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Managerial Insights

From Risk to Reward: Electrifying Supply Chains for Competitive Products

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Any product that has fossil fuels in its value chain will end up uncompetitive with products that have decarbonized end-to-end. Electrification of all aspects of supply chains is one of the easiest levers that professionals defining supply chains for the future can pull in order to maintain and grow market share. Bold statements, so let's unpack them a bit.

Let's start with the European Union's just started carbon border adjustment mechanism (European Commissions , 2024a). That's a carbon price on goods imported to the European Union from any country in the world. The European Union and its neighboring countries are aligning on the carbon price and the carbon border adjustment, so the second biggest economic block in the world is pricing carbon for all its imports. If you have a high-emissions product, expect to add a lot of carbon price to it in the European market.

The carbon price is the same as the EU's domestic price under their European Union Emission Trading System (European Commission, 2024b), which is the highest in the world already. It peaked at €100 per metric ton in early 2023 and has declined somewhat since because the European Union's response to the energy crisis was to accelerate renewables, storage and electrification, so there are fewer market demands for the credits. But that's today. The European Union has published budgetary guidance for projects about what carbon price they should include in business cases for every year through 2050, and the numbers are eye-opening (European Commission, 2021). For 2024 they advise organizations to use €148. For 2030, €198 in 2024 currency values. For 2035, €253. For 2040, €280.

This budgetary guidance is a very clear policy signal that the European Union will drive the European Union Emission Trading System to these price points by adjusting the caps, withdrawing allowances, withholding auctioning, including new sectors, covering new greenhouse gasses and more. It's already pulled several of those levers, reducing allowances to domestic aviation and bringing more of aviation and maritime shipping into the European Union Emission Trading System. In 2026, when the carbon border adjustment starts being collected as opposed to just reported on, they are adding methane (the primary component of natural gas) and refrigerants.

Managers who are reading and have information regarding their organization's Scope 1 and 2 should take a moment to calculate total per product emissions, multiply that number by €280 per ton, reduce the total by 75% or even 90%, and then, imagine what they could do with the extra funds to create competitive advantage. Note that this thought exercise doesn't include the Scope 3 emissions that supply chain partners are burning and therefore, must be be included when considering the impact of public policies such as the Carbon Border Adjustment Mechanisms (European Commissions, 2024a). Indeed, every carbon pric-

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ing system in the world is looking at Scope 3 upstream emissions and working to include them. In addition, managers who think their organizations can just pivot to big markets that aren't in the European Union will also find that this approach doesn't address the carbon cost issue. Both Canada and America have harmonized their social cost of carbon, and it's about the same as the budgetary guidance for the European Union Emission Trading System. China has a cap-and-trade system not dissimilar to California's and 12 affluent U.S. states that have signed on to it, and Canada has a national carbon price.

The U.S. came close to putting in place a China-focused carbon tariff, which is to say a North American carbon border adjustment mechanism with Canada and Mexico, which included a U.S. domestic carbon price. While that didn't get through the U.S. Congress, a methane greenhouse gas tax did (U.S. Environmental Protection Agency , 2024). Starting in January of 2024, leakage of natural gas in extraction, processing, distribution and burning now costs the industry $900 per ton, and that's going up to $1,500 per ton in 2026. Whenever U.S. industry can't cheaply abate that, they'll pass that cost on to the supply chains. The second largest import economy in the world is putting a global price on carbon emissions. All three of the biggest economies are pricing greenhouse gasses today. This is the way the world is going. Supply chain strategists not paying attention will end up with uncompetitive products as competitors are paying attention.

Luckily, there's a solution, electricity. Every realistic list of climate actions that will work starts with electrifying everything. My own list does (Barnard, 2024b) as do the priorities developed by Dr. Jacobson of Stanford and colleagues, famous for their highly influential 100% renewables by 2050 scenario for 145 countries globally (Jacobson et al., 2022) and Griffith (2021), hired by the U.S. Department of Energy in the 2010s to do an incredibly detailed analysis of the energy pathway flows for the U.S.

Why is that? Because anything that uses electricity instead of fossil fuels uses a lot less energy. That's true for generating electricity, where 50% to 70% of the energy in coal, gas or oil turns into waste heat of no value. That's not true for wind turbines and solar panels because the fuel is free. That's true for heat, because heat pumps move 2-8 units of heat between the environment and homes, commercial buildings and industrial processes for every unit of electricity. It's true for transportation, where every bit of electricity turns into 80% forward motion, instead of every bit of fossil fuels turning into 20% forward motion, lots of waste heat and, most importantly for this discussion, three times as much greenhouse gas. Everything that can be electrified with batteries or grid ties will be. This has been a recurring pattern since the harnessing of electricity and creation of electric motors. Factories that had massive steam boilers and mechanical linkages from the boilers to all of the floor machines replaced that with electric motors as soon as they became available because it was so much more efficient (Griffith, 2021).

