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ROAD FREIGHT MODELS TO ACCELERATE GREEN TRANSITION IN EUROPE

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Agenda

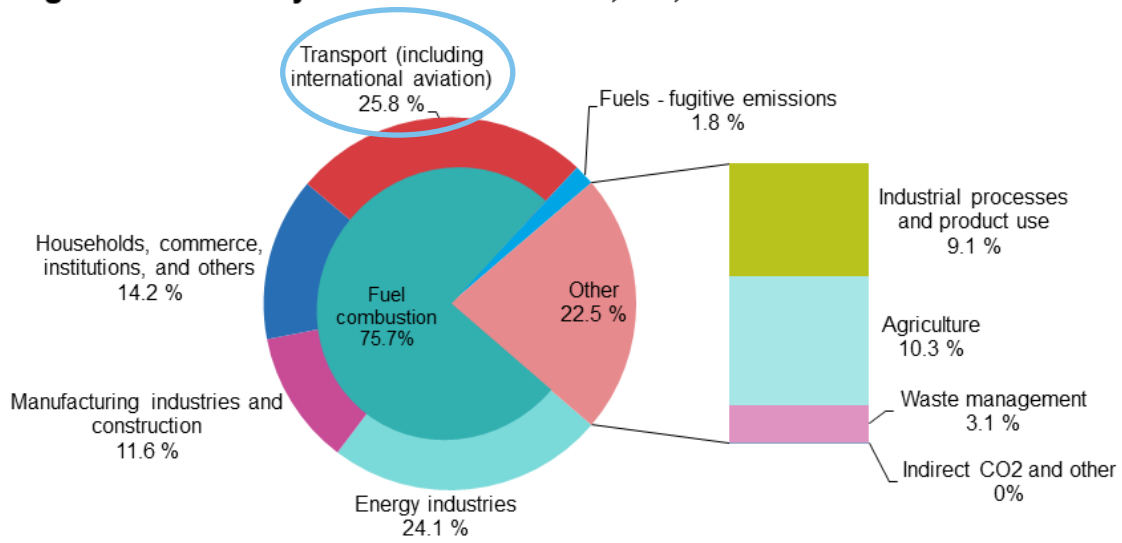
- Background
- Purpose, Aim & Research Questions
- Methodology
- Findings
- Future Directions
- Practical Implication & Limitation
- Key Takeaways

Source: Stock Images

Background - General

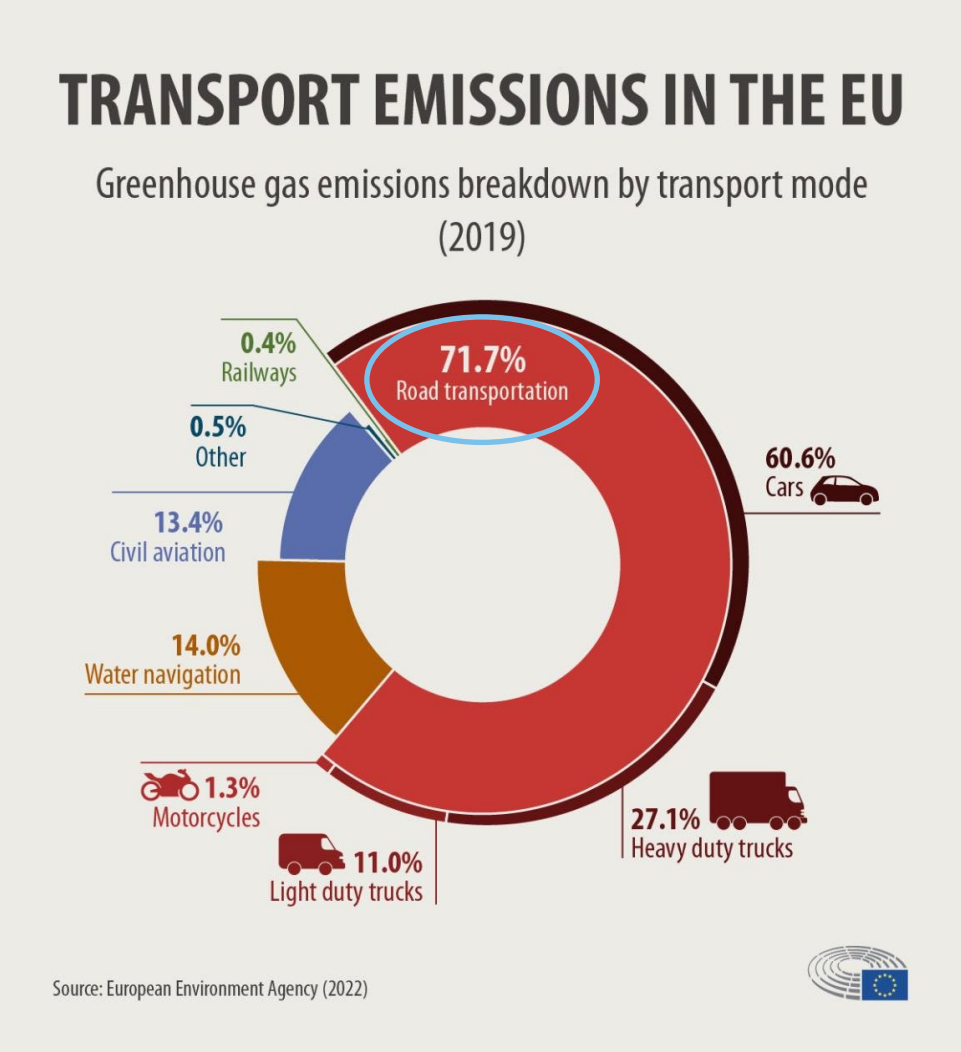
- Global urban population is expanding.
- Fossil Fuels are still essential & still a source of energy.
- Reducing dependency on fossil fuels is a huge challenge.

