Taking First Steps Towards Sustainable Road Freight

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forward together
sonke siya phambili
saam vorentoe

Prof Joubert van Eeden

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Photo by Stefan Els

Engineering | EyobuNjineli | Ingenieurswese

Agenda

- Why is carbon emissions important for SA Exporters
- Macrologistics data to support evidence-based decision making
- Decarbonising Logistics: Where to next?
- Electric Vehicle Ecosystem
- SU Initiatives

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Background on Global Mobility

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Global transport systems will change, are changing…

- South Africa are dependent on global OEMs:
  - Availability of replacement vehicles
  - Local vehicle manufacturing industry (SA Economy)
- Energy situation:
  - Electricity generation and distribution pressure
  - Government dependence on fuel income (Policy)
- SA public dependent on:
  - Consumer goods (Logistics)
  - Individual mobility (Public transport)

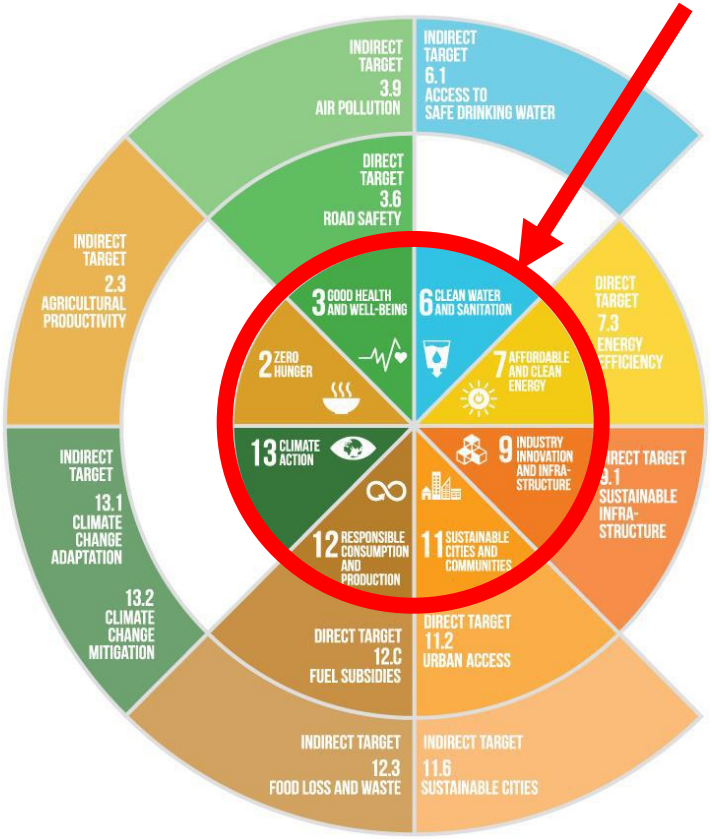
Threat: Should Emissions Really Worry You?

- EU setting a global trend – The **Carbon Border Adjustment Mechanism (CBAM)**[1]
- Energy- and GHG-intensive **goods** such as:
  - Cement, steel, aluminium, fertilizers, electricity and hydrogen (and what next???)
  - EU adamant: All importers to map entire product SC
- **Timeline** for CBAM?
  - Phased in by 1 October 2023, full implementation by 2026
- **Financial impact** of CBAM?
  - Africa might lose 5,7%[2] of its exports to the EU, equivalent to $16 billion in trade…
- Will your business be part of these statistics?

[1] https://taxation-customs.ec.europa.eu/green-taxation-0/carbon-border-adjustment-mechanism_en
[2] https://www.engineeringnews.co.za/article/eu-carbon-border-tariffs-could-knock-16bn-off-africas-yearly-gdp-2023-02-15

Sustainable Development Goals (SDGs) AND Transport

Transport – Integrated into 8 SDGs



(United Nations, 2023)

Where does sustainable transport fit into the United Nations SDGs?

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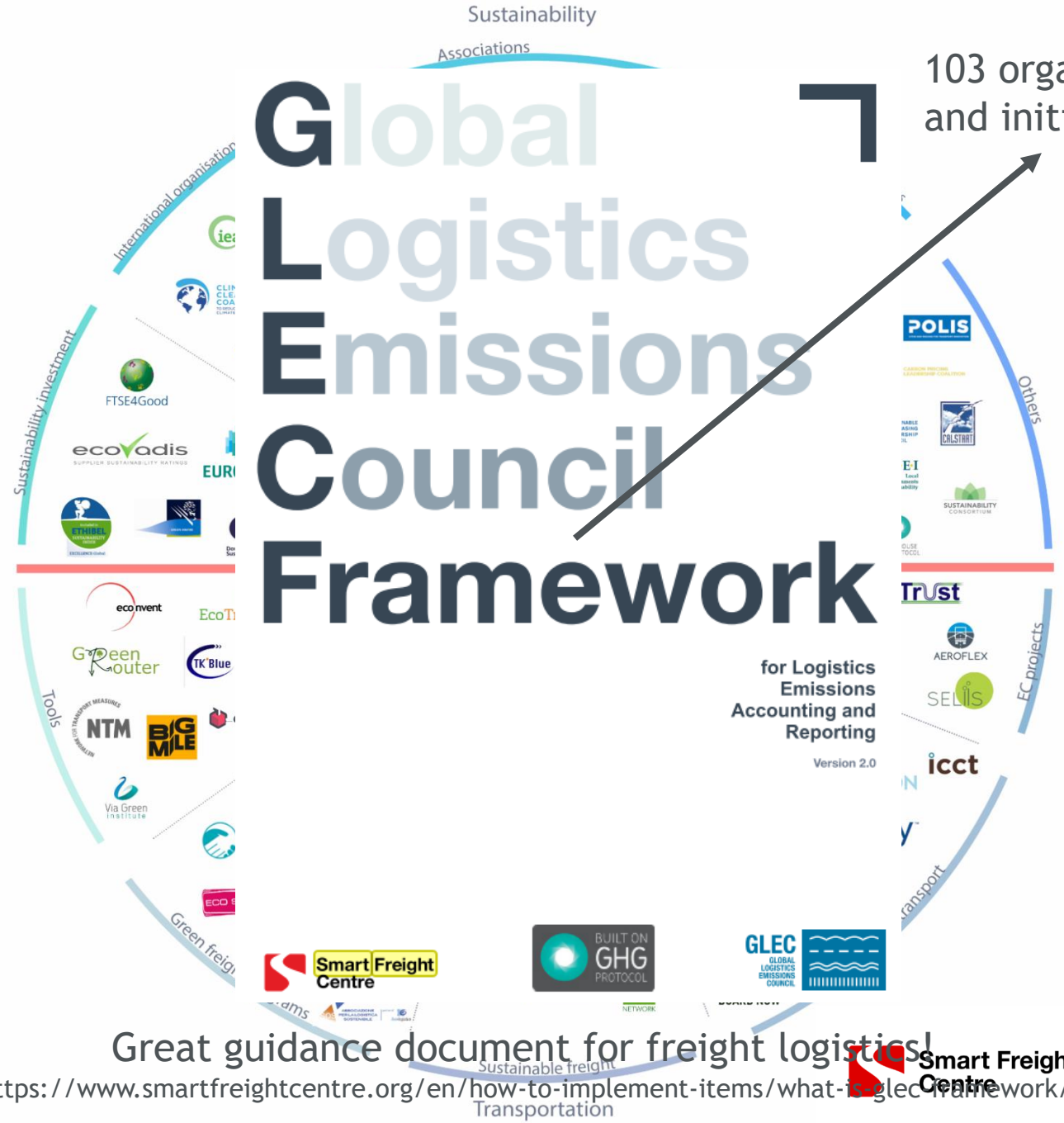

103 organisations and initiatives!

