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Reflection on sufficient measure packages, and the properties of some types of measures

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Purpose & Contents

(1) Some example measure packages and discuss the estimated effects.

Cases:

- Backcasting The Hague 2 (2018/2019 for 2030)
- Backcasting The Hague 1 (2013 for …)
- Backcasting Amsterdam

(2) Some additional bnackground on PT and logistics

- **From PT stop to mobility hub**
- **Urban freight transport – logistic patterns**

Backcasting The Hague 2 (2018/19)

Coherent package of measures on the municipal level in the field of mobility

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Between 2015 and 2030:

1) **Green tenders (8.1 kton)**
2) **Stimulating clean transport use by private individuals and businesses (8 kton)**
3) **(Steering modal shift with) spatial policy and parking standards and parking fees (11.2 kton)**
4) **Modal shift to bicycle and PT (45.9 kton)**
5) **City logistics (2.9 kton)**
6) **Environmental zone in the whole of The Hague (287.4 kton). This measure overlaps with the other ones**

Municipal measure package in the field of mobility

Green tendering. This package leads to CO_2 neutrality of vehicles of all tenders:

- All PT busses completely electric
- All contract transport (schools, regional taxis) completely electric
- The total municipal vehicle park is electric

Stimulate clean individual and company transport. This package serves further stimulation of electric transport:

- Accelerated installation of additional fast and other charging points, above het current introduction rate
- Continuation of the current subsidies to buy clean vehicles
- Only electric taxis allowed in the taxi regulation
- Financial advantage for parking and parking allowance for electric cars
- Employers' agreements with employees concerning sustainable mobility

Spatial policy, parking standards and parking fees. This package is about the adjustment of parking standards for new buildings around PT nodes (2 main stations, 2 regional stations) and high performance tram lines. The parking standard for such developments (in DH now being 1 parking lot for each 10 work places) will be reduced … In addition this package contains the increase of parking fees for visitors by 50% in order to make car use less attractive. … more in accordance to other large cities.

Modal shift. In this package measures are calculated that lead to a shift from car mobility to bicycling and public transport.
Concerning the promotion of bicycling one must think of:

- Building new bicycle lanes
- Fast bicycle lanes between cities
- More parking capacity for bicycles at train stations and PT stops
- Giving more right of way at junctions and shorter waiting times at signal lights
- More attention the bicycle in chain trips
- Improving bicycle routes to PT stops and train stations

Next, the frequency and infrastructure of public transport (PT) are improved. Having in mind:

- High frequencies of regional and local tram lines
- Extension of the regional tram network with new lines …
- Chain solutions (last mile for specific target groups) including shared bicycles
- Smart bus-taxi solutions (demand dependant)
- Smart PT concessions (thinking in terms of accessibility instead of bus lines)
- Car2go coupled to PT at selected nodes
- Improving pedestrian routes to PT stops and train stations

In case of compelling policies more can be achieved. Think of stringent parking policies, road pricing, compelling agreements with employers, event traffic and public locations, by which more trips go by bicycle and PT instead of by car.

City logistics. This package contains measures for city logistics in the city centre. City logistics is broader than freight transport between the edge and the centre of the city. It is about the logistics between distribution centres and the destinations in the city v.v., involving vans to heavy trucks. It includes post, packages, fresh-logistics, supplying shops, reverse logistics, … and construction logistics.
These measures are carried out in combination with subsidies to purchase electric vans and conducting more efficient freight transport: better loaded vans and trucks, bundling of shipments via hubs, more retour loads etc. guided by ICT (“Smart logistics”).

Emission free environmental zone in all the city. The government agreement (national government, 2017) mentions that the public sector will envisage enabling emission free environmental zones in city centres. In this measure package we go one step further, namely envisaging the implementation of zero emission zones for all the city for all vehicles. In that case only emission free cars, vans and trucks are allowed to run in all the city.
… This option has an overlap with the other measure packages, and is therefore analysed separately.

