Decarbonising Logistics:
A South African Export Supply Chain Perspective

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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
- Carbon emissions calculations
- Case Study: Fruit Exports – Packhouse to international port
- Decarbonising Logistics: Where to next?
- SU Initiatives

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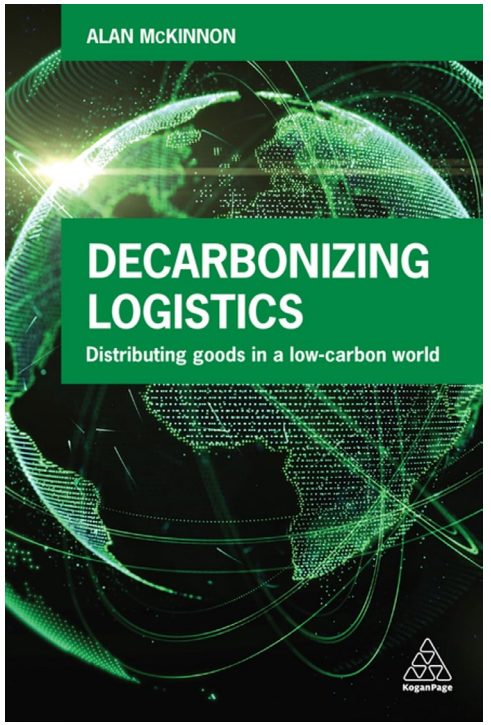
Sustainable Development – Just a *buzzword* or a *personal responsibility*?

"We are facing a man-made disaster on a global scale – irreversible damage to the natural world and the collapse of our societies"

Sir David Attenborough, 2019

"Climate change has evolved from being just another environmental problem to potentially the greatest threat facing our civilization"

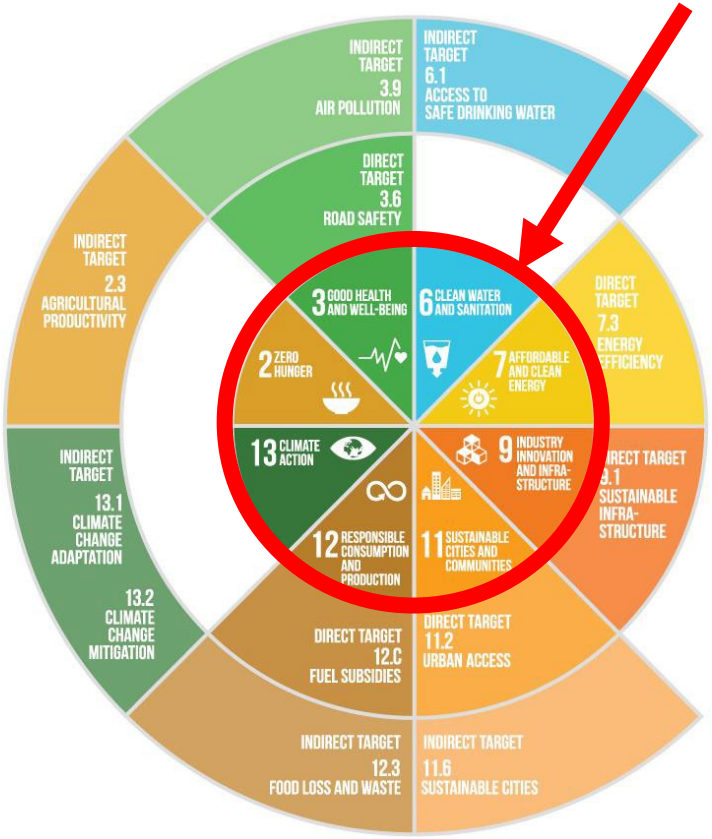
Prof. Alan McKinnon, 2018



Why we should care – we only have one world and one life, we need to use it right!

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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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

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Navigating the World of Sustainable Freight

- Organisations
- Programmes
- Projects
- Tools
- Interventions

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Navigating the World of Sustainable Freight

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Smart Freight Centre

BUILT ON GHG PROTOCOL

GLEC GLOBAL LOGISTICS EMISSIONS COUNCIL

Great guidance document for freight logistics!

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

Carbon emissions calculations

- Entity/facility emissions vs End-to-end/life-cycle-analysis SC emissions
  - Focus to date has been on entity/facility/region/country
  - Translating entity emissions into **fair** product end-to-end chain emissions

- Emissions calculation dilemma:
  - Accurate vs Simplicity
  - Comparable locally and internationally

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A Carbon Mapping Framework for the International Distribution of Fresh Fruit

Martin Du Plessis [1], Prof Joubert van Eeden [1], Prof Leila Goedhals-Gerber [2]

[1] Department of Industrial Engineering, Stellenbosch University, South Africa.

[2] Department of Logistics, Stellenbosch University, South Africa.

