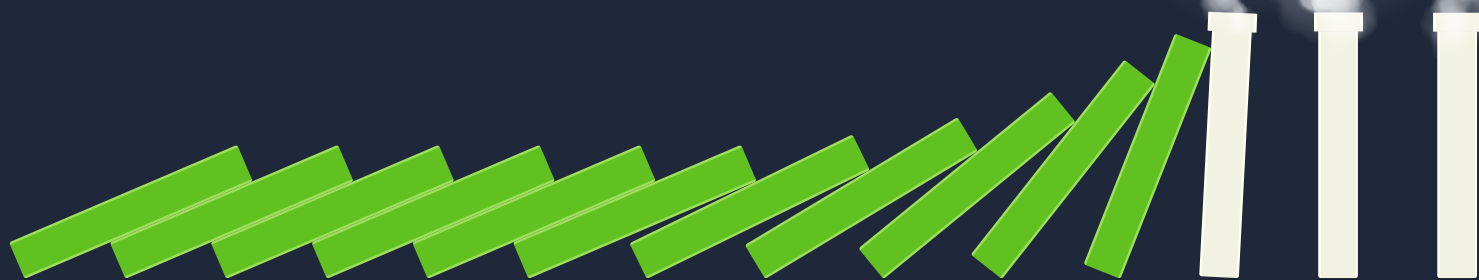


Cheaper. Cleaner. Unstoppable.

Clean technologies that are
delivering for the climate



1. Positive tipping points and their strategic potential¹

Climate impacts are intensifying, and global temperatures are likely to exceed 1.5 degrees Celsius (°C) within the next decade (United Nations Environment Programme [UNEP] 2025a). Delivering on the Paris Agreement will require immediate action to reduce greenhouse gas emissions. In doing so, we can limit peak warming.

Recent trends indicate that many low-carbon technologies and behaviours are no longer just emerging. Across energy, transport, buildings, and food systems, several low-carbon technologies and practices are approaching, and in some cases have already crossed, critical thresholds at which adoption can accelerate rapidly and become increasingly self-reinforcing.

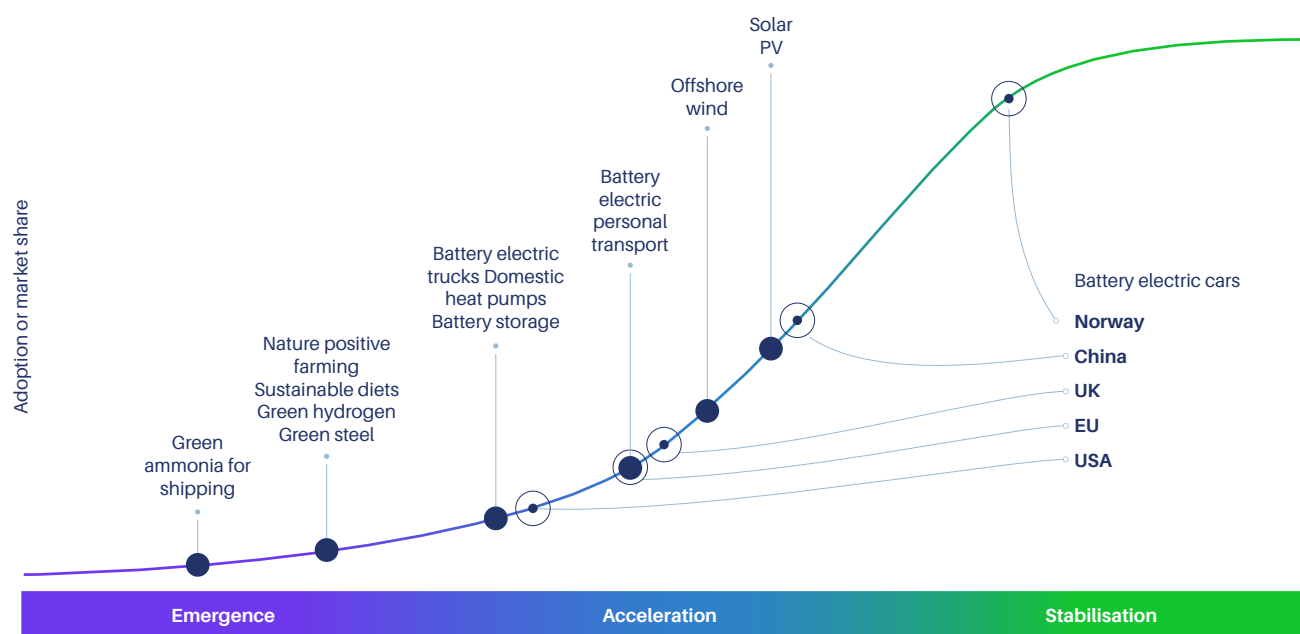
1 While this Policy Brief focuses on positive trends, it draws on the same logics and phenomena of “negative climate tipping points,” which are critical thresholds in the Earth’s biophysical systems beyond which small additional warming can trigger self-reinforcing, potentially irreversible changes. These include ice-sheet collapse, coral reef dieback, and disruption of ocean circulation with severe global consequences for ecosystems and human societies (Lenton *et al.*, 2025a). While the concept draws on analogies with Earth system tipping points, positive tipping points in socio-technical systems are not inevitable or irreversible, but remain contingent on sustained policy support, investment and enabling conditions.

These “positive tipping points” arise when reinforcing feedback, including declining costs, infrastructure expansion, policy support and shifting market expectations, drive nonlinear rates of uptake beyond those anticipated by linear predictions (University of Exeter 2023). If supported through sustained policy, finance, and institutional action, these dynamics could contribute to limiting temperature exceedance, strengthening adaptation to unavoidable climate impacts and supporting pathways consistent with returning warming to 1.5°C above pre-industrial levels over the longer term.

A positive tipping point is reached when a clean technology, practice or behaviour becomes increasingly affordable, competitive and socially accepted, leading to rapid and self-reinforcing uptake (Lenton *et al.*, 2025a, OECD 2025a). Adoption typically follows an S-curve: slow initial uptake, followed by rapid acceleration once affordability, accessibility and attractiveness align, before stabilizing at scale (see Figure 1). Crucially, positive tipping points can cascade² across sectors, for example, cheap renewable electricity accelerates the deployment of electric vehicles and heat pumps, while sustainable food systems reduce emissions and improve food security.

Figure 1. The S-curve progression of select low-carbon technologies

Adapted from: [Lenton *et al.*, 2025](#)



Note: The sectors labelled above the curve relate to global progress, whereas the examples labelled under the curve illustrate the range of progress at the national level in just one of those sectors (electric cars).

² A tipping cascade occurs when hitting one threshold triggers a domino effect across interconnected systems. This creates a chain reaction where self-sustaining cycles amplify the speed and scale of change.

The period to 2030 is decisive. Many clean technologies are at or near cost parity with fossil-based alternatives and are less exposed to external price volatilities (Nijse, *et al.*, 2024). Solar power is now cheaper than new coal and natural gas in most of the world. Electric vehicles have crossed affordability thresholds in leading markets on a lifetime-cost basis (BloombergNEF 2025). Heat pumps are increasingly cost-competitive with fossil boilers. These trends suggest that rapid, system-wide decarbonisation is within reach, if supported by the right policy and investment signals.