Difference between measure 2 and 6

2)

Market penetration of electric cars and implementation of charging infrastructure in ambitious rates.
EK: this apparently is not 100% in 2030

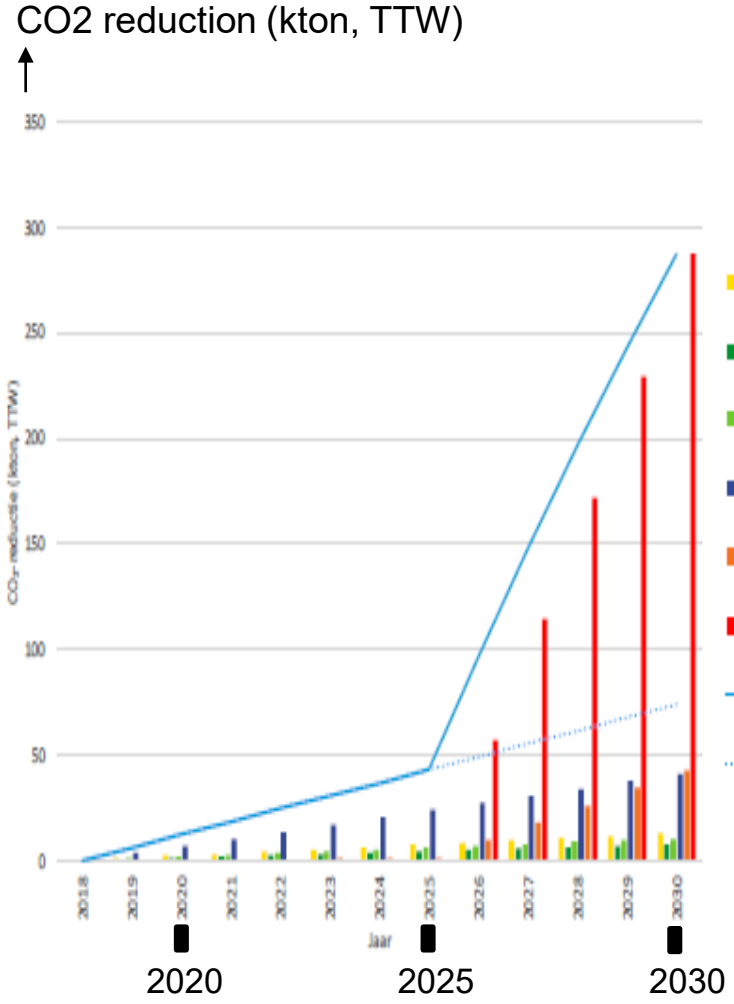
6)

Prohibiting non zero-emission vehicles in the entire city.
EK: rather for demonstration than representing a realistic policy.

Why no realistic policy?

- Because the accessibility of the city is under pressure if alternatives (PT, bike, electric cars etc.) are not developed in advance
- Because politicians in Europe are not likely to take such radical decisions

CO2 reduction of the different measure types



- Green tenders (8.1 kton)
- Stimulate clean individual and company transport (8 kton)
- Modal shift, spat. policy, park. stand. and fees (11.2 kton)
- Modal shift to bicycle and PT (45.9 kton)
- City logistics (2.9 kton)
- Environmental zone in all the city (287.4 kton)
- Combined effect with environmental zone (but overlap)
- Combined effect without environmental zone

Source: on the basis of CE Delft, 2018.

Backcasting The Hague 1 (2013)