INDUSTRIAL ENGINEERING

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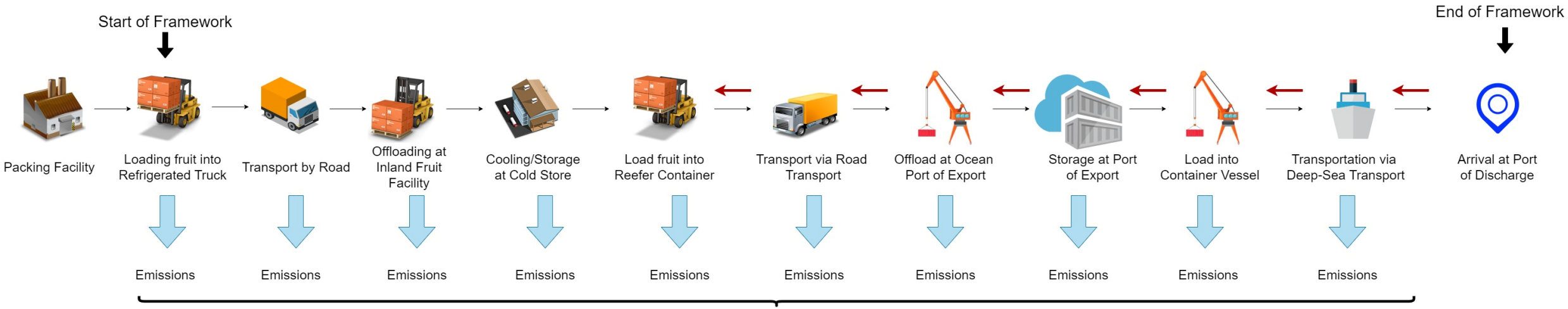
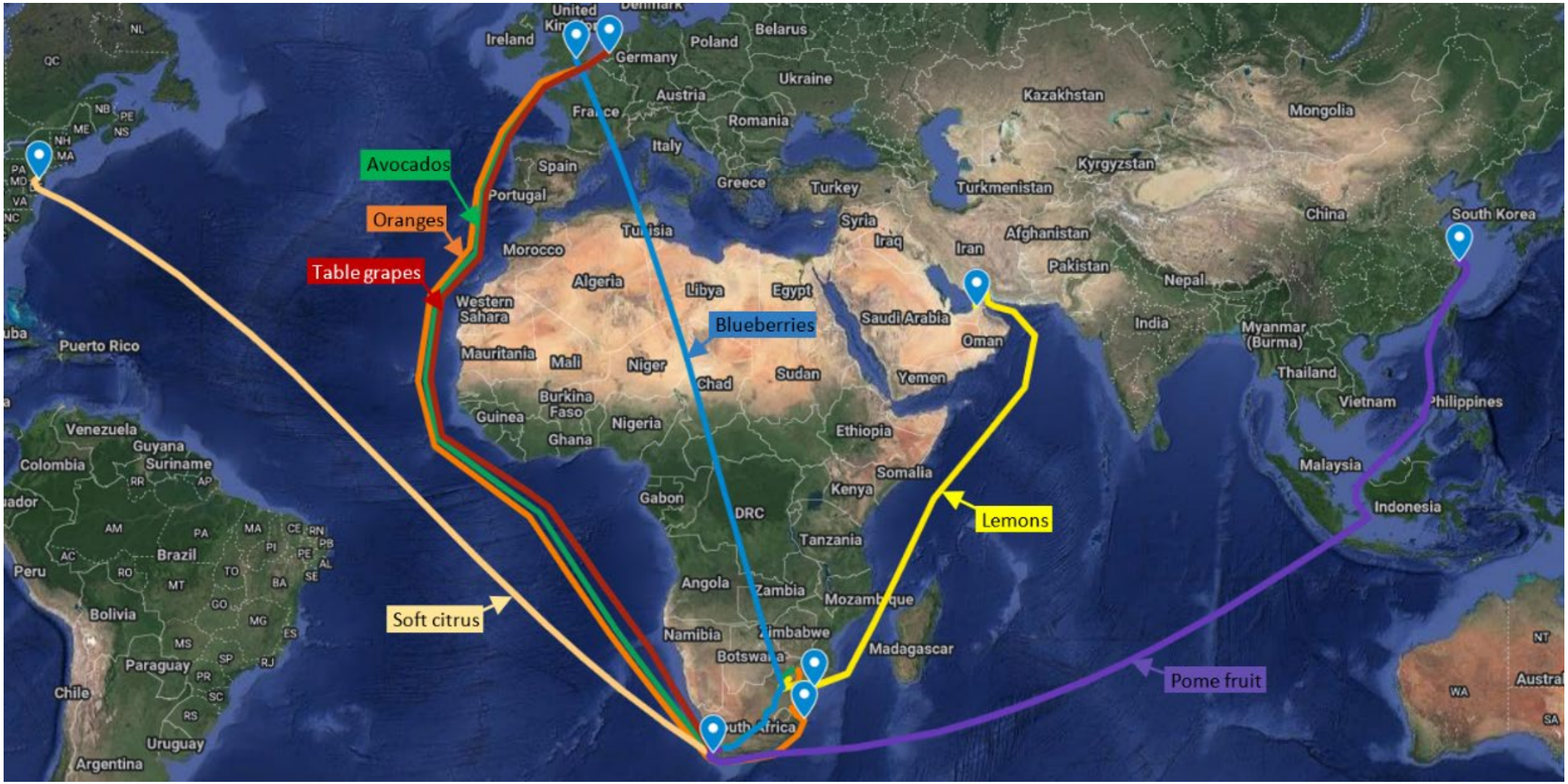
The Problem