However, tipping points do not occur automatically or uniformly. Deliberate and coordinated interventions by governments, financial institutions, businesses, private sector, civil society and citizens can accelerate or stall their emergence (Smith, *et al.*, 2026). Policy certainty, targeted public finance, regulatory reform, procurement commitments and shifts in consumer behaviour can collectively push systems past critical thresholds. Embedding tipping point strategies into national climate plans³ offers a powerful way to convert climate ambition into reality. (University of Exeter, 2023).

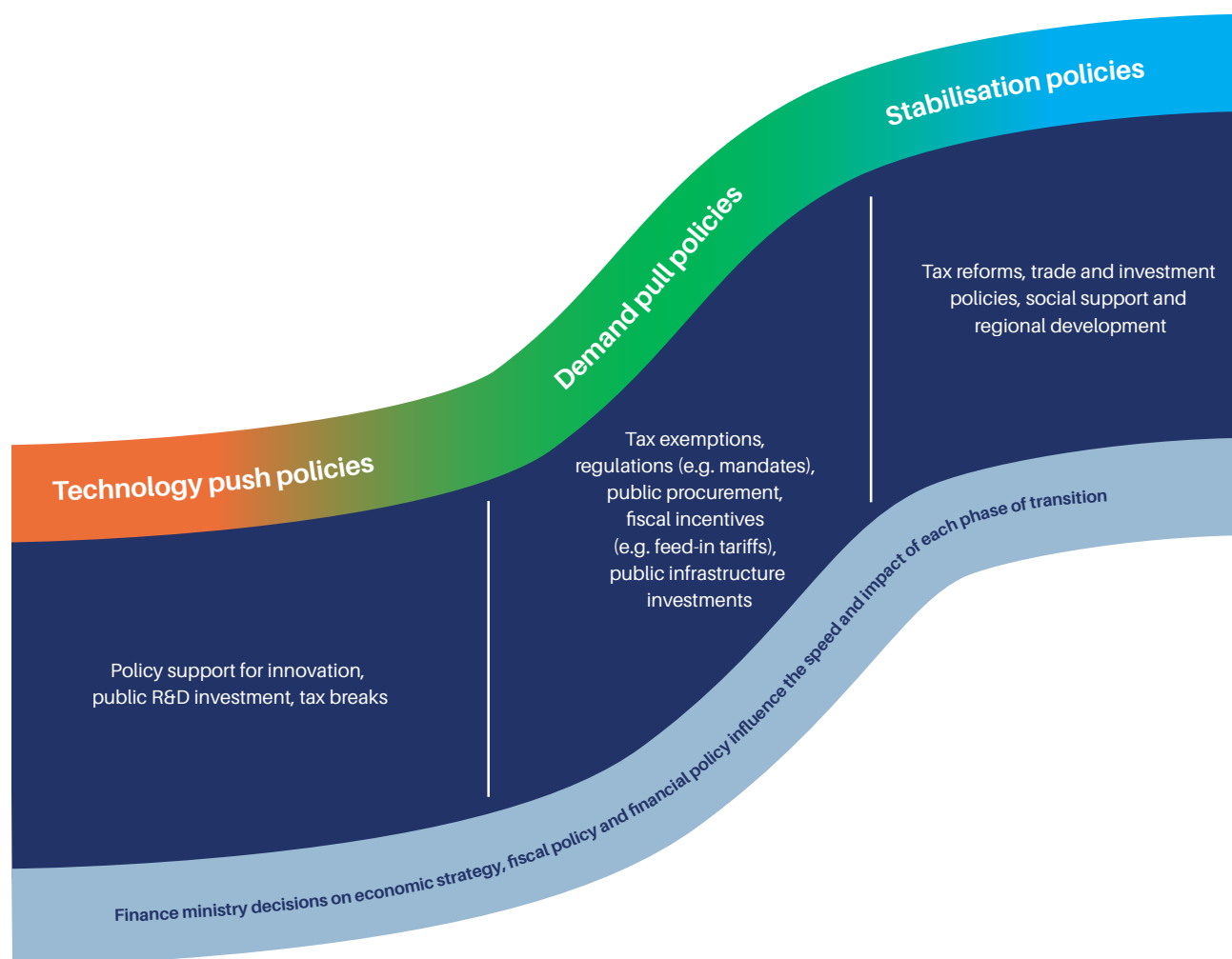
This Policy Brief highlights sectors where positive tipping dynamics are under way, identifies their enabling conditions and proposes actionable steps. Equity is central to this agenda. Positive tipping dynamics will need to scale globally and not concentrate only in leading and often higher-income countries. They will need to deliver benefits across countries, regions and social groups, rather than reinforcing existing inequalities (Pereira *et al.*, 2024). Expanding access to affordable clean technologies in emerging markets and low-income communities is essential for both climate effectiveness and fairness, while also delivering co-benefits such as improved air quality, energy security and economic opportunity. It is imperative that this effort is distributed across income strata and geographies, and a gender-responsive approach is essential to ensure equitable outcomes.

Three features make positive tipping points particularly relevant:

- 1. Affordability thresholds are being crossed:** Clean alternatives are already cost-competitive with, or even cheaper than, fossil-based incumbents. These trends signal that structural economic conditions are aligning with climate objectives.
- 2. High diffusion potential:** Many clean technologies are modular, mass-producible and compatible with digital innovation. They can scale rapidly once supply chains mature and financing barriers fall.
- 3. A narrowing policy window:** The 2026–2030 period is pivotal for implementation and investment alignment as governments are refining industrial strategies, reforming energy markets and mobilising climate finance, while rising climate impacts are increasing public pressure for action. Positive tipping points could become a focus for upcoming COP Presidencies, linked to Action Tracks and the ‘Global Implementation Accelerator’. Political feasibility is shifting in some regions toward stronger commitments, as reflected in NDC 3.0 submissions, though resistance persists elsewhere. Strategic intervention now can lock in positive dynamics before high-carbon systems regain momentum.

Positive tipping points are not inevitable. They require coordinated action and credible policy signals. Evidence shows key thresholds are within reach, making the coming years critical for shifting from incremental change to rapid, self-reinforcing transformation.

³ In this Policy Brief, “national climate plans” refer to Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs) and Long-Term Low Emission Development Strategies (LT-LEDS).



2. Identifying and assessing positive tipping points with the greatest potential

Not all climate solutions are equally positioned to trigger rapid, self-sustaining change. For that to happen, governments and investors are required to prioritize interventions that are nearing critical thresholds, with cascading impacts. Based on extensive analysis, this Policy Brief presents a practical framework to identify and assess “positive tipping point opportunities” across sectors. However, specific technology transitions exist in different stages of the S-curve, with some being closer to tipping than others, requiring different levels of concerted action to accelerate progress (Lenton *et al.*, 2025a).

This Policy Brief builds on a growing body of research on system transformation and positive tipping points, including recent work by Lenton *et al.*, (2025a, 2025b), the University of Exeter team and broader scholarship on this topic. Based on this work, the Brief presents criteria (see Table 1) that enable decision-makers to focus resources where exponential change is most plausible. The idea is to shift attention from incremental improvements to market-transforming interventions, accelerating NDC implementation and triggering cascading progress across the global economy (Lenton *et al.*, 2025b).

