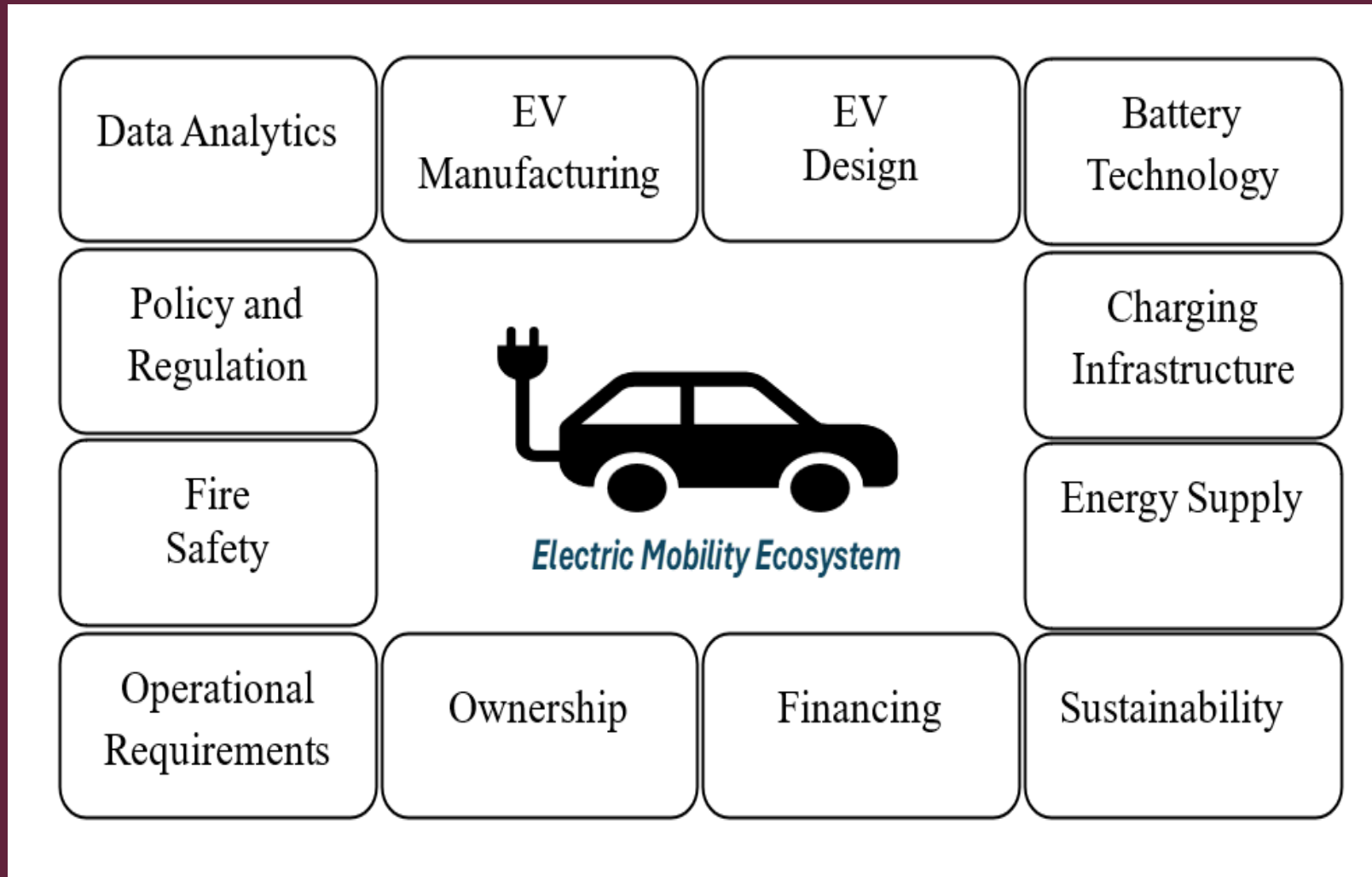


The Electric Mobility Ecosystem Workshop:

Explore Electric Mobility (EM) - Indicate your area(s) of interest



The Electric Mobility Ecosystem:
Stakeholder Survey (SU
Engineering Industry Showcase)





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Engineering
EyobuNjineli
Ingenieurswese



The Electric Mobility Ecosystem Workshop

Faculty of Engineering

Industry Showcase 2025

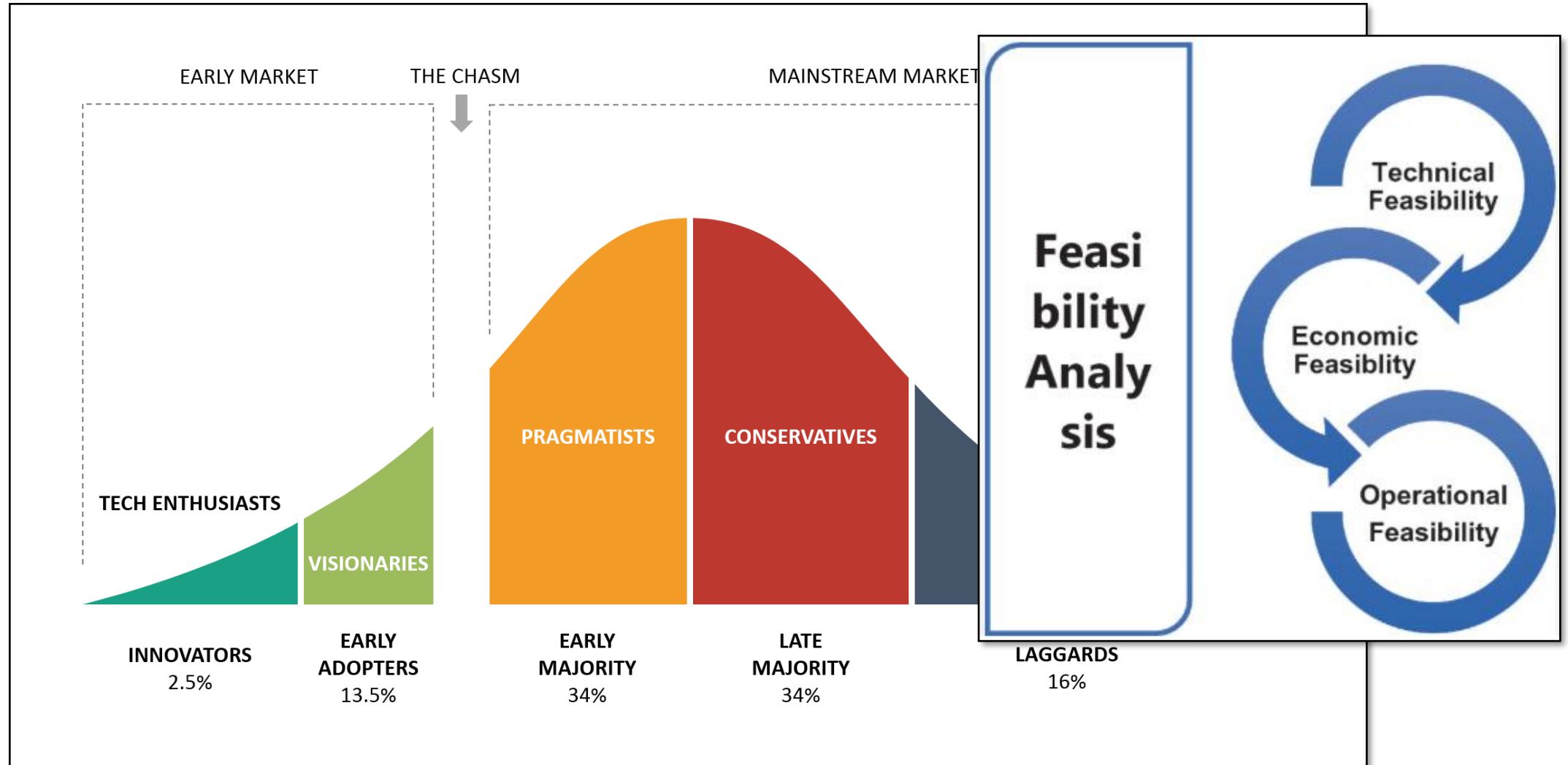
Technology Adoption Chasm: Data-driven informed decision-making



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forward together
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saam vorentoe

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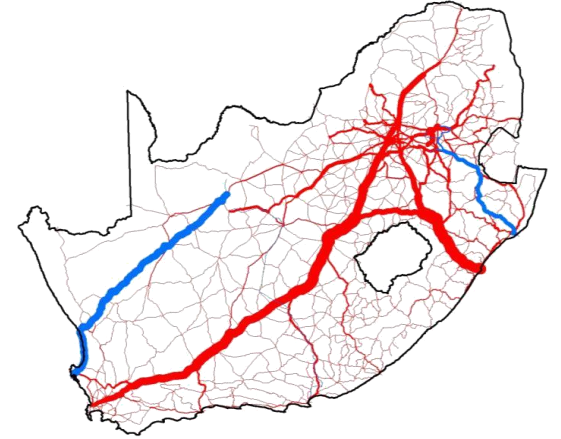


Agenda

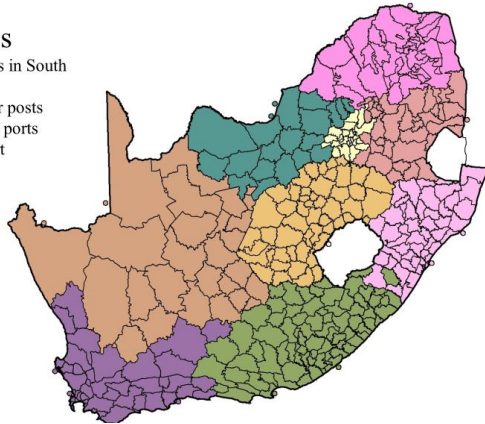
- **Introduction and research background:**
 - **Joubert van Eeden**
 - Megan Bruwer
 - Thinus Booysen
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- Open Discussion/Comments/Next Steps (Joubert & Thinus & Megan)

MacroLogistics planning and modelling

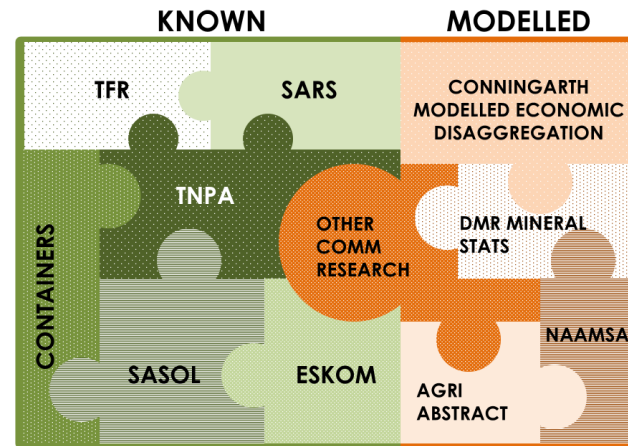
- Past 18 years:
 - 2006+ Freight Demand Model for SA: with Prof Jan Havenga
 - 2010+ Freight Corridor modal shift: with Prof Jan Havenga
 - 2014+ Port infrastructure planning: Based on Economic Trade Activity



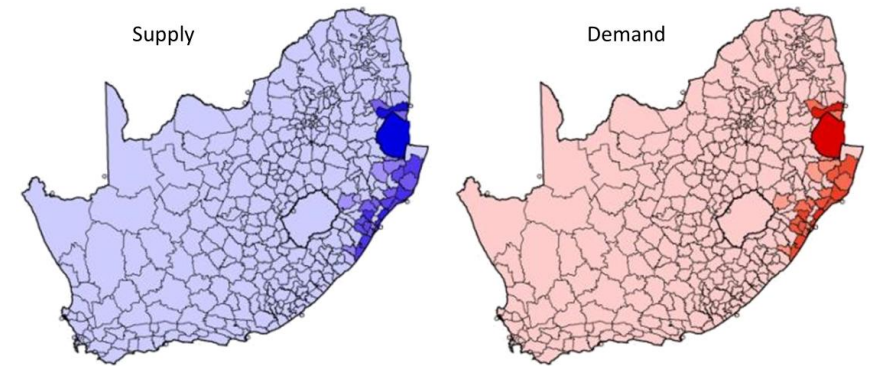
- 372 GD's
 - 356 GDs in South Africa
 - 8 Border posts
 - 7 Ocean ports
 - 1 Airport



