¹

As civilisations developed, humanity gained progressively greater control over the natural world that had once supplied its essentials. Its decisive moment was the Industrial Revolution, which unfolded in phases that may loosely be described as steam, science and digital technology. Steam power gave humanity a potent new source of energy for activities from agriculture to textile production; rural economies became industrial societies, and factories displaced village fields as the centre of social life.

In the second phase, science met mass production: the Ford Model T, a petrol-engined car built on assembly lines in the early twentieth century, became its emblem and accelerated migration from the countryside to cities.

Two events then spurred the development of green and clean technologies: the Second World War and the oil crises. Wartime salvage and recycling campaigns in the United States were an early sign that recycling could serve the national interest. In the 1950s, solar cells capable of generating electricity began to take shape, making them one of the earliest examples of green technology. The oil crisis of the 1970s then stimulated interest in renewable sources such as wind and biofuels, because dependence on imported fossil fuels was now seen as an economic and strategic vulnerability. In the 1980s and 1990s a wave of technologies designed to lower energy use and emissions appeared, among them energy-efficient lighting, electric vehicles and environmentally friendly building materials.

Since then, rising environmental consciousness and the need to cut carbon emissions and slow climate change have accelerated the creation and uptake of green technology. The term now covers a broad range of goods and processes, including sustainable agriculture, waste management, renewable energy and energy-saving technology.

3. From End-of-Pipe to Clean Technology

One of the first technological responses to pollution was the development of end-of-pipe technology. Industrial processes involve chemical reactions, and alongside the intended product they generate by-products such as extremely hot water or noxious fumes, including carbon monoxide. End-of-pipe technologies, such as scrubbers, filters, flares and effluent treatment plants, capture or neutralise pollutants after they have been formed and before they escape into the environment. They are accordingly essential for any industry that releases potentially harmful by-products.²

Their weakness, however, is that they are an additional layer of cost. When pollution-control equipment is regarded as a burden on profit and not as an integral part of production, it is liable to be switched off, neglected or poorly maintained. The Bhopal Gas Disaster of December 1984 is the starkest illustration. Methyl isocyanate (MIC), an intermediate in the manufacture of pesticides, was produced and stored at the plant of Union Carbide India Limited (UCIL). The plant had several safety systems designed to prevent or contain an escape of MIC, but many were disregarded in an effort to cut costs:

- the refrigeration system for the liquid MIC storage tanks had been switched off;
- the flare tower intended to burn off escaping MIC gas was out of operation and, when it was needed, could not neutralize the leak; and
- The vent gas scrubber was also not functioning.

The end-of-pipe technologies in place therefore could not avert the disaster, which killed thousands and left many more with chronic illness.

The legal consequences of Bhopal shaped Indian environmental law for decades. In *M C Mehta v Union of India* the Supreme Court, dealing with a gas leak from a Delhi factory, developed the doctrine of absolute liability for enterprises engaged in hazardous activities, a principle that is plainly a response to the lessons of Bhopal.³ The civil claims arising from the disaster were settled in 1989 for US\$470 million,⁴ and the Environment (Protection) Act 1986 was enacted in its aftermath.

The episode shows why the policy emphasis has shifted from end-of-pipe technologies to cleaner, green technologies that aim to eliminate the creation of pollutants altogether by modifying the underlying chemical processes. Clean technologies offer distinct advantages. They are more reliable because there is less to fail, and a process that does not produce a hazardous intermediate does not depend on a control device functioning at the critical moment. Their adoption also tends to have a smaller long-term effect on production costs, since the firm avoids the expense of capturing, treating and disposing

¹Wilson Nwankwo, 'Climate Change and Innovation Technology: A Review' (2020) 62(3) Technology Reports of Kansai University.

²Dustin Mulvaney, *Green Technology: An A to Z Guide* (1st edn, Sage Publications 2011).

³*M C Mehta v Union of India* (1987) 1 SCC 395.

⁴*Union Carbide Corporation v Union of India* (1989) 1 SCC 674.

of waste. The economic point is that clean technology internalises what end-of-pipe technology merely tolerates: pollution is an externality, and the cheapest way to deal with an externality is, wherever possible, not to create it.