Great guidance document for freight logistics!

https://www.smartfreightcentre.org/en/how-to-implement-items/what-is-glec-framework/58/

Smart Freight Centre

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Navigating the World of Sustainable Freight

- Organisations
- Programmes
- Projects
- Tools
- Interventions

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MacroLogistics planning and modelling

- Past 17 years:
  - Freight Demand Model for SA: with Prof Jan Havenga
  - Freight Corridor modal shift: with Prof Jan Havenga
  - Port infrastructure planning: Based on Economic Trade Activity
- More recent:
  - End-to-end supply chain emissions: Mapping fruit carbon emissions from pack house to international port of destination
  - Modal shift/Third Party Rail Access: Potential for energy and carbon savings known, implementation opportunities to be explored
  - Transport Ecosystem for transition to Renewable Energy Freight Vehicles: Definition of Elements, Stakeholders and system interactions

Multiple outputs over the years from this research

Port Container Demand planning models

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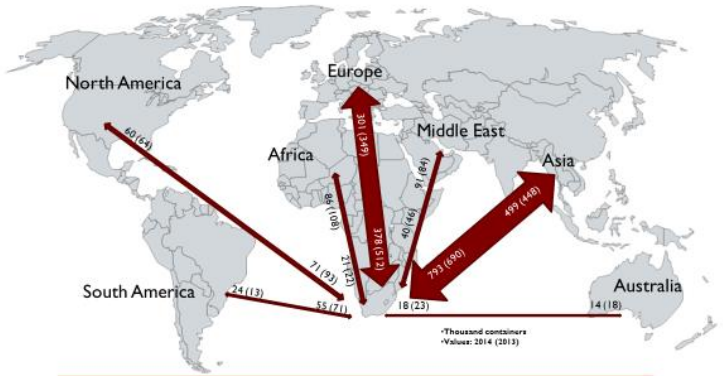
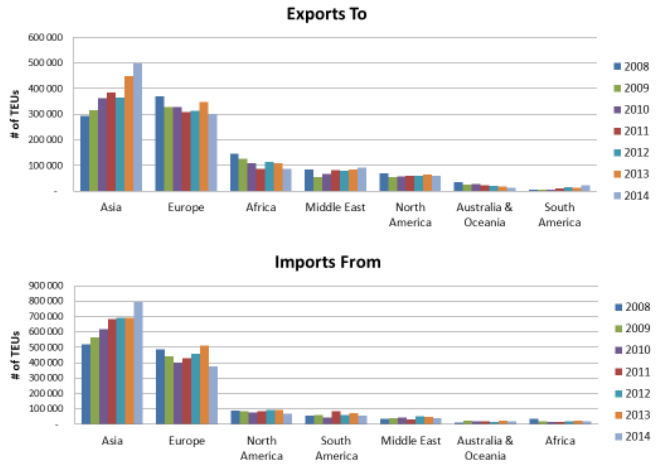
Trade flows of containers in 2014

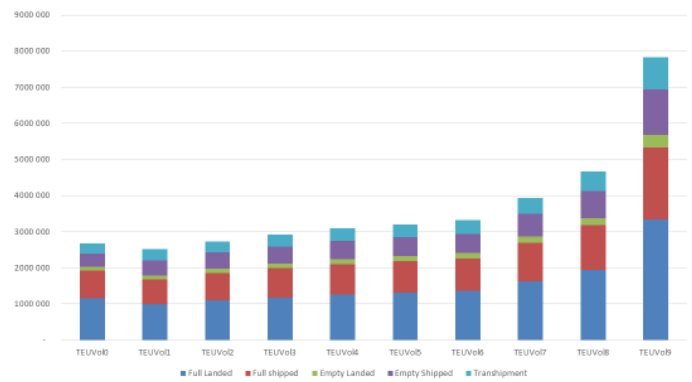


Total exports of 1 075 389 TEUs in 2014
Total imports of 1 374 748 TEUs in 2014

Imports and Exports of TEUs to and from global regions (2008-2014)

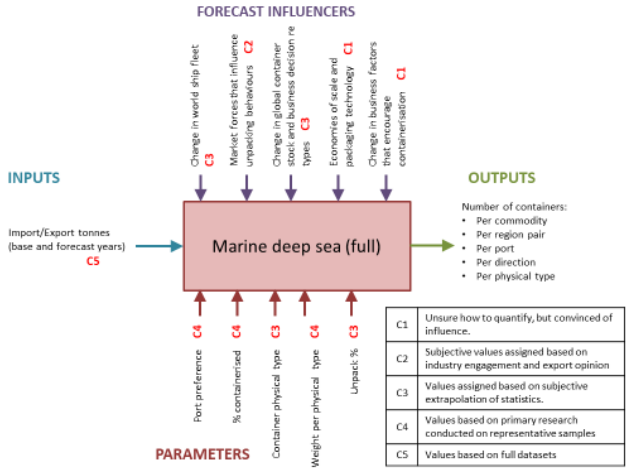


Durban: Container volumes per typology



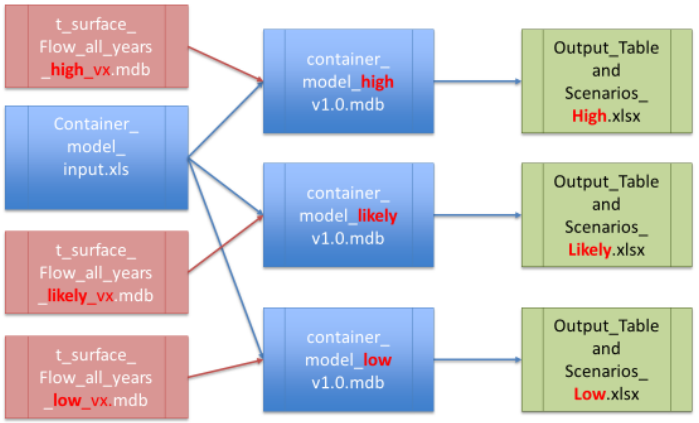
Durban shows continued large-scale growth over all typologies

Container Model: Marine Full Deep Sea



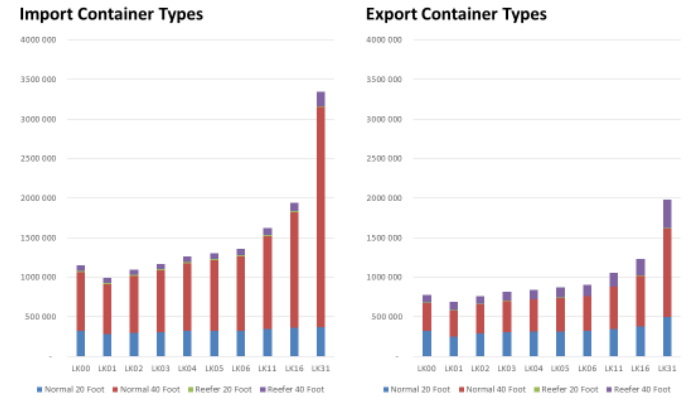
C1	Unsure how to quantify, but convinced of influence.
C2	Subjective values assigned based on industry engagement and export opinion
C3	Values assigned based on subjective extrapolation of statistics.
C4	Values based on primary research conducted on representative samples
C5	Values based on full datasets

