

# Overall design of the Danish National Transport Model

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# Outline

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- The zone system
- Overall model system
  - Passenger transport, freight, and choice of route
- Forecast strategy
- Linkage between difference aggregation levels
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# Introduction

- The basic motivation has been to introduce a "unified" model, which will ensure that different projects are **judged** according to the same "metric system"
- This is completely similar to the use of standard value-of-time estimates
- It also resembles the development seen in other European countries and in the European Commission



# Data

- The model will apply a range of different data
  - TU data and Danish register data will be a fundamental source to the share of transport generated by Danish Citizens
  - Stop interviews in the airport, at ferries, and at the Great Belt will explain demand of foreigners as well as for Danish citizens on longer trips
  - A family based overnight survey will yield information about trips with a duration longer than 24h



	+2.688
	+5.000
	+1.500
	+1.125
	+1.062

# The zone system

- The zone system constitute the all important geo-reference of the model
- Generally, there is a trade-off in that
  - More zones will improve precision
  - But also increase computation time

Level	Description	Zealand	Jutland/Funen	Total
L <sub>0</sub>	Municipality level	45	53	98
L <sub>1</sub>	Strategic level	70	106	176
L <sub>2</sub>	National level	530	377	907
L <sub>3</sub>	Regional level	2234	1436	3670