4. The International Legal Framework for Technology Transfer

Climate change is a phenomenon produced by human development that crosses national boundaries and has reached a global scale, affecting even those who had no direct hand in causing it. The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 to address it.

The Convention rests on the premise that industrialised states have historically been the principal contributors to climate change and bear a correspondingly higher obligation to reverse the trend. This is the principle of common but differentiated responsibilities and respective capabilities. The Convention also recognises that tackling climate change is impossible without technological innovation, and it makes technology transformation a vital component of the measures needed to mitigate it.

The obligations are expressed in Article 4. Under Article 4(1)(c), all parties must promote and cooperate in the development, application and diffusion, including transfer, of technologies that control, reduce or prevent anthropogenic emissions of greenhouse gases. Article 4(5) goes further in respect of developed country parties, requiring them to take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other parties, particularly developing country parties, to enable them to implement the Convention.⁵ The phrase "as appropriate" and the qualifier "all practicable steps" reveal the central weakness of the provision: it is a soft obligation of conduct, not a hard obligation of result.

The technology transfer framework agreed at the Marrakesh conference in 2001 has five themes: technology needs and needs assessments; technology information; the creation of enabling environments; capacity-building; and mechanisms for technology transfer.⁶ In 2007, states added four sub-themes to the mechanisms theme, namely innovative financing, global collaboration, endogenous technology development, and joint research and development. The Technology Mechanism established in 2010, comprising a policy-oriented Technology Executive Committee and an implementation-oriented Climate Technology Centre and Network, gave the framework institutional machinery.

The Paris Agreement, adopted in 2015, opens a new chapter in the global response. Article 10 affirms a long-term vision on technology development and transfer, and states decided that the Technology Mechanism should serve the Agreement and be anchored within it. They also called for further work on endogenous capacities and technologies and on technology research, development and demonstration. The Agreement established a technology framework to provide overall guidance to the Technology Mechanism, which was subsequently elaborated by the parties in 2021.⁷

A correspondingly greater onus therefore rests on developed countries to develop clean technologies and to share them with developing countries, so that the latter can pursue sustainable development without sacrificing growth. Whether that obligation is honoured in practice is the question that runs through the rest of this paper.

5. Green Products: Concept and Examples

Having outlined the technological and legal background, the paper turns to green products. A green product is a good or service designed to reduce its environmental impact at every stage of its life cycle. Harmful materials are avoided, renewable resources are used in accordance with their rate of replenishment, and the use of non-renewable resources is minimised. The life-cycle perspective matters, because a product that is clean in use but dirty in manufacture or disposal is not truly green. Several well-known green products owe their existence to technological advancement.

Electric vehicles (EVs) run on rechargeable batteries instead of petrol or diesel, but need auxiliary infrastructure, above all charging networks, before they can be widely adopted. **Solar panels** use crystalline photovoltaic cells to convert sunlight into electricity, but can be expensive because of the technology involved and the large area needed to collect sunlight. **Organic food** is grown without synthetic fertilisers and pesticides; it benefits the environment and human health, but costs more to produce because organic farming is labour-intensive. **Energy-efficient appliances** use modern technology to reduce energy consumption and electricity bills over time, though they may cost more initially. **LED lighting** is more durable and energy-efficient than incandescent lighting, yielding long-term savings despite higher initial costs.

The five examples share an economic structure. Each offers a lower environmental cost and, often, a lower running cost, but each also carries a higher

⁵United Nations Framework Convention on Climate Change (adopted 9 May 1992, entered into force 21 March 1994) 1771 UNTS 107, arts 3(1), 4(1)(c) and 4(5).

⁶UNFCCC Conference of the Parties, Decision 4/CP.7, 'Development and transfer of technologies' (Marrakesh, 2001).

⁷Paris Agreement (adopted 12 December 2015, entered into force 4 November 2016) 3156 UNTS 79, art 10; UNFCCC CMA, Decision 15/CMA.3, 'Technology framework under Article 10, paragraph 4, of the Paris Agreement' (Glasgow, 2021).

upfront price, which economists call the green premium. Whether consumers will pay that premium depends on income, information and policy, which is the subject of the next part.

