

The Grid Fixed Itself. Transport Didn't.

UK Greenhouse Gas Emissions 1990-2024 — Bootstrap CUSUM Analysis — Executive Summary

stepchangeanalysis.com | [DESNZ & DEFRA Data](#) | [May 2026](#) | [Syd Stewart, Chartered Chemical Engineer](#)

Emissions from within UK borders: DESNZ Final UK GHG Statistics 1990-2024, N=35. Consumption-based (what UK residents actually cause, wherever in the world): DEFRA UK Carbon Footprint to 2022, N=27. Bootstrap CUSUM, Loops=10,000, Turn Length=5.

Five Key Findings

1 53% reduction — three causes, only the last is climate policy

(1) Energy market liberalisation (1998): -8.4% at 95.46% — coal replaced by gas as privatised electricity markets drove fuel switching. Predates serious climate policy. (2) Global financial crisis (2008): -17.2% at 93.88% — GDP fell 4.2%, industry contracted. Climate Change Act passed same year but change point predates it. (3) Carbon price floor (2015): -24.5% at 93.88% — coal phase-out, renewables scaling. The first genuinely policy-driven structural stage — arriving 25 years after the 1990 baseline.

1998: energy market | 2008: financial crisis | 2015: climate policy | N=35 | Loops=10,000

2 Electricity: one mechanism transformed a sector in 11 years at 99.8% confidence

Electricity supply emissions flat from 1990 to 2013 despite Kyoto, Renewables Obligation, and Climate Change Act. The carbon price floor (April 2013) — a Treasury revenue mechanism, not primarily a climate policy — made coal generation uneconomical for all 300 generators simultaneously. Result: -55.4% at 99.8% confidence. Three lucky enabling conditions: EU ETS price had collapsed, US shale gas made gas cheap, decade of renewable build meant capacity was ready. A positive unintended consequence of a policy framed as a fiscal instrument.

Stage 1: 1990-2013, mean 167.53 MtCO_{2e} | Stage 2: 2013-2024, mean 74.76 MtCO_{2e} | Conf: 99.8%

3 Transport: no structural change at 95% confidence — four precise reasons

34 years of transport policy, all four stage boundaries below 95% confidence. Four reasons: (1) The compensating feedback loop: fuel duty raised costs, efficiency improved, cost per mile fell, miles driven maintained. System absorbed every cost signal. (2) Population growth (+19%) absorbed per-capita gains. (3) Wrong layer: all policies at administrative/behavioural level, none redesigned the system. (4) No equivalent of carbon price floor: no mechanism making fossil fuel vehicles simultaneously unviable for all 35M drivers. Stage 4 (2019-2024) partly a COVID artefact.

Stage 2: 93.24% | Stages 3-4: 91.85% | All below 95% | Population +19% 1990-2024

4 EVs are not yet visible — the maths shows when they will be

1.2M EVs out of 35M vehicles = 3.5% of fleet. Annual saving ~1.44 MtCO_{2e} against sector total of 108 MtCO_{2e} = 1.3% of emissions, below the statistical noise floor. Detection requires 12-15M EVs. At 300-400k new EVs/year: expected change point 2034-2038. The Bootstrap CUSUM is not a verdict on EV policy. It is a clock. The 2030 ban is the closest equivalent to the carbon price floor — making the fossil fuel option legally unavailable — but fleet turnover takes 15 years, not months.

Detection threshold: ~12-15M EVs | Expected CUSUM change point: 2034-2038 | Current fleet: 3.5%

5 Consumption data: ~8 percentage points of the 53% reflects production shifts, not decarbonisation

Consumption-based emissions confirm 2008 and 2015 are genuine reductions on both measures. But the 1998 stage change in UK-border emissions has NO consumption equivalent. UK residents continued consuming at the same level; what changed was fuel source for electricity generation. Roughly 8 percentage points of the headline 53% reflects production restructuring, not genuine decarbonisation of UK economic activity. The remaining ~45 percentage points are real structural change.

Consumption stages: 2008 (-17.8%) and 2015 (-23.4%) confirmed | 1998 shift absent from consumption data

Three Frameworks, One Lesson

COMAH (Control of Major Accident Hazards Regulations 2015), Meadows leverage points (Thinking in Systems, 2008), and Joiner's Levels of Fix (Fourth Generation Management, 1994) converge on the same diagnosis: the higher the level of intervention, the more effective — and the more politically difficult and threatening to existing power structures.

COMAH hierarchy	Meadows leverage point	Joiner level	UK transport	UK electricity
Layer 4 Training & procedure Weakest — relies on individual behaviour	9. Parameters Taxes, subsidies, standards within unchanged system	Level 1 Fix the output Correct problems as they appear	Fuel duty, road tax bands, awareness campaigns	Renewables Obligation (2002). No CUSUM change point.
Layer 3 Administrative Absorbed by compensating behaviour	4. Rules of system Incentives, constraints, regulations	Level 2 Fix the process Prevents recurrence of specific event	2030 ban, emission zones, MOT standards	Climate Change Act 2008. No CUSUM change point on announcement.
Layer 2 Engineering controls System changes regardless of behaviour	6. Material flows & nodes Change structure at key nodes	Level 3 Fix the system Deming's 14 points	Ubiquitous EV charging making EVs the default. Not yet at scale.	Carbon price floor (2013) 99.8% confidence. -55.4% in 11 years.
Layer 1 Elimination Strongest — redesign so problem cannot arise	1-2. Paradigm & goals Highest resistance. Changes everything.	Level 3 deep Fix system root Constancy of purpose	Redesign cities — housing near employment, public transport as default. Generational.	Fully renewable grid — the destination, not yet reality.

Effectiveness increases from top to bottom. Political difficulty and resistance to change also increase.

What the Data Says Governments Should Do

Action	Detail	Level
1. Find the carbon price floor equivalent for each sector	For transport: ubiquitous EV charging at a price making EVs cheaper than petrol for every income level. For buildings: gas boiler ban + heat pump programme. For agriculture: land use incentives that change what farmers grow, not what consumers eat. Frame as fiscal/market mechanism, not climate policy — the carbon price floor survived because it was a revenue instrument.	Layer 2 Meadows 6 Joiner L3
2. Apply Bootstrap CUSUM prospectively	Before any intervention, publish the prediction: "We expect a detectable structural change point within X years at Y% confidence measured by Bootstrap CUSUM on Z data series." Monitor annually. Publish results. Creates accountability the current system entirely lacks — ministers claim credit for trends they did not cause.	All layers Measure output not input
3. Measure success by output not announcement	Policies announced and investment committed are activity metrics. The Bootstrap CUSUM is a lag measure. Switching accountability from activity metrics to CUSUM-verified change points changes the incentive structure entirely. Must be combined with lead measures (action 4) for early warning.	All layers Lag measure output
4. Track lead measures and publish quarterly	Policies announced, investment committed, targets set are input measures. The Bootstrap CUSUM is an output measure. It does not care what was announced. It asks: did the process structurally change? Switching accountability from inputs to CUSUM-verified change points changes the incentive structure for policy design entirely.	Deming System not tampering

The honest caveat: Electoral cycles are 4-5 years. Level 6 interventions take 5-15 years. A government bears the cost before the benefit appears in the CUSUM. The next government takes credit. O'Neill at Alcoa could act at Level 3 because he answered to a board, not 35 million voters. The Bootstrap CUSUM cannot fix the political system. It can hold the policy system to account. That is not nothing. See also: *Wholly Preventable* — the same argument applied to NHS medication safety at stepchangeanalysis.com.



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Key References

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