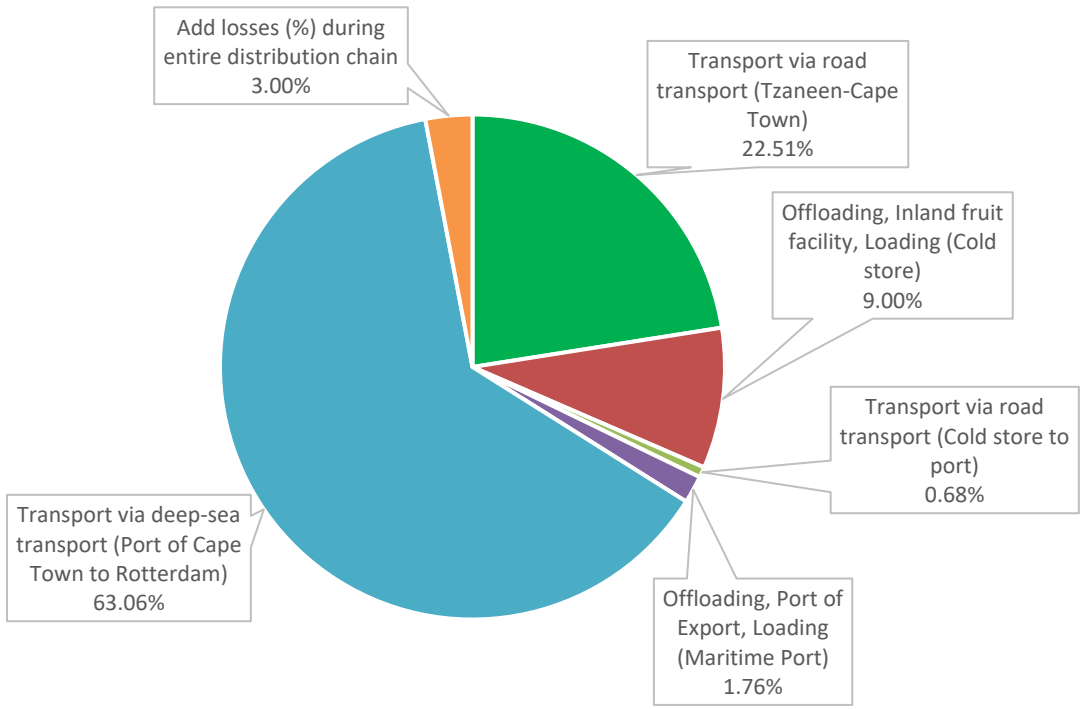


1. Carbon footprint (*ABC kg CO_2e/kg fruit)*
2. Total emission value (*XYZ kg CO_2e)* for the distribution chain

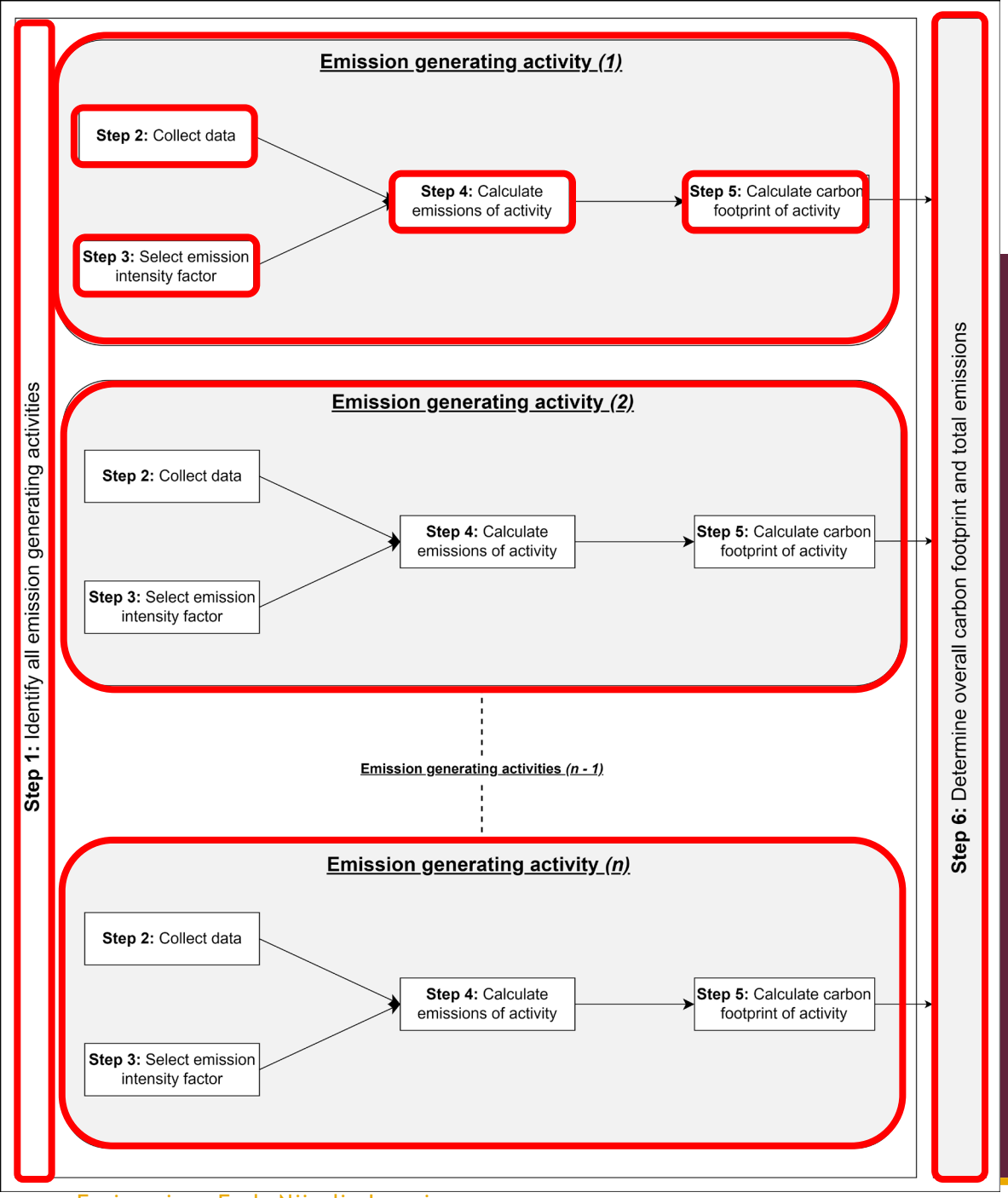
The scale of emissions: results of typical example scenarios



The scale of emissions: results of typical example scenarios



Description of distribution activity	Carbon footprint (kg CO_2e/kg of fruit)
Transport via road transport (Tzaneen to Cape Town)	0,1425
Offloading, inland fruit facility, loading (cold store)	0,0570
Transport via road transport (cold store to port)	0,0043
Offloading, port of export, Loading (maritime port)	0,0111
Transport via deep-sea transport (Port of Cape Town to the Port of Rotterdam)	0,3991
Loss percentage of 3% during the distribution chain	0,0190
Total	**0,6330**



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The 6 steps of the framework

We'll go into the detail of each Step in the next slides…

Step 2: Collect data of each activity

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Weight

Distance

Accounting for losses during distribution

Required data per activity

Step 3: Select emission intensity factors

A COMPREHENSIVE SET OF EMISSION INTENSITY FACTORS IS SUGGEST FOR ALL POSSIBLE EMISSION GENERATING ACTIVITIES

Step 3: Select emission intensity factors (four modes of transport)

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Transportation Research Part D 117 (2023) 103623

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Road fuel and emission factors methodology