Greenhouse gas emissions by IPCC source sector, EU, 2019



Source: EEA, republished by Eurostat (online data code: env_air_gge)

eurostat



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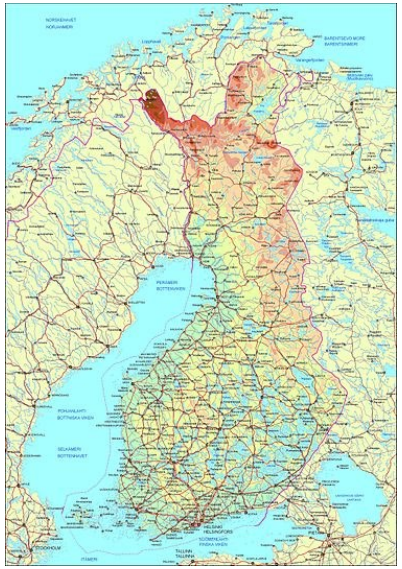
Background - Finland

- Finland – 85% tonnes of goods use road transport



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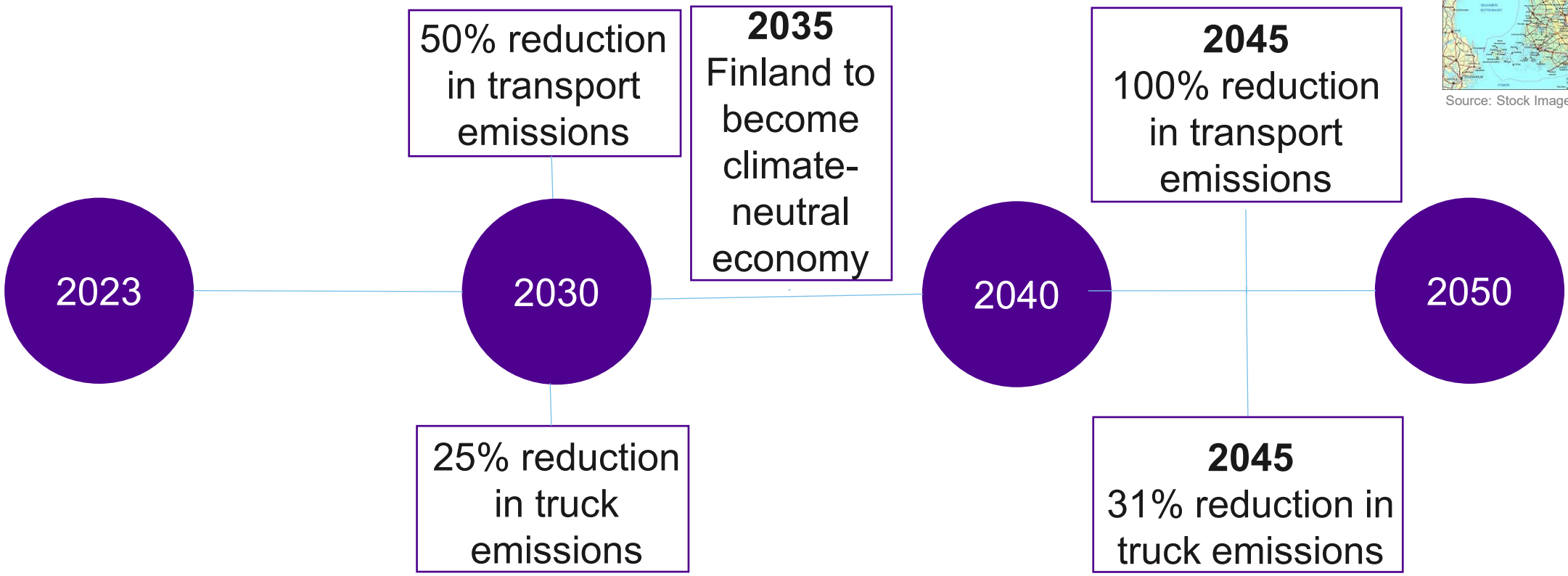

Source: Traficom (2023). Goods transport in Finland. Goods transport in Finland, Tieto Traficom (accessed on 1 June 2023)
LVM (2021). Roadmap to fossil-free transport: Government resolution on reducing domestic transport's greenhouse gas emissions, Publications of the Ministry of Transport and Communications 2021:19. http://urn.fi/URN:ISBN:978-952-243-604-7.
Data.Traficom (2022). CO2 emissions from transport by mode of transport and region. https://tieto.traficom.fi/en/statistics/co2-emissions-transport-mode-transport-and-region (accessed on 1 June 2023)

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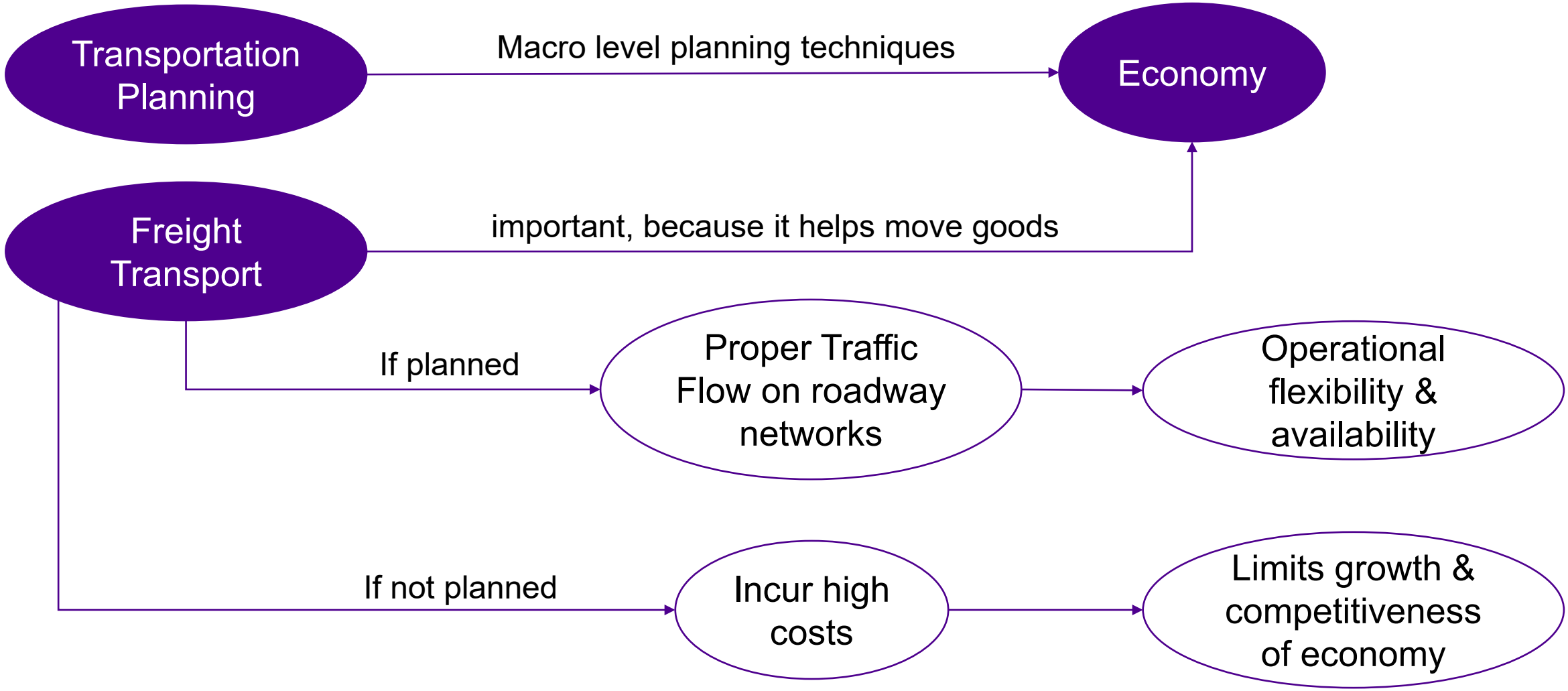
Background – Transportation Planning