Total economy: Supply and Demand



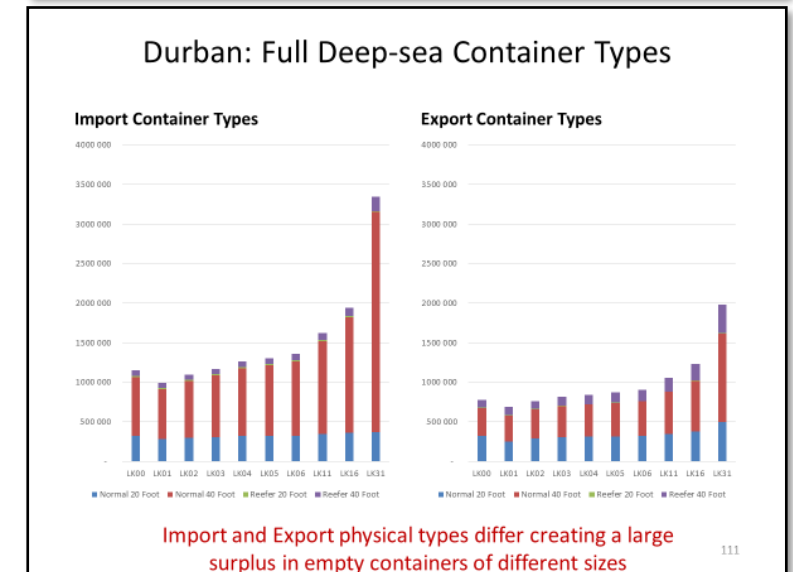
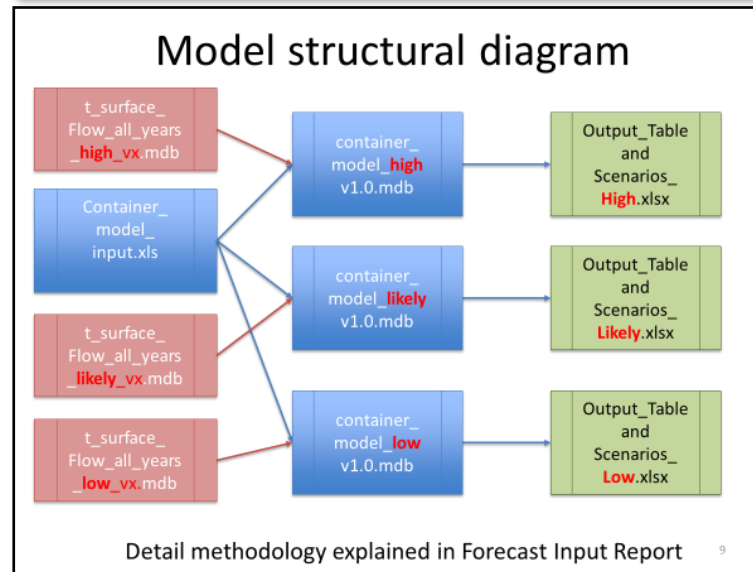
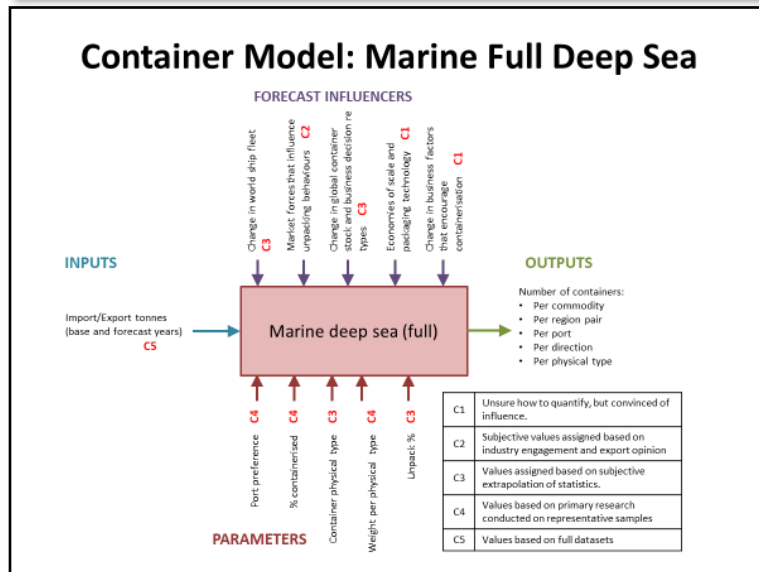
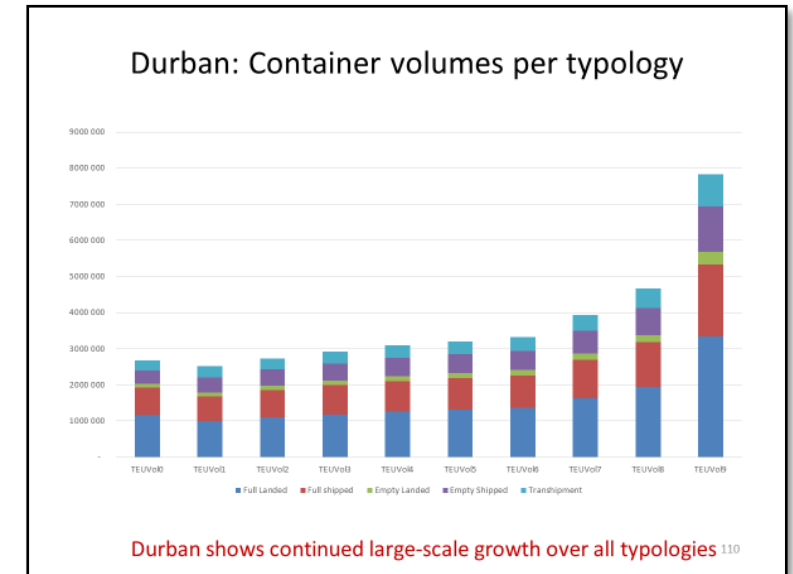
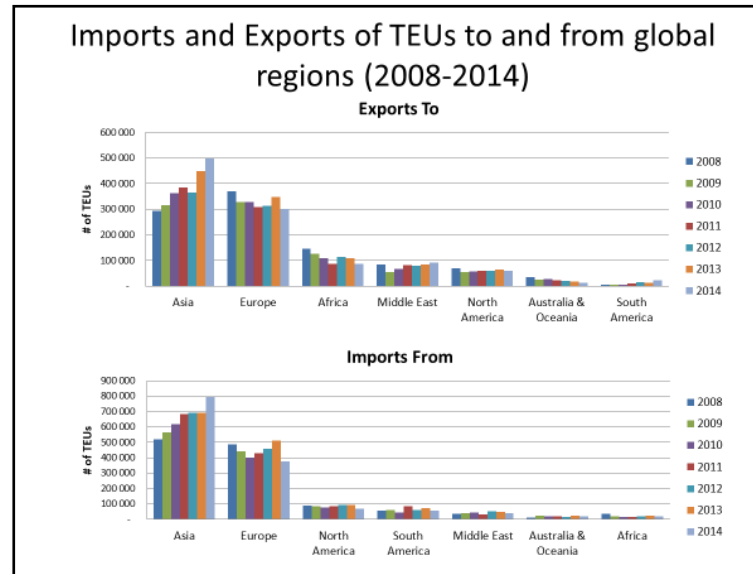
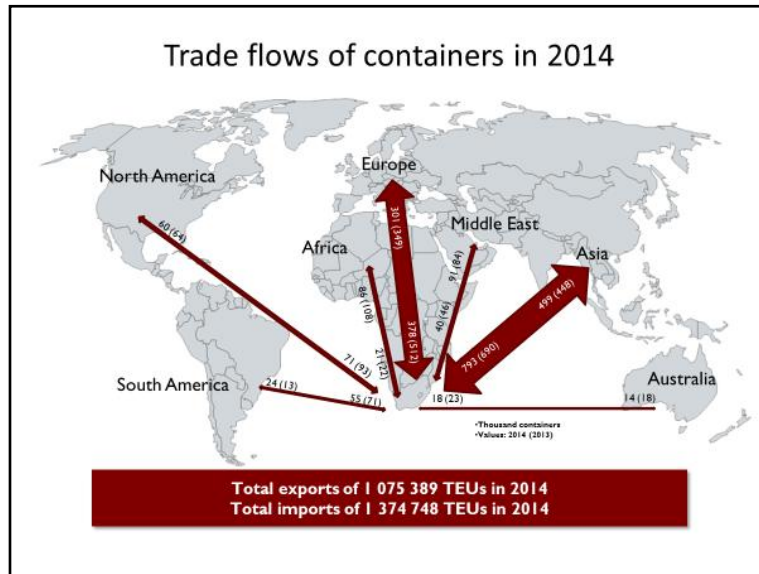
Methodology: MD Map – Supply and Demand for Sugar Cane



Source: GAINGROUP

Multiple outputs over the years from this research

Port Container Demand planning models



Road to Rail: Modal shift

Moving Freight From Road to Rail; no freight left behind

Innovative trailer design - wide range of freight can be transported

bosch

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saam saam voorwaarts

Technology:
bogie | trailers

Terminal:
Anywhere

Transnet:
Freight Rail



Multiple trailer designs:

- Curtainside
- Container (6/12m)
- Side Tipper
- Car Carrier

Terminal:

- Efficient
- No specialised equipment
- Rail lines on level area



• Twenty year 'Hook & Haul' agreement with TFR

2020


RailRunner Value Proposition South Africa 2020

4

RAILRUNNER

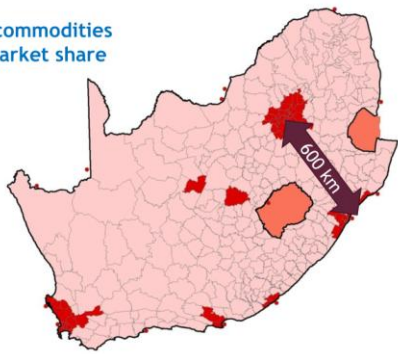
Engineering | EyobuNineli | Ingenieurswese

Modal shift Impact: Durban - Gauteng



Catchment areas:
Durban = 40 km
Gauteng = 150 km

Note:
Six (6) commodities
100% market share



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)**

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Background

Problem

Objectives

Methodology

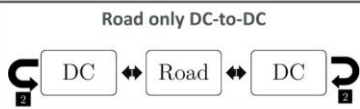
Toolkit

Conclusions

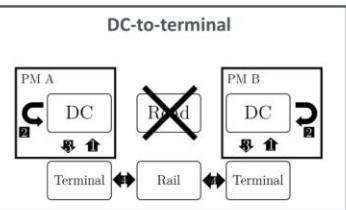
Recommendations

Financial model: Three methods of transport

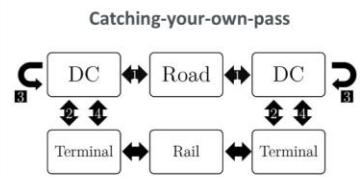
Road only DC-to-DC



DC-to-terminal



Catching-your-own-pass



The RailRunner system/technology

Selection criteria for potential users

Stakeholder analysis

Financial model

Decision matrix

Frequently asked questions

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Background

Problem

Objectives

Methodology

Toolkit

Conclusions

Recommendations

Financial model: Variable cost

Transport method	DC-to-DC (superlink)	DC-to-DC (tri-axle)	Catching-your-own-pass	DC-to-Terminal
Total Fuel (rand)	R 1 336 953	R 1 336 953	R 1 098 314	R 2 208 128
Top-up oil	R 66 848	R 66 848	R 54 916	R 110 406
Total repair & maintenance	R 616 187	R 616 187	R 489 041	R 743 142
Total tyres	R 181 384	R 156 263	R 306 539	R 592 426
Cost per tonne-km charged for RR trailer on rail	NA	NA	R 0,30	R 0,30
Cost to move RR trailer(s) over rail	NA	NA	R 3 294 720	R 17 571 840
Toll fees per annum	R 118 118	R 118 118	R 78 745	NA
Unforeseen expense	R 125 000	R 125 000	R 130 000	R 130 000
TOTAL VARIABLE COST	R 2 444 489	R 2 419 368	R 5 373 529	R 21 355 942
TOTAL OPERATING COSTS	R 3 551 914	R 3 492 985	R 6 997 562	R 26 221 784

The RailRunner system/technology

Selection criteria for potential users

Stakeholder analysis

Financial model

Decision matrix

Frequently asked questions

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Fruit Packing

Establish the carbon footprint of packing different types of fresh fruit.

Cold Stores

Assess the energy and carbon footprint of storing and handling fresh fruit.

Maritime Shipping

Determine the energy and emissions of break-bulk fruit shipping.

Cold Chain Duration

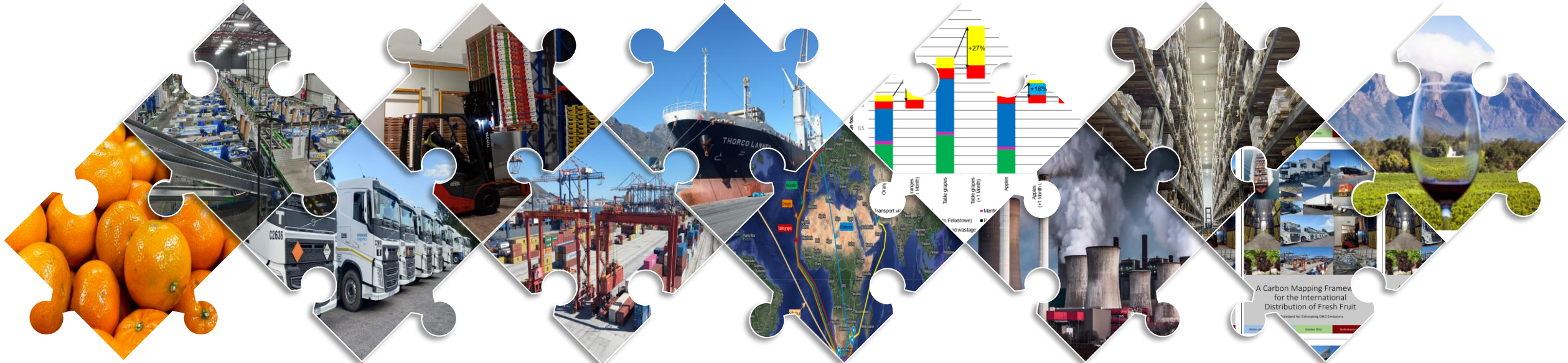
Assess the impact of cold chain duration for different fruit types from SA.

Pharmaceutical Distribution

Investigate the energy and carbon intensity of pharmaceutical distribution in Southern Africa.

Carbon Footprint of Wine Distribution

Assess the carbon footprint (kgCO₂e/kg fruit) of wine logistics from cellar-door to EU retailer.



Citrus Fruit Production

Determine the GHG emissions (CO₂e) of producing 1 ton of hard and soft citrus.

Road Freight Transport

Establish the GHG emissions (CO₂e) of transporting various goods by road in SA.

Logistical Facilities

Determine the GHG emissions of moving cargo through different types of facilities.

Carbon Footprint of Fruit Distribution

Assess the carbon footprint (kgCO₂e/kg fruit) of different types of SA fruit from packhouse door to port-of-import.

Carbon Emissions Calculator

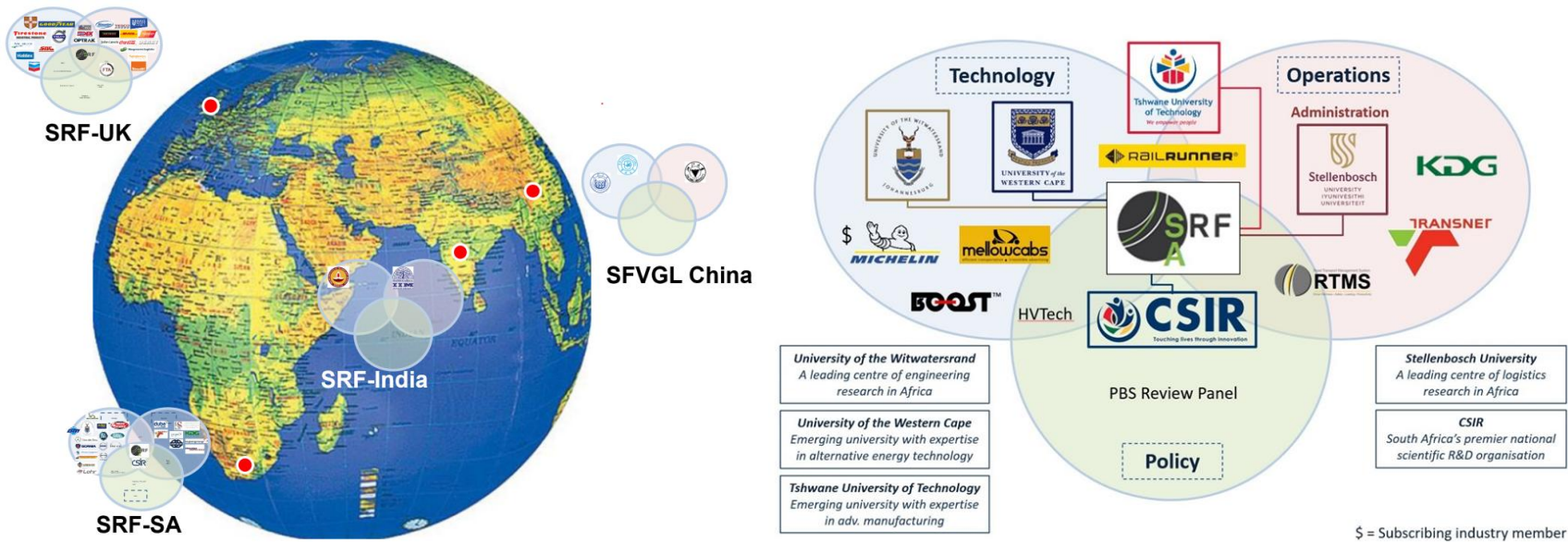
Develop a carbon emissions calculator that easily calculates the GHG emissions on a shipment and company level.