Calculating Fuel Usage and Emissions for Refrigerated Road Transport Using Real-World Data

Martin Johannes du Plessis [a], Joubert van Eeden [a,*], Leila Goedhals-Gerber [b], Jacques Else [c]

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[b] Department of Logistics, Stellenbosch University, South Africa, Private Bag X1, Matieland 7602, South Africa
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ARTICLE INFO

Keywords:
Emissions
Fuel consumption
Heavy goods vehicles
Refrigeration
Road transport
Sustainable logistics

ABSTRACT

Road freight transportation is and portant in all distribution chains. However, little research has a vider (LSP) data on a transport service level to determin scenarios. Subsequently, this article analyses 147 200 000 km were travelled, 3 693 tonnes of c diesel fuel were burnt. In addition, 23 250 hours n on the assessed data, a novel formula was developed transport service by incorporating the trailer type, n distance and use and time duration of refrig- era formula enables estimation of the total fuel use (ℓ), print (kg CO_2e/t cargo) and emission intensity factor

1. Introduction

Road freight trans an indispensable part of all freight transportation systems (IEA, 2017). According to the Global F , more goods are transported by heavy goods vehicles (HGVs) than ever – an estimated 120 trillion tonn 017 alone (SLOCAT, 2021). In the USA and EU, respectively 59.3 % and 77.4 % of all freight is moved by road tra S Bureau of Transportation Statistics, 2020; Eurostat, 2022). However, in developing countries such as South Africa, % of all freight is moved by road (DoT, 2018).