Source: Arbués, P., Baños, J. (2016). A dynamic approach to road freight flows modeling in Spain, Transportation, 43, 549–564.
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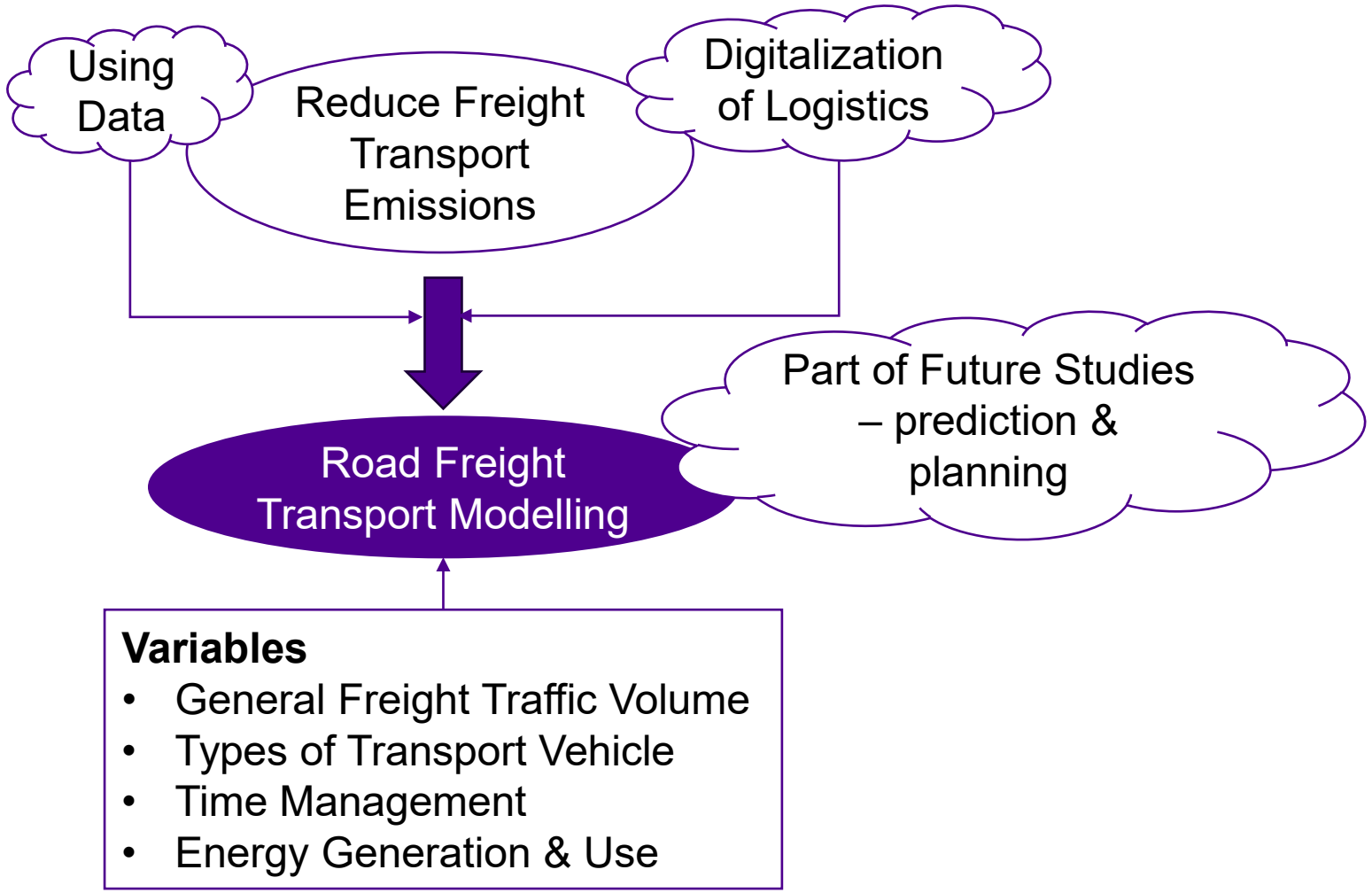
Yu, Z., Khan, A. R., Thomas, G., Jameel, K., Tanveer, M., Janjua, L. (2022). Nexuses be-tween international trade, renewable energy, and transport services: Leading toward practical implications and trade policies, Frontiers in Environmental Science.