Table 1: Criteria to identify and assess tipping point opportunities

Criteria	Key questions or considerations	Example indicators
Proximity to an affordability threshold	A tipping point is more likely when a clean solution approaches or surpasses cost parity with the incumbent	- Total cost of ownership compared to fossil-based alternatives - Levelized cost of energy* or production trends - Projected time to parity under existing policy - Flexible/Just financing - When affordability aligns with climate objectives, market uptake can accelerate rapidly.
Investment readiness and scalability	Solutions must be capable of attracting capital at scale	- Existence of bankable business models - Availability of blended finance or risk-mitigation instruments - Volume of committed private capital or pipeline projects - If a relatively small group of major asset owners or public finance institutions can unlock large-scale deployment, tipping becomes plausible.
Speed of diffusion potential (S-Curve progression)	Technologies that are modular, replicable, and compatible with mass production tend to scale faster	- Manufacturing scalability and supply-chain maturity - Installation or deployment timeframes - Historical adoption rates in lead markets - High diffusion potential allows exponential uptake once thresholds are crossed.
Reinforcing feedback loops and increasing returns to adoption	Self-reinforcing dynamics: economic, technological, or social are central to tipping	- Learning rates and cost declines with cumulative deployment - Network effects (e.g. charging infrastructure density) - Consumer visibility and social acceptance - Adoption that lowers future costs or increases social desirability strengthens momentum.
Cross-sector cascading potential	Some interventions unlock transformation elsewhere (cascading effect)	- Degree of electrification linkage (power → transport → heating) - Supply-chain interdependencies - Emissions reduction spillovers across sectors - Cascading positive tipping points** can amplify impact and deliver Sustainable Development Goal (SDG) co-benefits beyond a single industry.
Emissions leverage per unit of uptake	Priority should be given to interventions that deliver high emissions reductions relative to scale	- Tons of carbon dioxide (CO₂) equivalent avoided per unit deployed (carbon intensity) - Share of sectoral emissions addressed - Potential contribution to national NDC targets
Political feasibility and equity	Durable tipping requires legitimacy and global scalability	- Policy support and enabling regulatory environments across diverse market contexts - Compatibility with development priorities in emerging markets - Distributional impacts and affordability for low-income households

*The concept of levelized cost of electricity (LCOE) spreads the net present value of the cost of electricity over the lifetime costs of the electricity system, e.g. the mix of capital and operational costs. As such, the LCOE is the full life-cycle cost (fixed and variable) of a power generating technology per unit of electricity (kilowatt-hours) (National Renewable Energy Laboratory 2021).

**See footnote 2 for a definition.



3. Sectoral tipping points that are ‘ripe’ for acceleration

Using the criteria in Table 1, the following examples illustrate positive tipping points at different stages of the S-curve. They range from technologies that are already at or beyond tipping in some regions (such as renewable power), to those approaching tipping in leading markets (such as e-mobility), to others still in early phases of the S-curve with strong potential for acceleration (such as passive cooling, heat pumps and sustainable food systems).

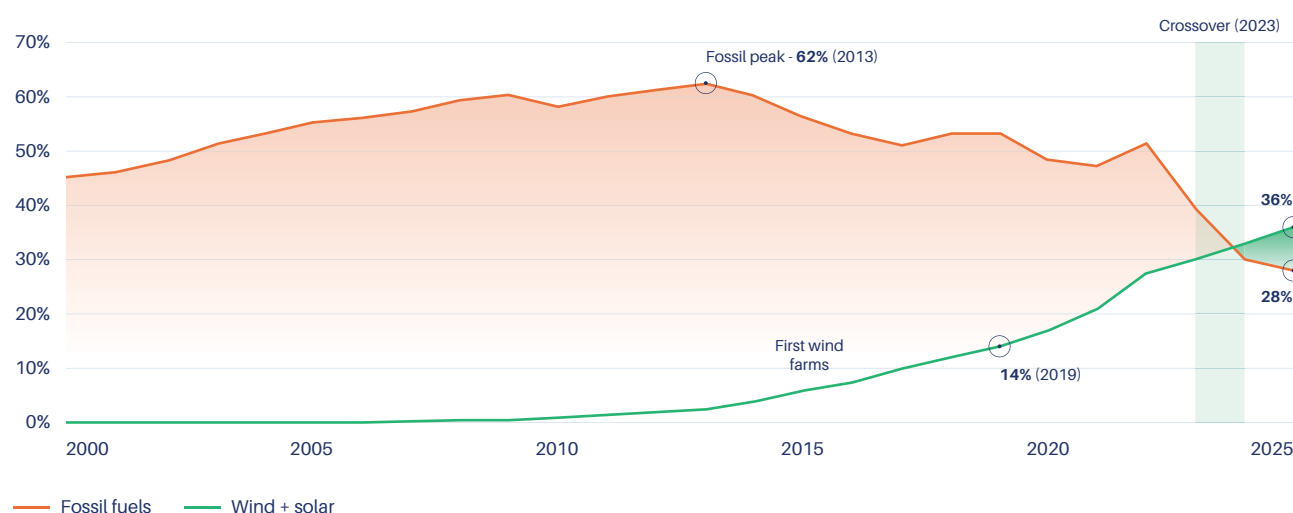
3.1 Renewable power and storage

Renewable power and storage in many regions have progressed along the S-curve into the stabilization phase, where positive tipping points have already been reached and self-reinforcing adoption dynamics are well established.

Renewable electricity has experienced dramatic cost reductions over the past decade. In most regions, new solar and onshore wind generation are now cheaper than new coal or gas-fired power based on a levelized cost of electricity analysis (Imperial College London 2024; International Renewable Energy Agency [IRENA] 2026a). Solar and onshore wind are now the single largest item in the global energy investment inventory, valued at US\$450 billion (International Energy Agency [IEA] 2025a). Since 2020, renewables have accounted for more than 75 per cent of new power capacity, with solar and wind scaling faster than any previous energy sources (United Nations [UN] 2025a). Many countries have already passed a tipping point where variable renewable energy sources (principally solar and wind), often paired with on-grid battery storage, now account for the majority of annual electricity generation (see example of Chile in Figure 3).