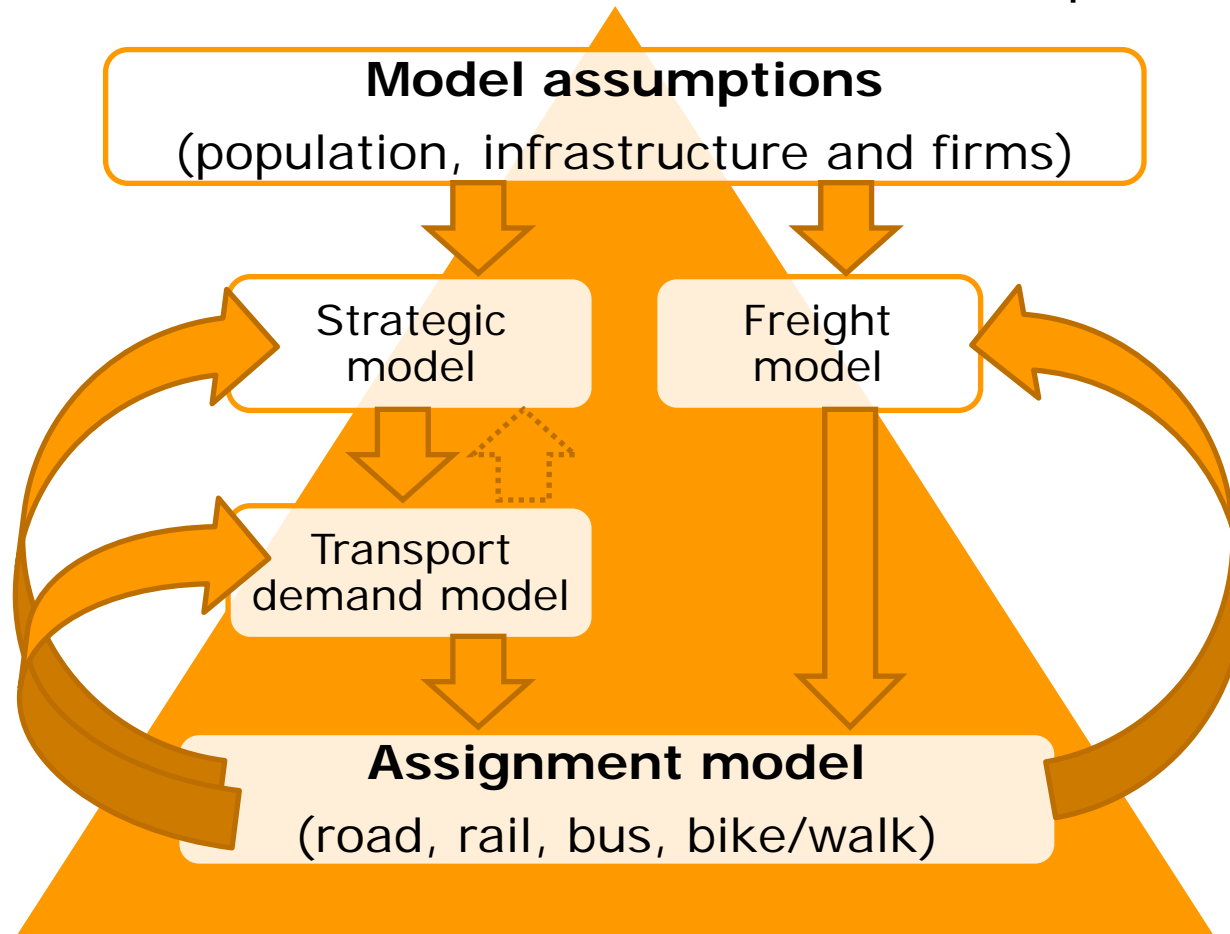
# Zone system

- The idea behind the zone system has been that zones should be
  - Homogeneous in size, primarily with respect to the population but also with respect to the geographical size

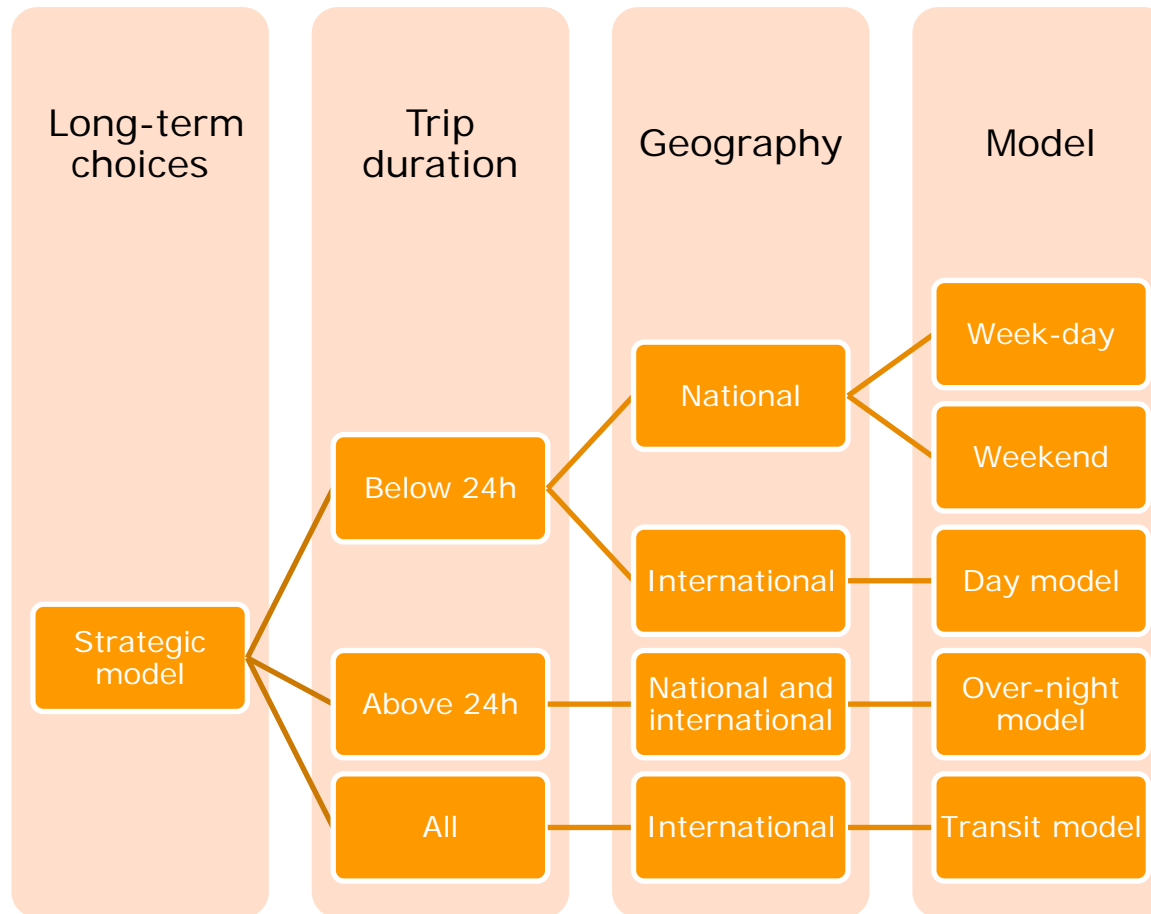
Level	Region	Avg. addresses	Avg. size (km <sup>2</sup> )
L <sub>0</sub>	Zealand	19,522	204.5
L <sub>1</sub>		12,919	131.5
L <sub>2</sub>		2,355	24.4
L <sub>3</sub>		612	15
L <sub>0</sub>	Jutland and Funen	27,753	636.2
L <sub>1</sub>		14,260	318.1
L <sub>2</sub>		2,832	63.6
L <sub>3</sub>		667	6.4