Emissions Standard for Fresh Fruit Distribution

Develop an industry standard for calculating distributional emissions of SA fruit exports.

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



Masters in Industrial Engineering

FOCUS: LOGISTICS AND SUPPLY CHAIN SYSTEMS
(STRUCTURED)

The logistics and supply chain systems programme focuses on enabling students to develop forward-thinking strategies to enhance the global competitiveness of supply chains, making significant contributions to logistical frameworks and ensuring these systems are resilient and future ready.

- Structured module-based degree on NQF level 9
- Part-time and full-time options available
- 8 modules (6 core, 2 or 3 elective modules) and a research assignment in industry relevant topics
- 2-3-year commitment

For more information send an email to mfrei@sun.ac.za or
Prof Goedhals-Gerber leila@sun.ac.za

MASTERS IN ENGINEERING MANAGEMENT (RESEARCH)

The luxury of two years' dedicated skills development on a topic of your choice, with a topic guru as supervisor.

- Deliverables: 180 credit Thesis and finalized journal paper
- Thesis hand-in due dates:
- End August for December graduation
- Middle November for March graduation
- NOF level 9 qualification

- Full-time or part-time registrations possible

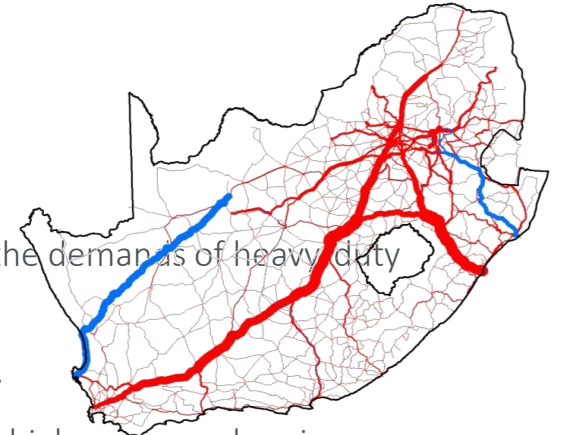
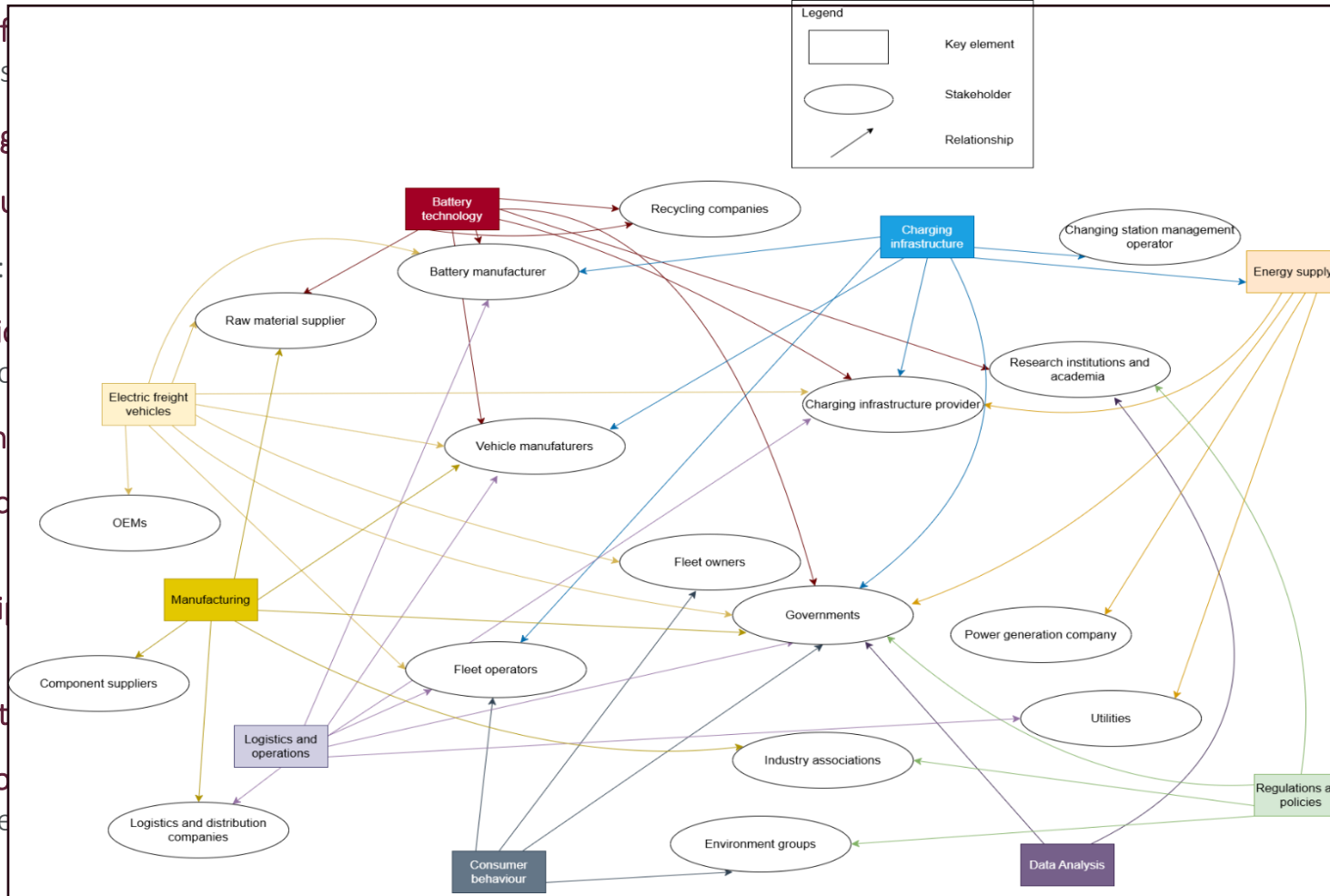
For more information send an email to mrust@sun.ac.za

- Industrial Engineering offerings includes PhD studies.
 - Research programme comprising 240 project-work credits in the form of a research dissertation.
 - Minimum residency of 2 years.
- For more information send an email to mmolapo@sun.ac.za

FIND OUT MORE: www.le.sun.ac.za

Elements of a Transport Ecosystem for transition to Electric Freight Vehicles

1. Different types of commercial transport
2. Battery technology
3. Charging infrastructure
4. Energy suppliers:
5. Government policies and regulations for commercial transport
6. Manufacturing infrastructure
7. Data and analytics ecosystem.
8. Vehicle ownership and fleet management for freight vehicles.
9. Passenger operations
10. Logistics operations is essential to the



the demands of heavy-duty transport. S. s, higher power charging. infrastructure, the development of in the development of EVs. improving overall efficiency of the cal role in the adoption of electric and locations, etc. portation and delivery of goods, and

Elements, Attributes, Relationships ???

Agenda

- **Introduction and research background:**
 - Joubert van Eeden
 - **Megan Bruwer**
 - Thinus Booysen
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- Faculty of Engineering capabilities (Megan)
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Traffic Engineering - Dr Megan Bruwer



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- Department of Civil Engineering.
- Research unit for mobility studies.
- Focus on ITS, Big Data & sustainable mobility improvements for the developing country context.
- Strong industry connections.



transport
Department:
Transport
REPUBLIC OF SOUTH AFRICA

ROUNDBABOUTS - tracking data, geometric design, safety



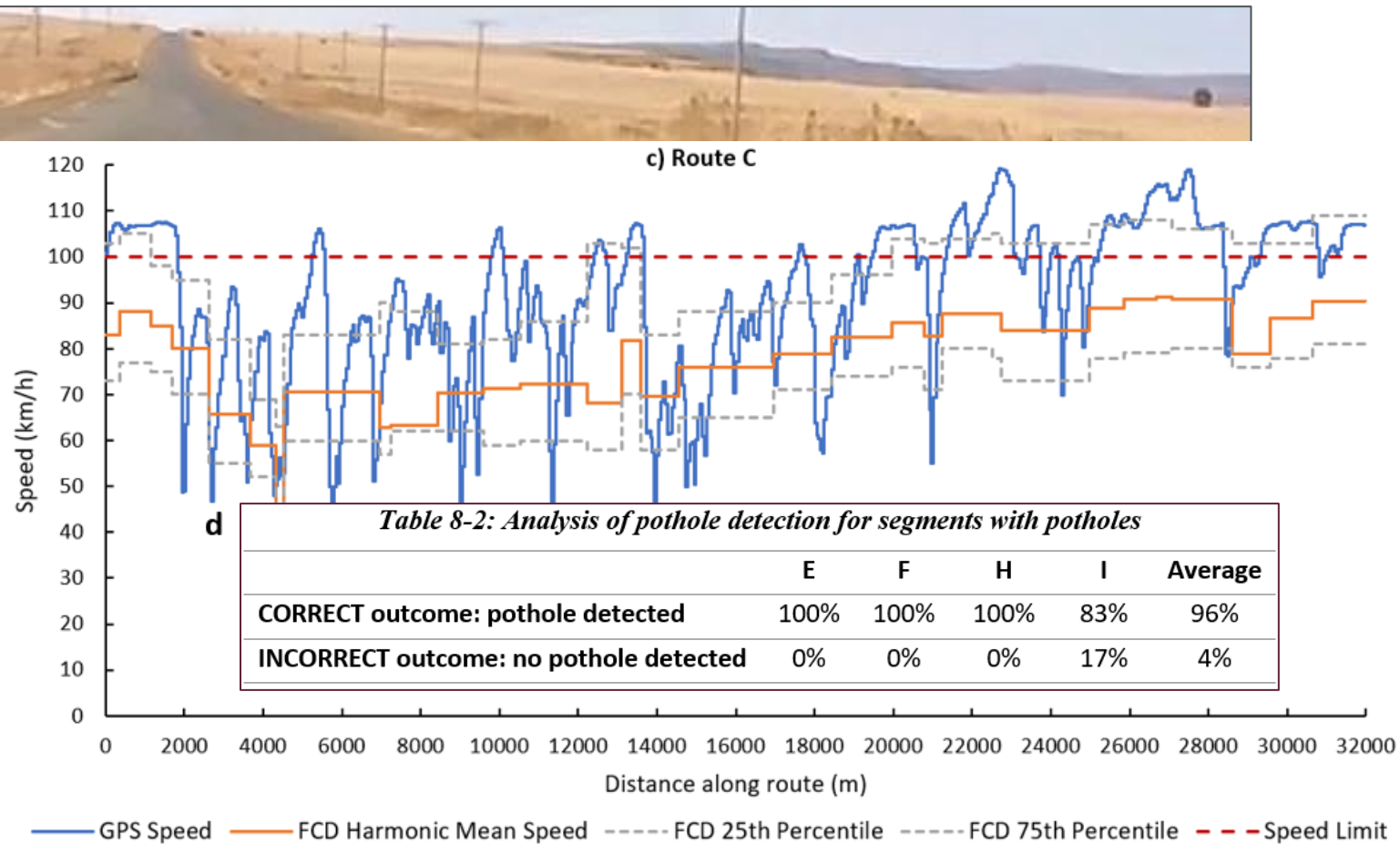
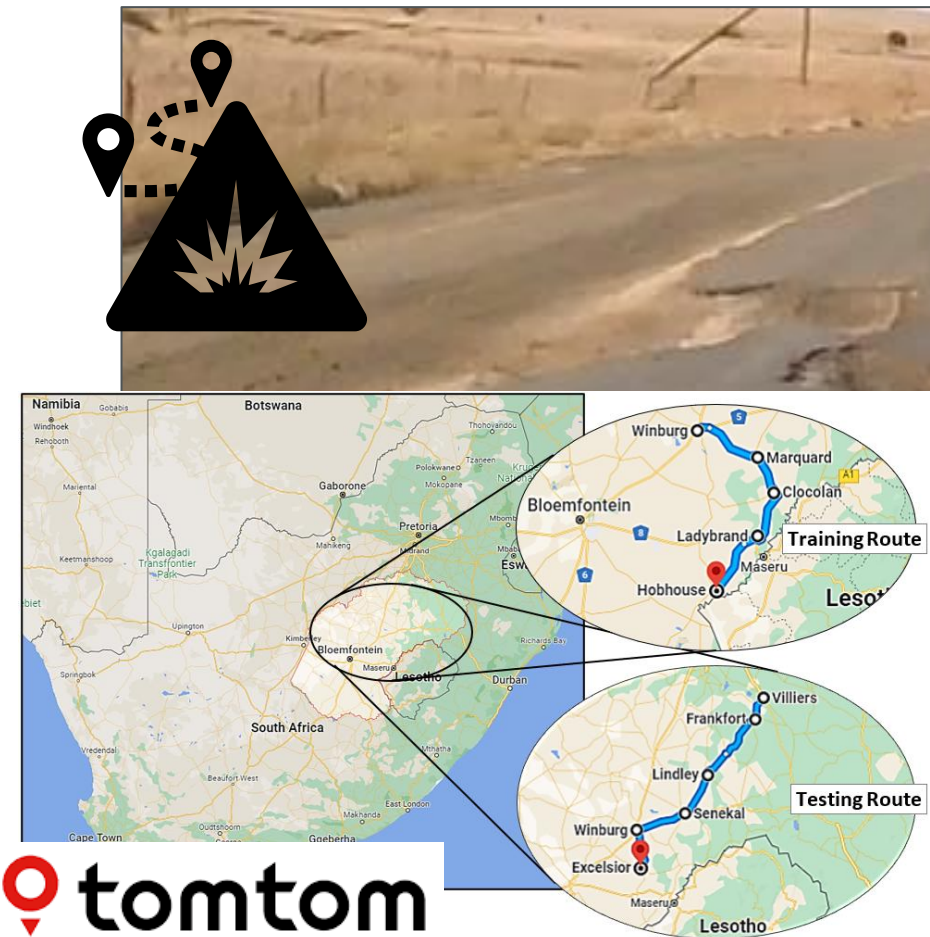
SANRAL



