From Stirrups to Supply Chains

How modest technologies relocate power, and why electrification accelerates a new industrial geopolitics

Stephen Bray, Family Business Consultant

Synopsis

This paper develops a single causal chain for understanding how apparently simple technologies trigger disproportionate social and geopolitical change. The chain runs as follows. A modest tool lowers the cost of a critical activity such as trust, movement, replication, coordination, or protection. That cost drop shifts the bottlenecks that decide advantage. Institutions then reorganise around the new bottlenecks, because states, firms, and social classes tend to reward what now works reliably. Finally, the geographic centre of power migrates toward the regions that scale the new system earliest, then compound its advantages through infrastructure, standards, and production capacity.

The paper tests the chain against historical examples often treated as "small" technologies: coinage, the stirrup, the printing press, container shipping, and public-key cryptography. It then applies the same chain to the contemporary shift from oil-based mobility to electrified transport, with particular focus on electrification as an industrial system rather than a fuel substitution. The analysis places recent electric vehicle adoption and regulation within a longer historical pattern: power moves toward actors who control the new chokepoints, which increasingly include batteries, processing, grid hardware, and manufacturing scale. This frame also clarifies why petrostate diversification often struggles under time pressure, and why information-age dynamics, as argued in The Sovereign Individual*, intensify the bargaining power of mobile capital and technical networks (Davidson and Rees-Mogg, 1997).*

Introduction

Grand changes rarely arrive wearing grand costumes. More often, a civilisation changes its posture because a small tool changes what becomes cheap, repeatable, or dependable. The outward sign might look technological, but the real transformation typically appears in institutions: tax systems, labour organisation, property rights, military doctrine, and the social contracts that bind elites to the governed.

The temptation in energy discussions lies in treating electrification as a single variable, like swapping a fuel source. That misses the deeper historical rhyme. Electrification resembles earlier phase shifts where power moved away from owners of a finite resource and toward controllers of scalable systems. In oil's peak era, the leverage point sat in reserves, spare capacity, pipelines, and maritime chokepoints. In a more electrified world, the leverage point increasingly sits in manufacturing and processing capacity, system integration, and the ability to iterate faster than rivals.

This paper's purpose involves placing contemporary electrification, and the industrial strategies associated with it, within a longer historical logic that began long before modern geopolitics and will likely persist after it.

A single causal chain for technology-driven power shifts

A usable theory needs to travel. It must apply to medieval cavalry and modern grids without collapsing into metaphor. The chain proposed here runs in five linked steps.

First, a modest technology lowers the cost of an activity that previously relied on brute force, proximity, or fragile trust.

Second, the cost drop changes which bottlenecks matter. The new bottleneck might involve minting and standards, printing capacity and distribution, cranes and port throughput, or computation and cryptographic protocols.

Third, institutions reorganise around the new bottleneck. The winners build rules, infrastructure, and training systems to stabilise their advantage.

Fourth, scale effects compound. Once a system becomes standard, late movers face increasing catch-up costs.

Fifth, geography realigns. Power migrates toward regions that can scale the new bottleneck most completely, and that migration alters norms, alliances, and the "default settings" of modern life.

This chain deliberately avoids claiming mono-causality. It does not say "the stirrup caused feudalism" or "the container caused globalisation." It says these tools shifted costs and bottlenecks, and those shifts made certain institutional adaptations more likely and more rewarding.

Coinage as portable trust and the rise of legible extraction

Coinage looks like administration, not revolution. Yet money that carries a widely accepted stamp compresses trust into a portable object. Where barter requires local knowledge and repeated relationships, coinage permits exchange among strangers. That change expands markets, simplifies taxation, and makes military pay more reliable.

Historical sources commonly locate early true coinage in the mid-seventh century BCE, associated with Lydia and early electrum issues, followed by later standardisation under rulers such as Croesus (Britannica, n.d.).
What matters here involves the political geometry. Once a state can mint and enforce a standard unit, it gains a fiscal and administrative advantage. It can more easily finance soldiers, settle obligations, and extract revenue with less negotiation at each transaction. Power shifts toward authorities that can guarantee the unit and punish counterfeits, because enforcement becomes part of the monetary system itself.