Model structural diagram



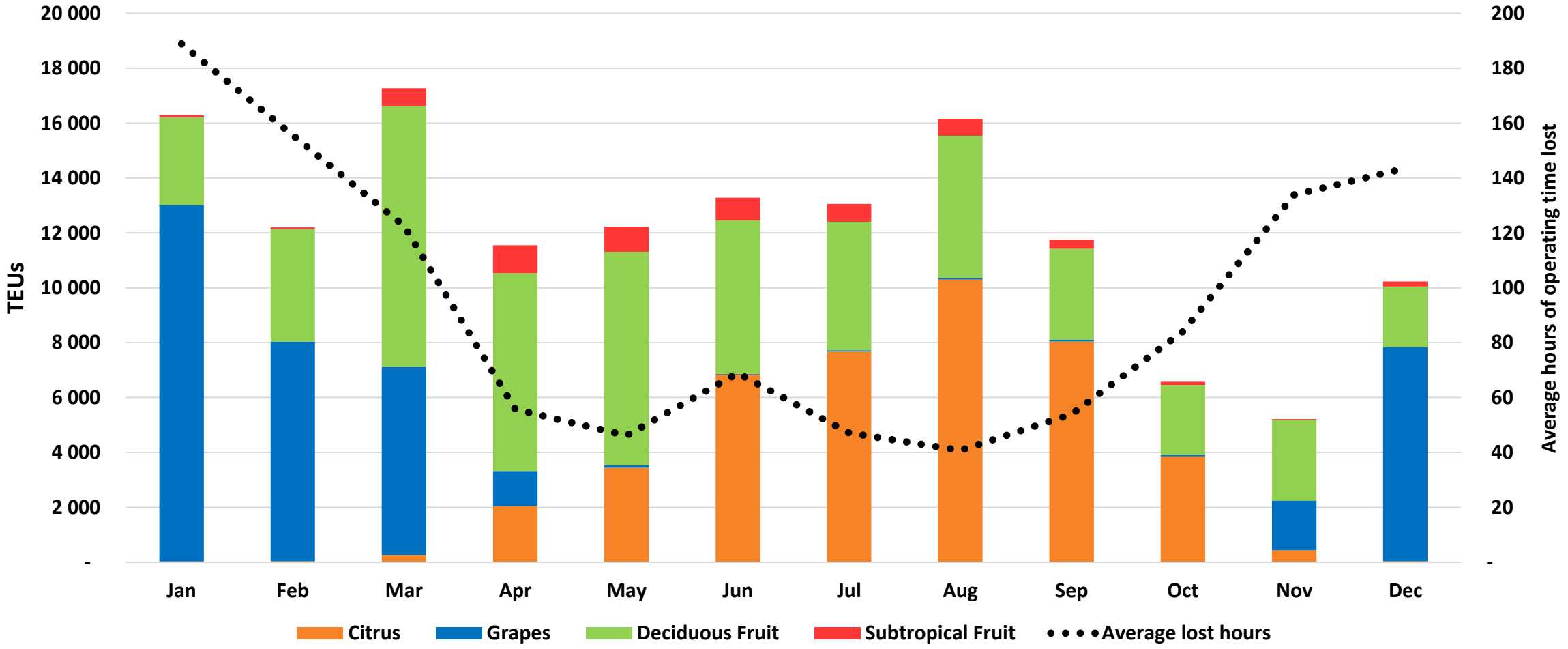
Detail methodology explained in Forecast Input Report

Durban: Full Deep-sea Container Types



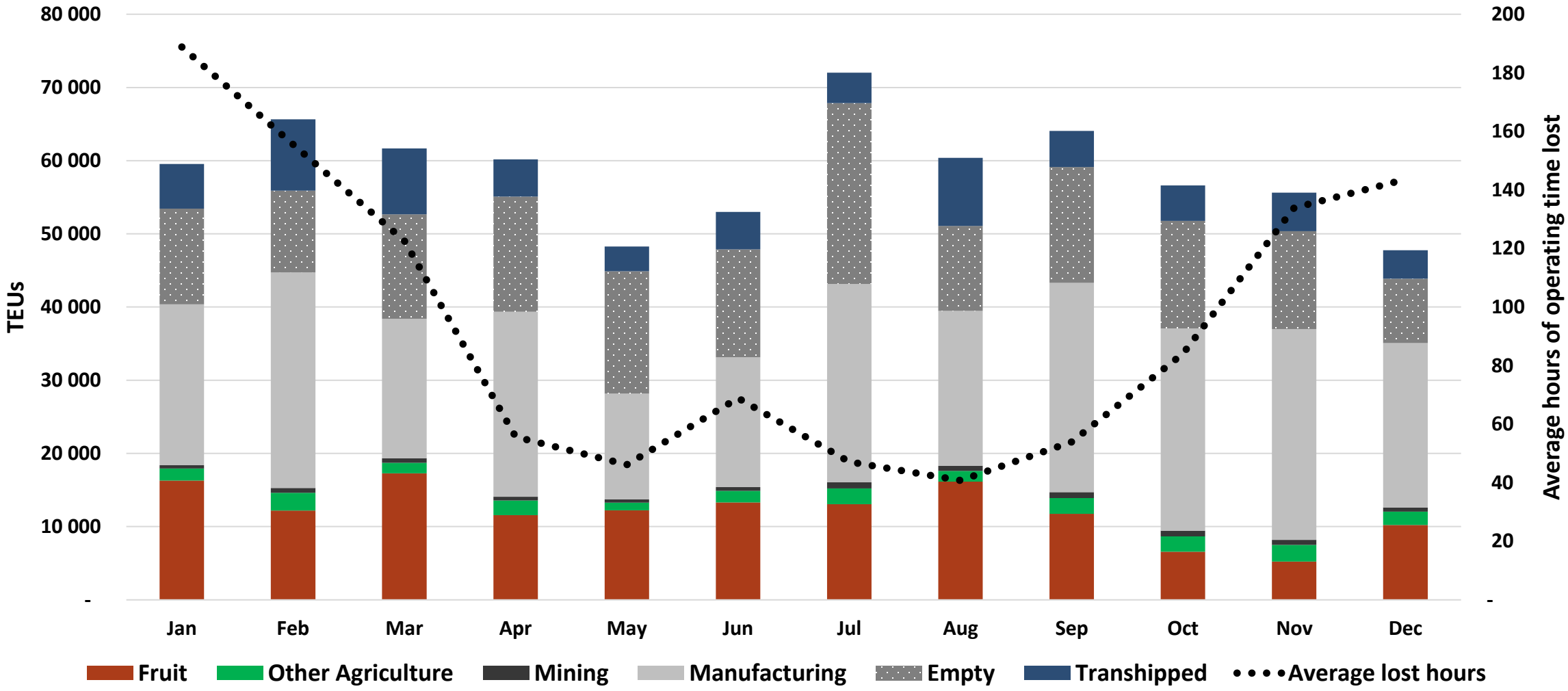
Import and Export physical types differ creating a large surplus in empty containers of different sizes

TEUs per fruit type (2020)