Road transportation will rema an essential part of the vast majority of all supply chains worldwide for the foreseeable future. Nearly all goods, products and raw materials are transported by road during some parts or the entire distribution process. This is due to the flexibility, speed, cost, low capital investment in infrastructure and equipment, and ease of using road transport compared to other modes. However, logistics is entering a new age – from the enabler of international trade to the kingpin of universal sustainability (Havenga, Witthöft, De Bod & Simpson, 2020).

According to the IEA (2017), the road freight industry consumed nearly 17 million barrels of crude oil per day in 2015 alone, representing nearly 20 % of the global oil demand and half of the global diesel consumption. Growth in the road freight industry is

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https://doi.org/10.1016/j.trd.2023.103623
Received 25 September 2022; Received in revised form 11 December 2022; Accepted 18 January 2023
Available online 27 January 2023
1361-9209/

sustainability

MDPI

Article

Cold store emission factor methodology

The Carbon Footprint of Fruit Storage: A Case Study of the Energy and Emission Intensity of Cold Stores

Martin Johannes du Plessis [1,*], Joubert van Eeden [1] and Leila Louise Goedhals-Gerber [2]

[1] Department of Industrial Engineering, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa; jveeden@sun.ac.za
[2] Department of Logistics, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa; leila@sun.ac.za
* Correspondence: martinduplessis6@gmail.com

Abstract: Despite their importance in all transportation chains, logistical sites—and in particular refrigerated facilities—are the weakest link in current emissions literature. This is largely due to a lack of quantitative research that focuses on these facilities. This article is the first of its kind to assess the emissions of eight refrigerated facilities that ha dle and store fresh fruit. In 2020, the analyzed facilities moved a total of 646,572 pallets of fr and emitted 32,225 t of CO_2e. Five of the largest facilities were responsible for hand the total fresh fruit exported from South Africa during 2020. The results reveal handling a pallet of fruit in a large-scale commercial cold store requires 7.6 day. Storing and handling fresh fruit is carbon intensive since each pal CO_2e d^{-1}. However, other factors such as the seasonality and vol eristics and the availability of solar electricity systems, am duct on the emissions value of the facility and on the emissi the facility.

Keywords: orage; decarbonization; GHG emissions; fresh fruits; refri ports; sustainable supply chain

check for updates

Citation: du Plessis, M.J.; van Eeden, J.; Goedhals-Gerber, L.L. The Carbon Footprint of Fruit Storage: A Case Study of the Energy and Emission Intensity of Cold Stores. *Sust* **2022**, *14*, 7530. https:// 10.3390/su14137530

Academic Editor: Vladim

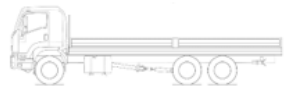
Received: 26 May 2022
Accepted: 11 June 2022
Published: 21 June 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

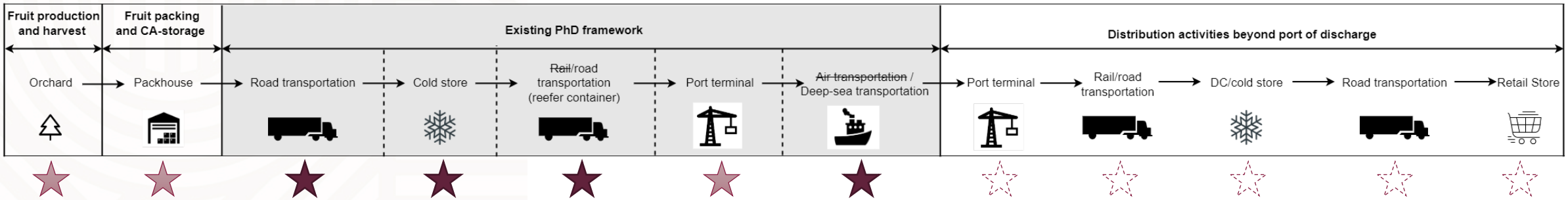
de was at an all-time high of USD28.5 trillion for 2021—an increase of o pre-pandemic levels [1]. The global economy has evidently recovered tent after the COVID-19 pandemic. Alongside this recovery is an automatic n freight logistics since the exchange of goods still represented 78.2% of the total al trade (USD22.3 trillion) during 2021 [1]. Freight logistics has been and will always e a vital part of the world economy because all supply chains depend on the movement of goods [2]. If GDP growth remains coupled with international freight flow, the International Transport Forums (ITF) project that by 2050, freight transport alone will have grown by a factor of 2.6 to 345 trillion t-km compared to 2015 [3].