Background - Road Freight Transport Modelling

Source: Stock Images



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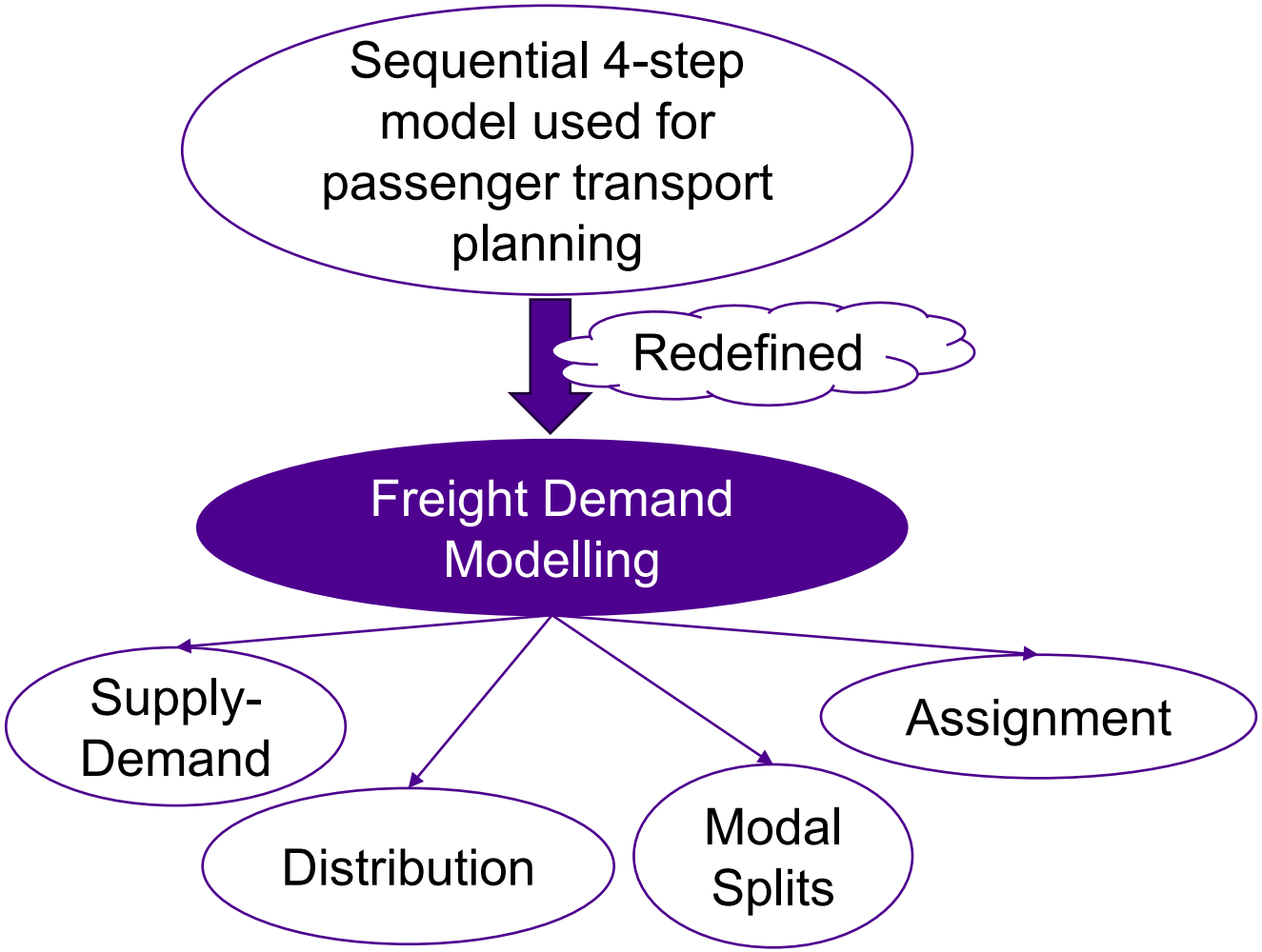

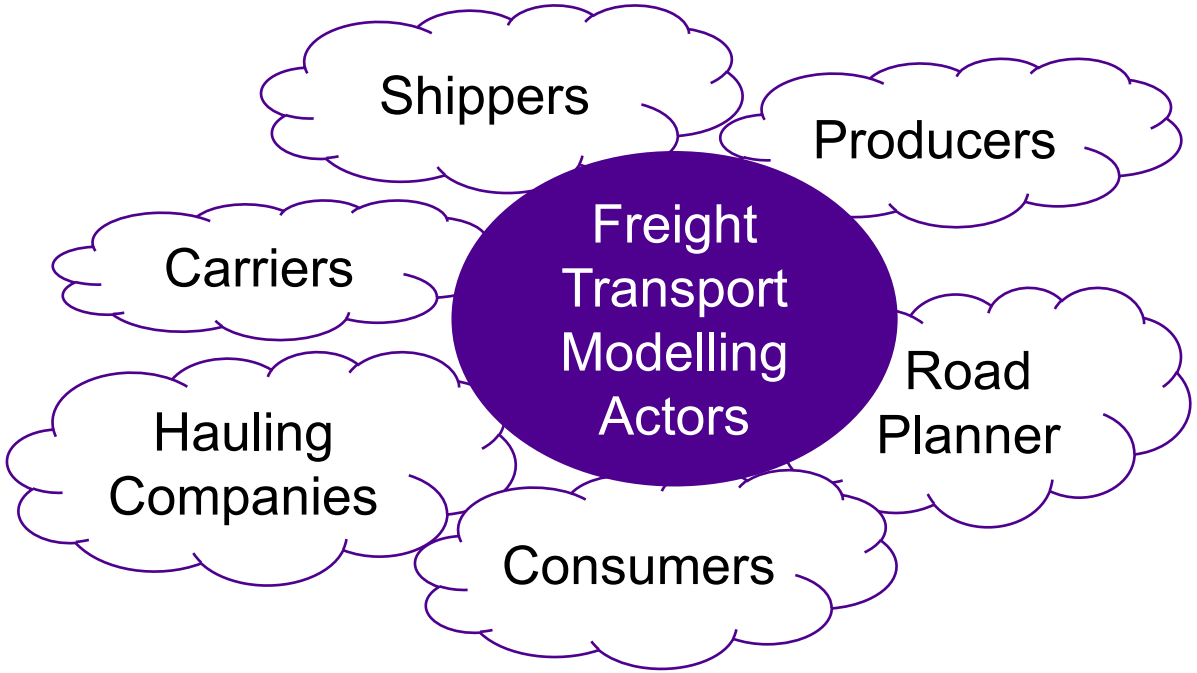

Source: Havenga, J. H. (2018). National freight demand modelling: a tool for macrologistics manage-ment, The International Journal of Logistics Management 29 (4), 1171-1195.
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Purpose, Aim & Research Questions

- **PURPOSE**: To understand how to integrate electric freight vehicles in the future national road freight model of Finland.
- **AIM**: To identify & describe the existing road freight transport models & road freight traffic flows in different European countries.
- **RESEARCH QUESTIONS:**