BUILDING SOUTH AFRICA
THROUGH BETTER ROADS



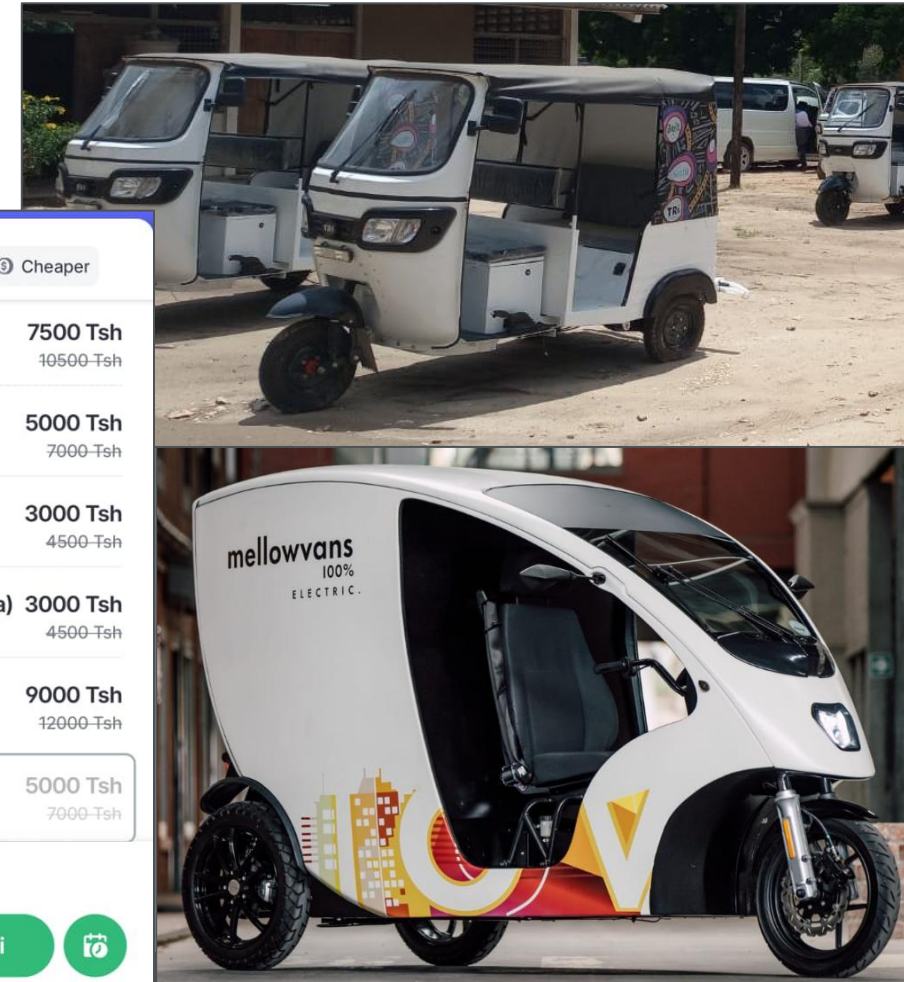
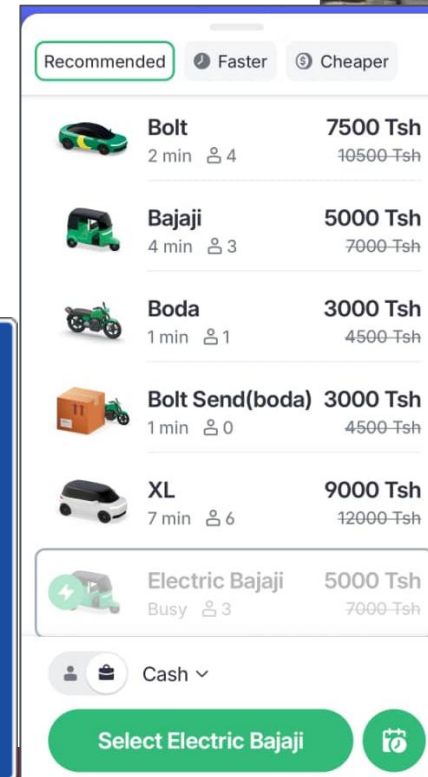
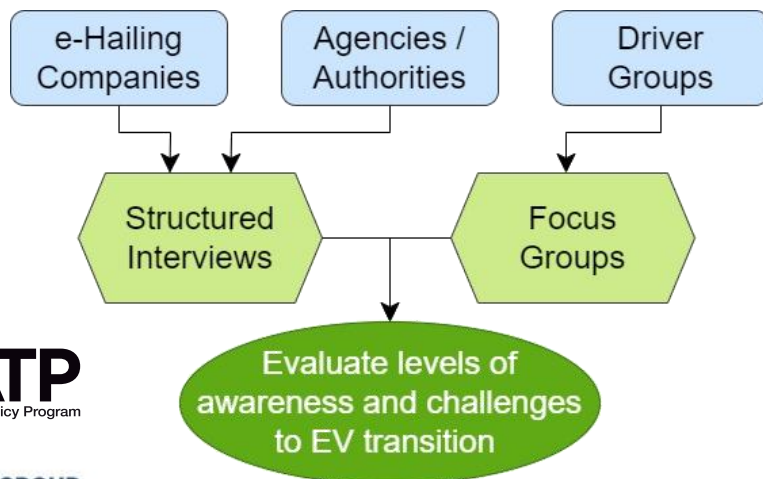
Floating car data - inferring the location of POTHOLE



Electric Mobility in the ride-hailing space

EM for ride-hailing (Tanzania, South Africa and Nigeria)

1. Identify challenges and opportunities for e-mobility and ride-hailing in Africa.
2. Develop recommendations to unblock the bottlenecks.



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Collaboration on Electrification of Transport



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- Industry (SA)

- MTN
- Golden Arrow
- Rham Equipment
- HYDAC
- Takealot
- Balancell
- Scatec
- MiX Telematics (Powerfleet)
- Mtracs
- TESS
- ODA
- Nova Machina
- Mellowvan
- Zimi
- Transaction Capital

- Industry (Africa)

- Roam Electric
- BasiGo
- Transitec

- Statal/parastatal

- City of Cape Town
- TETA
- Western Cape Government
- GreenCape
- Stellenbosch Municipality
- SANEDI
- DSI
- DEE

- Universities

- Oxford University
- TU Munich
- Reutlingen University
- University of Pretoria
- University of Cape Town
- University of the Western Cape

- Finance

- World Bank
- GiZ

Main Research Questions

- How do we prepare for the electrification of transport in sub-Saharan Africa?
 - Vehicle production
 - Charging infrastructure
 - Grid stability and greening
- How do we leverage the electrification of transport to improve lives?
 - Job creation
 - Improving mobility
 - Safety and efficiency
 - Improving health
- Report “Decarbonising Transport in Africa”: bit.ly/decarbtransport



Research focus

Electrifying transport in Sub-Saharan Africa

1

Vehicles

- Multimodal
- New / conversion

2

Infrastructure

- Electrical infrastructure
 - Storage
- Road infrastructure

3

Operations

- Charging
- Mobility

4

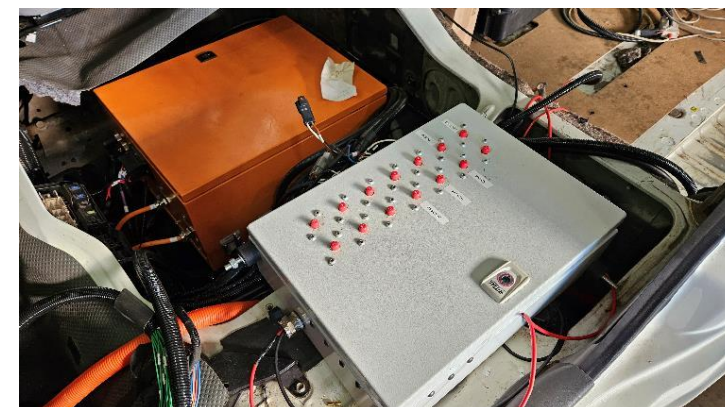
Software

- Vehicle
- Infrastructure
- Operations

Electric Mobility Lab



Electric minibus taxi conversion (retrofit)



Electric minibus taxi conversion (retrofit)



mineral resources
& energy
Department:
Mineral Resources and Energy
REPUBLIC OF SOUTH AFRICA



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sonedi
South African National Energy
Development Institute



RHAM
EQUIPMENT

Electric bus conversion



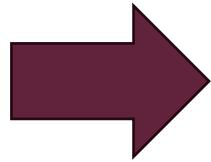
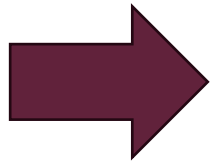
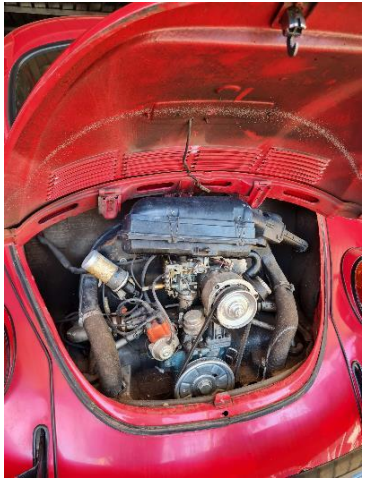
Electric bus conversion



First imported electric minibus



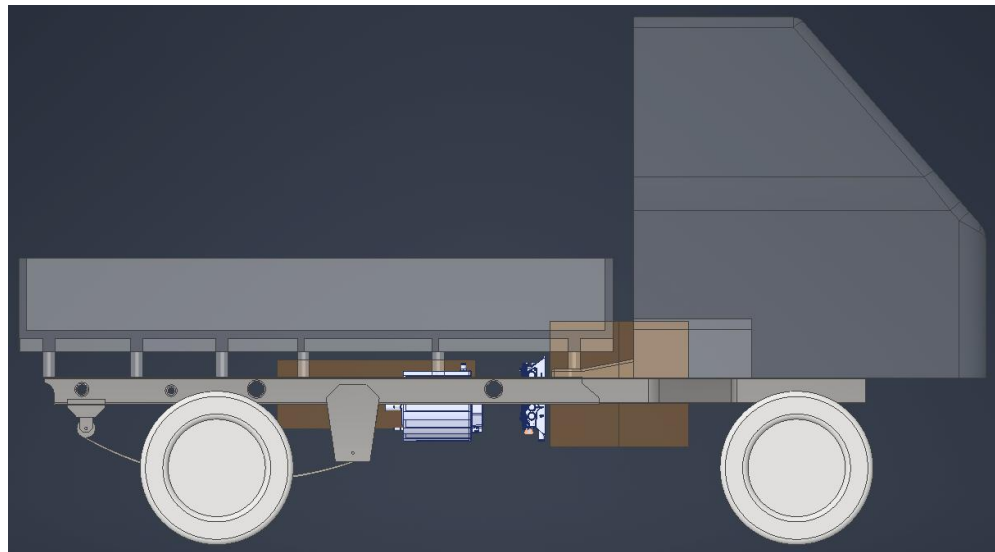
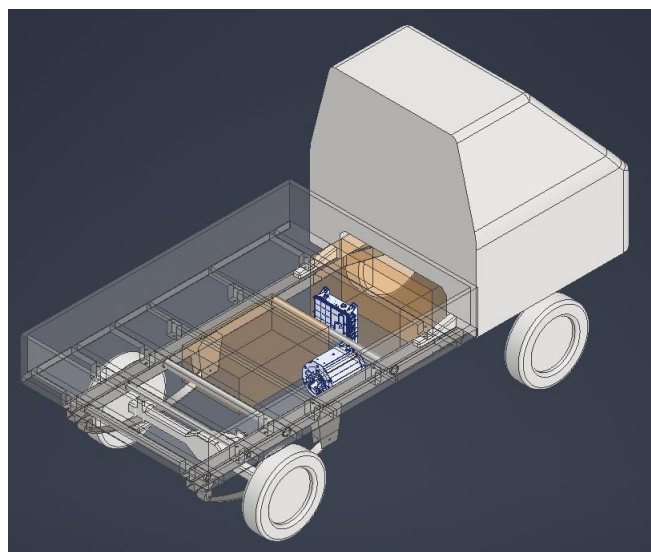
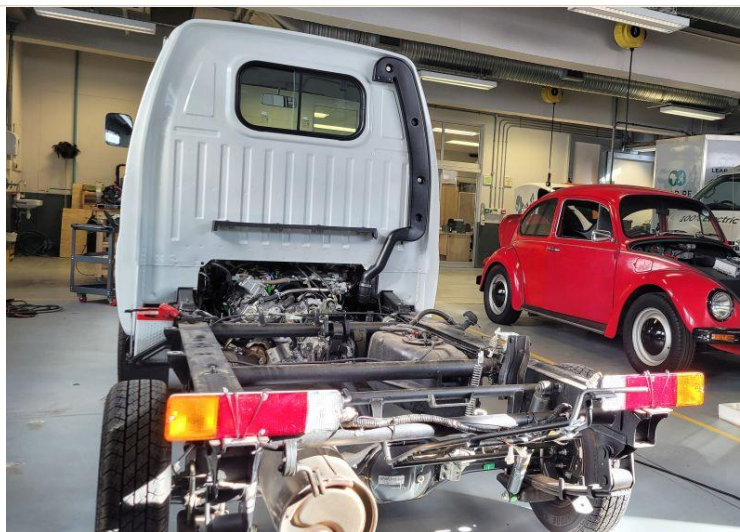
Electric Beetle conversion



Electric Beetle conversion



Small delivery vehicle conversion



LEAP-RE off-grid solar EV charger and electricity kiosk (SANEDI)



Electric micromobility

- Last-mile delivery
- Rural mobility
- Renewable charging



E-cross Africa

6,000km from Nairobi to Stellenbosch in 18 days on solar power



≡ CNN World

Electric motorcycle completes solar-powered 6,000-kilometer journey through Africa