In the chain's language, coinage lowers the cost of trust at a distance, creates bottlenecks in minting and legal enforcement, and rewards polities that scale standardisation.

The stirrup as a modest tool that changes the economics of violence

The stirrup provides a stable platform for the rider. That sounds like comfort. In practice, stability changes what a mounted fighter can do reliably. It increases the efficiency of force transfer and reduces the skill threshold for certain manoeuvres, even if it does not single-handedly determine social structure.

The "Great Stirrup Controversy" grew out of debates sparked by Lynn White Jr.'s thesis that military technologies, including the stirrup, shaped medieval social orders in consequential ways (White, 1962).
Scholars dispute the degree of causation, but the mechanism remains instructive. When a battlefield advantage increases the value of a particular military asset, it increases the need for predictable financing, training, and maintenance. That need tends to reshape land tenure, obligation, and elite formation. The point does not require the stirrup to "cause" feudalism. It requires only that a small improvement can change the return on organised violence, and organised violence often sits near the foundations of political order.

Here, the chain shows itself in a hard form. A small tool lowers the cost of a critical capability. The bottleneck becomes financing and organisation. Institutions adapt to fund that capability.

The printing press as replicable information and the weakening of old monopolies

If coinage compresses trust into a stamp, printing compresses persuasion into a repeatable artefact. Before print, copying demanded slow labour and patronage. After print, texts scale through presses, paper supply, and distribution. The effect does not merely increase literacy. It changes who can argue, who can coordinate, and how rapidly ideas can harden into movements.

The historical scholarship on printing's systemic consequences remains extensive, with particular emphasis on how print reshaped religious authority, scientific exchange, and political mobilisation (Eisenstein, 1979).
The chain reads cleanly here. Printing lowers the cost of replication. Bottlenecks shift from scribes and monasteries toward presses, paper, routes, and censorship. Institutions reorganise. New elites emerge: publishers, pamphleteers, and eventually mass parties. Regions that scale printing capacity and literacy infrastructures gain a long-term compounding advantage in administration and innovation.

Container shipping as the standardisation of movement

Containerisation looks like logistics, which means it often gets treated as background. Yet the shipping container standardised cargo into a unit cranes could move quickly, predictably, and with less labour. Port turnaround times fell. Shipping costs fell. Reliability rose. That combination made distributed production not only possible, but attractive.

A widely cited historical marker involves Malcolm McLean's early container-shipping experiments, including the 1956 voyage of the *Ideal X*, which helped catalyse a shift in maritime transport practices (Levinson, 2006).
Once again the chain holds. Containerisation lowers the cost and uncertainty of long-distance movement. The bottleneck becomes port infrastructure, crane capacity, intermodal integration, and scale. Institutions adapt: customs procedures, warehouse models, industrial siting, labour structures. Geography realigns: regions with efficient ports, manufacturing ecosystems, and export infrastructure become new centres of gravity.

Public-key cryptography as secure distance and programmable trust

If printing scales persuasion, cryptography scales secure coordination. Public-key cryptography enables parties to communicate securely without first sharing a secret in person. It makes secure commerce and identity possible across open networks, which changes the relationship between individuals, firms, and states.

Diffie and Hellman's 1976 paper formalised "new directions" that made this approach widely discussable and implementable within modern computing systems (Diffie and Hellman, 1976).
In the chain, cryptography lowers the cost of secure distance. The bottleneck shifts toward computation, standards, chip supply chains, and protocol governance. Institutions adapt in finance and law, often with a lag that creates grey zones. Geography becomes less decisive for some forms of economic life, because value transfer and verification can occur across borders without the same physical frictions.

This example matters directly for energy geopolitics, because electrification does not travel alone. It travels with software, markets, grid optimisation, and data. Energy increasingly behaves like a technical network, not only a commodity.