For decarbonization, there are two different levers that electrification pulls. The first is that generating electricity is much more efficient than using fossil fuels in trucks and delivery vans and heat pumps are three or more times as efficient as burning natural gas for heat so there's an immediate carbon gain. But as more and more renewables are built on grids, electricity's carbon footprint will decline rapidly and so electric vehicles and machinery will become lower carbon without doing anything else over time.

The combination means that a country like the U.S. will require only 42% of the energy to produce all of the same economically valuable work and deliver the same creature comforts as Americans experience today. That only requires six times the low-carbon generation in the U.S. today. The 42% is from Griffith (2021), based on work with the U.S. Department of Energy, but Jacobson et al. (2022) have done that math as well, and so have I (Barnard, 2023); all finding over 50% savings. The United States already meets 70% of its steel demand with scrap steel fed into electric arc furnaces, because once again that's more efficient and less expensive. Now we're entering an age of electric heat for all steel and hydrogen or more electric processes producing the new steel to go with the scrap steel. Firms like Boston Metals, Fortescue and others are commercializing processes that don't use expen-

sive hydrogen but go directly from electricity and iron ore to iron and then to steel.

Transportation is electrifying globally. There are about 600,000 electric trucks on China's roads and due to their clustering industrial policy, their supply chain distances are much shorter than in the U.S. or Europe. They are at 75% rail electrification and are electrifying their inland and short sea shipping, with 700 container electric ships traveling 1,000 kilometer routes along the Yangtze. Three-quarters of India's domestic freight moves by rail, and they'll be finished electrifying all heavy rail this year, leading the world in domestic freight decarbonization.

Europe's freight moves mostly by road, and they've just agreed on a radical strengthening of decarbonization targets for road freight. Trucking has an existing target of 15% reduction in emissions starting in 2025. In 2030, that leaps up to 45%. In 2035, it's 65%. 2040? 90% (European Commission, 2024c).

Having reviewed and critiqued every major road freight decarbonization study done in Europe and the U.S. over the past decade, and having participated in a Swedish study of European road freight decarbonization options (Rogstadius et al., 2024), I'm comfortable that battery electric trucks will eventually carry all European road freight, but within what time period? If a logistics firm is touting their hydrogen trucks, managers should make sure they aren't charged a premium or expected to absorb the added costs if the trucks are proven to be economically non-viable.

Every major geographical economic block is electrifying transportation with a notable exception, North America. Due to decisions made long ago, North America's railroads are privately held, not publicly held as strategic infrastructure like roads and transmission lines. North America's railroad association is fighting electrification hard (Association of American Railroads, 2023), and while the rest of the world is well on the way to fully electrified freight rail, North America is at 0% and holding.

The Jones Act (also known as the Merchant and Marine Act of 1920), while well intentioned after World War I, along with the allowed shift of heavy industry to Asia over the past decades, has severely limited domestic inland and coastal shipping, and is hindering the shift to electric drive trains and batteries. China's electric ships (Morris, 2024) and South Korea's alternative fuel ships (Argus, 2023), which can't be used in domestic freight or passenger applications in the U.S., are already sailing their seas and rivers and being delivered to Europe, but can't be sold in the U.S. (Grabow, 2019)

Trucking in North America is the most likely bright spot for decarbonized freight. While the U.S. trucking lobby group is fighting against electrification, it's growing rapidly in drayage operations on both coasts and spreading rapidly with electric cargo trikes for urban UPS and FedEx deliveries, electric delivery vans and an increasing number of semi-trucks from multiple manufacturers including Daimler, Volvo, Tesla and others. The plummeting cost of batteries, where we are seeing prices this year that optimists thought would arrive in 2030 and energy densities this year that analysts thought we wouldn't see until 2050, have upended all analyses. The U.S. trucking lobby is now in a King Canute position, fighting the tide that's sweeping in. Battery vehicles are dropping in cost and increasing in capability annually. GM's Brightdrop step van has 250 miles of range, fast charging and an $85,000 price tag. Tesla's Semi, which has the best range of any of the electric Class 8 trucks, is expected to sell for $250,000, well under most manufacturers' price points and in California will be eligible for $24,000 of combined state and federal rebates (GM Envolve , 2024). In Canada, incentives are higher than in the U.S. (Transport Canada, 2024). In Germany, companies can receive up to €25 million and 50% of fleet purchases.