6. Demand and Supply of Green Products

In economic terms, the demand for green products is the capacity and readiness of consumers to purchase environmentally friendly and socially responsible goods at various possible prices over a given period. Supply is the quantity of such products that a producer is willing and able to place on the market at a given price over a given period.

Consumer preference for green products has grown in recent years because of mounting concern about climate change and environmental deterioration. As consumers become more conscious of how their choices affect the environment, many are willing to pay extra for goods that are socially and environmentally responsible. This trend has been shaped by greater awareness, easier access to information and rising wealth around the world. In economic language, green products have a positive income elasticity of demand: as incomes rise, spending on them rises proportionately more.

Supply has expanded in step, as firms adjust to evolving tastes and legislative requirements by cutting carbon footprints, adopting sustainable production methods and investing in eco-friendly packaging and labelling. Some firms, however, find green manufacturing difficult because it raises costs or requires new infrastructure.

Several factors affect the supply of any product, and two are of particular importance here: the state of technology and government policy. As technology advances, more supply becomes possible. Yet the technology may be too costly for small producers, whose production costs rise significantly and whose supply may consequently fall. That result can be reversed if the government offers incentives, such as subsidies, tax credits or concessional finance, to manufacturers of eco-friendly goods, offsetting the cost of the new technology.

In the same way, higher production costs raise the price of green products, and a higher price reduces demand among the population of low-income countries, where price elasticity is high and budgets are tight. The supply and demand of green products accordingly differ between developed and developing countries. In wealthy economies, a combination of high incomes, strong environmental awareness and generous incentives sustains both sides of the market. In poorer economies, high prices, limited incomes and fiscal constraints weaken both. This asymmetry is the key to understanding the diffusion of electric vehicles, to which the paper now turns.

7. Electric Vehicles in Developed and Developing Countries

7.1 *The technology and its promise*

The electric vehicle is the most recent environmentally friendly alternative to conventional cars, which release large quantities of harmful pollutants. EVs draw power from rechargeable batteries that are considerably larger than those in laptops and mobile phones, and they are smoother and quieter to drive than conventional automobiles. Even so, sustainable transport cannot become a reality until people actually use these vehicles in large numbers and thereby reduce air pollution.

Examination of the EV market shows that industrialised countries hold a much larger share than developing and low-income countries. Because a significant part of the world's population lives in the latter, the real challenge is to make the transition possible there.

7.2 *Why adoption differs*

The reason for the discrepancy lies in government action. In industrialised countries, incentives such as tax reductions, financial support and access to high-occupancy vehicle lanes make EV adoption feasible.

Norway is the leading example. To encourage people to move from polluting vehicles to electric ones, the Norwegian government provided exemptions from import and purchase taxes, inexpensive charging and access to bus lanes. The result was the highest rate of EV adoption in the world: about 75 per cent of new car sales in 2020 were plug-in electric,⁸ and by 2024 the share had risen to close to 90 per cent.⁹ California is the leading state in the United States, with roughly 8 per cent of new car sales in 2020 coming from EVs, supported by government incentives and a strong charging network.

⁸International Energy Agency (IEA), *Global EV Outlook 2022* (IEA, May 2022).

⁹IEA, *Global EV Outlook 2025* (IEA, May 2025).

7.3 The developing-country dilemma

The question that follows is whether developing nations can afford to spend scarce revenue on comparable subsidies when a sizeable proportion of their populations is unemployed or living below the poverty line, and when most citizens cannot afford even a cheaper conventional car. And yet these countries will also suffer if they neglect sustainable growth and a clean environment, through urban air pollution, a swelling oil-import bill and acute exposure to climate impacts. The Sri Lankan experience, discussed in Part 9, shows what can go wrong when sustainability is pursued without regard to capacity.

The position in emerging economies is mixed. Adoption is at an early stage in most of them, but it is expected to accelerate. China, supported by purchase subsidies and tax exemptions, accounted for roughly half of global electric car sales in 2021 and for a larger share thereafter. It is, however, a middle-income economy with a large domestic industrial base and is not representative of poorer countries. India has set the goal that 30 per cent of all vehicles sold by 2030 should be electric, and has launched a number of initiatives, including the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme, to encourage adoption.¹⁰

8. India and Electric Vehicles

The Government of India has adopted a series of policies and initiatives to promote the adoption of electric vehicles. The principal measures, as they stood at the time of the original study, were the following.