By Nell Lewis, CNN

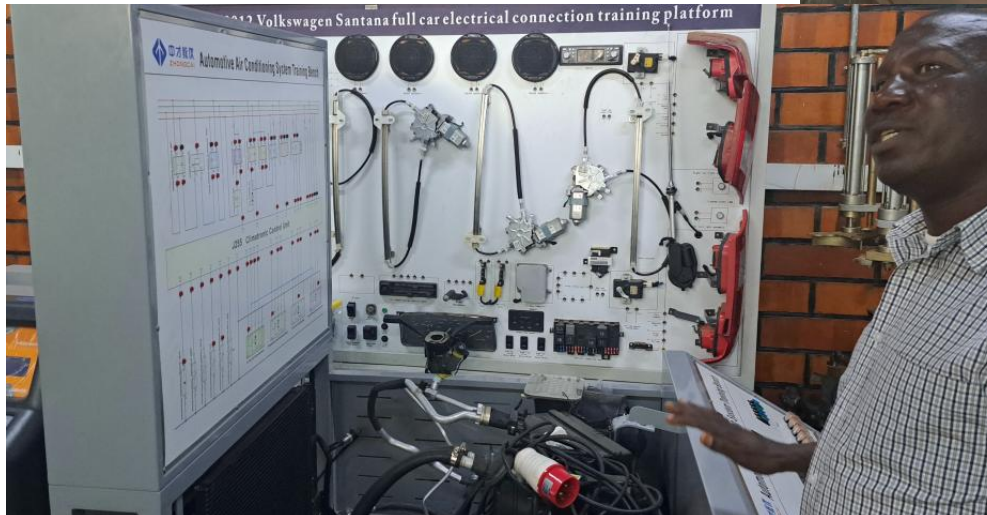
🕒 5 minute read

Published 5:32 AM EDT, Thu October 31, 2024



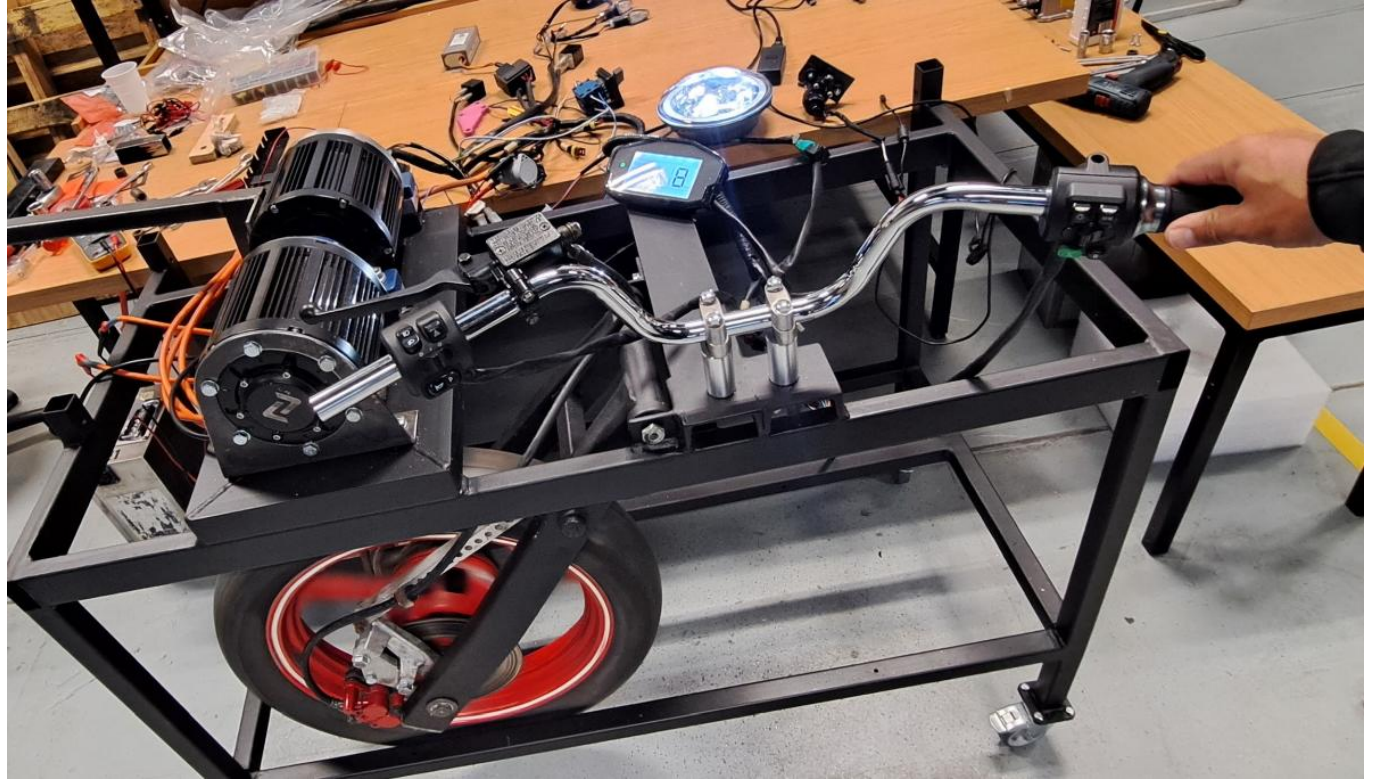
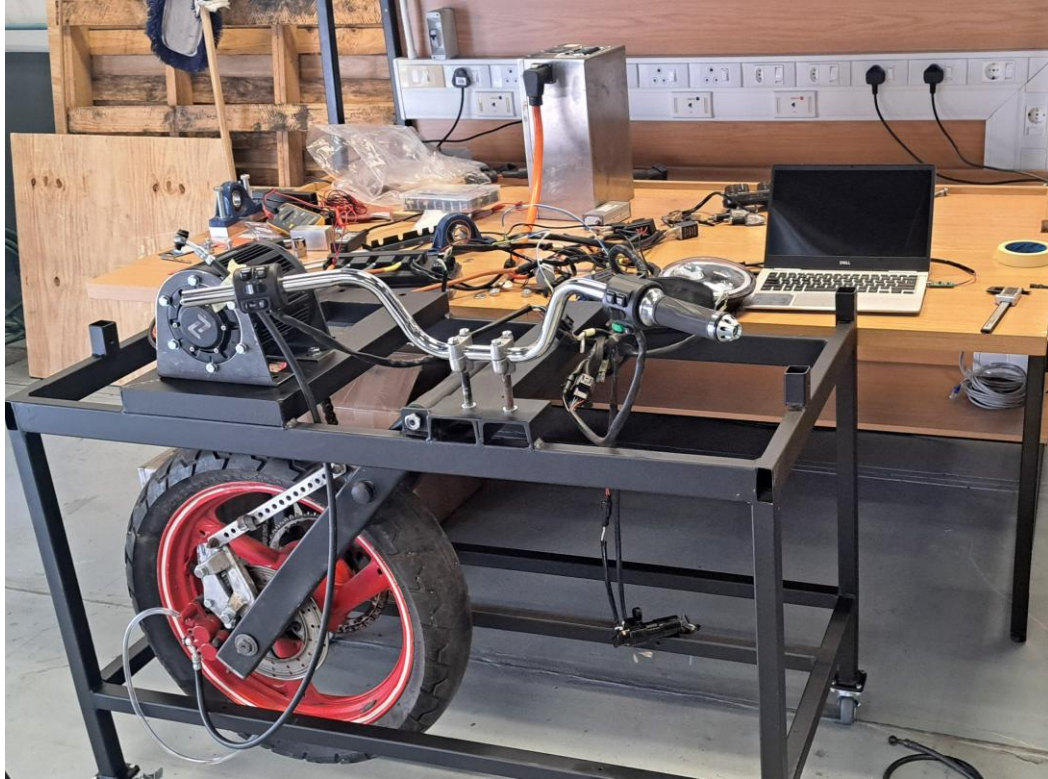
The Roam Air electric motorcycle traveled from Kenya to South Africa powered entirely by solar energy. Lewis Seymour

Skills development - TETA



- Transport Education and Training Authority

Skills development - TETA



- Transport Education and Training Authority

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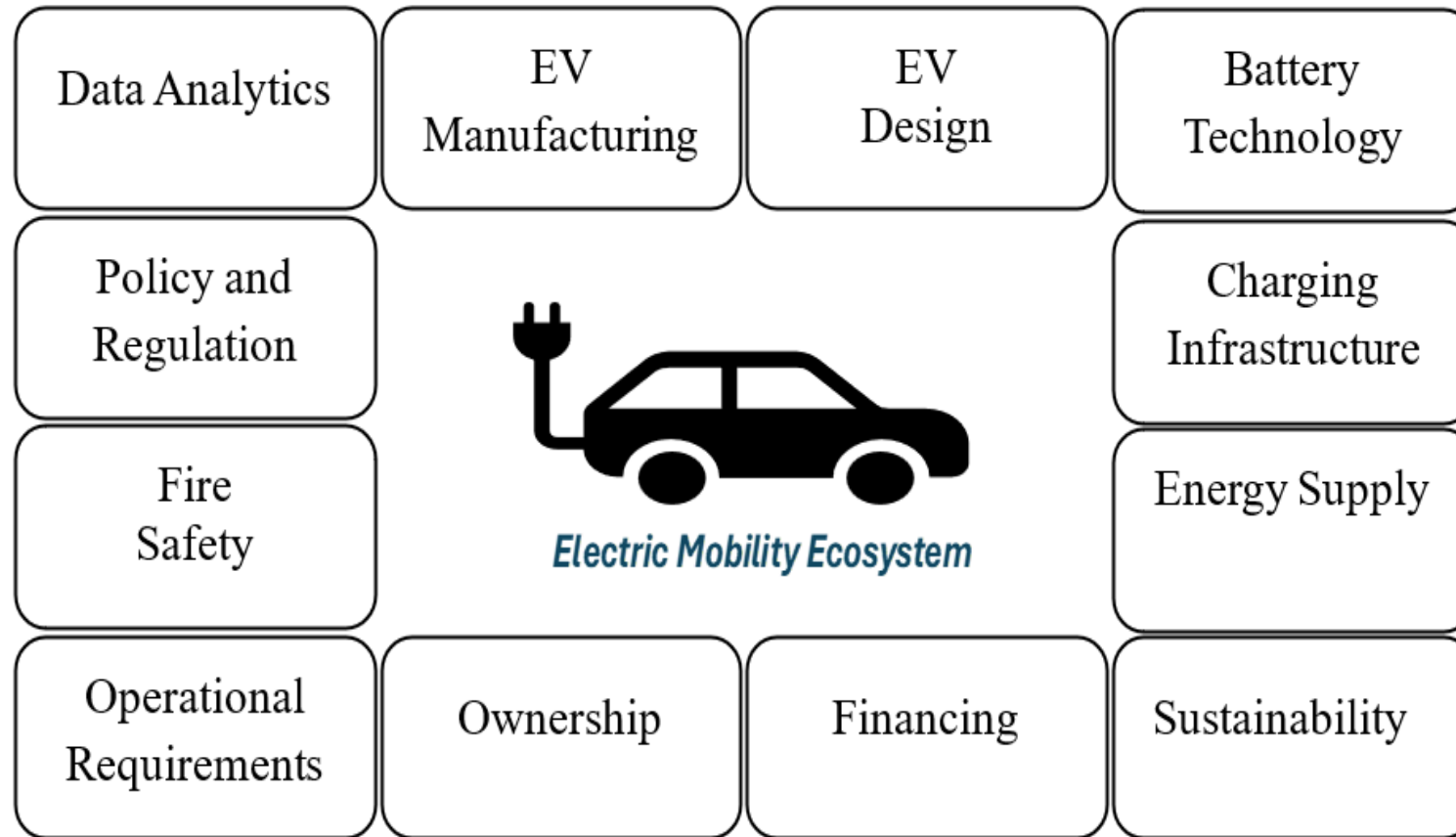
The Electric Mobility Ecosystem: A Literature Review of Transport Electrification to Define Research Paths for Africa



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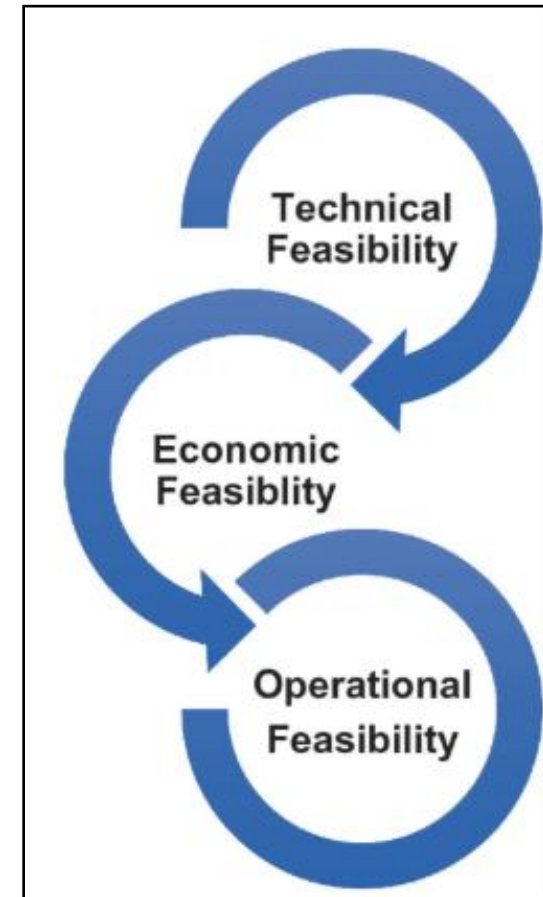
The Electric Mobility Ecosystem:
Stakeholder Survey (SU
Engineering Industry Showcase)



EME: Understanding the complexity

Illustrative case examples of experienced challenges:

- Policy: Homologation specifications, vehicle length, axle weight limits, municipal bylaws (charging & energy generation), import tariffs
- Battery chemistry: Decision has implications for cost, range, weight, useful life, temperature, safety (Key most distinguishing factor for OEMs)
- Financing and TCO: Fixed Cost vs Running Cost shift
- Energy availability and transmission uncertainty.
- Routes too short vs vehicle range limitations.



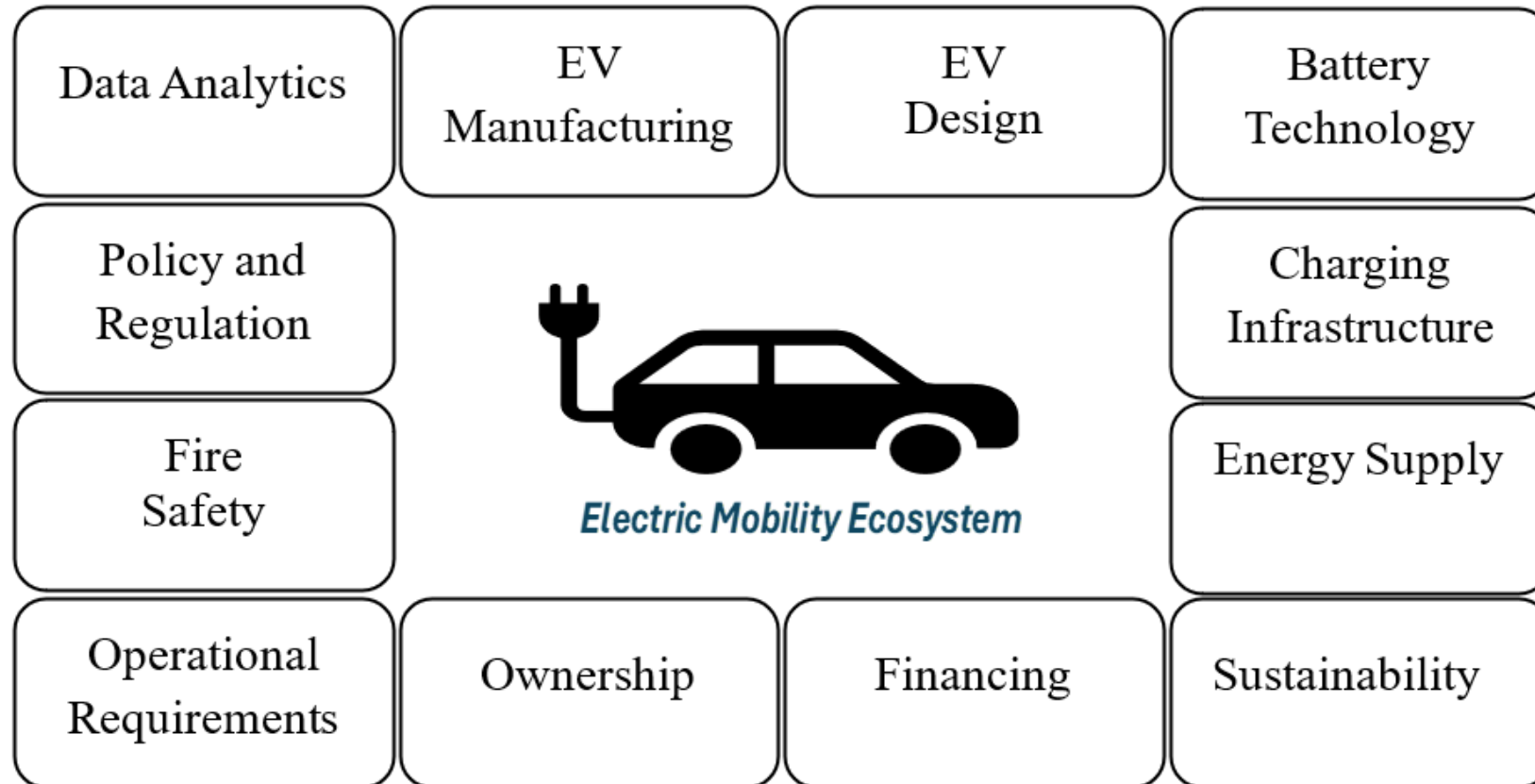
Final element selection of the EME: Internal process by current team of four



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The Electric Mobility Ecosystem:
Stakeholder Survey (SU
Engineering Industry Showcase)



What we did



This review adopted a **bibliometric analysis** methodology, which assessed the output of publications in EME.