The Sovereign Individual and the information-age pressure on states

Davidson and Rees-Mogg argue that the information age changes the cost structure of coercion, taxation, and control, often in ways that favour mobile individuals and networked capital over territorially bounded states (Davidson and Rees-Mogg, 1997).
Whether one accepts the book's stronger predictions or not, its framing helps integrate the earlier case studies. The recurring story involves states losing their grip on older choke mechanisms when technology reduces friction for exit, coordination, or substitution. Coinage helped states extract and pay. Print weakened monopolies over knowledge. Containers

shifted production geographies. Cryptography made certain forms of value and identity more portable.

Electrification now enters as a new kind of portability. It reduces dependence on a geographically concentrated fuel, while increasing dependence on industrial systems that can be scaled and replicated where capital and capability concentrate.

Oil power as a scarcity regime

For much of the twentieth century, geopolitical energy power ran through a scarcity regime. Reserves concentrated in particular regions. Transport relied on chokepoints. Spare capacity and coordinated supply management could move prices quickly. States with large reserves could translate geology into leverage, because buyers faced limited substitutes for transport, heat, and industrial energy.

This model rewarded control of extraction and transit. It also rewarded narrative management, because expectations about future supply and demand influence present prices. The bottlenecks sat in wells, pipelines, shipping lanes, and the political stability required to keep them functioning.

Electrification as a manufacturing regime

Electrification changes the texture of advantage. Electricity can come from multiple sources. The tools that generate, store, transmit, and use it improve through iteration and scale. Batteries, power electronics, motors, and grid management systems behave like industrial products with learning curves, not like finite barrels.

Transport electrification strikes at oil's deepest demand base, because mobility consumes a large share of petroleum. Recent market data supports the speed of this shift. Global electric car sales topped 17 million in 2024, and China's electric car sales exceeded 11 million, with electric cars reaching almost half of new car sales there (IEA, 2025).
The implication does not require claiming an immediate collapse in oil. It requires recognising that the marginal growth logic has changed. Once adoption follows a diffusion curve, and once total cost of ownership becomes competitive at scale, substitution pressure becomes structural.

Policy as directional force, and policy uncertainty as a second-order variable

Regulation does not create technology diffusion alone, but it can lock in expectations for manufacturers, investors, and infrastructure planners. The EU's Regulation (EU) 2023/851 strengthens CO_2 emissions performance standards for new cars and vans, embedding the 2035 target as a legal trajectory in the EU framework (European Union, 2023).
At the same time, policy "direction" can coexist with political renegotiation. Recent reporting describes EU debate about relaxing or reframing post-2035 rules, including proposals that

could alter how compliance is achieved, and whether certain powertrains persist beyond 2035 in limited forms (Reuters, 2026).

California's Advanced Clean Cars framework sets a pathway toward 2035 in state-level regulation, though implementation remains entangled with federal waiver politics and legal challenges (California Air Resources Board, 2022; Reuters, 2024).
For this paper's causal chain, policy sits as an accelerant and a signalling device. It shapes where capital builds capacity, which matters because capacity becomes the new bottleneck.

The new choke-points: processing, manufacturing scale, and system integration

In oil, choke-points appear where physical flow concentrates. In electrification, chokepoints appear where industrial capability concentrates. Processing of key materials, battery manufacturing capacity, power electronics, motor components, and grid hardware can all become strategic constraints. The point is not that any one state will "own electricity." The point is that control over the enabling stack can confer pricing power, timeline power, and bargaining power.

Contemporary data underscores the scale differentials that make these choke-points politically meaningful. China remains the world's electric car manufacturing hub, accounting for more than 70% of global electric car production in 2024, according to IEA reporting (IEA, 2025).
Once a region becomes the manufacturing hub, it tends to pull in suppliers, skills, toolmaking, standards, and finance. That is compounding in its purest form.

China in historical context: scaling the new regime before it feels inevitable

The most useful way to position China within this dissertation's framework involves avoiding melodrama and leaning on structure. A region gains power when it scales a new bottleneck early, then makes its system the default. That pattern describes Britain in certain phases of the industrial revolution, the United States in parts of the twentieth century, and export-led East Asia in late twentieth-century manufacturing. It also describes how containerisation re-centred production geographies.