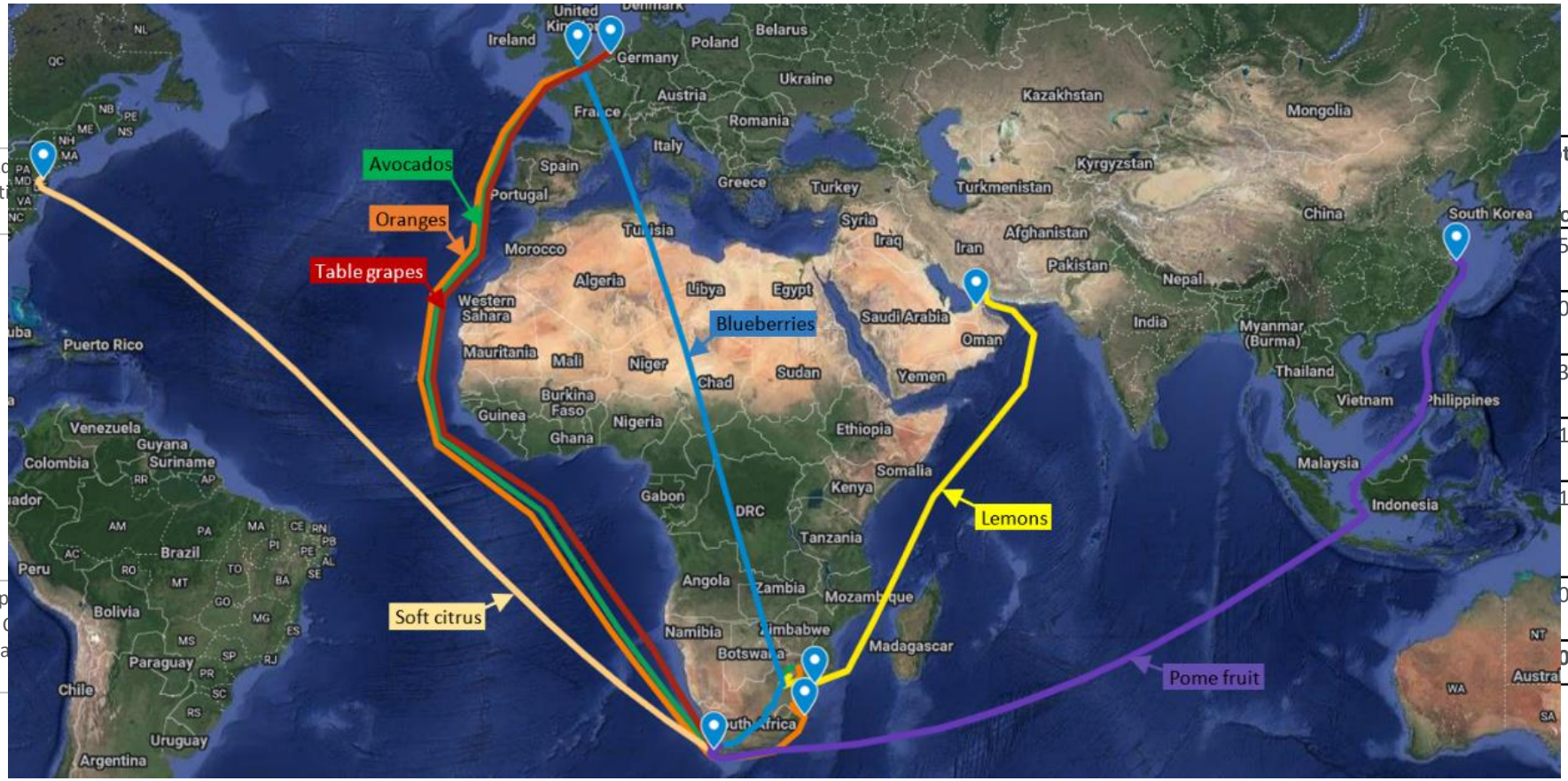
Source: WC FDM™ PE (2022); GAINGROUP

Total Cape Town Container Terminal TEUs (2020)



Source: WC FDM™ PE (2022); GAINGROUP

The scale of emissions: results of typical example scenarios



tprint of fruit)
5
0
3
1
1
0
0

Transport via deep transport (Port of Town to Rotterda 63.06%

The scale of emissions: results of typical example scenarios

- Short vs long cold chains do matter
- Increasing cold chain by six months leads to
  - Emissions increase of 96% (g CO_2e/kg of apples)
  - 1.73 kg CO_2e/kg of fruit.

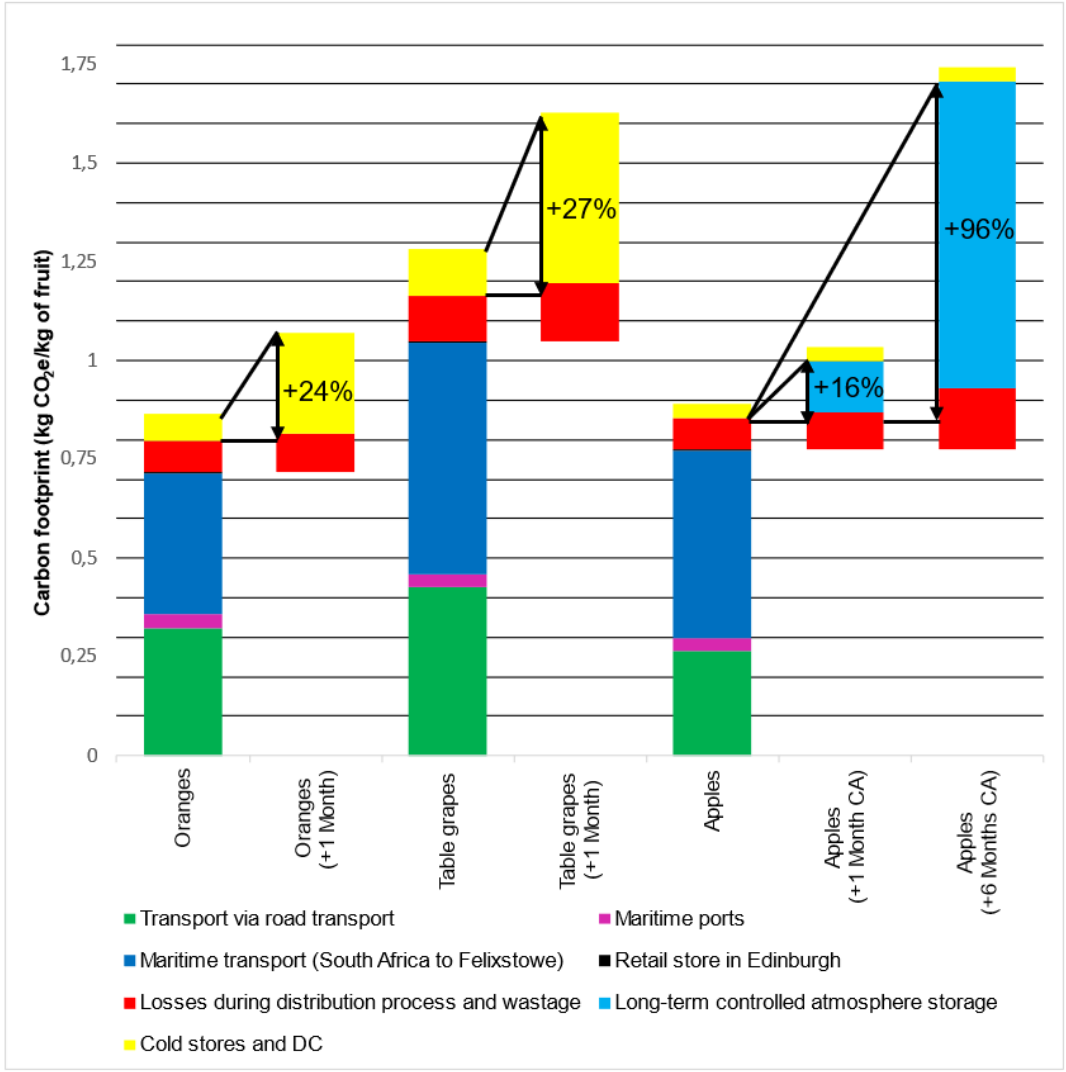


Figure 6: The emissions impact of increasing the cold chain length

Modal shift Impact: Durban – Gauteng

Catchment areas:

Durban = 40 km

Gauteng = 150 km

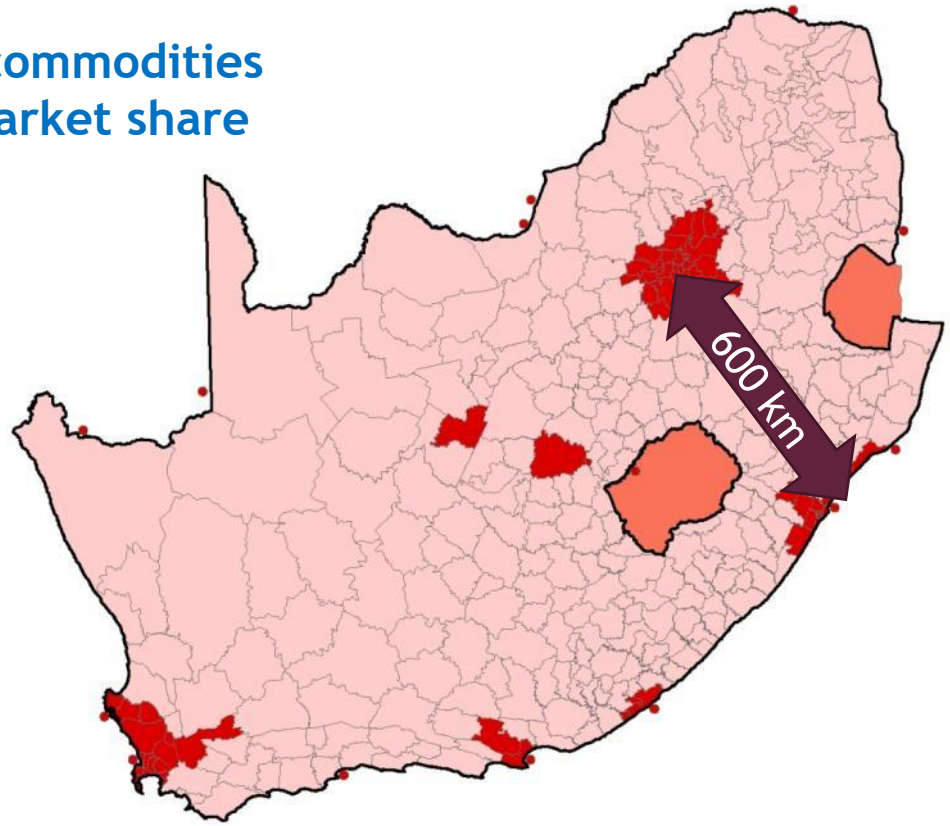
Import/Export only:

- Tonnes = 0.95 million
- Tonne-km = 0.57 Billion
- Trains per week = 26 (sum)

Domestic & Import/Export:

- Tonnes = 2.4 million
- Tonne-km = 1.4 Billion
- Trains per week = 66 (sum)
- **Truck trips = 1 150 per week (reduction)**

Note:
Six (6) commodities
100% market share



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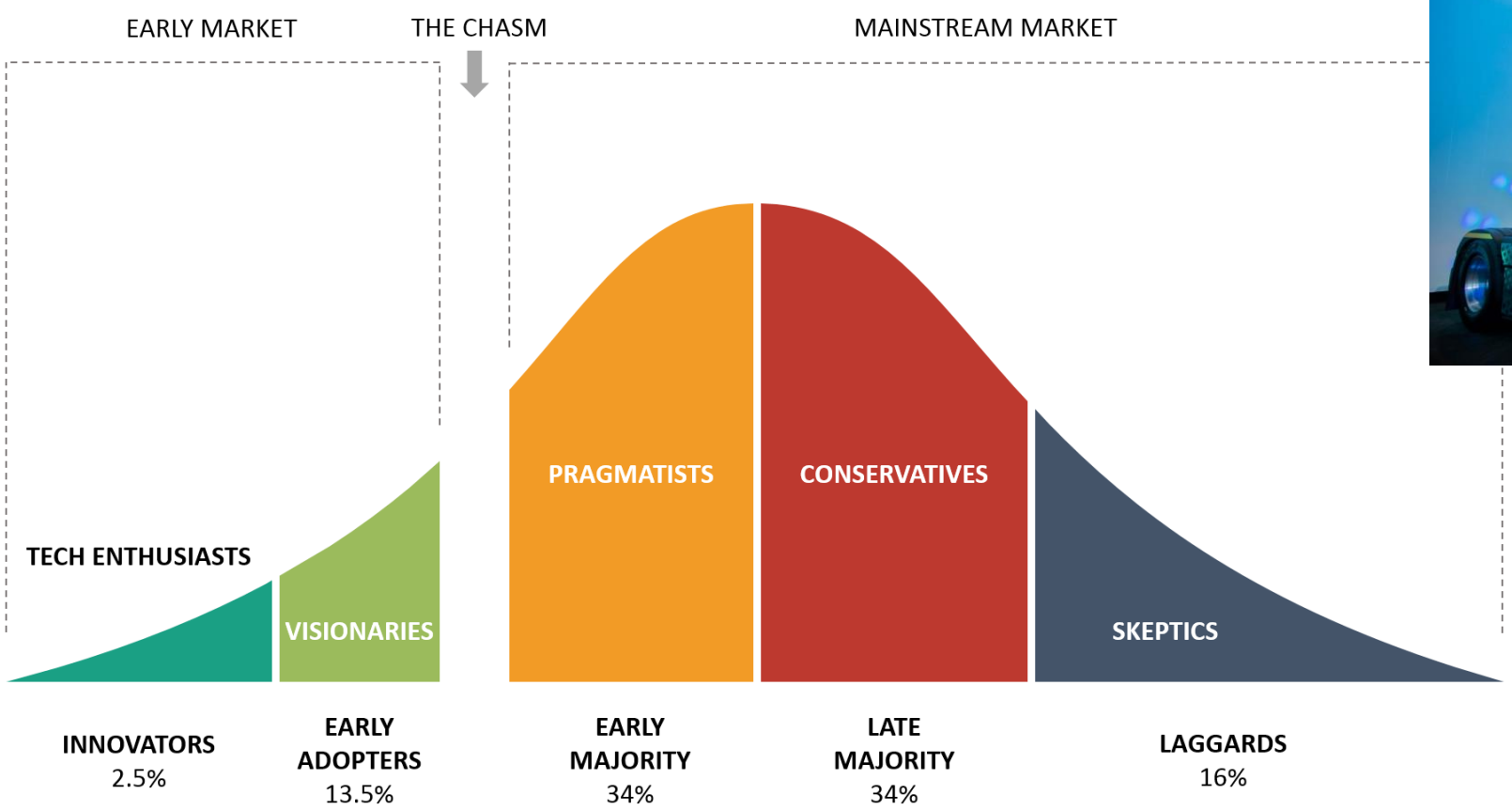
Technology Adoption Chasm: Data-driven informed decision-making



Vehicle and transport tasks (RFA classes)

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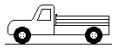
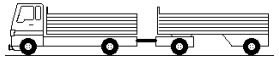
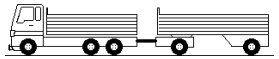
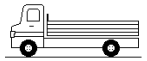
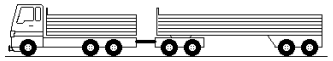
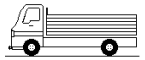
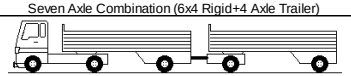
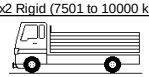
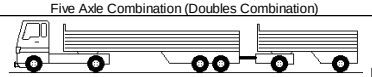
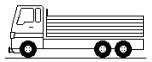
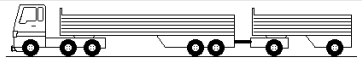
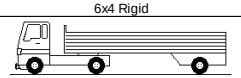
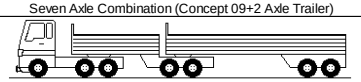
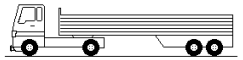
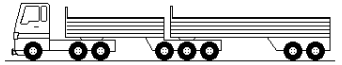
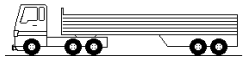
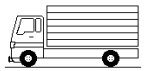
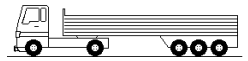
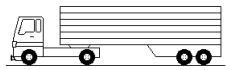
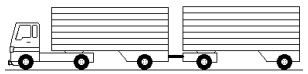
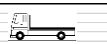
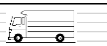
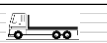
VEHICLE CONCEPTS