Figure 3. Decarbonization of Chile’s electricity grid, 2000-2025

Source: Ember, 2026a

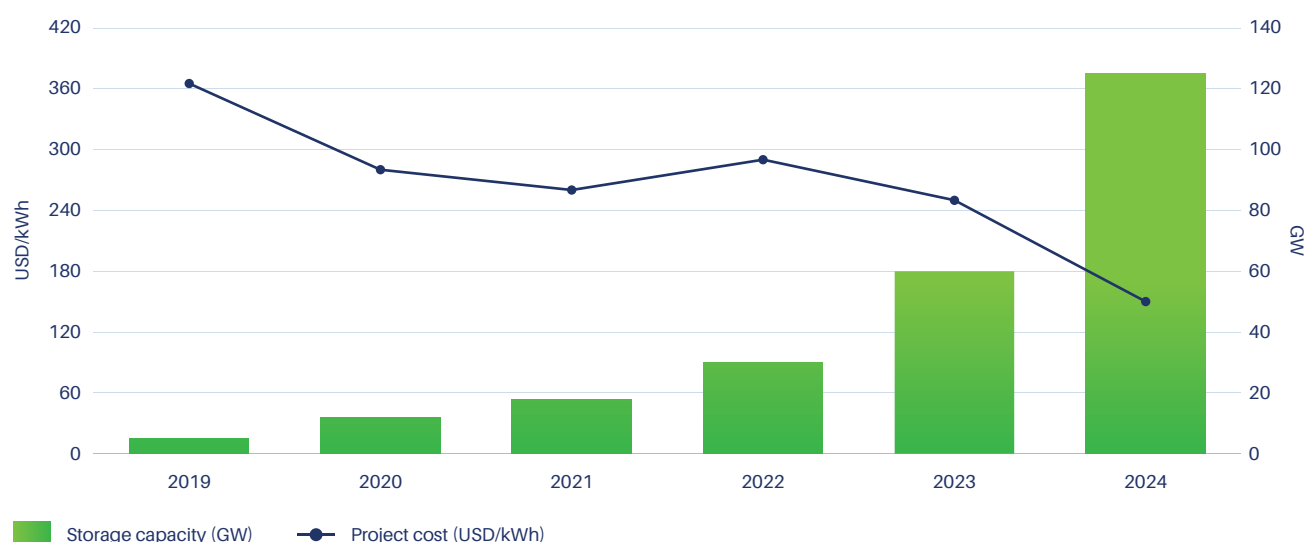


Corporate procurement of renewable electricity, through power purchase agreements, is expanding rapidly, signalling strong private-sector confidence. Furthermore, many renewable technologies are modular, mass-producible and deployable at scale across diverse geographies. As renewables grow, political and financial support strengthens, reinforcing adoption. Given that 34 per cent of global greenhouse gas

emissions come from the electricity sector (UNEP 2026a), renewables are a key catalyst for broader system-wide positive cascading effects. Globally, the CO₂ intensity of electricity generation is expected to fall by 3.6 per cent on average in 2026, to reach 400 grams of CO₂ per kilowatt-hour in 2027 (IEA 2025b)

Crucially, beyond cost and scalability, a greater share of renewables also enhances energy system resilience during climate shocks, making it not only a mitigation solution but a cornerstone of climate adaptation, energy security and economic stability (REN21, 2025).

Figure 4. Global utility-scale battery project costs and storage capacity relative to peak load



Source: **Adapted from IEA data; for detail on the composite data sources, see IEA (2026a).**

Battery storage has rapidly emerged as a critical enabler of renewable energy transitions, supporting grid flexibility, resilience and energy security as variable renewable energy supplies ramp up (especially solar and wind power). Battery storage was the fastest-growing power sector technology in 2025, with 108 GW of new capacity deployed globally, which was a 40 per cent increase from 2024 and more than eleven times the installed capacity recorded in 2021 (IEA, 2026b). Lithium iron phosphate (LFP) batteries now account for around 90 per cent of new battery capacity, driven by falling costs, manufacturing scale-up, improved performance and high deployment readiness. The IEA also reports that global battery energy storage system costs in 2025 fell to roughly one-third of 2020 levels, reinforcing the diffusion of storage technologies across electricity systems. Rapid growth is particularly evident in China, the United States, Australia and the European Union, where battery storage is increasingly paired with utility-scale solar and wind projects to support peak demand, reduce curtailment, and improve reliability.

Based on analysis of the literature, the following is a synthesis of actions to accelerate the tipping point for renewable power and storage (Nijse *et al.*, 2024; Lenton *et al.*, 2025a, 2025b; IEA 2025a, 2025b):

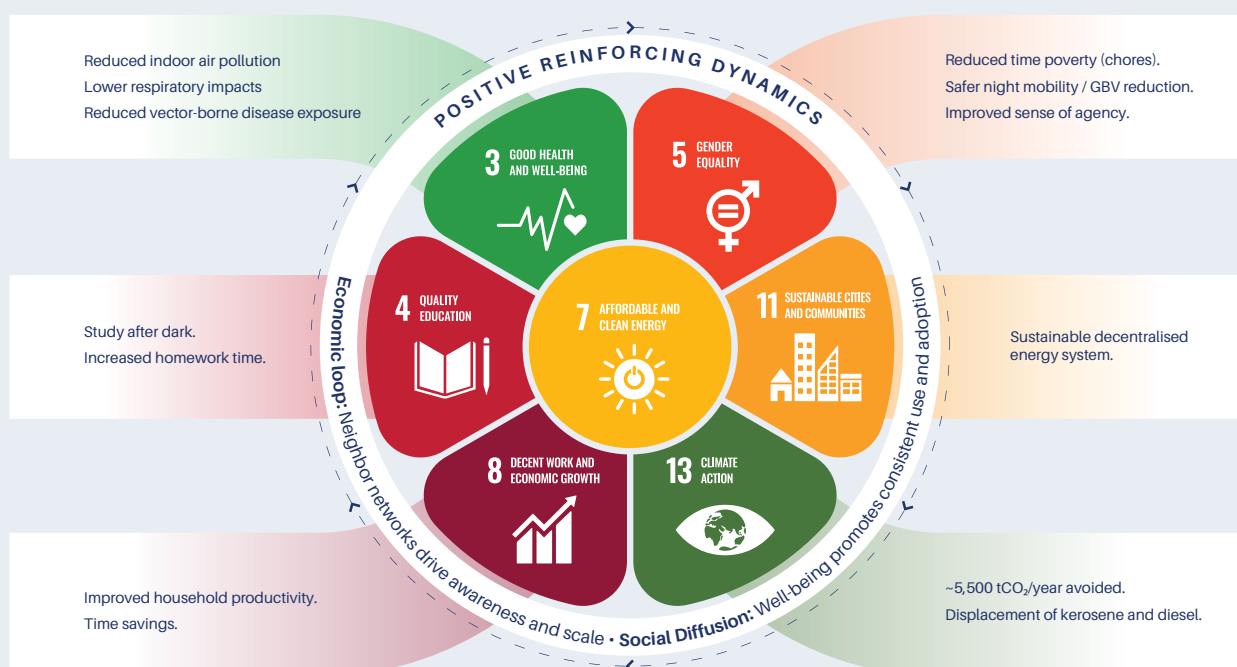
- Set clear timelines and roadmaps for a transition away from fossil fuels and reallocate subsidies towards technologies with the most promising positive tipping potential.
- Modernize electricity grids for distributed generation and storage.
- Expand concessional finance to de-risk renewable energy investment.
- Use green public procurement to anchor long-term demand for renewables.
- Reform electricity market design and business models to reward flexibility, storage, demand response and decentralised renewable energy generation.
- Streamline and fast-track licencing and permitting processes for renewable energy projects.

Box 1: Decentralised solar as a positive tipping point in vulnerable settings

Decentralised solar energy offers a compelling example of how positive tipping dynamics can emerge in highly constrained settings when affordability, access, and social uptake align. Evidence from the distribution of more than 34,000 Solar Home System (SHS) intervention among refugee communities in Pakistan demonstrates how removing upfront cost barriers can rapidly trigger self-reinforcing development gains across sectors.

SHS access is associated with near-universal improvements across multiple Sustainable Development Goals (SDGs), with most outcomes exceeding 95 per cent positive prevalence. Gains include reduced indoor air pollution (health), extended study hours (education), improved night-time safety (safety), enhanced agency and reduced time poverty for women (gender equality), and increased household productivity alongside reduced energy expenditure (livelihoods).

Figure 5. Decentralised solar access (SDG7) drives cross-SDG gains through reinforcing feedback loops.



These outcomes exhibit core characteristics of a positive tipping point. First, threshold effects: even low levels of energy access unlock disproportionately large welfare gains. Second, reinforcing feedbacks: improvements in lighting, safety, and productivity interact across domains, amplifying system-wide benefits. Third, diffusion potential: near-universal willingness to recommend and adopt higher-capacity systems indicates early-stage social contagion and demand deepening.