In 2019, the transport sector as a whole was responsible for 8.2 Gt of CO_2 or 27% of all greenhouse gas (GHG) emissions [4]. After the industrial and building sectors, the transportation industry is the sector responsible for most global emissions. This is confirmed by Wang and Ge [5] from the World Resource Institute (WRI), who estimate that the transport sector as a whole emitted 24% of all emissions during 2016. Focusing on freight logistics specifically, road freight, ocean freight, rail freight, air freight, and logistics sites collectively emit approximately 5 to 5.5% of the total global GHG emissions [6,7]. Other authors, such as Rüdiger et al. [8], estimate that up to 7% of Germany's total GHG inventory for 2015 is due to freight logistics. Note the difference between freight transport (physical movement of cargo by various modes) and logistics, which includes both freight transport and activities at logistical sites such as warehouses, terminals, and ports. Higgins et al. [9] emphasize the importance and fundamental role of logistical sites in international, national

Vehicle configuration emission factors

Vehicle description	Description of factor			Emission intensity factor (g CO_2e/t-km)	
	Load type	Empty Running	Load factor	Dry	Refrigerated
 4x2 Rigid (GVM:±14 t, max payload:±8 t)	Pallets	45%	55%	150	171
			85%	107	128
 6x4 Rigid (GVM:±24 t, max payload:±15 t)	Pallets	45%	55%	121	143
			%	86	100
 4x2 truck tractor and tandem semi-trailer (GCM: ±34 t, max payload: ±15 t)	Pall	%	55%	174	184
			85%	116	122
 6x4 truck tractor and (GVM: ±49.5 t, max pa	allets	10%	55%	87	91
			85%	59	62
		50%	55%	148	157
			85%	99	105
 6x4 truck tractor and tridem semi-trailer loaded with 40-foot reefer container (GCM: ±49 t, max payload excl. container: ±28 t)	Container	10%	55%	98	103
			85%	66	70
		50%	55%	168	173
			85%	112	115
 Standard interlink tautliner - 6x4 truck tractor with tandem- tandem trailer (GCM: ±56 t, max payload: ±36 t)	Pallets	10%	55%	99	-
			85%	67	-

Future plans - where to next and potential collaboration?