In electrification, China's scale in EV production and sales provides a platform for this kind of compounding. The IEA reports China's 2024 EV sales at over 11 million, with electric cars reaching almost half of new car sales (IEA, 2025).
Further reporting suggests that China's "new energy vehicle" share crossed above 50% in parts of 2025, indicating continued acceleration beyond the already high 2024 baseline (China Daily, 2025).
I have not pulled a dedicated Reuters or IEA statement for "over 50% of all cars sold in China now electric" in 2025 within the sources above, so I treat the 2024 "almost half" as the firm

anchor, and the 2025 “over 50% in some months” as directional but dependent on how “cars” and “new energy vehicles” are defined in each dataset.

In historical terms, this resembles an industrialisation of a new regime. The system becomes cheaper because it becomes common. It becomes common because it becomes cheaper. A feedback loop forms. When feedback loops form, the geography that hosts them often becomes the new centre of gravity.

Petrostate exposure as a timing problem, not a morality tale

A petrostate relies on oil rents not merely for income, but for legitimacy and stability. That dependency creates a structural vulnerability when substitution pressure increases. Diversification plans can generate real activity, but they often struggle to replace hydrocarbon rents in both scale and speed, especially when the new advantage sits in manufacturing depth and export capacity, not in tourism, finance, or prestige projects.

The causal chain clarifies why timing matters. When a new bottleneck emerges, the catch-up cost rises with every year the early mover compounds. A refinery can be financed in years. A full industrial ecosystem, including toolmaking, supplier networks, trained labour, and export logistics, tends to take longer. Containerisation taught a similar lesson to port cities that assumed their old advantages would persist (Levinson, 2006).

Geographic power shifts and the “centre of gravity” lens

Power does not migrate only through conquest. It migrates through production, standards, and compounding networks. Economists have described this movement using the notion of an “economic centre of gravity,” meaning the average location of global economic activity. Quah’s analysis argues that this centre has drifted eastward with the rise of East Asia (Quah, 2011).
In the dissertation’s frame, electrification accelerates the same drift if the enabling industries cluster where the centre already moves. That creates a reinforcing loop between geography and technology.

Synthesis: electrification as the newest instance of an old pattern

Placed in historical context, electrification looks less like a novelty and more like a familiar kind of re-bottlenecking.

- Coinage makes trust portable and legible, and strengthens administrative extraction (Britannica, n.d.).
- The stirrup alters the economics of violence and encourages new financing arrangements for force (White, 1962).
- The printing press scales replication and weakens monopolies over information (Eisenstein, 1979).

- Container shipping standardises movement and re-situates production (Levinson, 2006).
- Public-key cryptography makes secure distance cheap and changes how value and identity travel (Diffie and Hellman, 1976).

Electrification fits the same chain. It reduces dependence on a scarce, geographically concentrated fuel in the most substitution-prone sector, transport. It then increases dependence on industrial choke-points that reward scale, integration, and speed. Those choke-points sit in manufacturing and processing. Whoever scales them early tends to accumulate the "default settings" power that once belonged to oil reserve holders.

This does not guarantee a single outcome. It does, however, shift the question. The question becomes less "Who has the resource?" and more "Who can build, iterate, and deploy the system at scale, and who can set the standards others must follow?"

Conclusion

The story of power in technological history rarely reads as a story of the biggest machines. It reads as a story of small levers and shifted bottlenecks. Those levers change what becomes cheap. What becomes cheap becomes common. What becomes common becomes infrastructure. Infrastructure becomes governance. Governance becomes geography.

Electrification now enters that lineage as a manufacturing regime, not merely an energy transition. It offers substitution in oil's strongest demand category and shifts leverage toward industrial ecosystems that compound through scale. The historical context provided by coinage, the stirrup, the printing press, container shipping, and public-key cryptography suggests a durable lesson. Power relocates toward those who scale the new bottleneck early enough that the rest of the world must interface with their system.

In that sense, the contemporary contest between oil and electricity resembles earlier phase changes that reordered civilisation. The visible surface involves vehicles and grids. The deeper motion involves bottlenecks, institutions, and the slow drift of the world's centre of gravity toward the places that build the next default.

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