Decarbonizing Long Haul Freight

A study on intermodal rail as a viable option for freight decarbonization

SUPPLY CHAIN ECOLOGY

Authors: Bill Loftis & Therese Langer (March 2023)

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Overview

This presentation summarizes the findings of a study on the sustainability benefits of intermodal freight, undertaken by Supply Chain Ecology in 2022-23.

The study was supported by Environmental Defense Fund

Summary of Methodology

Design

The study evaluated North American long-haul trucking and rail. All railroads are covered in the project scope (Class 1, regional and short-line).

Desk Research

Disclosures on shipping mode was limited and varied across shippers

Expert Interviews and SGD's

12 shipper and 4 carrier SMEs have been interviewed

Data Analysis

Findings were presented to the Environmental Defense Fund panel along with recommendations

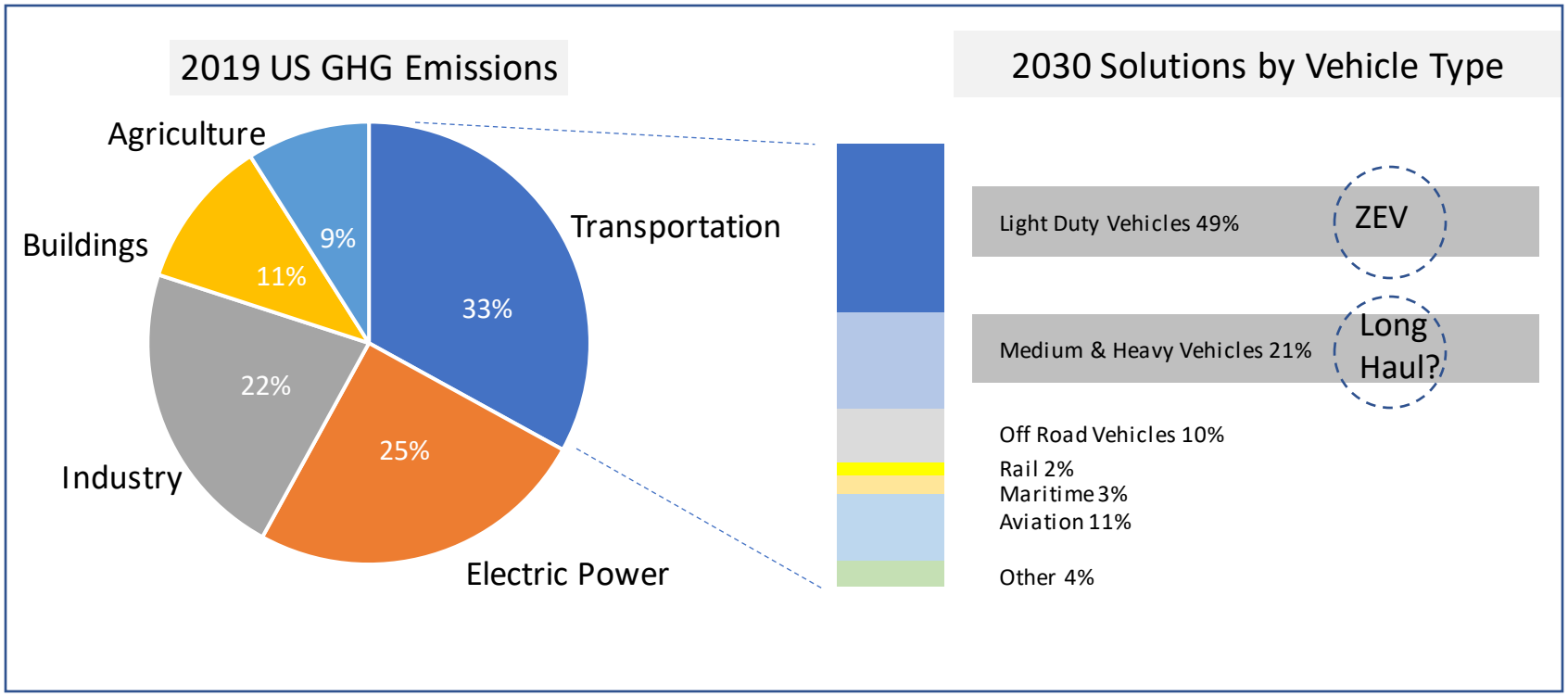
Acknowledgments

- The following experts contributed their insights to this report:
  - **Scott Bernstein,** President of ACEEE's board and Founding Director of the Center for Neighborhood Technology Chicago
  - **Larry Gross**, Gross Transportation Consulting
  - **José Holguín-Veras**, RPI, Director of VREF Center of Excellence for Sustainable Urban Freight Systems
  - **Jim Hertwig**, Consultant, Career Logistics Executive
  - **Mike Roeth**, Executive Director of North American Council for Freight Efficiency
  - **Kevin Perry**, Transportation Consultant and Board member of North Carolina League of Transportation & Logistics

Intermodal rail: Overview

The potential of intermodal (IM) as a lever for decarbonization

70% of total transportation emissions in the US originate from road vehicles, but ZEVs have a long way to go…



Transportation emissions are a large part of the decarbonization problem
Zero Emission Vehicles (ZEVs) is a strong solution to passenger/light duty & return-to-base vehicles.
In the near-term, long-haul road freight remains unresolved

Source: U.S. National Blueprint for Transportation Decarbonization.
Data derived from EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks

Technology to accelerate ZEVs at scale will not be immediate, as it requires significant amounts of capital deployment…

ZEV Long Haul Trucks Will Take Time

- "Hydrogen FCEVs become cost-competitive for long-haul (>500 miles) heavy trucks by 2035"
- "ICEVs are used substantially in heavy and long-haul applications. Across all classes and applications, ICEVs represent 20% of stock in 2050 but over half of energy consumption"

Electrification Infrastructure Will be Expensive

FCEV Electrification:

- "In transport, the refueling and distribution networks required and the cost differential for fuel cells and hydrogen tanks compared with low-carbon alternatives imply an additional required investment of **USD 30 billion*** to cover the economic gap."

BEV Electrification:

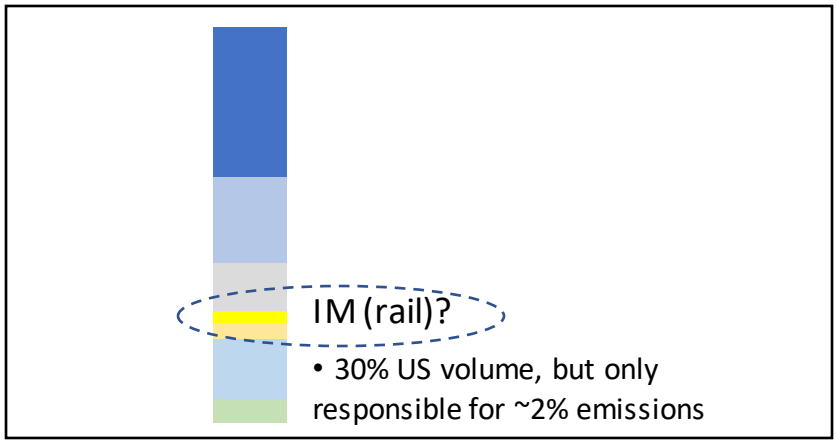
- "Based on the average charging needs…320,571 chargers would be needed for the U.S. combination truck fleet (2.9M trucks) **at a cost of at least $35.9B."**

Long haul electrification may require another decade+ to become competitive and $B's for infrastructure investment.

Sources: "Decarbonizing Medium-& Heavy-Duty On-Road Vehicles: Zero-Emission Vehicle Cost Analysis"; NREL, March 2022 | "Charging Infrastructure Challenges for the US Vehicle Fleet"; ATRI; December 2022 | "Path to Hydrogen Competitiveness. A Cost Comparison; Hydrogen Council, analysis by McKinsey & Co.; January 20, 2020

*Refers to a global investment

This presents an opportunity to highlight intermodal rail as a viable option in decarbonizing transport…



Key Considerations

- Most emissions efficient (3-6x truck)
- Most energy efficient (less friction)
- ESG and sustainability is trending
- Increased investment funds are available
- New technologies are emerging
- Featured in the U.S. decarbonization plan
- Class I rail's growth solution

Possible Constraints

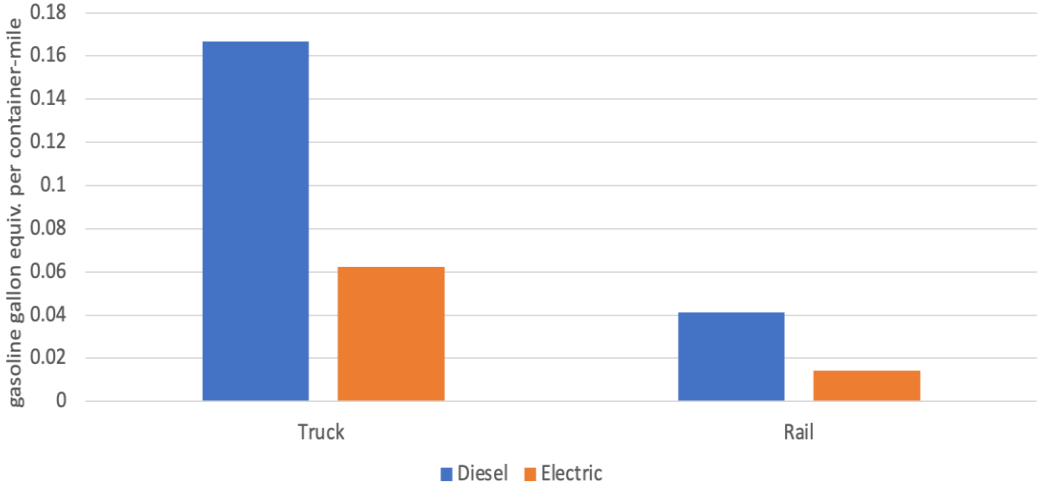
- It's been tried (max share ~8%)
- Volume is declining (~ currently ~6%)
- Constrained to long-haul dense lanes
- The network is getting smaller
- Low cost or capacity drives shipper choice: emissions are the tie-breaker
- Service is an issue
- Industry often cited as oligopolistic

Rail is a great public benefit; it is the most efficient and sustainable long-haul freight solution…

A 20% increase in IM share of long-haul freight reduces total truck fuel use today by 6% given:

- Long-haul accounts for 40% of truck fuel use
- IM efficiency of 4.1*x truck efficiency (roughly 75% emissions reduction using IM vs TL)

Efficiency advantage remains with vehicle electrification



Additional benefits that persist through the energy transition

Additional societal benefits:

- Safer
- Less highway congestion
- Less highway destruction and maintenance expense
- Rids the TL sector of chronic labor shortage
- Improved quality of life

Additional industry benefits:

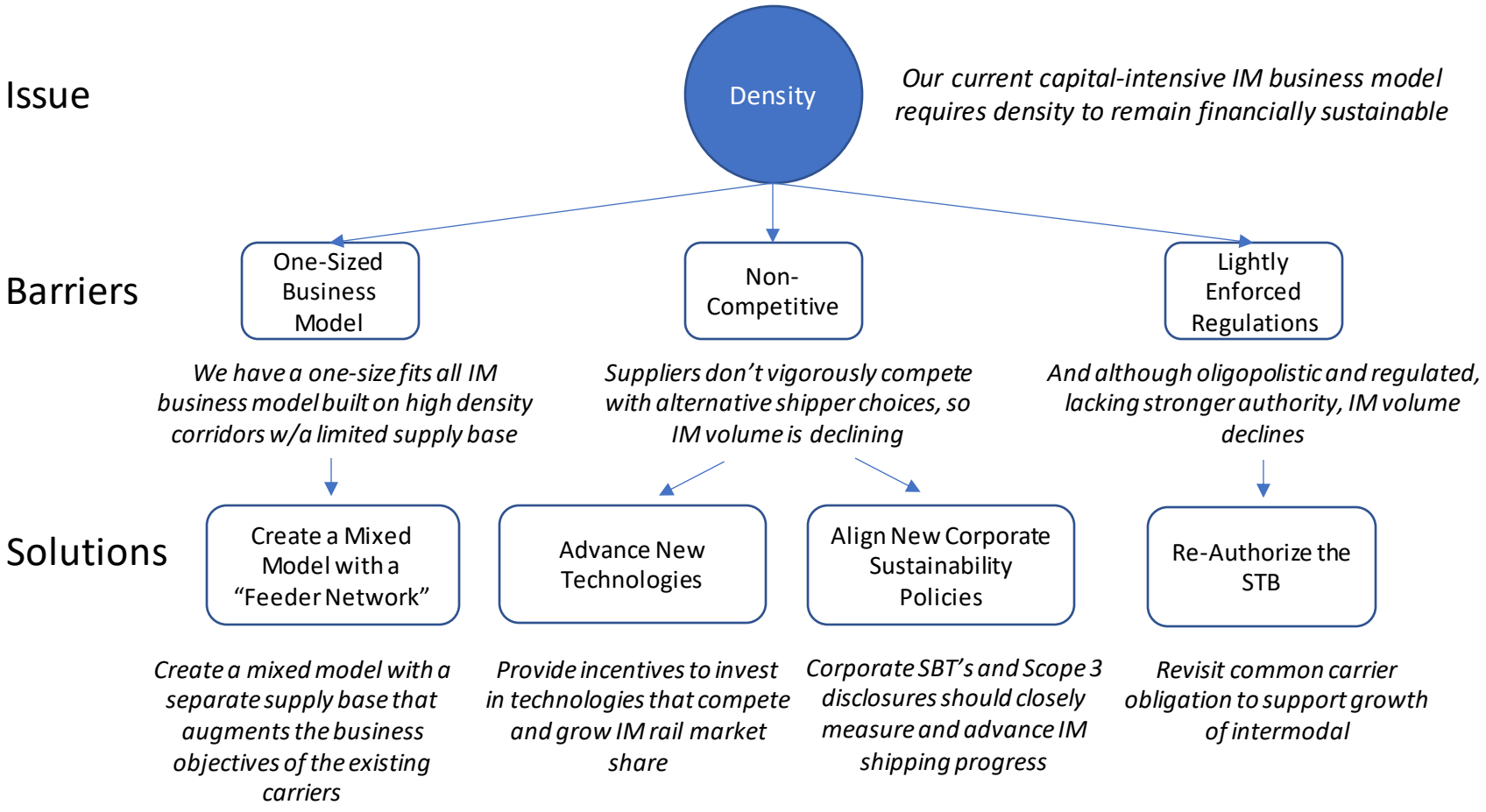
- More freight capacity for future demand
- More freight capacity for promotional surges
- More stable pricing
- Less dependence on volatile fossil fuel costs

Rail freight is a public benefit too great to ignore.

Source: ICF 2009 study

But unlocking its benefits require a complex set of solutions…

A multi-faceted approach can overcome IM's root cause issue and barriers.



A flux of financial constraints impedes intermodal from becoming cost-competitive on many routes…

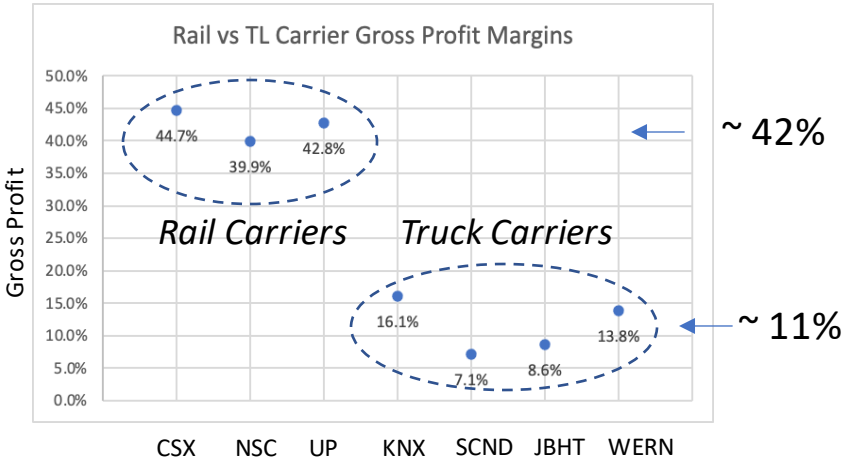
Demand Side (Cost)

Cost is a shipper's primary driver of mode choice (provided acceptable service).

- "Cost is critical. 95% of surveys report that cost savings is the primary reason for intermodal choice". *This study's shipper survey results.*
- "Sustainability is the tie breaker. If cost is less and service is acceptable, then sustainability can move the decision." *Larry Gross, IM Consultant*
- "Dollars are the decider. Mode/carrier choice models do not dollarize on ESG criteria". *Oliver Wyman study, 2021*

Supply Side (Profit & Price)

- Gross profit level expectations of Class I rail is much higher than TL. The net effect is that CI carriers do not reduce prices to compete with TL on many lanes.



- Note that FRA reports ~ 19% of rail revenue is committed to adding and maintaining system infrastructure

Key Findings

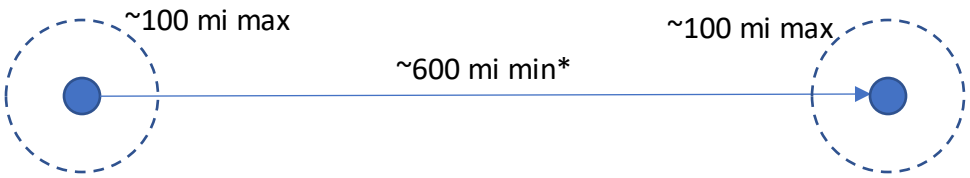
- Sustainability is still in a state of "nice-to-haves" in shipping considerations.
- Class I rail does not compete in many TL markets.

Sources:

- 2021 annual reports from largest public carriers; Gross profit expressed as inverse of company-reported "Operating Ratio". Companies include CSX, Norfolk Southern and UP rail carriers; and Knight-Swift, Schneider National, JBHunt and Werner truckload carriers
- *"The Growth Imperative: Rail Pursuit of Freight Share";* Adriene Bailey, Partner, Oliver Wyman; Oct 24, 2021

Changing design requirements is also a key point to drive significant changes…

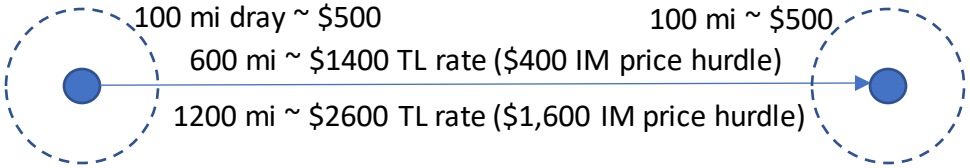
Long distance routes are necessary to absorb expensive dray costs



Current model issues:*

- *Cost of longer dray minimizes "reach"*
- *Significant density must exist within 100 miles of a hub*
- ***Constraint = density***

Long trains are necessary to meet profit objectives, requiring shipment density.
Longer dray moves increase density but ultimately become cost-prohibitive.



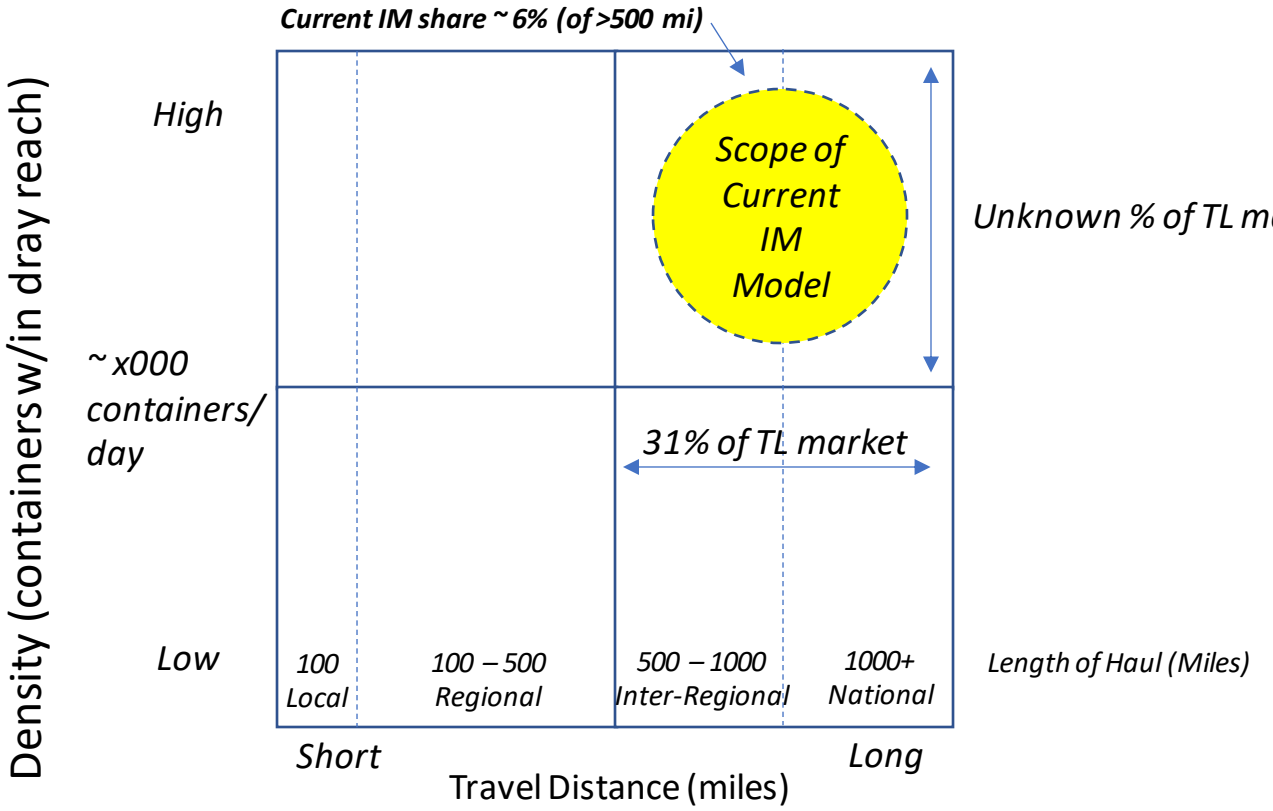
- *Dray costs absorb most of the market price on hauls < 500 miles*
- ***Constraint = distance***

These cost challenges are manifested in significant network constraints

*Footnotes:

- Current CI carrier model runs two to four-mile-long trains to meet profit goals
- Experts assume dray length < 33% of total door-to-door miles.
- 100 miles is a practical dray limit (two driver-trips/day); Longer occurs but is rare; < 25 miles = ideal.