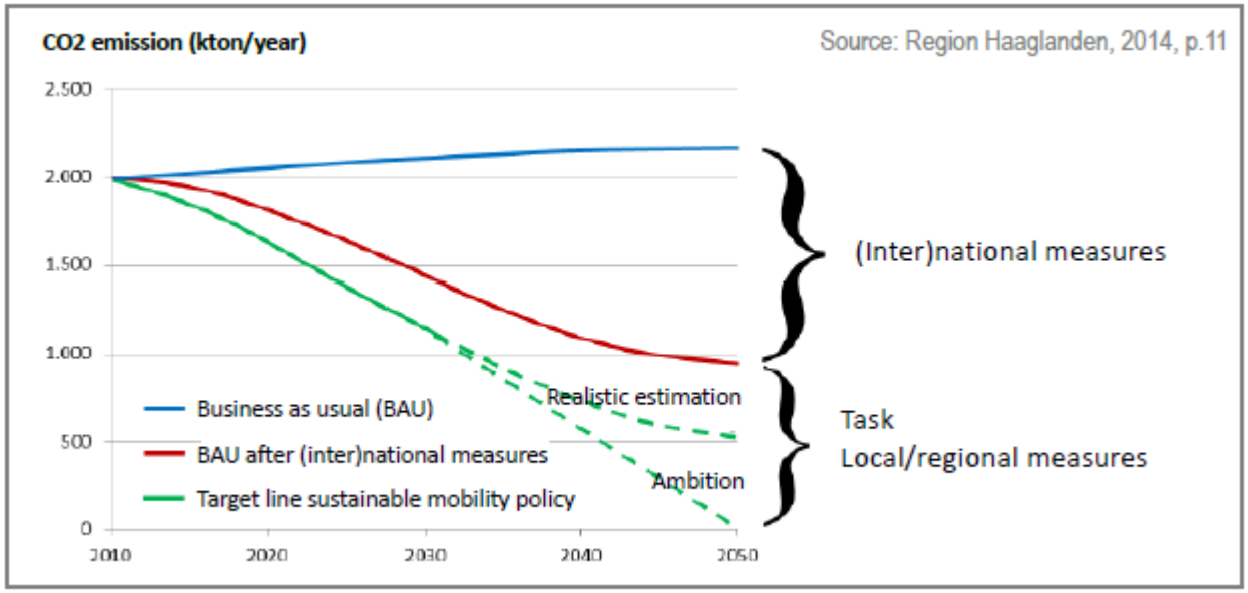
Municipal measure package in the field of mobility.

Spatial development and infrastructure	• **More attention to sustainable mobility in spatial plans with focus on limiting car mobility** • **Densification of land use** • **Further functional mix: more amenities in the residential areas** • **Road profile: more space for bicycling and pedestrians, radically and throughout the entire city** • **Further extension of car-free and low-traffic zones in the city centre and around shopping centres, schools etc.** • **Development of economic centres around public transport nodes** • **When restructuring existing or developing new (residential) areas, mobilise all options for modal shift (e.g. by implementing bicycle and public transport access in an early stage, arranging agreements about less parking lots)**

Traffic management	• **Reduction of maximal speed (from 50 to 30km/h, from 80 to 60km/h) including strict enforcement** • **Priority for pedestrians and bicyclers in many situations** • **When tuning traffic signal lights, give pedestrians and bicyclers priority and an extra green phase (for all directions)** • **Stimulate car sharing** • **Introduce cuts in road connections … to discourage car use**
Parking and pricing policies	• **Extend payment for parking (in space and time) and increase fees** • **Differentiate fees for parking permissions according to CO2 emissions** • **No new parking garages in the city centre** • **Less parking space on street …** • **Environmental zones, differentiate parking fees and pricing measures (advocate on the national level more municipal policy freedom)** • **Introduction of congestion charging for the most traffic intensive parts on the city. Use the revenues for improvement of low carbon transport**

Pedestrians and bicyclers	• **Good, safe and fast bicycle routes and sidewalks for pedestrians, optionally with multi-level junctions** • **Fast bicycling routes 2x2 on main connections …** • **Obligation to include bicycle parking facilities in new buildings. Develop bicycle parking standard** • **Remove roaming bicycles on time** • **Charging point for bicycles** • **Stimulate firms to encourage the use of bicycles for customers and employees** • **Strengthen the city's image as bicycle city, focussing on health and liveability**
Public transport policy	• **Extra impulse for PT on heavy corridors to surrounding agglomerations** • **Functional tendering of PT: steering via aims** • **Formulate CO2 requirements in the tenders**
Freight transport	• **Bundled distribution concepts …** • **Stimulate firms to use relative clean and economical vehicles** • **Use of 2nd generation bio fuels**

A comparable study carried out for the region of The Hague led to the following CO2 reduction results



Effects of local package of measures

Additional local package needs to reduce CO2 by another 20-25%. A few indications, given in the report, of what such package should include:

- **Bicycle growth of bicycling: 30% until 2030 and another 20% by 2050**
- **Bicycle share share “now” 18%. Other cities have 30%**