Page C1

01	 4x2 Rigid LDV (2400 kg or Less)	Permissible Unladen PAYLOAD up to	2 400 1 400 1 000	12	 Four Axle Combination (4x2 Rigid+2 Axle Trailer)	Permissible Unladen PAYLOAD up to	28 000 11 400 16 600
02	 4x2 Rigid (2400 to 5000 kg)	Permissible Unladen PAYLOAD up to	5 000 2 680 2 320	13	 Five Axle Combination (6x4 Rigid+2 Axle Trailer)	Permissible Unladen PAYLOAD up to	43 000 15 780 27 220
03	 4x2 Rigid (5001 to 7500 kg)	Permissible Unladen PAYLOAD up to	7 000 3 100 3 900	14	 Seven Axle Combination (6x4 Rigid+4 Axle Trailer)	Permissible Unladen PAYLOAD up to	55 200 19 680 35 520
04	 4x2 Rigid (7501 to 10000 kg)	Permissible Unladen PAYLOAD up to	10 000 4 210 5 790	15	 Five Axle Combination (Doubles Combination)	Permissible Unladen PAYLOAD up to	43 000 17 150 25 850
05	 4x2 Rigid	Permissible Unladen PAYLOAD up to	13 700 5 610 8 090	16	 Six Axle Combination (Concept 08+2 Axle Trailer)	Permissible Unladen PAYLOAD up to	44 000 19 550 24 450
06	 6x4 Rigid	Permissible Unladen PAYLOAD up to	24 000 8 660 15 340	17	 Seven Axle Combination (Concept 09+2 Axle Trailer)	Permissible Unladen PAYLOAD up to	56 000 21 730 34 270
07	 Three Axle Artic (4x2 TT+Single Axle ST)	Permissible Unladen PAYLOAD up to	25 000 10 720 14 280	18	 Seven Axle Interlink (6x4 TT+Tandem/Tandem ST)	Permissible Unladen PAYLOAD up to	56 000 22 125 33 875
08	 Four Axle Artic (4x2 TT+Tandem Axle ST)	Permissible Unladen PAYLOAD up to	34 000 14 440 19 560	19	 Eight Axle Interlink (6x4 TT+Tridem/Tandem ST)	Permissible Unladen PAYLOAD up to	56 000 23 180 32 820
09	 Five Axle Artic (6x4 TT+Tandem Axle ST)	Permissible Unladen PAYLOAD up to	43 000 16 250 26 750	20 PMA	 4x2 Rigid	Permissible Unladen PAYLOAD up to	13 700 5 390 8 310
10	 Five Axle Artic (4x2 TT+Tridem Axle ST)	Permissible Unladen PAYLOAD up to	40 000 15 420 24 580	21 PMA	 Four Axle Artic (4x2 TT+Tandem Axle ST)	Permissible Unladen PAYLOAD up to	34 000 13 650 20 350
11	 Six Axle Artic (6x4 TT+Tridem Axle ST)	Permissible Unladen PAYLOAD up to	49 500 17 520 31 980	22 PMA	 Five Axle Artic (Doubles Combination)	Permissible Unladen PAYLOAD up to	43 000 18 350 24 650

ALL THE VEHICLE CONCEPTS IN THE RFA VEHICLE COST SCHEDULE

Page C2

No	Drop Side	Van	Flat Bed	Tipper	Tanker	Fridge	Lowbed	PMA
01			NA	NA	NA	NA	NA	NA
02			NA	NA	NA	NA	NA	NA
03			NA	NA	NA	NA	NA	NA
04			NA	NA	NA	NA	NA	NA
05							NA	 20 PMA
06							NA	NA
07				NA	NA	NA	NA	NA
08						NA	NA	21 PMA
09								NA
10							NA	NA
11								NA
12				NA	NA	NA	NA	NA
13				NA		NA	NA	NA
14				NA	NA	NA	NA	NA
15				NA	NA	NA	NA	22 PMA
16				NA	NA	NA	NA	NA
17						NA	NA	NA
18							NA	NA
19				NA	NA		NA	NA

No	Drop Side	Van	Flat Bed	Tipper	Tanker	Fridge
18	Seven Axle Interlink (6x4 TT+Tandem/Tandem ST)					

Vehicle and transport tasks (RFA classes)

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V E H I C L E C O N C E P T S — Page C1

01	4x2 Rigid LDV (2400 kg or Less)	Permissible 2 400 Unladen 1 400 PAYLOAD up to 1 000	12	Four Axle Combination (4x2 Rigid+2 Axle Trailer)	Permissible 28 000 Unladen 11 400 PAYLOAD up to 16 600
02	4x2 Rigid (2400				
03	4x2 Rigid (5001				
04	4x2 Rigid (7501				
05	4x2 Ri				
06	6x4 Ri				
07	Three Axle Artic (4x2 T				
08	Four Axle Artic (4x2 TT				
09	Five Axle Artic (6x4 TT				
10	Five Axle Artic (4x2 TT				
11	Six Axle Artic (6x4 TT				

31 December 2022 - Live vehicle population as per the National Traffic Information System - eNaTIS

Vehicle Class	Province									Total	% of total self-propelled
	GP	KZ	WC	EC	FS	MP	NW	L	NC		
Motor cars and station wagons	3 183 211	1 058 685	1 330 321	482 295	323 010	453 451	344 686	374 597	134 897	7 685 153	65,54%
Minibuses	129 336	59 118	37 759	26 914	13 113	26 805	21 934	27 649	6 707	349 335	2,98%
Buses, bus trains, midibuses	20 004	8 187	6 894	4 668	3 482	8 013	4 029	6 937	1 956	64 170	0,55%
Motorcycles, quadrucycles, tricycles	143 664	32 153	87 707	20 959	16 839	16 755	12 460	8 444	7 172	346 153	2,95%
LDV's, panel vans, other light load veh's GVM <= 3500kg	871 343	379 387	345 867	207 929	134 607	227 224	161 579	247 541	82 939	2 658 416	22,67%
Trucks (Heavy load vehicles GVM > 3500kg)	143 065	52 272	47 028	22 313	23 845	42 814	17 875	27 362	9 271	385 845	3,29%
Other self-propelled vehicles	37 413	31 553	41 438	16 810	34 679	27 478	21 047	17 259	9 522	237 199	2,02%
Total self-propelled vehicles	**4 528 036**	**1 621 355**	**1 897 014**	**781 888**	**549 575**	**802 540**	**583 610**	**709 789**	**252 464**	**11 726 271**	
Provincial % of total	38,61%	13,83%	16,18%	6,67%	4,69%	6,84%	4,98%	6,05%	2,15%	100,00%	% of total tow vehicles
Caravans	35 344	6 389	19 046	4 997	6 862	9 325	6 011	5 315	2 596	95 885	7,92%
Light load trailers GVM <= 3500kg	331 847	82 438	157 560	59 126	62 502	65 704	54 994	45 190	30 616	889 977	73,52%
Heavy load trailers GVM > 3500kg	70 054	26 905	26 292	7 655	22 401	39 475	11 758	13 657	6 383	224 580	18,55%
Total trailers	**437 245**	**115 732**	**202 898**	**71 778**	**91 765**	**114 504**	**72 763**	**64 162**	**39 595**	**1 210 442**	
Total provincial % of total	36,12%	9,56%	16,76%	5,93%	7,58%	9,46%	6,01%	5,30%	3,27%	100,00%	
All other and unknown vehicles	4 119	2 599	4 245	2 799	3 426	3 276	3 767	2 212	1 274	27 717	
Total number	**4 969 400**	**1 739 686**	**2 104 157**	**856 465**	**644 766**	**920 320**	**660 140**	**776 163**	**293 333**	**12 964 430**	
Provincial % of total	38,33%	13,42%	16,23%	6,61%	4,97%	7,10%	5,09%	5,99%	2,26%	100,00%	