Welfare gains are widespread and stronger gains are concentrated in economic and practical domains, suggesting that tipping processes are layered and context-specific rather than immediately system-transformative. This case study highlights the importance of equity-focused deployment pathways: by overcoming affordability constraints, decentralised solar can extend tipping dynamics to populations typically excluded from market-led transitions, accelerating low-carbon and climate resilient development.



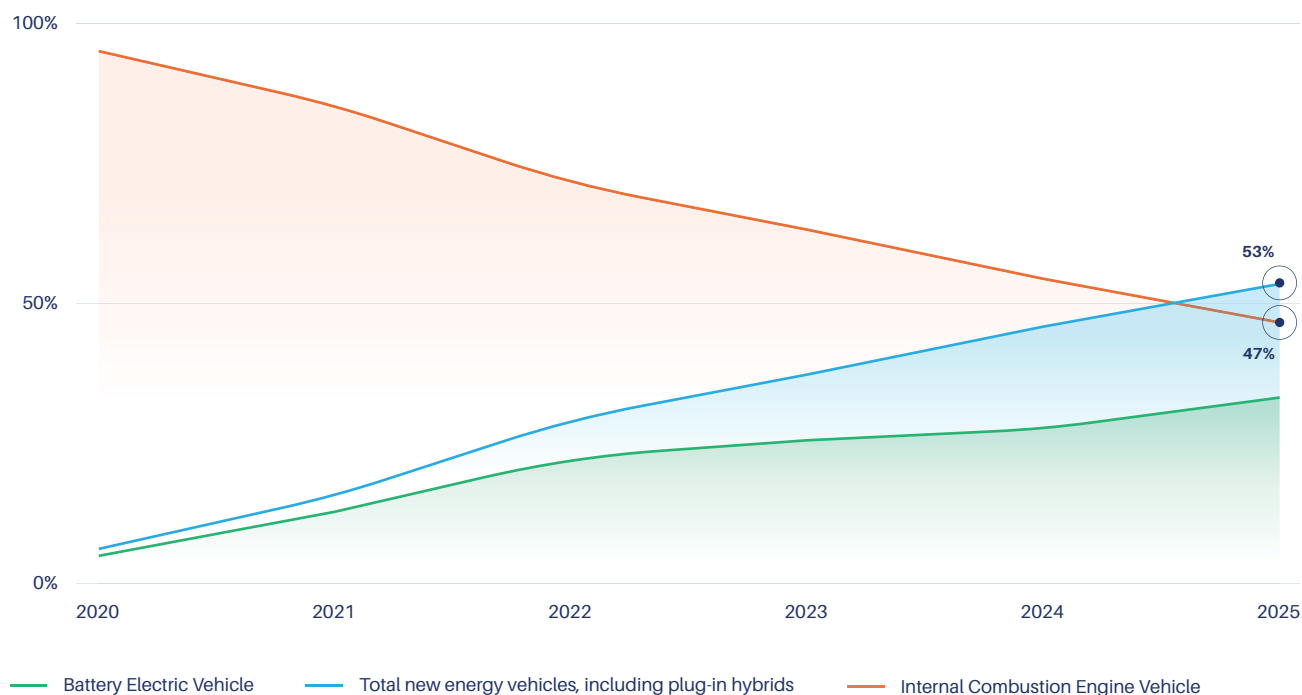
3.2 Electric mobility

Electric mobility is advancing along the S-curve and is entering the acceleration phase in several leading markets, where reinforcing feedback is pushing systems towards positive tipping points.

Electric vehicles are reaching cost parity with internal combustion vehicles in many markets, as battery costs fall and production scales. Strong feedback loops, between increasing infrastructure, lower costs and growing range, are accelerating adoption (Nijse *et al.*, 2024). In 2025, electric vehicles accounted for over one-quarter of global new car sales, a massive leap from less than 3 per cent in 2019 (IEA 2026c). The electric two- and three-wheeler market is particularly strong in low- and middle-income countries, where around 570 million of these vehicles account for 15-20 per cent of total transport fuel use (UNEP 2024a).

Norway has demonstrated that decisive policy can shift new car sales overwhelmingly towards electric models: in 2025, electric cars represented 96 per cent of new car sales and more than 30 per cent of all registered cars in the country (Figenbaum 2026). China, meanwhile, has scaled electric vehicle manufacturing and adoption at unprecedented speed (see Figure 6), creating global supply chain momentum; the Chinese domestic market alone accounts for 57 per cent of total global electric vehicle car sales since 2010 (22.4 million units) (IEA 2025c). Globally, major automakers have committed billions of dollars to electrification, while logistics and ride-hailing and delivery fleets are increasingly transitioning to electric models (UNEP 2026b).

Figure 6. China's electric vehicle sales market, 2018–2025



Adapted from: **China Passenger Car Association (CPCA) and the China Association of Automobile Manufacturers (CAAM)**



In Viet Nam, the share of electric car sales more than doubled in 2025 to reach close to 40 per cent, exceeding levels seen in most European countries (IEA 2026c). In Africa, Ethiopia is leading with electric vehicles making up 60 per cent of new sales, and in Latin America, Uruguay leads with a 27 per cent electric vehicle sales share, where the grid is more than 95 per cent renewably powered. Electric buses are also emerging as a major positive tipping opportunity in urban transport, with global sales growing 12 per cent in one year, surpassing 70,000 in 2025 as cities increasingly prioritize cleaner and lower-cost public mobility (IEA 2026c).

At scale, electric vehicles reduce oil demand, improve air quality and support the integration of renewable energy, while growing social acceptance accelerates uptake.

Based on analysis of the literature, the following is a synthesis of actions to accelerate the positive tipping point for electric mobility (Nijse *et al.*, 2024; Lenton *et al.*, 2025a):

- Set phase-out dates for internal combustion engines and align trade, tax and vehicle standards accordingly.
- Invest in equitable and gender-responsive charging infrastructure and battery swapping, including in rural and underserved areas, while integrating charging with renewable electricity supply and grid planning
- Electrify public bus fleets, government vehicle fleets, and freight and delivery fleets.
- Support battery recycling and join international efforts to mitigate supply chain risks.
- Implement low-emission zones in major cities and drive urban electric vehicle adoption.
- Incentivize local manufacturing of electric vehicles.

Box 2: Why the clean energy transition is also a security and an economic imperative

A growing body of research shows that geopolitical disruptions and energy price shocks can act as catalysts for structural shifts in energy systems (Skalamera 2023; IEA 2024a; Kim, Panton and Schwerhoff, 2024). Evidence from recent crises, including the 2022 energy shock caused by the war in Ukraine, indicates that such events accelerate policy support, investment and deployment of clean energy technologies (Skalamera 2023; Kim, Panton and Schwerhoff 2024).

As renewable energy technologies have become cost-competitive and widely available, countries increasingly have viable alternatives to fossil fuel dependence, with the potential to improve energy security and reduce exposure to external supply risks (Skalamera 2023; Kim, Panton and Schwerhoff 2024). This changes the strategic calculus: climate action is no longer driven solely by emission reduction, but also by energy security, economic resilience and macroeconomic stability (UN 2022; Skalamera 2023; Kim, Panton and Schwerhoff 2024).