Smart fleet owners are looking at maintenance that costs 40% less and fuel that costs 80% less for the same distances and just waiting for the capital expenditure and big federal and often state grants to bring the business cases into line (Noregon, 2022). Many are already converting their fleets. Owners with depots are investing in the very cheap solar panels and batteries on the market to 'make' their own fuel, cutting costs further and avoiding concerns about electricity supply and

infrastructure upgrades.

The North American Council on Freight Efficiency's annual Run on Less study ran in September of 2023. Tesla's Semis delivered over 1,000 miles of work in a single day fully loaded. Other manufacturers trucks did work days of 500 miles. The majority of regular routes and schedules are already well within the range of current electric trucks (North American Council for Freight Efficiency, 2023). But as with everything else, there are early adopters, early majority, late majority and never adopters. Managers don't have to use the late majority and laggards increase their Scope 3 carbon price. Instead, funneling their business to the early majority logistics firms will send a strong signal to the trucking industry.

The combination of battery electric trucking and the further savings that will come with autonomous trucking on North American highways will bring road freight costs in line with rail and reverse the current higher emissions for road freight. While North America's railroads will eventually electrify, they are going to lose a third of their revenue as coal and oil cars disappear in the coming decades while having to maintain all of their tracks, eliminating the revenue they might have used for transformation while at the same time paying higher fuel prices (American Railroad Association, 2019).

In many places, electric trucks are already lower carbon than rail, so the rail companies' online calculators extolling their carbon savings are now wrong. Ten rail cars of fertilizer from San Diego to Bakersfield, 250 miles away, require about 45 electric semis. With California's electricity's carbon intensity, that's under 5 tons of emissions for the trucks, and over 5 tons by rail. Wyoming's coal heavy grid still favors rail, but there are states with much lower carbon electricity than California (Barnard, 2024a). Europe's biggest countries have an average grid carbon intensity lower than California's and dropping quickly. The biggest provinces in Canada have electricity with a tenth to a twentieth of the carbon intensity of California, as an example, so the greenhouse gas savings with electric trucks are much higher. Trucks are no longer the climate laggards.

What should supply chain designers do? First, assess their product line for immediacy of exposure to significant carbon pricing. If a subset of products sell well in Europe today, pay attention to their supply chains first. Second, consider logistical freight shipping geographies. If rail is used between California destinations, consider shifting to electric freight trucks, which are already lower carbon than rail. The reality is that all U.S. grids are decarbonizing simply because electricity generated by wind and solar is cheaper, but there are leaders and followers, just as with trucking companies. Running the math for each major part of the supply chain will indicate whether switching to electric trucking will save carbon emissions and consider discussing the truckers the possibility of passing on some of the maintenance and fuel cost savings.

Third, China is electrifying rapidly, but unevenly. U.S. electrical demand and supply has been fairly flat since 2000, with coal being replaced by gas and renewables and little net new electrical generation. Over the same period, China has gone from generating a third of the electricity the U.S. does to twice as much and is expected to add 30% more renewable generation than the rest of the world combined through 2027. China's grid intensity will fall much faster than U.S. grid intensity in the coming decade and electricity will be much more heavily leveraged in supply chains. While U.S. grid carbon dioxide intensity has declined, natural gas methane leakage has completely counterbalanced that (International Energy Agency , 2024). China's higher emission coal-fired power plants, which operate like U.S. natural gas plants to supply energy at peak times during the day, are being replaced by lower emission plants. However, they still have coal bed methane problems similar to the natural gas methane problems in the U.S.. If a company has significant parts of their supply chain in China, managers should work with their suppliers and logistics firms to get freight onto electrified rails and on-board ships, especially electrified ships. Work with them to assess their road vehicle electrification – climate-friendly innovations that have experienced much higher penetration in southeastern major urban areas than in the western provinces.

Fourth, assess the materials that go into their prod-

ucts. Which products can charge a premium for green steel or green ammonia fertilizer? European car manufacturers are buying green steel and marketing that to customers, gaining lower carbon prices on their manufacturing and charging more to clients, more than offsetting the additional costs.

Fifth, assess heat in their product supply chains. 45% of industrial heat is below 200° Celsius and can be supplied by heat pumps that use one unit of electricity to move 2-8 units of heat to where they are needed, often at tremendous cost savings. There are already fully electric heating solutions for every temperature range and industrial process, with resistance, induction, infrared, microwave and even electric flames (plasmas). The reality is that there are no heating solutions that can't be electrified. There are only business cases for capital and operational costs which are often favorable even before carbon pricing.