1. **FAME India.** The Faster Adoption and Manufacturing of Electric Vehicles scheme provided financial incentives for the purchase of electric two- and three-wheelers and four-wheelers, and supported the construction of charging infrastructure.¹¹
2. **Goods and Services Tax.** The GST on electric vehicles was reduced from 12 per cent to 5 per cent, making them more affordable for consumers.
3. **Charging infrastructure.** The National Electric Mobility Mission Plan (NEMMP) aims to build a dependable EV charging network across the country, and building rules and guidelines make provision for charging facilities in public and commercial buildings.
4. **Tax exemptions and research.** Many states exempt electric vehicles from road tax and registration fees. The government also funds the development of EV technology and offers financial incentives to domestic producers of EV components.
5. **Public transport.** Incentives encourage the use of electric rickshaws, taxis and buses for public transport.

The overarching objective of these policies is to create an environment in India that is favourable to electric vehicles. Several obstacles nevertheless remain: the high cost of batteries, an inadequate charging network and limited consumer awareness. It is notable that Indian incentives have been directed chiefly at two- and three-wheelers and at public transport, the vehicles that most Indians actually use. This is an example of policy fitted to the income distribution of a developing country.

9. Case Study: Sri Lanka's Organic Farming Crisis

The Sri Lankan crisis illustrates the danger of pursuing an environmental goal through technology and policy that the country is not equipped to sustain. The story begins with the election campaign of President Gotabaya Rajapaksa, who pledged to move the country from conventional to organic agriculture over a ten-year period. To honour that pledge, the government announced in April 2021 an immediate ban on the import and use of synthetic fertilisers and pesticides.¹² Some two million farming households had to switch to organic methods without adequate time or training.

The consequences were severe. Although it had been predicted that organic farming would yield outputs comparable to conventional farming, rice production fell by roughly a fifth within six months. A country that had been largely self-sufficient in rice was forced to import rice worth about US\$450 million, and domestic rice prices rose by about 50 per cent. The ban also damaged tea, the country's principal export crop, and the loss in tea production alone has been estimated at US\$425 million. By November 2021 the government had withdrawn the restrictions for certain crops, including tea and rubber. To quell protests, it provided farmers with US\$200 million in compensation and a further US\$149 million in price subsidies, which proved insufficient. Around 500,000 people are estimated to have fallen back into poverty, and severe currency depreciation and high inflation forced Sri Lankans to reduce their consumption of food and fuel.

It would be an oversimplification to attribute the whole of Sri Lanka's economic collapse to the fertiliser ban. The crisis had several causes, including the loss of tourism revenue during the pandemic, reductions in taxation, heavy external debt and a shortage of foreign exchange. The country defaulted on

¹⁰IEA, *Global EV Outlook 2022* (IEA, May 2022) (regional sales shares and national targets).

¹¹Press Information Bureau, Government of India, 'Phase II of FAME India Scheme' (13 December 2022) Release ID 1883045.

¹²Kenny Torella, 'Sri Lanka's Organic Farming Disaster, Explained' (*Vox*, Future Perfect, 15 July 2022).

its sovereign debt in 2022 and secured an Extended Fund Facility of about US\$2.9 billion from the International Monetary Fund in March 2023.¹³ The agricultural policy was nonetheless a significant and avoidable contributor. In one assessment, both the political leadership and the proponents of sustainable agriculture bear responsibility: the former for seizing on the organic pledge as a hurried way of cutting fertiliser subsidies and imports, and the latter for advocating a transformation of the agricultural sector that the country could not absorb.

Three lessons follow. First, a developing country like Sri Lanka may lack the scientific and extension capacity needed for a large organic farming programme, and the assumption that yields would hold was fallacious. Second, resources in such a country are scarce and must be used first to promote welfare, not to fund an expensive transition. Third, and most important, the worst feature of the decision was the absolute ban. Sustainability policy in a developing country must be gradual, sequenced and supported by finance, training and substitutes.