Crucially, as lower-cost renewables are set to scale faster, the energy security imperative also accelerates investment and electrification across key sectors. This shift stands to unlock cascading climate and SDG co-benefits as countries move away from traditionally fossil-dependent uses, from transport to cooking, as documented in the International Energy Agency's 2026 Energy Crisis Policy Response Tracker (IEA 2026d). A 2026 analysis by the International Renewable Energy Agency on transitioning away from fossil fuels highlights how electrification is a triple-win for energy security, competitiveness and climate goals (IRENA 2026b).

3.3. Passive cooling and Nature-based solutions

Passive cooling and Nature-based solutions remain in the early emergence phase of the S-curve but show strong potential to move into acceleration as enabling policies and urban planning frameworks take effect.

Positive tipping points for climate action are not only about emission reductions; they also provide adaptation and resilience benefits. Extreme heat is a growing urban risk, with cities often 5–10°C warmer than surrounding areas. A “passive first” approach, prioritizing design and Nature-based solutions before mechanical cooling, offers a low-cost, scalable response. Passive technologies are well-positioned for tipping dynamics when embedded in building codes and urban planning frameworks and have payback periods ranging from around 2 years for external shading to around 14 years for green roofs (UNEP 2025b).

Efficiency measures in buildings, including improved insulation, glazing and smart energy management, reduce overall energy demand and lower household energy bills (IEA 2024b). When deployed at scale, these measures reinforce affordability and reduce pressure on electricity systems, particularly during heatwaves.

Combined passive measures, including shading, reflective surfaces, insulation and ventilation, can deliver 6–9°C reductions in indoor temperatures, in some climates substantially reducing or eliminating the need for mechanical cooling. In urban areas, passive and nature-based cooling strategies could reduce emissions by up to 25 per cent, with additional savings from low-energy cooling solutions such as fans and evaporative cooling (UNEP 2025b). Urban greening, forests, green roofs and vegetated corridors, not only cools cities but also improves air quality, biodiversity and public health. With nearly 3 billion people lacking access to adequate cooling, these approaches are critical for equitable climate adaptation (UNEP 2026c).

When passive cooling becomes standard practice, cooling loads decline permanently. This eliminates or reduces the need for air-conditioning systems, peak electricity demand falls, and grid stress during heatwaves decreases. Lower energy bills reinforce affordability, while improved thermal comfort enhances public health and productivity.

These benefits are also gender-differentiated. Women, especially those spending longer periods in overheated homes due to unpaid care responsibilities, informal work or limited mobility, can experience disproportionate health, time-use and productivity gains from improved thermal comfort. Cooling and retrofit programmes are most effective when they prioritize low-income and women-headed households and incorporate women’s perspectives in settlement and housing planning.



In rapidly urbanizing regions across Africa and Asia, where cooling demand is projected to grow steeply, early integration of passive and nature-based cooling can prevent long-term lock-in to inefficient, high-emission infrastructure. Passive cooling therefore represents a dual mitigation-adaptation positive tipping point: one that strengthens resilience, reduces emissions, improves equity and lowers long-term infrastructure costs.

Box 3: Cooling and greening cities: local solutions to climate extremes

Ahmedabad's Cool Roofs: In response to an extreme heat event of 46.8°C in 2010 that led to almost 1,500 excess mortalities, Ahmedabad, India launched South Asia's first Heat Action Plan in 2013, along with an early warning and protection system. By 2017, the city launched a Cool Roofs Initiative to protect vulnerable urban slum residents. By using affordable reflective coatings such as white paint and lime-wash, these roofs stay up to 30°C cooler, reducing indoor temperatures by 3–5°C. The programme serves as a scalable, life-saving model for cities across India to combat intensifying climate-driven extreme heat events (Natural Resources Defense Council 2017).

Freetown the Treetown: The "Treetown" initiative in Freetown, Sierra Leone is advancing urban greening through a data-driven, community-led reforestation model. Designed to strengthen climate resilience, the programme aims to plant 5 million trees by 2030, targeting risks such as flooding, extreme heat and landslides. More than 1.2 million trees have already been planted, tracked and verified, restoring over 1,200 hectares of urban land. Residents in climate-vulnerable communities receive incentives to grow and maintain trees, creating over 5,000 local jobs (Freetown the Treetown 2026).

Based on analysis of the literature, the following is a synthesis of actions to accelerate the positive tipping point for passive cooling and Nature-based solutions (IEA 2024b; UNEP 2025b):

- Embed passive cooling standards into national building energy codes and urban planning regulations.
- Mandate reflective roofing, shading and insulation standards in retrofits and new construction.
- Scale urban greening programmes, especially in heat-vulnerable neighbourhoods.
- Integrate passive cooling into National Adaptation Plans and extreme heat strategies.
- Expand concessional finance and on-bill financing for retrofits in low- and middle-income communities.

3.4 Heat pumps, active cooling and buildings efficiency

Heat pumps, active cooling and buildings efficiency measures are progressing along the S-curve, with some technologies entering the acceleration phase in leading markets while others remain in the emergence phase, indicating untapped potential for positive tipping points.

Buildings accounted for 21 per cent of global greenhouse gas emissions in 2019, over half of which were indirect CO₂ emissions from off-site generation of electricity and heat (Cabeza *et al.*, 2022). While heating dominates emissions in colder regions, cooling demand is rising fastest in emerging economies. Without intervention, cooling alone could sharply increase electricity demand and peak loads across Africa, Latin America, Asia and the Middle East (IEA 2018).

In 2019, India launched the world's first national Cooling Action Plan, in which district cooling is identified as a priority technology for sustainable urban development (UNEP 2019). These systems can be up to 50 per cent more energy efficient than standalone air-conditioning and contribute to national targets of reducing energy demand in buildings by 25 to 40 per cent.

India's first operational district cooling system, in Gujarat's International Finance Tec-City (GIFT City), demonstrates this potential at scale. Operational since 2015, the system distributes chilled water from a central plant to multiple buildings, replacing individual air-conditioning units, with an initial capacity of 10,000 tonnes of refrigeration, with plans to expand to 180,000 tonnes. The plant uses a system that stores cooling in large water tanks when electricity demand is low (off-peak hours) and uses it later when demand is high. This cuts electricity demand from 240 megawatts (MW) to 135 MW (Kumar *et al.*, 2021).

Another promising set of technologies is heat pumps, which occupy a location further along the S-curve than district cooling systems. Heat pumps are highly efficient and increasingly cost-competitive (UNEP 2025c) and can provide both central heating and cooling. Adoption is accelerating in leading markets, as Nordic countries have achieved high heat pump penetration (Carbon Brief 2023). Meanwhile, several developing countries are strengthening Minimum Energy Performance Standards (MEPS) for cooling appliances (United for Efficiency 2025).

Scaling efficient heating and cooling can cut emissions, reduce peak demand and avoid high-carbon lock-in in fast-growing urban areas. This makes it one of the most consequential positive tipping point opportunities of the coming decade.

Based on analysis of the literature, the following is a synthesis of actions to accelerate the positive tipping point for heat pumps, active cooling and buildings efficiency (UNEP 2025c):

- Phase out fossil heating systems and inefficient cooling appliances, with exemptions or additional incentives for lower-income households.
- Expand concessional finance and on-bill financing for retrofits in low- and middle-income communities and for operation and maintenance costs.
- Strengthen MEPS for cooling technologies and promote passive cooling in urban planning.
- Invest in skills and local manufacturing capacity, with dedicated measures to recruit, retain and advance women in technical, construction and maintenance roles in the buildings and cooling sectors.