Not all countries have the same bicycling tradition as NL

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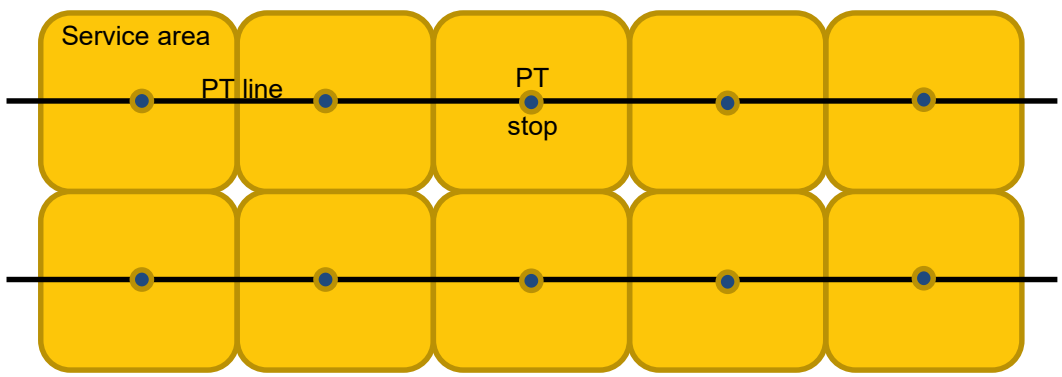
But one can try to make PT more attractive in any country

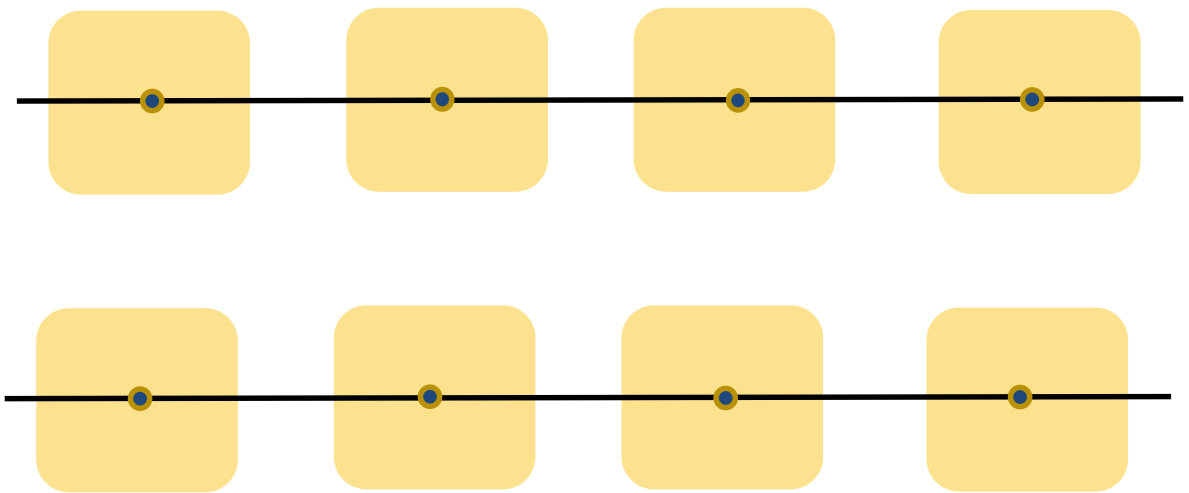
Measure example (next slide): Responding to large walking distances from/to PT stops

From PT stop to mobility hub ?



Example of a theoretically ideal design of PT lines, tram stops and service areas

Grid of PT stops can be easily reached by walking only



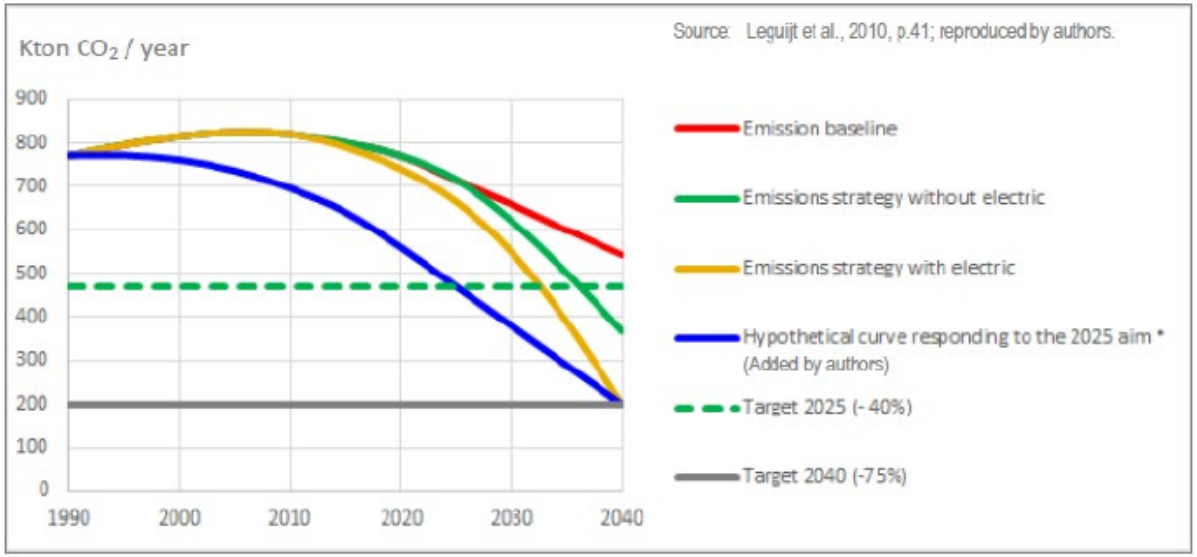
In practice, certainly for high performance PT lines, the walking distance to stops is larger than generally accepted