Density and distance are the main constraints to market expansion



% of TL Moves	32%	37%	19%	12%
% of IM Moves		8%	36%	56%

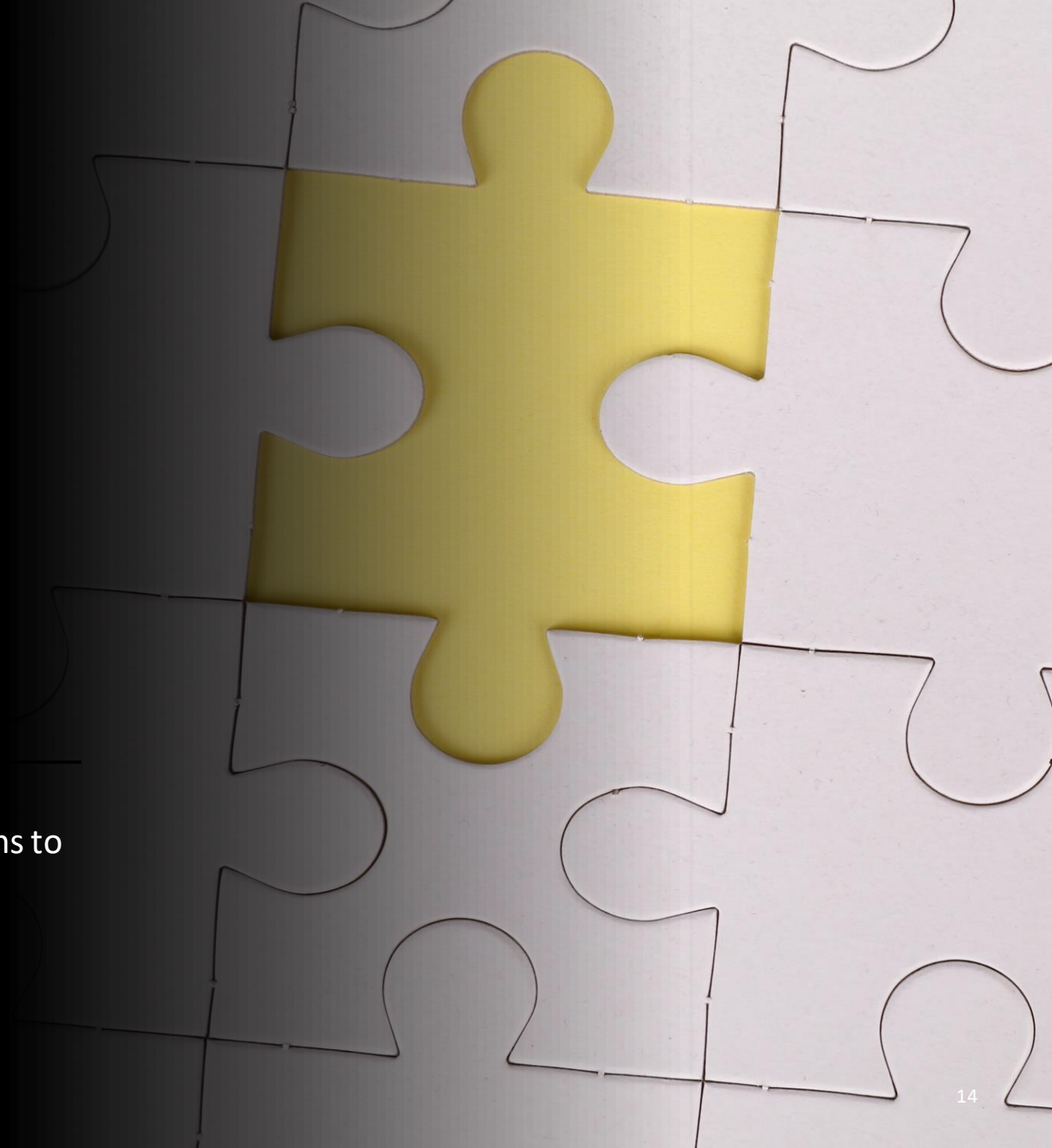
Today's IM market is limited to a relatively small part of the freight market. These constraints, unless changed, limit expansion.

Sources:

- ATRI Operational Cost of Trucking 2021
- Gross Transportation Consulting

Solutions

Defining the vision and paths to overcome the barriers



Our Vision: Broaden the market scope of IM viability, while increasing CI profits and becoming the shipper's mode of choice…

- **Intermodal expands into lower density lanes.** In the next two years, the network expands by building small low-cost IM hubs that support lower density IM corridors, operated by SL RRs, with later integration into the larger C1 network via track haulage agreements. Lower-density corridors become profitable.
- **Autonomous electric bogies are introduced.** This new technology reduces cost and increases capacity, providing additional low-density routes and increased network expansion.
- **EV dray becomes the industry standard**. Intermodal becomes more cost competitive and dray distances are slightly extended as EV expands. Emissions impact is greatly enhanced and air quality around high-volume rail-heads improve.
- **Intermodal visibility reaches parity with TL**. Intermodal remains slower than truck, and on-time performance remains less, but both are acceptable to shippers of all but the most service-sensitive shipments.
- **The mode decision becomes clear and easy, increasing traffic on existing lanes**. With better visibility and service, the IM trade-off is clear and starts to become a default choice (rather currently a cost or capacity choice). IM conversion means:
  - Transport cost reduced ~10%*
  - Highway emissions reduced ~75%
  - Inventory increased ~ 4% (2+ days)*
- **Policy changes increase IM incentive**. Scope 3 emissions disclosure and SBT targets combine to influence additional IM mode decisions.

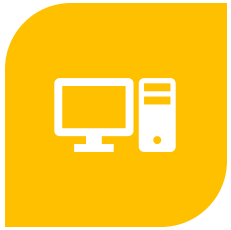
*Inventory: 4% of a business turning inventory 8 times/yr; Cost: IM is typically acceptable at 10-15% less cost than TL; IM is ~ 4x more fuel efficient than TL

Our operating framework: 4 Pillars of IM scaling success…

Focus areas of deployment

LEVERAGE PUBLIC FUNDING

AN INNOVATIVE BUSINESS MODEL



DEPLOY NEW TECHNOLOGY

CORPORATE & REGULATORY REFORM

Broaden the Reach

- ***Build low-cost hubs***
- *Short-Line Rail: a nimble player for low volume lanes*
- *Short-Lines provide increased density for Class I's*

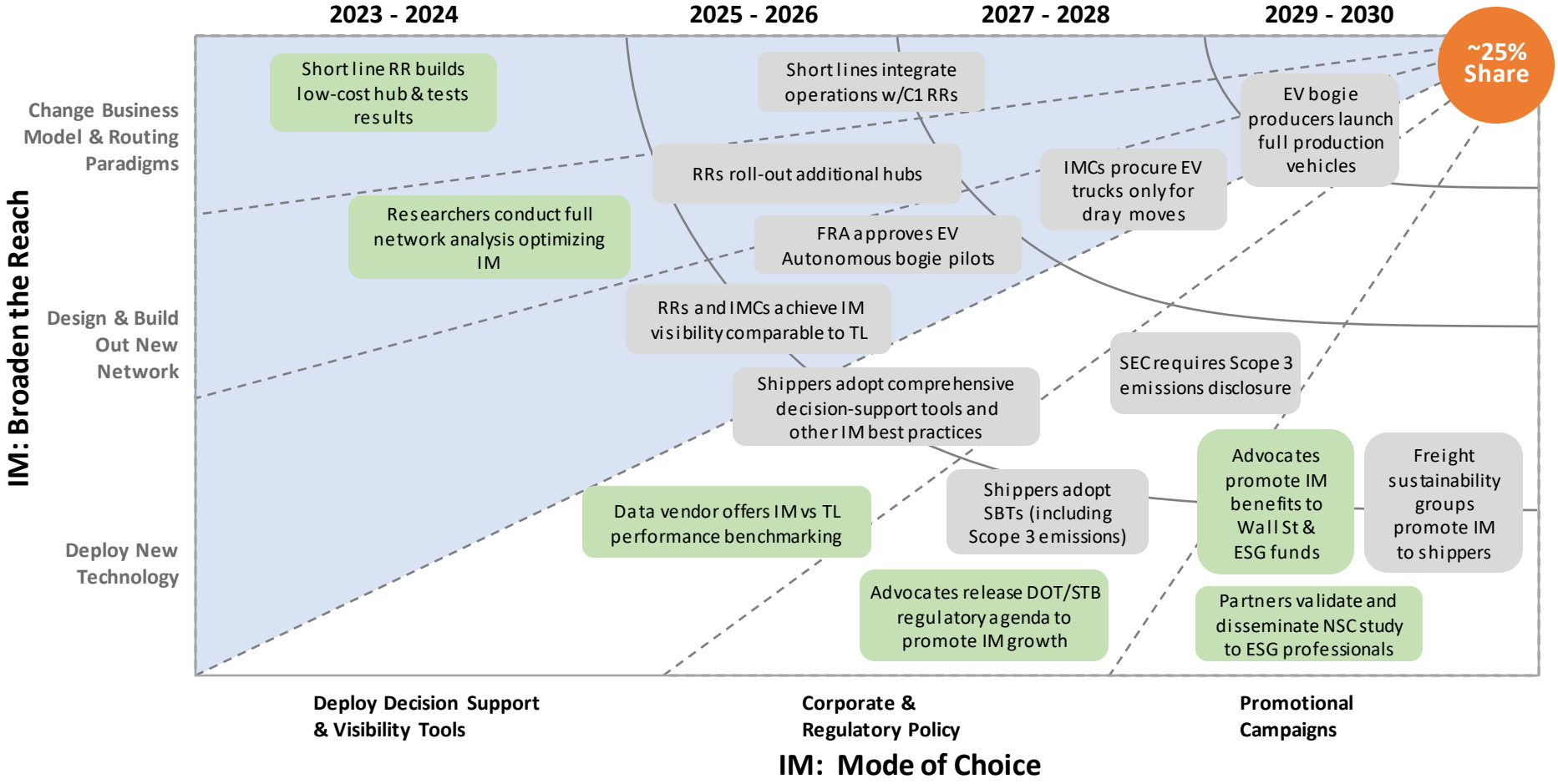
Mode of choice

- Shipper visibility & agility
- ***Autonomous electric bogies***
- EV dray
- ***New regulatory agenda***
- Scope 3 emissions disclosure req'd
- Shipper SBTs

Legend
New
Rare & Revisited
In Process

We propose a refined model built with new pieces.

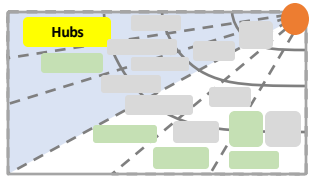
Our Recommendation: A phased approach to solutions deployment for intermodal rail expansion...