3.5 Sustainable food systems, food waste prevention and behavioural change

Sustainable food systems are largely in the emergence phase of the S-curve, with early behavioural shifts and policy interventions indicating potential to build towards acceleration and future positive tipping points through concerted actions.



Globally, food systems are responsible for around 30 per cent of anthropogenic greenhouse gas emissions, with animal-sourced foods accounting for nearly 60 per cent of these emissions. Livestock production remains a major source of methane emissions and a key driver of deforestation and land degradation (Xu *et al.*, 2021).

Reducing food loss and waste is a critical and complementary, yet often overlooked, lever for transforming food systems. In 2022, 1.05 billion tonnes of food, representing 19 per cent of all food available to consumers, was wasted at the retail, food service and household levels (UNEP 2024b). Combined with the 13 per cent loss post-harvest (Food and Agriculture Organization of the United Nations [FAO] 2023), food loss and waste contributes 8–10 per cent of global emissions (Mbow *et al.*, 2019). Given the scale of its impacts and the multiple co-benefits it offers, tackling food waste is often one of the fastest entry points for triggering positive and cascading positive tipping dynamics: reducing emissions, improving food security and reinforcing resilience.

Households are the primary source of food waste, generating around 60 per cent of the global total. This equates to 79 kilograms per person annually or 1 billion meals discarded every day, which underscores the importance of consumer behaviour change, and systemic measures across the food value chain. Notably, per capita food waste differs by only 7 kilograms per year across different country income groups, reaffirming it as a universal challenge rather than one limited to high-income countries (UNEP 2024b).

Cities serve as the frontline for this transition, consuming 70 per cent of the global food supply (FAO 2020) while facing greater pressure on landfills. As urbanization accelerates, cities are increasingly becoming key nodes where food and resource systems intersect, making them strategic entry points for integrated and effective action. Many cities are piloting innovative prevention measures. Bangkok, Thailand has introduced financial penalties, tripling the waste fees for households that refuse to participate in its app-based collection programmes (Greener Bangkok 2026). In Rio de Janeiro, Brazil, where food comprises over 60 per cent of household waste, authorities are focusing on school engagement and circular initiatives (UNEP 2024b). Meanwhile, Yokohama, Japan uses “SDG lockers” in metro stations to sell surplus retail food at discount, a model expected to divert 12 tonnes annually (Kang 2025).

Based on analysis of the literature, the following is a synthesis of actions to accelerate the positive tipping point for sustainable food systems, food waste prevention and behavioural change (UNEP 2024b; OECD 2025b):

- Scale behavioural change through food literacy drives, youth engagement and community-level programmes to promote household and consumer-facing food waste prevention.
- Introduce city-level financial mechanisms and incentives to facilitate food waste segregation at source, and reward proactive food waste prevention.
- Build circular food systems through tech-based solutions such as smart lockers and redistribution apps that connect retail surplus food with consumers.
- Establish robust data and measurement systems that enable the identification of hotspots and demonstrate the environmental, social, and economic impact of food waste prevention, thereby supporting evidence-based policymaking at the national and subnational levels.

4. The role of the state: Mission-oriented market creation or expansion

Positive tipping points rarely emerge from market forces alone. Strategic public intervention is essential to shift systems past critical thresholds. The state can act as investors, regulators and coordinators, shaping markets and reducing risk. Mission-oriented innovation theory, as articulated by Professor Mariana Mazzucato, highlights how governments can set clear directions, mobilise public and private actors around shared objectives, and create the conditions for innovation to scale (Mazzucato and Semieniuk, 2018). Many transformative technologies, from renewable energy to digital infrastructure, have depended on sustained public investment, long-term policy signals and procurement that reduced uncertainty and stimulated private capital (Mazzucato, 2021).

Targeted interventions, such as carbon pricing, phase-out timelines for high-carbon assets, public guarantees for first-of-a-kind projects and mission-driven industrial strategies, can reduce risk, close cost gaps and shift investor expectations. As expectations shift, capital reallocates and tipping dynamics accelerate. This market-shaping role extends beyond emissions reductions. By setting strategic direction, the state enables sectoral solutions that advance development priorities, including food, energy and resource security to ensure economic resilience. These sectors create future-proof jobs, enhance competitiveness and increase resilience to climate and economic shocks. Financing solutions and mission-driven industrial strategies help scale new industries, especially in developing countries, supporting a just transition and mobilizing capital for systemic change.

UNEP's 2025 Policy Brief on NDC implementation reinforces this governance-centred perspective (UNEP, 2025e). Effective climate action depends not only on ambition, but on institutional capacity, coherent policy design and credible climate investment portfolios. NDCs function as signals to markets: when they include sectoral pathways, financing mechanisms and implementation roadmaps, they reduce uncertainty and unlock private investment. Given rising climate risks, delayed action further increases systemic exposure and reduces available response options, justifying immediate intervention (Ley *et al.*, 2022; J.P. Morgan, 2026).

Embedding tipping point logic into national climate plans strengthens this function. For example, setting binding timelines for phasing out fossil heating systems or internal combustion engine vehicles sends powerful long-term signals. Public procurement, from district heating and cooling to plant-based meals in public institutions, can create guaranteed demand that accelerates cost reductions through economies of scale. Blended finance structures and development finance institutions can de-risk investment in emerging markets.

The state also plays a critical enabling and coordinating role. Positive tipping points depend on complementary infrastructure, grids, charging networks, workforce skills or standards frameworks. A transition to hit net-zero globally by 2050, will require six times more metals inputs in 2040 than today, requiring significant investments while straining communities and ecosystems surrounding mines (IEA 2022; UNEP 2025e).

Box 4: Climate litigation as a positive tipping point

Climate litigation and shifting legal norms are increasingly acting as a non-technology positive tipping point in the climate transition, sending non-market signals that are independent of technological cost curves. In May 2026, the United Nations General Assembly voted in favour of the International Court of Justice's 2025 ruling that States have an obligation to protect the environment from greenhouse gas emissions (UN 2026). These legal developments are compelling governments and corporations to strengthen emission targets, disclose climate risks and align strategies with net zero emission pathways. As climate liability becomes embedded across legal and financial systems, litigation risk is increasingly influencing capital allocation and corporate governance, reinforcing market transformation and amplifying technological tipping dynamics.

As positive tipping points take off, demand for clean technology can be tempered through system design: Passive cooling, urban greenery and well-developed walking, cycling and public transport systems lower reliance on air conditioning, heat pumps and private EVs. Circular design rules, battery recycling, vehicle lightweighting and limits on virgin materials can cut resource use while improving system efficiency (International Resource Panel, 2023). Lastly, clear minerals traceability regulation can drive higher environmental and social standards supporting fair development, local value addition, benefit sharing and economic diversification in the Global South (UN, 2025b). Coordinated planning reduces bottlenecks and strengthens reinforcing feedback loops.

Ultimately, mission-oriented governance reframes public institutions as proactive shapers of economic transformation. By setting clear directions, coordinating systems and mobilising finance, governments can convert emerging momentum into self-sustaining change, accelerating progress toward resilient, net-zero economies.

5. The global imperative to spread positive tipping points

Equity is central to ensuring the transition supports development. Tipping points can lower energy costs, improve urban air quality, create future-proof jobs and increase systemic resilience, particularly in emerging markets and developing economies where energy demand and urbanization are growing most rapidly.