Only part of the areas around PT stops can be easily be reached by walking

Implication: good facilities for alternative modes needed at the PT stop (in particular private and shared bicycle facilitites). This may lead to mobility hubs at PT stops

Backcasting Amsterdam (2011)

Measure package backcasting study Amsterdam (2011)



Source: CE Delft, blue curve added by EK

The study shows the effects of alternative measure packages for CO2 reduction.

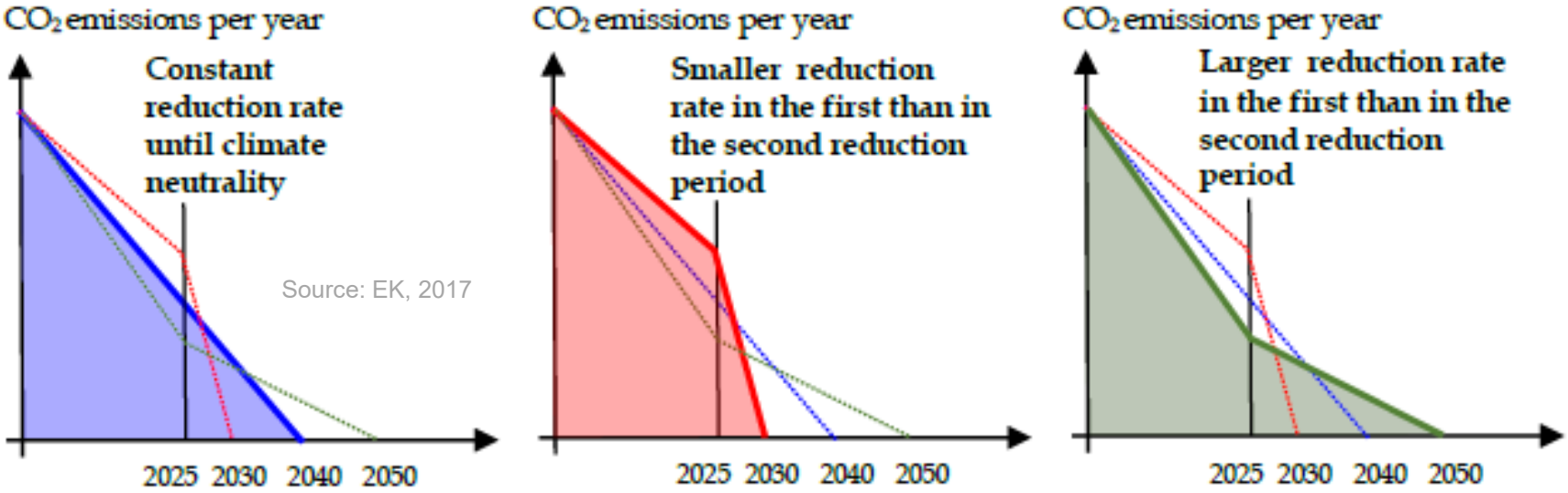
The curves does not meet the reduction aim for the intermediate year, 2025 (dotted line)

To respond to that aim, the reduction should have been according to the blue line.

Is it a problem that the intermediate aim has not been met, if after all the final aims is met?

Yes, this very likely is a problem, because more CO2 is emitted until the year of the final aim. In many cases the implication is that the carbon budget of a city is exceeded (see following slide).