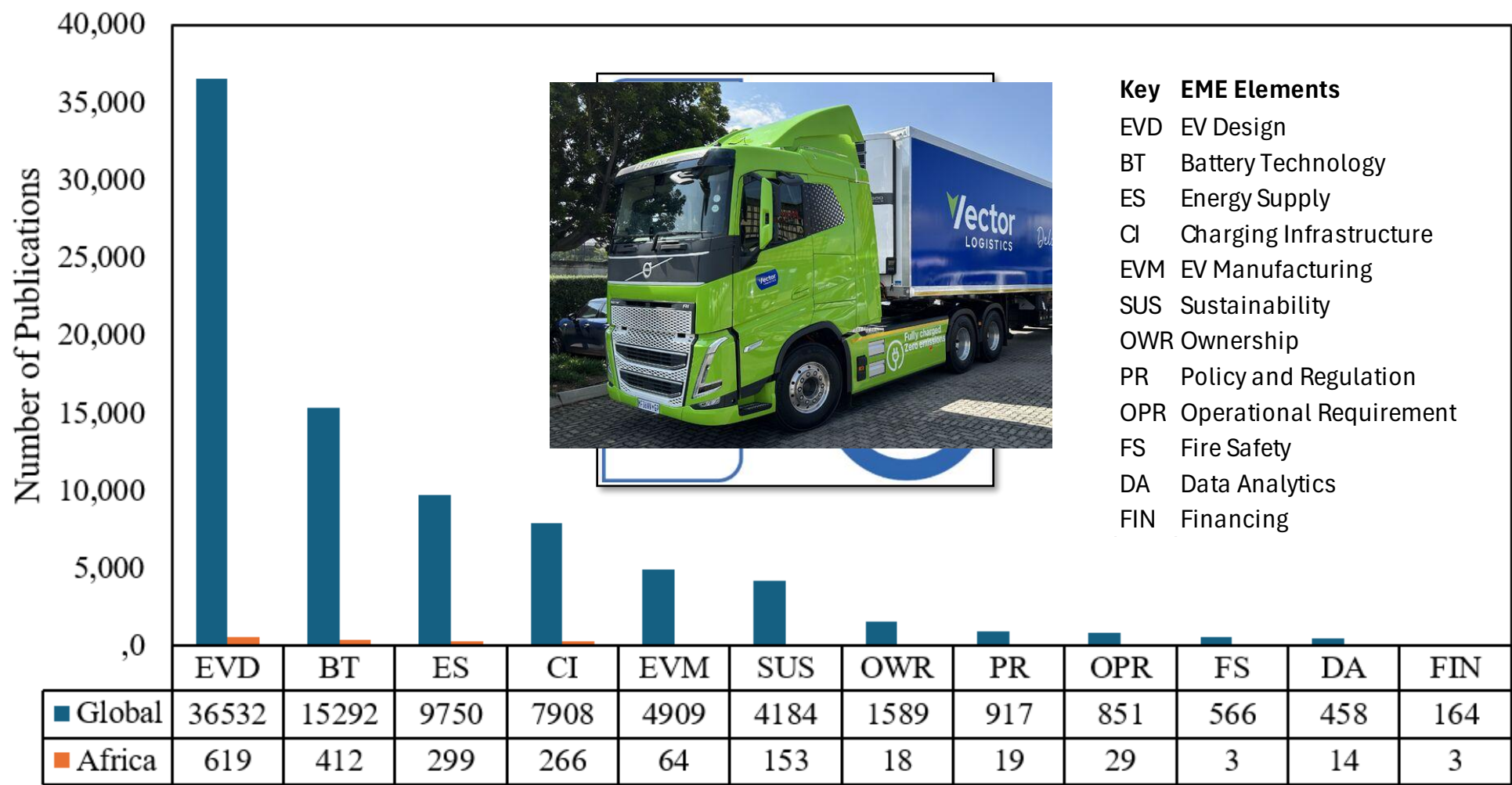


It also created **network maps of academic communities** and discovered networks of researchers using the Vos viewer and Biblioshiny software for each of the elements under study.

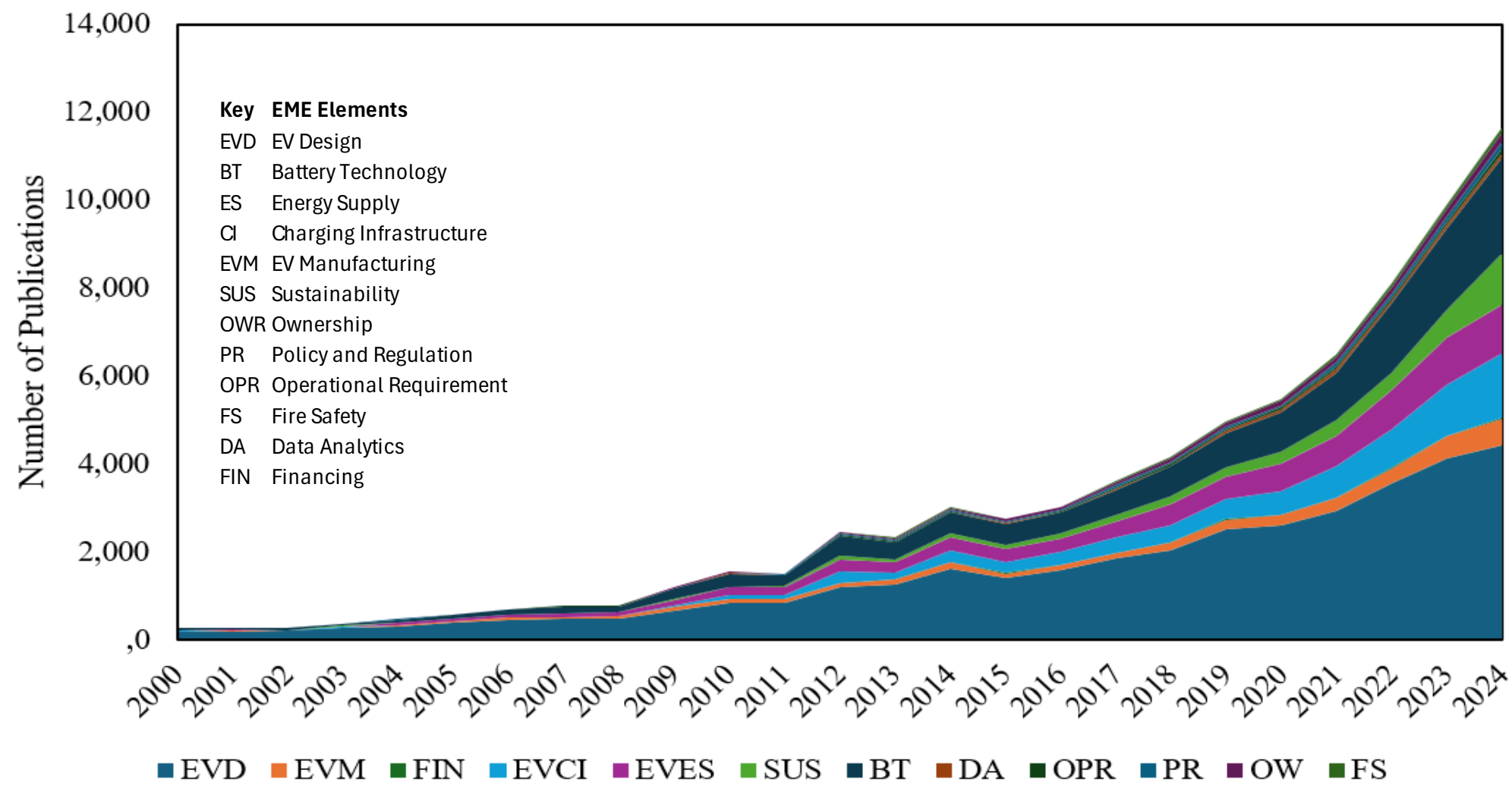


Scholarly publications were restricted to Scopus database output, English language, **2000-2024**, specific publication formats including journal articles, reviews, books, book chapters and conference proceedings were included for the review.

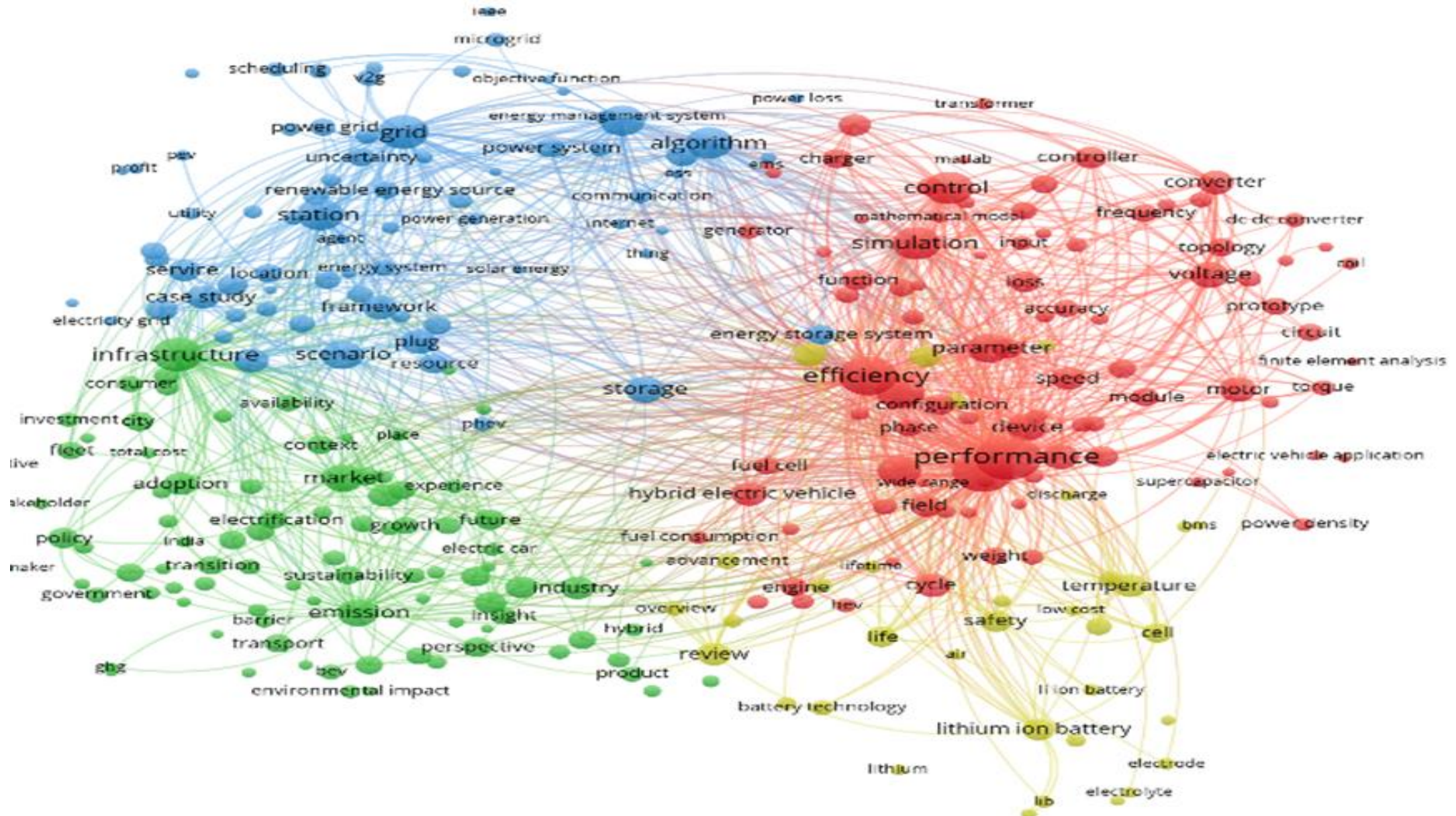
Most researched element of the EME between 2000 and 2024 highlighting the continent’s anemic contribution of below 3.5% (between 0.5%-3.48%) across all elements.



Annual publication growth trend for individual elements



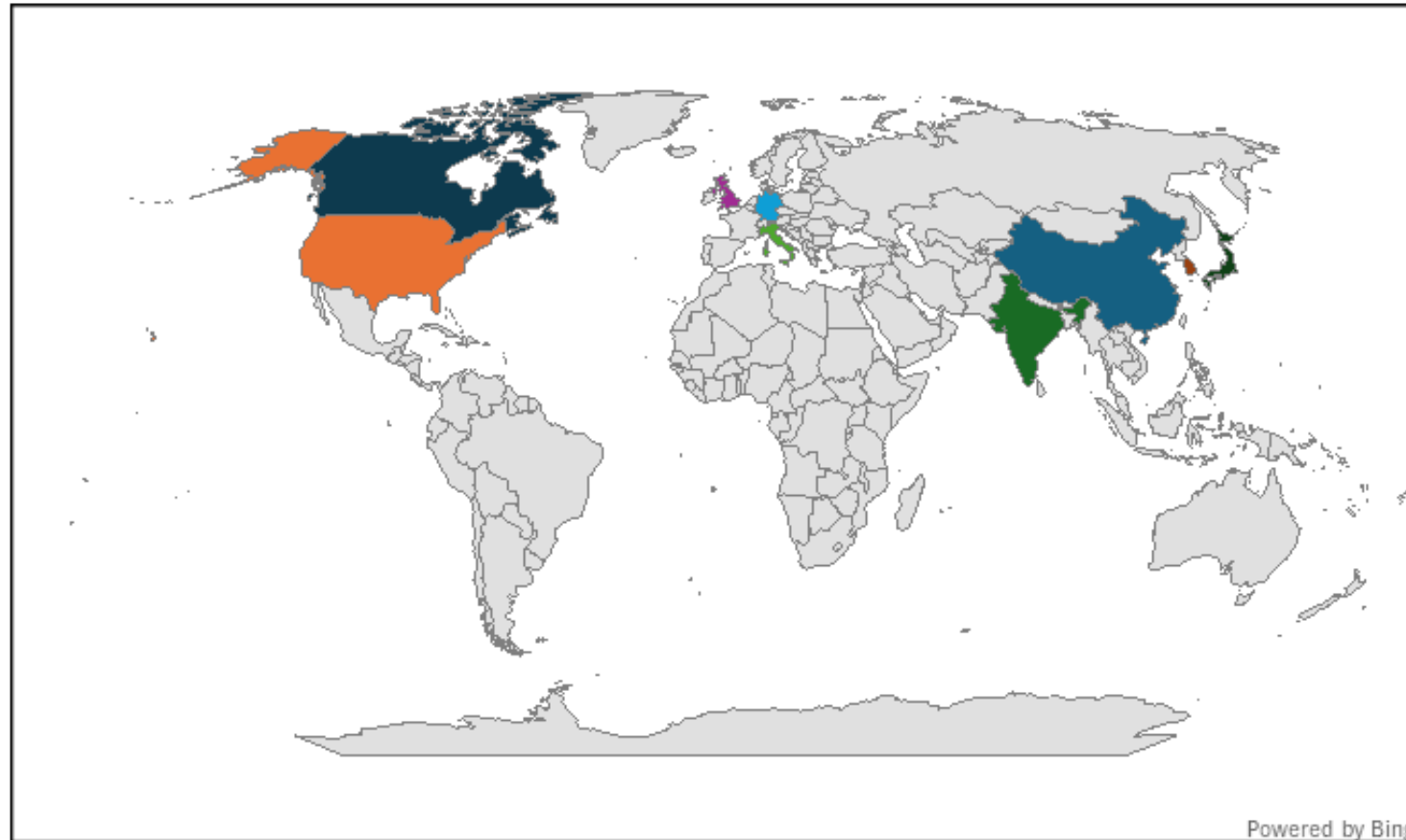
Vos viewer visualization of a co-occurrence network of terms extracted from the titles and abstracts of publications of all EME elements combined (minimum occurrence of 251 for each term)



Top 10 countries (globally) for all elements combined



- No African country made the top 20 list



China-	12,157
USA-	8,325
India-	7,463
Germany-	3,714
UK-	3,029
Italy-	2,360
Canada-	1,910
South Korea-	1,806
Japan-	1,608
Singapore-	1,513

Top 10 countries in Africa for all elements combined

- In Africa, the top three countries were **Egypt**, **South Africa**, and **Morocco** with 522, 276 and 254 publications, respectively.