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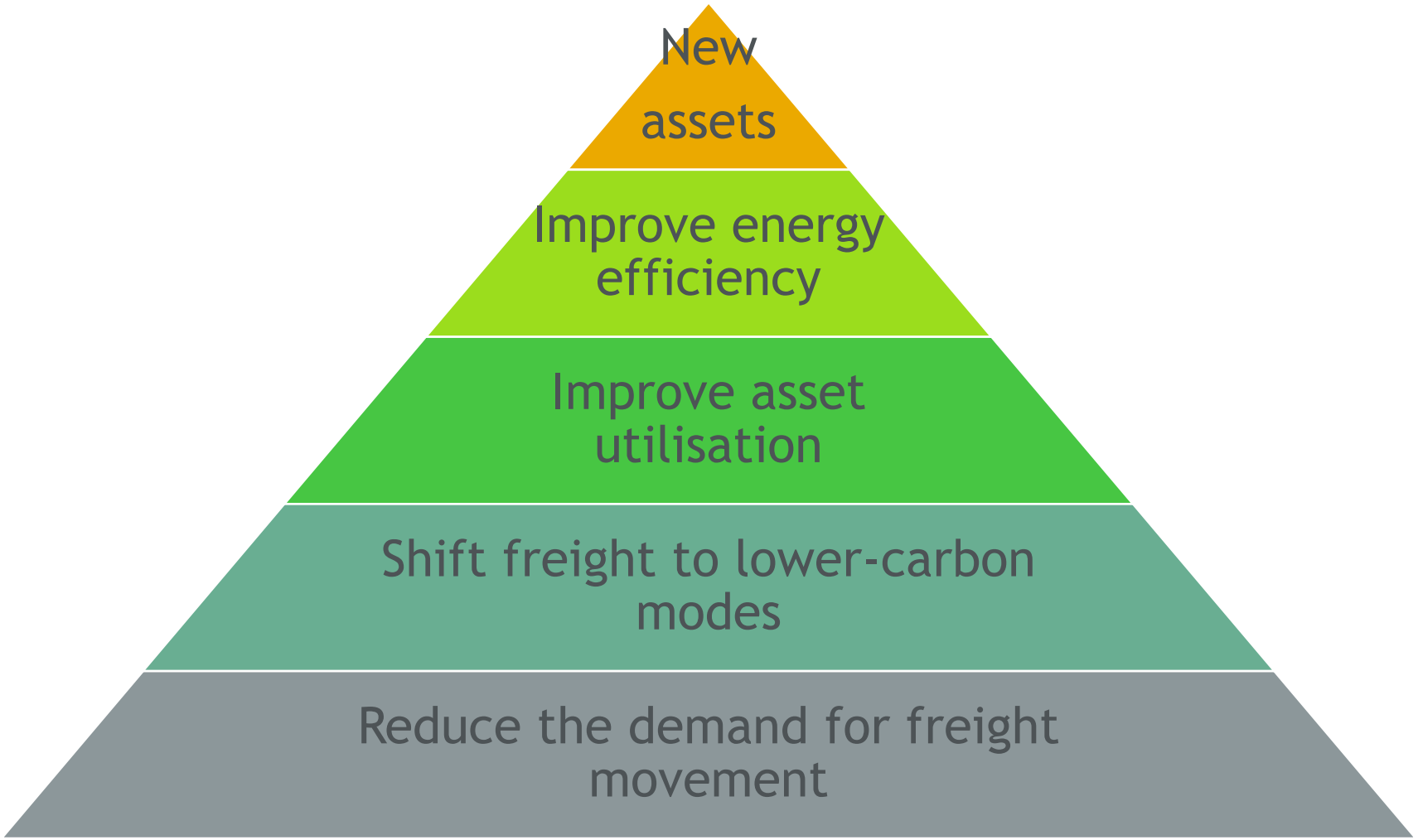
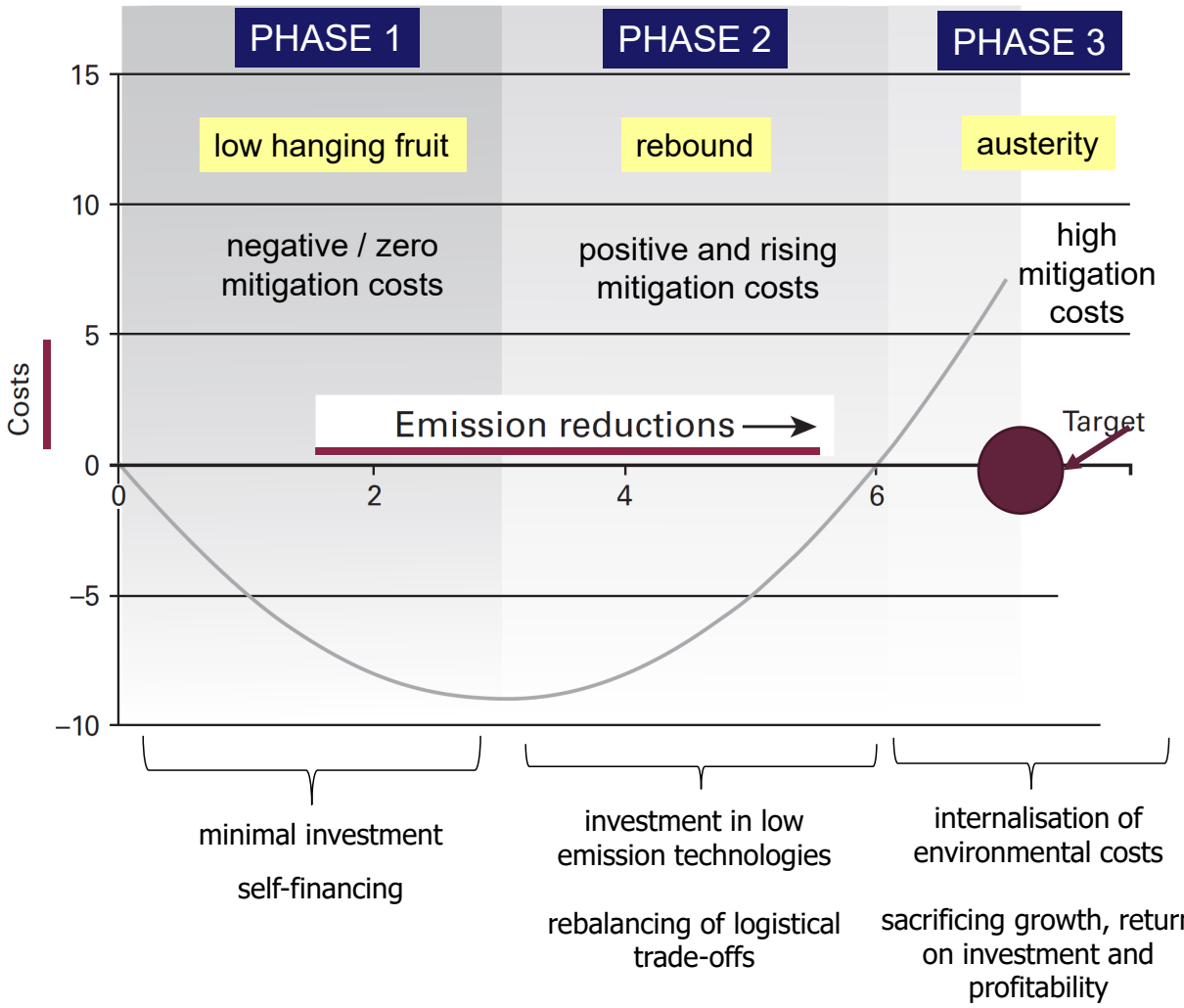
Hierarchy of Intervention - how to go about decreasing freight emissions



Adapted McKinnon (2018)

Will being *green* cost you more?