10. Green Products in Developing Countries

Demand for green products is growing in emerging countries for several reasons. First, people are increasingly aware of pollution, climate change and deforestation, and they look for ways to reduce their own environmental impact. Second, the growing middle class in developing countries is better informed, more aware of how consumption affects the environment, and more willing to pay a premium for products that protect it. Third, government laws and policies that encourage the use of green products fuel demand.

Supply, by contrast, lags. Many manufacturers do not yet appreciate the value of eco-friendly products and remain focused on affordable items, and the technologies and infrastructure needed to make green products are lacking, although growing market demand is drawing in investment.

In sum, rising middle-class demand, government regulation and heightened public awareness are driving the growth of the green product market in emerging countries. More green products are available, but problems remain which relate to social change, and which no technology can solve on its own.¹⁴

11. Recent Developments

The years since this study was first framed have been among the most intense in the history of climate law and technology policy. Together they thicken the legal framework within which green technology is produced and traded. They also reveal how fragile the political and financial commitments behind that framework remain.

11.1 Climate diplomacy: COP28 to COP30

At COP28 in Dubai (2023), the outcome of the first global stocktake called on parties to contribute to transitioning away from fossil fuels in energy systems in a just, orderly and equitable manner, and to work towards tripling global renewable energy capacity and doubling the global average annual rate of energy efficiency improvements by 2030.¹⁵

COP29 in Baku (2024) addressed finance, the other half of the technology-transfer equation. The New Collective Quantified Goal on climate finance committed developed countries to take the lead in mobilising at least US\$300 billion annually by 2035 for developing countries, and called on all actors to work together to scale finance to US\$1.3 trillion a year.¹⁶ Several developing countries, India among them, criticised the figure as far short of need.

COP30 in Belém (2025) closed with a package built around the Global Mutirão decision. It established a Global Implementation Accelerator and a Belém Mission to 1.5°C, called for efforts to triple adaptation finance by 2035, and launched a work programme on climate finance.¹⁷ The package also launched the Belém Technology Implementation Programme, intended to move cooperation on technology development and transfer from planning towards implementation, with greater emphasis on finance and on support for developing countries. Commentators observed that the tripling pledge lacked an agreed baseline and that repeated failures to deliver finance cast doubt on its credibility. The lesson is consistent with the thesis of this paper: the technology-transfer provisions of the climate regime are now more detailed, but their value depends on finance that has not yet been reliably supplied.

¹³International Monetary Fund, 'IMF Executive Board Approves US\$2.9 Billion Under the Extended Fund Facility Arrangement for Sri Lanka' (press release, 20 March 2023).

¹⁴Michael Hasper, 'Green Technology in Developing Countries: Creating Accessibility Through a Global Exchange Forum' (2009) 32(1) Duke Law and Technology Review.

¹⁵UNFCCC CMA, Decision 1/CMA.5, 'Outcome of the first global stocktake' (Dubai, 2023).

¹⁶UNFCCC CMA, Decision 1/CMA.6, 'New collective quantified goal on climate finance' (Baku, 2024).

¹⁷UNFCCC CMA, 'Global Mutirão: Uniting humanity in a global mobilization against climate change' (Belém, November 2025); see also COP30 Presidency, 'COP30 Outcomes' <<https://cop30.br/en/cop30-outcomes/normative>> accessed 7 October 2026.

11.2 International and regional adjudication

Courts have begun to convert climate commitments into legal duties. In May 2024, the International Tribunal for the Law of the Sea, in an advisory opinion requested by the Commission of Small Island States, held that anthropogenic greenhouse gas emissions constitute pollution of the marine environment and that states have specific obligations to prevent, reduce and control it.¹⁸ In *Verein KlimaSeniorinnen Schweiz v Switzerland* (April 2024), the European Court of Human Rights held that Article 8 of the European Convention on Human Rights encompasses a right to effective protection by the state from the serious adverse effects of climate change on life, health, well-being and quality of life, and found Switzerland in breach.¹⁹