The meaning of intermediate reduction aims for the CO2 budget (independent of G4)



The blue line shows a linear reduction of CO2 until 2040, the year the city aims for climate neutrality. We in this example assume the blue surface beneath the line to represent the CO2 budget of the city, meaning the maximal CO2 emission to sufficiently contribute to the aim of limiting global warming to 1,5° degrees Celsius.

If the expected reduction instead takes place more slowly in the first part of the reduction period (as in the middle picture), the CO2 budget will require achieving climate neutrality in an earlier year than 2040.

If instead one is more ambitious in the first part of the period (right picture), it may be acceptable to achieve climate neutrality in a later year than 2040.

Freight transport

Properties of urban distribution

1) Large trucks (articulated trucks):

- Commonly outside of the city
- If well loaded, result are low (fixed) costs per freight unit
- Good loading degrees often require bundling of flows to truckloads
- Can run in many parts **in the city**, although relative bad for liveability in the city. If well loaded, currently a relative good solution for energy and CO_2, in the future only in case of zero-carbon engines
- Switch of scale to small truck/van before entering the city, is useful for liveability, and potentially negative for energy and CO_2, unless electric vehicles are used

Properties of urban distribution

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2) Very long trucks:

- Increasing market share outside of the city
- If well loaded, result are very low (fixed) costs per freight unit
- Good loading degrees often require bundling of flows to truckloads
- **Can hardly run into cities**. Decoupling required at the edge of the city or in the city's region
- Switch of scale to large truck still before entering the city provides disadvantages for the liveability in the city, currently a relative good solution for energy and CO_2, in the future only in case of zero-carbon engines
- Switch of scale to a small truck/van before entering the city is useful for the liveability in the city, and potentially negative for energy and CO2, unless electric vehicles are used

Properties of urban distribution

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3) Small trucks/vans:

- If well loaded, result are still relative high (fixed) costs per freight unit, compared to large and well loaded truck
- Therefore the small truck/van ideally does not cover large distances outside of the city
- Therefore running large trucks outside of the city and decoupling large truckloads to loads for small trucks/vans before entering the city is often beneficial, for transport costs, energy and CO_2
- In case of large flows, the small truck/van implies high service frequencies in the city
- Liveability in the city is OK, for small flows. For flow sizes implying high service frequencies:
  - Customers only need small storage facilities
  - Disturbances in public space are relative small per visit, but frequent
  - Energy and CO2 levels per freight unit are relative high.

Properties of urban distribution

3) Small trucks/vans:
Don’t run them too much outside of the city

Conclusion for network and operational design

- The choice of vehicle type and of bundling and decoupling networks are cores issues in the transport sector

- Short term and strategic decisions to be taken periodically with regard to best vehicle, bundling and decoupling networks and operations

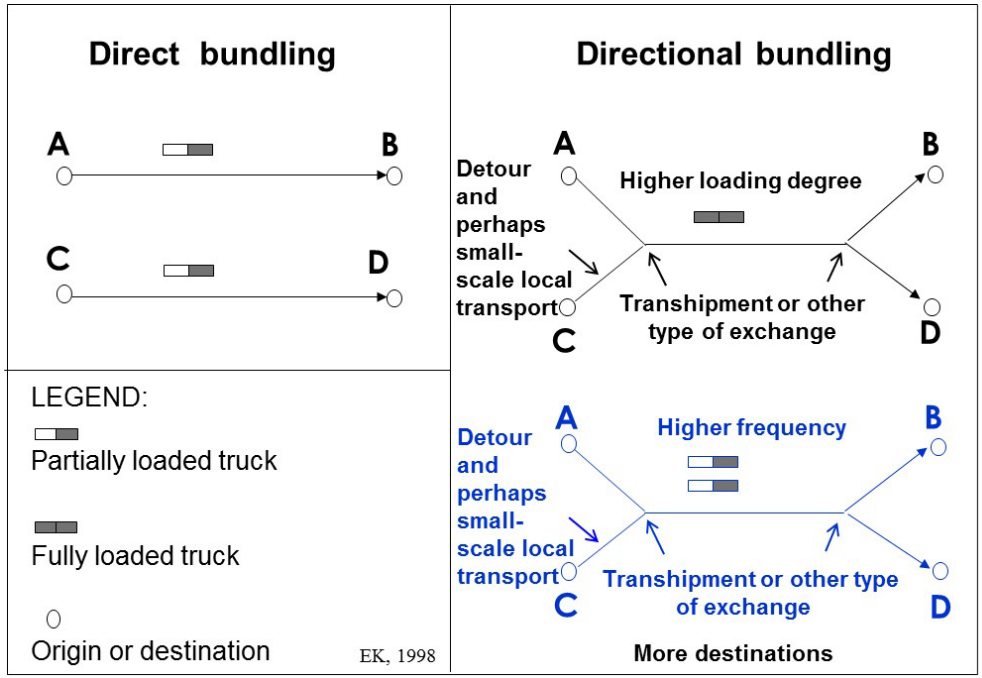
- Reconsideration of past decisions is needed because of changing frameworks