The goal is to significantly grow IM market share

Note: Green fill indicates direct involvement of project team

Recommendation 1: Build small low-cost IM Hubs to expand the network



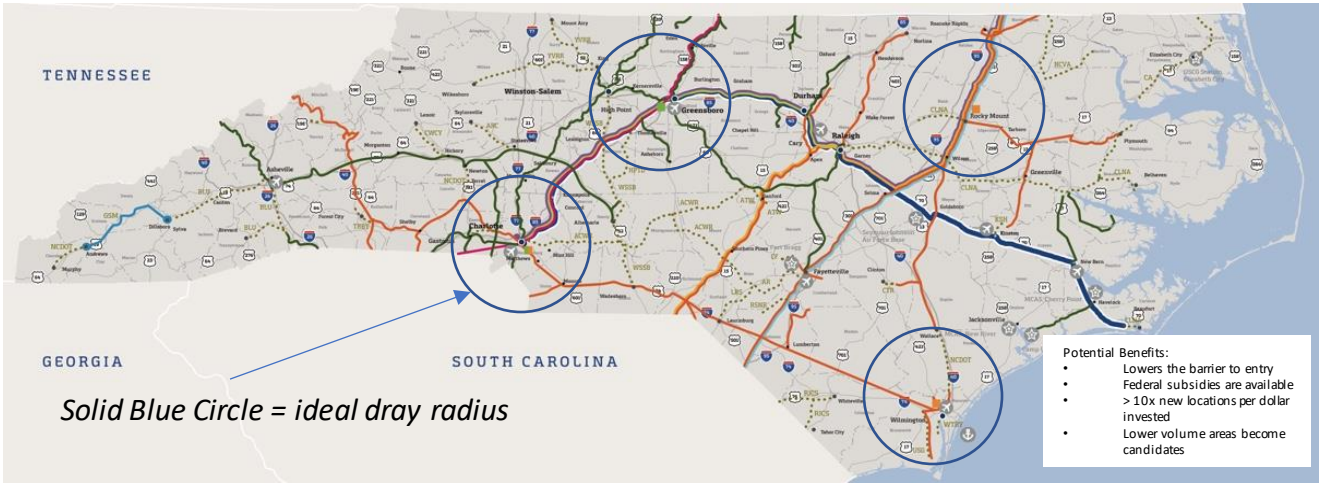
Recommended Low-Cost IM Hub

- 25 – 50 acres
- $5M - $10M investment
- 15,000 – 50,000 lifts per year

Vs.

Contrasts with Hi-Volume Model

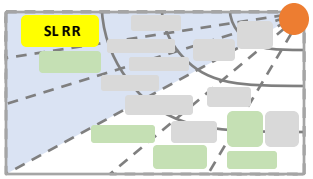
- 2,000+ acres
- $100M - $150M investment
- 1M+ lifts per year
- Limited to densest locations only



Example: NC, a midsized industrial and population center, contains 5 hubs in 4 hub locations. Despite abundant rail tracks, most of the state is outside "ideal" dray reach

The U.S. network needs more hubs. $1B can add 133 hubs.

Recommendation 2: Build more routes by introducing Short Line (SL) rail



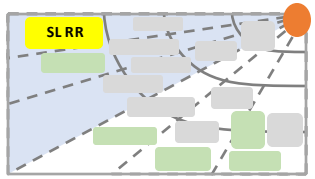
- Short Line RR 101:
  - Small or mid-sized RR's, shorter tracks, yet aggregated ~40% of the US network
  - "The primary function of short-line or regional railroads is to provide connecting service to customers or communities not located on the Class 1 networks"*
  - Known as "the first and last mile" network

- Why Short Line RRs?:
  - Lower operating cost structures; IM cost competitive with TL between 150 and 200-miles
  - Federal funds are available to subsize IM investments
  - Pre-existing interline relationships with Class I's
  - No required major CI routing changes
  - Their mission of connecting locations with the Class I network is what IM needs

IM is currently < 1% of total SL volume, a missing piece of short line operations

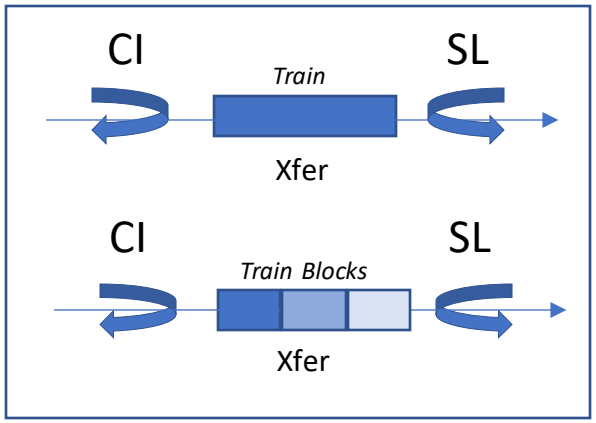
*Statement and diagram from Genessee & Wyoming 2018 Annual Report

Recommendation 3: Integrate Short Lines Into Class 1 Network

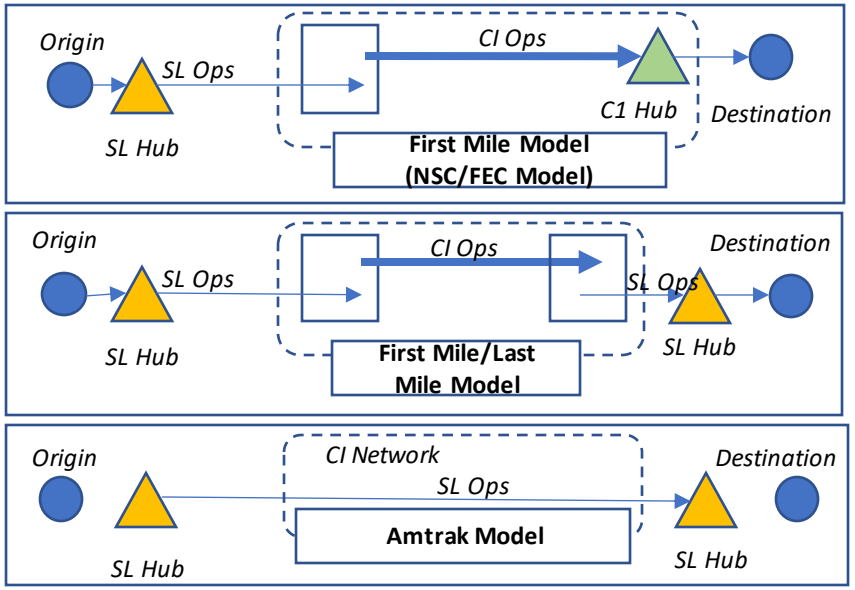


- Recommend Short Line/Class I Intermodal partnerships utilizing "haulage agreements"
- Why?
  - Precedents exist, but rare for IM
  - Accretive revenue enhancements for both carriers
  - Short lines absorb more costly operations, increasing cost competitiveness vs TL and decreasing CI's IM operating cost burdens
  - Short lines add density to fill out CI route combos.

Interchange full trains or train blocks

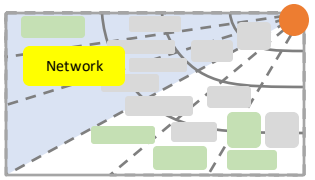


Configurations w/various SL roles



The goal aligns carrier roles with their respective strengths. Everybody wins.

Recommendation 4: Conduct a Network Optimization Analysis Using New Demand and Cost Criteria



- Network optimization analysis is a common strategic initiative undertaken by shippers to determine the optimal facility network nodes, flow-paths and modes as business conditions evolve.
- The recommended solutions presented here contain much different volume and cost conditions, potentially right-sizing the entire intermodal network:
  - The introduction of lower density routes
  - Lower cost short line railroads; either stand-alone routing or integrated with CI's
  - Automated electric bogies
- The objective: determine where additional hubs should be located, cost and lead time variance between TL and IM, potential mode shift and volume per hub.

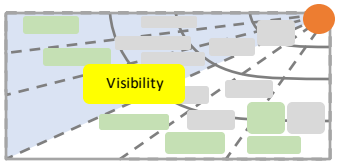
To our knowledge, entire IM network optimization has not been done in the current era.*

- Recommendation:
  - Obtain entire network TL and IM volume, cost and lead time data for the entire network*
  - Identify academic or consulting partner capable of modeling the baseline and alternative scenarios (selected what-if scenarios using different cost and mode-shift assumptions)
  - Outcome is a prioritized ranking of future hub locations, resident carrier or municipality ownership, and estimated mode shift.
- Benefit is targeting locations for future hubs, to:
  - Initiate new IM investments
  - Establish geographical targets for motivating shippers and receivers.

Recommendations suggest a completely new network with optimal location options.

*An internet search found none. FRA commissioned "The National Intermodal Network Feasibility Study" in 1975. (From L. Gross). https://trid.trb.org/view/62569

Recommendation 5: Leverage freight technology modernization and digitization



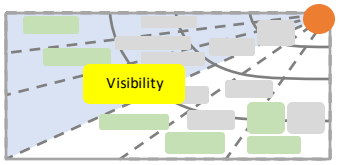
- Airlines report aircraft location, ETA; trucks use electronic logging devices. For-hire fleets increasingly participate in automated digital services to optimize load assignment.
- While domestic containers now have tracking devices, IMCs may not know when trains will arrive and whether chassis are available.

Digitalization allows better supply chain visibility, predictive analytics, dynamic decision-making (including mode choice), and performance evaluation.

But rail appears to be behind in this area, creating a competitive disadvantage for IM.

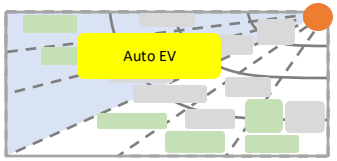
- "Rail is the last frontier for API data. Even where available, it's too expensive for SMEs." --Cargologik
- "We are actively using four of the big [digital freight] platforms, but they currently focus primarily on dry van truckload so it's not impacting our mode or carrier selection to a great extent." --Retail shipper

Recommendation 5 (cont.)



- Data sharing could increase rail share in several ways, including by making preference for rail possible by providing reliable truck back-up coverage. Requires dynamic decision making by shippers and logistics providers.
- Need data sharing not only for visibility and more generally to compete, but also specifically to facilitate growth of IM. Transportation Decarbonization Blueprint notes that "new technologies can help improve multimodal freight transport and logistics and enable the use of shared transport assets and services, and more effectively respond to changes or unexpected delays using real-time data."
- Up-to-date, lane-specific data on transit time, on-time performance, and cost would give shippers the ability to make lane-by-lane mode choices rather than defaulting to truck.
- More generally, RRs must achieve parity with other modes on visibility, but also must join their data ecosystems.

Recommendation 6: Approve and Deploy Autonomous Electric bogies

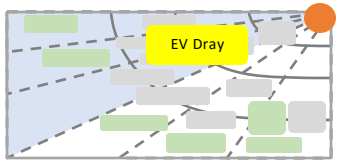


- New technology is being developed for taking freight rail into new markets
  - Utilizes autonomous electric bogies to haul small trains, or "platoons" of railcars
  - Communications systems to provide enhanced visibility
  - Built for low-cost micro terminals and direct linkage into high volume facilities

- Features:
  - Low volume electrification to the rail industry
  - Cost target is approximately one-half a truckload cost (truck ~ $2M per lifecycle; bogie ~ $1M per lifecycle)*
  - Built to solve intermodal's "density conundrum"
  - 500-mile range
  - Reduced stopping distances and road crossing times
  - More efficient smaller "blocks" to fill available infrastructure capacity
- Vehicles are currently in Phase 2 testing with SL RR; plan is another multi-phased, 18 months testing period prior to FRA approval

*Cost: Matt Soule, Parallel Systems
Photo: Parallel Systems website

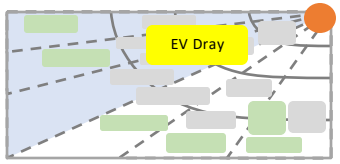
Recommendation 7: Accelerate dray truck electrification



Accelerating dray truck electrification can promote IM growth.