The most significant development is the advisory opinion of the International Court of Justice of 23 July 2025, delivered unanimously in response to a request by the General Assembly following an initiative led by Vanuatu. The Court held that states are bound by obligations under the climate treaties, customary international law and human rights law. Parties to the Paris Agreement must act with due diligence, in accordance with common but differentiated responsibilities and respective capabilities, to make an adequate contribution to the temperature goal, and must prepare, communicate and maintain successive nationally determined contributions. The duty to cooperate in good faith extends to finance, technology transfer and capacity-building. A breach of these obligations may entail legal responsibility, including full reparation where a sufficiently direct and certain causal link is established.²⁰ The opinion is not binding, and commentators note that it says relatively little about the detailed content of technology-transfer obligations. Even so, it converts what was often presented as a political or moral aspiration into a legal duty, and it strengthens the argument made in Part 4 that developed countries bear an onus to develop and share clean technology.

11.3 Legislation and policy in major markets

The European Union has moved from voluntary commitments to product regulation. Regulation (EU) 2023/1542 imposes carbon-footprint declarations, minimum recycled content, due-diligence duties and end-of-life obligations on batteries, including EV batteries. The Ecodesign for Sustainable Products Regulation, Regulation (EU) 2024/1781, introduces life-cycle design requirements and digital product passports, and the Net-Zero Industry Act, Regulation (EU) 2024/1735, seeks to scale up domestic manufacture of clean technologies.²¹ These measures write the life-cycle definition of a green product, discussed in Part 5, into binding law. The Carbon Border Adjustment Mechanism, Regulation (EU) 2023/956, completed its transitional reporting phase at the end of 2025 and entered its definitive phase on 1 January 2026, requiring importers of covered goods to account for embedded emissions.²² For exporters in developing countries, CBAM is at once a push towards cleaner technology and a trade barrier.

Policy has also moved in the opposite direction. In December 2025 the European Commission proposed to relax the 2035 target for new cars and vans from a 100 per cent to a 90 per cent reduction in CO₂ emissions relative to 2021, allowing residual emissions to be offset through low-carbon steel and certain fuels, following pressure from manufacturers and some member states. The proposal remains subject to the legislative process.²³ In the United States, the One Big Beautiful Bill Act, signed on 4 July 2025, terminated the federal tax credits for new, used and commercial clean vehicles acquired after 30 September 2025, reversing a central feature of the Inflation Reduction Act of 2022.²⁴ These reversals make a point of central importance: the incentives on which EV adoption in developed economies has depended are political choices that can be withdrawn, and the success stories of Norway and California are not self-sustaining market outcomes.

11.4 Indian legislation and policy

India's domestic law has also evolved. The Energy Conservation (Amendment) Act 2022 empowered the Central Government to establish a carbon market, and the Carbon Credit Trading Scheme (CCTS) was notified in 2023. Binding greenhouse gas emission-intensity targets for the compliance years 2025–26 and 2026–27 have now been notified for about 490 entities in seven energy-intensive sectors, namely aluminium, cement, chlor-alkali, pulp and paper, petroleum refining, petrochemicals and textiles. Targets for iron and steel and for fertilisers were still pending at the last report, and entities that

¹⁸*Request for an Advisory Opinion Submitted by the Commission of Small Island States on Climate Change and International Law (Advisory Opinion)* (ITLOS Case No 31, 21 May 2024).

¹⁹*Verein KlimaSeniorinnen Schweiz v Switzerland* App no 53600/20 (ECtHR, 9 April 2024).

²⁰*Obligations of States in respect of Climate Change* (Advisory Opinion) (ICJ, 23 July 2025), responding to UNGA Res 77/276 (29 March 2023).

²¹Regulation (EU) 2023/1542 concerning batteries and waste batteries [2023] OJ L191/1; Regulation (EU) 2024/1781 establishing a framework for eco-design requirements for sustainable products; Regulation (EU) 2024/1735 establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem.

²²Regulation (EU) 2023/956 establishing a carbon border adjustment mechanism [2023] OJ L130/52.

²³Regulation (EU) 2019/631 setting CO₂ emission performance standards for new passenger cars and vans, as amended, and the European Commission's proposal of December 2025 to amend the 2035 target.