Adapted from Tavasszy (2014) and McKinnon (2023)

A *Limitation* or *Opportunity*?

ENVIRONMENTAL IMPACT

REGULATORY COMPLIANCE

COMPETITIVE ADVANTAGE

COST SAVINGS

REPUTATION AND BRAND IMAGE

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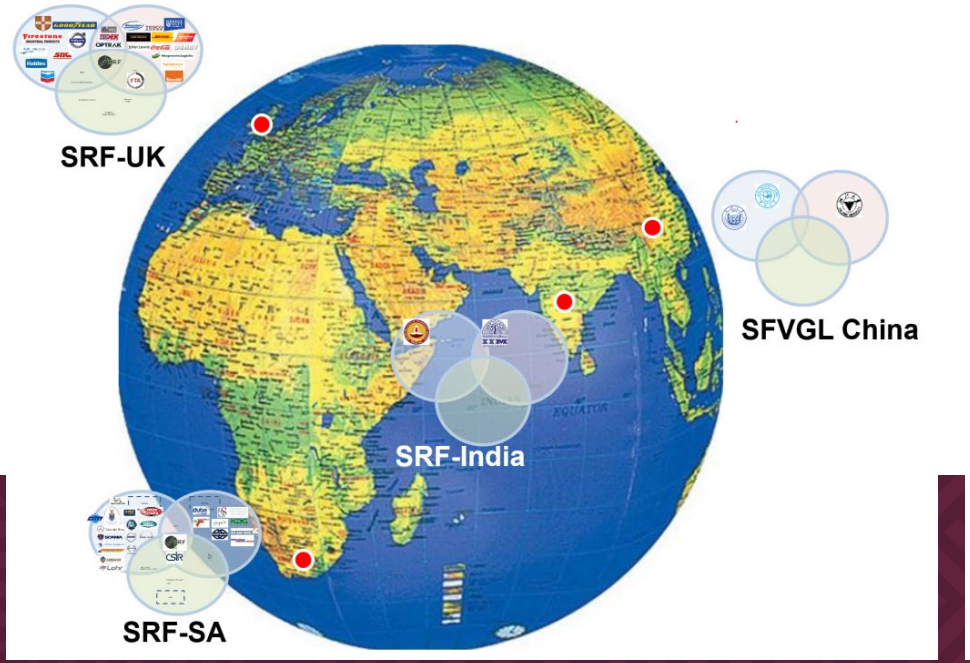
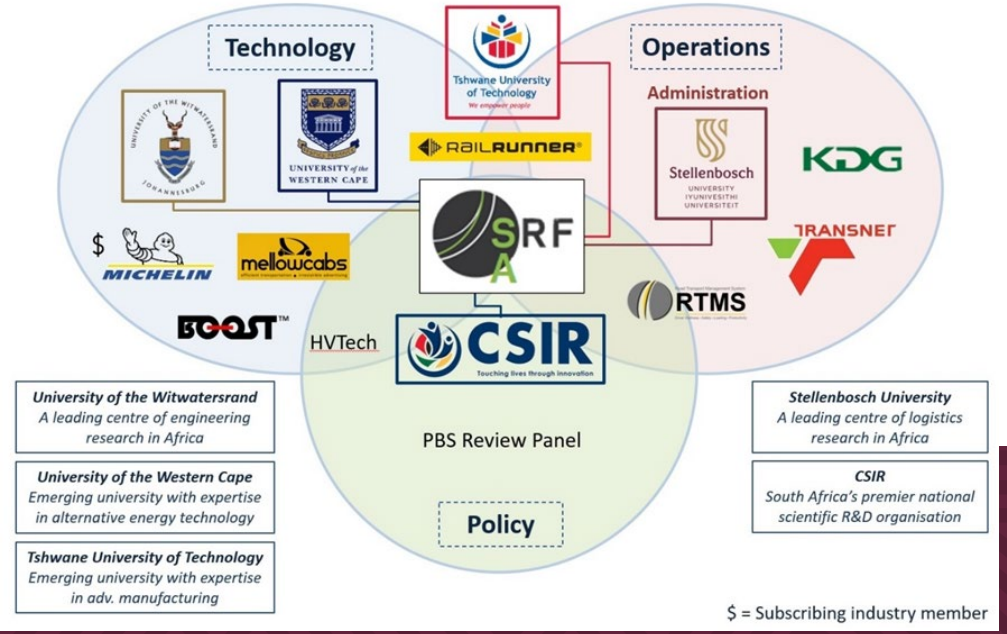
Department of Industrial Engineering Initiatives

- 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





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Department of Industrial Engineering Initiatives

- Sustainable Road Freight (SRF-SA) research group
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- 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)
  - WEF First Mover Coalition: Investigations into Green Shipping Corridors
  - 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