Assumptions		
Diesel regional tractor fuel efficiency	7.00	miles per gallon
Diesel fuel cost	$4.29	per gallon
	$0.61	per mile
Electric tractor	2.1	kWh per mile
Electricity cost	$0.12	per kWh
	$0.24	per mile
Total cost of IM move	$700	
Conclusion		
Fuel savings from two 50-mile drays (RT fuel)	$74.19	
Fuel savings as % total cost of IM move	**10.6%**	

- Also provides pollution reduction in terminal communities.
- But limited range (up to 250 miles) could constrain # dray trips per day for some drivers.



Recommendation 7 (cont.)

- The ICCT finds short haul BEV tractors approaching purchase cost parity in 2030:

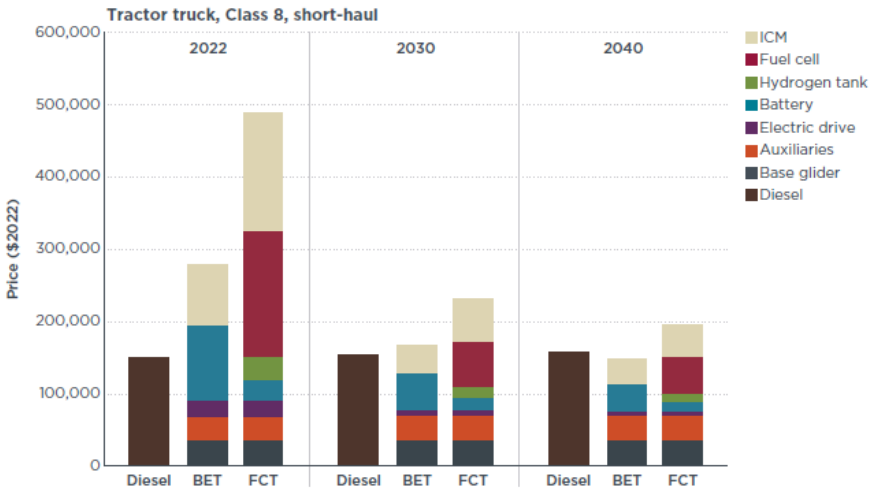
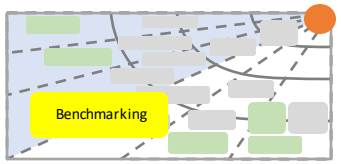


Figure 15. Estimated retail price of a short-haul tractor truck, Class 8, in 2022, 2030 and 2040, broken down by separate component areas

- ERM analysis for EDF found that, with IRA incentives, electric Class 8 day cab tractors would reach purchase cost parity with diesels in 2027
- CA's Advanced Clean Fleets rule to require all-electric dray trucks purchases starting in 2024, with the entire dray fleet to be electric by 2035.

Recommendation 8: Institutionalize Sophisticated Freight Market Intelligence Data (Performance Benchmarking)



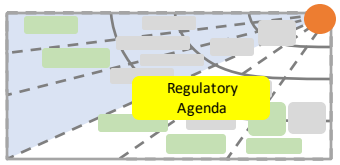
- External TL benchmarking is common and considered a best practice
  - Consists of multi-company performance data, used for strategic sourcing purposes
  - Results show how a company's TL spend "ranks" vs market, in total and by lane
  - Investing in procurement benchmarking is usually self-funding or better
- However; IM vs TL benchmarking, does not exist
- Interviews indicate that shippers lack comprehensive, valid IM vs TL performance benchmarking data; it is extremely challenging to make informed mode choices
  - Shippers are confined to their own data, and typically limited to rate comparisons
  - OT reliability is typically used by only the most sophisticated shippers; perceptions rule
  - Existing reliability data is internal only; un-served lane performance data is invisible
- An emissions-focused procurement strategy suggests that efficiency improvements require sophisticated freight market intelligence data
- Objective: lane-level (3DZ to 3DZ) performance measurements showing IM vs TL:
  - All-in costs (rate + fuel)
  - OT reliability percentage
  - Lead times
  - Emissions

  Note: this is more complex than TL benchmarking; results require combining Order and Transportation files
- We envision a collaboration of participating shippers may create an advocacy group to proactively engage with rail carriers regarding various service and performance issues

Recommendation 9: Advocate and Promote IM Shipper Best Practices

- Conduct regular procurement events and include all lanes as either TL or IM (no pre-designating mode choice).
- Develop comprehensive cost tools for mode choice, including rate, fuel cost and inventory cost (including reliability and lead time) as decision criteria. Include Finance as a decision partner, reflecting all true costs and strategic impacts.
- Develop an "agile" mode choice process with enabling technology, regularly monitoring TL lane choices as service conditions, fuel costs, and trucking capacity regularly varies. Do not "set and forget" mode choice.
- Proactively engage with IMCs and rail carriers. Share lane volume data, peak season needs, service issues.
- Consider transloading domestic inbound to minimize number of shipments and reduce mileage.
- Join EPA Smartway to recognize emissions reductions, establish baselines, and show year/year progress for efficiency initiatives (such as intermodal conversions).
- Ensure reasonable unloading times to maximize intermodal system capacity and minimize detention charges.

Recommendation 10: Integrate carbon commitments to reduce carbon emissions in procurement process



Policy push builds necessity to integrate…

Carbon tax adopted

Shippers adopt science-based targets (SBTs) for carbon emissions from operations and supply chains

Federal agencies require companies to report their GHG emissions, including outsourced ("Scope 3") transportation emissions

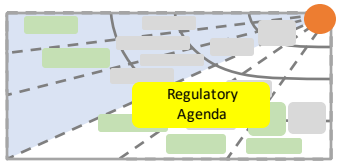
Sustainability team works with transportation team to develop protocols for including low-emitting modes in procurement and factoring benefits into mode selection, including contribution to meeting SBTs

IMCs promote new services, relationships w RRs to shippers

Transportation procurement team designates rail as preferred mode whenever available

Tools from freight sustainability groups help quantify emissions reductions associated with IM usage, facilitating contribution to achieving shipper's SBTs

Recommendation 11: Federal policy advances IM expansion through increased funding and legislation



- The U.S. National Blueprint for Transportation Decarbonization (January 2023) advocates "shifting parts of shipment journeys away from trucks to rail and water shipping when feasible" and calls for investment and policies to facilitate shift to efficient modes.

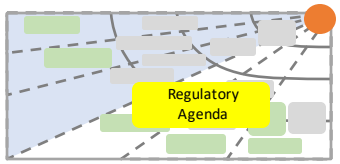
- Due to the essential nature of the services they provide to the U.S. economy, railroads are regulated entities. Hence it is reasonable to seek societal benefits such as emissions reductions from their operations, including through expanded mode share.

- This outcome is consistent with U.S. rail transportation policy (49 U.S. Code § 10101), including:

> …(4) to ensure the development and continuation of a sound rail transportation system with effective competition among rail carriers and with other modes[*], to meet the needs of the public and the national defense; (5) to foster sound economic conditions in transportation and to ensure effective competition and coordination between rail carriers and other modes; …[and] (14) to encourage and promote energy conservation

* However 49 U.S. Code § 10502(f) says: "The Board may exercise its authority under this section to exempt transportation that is provided by a rail carrier as part of a continuous intermodal movement."

Recommendation 12: Dedicate federal funding to a multi-year program of IM expansion



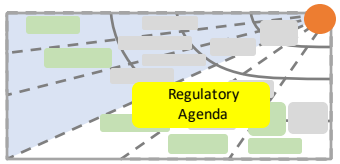
In recent transportation funding laws, Congress has increasingly acknowledged the need for federal investment to improve the multimodal freight transportation system. IM projects are now eligible for freight-specific formula funds and many discretionary programs as well. (See appendix for examples.)

In implementing these funding programs, DOT should:

- Encourage States and MPOs to develop IM expansion programs as part of state freight planning
- Promote short line and regional RRs' development of IM services and infrastructure, e.g. low-cost hubs
- Cultivate and support freight sector transportation demand management projects

Given IM's ability to reduce emissions and highway expansion, revenue from policies such as a carbon tax or weight-distance fees could also be directed to IM expansion in the future.

Recommendation 13: Regulatory agenda should support IM growth as part of STB reauthorization

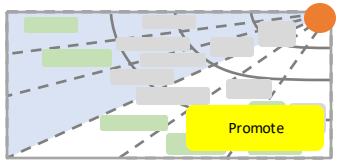


Congress and the STB have generally minimized requirements on RRs, though ongoing discussions of STB reauthorization are highlighting the opportunity to revisit major issues potentially affecting IM rail. Provisions that could be considered include, e.g.:

STB action	Possible result for IM
Revise the interpretation of common carrier obligation to better align with U.S. rail policy under current conditions	Remove IM from the list of exempt goods*, extending STB oversight to IM service and rates
In mandating service requirements for rail contracts, set minimum standards of service, including for on-time performance	Facilitate IM integration into carload freight trains on routes where density does not support dedicated Class I IM service
Continue to require Class I RR reporting of performance data, with more meaningful definitions of on-time arrival; add performance at terminals	Tighten window for on-time IM arrival from 24 hours to 4 hours; minimize friction at IM terminals

**IM is currently exempted from STB oversight. The rationale for this rule is that shippers are not "captive" to IM, because unlike rail-only transport, truck transportation is always available for shipper use. This recommendation is the opinion of the authors. It should be noted the Project Advisors were divided on this recommendation. Two schools of thought emerged: those opposed to removing the exemption argue for less regulation and free market behavior; those in favor argue that rail's "common carrier obligations" should extend to IM to allow shippers access to the emissions and societal benefits of IM when it can be provided at reasonable service and rates.*

Recommendation 14: Promote Intermodal Growth Solution Proposal To Key Stakeholder Groups