²⁴One Big Beautiful Bill Act, Pub L No 119-21 (4 July 2025).

exceed their targets must purchase carbon credit certificates.²⁵

The end-of-life stage of green products is addressed by the Battery Waste Management Rules 2022 and the E-Waste (Management) Rules 2022, which impose extended producer responsibility on producers, including makers of EV batteries, for collection and recycling.²⁶ In electric mobility, FAME II was succeeded by a short-lived Electric Mobility Promotion Scheme in 2024 and then by the PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) scheme, notified on 29 September 2024 with an initial outlay of ₹10,900 crore. It supports electric two-wheelers, three-wheelers, ambulances, trucks and buses, together with charging infrastructure, and has since been extended to 31 March 2028, with revised timelines for the two-wheeler and three-wheeler incentives.²⁷ Private electric cars receive no direct purchase subsidy under it. Their advantage lies in taxation: electric vehicles remain at a GST rate of 5 per cent, while the rationalisation of GST rates in September 2025 placed petrol and diesel cars at 18 or 40 per cent, depending on size and engine.²⁸ The Scheme to Promote Manufacturing of Electric Passenger Cars in India, approved in 2024, offers a reduced customs duty on a limited number of imported vehicles to manufacturers who commit to minimum investment and local value addition.²⁹

11.5 Indian case law

The most important recent decision is *M K Ranjitsinh v Union of India*, decided on 21 March 2024 by a three-judge bench of the Supreme Court led by Chandrachud CJI. The proceedings arose from a petition to protect the critically endangered Great Indian Bustard from collisions with overhead power lines connected to renewable energy projects in Rajasthan and Gujarat. The Court recalled its earlier blanket direction for undergrounding power lines and, in doing so, recognised a right to be free from the adverse effects of climate change, derived from Articles 14 and 21 of the Constitution.³⁰

The case is significant for this paper in two ways. It confirms that climate protection is now enforceable as a constitutional right in India, and not merely a policy aspiration, so that it can ground challenges both to inaction on mitigation and adaptation and to polluting technologies. It also shows that technology can be green and still harmful: the renewable energy infrastructure at issue threatened an endangered species, and the Court had to balance sustainable development against biodiversity. Greenness is contextual, and it cannot be assumed from the nature of the technology alone.

Bhopal, too, continues to be litigated. In March 2023 the Supreme Court dismissed the Union's curative petition seeking additional compensation from the successors of Union Carbide, holding that the 1989 settlement could not be reopened on the grounds advanced, and it criticised the Union's failure to take out insurance to cover any shortfall.³¹ In December 2024 the Madhya Pradesh High Court rebuked the authorities for failing to clear the abandoned Union Carbide site despite earlier directions, and about 337 tonnes of hazardous waste were moved to Pithampur for incineration in January 2025. The Supreme Court declined to halt the disposal in February 2025, noting that it was supervised by an expert committee, and trial incineration began amid local protests.³² Four decades after the leak, the legacy of an end-of-pipe failure is still being managed in court, which illustrates the cost of failing to prevent pollution at source.

These cases rest on older foundations. The principles that the polluter pays and that precaution is part of Indian environmental law were established in *Indian Council for Enviro-Legal Action v Union of India* and *Vellore Citizens' Welfare Forum v Union of India*, and they supply the regulatory logic that makes clean technology economically rational.³³

11.6 Assessment

Three observations emerge. First, the legal framework for green technology is thicker than ever before, with binding product regulation in Europe, an operating carbon market in India, and authoritative statements of states' duties from the International Court of Justice. Second, implementation still

²⁵Energy Conservation (Amendment) Act 2022; Greenhouse Gases Emission Intensity Target Rules 2025 (Ministry of Environment, Forest and Climate Change); ICAP, 'Compliance obligations under India's Carbon Credit Trading Scheme enter into force for seven sectors' <<https://icapcarbonaction.com/en/news/compliance-obligations-under-indias-carbon-credit-trading-scheme-enter-force-seven-sectors>> accessed 7 October 2026.

²⁶Battery Waste Management Rules 2022; E-Waste (Management) Rules 2022 (Ministry of Environment, Forest and Climate Change).