I. *What are the current road freight transport models?*

II. *How are the road freight transport models developed & for what purposes are they used?*

III. *How can electrified road freight transport be modelled to strengthen the green transition by adoption of electric freight vehicles?*

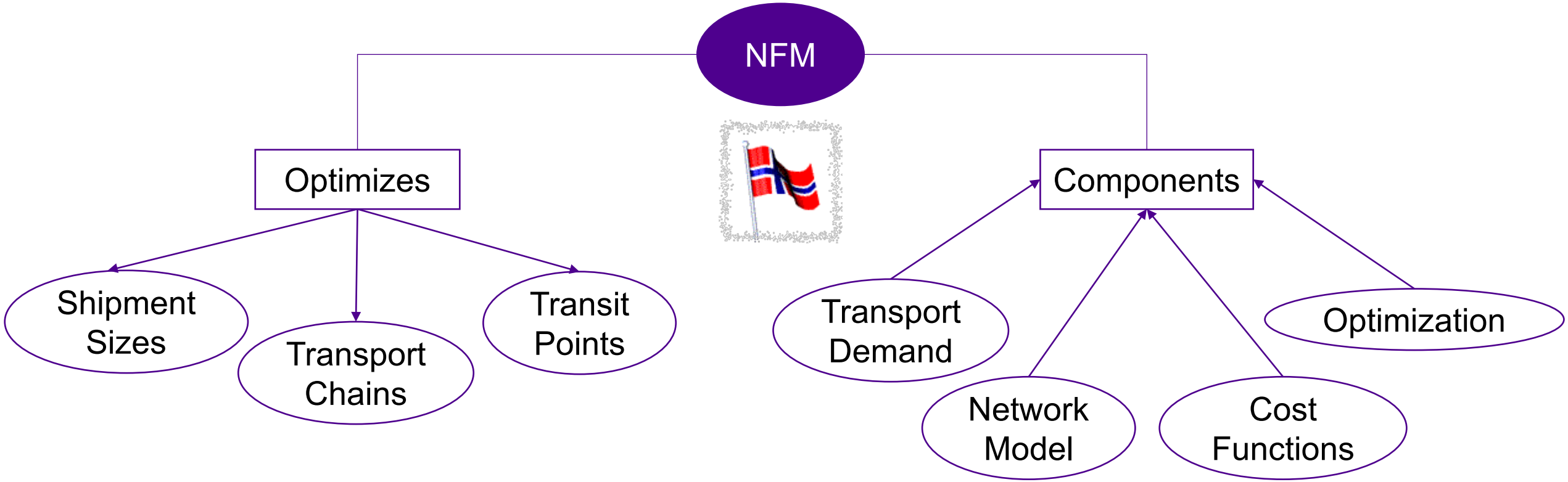
Methodology

- Literature review
  - Searched for articles on Scopus' database
  - Keywords used:
    - "Road freight"
    - "transport"
    - "traffic"
    - "modelling"
    - "model"
    - "flow"
    - "density"
  - Most relevant articles after filtering = 15

Picture: Erika Kallionpää

Findings - Road Freight Transport Models

The National Freight Model or NFM for Norway



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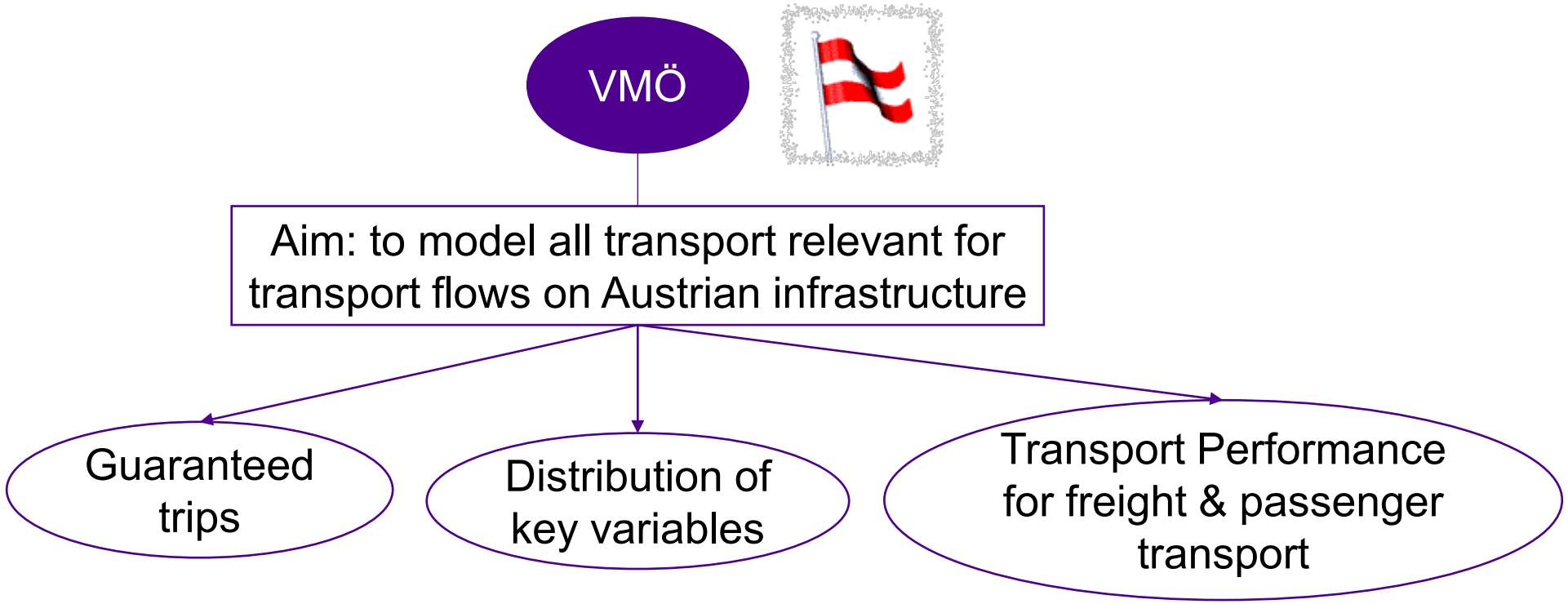
Findings - Road Freight Transport Models