ALL THE VEHICLE CONCEPTS IN THE RFA VEHICLE COST SCHEDULE — Page C2

No	Drop Side	Van	Flat Bed	Tipper	Tanker	Fridge	Lowbed	PMA

No	Drop Side	Van	Flat Bed	Tipper	Tanker	Fridge
18	Seven Axle Interlink (6x4 TT+Tandem/Tandem ST)					

Agenda

- Why is carbon emissions important for SA Exporters
- Macrologistics data to support evidence-based decision making
- Decarbonising Logistics: Where to next?
- Electric Vehicle Ecosystem
- SU Initiatives

Elements of a Transport Ecosystem for transition to Electric Freight Vehicles

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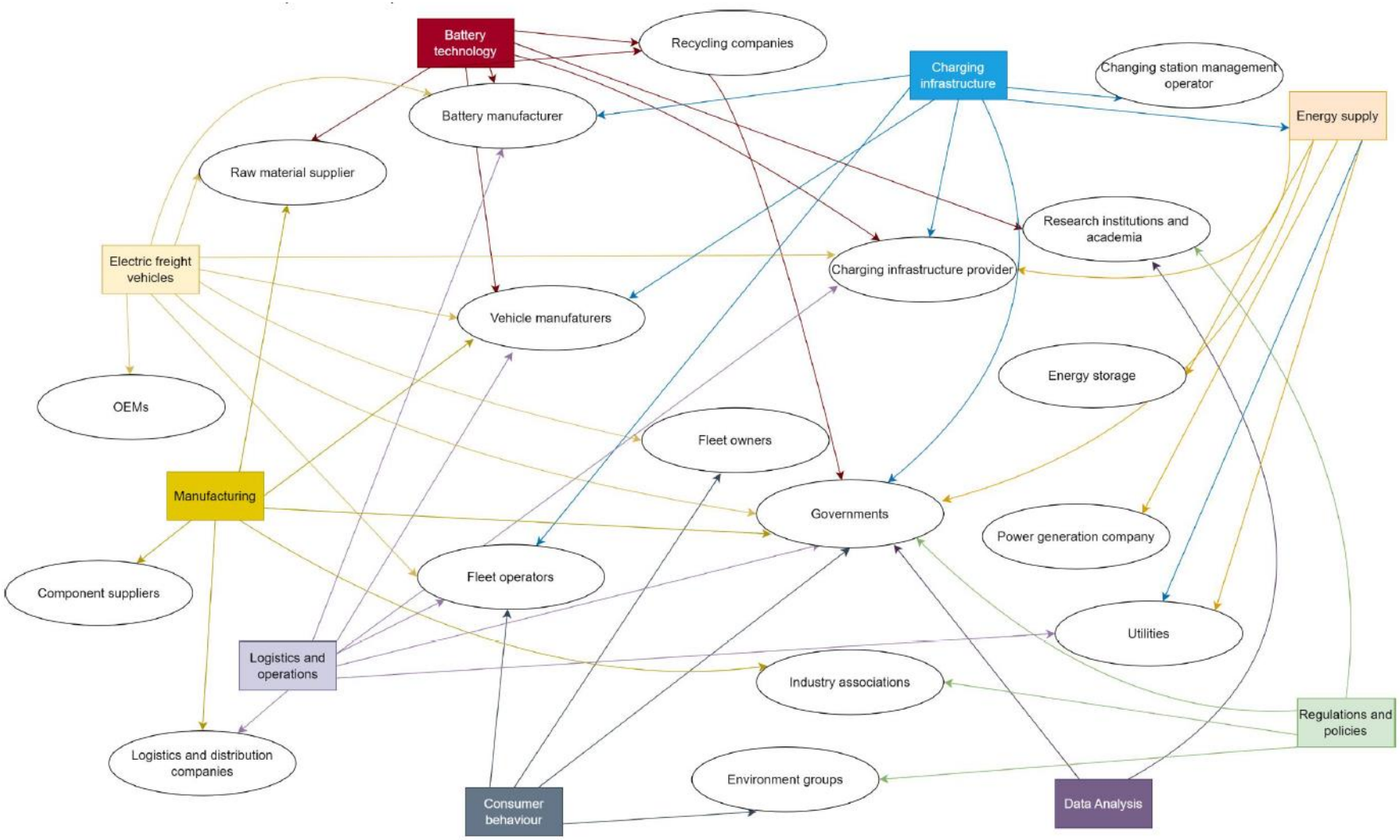
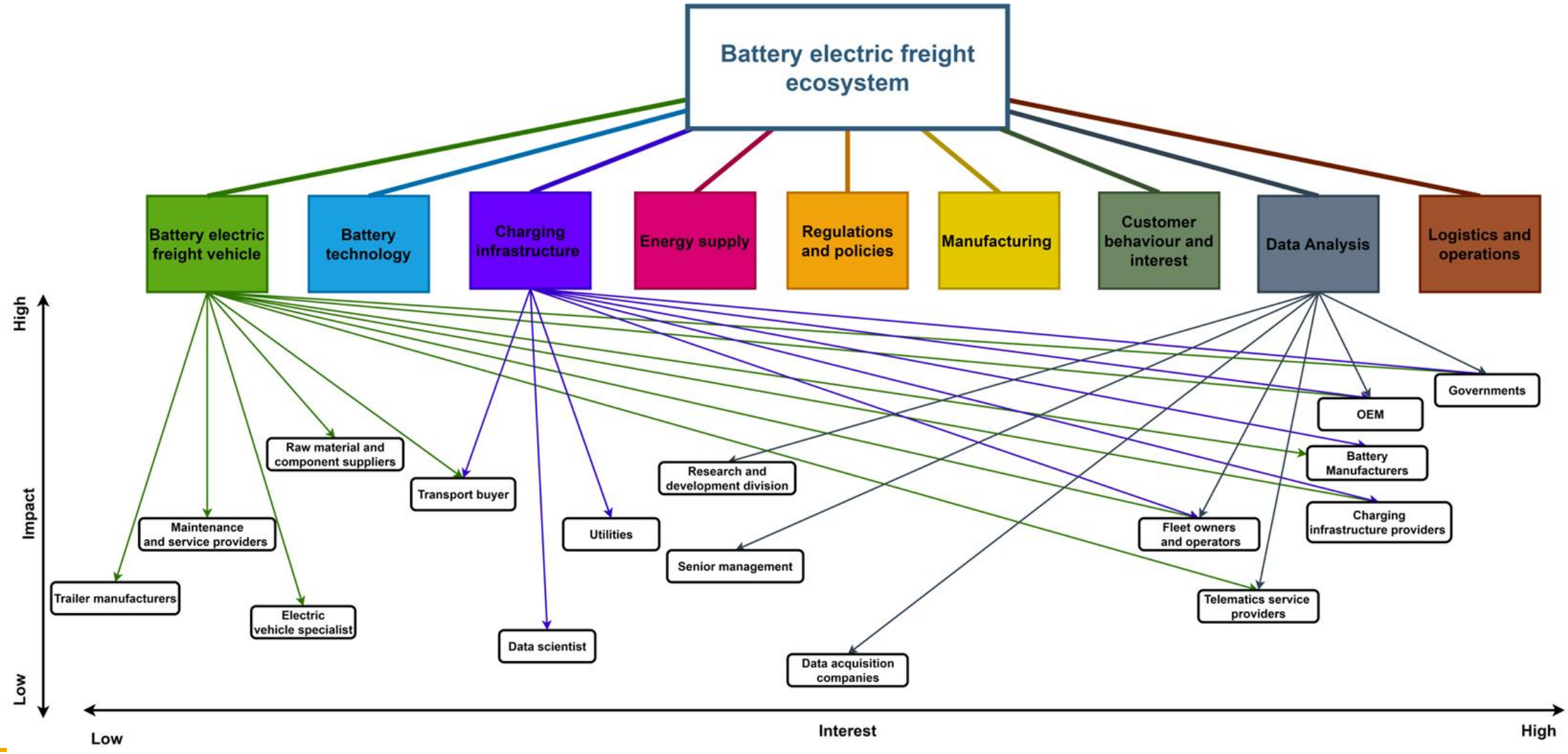
1. **Different types of vehicles:** Require different types of EVs with larger battery capacities and charging systems to meet the demands of heavy-duty commercial transport.
2. **Battery technology**: The specific requirements, including longer battery life and more efficient energy storage systems.
3. **Charging infrastructure**: Adapted to accommodate unique needs of heavy freight vehicles, i.e. larger charging stations, higher power charging.
4. **Energy suppliers**: Energy suppliers would need to consider the increased energy demand of heavy freight vehicles.
5. **Government policies**: Challenges facing the adoption of electric freight vehicles, such as the availability of charging infrastructure, the development of regulations for commercial transport, and incentives businesses to switch.
6. **Manufacturing industry**: Manufacturers of heavy goods freight vehicles and their components would need to invest in the development of EVs.
7. **Data and analytics**: The collection and analysis of data generated by electric freight vehicles in optimizing usage and improving overall efficiency of the ecosystem.
8. **Vehicle ownership and Customer behaviour**: Behaviour and habits of freight operators and fleet managers play a critical role in the adoption of electric freight vehicles.
9. **Passenger operational requirements:** Trip identification, urban traffic management, opportunity charge technology and locations, etc.
10. **Logistics operational requirements**: Logistics encompasses the planning, organization, and management of the transportation and delivery of goods, and is essential to the efficient operation of freight transport.

