FACT SHEET: GLOBAL

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

MODELING SUPPLY CHAIN ENERGY AND ENVIRONMENTAL PERFORMANCE WITH REAL-WORLD DATA

One of the biggest hurdles to emerge in analyzing freight environmental performance is access to real-world data. To contribute, a new ICCT study leverages data from The Home Depot (THD), a leader in reducing its supply chain impacts under the U.S. Environmental Protection Agency's (EPA) SmartWay program, to evaluate the energy, climate, and health impacts of technology and other emissions reduction strategies. In assessing a trade route from China to the continental United States, researchers constructed three scenarios: (1) the *Conventional* scenario models business as usual and excludes green strategies already adopted by THD; (2) the impacts of THD's existing green strategies are represented in the *Green* scenario, which also serves as an industry benchmark; and (3) the *Green Plus* scenario builds upon the *Green* and is a future, hypothetical supply chain with additional improvements evaluated in the short, medium and long term.

This is one of the first studies to incorporate technology research, operational best practices, and emissions accounting methodologies in an in-depth assessment of a real-world supply chain. To help facilitate future improvements, it also highlights key stakeholders and opportunities for collaboration across industry, government, and civil society.

ANALYTICAL FRAMEWORK

The Avoid-Shift-Improve framework, which incorporates all elements of transportation system efficiency, is adapted for this study such that the elements correspond with **logistics**, **modes**, and **equipment**. Clean and efficient logistics like cargo consolidation optimize existing freight activity (*Avoid*). Clean and efficient modes, which include switching from truck to rail and from air to marine, aid in emission reductions (*Shift*). And clean and efficient equipment strategies, including truck and rail technology, help reduce energy consumption (*Improve*). The suite of environmental strategies applied in the study's models are categorized according to this framework in Table 1. Note that ICCT conducted a "tank-to-wheels" assessment of the energy use and CO_2, particulate matter (PM), and NO_x emissions from the six transportation segments of the THD supply chain listed in Table 1.

Table 1. Strategies evaluated in each scenario and supply chain segment

Strategy type	Strategy	Supply chain segment																			
		China drayage				Marine				U.S. drayage				U.S. inland				SDC to store				RDC to store			
		Green	*Green Plus* (ST)	*Green Plus* (MT)	*Green Plus* (LT)	*Green*	*Green Plus* (ST)	*Green Plus* (MT)	*Green Plus* (LT)	*Green*	*Green Plus* (ST)	*Green Plus* (MT)	*Green Plus* (LT)	*Green*	*Green Plus* (ST)	*Green Plus* (MT)	*Green Plus* (LT)	*Green*	*Green Plus* (ST)	*Green Plus* (MT)	*Green Plus* (LT)	*Green*	*Green Plus* (ST)	*Green Plus* (MT)	*Green Plus* (LT)
Clean and efficient logistics	Cargo consolidation (CFS)	●								●															
	Cube optimization	●								●				●				●				●			
	Transloading (network reconfiguration)									●															
	Floor loading	●								●				●				●				●			
	Shore power					●	●	●	●																
	Schedule optimization (port and ship)					●	●	●	●																
Clean and efficient modes	Truck to rail															●	●								
	Transloading (container switch)													●											
	Move to larger container ships[a]					●	●	●	●																
Clean and efficient equipment	Truck technology	●	●	●	●					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Truck electrification			●	●							●	●							●	●			●	●
	Eco-driving training	●	●	●	●					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Rail technology														●	●	●								
	Cleaner fuels[b]							●	●																
	Marine engine efficiency					●	●	●	●																
	Vessel operations (slow steaming, weather routing)					●	●	●	●																
	Vessel thrust efficiency						●	●	●																
	Vessel aerodynamics								●																
	Emission control policies	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

● *Green* ● *Green Plus* – short term (2020) ● *Green Plus* – medium term (2025) ● *Green Plus* – long term (2030)

Note: SDC=stocking distribution center and RDC=rapid deployment center

[a] This strategy could also be categorized as a logistics strategy.

[b] Benefits from higher use of low-carbon fuels are not included, except for the marine sector, because of the uncertainty around their carbon savings and ability to produce sufficient amounts of truly sustainable biofuels in the timeframe of this study.