Top 10 countries (Africa) publication across the EME Elements

Colour codes for the Top 3: **Green (Egypt)**; **Orange (South Africa)**; **Red (Morocco)**

Rank	EV Design	EV Manufacture	EV Financing	Charging Infrastructure	Energy Supply	Sustainability	Battery Technology	Data Analytics	Operational Requirements	Policy and Regulation	EV Ownership	Fire Safety
1	Egypt	South Africa	Nigeria	Egypt	Egypt	Egypt	Egypt	South Africa	Egypt	Egypt	South Africa	Morocco
2	Morocco	Egypt	Ghana	South Africa	South Africa	South Africa	Morocco	Morocco	South Africa	South Africa	Ghana	Kenya
3	Algeria	Nigeria		Morocco	Algeria	Morocco	South Africa	Egypt	Morocco	Egypt	Egypt	Egypt
4	South Africa	Tunisia		Tunisia	Morocco	Nigeria	Ethiopia	Algeria	Uganda	Tanzania	Tunisia	
5	Tunisia	Algeria		Ethiopia	Tunisia	Ethiopia	Algeria	Ethiopia	Algeria	Tunisia	Chad	
6	Nigeria	Ghana		Nigeria	Nigeria	Ghana	Nigeria	Mauritius	Nigeria	Algeria	Morocco	
7	Ethiopia	Ethiopia		Algeria	Ethiopia	Algeria	Libya	Nigeria	Ethiopia	Mali	Nigeria	
8	Botswana	Rwanda		Chad	Libya	Libya	Rwanda	Kenya		Morocco	Rwanda	
9	Zambia	Benin		Botswana	Kenya	Zimbabwe	Chad			Kenya		
10	Rwanda	Uganda		Ghana	Mali	Kenya	Uganda					
No of countries contributing	21	11	2	18	22	15	23	8	7	9	8	3
Contribution of top 10 to total publication	95.9%	92.2%	100%	92.1%	92.6%	92.8%	92.9%	100%	100%	100%	100%	100%

Researchers on EME from Stellenbosch University

Researchers from Stellenbosch University			
EV Design	Energy Supply	Battery Technology	EV Manufacture
Booyesen, M.J., McCulloch, M.D., Lacock, S., Du Plessis, A. A., Strauss, J., Menelaos, M., Wang, R.J., Pastellides, S., Gerber, S., Kamper, M., Dippenaar, J.M., Bekker, B., Brent, A. C. Du Plessis F., Gerber S., Kamper M.J., Chihota M.J.	Giliomee, J.H., Booyesen, M.J., Brent, A.C., Salie, F., Etuket, M.D., Manuel, J., Louw, L., Grobbelaar, S., Chihota, M.J., Bekker, B., Pillay, N.S. Kamper, Maarten J.	Booyesen M. J., Götz K., de Kock I., Chihota M.J., Bekker B., Otto, W. L., Oosthuizen, G. A., Kamper, M. J.	Tombido L., Louw, L., Van Eeden J., Schutte, C.S.L. Otto, W. L., Oosthuizen, G. A.
		Charging Infrastructure	Operational Requirement
		Buresh, K.M. Booyesen, M.J. Pretorius, B.G. Wüst, J., Strauss, J.M. Bekker, J. Giliomee, J. H., Sitas, N.	Booyesen, M.J., Abraham, C.J., Rix, A.J., Ndibatya, I.

Country collaboration map for EVD



Country collaboration map for EV Manufacturing

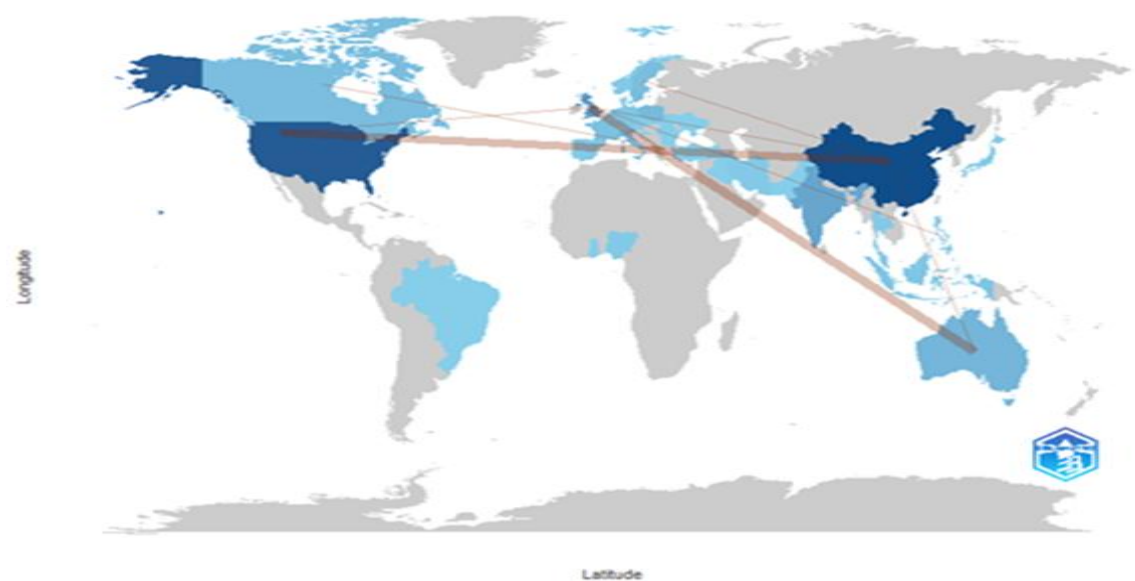


Country collaboration map for Sustainability

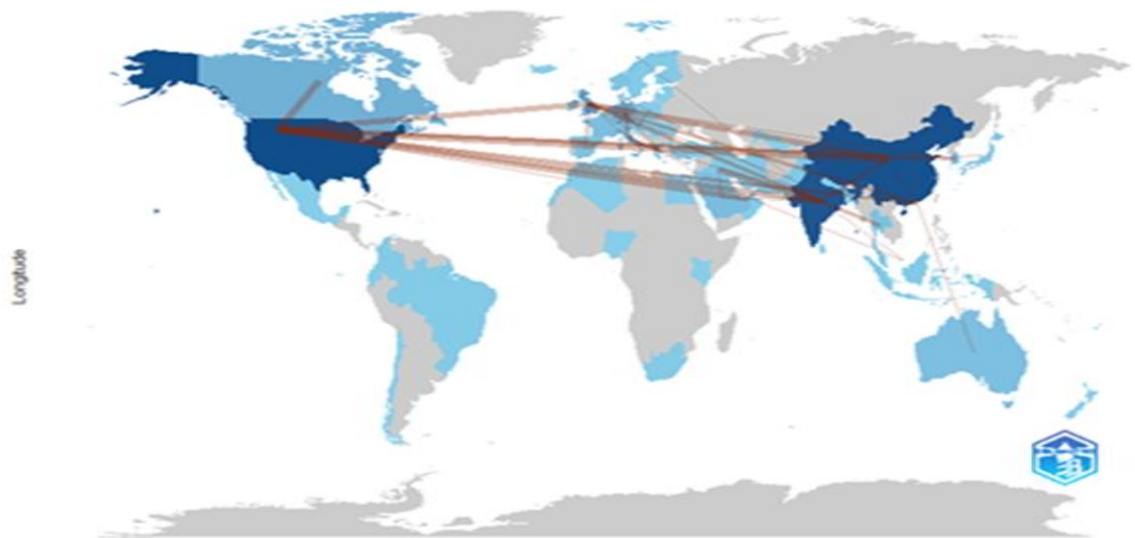


Country collaboration map for Charging Infrastructure

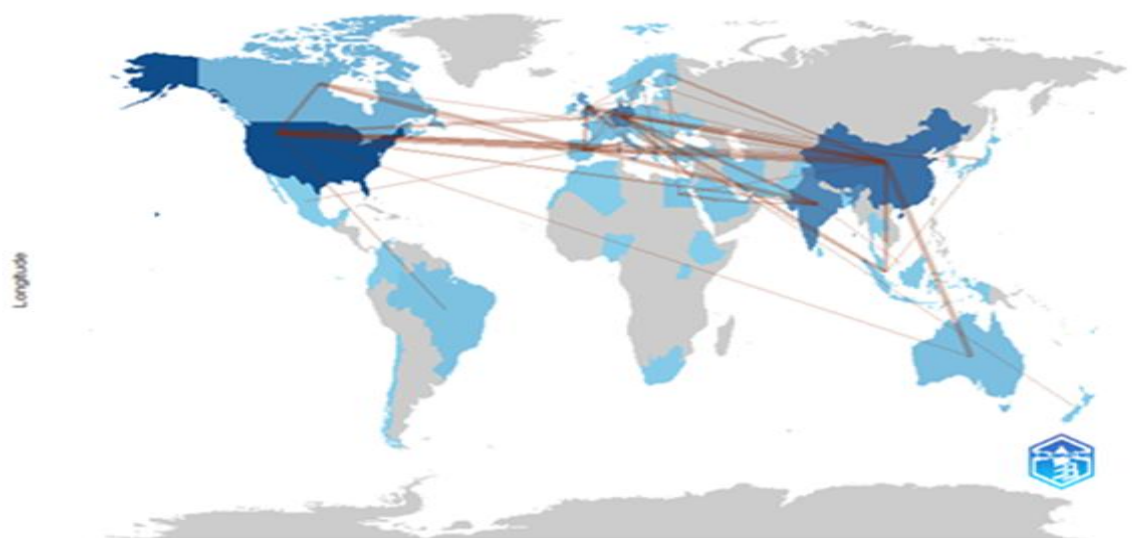
Country collaboration map for EV Financing



Country collaboration map for Battery Technology



Country collaboration map for Data Analytics

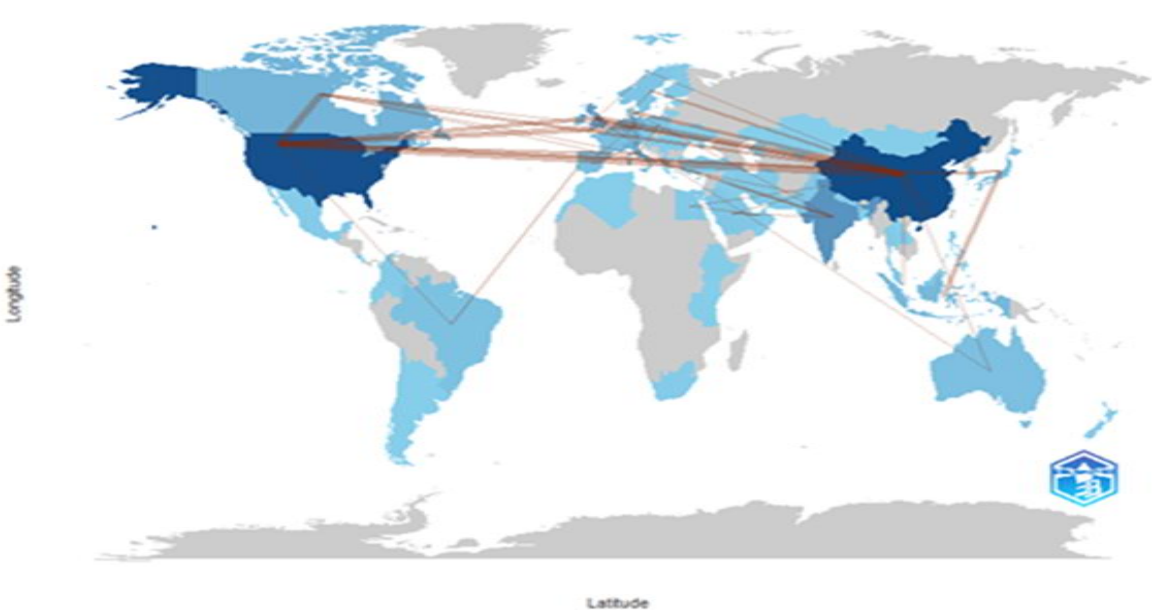


Country collaboration map for Operational Requirement

Country collaboration map for Fire Safety



Country collaboration map for Policy and Regulation



Country collaboration map for EV Ownership



Country collaboration map for Energy Supply



Agenda

- Introduction and research background:
 - Joubert van Eeden
 - Megan Bruwer
 - Tinus Booysen
- EME Scoping research (Joubert)
- **Faculty of Engineering capabilities (Megan)**
- Examples of Industry Participation (Thinus)
- Stakeholder Interest from survey (Megan)
- Open Discussion/Comments/Next Steps (Joubert & Thinus & Megan)