For those sustainable marketing scholars who study supply chains, here are some key questions whose answers would assist supply chain designers in organizations.

1. Which modes of transportation are lowest carbon in which geographies?
2. What price points per ton of cargo per mode of electrified and increasingly low-labor transportation will make sense in the future?
3. What is preventing logistics firms from being in the early majority?
4. What product segments are best aligned with charging a green premium for electrified transportation?
5. What product segments are most exposed to increasing carbon pricing?
6. What product segments should gain more by focusing on heat rather than transportation?
7. What messaging about full lifecycle low-carbon products best aligns with customers' brand loyalty?
8. How should the uncertainty of greenhouse gas pricing be valued by supply chain designers?
9. What is the awareness among supply chain designers of the rapidly changing world of carbon pricing and its implications?

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References

American Railroad Association (2019), Railroads and Coal. Retrieved from https://www.aar.org/wp-content/uploads/2018/05/AAR-Railroads-Coal.pdf

Argus (2023). Retrieved from https://www.argusmedia.com/en/news-and-insights/latest-market-news/2422258-korea-unveils-roadmap-for-net-zero-in-shipping-by-2050

Association of American Railroads (2023), Oppose Rail Electrification & Support Sensible Climate Policy. Retrieved from https://web.archive.org/web/20230930013417/https://www.aar.org/wp-content/uploads/2020/12/AAR-Electrification-Fact-Sheet.pdf

Barnard, M. (2023). Retrieved from https://cleantechnica.com/2023/03/14/with-heat-from-heat-pumps-us-energy-requirements-could-plummet-by-50

Barnard, M. (2024a). Retrieved from https://cleantechnica.com/2024/05/17/electric-trucks-are-already-lower-carbon-than-rail-in-much-of-north-america/

Barnard, M. (2024b), The Short List of Climate Actions that will Work. Retrieved from https://cleantechnica.com/2024/04/11/the-short-list-of-climate-actions-that-will-work-india-edition-transcript/

European Commission (2021), Economic Appraisal, Vademecum 2021-2027, General Principles and Sector Applications. Retrieved from https://www.gihub.org/resources/publications/european-commission-economic-appraisal-vademecum-2021-2027

European Commission (2024b), EU Emissions Trading System. Retrieved from https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en

European Commission (2024c), Questions and Answers: Revised CO2 emission standards for Heavy-Duty Vehi-

cles. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/qanda_24_2527

European Commissions (2024a), Carbon Border Adjustment Mechanism. Retrieved from https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

GM Envolve (2024), [About page]. Retrieved from https://www.gmenvolve.com/about

Grabow, C. (2019), Rust Buckets: How the Jones Act Undermines U.S. Shipbuilding and National Security. Retrieved from https://www.cato.org/policy-analysis/rust-buckets-how-jones-act-undermines-us-shipbuilding-national-security#introduction

Griffith, S. (2021). *Electrify: An Optimist's Playbook for Our Clean Energy Future?* Massachusetts Institute of Technology.

International Energy Agency (2024), Global Methane Tracker 2024. Retrieved from https://www.iea.org/reports/global-methane-tracker

Jacobson, M.Z., Krauland, A.K.V., Coughlin, S.J., Dukas, E., Nelson, A.J.H., Palmer, F.C., & Rasmussen, K.R. (2022).

Morris, C. (2024). Chinese Firm Launches Fully Electric Container Ship with Massive 50,000 kWh Battery Capacity. *Charged EV Fleet & Infrastructure News*.

Noregon (2022), Comparing the Total Cost of Ownership of Electric Vs. Diesel Trucks. Retrieved from https://www.noregon.com/electric-vs-diesel-truck-fleets/

North American Council for Freight Efficiency (2023), Run on Less – Electric. Retrieved from https://nacfe.org/research/run-on-less-electric/

Rogstadius, J., Alaküla, M., Plötz, P., Márquez-Fernández, F.J., & Nordin, L. (2024). Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:ri

Transport Canada (2024), Incentives for Medium- and Heavy-Duty Zero-Emission Vehicles. Retrieved from https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/incentives-medium-heavy-duty-zero-emission-vehicles

U.S. Environmental Protection Agency (2024), Waste Emissions Charge. Retrieved from https://www.epa.gov/inflation-reduction-act/waste-emissions-charge