What are some major changing framework conditions?

- Zero emission zones in cities
- The market penetration of zero carbon trucks and vans
- Increasing scale of trucks between cities
- Other powering of trucks: hydrogen or overhead lines for electric trucks? The latter will only exist on highways, making decoupling (at least a change of tractor) necessary at the city egress-points of distribution centres.

  The strategies in this regard are not clear yet. Japan is developing and the German Ministry of Economy and Energy is advocating hydrogen power. This is less energy-efficient than battery-electric power, but transport is seen as only part of the general transition from a carbon to a hydrogen society. The German Bundesumweltamt has analysed, is testing and advocates overhead power lines on motorways for electric heavy trucks. This would require large investments, but so much less than the development to hydrogen freight transport by trucks.

The bundling challenge

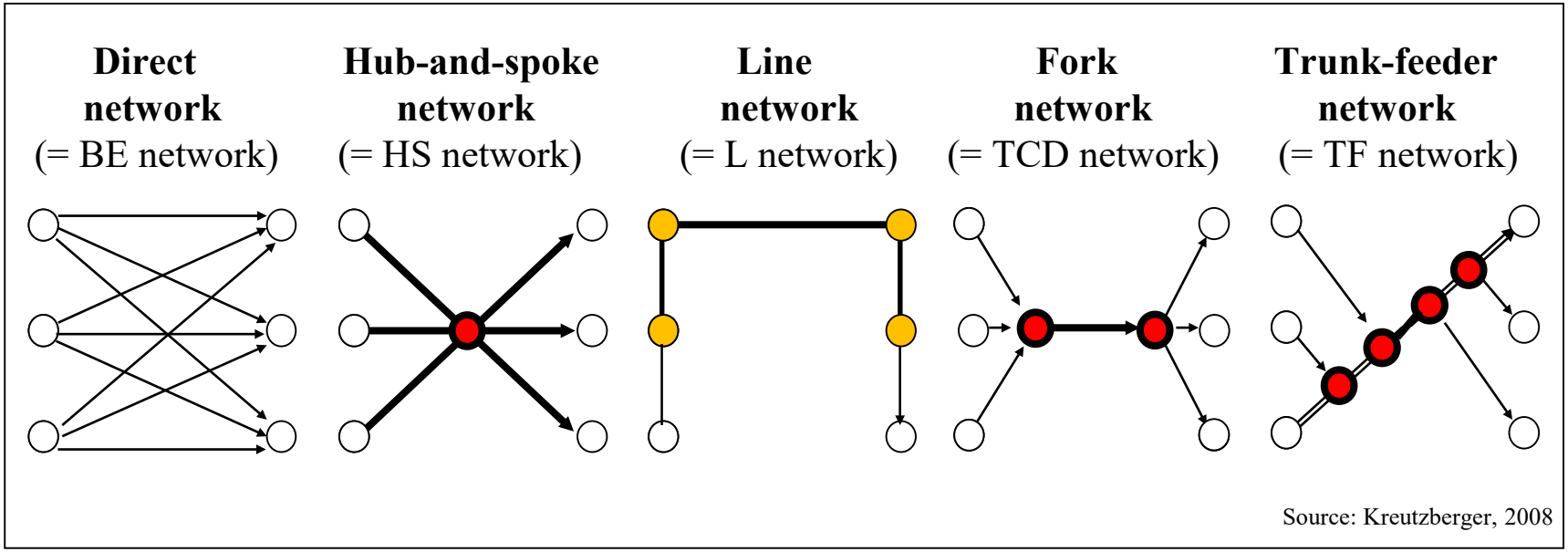


In the **left picture** there are two transport services, one from A to B, the other one from C to D. The small rectangles represent trucks, each of them partially loaded. The transport services represent "direct bundling" services.