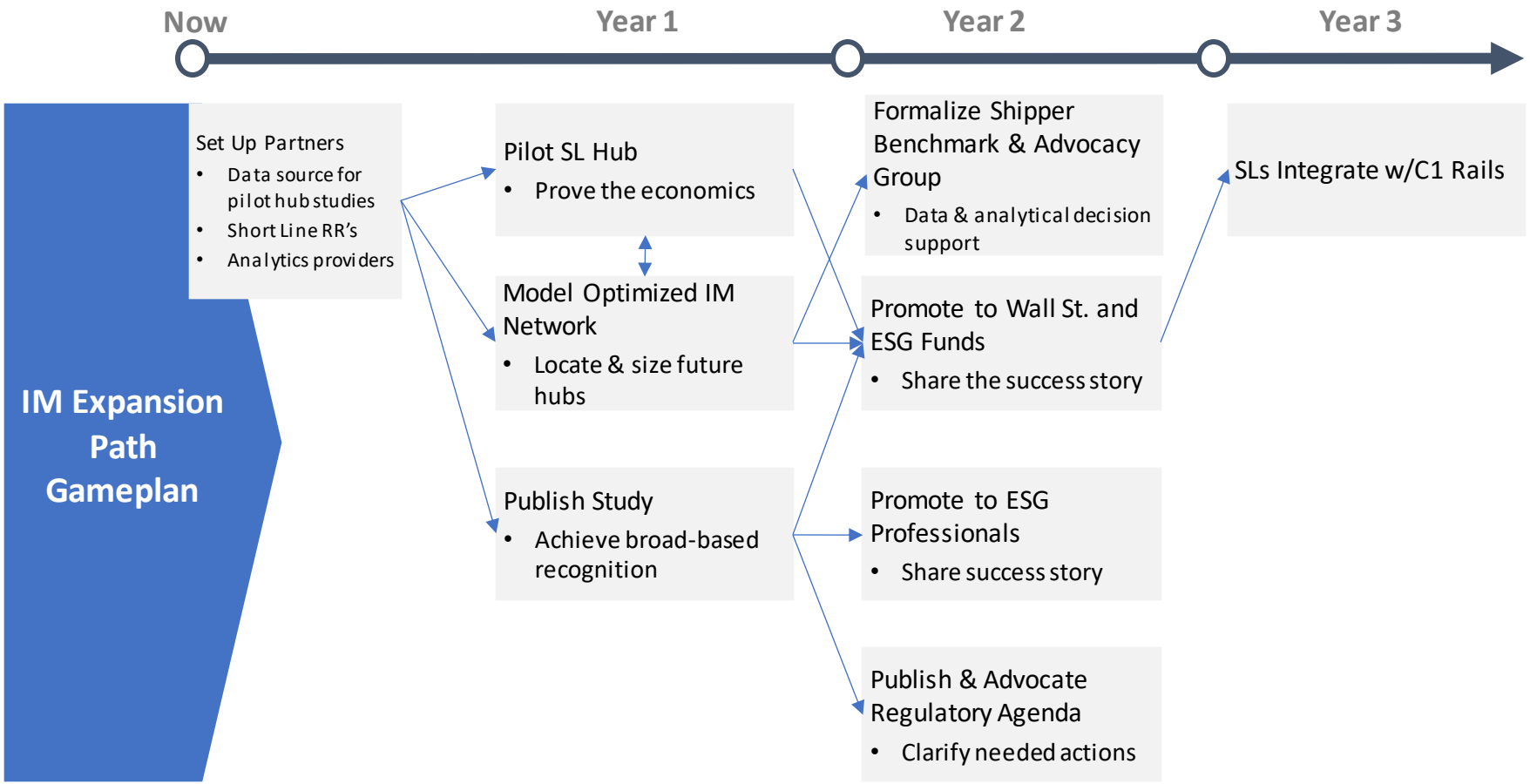


- Intermodal conversion is dated and often perceived as overly difficult, service challenged, or bound by other constraints.
- We recommend a proactive advocacy given the new technology, business model and refined conditions that have been surfaced.
  - Multiple position papers geared to different audiences
  - Speaking at industry events
- Validating the NSC study and disseminating to ESG professionals would be an ideal “start”
  - It is current, sourced from new rail technology, and based on the industry’s most well-known study
  - It would behoove finding a partner to submit similarly-detailed dray data (but not mandatory).
  - An academic analysis would also add credibility and expand the network.
- Key stakeholder groups would include:
  - Sustainability professionals. Important to build a ”supply chain bridge” into this group.
  - Wall Street and/or activist investors. Recommendations are a positive impact to CI revenue growth, profitability (we think) and ESG.
  - Industry logistics and supply chain groups. The recommended business model innovation and intermodal’s shift to lower density lanes causes a strategic shift for many industries.

Blueprint for Action

Integrated Steps to influence domestic IM growth and key outcomes

Steps to influence key stakeholders in driving mass adoption and growth



We propose a two-year program approach to achieve critical mass

*Current suggestions, other partners may emerge

Expected outcome 1: IM Will Fill a Key Role in Sustainable Supply Chain Designs

TL =
The **quick & precise** delivery solution

Suited for:
- Quick turn customer-order shipments
- 30-minute delivery appointment requirements

Expectations:
- 93% on-time performance w/in the hour

IM =
The **sustainably-paced** delivery solution

Suited for:
- Regular replenishments to stocking facilities
- Low margin businesses where cost matters
- 2-day delivery appointment requirements
- Sustainably focused companies and brands

Expectations:
- Less emissions generated
- 5-10% transportation cost reduction
- 90% on-time performance w/in the day
- Additional 2-4 days of safety stock

Supply chains need alternative solutions for different requirements

Expected outcome 2: Rapid Growth in Market Share

Strategy	2023	2025	2030	2035
Freight Market Benchmarking	1.00	1.07	1.25	1.30
Visibility	1.00	1.04	1.10	1.10
Short Line Low-Cost Hubs		1.00	1.03	1.25
Shippers Adopt Emissions Req'ts	1.00	1.02	1.13	1.31
Autonomous EV Bogey		1.01	1.09	1.21
EV Dray		1.00	1.05	1.11
IM-Favorable STB Policy		1.00	1.20	1.20
Combined Impact	**1.00**	**1.15**	**2.21**	**3.74**
IM Share of Long Haul	**6.0%**	**6.9%**	**13.3%**	**22.4%**

Assumptions:

- Benchmarking: 50% of shippers use benchmarking by 2030, and 50% of that volume is converted. Linear ramp-up to 2030; 1% growth thereafter
- Visibility: IM share increases 10% per year through 2030
- SL Low-Cost Hubs: First hub 2026, new hubs double each year thereafter; 25,000 lifts/yr per hub, equates to 0.15% market share per hub based on 2021 CI IM revenue
- Shipper Emissions Measurements: 1% per year early, rising to 2% later, to 3% by 2030 and thereafter
- Autonomous EV bogie: Start 2025, 1% per year first 3 years, 2% each year thereafter
- EV Dray: 10% fleet electrification by 2026, fuel savings of $0.37 drops dray cost by 10.6%, growing share 10% per year
- IM favorable STB policy: IM share increase of 20% by 2030

IM long haul market share of 20% - 25% seems reasonable (3-4x).

Summary

A recap of the discussion

A Multi-Faceted Approach to grow intermodal rail

This study utilizes a relatively rare pre-existing model to capture new IM opportunities and key insights have been summarized below:

- **Insight 1**: Newly examined short line rail economics compete well with TL
  - It just hasn't been tried before
  - IM has always been conceptually confined to long haul CI routes
- **Insight 2**: System-wide IM network optimization has never been tried
  - It will pin-point opportunities available with the new economics
- **Insight 3**: Shippers gain exposure to better tools to make better choices, enhance visibility and provide better service
- **Insight 4**: CI encouragement includes:
  - CI rails are trying to pivot to growth, but have lacked a strong profitable solution
    - This model enables CIs to monetize their tracks, a prize asset
  - Wall Street addresses three-fronts: increased revenue, profits and ESG
  - STB re-authorization
- **Insight 5:** Recent federal policy* is calling for new transportation decarbonization solutions
  - Policy emphasizes mode shift enabled by innovative business models
  - This proposal is a conceptual answer to the "how".

*"The U.S. National Blueprint for Transportation Decarbonization"; Jan 10, 2023; Biden-Harris Administration


Appendix

Survey Results

Do you currently use Intermodal Transportation in North America? Please select one answer

Yes:	33	83%
No:	7	17%

What is your annual company revenue? Please select one answer.

Under $2 Billion:	14
Over $2 Billion:	26

Which shipment mode best describes your company? Please select one answer.

Primarily TL:	19
Primarily LTL:	2
Primarily Parcel:	1
Primarily Intermodal:	0
Mixed:	18

How are your current Truckload and Intermodal RFQ's conducted? Please select one answer.

Separate TL and Intermodal RFQ's:	15
Combined TL and Intermodal RFQ's:	21
We do not conduct formalized RFQ's:	4

Which company function makes the final decision on determining intermodal lanes? Please select one answer.

Transportation:	32	
Sales:	0	
Customer Service:	0	
Logistics Provider:	2	
Other:	6	(Primarily Procurement)

Do you have access to data to compare intermodal on-time service to that of on-time truckload performance?

Yes:	21
No:	19

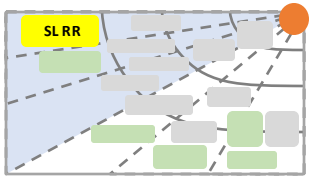
What factors go into converting Truckload lanes to Intermodal Lanes? Please select all that apply.

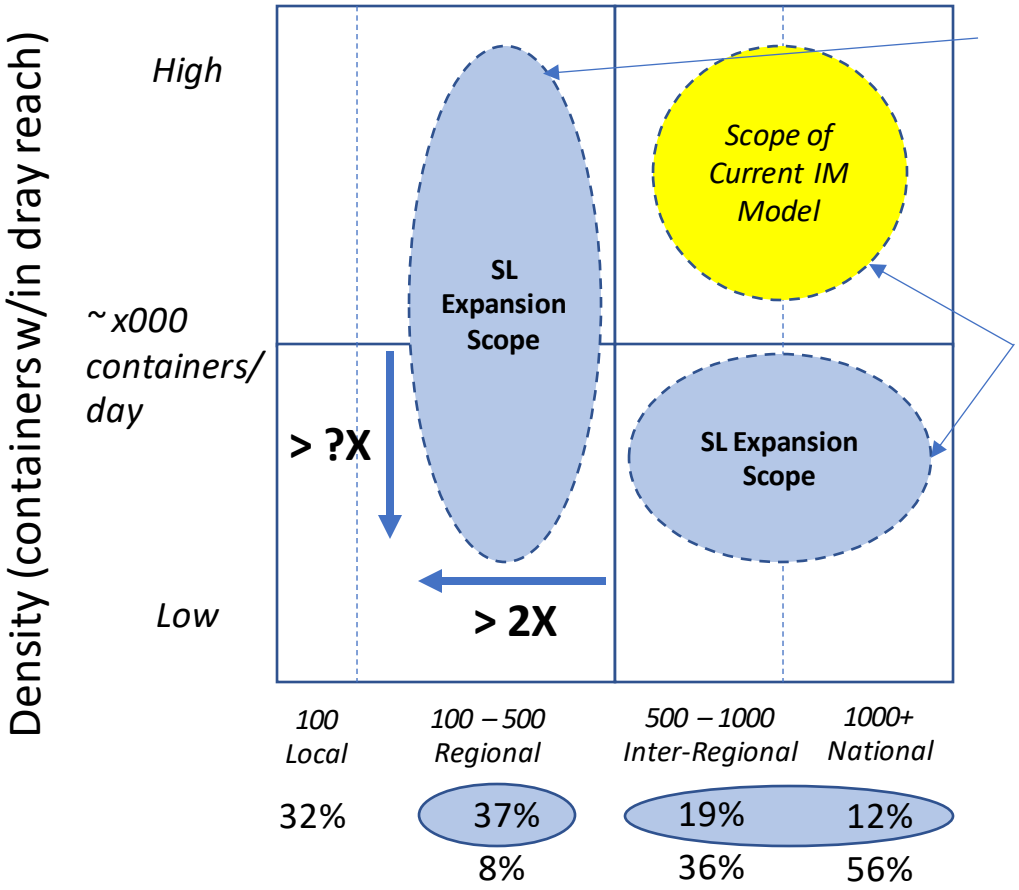
Cost Savings:	38	
Emission Savings:	12	
Shortage of TL Capacity:	21	
Company Sustainability Goals:	14	
Other:	11	(primarily transit or service levels)

What are your company's largest barriers to converting more lanes to Intermodal? Please select all that apply.