National transport model Austria (Verkehrsmodell Österreich, VMÖ)

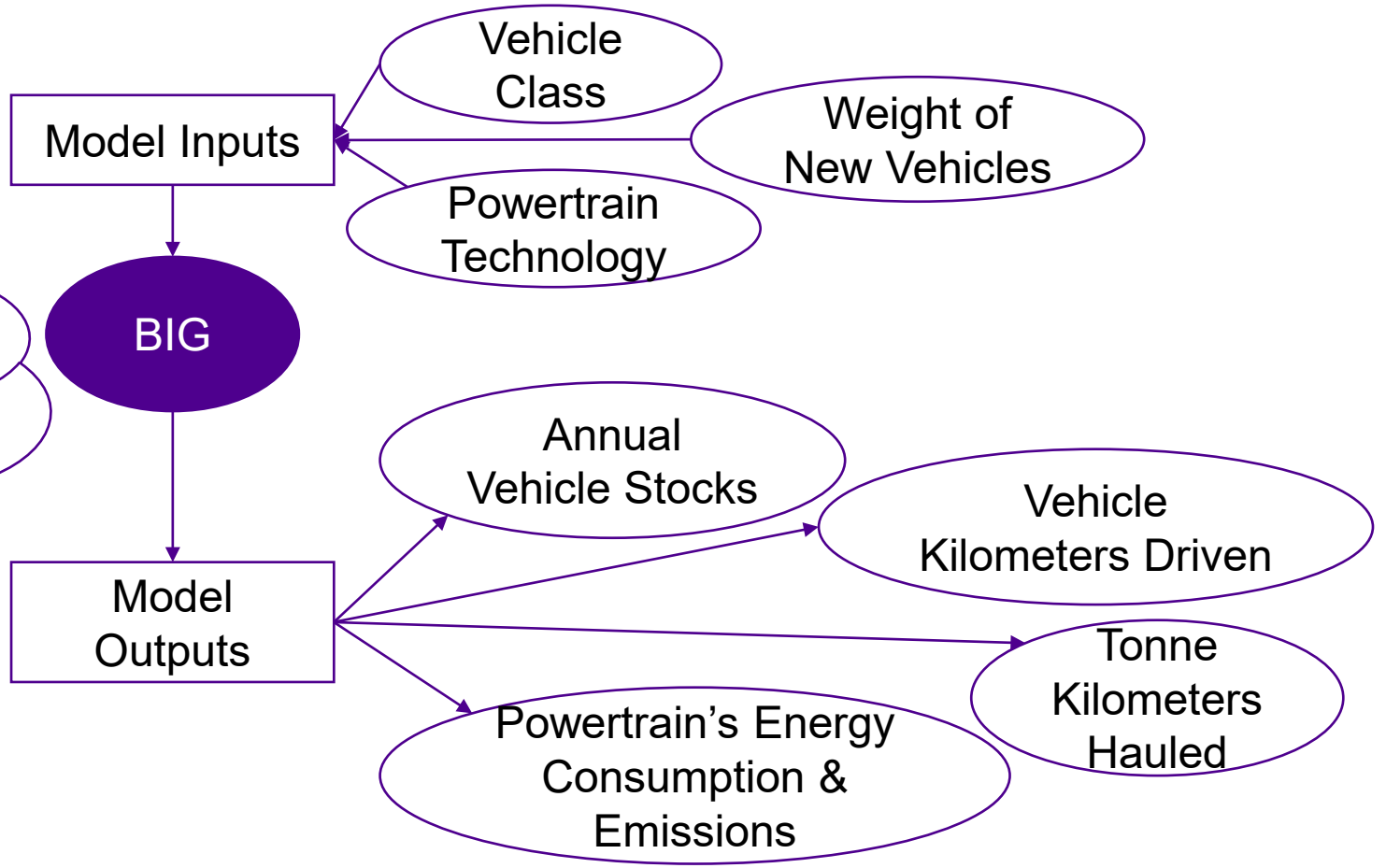


Source: Grebe, S. de Jong, G., Wampera, C., Obermayer, C., Pompl, R. (2020). VMÖ – A new strate-gic transport model for Austria, 47th European Transport Conference 2019. Transportation Research Procedia, 49, 95–106.

Findings - Road Freight Transport Models

Stock-flow model (BIG) of the Norwegian vehicle fleet

- Differentiates vehicles into 7 types
- Includes: Vehicles that drive on road
- Excludes: Two-wheelers



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Findings - Road Freight Transport Models

TRANS-TOOLS of the European Union (EU)

2004

Integrated transport policy tool

Supports HIGH-TOOL (2015) for strategic high-level transport policy assessment & to analyze policy scenarios