Elements, Attributes, Relationships ???

Ecosystem design for large scale transition to e-Mobility for passenger and freight transport:
Stakeholders



Ecosystem design for large scale transition to e-Mobility for passenger and freight transport:
Ability to Impact vs Interest

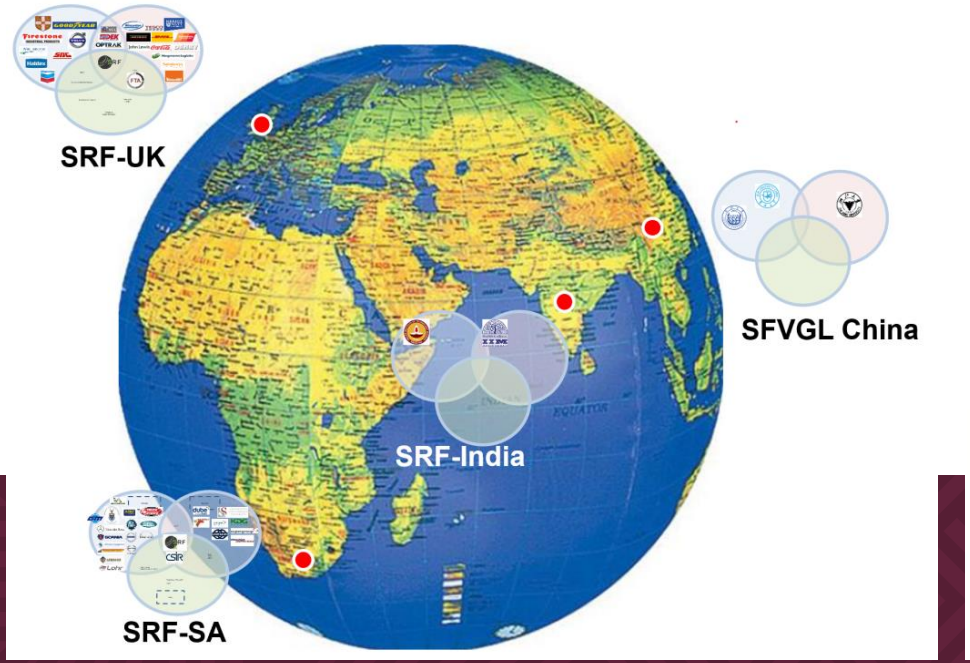


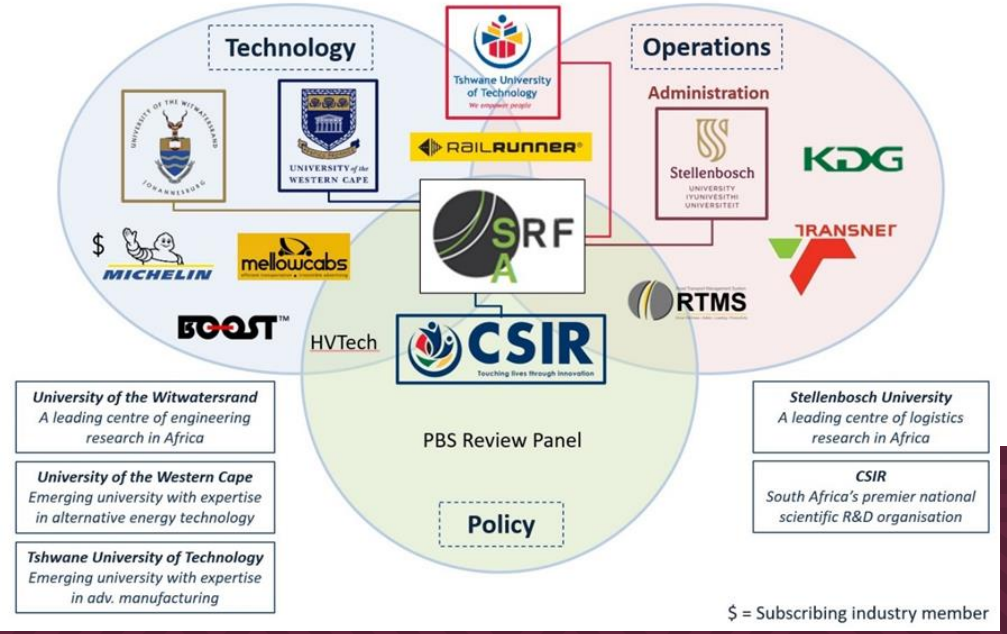
Agenda

- Why is carbon emissions important for SA Exporters
- Macrologistics data to support evidence-based decision making
- Decarbonising Logistics: Where to next?
- Electric Vehicle Ecosystem
- Department of Industrial Engineering Initiatives

Department of Industrial Engineering Initiatives

- Sustainable Road Freight (SRF-SA) research group (since 2018)
  - Collaboration with SRF centres in UK, India, China
  - Focus: Technology, Logistics operations and Policy
  - Research via funded projects and international partnerships





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Department of Industrial Engineering Initiatives

- Sustainable Road Freight (SRF-SA) research group
  - Collaboration with SRF centres in UK, India, China
  - Focus: Technology, Logistics operations and Policy
  - Research via funded projects and international partnerships
- Framework for fruit export emissions:
  - Collaboration between Departments of Industrial Engineering and Logistics (EMS)
  - Developed process framework and SA specific emissions factors
- Other WIP:
  - Third Party Rail Access: Potential for energy and carbon savings known, implementation opportunities to be explored
  - Smart Freight Centre: Discussions for SSA truck emissions factors (GLEC focussed chapter)
  - Elements of a Transport Ecosystem for transition to Renewable Energy Freight Vehicles

We are open for collaboration!

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Thank you
Enkosi
Dankie