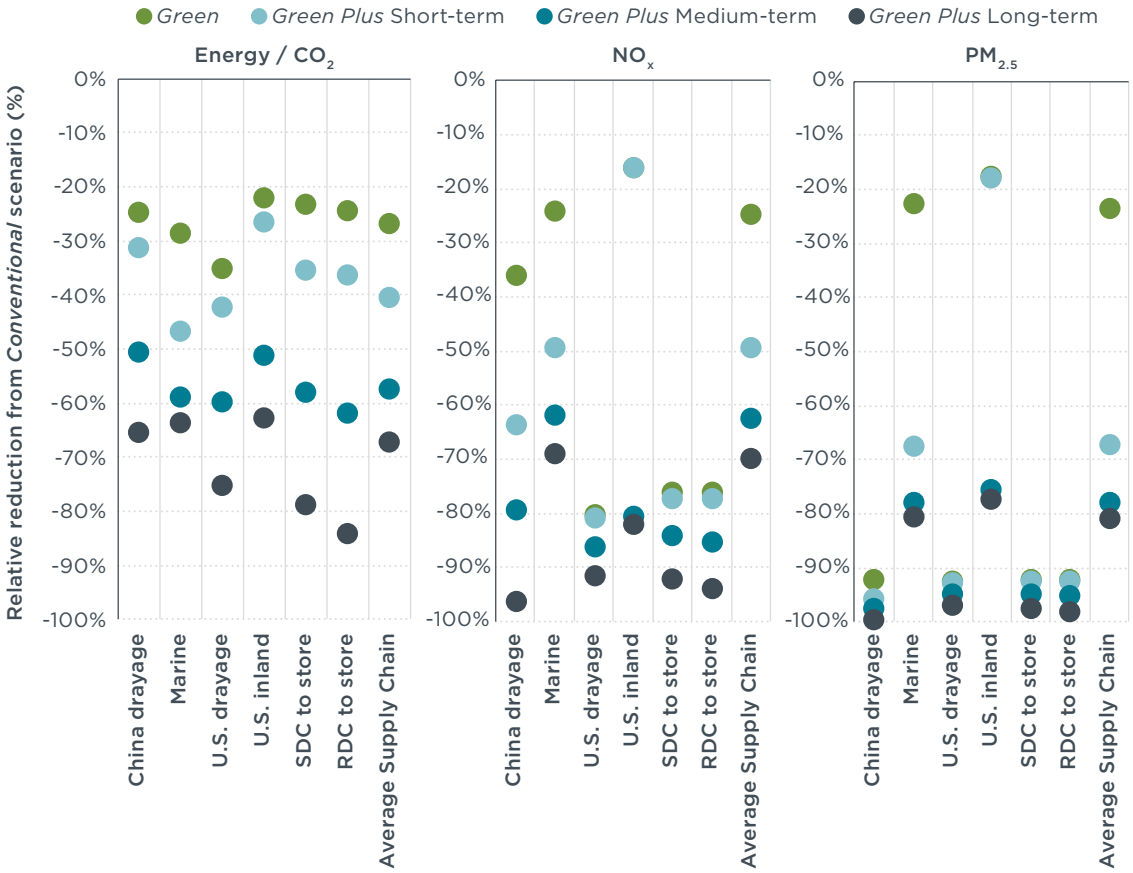

Figure 1. Reduction in energy and emissions intensities by scenario.
Note: Land-based segments calculated $PM_{2.5}$ emissions and the marine segment calculated PM_{10} emissions. Approximately 96% of PM_{10} emissions are primary tailpipe emissions of $PM_{2.5}$.

KEY FINDINGS

The *Green* scenario shows substantially better environmental performance than the *Conventional* scenario. By adopting current best practices, savings of nearly 30% for energy use and CO_2 emissions and 23%–25% for local pollutants (NO_x and PM) are possible. Importantly, these are performance gains that are achievable today if businesses prioritize environmental strategies.

Significant savings are also modeled under the *Green Plus* scenario. As shown in Figure 1, which presents all *Green* and *Green Plus* savings, the long-term potential exists to reduce the *Conventional* supply chain's energy use and CO_2 emissions by more than 60%. Regarding health impacts from the land-based modes of transport specifically, local pollutants NO_x and $PM_{2.5}$ could be reduced by more than 80%.

Additional highlights of the climate (i.e., energy use and CO_2 emissions) and health (i.e., local pollutants) results are below. These segments represent almost three quarters of all supply chain contributions to energy use and CO_2 under the *Conventional* scenario—Marine (53%), SDC to store (16%), and U.S. inland (13%).

CLIMATE

- **Marine:** *Green* scenario strategies generate 28% reductions, primarily from improvements in vessel technology. Via a combination of modal and equipment strategies, potential reductions in the long-term *Green Plus* scenario are up to 63%.
- **SDC to store:** 23% reductions in the *Green* scenario, where logistics and equipment strategies each contribute roughly half the savings. Decarbonization along this segment will require zero-emission trucks.

- **U.S. inland:** 22% savings in the *Green* scenario, where green logistics strategies significantly contribute. Further reductions in the medium- and long-term *Green Plus* scenarios will require more fuel-efficient trucks and locomotives.

HEALTH

- **Marine:** Fuel savings combined with international regulations can reduce $PM_{2.5}$ by more than 50% under the short-term *Green Plus* scenario, and NO_x emissions by almost 70% under the long-term *Green Plus* scenario.
- **SDC to store:** In the *Green* scenario, improvements in truck technology and hiring the cleanest SmartWay carriers contributed to reductions of approximately 75% for NO_x and more than 90% for $PM_{2.5}$.
- **U.S. inland:** 16% (NO_x) and 18% ($PM_{2.5}$) reductions are achieved in the *Green* scenario, with significant contribution from truck technology. Strategies in the *Green Plus* scenario are driven by improvements in rail technology, and adoption of U.S. Tier 4 standards for locomotives could reduce local pollutants by 65%–70%.

OPPORTUNITIES AND OUTLOOK

While this study analyzed just one supply chain, the variety of strategies that reduce emissions show that opportunities to improve are available for virtually every supply chain, regardless of business size or industry. Governments can promote the adoption of *Green* and *Green Plus* technologies in supply chain modes and equipment through regulation, market-based mechanisms, and fiscal strategies. Logistics strategies, however, are primarily driven by industry, and thus our ability to model future logistics strategies in the *Green Plus* scenario was limited.

Still, markets are increasingly considering a company's environmental, social, and governance track record. This, coupled with the complex nature of global supply chains, underscores the need for more comprehensive data. Policymakers, including those at the EPA, are working with business leaders and civil society to expand programs like SmartWay and other freight accounting and reporting in ways that streamline and facilitate standard methods and tools. As these efforts evolve, a global data exchange and collaboration platform could accelerate efficiency efforts and emissions reductions.

PUBLICATION DETAILS

Title: *Toward greener supply chains: A critical assessment of a multimodal, multinational freight supply chain of a Fortune 50 retailer*

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Download: www.theicct.org/publications/greener-supply-chains-2019

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