TRANS-TOOLS

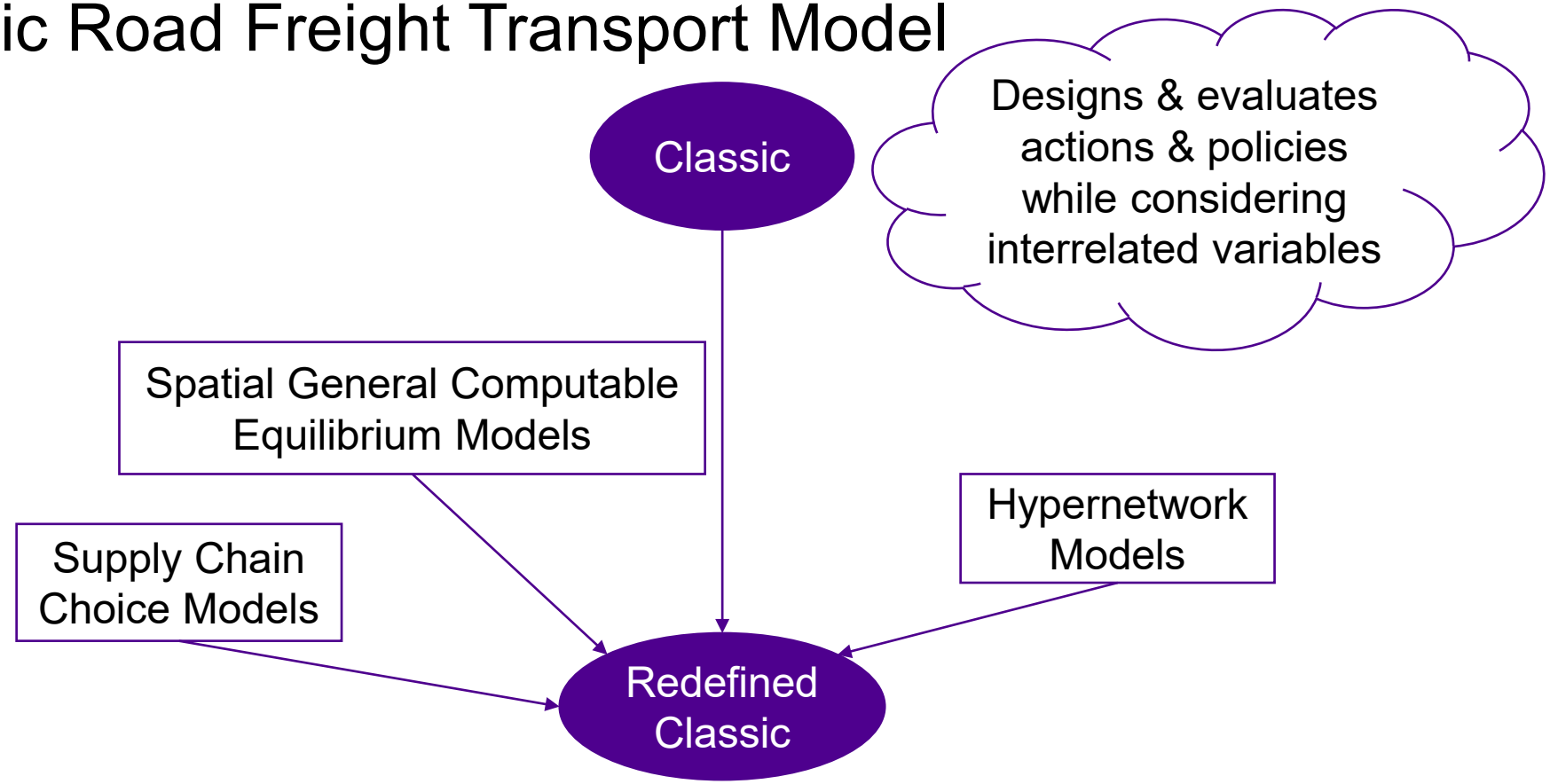
Used for TENT-T's development & its policies

support transport forecasting, infrastructure planning & policy analysis

Source: Havenga, J. H. (2018). National freight demand modelling: a tool for macrologistics manage-ment, The International Journal of Logistics Management 29 (4), 1171-1195.

Findings- Development of Road Freight Transport Models

Classic Road Freight Transport Model



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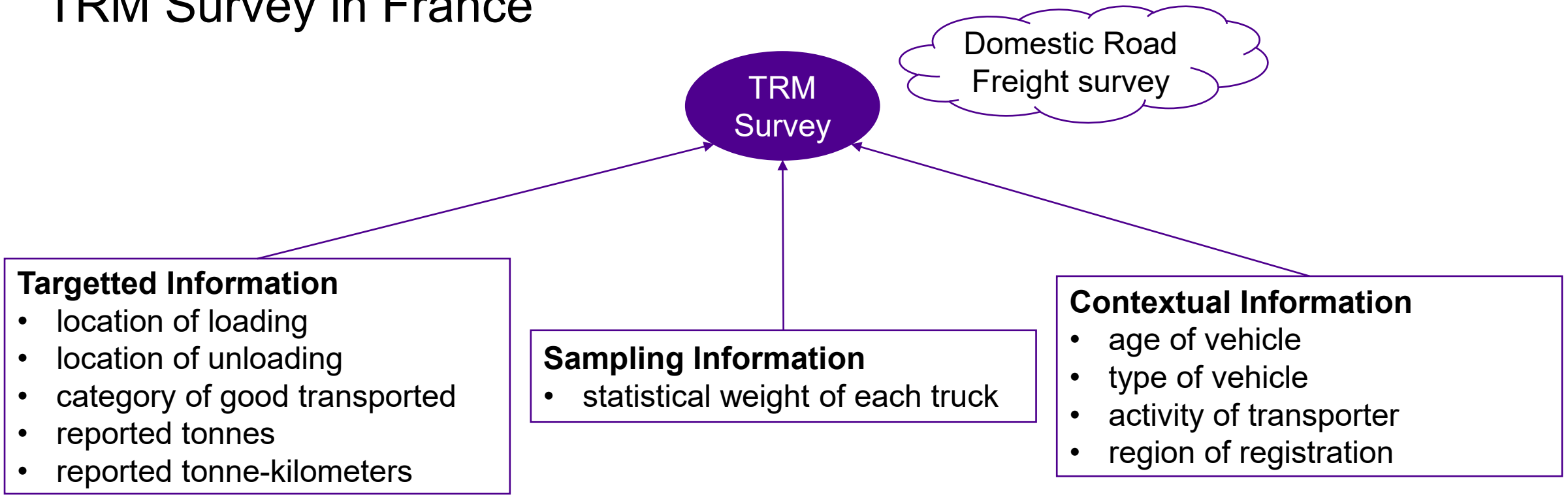
Findings - Development of Road Freight Transport Models