# Overall model structure

- The framework will consist of the several componts



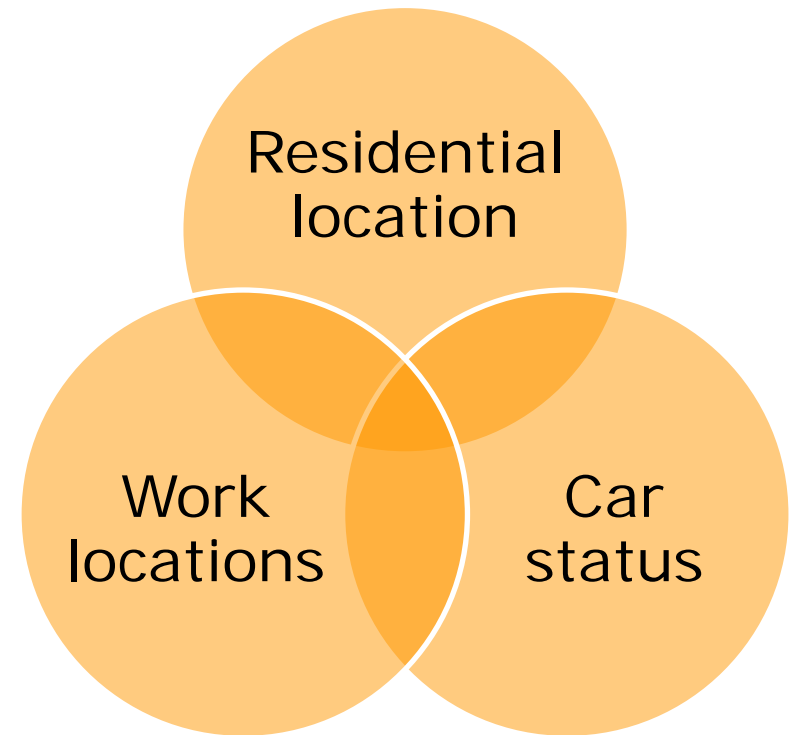
# Modelling passenger demand





# The strategic model

- The strategic model will **not** consider transport
- It will only consider a set of strategic choices at the household level, which can be seen as a “pre-condition” for transport
  - Residential location
  - Work locations for up to two workers
  - Car status (number and type)
- The strategic model can be based on register data
  - This will allow us to investigate interrelations within the family at the strategic level



# The demand models

- There are five parallel models
- **Week-day** model
  - Danish citizens
- **Weekend** model
  - Danish citizens
- **International day trip** model
  - Trips in and out of Denmark and below 24h
- **Overnight** model
  - Danish citizens
- **Transit** model
  - Trips that start outside Denmark and ends outside Denmark

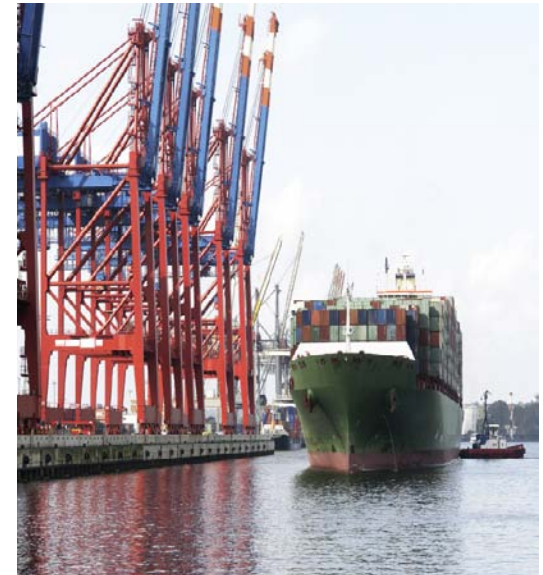
## Route choice model

- The route choice take as input tour matrices and assign the transport to the network
- There are a set of different route choice models
  - Road assignment (cars, freight, feeder traffic, and preloaded bus routes)
  - Public transport (combined schedule based and frequency based model)
  - Air assignment