Faculty of Engineering EME capabilities



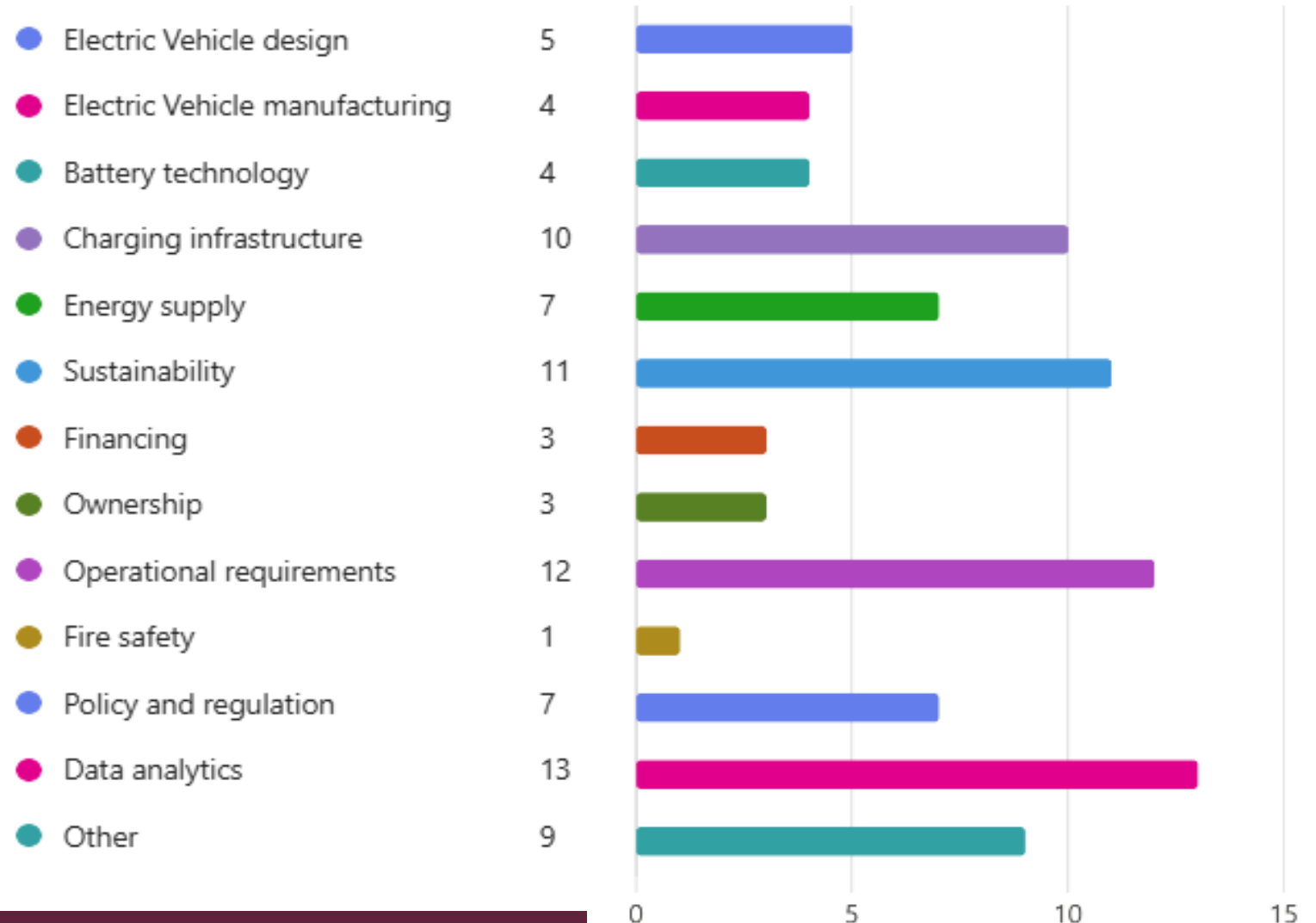
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sonke siya phambili
saam vorentoe

Engineering | EyobuNjineli | Ingenieurswese

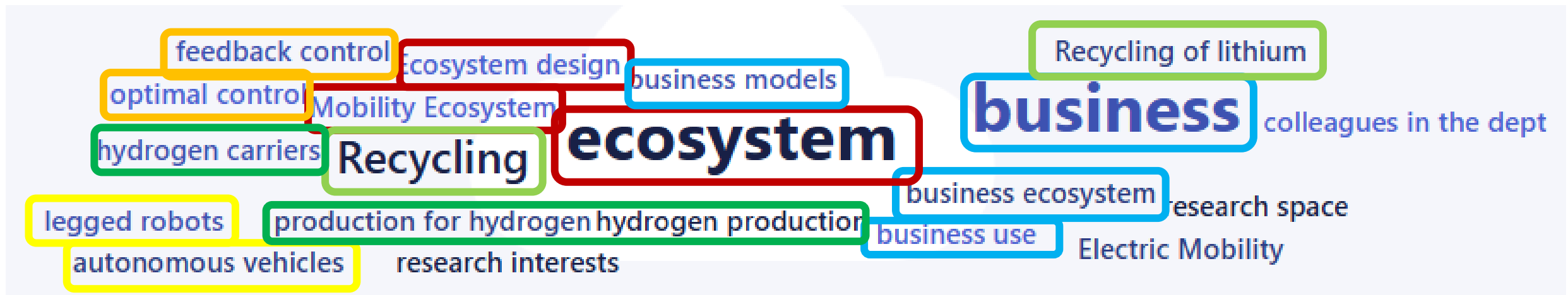
12 EME components

- Involvement from all 5 Engineering Departments
- We cover every area of the identified EME

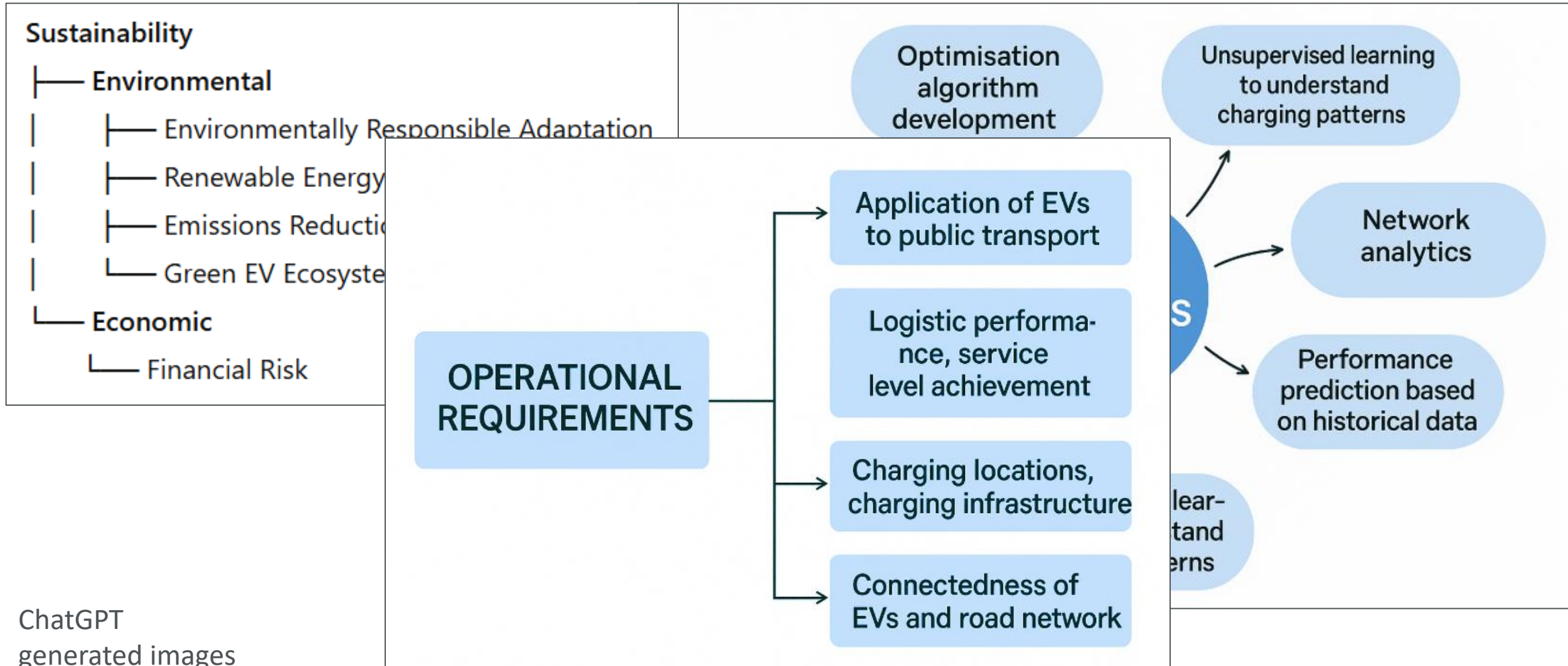


Faculty of Engineering EME capabilities

Other capabilities in support of EME



Faculty of Engineering EME capabilities



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Collaboration configurations

Different ways to work with us on electric mobility

- Sponsorships
- Funding of bursaries
- Research Chair
- Funding research & development
 - Without IP transfer (IP stays with Uni)
 - With IP transfer (IP moves to partner)

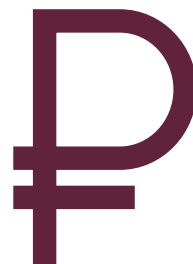
Collaboration configurations

Full Economic Costing in the IPR Act



Section 15(4)(a):

Any research and development undertaken at an institution and funded by a private entity or organisation on a **full cost basis** shall not be deemed to be publicly financed research and development and the provisions of this Act shall not apply thereto.



Section 15(4)(b):

“full cost” means the full cost of undertaking research and development as determined in accordance with international financial reporting standards, and includes all applicable direct and indirect cost as may be prescribed.

Intellectual Property and the IPR Act - “NIPMO”

- Intellectual Property Rights from Publicly Financed Research and Development Act (Act No. 51 of 2008)
 - University owns IP
 - Created by staff in the scope of their employment
 - Created by students in the scope of their academic work towards a qualification
 - Staff and students disclose IP creation to InnovUS (University Commercialisation Entity)
 - University protects IP
 - InnovUS commercialises IP
 - Shares income with Inventor and SU
- Industry partners can access IP via licensing, including exclusive licences. Licences must be fair, protect public interest, and involve benefit-sharing mechanisms (e.g. royalties or equity).

Collaboration configurations

Components of the Full Cost Budget

Direct Cost

- Personnel Cost
- Equipment
- Running Cost
- Audit Cost
- Travel cost (conference, workshops, partner visits)

Indirect Cost

- ICRR: If without IP: 20% of Direct Cost. If with IP: 24%

Price: IP Transfer

- IP Transfer: Typically, 15% to 25% (negotiable)

VAT

- 15.5%

Direct Cost

- Bursaries (VAT exempt)

Collaboration configurations

Bursaries

- Uni and SARS gets nothing
- Tax-free flow-through to students
- Potential employment or workback
- Amounts of part thereof
 - MEng R100 – 150k pa (2y)
 - PhD R150 – 200k pa (3y)
 - Post-doc R300 – 480k pa (max 2y)
- Tax benefit to sponsor
 - Skills Development Section 10(1)(q)
 - Donations via Uni (Section 18A)

Examples

- Nedbank
- Power fleet
- Friedrich Wilhelm Trust
- Golden Arrow
- SATC

Collaboration configurations

Sponsorship

- No strings attached
- Sponsor
 - Data
 - Hardware, software
 - Money
- Tax benefit
 - Section 18A Certificate

Examples

- Takealot – data
- Balancell – batteries
- HYDAC – hardware
- Rubicon – chargers
- PowerFleet – trackers and data
- Golden Arrow – bus, data

Collaboration configurations

Contract research (rent a researcher)

1. University keeps IP

- Full cost
- Could include bursaries
- Could include a Research Chair
- **Access to methods and results - Report**

2. Funder keeps IP

- Full cost
- Could include bursaries
- Could include Research Chair
- IP transfer (15–25%) **before** IP generated
- **Access to methods and results - Report**
- Owns IP

Examples

- SANEDI

- MTN

- BMW

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EME Stakeholder Interest



- OTHER:
 - Skills requirements required for EV
 - E-motors
 - Motor and battery supply
 - Comms Infrastructure
 - Operational requirements

EME Stakeholder Interest



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Open Discussion/Comments/Next steps

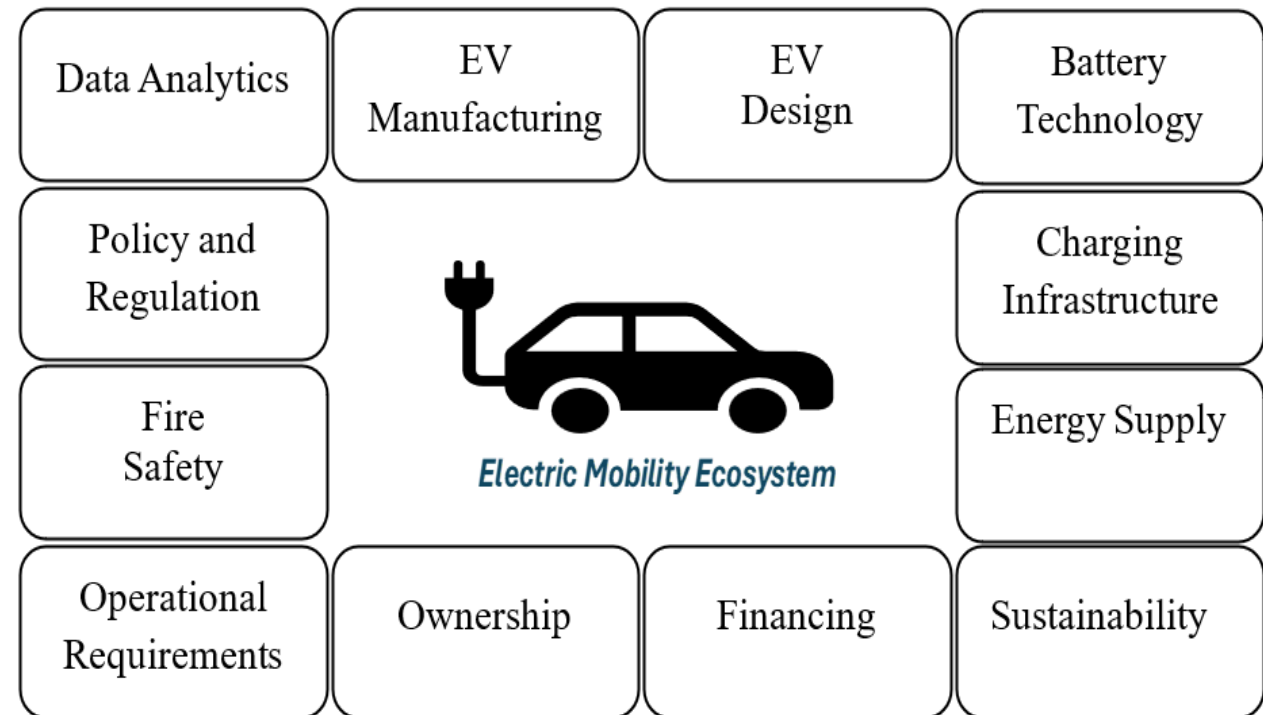


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- How do we develop the EME space in South Africa?
- What role do you see us play?
- How can we help you?
- How can you help us.





The Electric Mobility Ecosystem:
Stakeholder Survey (SU
Engineering Industry Showcase)