²⁷Ministry of Heavy Industries, Government of India, notification of the PM Electric Drive Revolution in Innovative Vehicle Enhancement Scheme (29 September 2024), as subsequently revised and extended.

²⁸GST Council, 56th meeting (3 September 2025) (rate rationalisation effective 22 September 2025).

²⁹Ministry of Heavy Industries, Government of India, Guidelines for the Scheme to Promote Manufacturing of Electric Passenger Cars in India (March 2024).

³⁰*M K Ranjitsinh v Union of India* (2024) 19 SCC 139 (WP (C) No 3570 of 2022, 21 March 2024).

³¹*Union of India v Union Carbide Corporation* (SC, 14 March 2023) (curative petition).

³²Madhya Pradesh High Court, order of 3 December 2024; Supreme Court of India, order of February 2025 declining to halt disposal of Union Carbide waste at Pithampur.

³³*Indian Council for Enviro-Legal Action v Union of India* (1996) 3 SCC 212; *Vellore Citizens' Welfare Forum v Union of India* (1996) 5 SCC 647.

depends on finance, political stability and administrative capacity. The reversals in the European Union and the United States, the contested adaptation-finance baseline from Belém and the shortfall in the Baku finance goal all show that commitments are not self-executing. Third, courts are expanding accountability, but rights such as the one recognised in *Ranjitsinh* require legislative and executive follow-through before they change outcomes. The recent developments therefore confirm the central hypothesis of this paper. Better technology and better law are both necessary, but neither suffices without social acceptance, institutional capacity and reliable finance.

12. Conclusion and Suggestions

12.1 Conclusion

Demand for green products in developing nations is growing, driven by an expanding middle class, government policy and public awareness of environmental problems. Consumer behaviour is shaped by the price, accessibility and availability of green products and by wider social and economic factors. Encouraging the use of green products and achieving sustainable development therefore require a combination of technological change, social change and policy intervention.

The evidence reviewed in this paper points in one direction. The Bhopal disaster showed that technology without institutional discipline fails, because safety systems that existed were switched off. The comparison between Norway and the developing world showed that clean technology spreads where incentives and incomes support it and stalls where they do not. Sri Lanka showed that an environmental goal pursued without regard to capacity can cause economic and human harm. Recent developments, finally, show that legal frameworks are growing denser while the finance and political will behind them remain uncertain. Technological advances can certainly make it easier for consumers to accept green products, but social change is just as important in shaping how consumers think and act towards sustainability.

The research therefore supports its hypothesis: technological change alone is not sufficient to bring about sustainable development.

12.2 Suggestions

- **Change social norms and attitudes.** For green products to be widely used, social norms must shift in favour of sustainability and environmental consciousness. This calls for consumer education and awareness campaigns, together with credible labelling, that make clear the benefits of eco-friendly products and the effect of consumer behaviour on the environment.
- **Balance necessary and sustainable development.** Because their resources are scarce, developing nations must strike a balance between meeting basic needs and pursuing sustainability. Transitions should be gradual, sequenced and piloted, supported by training and finance, and should avoid abrupt bans that outrun the country's capacity, as the Sri Lankan experience shows.
- **Provide reliable finance and technology from industrialised nations.** Developing nations can concentrate on sustainable development only when they receive financial and technological assistance from industrialised nations. The commitments under Article 4(5) of the UNFCCC, the Baku finance goal and the Belém Technology Implementation Programme should be translated into measurable, reported delivery, in line with the duty of cooperation affirmed by the International Court of Justice.
- **Prefer clean technology to end-of-pipe controls, and enforce the controls that remain.** Policy should favour processes that avoid creating pollutants, and where control equipment is necessary, regulators should ensure that it is operated, inspected and penalised for non-compliance, so that the lesson of Bhopal is not repeated.
- **Offer stable and well-targeted incentives.** Incentives should be predictable over a multi-year horizon, and designed for the income distribution of the country concerned, as India's emphasis on two- and three-wheelers and public transport illustrates.

Sustainable development is ultimately a social and political achievement, and technology is its instrument and not its substitute.