Intermodal On-Time Performance:	19
Intermodal Shipment Status Visibility:	5
Intermodal Cost:	9
Overall transit time differential vs. Truckload:	33
Other:	13

Short Line Integration Expands IM Scope





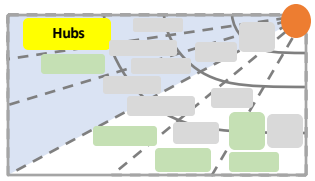
Add intra-network short-line loads

Note that additional expansion can also exist by increasing share of existing CI routes

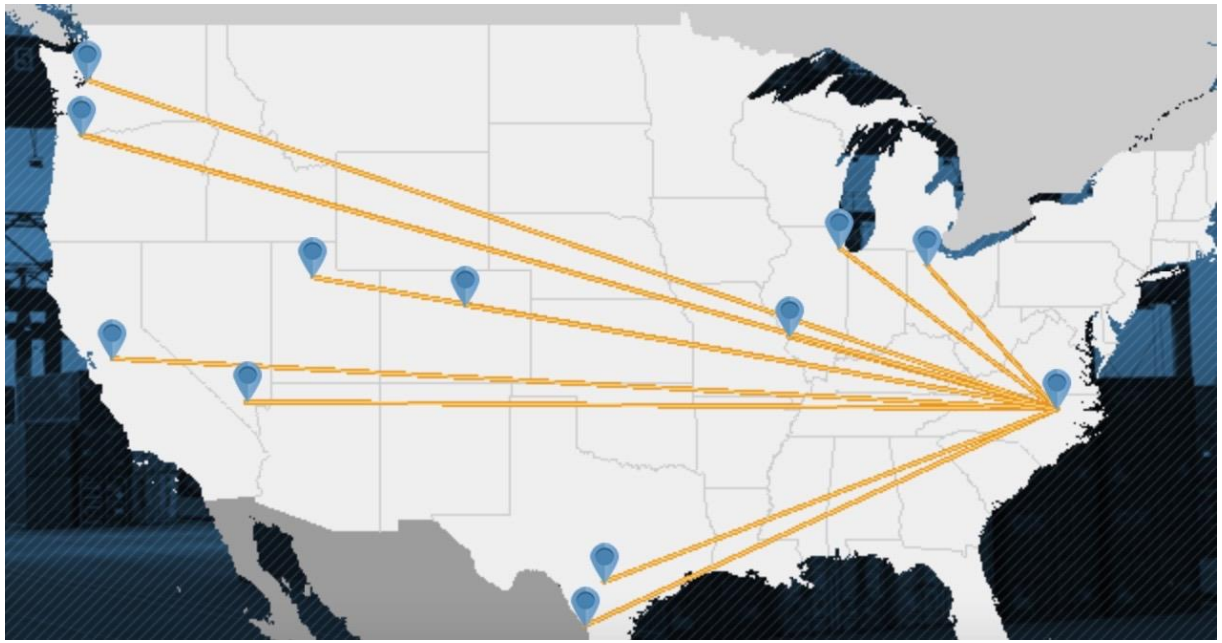
Add short-line integration w/C1 RRs

Expansion to Regional greatly expands IM potential. Expansion to lower density corridors grows it even more.

Routes are critical to network expansion



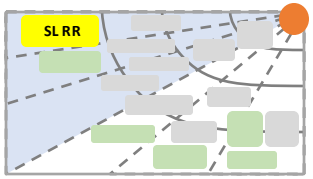
- Example: The new NC hub (operational November 2021) only ships to 11 hub locations.
- Why?
  - Limited to long hauls only
  - Interline agreements only exist with non-competing carriers
  - Time to build up density in a new market

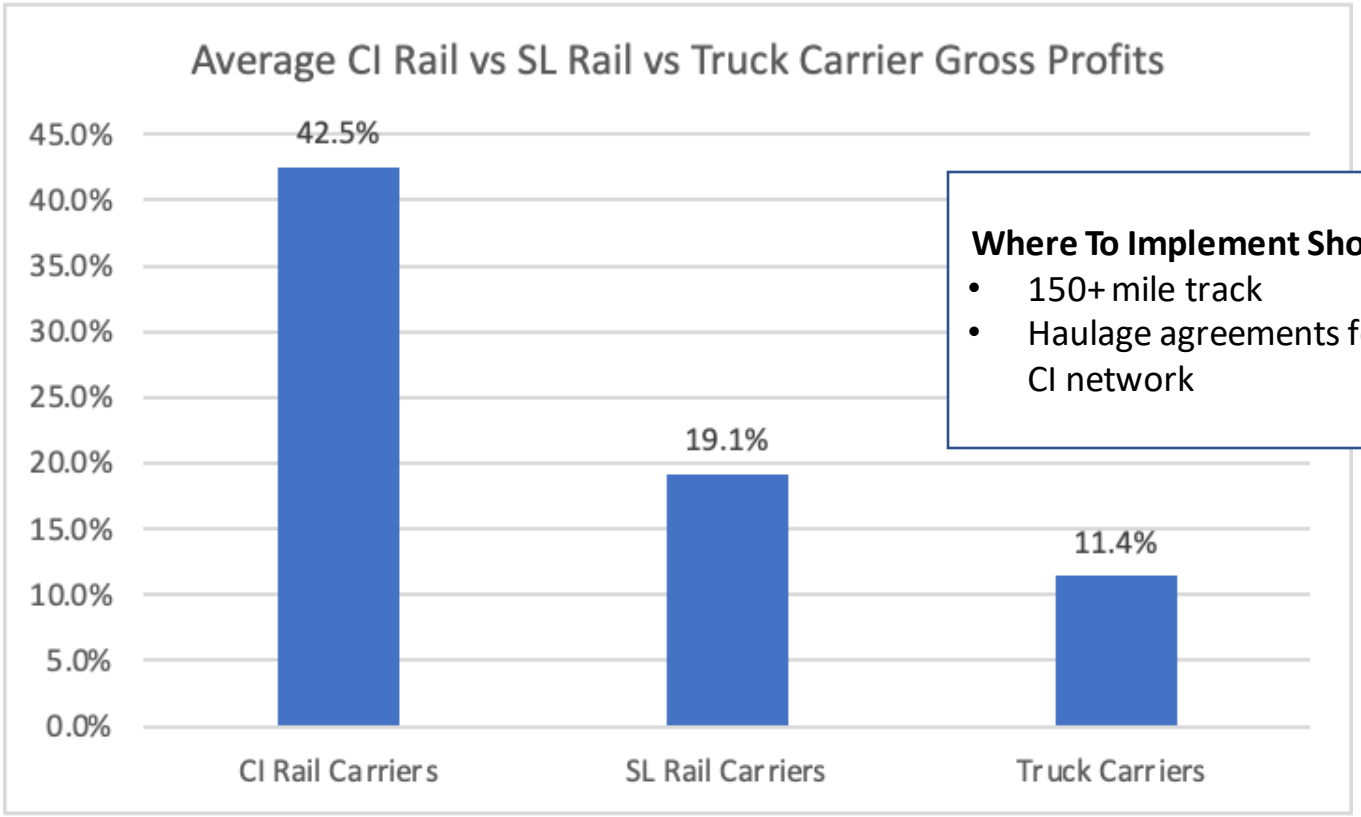


New hubs alone are not enough; the US model needs new routing methods.

Source: CSX website. Similar examples revealed on other CI sites.

The Short Line Financial Model Competes Better Vs. TL





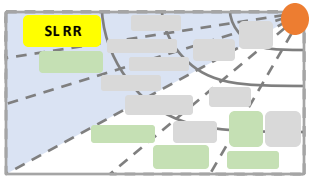
Where To Implement Short Lines IM

- 150+ mile track
- Haulage agreements feeding the CI network

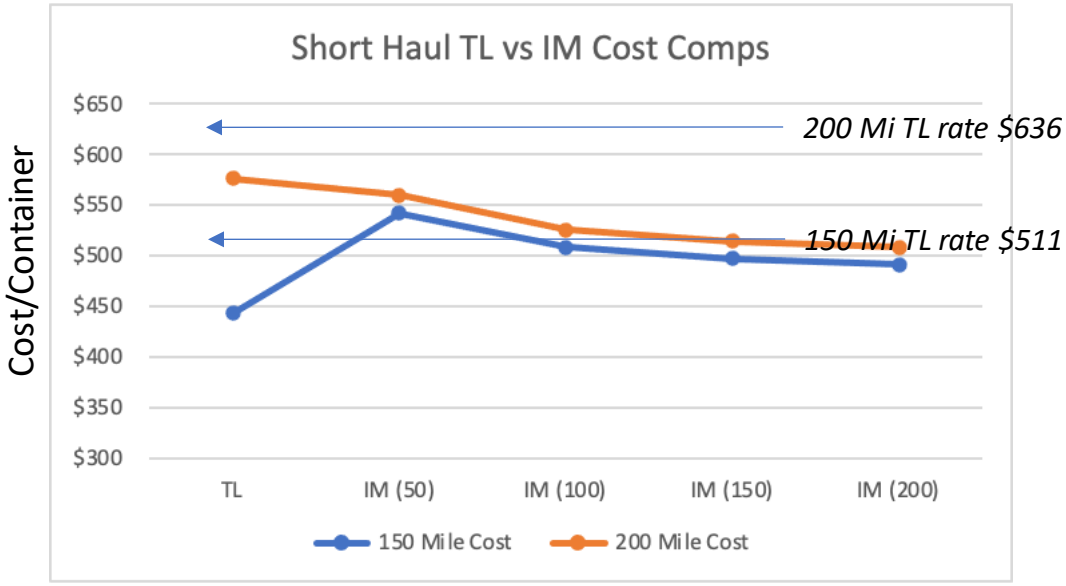
Annual reports show short line profit hurdles are more competitive than CI's. Other searches agree, separately suggesting short line labor costs ~ 25% less than CI's.

Sources: CI & TL from previous slide; SL data from G&W Annual Reports 2014 – 2018; Gross profit ranged between 14.5 to 26.3%; G&W became private in 2019. No other public SL reports have been found.