Many of the most promising tipping opportunities are highly relevant to non-OECD countries, and in several cases these economies are leading in areas such as solar deployment and EV adoption. As a prime example, India is forging a distinct "electrotech" path. Solar power accounts for 9 per cent of India's electricity generation in 2025, a massive leap from just 0.5 per cent in 2015 (Ember, 2026). Meanwhile, Viet Nam and Thailand have overtaken many European markets in EV penetration, and Ethiopia and Nepal have used import policies to pivot directly to e-mobility. Forty countries (a third of which are outside Europe) have now surpassed the 10 per cent EV sales tipping point (IEA, 2026d).

However, structural barriers remain including high capital costs and limited access to long-term finance, which can all slow down progress. Without targeted support, clean technologies may remain more expensive for developing economies than for wealthier nations, even when global cost parity has been achieved.

International cooperation, financial reform and market reforms are essential to enable equitable scaling. Concessional finance guarantees and blended finance mechanisms can reduce risk premiums and accelerate deployment. Equally important are market mechanisms, scalable business models and active private sector participation that can crowd in investment, strengthen delivery systems and make clean technologies commercially viable at scale. Reform of multilateral development banks and scaling up of climate finance are critical to ensure that emerging markets can leapfrog to clean systems rather than replicate fossil-intensive development pathways.

Equity also requires attention within countries. Clean transitions must be affordable for low-income households, workers in carbon-intensive sectors and women, and other vulnerable or marginalised groups. Well-designed subsidy reforms, just transition strategies, gender-responsive policies and targeted social protection measures can ensure that tipping dynamics strengthen social inclusion rather than deepen inequality.

Importantly, positive tipping points in non-OECD countries can generate global cascading effects. Rapid solar deployment in one region lowers global equipment costs. Scaled manufacturing in emerging markets strengthens supply chains. Regulatory innovation in one jurisdiction can reshape global standards. In this sense, equitable acceleration is not only a matter of justice, but a strategic accelerator of global decarbonisation.

An energy and climate transition that leaves behind the majority of the world's population will neither succeed nor endure. By ensuring that positive tipping points are accessible, financeable and socially inclusive, the international community can align climate ambition with development priorities, enabling emerging economies to lead in shaping the next phase of sustainable growth.

6. Policy recommendations

The following is a synthesis of recommendations (divided into key stakeholder groups) drawn from a range of academic literature as well as from analyses by the United Nations, OECD, International Energy Agency and the IRENA that focus on interventions most likely to push systems past critical thresholds and to lock-in self-reinforcing change.

6.1 Governments

- Set clear timelines and roadmaps for a transition away from fossil fuels, to provide long-term policy certainty, strengthen market confidence and accelerate investment in low-carbon growth sectors.
- Embed positive tipping point thresholds, such as renewable energy penetration milestones or electrification targets, in national climate and development plans.
- Align subsidies and public finance with transition and development goals by progressively shifting support towards clean technologies and practices that are close to tipping points, particularly in emerging markets and developing economies. Use green public procurement to create markets for example for low emission public transport and energy-efficient buildings.

- De-risk clean investment by expanding guarantees, concessional loans and blended finance mechanisms to reduce the cost of capital in non-OECD countries.
- Reform market rules and enable viable business models that support flexibility, distributed clean energy, electrification and affordable access to low-carbon solutions.
- Ensure that positive tipping point policies are socially inclusive, gender-responsive and accessible to low-income households, vulnerable groups and underserved regions.

6.2 Multilateral development banks and climate funds

- Prioritise sectors where modest financial interventions could unlock exponential growth and support climate resilience.
- Reduce risk premiums in emerging markets through currency hedging, guarantees and first-loss capital.
- Support green industrial strategies that build domestic manufacturing and workforce capacity, and viable business models capable of crowding in private investment.
- Apply gender-responsive investment criteria, including requirements for sex-disaggregated results, inclusive stakeholder engagement, support for women-led enterprises and workers, and safeguards to prevent the exclusion of women and marginalised groups from emerging clean-economy opportunities.

6.3 Private sector and institutional investors

- Align capital expenditure with net-zero pathways, prioritising renewable energy, electrification and low-carbon materials.
- Adopt science-based transition plans with transparent reporting and interim milestones.
- Adopt gender-responsive business and investment practices by tracking women's participation across supply chains and workforces, investing in inclusive skills development, improving women's access to green jobs and enterprise opportunities, and reporting on gender-related transition outcomes.
- For large asset owners and pension funds in particular, catalyse positive tipping dynamics by reallocating even a small share of capital towards emerging clean sectors.
- Invest in business models and delivery systems in emerging markets, underserved regions and low-income communities.

6.4 The role of the world's richest 1 per cent as a driver of systemic change

The wealthiest 1 per cent and the high-consumption middle class are not just individual actors, they are strategic levers for systemic tipping points. Their disproportionate control over capital, influence and consumption gives them the ability to reshape global markets and accelerate change. Key actions include:

- *Shift investment portfolios.* Redirect capital from fossil fuels to renewable energy, clean technologies, green hydrogen and climate resilient solutions. Even marginal reallocations at this scale can reshape capital markets.
- *Drive cost reduction through early adoption.* Acting as first movers helps bring technologies to cost parity, making them accessible to the global majority.
- *Electrify high-emitting consumption.* Transition private homes, transport and travel to low-carbon alternatives.

- *Deploy catalytic philanthropy.* Fund high-risk, high-reward interventions such as R&D, demonstration projects, policy advocacy, climate litigation, capacity building and just transition initiatives that can unlock systemic change.
- *Leverage social influence.* High-visibility behavioural shifts can normalise sustainable choices and accelerate adoption.
- *Advocate for structural reform.* Support progressive climate policy, carbon pricing and financial disclosure standards that align markets with climate stability. This creates political space for ambitious climate action.

When influential actors move first, costs fall, adoption rises and political momentum strengthens. The role of these actors is therefore not symbolic but structurally consequential (Westlake, Demski and Pidgeon 2024). The world's richest 1 per cent can help accelerate positive tipping points that will shift the global economy onto a self-sustaining path towards net zero and climate resilience.



7. Making 2026 the turning point for tipping points

Climate action is often framed in terms of constraints, shrinking carbon budgets, escalating impacts and narrowing timelines. Yet another reality is emerging. Across energy, transport, buildings, and food, structural shifts are underway. Clean technologies are becoming more affordable, markets are adjusting and social norms are evolving, making low-carbon solutions increasingly the rational choice.

The question is no longer whether transformation is possible, but whether it will be accelerated. Positive tipping points emerge when clear policy direction, strategic investment and coordinated action align. Governments set long-term signals, financial institutions reduce barriers and businesses shift capital toward low-carbon solutions, while bottom-up action from citizens and communities reinforces change.

World Environment Day 2026 offers a moment to move beyond awareness and focus on acceleration. By targeting tipping-ready sectors and embedding tipping strategies into NDCs, countries can shift from incremental reductions to structural transformation.

The coming decade is decisive. It will determine whether clean technologies become the global default, whether emerging economies leapfrog to resilient systems or lock into high-emitting pathways, and whether capital aligns with climate stability or prolongs risk.

Positive tipping points provide an evidence-based basis for optimism: rapid, self-reinforcing change is already within reach. With coordinated policy, targeted finance and shared responsibility, exponential progress can replace incremental drift. The opportunity now is to convert momentum into irreversible change and ensure this decade is remembered not for rising risks, but for accelerating solutions.

World Environment Day 2026 can mark that turning point.

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