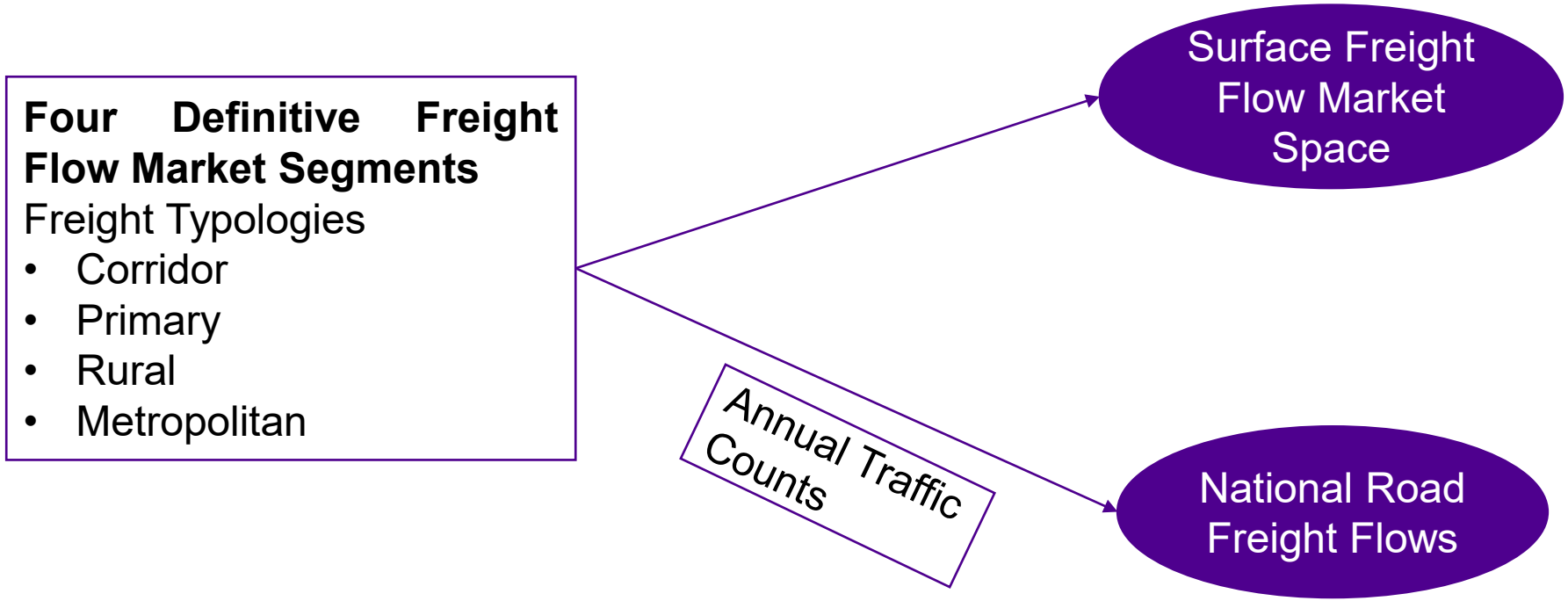
TRM Survey in France



Source: Courtonne, J.-Y., Longaretti, P.-Y., Dupré, D. (2017). Uncertainties of Domestic Road Freight Statistics: Insights for Regional Material Flow Studies, Journal of Industrial Ecology, 22 (5).

Findings - Development of Road Freight Transport Models

Methodology for South Africa's National Freight Flow Model



Source: Havenga, J. H., Pienaar, W. J. (2012). The creation and application of a national freight flow model for South Africa, Journal of the South African Institution of Civil Engineering, 54 (1), 2-13.

Findings - Uses of Road Freight Transport Models

Policies

- to assess impact of transport policies
- to form policies to use multi-modal network for freight transport optimally

Demand Patterns, Market & Schedules

- to understand spatial location demand patterns
- to structure the market
- to understand schedule of goods vehicle fleet

Infrastructure Development

- to develop transport infrastructure & related policies
- to conduct CBA on decisions regarding transport infrastructure development
- to conduct integrated planning for national infrastructure development
- to develop optimal network

Mode Of Transport, Vehicle Type & Fuel Type

- to make informed decisions on investments in certain transport modes
- to improve vehicle utilization & fuel efficiency
- to shift to alternative transport modes & lower use of carbon fuels
- to estimate future vehicle fleet requirements

Source: Gallo, M., Marinelli, M. (2023). The Use of Hydrogen for Traction in Freight Transport: Estimating the Reduction in Fuel Consumption and Emissions in a Regional Context, Energies, 16(1), 508.
Havenga, J. H. (2018). National freight demand modelling: a tool for macrologistics manage-ment, The International Journal of Logistics Management 29 (4), 1171-1195.
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Najaf, P., Famili, S. (2013). Application of an Intelligent Fuzzy Regression Algorithm in Road Freight Transportation Modelling, Promet–Traffic & Transportation, 25(4), 311-322.

Findings - Green Transition By Modelling Electric Freight Vehicles in Road Freight Transport Models

Road Freight Model
+
Scenario-based approach

→ Help policymakers understand role of electrification in road freight transport

→ **Policymakers design policies**

- To promote decarbonization of road freight transport
- To achieve environmental- & emission reduction targets
- To plan & develop charging- & refueling infrastructure

Source: Stock Images

Source: González Palencia, J. C., Nguyen, V. T., Araki, M., Shiga, S. (2020). The Role of Powertrain Electrification in Achieving Deep Decarbonization in Road Freight Transport, Energies, 13 (10), 2459.
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Future directions

- The paper is part of research project

SIX HOVE (Sustainable industry X – Heavy on-road vehicles ecosystem)

Aim: to produce a roadmap for the promotion of electrification of trucks in Finland.

- In the future, the project would lead us to create a national road freight transport model in Finland to facilitate green transition.
- With the background information from this study, we plan to take this research further by conducting a systematic literature review by expanding the inclusion criteria (to sources beyond journal articles, e.g., policy articles).

Practical Implication & Limitation

- **Practical Implication**: The newly developed Finnish model would serve as a decision support tool for public authorities & companies when considering investments in charging stations & hydrogen refueling stations for electric freight vehicles (BEVs & FCEVs), for deciding the optimal location of charging or refueling infrastructure in logistics centers & on the road network.
- **Limitation**: There are only a few journal articles on integration of electric freight vehicles & road freight transport models.

Key Takeaways

Current Road Freight Transport Models

- NFM Norway
- VMÖ Austria
- BIG Norway
- TRANS-TOOLS, EU
- HIGH-TOOL, EU

Development of Road Freight Transport Models

- By redesigning classic road freight transport model
- By combining
  - spatial general computable equilibrium models
  - supply chain choice models
  - hypernetwork models

Purpose of Road Freight Transport Models

- To design good policies
- To develop infrastructure
- To understand demand patterns, the market & schedules
- To choose the mode(s) of transport, vehicle type & fuel type

Integration of electric freight vehicles in Road Freight Transport

Road Freight Transport Models are necessary for policymakers:

- To understand the role of electrification of road freight transport
- To design policies to decarbonize & to reduce emissions of the transport sector

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Thank you! Kiitos!

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Doctoral Thesis Title: *The Emerging Electric Vehicle Market In Finland – Managing The Uncertainties In The Finnish Electric Vehicle Ecosystem*

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