Short Line IM Reaches TL Cost Parity Between 150 - 200 Miles



- Comparing TL and IM train cost vs. market rate on 150- and 200-mile trips



Details in appendix. Key assumptions

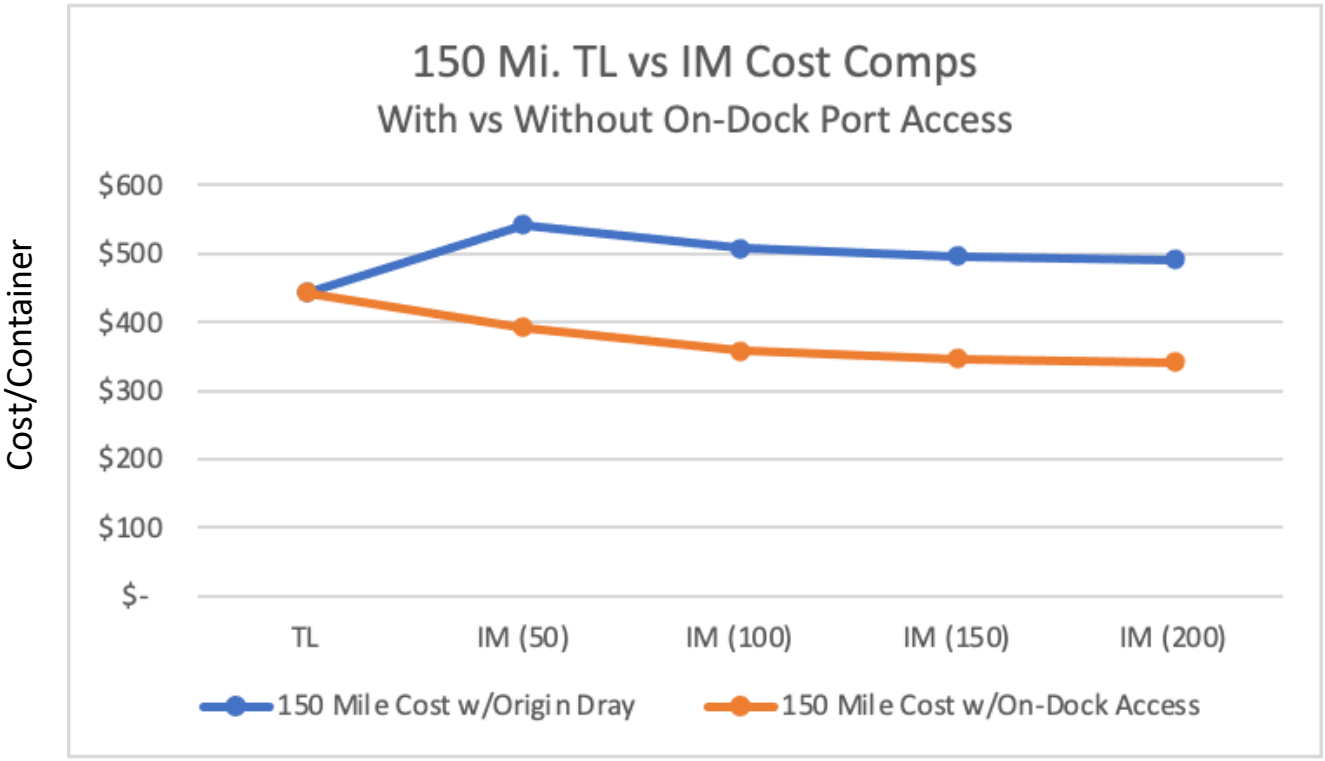
- TL cost applies ATRI annual cost of trucking, adapted for short hauls
- Driver wage & benes $78,000 (ATRI), allocated for 2.0 and 1.6 trips/day using 53mph avg.
- All other TL costs @ $1.34/mi
- 25% empty miles
- TL rate (price) assumes $1,000/day all in rate for driver/rig/miles
- IM cost adapted from NSC annual report; $132k/FTE, 2 FTE's per train; 15% SL discount*
- Train trips are out/back 50% empty
- $3M loco; 3.9% ann'l depreciation (NSC)
- Lift cost = $25 on + $25 off; loaded and empty; no empty handling revenue
- Insourced dray costs utilize ATRI study
- 25-mile dray, 4 trips/day, 200 mi/day
- 50-mile, 3 trips/day adds $95 per container

- @ 150 miles, TL is less expensive than IM
- @ 200 miles, IM is less expensive than TL
- IM is profitable @ <200 miles
- IM breaks even @ 150 miles and 100 containers
- Cost per container flattens out @ ~ 100 containers

Short line IM appears cost-competitive vs. TL on selected hauls

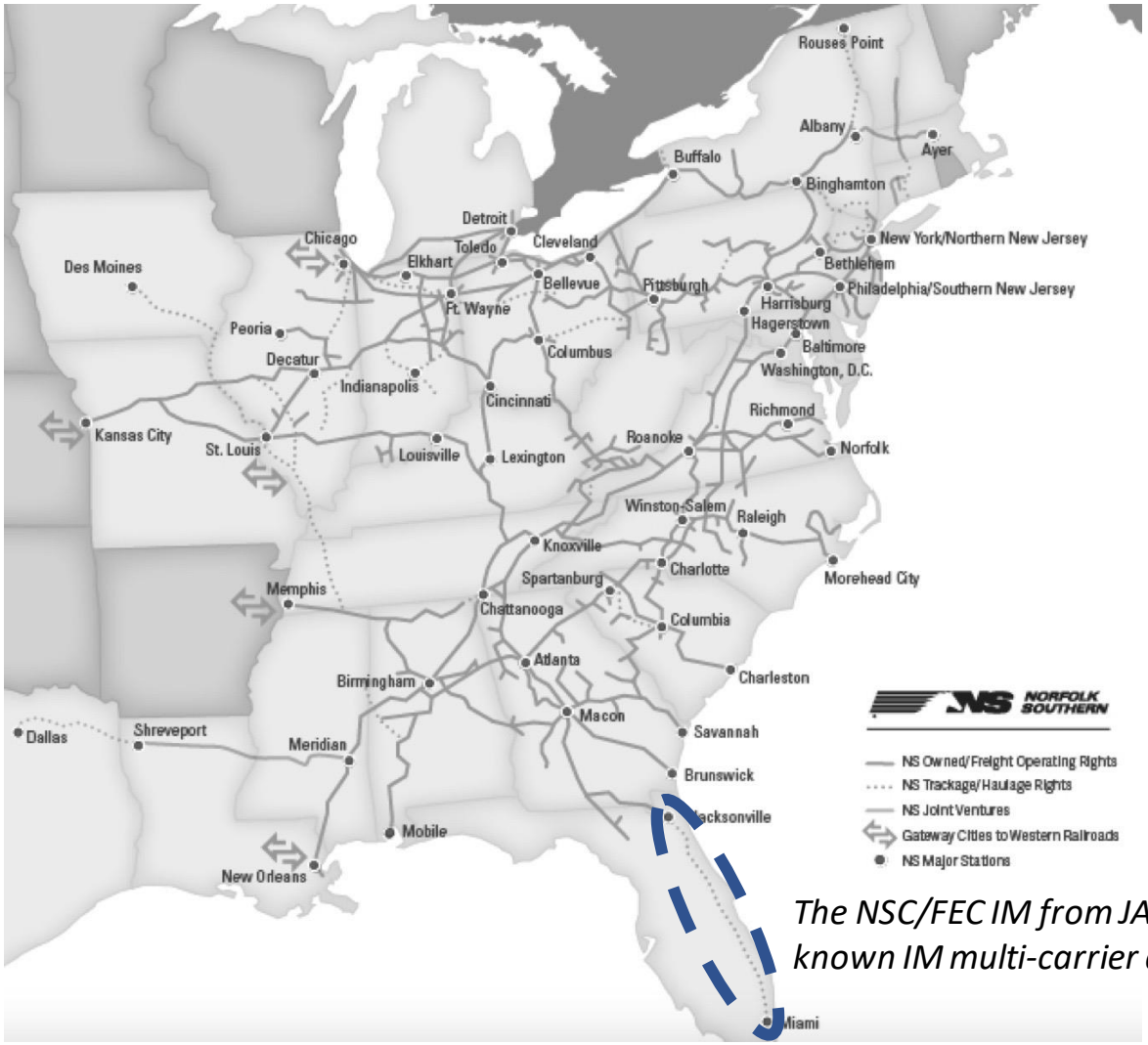
*Assumes SL labor cost of 15% less than CI's. From Commentary by Jim Blaze; FreightWaves, 10/15/19;SL https://www.freightwaves.com/news/commentary-short-line-railroads-custom-high-growth-freight-service

Gaining On-Dock Access to SL Rail Is Particularly Compelling



Eliminating dray costs with on-dock access is a sustainability and congestion-relief game-changer when paired with short line rail

Haulage Agreements Exist, But Are Rare For Intermodal

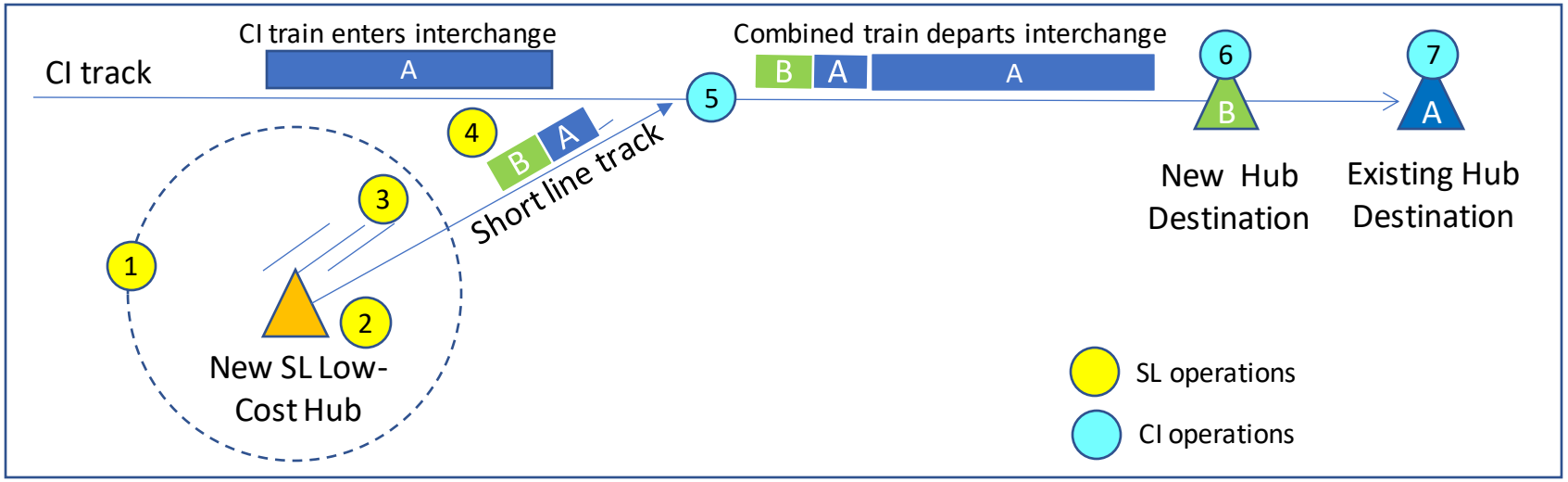


The NSC/FEC IM from JAX to MIA is a well-known IM multi-carrier agreement

Source: Norfolk Southern 2021 Annual Report

How? One Idea: Attach Short Line Train Blocks to Existing Routes

- Carriers will find various ways to integrate routes. One feasible concept calls for short line assembly of train blocks switched to CI trains.



1. Origin dray around new nub
2. Container staged, awaits loading
3. Train blocks loaded, await assembly
4. Train block moved to interchange
5. CI train assembles SL train block
6. Dropped @ new destination
7. Dropped @ existing destination

New investment and more complex assembly by short lines. More density for CI's. More revenue and profit for both carriers.