# Freight demand model

- The model involves three sub-models
- Trade model
  - Forecast trade between zones
- Logistic model
  - Choice of frequency and shipment size
  - Choice of loading unit (containerised or not)
  - Use of distribution centres, ports, and terminals
  - Choice of mode of each leg of the transport
  - Choice of crossing, e.g. new Femern Belt
- International vans and trucks, freight trains, and ships are assigned separately in the freight model



# Forecast strategy

- The forecast strategy is closely related to how we “expand” the model to represent a given future population
  - For models covered by Danish register data, we will “expand” at the micro-level by up-weighting individuals (divided into socio-groups)
  - For models that represent foreigners, we will “expand” at the matrix level

Model	Data	Geography covered	Forecast method
Week-day model	TU	DK↔DK	PSE
Weekend model	TU	DK↔DK	PSE
International day model	TU	DK → outside DK	Matrix Method
	Border RP/SP	Outside DK → DK	
Overnight model	TU	DK↔DK	Matrix Method
	Border RP/SP	DK → outside DK	
	Overnight RP	Outside DK → DK	
Transit model		Outside DK ↔ Outside DK	Matrix Method

## Linkage of different aggregation levels

- The will serve a variety of different objectives
  - In some cases many details will be needed
  - In other cases we will need to be able to run hundreds of screening tests to narrow down the solution space (e.g., road-pricing schemes)
- This calls for flexibility in how we run the model
- Different configurations of the model will be defined according to
  - The four zone systems
  - A break between Jutland+Funen and Zealand
  - A total of 15 configurations
- In addition, we foresee a number of special configurations
  - E.g., the Femern Belt model will indeed be one of them

# Model configurations

Model configurations	East	West	Outside DK	Description	Run-time
<b>M1</b>	<b>L1</b>	<b>L1</b>	<b>Z1,Z2</b>	<b>Screening model based on L1</b>	<b>Very fast</b>
M2	L1	-	Z1	East screening model	Very fast
M3	-	L1	Z2	West Screening model	Very fast
M4	L2	-	Z1	East screening model based on L2	Fast
M5	-	L2	Z2	West screening model based on L2	Fast
M6	L2	L1		East screening model with L1 West	Fast
M7	L1	L2		West screening model with L2 East	Fast
<b>M8</b>	<b>L2</b>	<b>L2</b>	<b>Z1-Z4</b>	<b>National L2 model</b>	<b>Medium fast</b>
M9	L3	-	Z1	Local East model	Medium
M10	-	L3	Z2	Local West model	Medium
<b>M11</b>	<b>L3</b>	<b>L1</b>	<b>Z1</b>	<b>Local East model with L1 West</b>	<b>Medium</b>
<b>M12</b>	<b>L1</b>	<b>L3</b>	<b>Z2</b>	<b>Local West model with L1 East</b>	<b>Medium</b>
M13	L3	L2	Z1	Regional East model combined with National L2 model	Medium-long
M14	L2	L3	Z1,Z2	Regional West model combined with National L2 model	Medium-long
M15	L3	L3	Z1,Z2	National L3 model	Long

# Policy assessment

- The policy assessment space will include
  - Infrastructure evaluations
  - Investigation of multi-modal transport systems for freight and passengers
  - Evaluation and design of road-pricing experiments
- At the level of the population
  - Enable detailed forecast of the population at the level of the zone system
  - Represent how demographical changes impact transport demand
- The model will also provide a framework for deriving
  - External environmental effects including accidents, noise, and emissions
- The model will extent abilities of previous models by
  - Allowing time-of-day substitution, decompose strategic and transport related choices, and introduce activity choices
  - It will be the first Danish freight model



## Summary and discussion

- The national represent the first unified transport model in Denmark
  - A major benefit because different projects are evaluated according to the same reference model
- The model will consist of a range of sub-model systems
  - Population synthesiser
  - Demand model
  - Freight model
  - Route choice model
- Different configurations will be available as combinations of the zone system and East and West Denmark
- Policy assessment will be easier and cover a wider range of policies