In the **right picture** the truckloads of both connections are transported in joint trucks during part of their journey. This I call "directional bundling". As a result the truck can be fully loaded (upper picture) or the service frequency can be increased (lower picture), or a combination of both takes place. In addition, more destinations can be reached from each origin. The directional bundling also has disadvantages: detours, additional transhipment at intermediate nodes and local network parts, in which the transport scale often remains small.

The challenge of the transport planner is to identify the bundling solution with the best ratio of advantages and disadvantages

Basic types of directional bundling



LEGEND

= trunk transport service

= local transport service

For directional bundling one can distinguish the shown basic types. Combinations are possible. Each bundling network connects three origins with three destinations.
In the shown example the direct network requires 9 connections, the hub-and-spoke network 3 connections. The other three bundling alternatives each have 1 trunk connection. This difference is the fundament for organising transport scale (see following slide).
Other differences are:

- the presence of intermediate transhipment nodes, as in the HS, fork and TF network. In the direct and line network each piece of freight only has two transhipments.
- The transport distance. This is shorter in the direct network than in the other bundling networks.

Exchange solutions in bundling networks with road-road transhipment, e.g. a hub-and-spoke network

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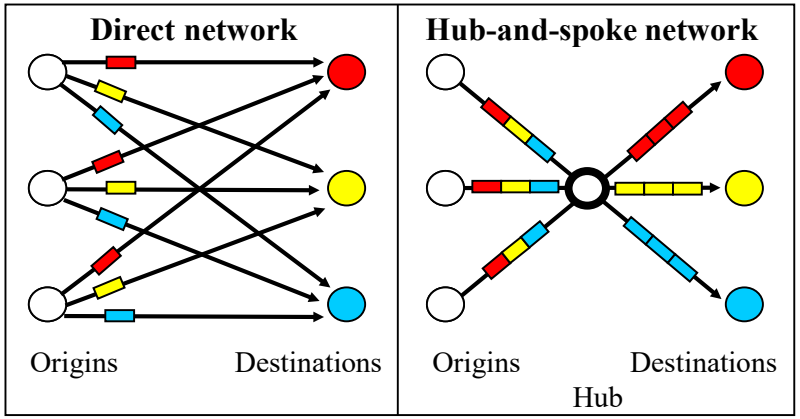
1) “Cross docking“, e.g. in a distribution centre, often including a sorting facility

2) Along the road

Illustration of organising transport scale by comparing the direct with the hub-and-spoke network



Source: on the basis of
Kreutzberger, 2008 and 2014

The figure shows transport from three origins (a city, factory or other shipper) to three different cities, in the left picture by means of direct bundling, in the right picture by means of hub-and-spoke bundling. For simplicity, I assume the transport volume to be the same on all transport relations.

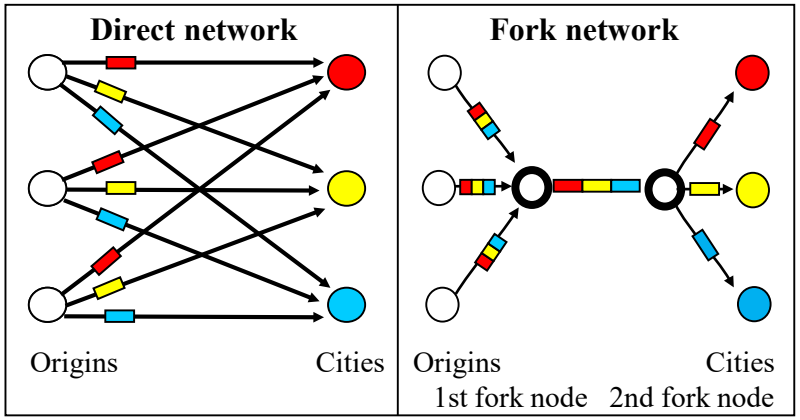
In the shown example the network transport volume is sufficient to – in the direct network - fill small trucks on the required frequency level.

What are the operations in the hub-and-spoke network? Each large truck transports freight to different cities from each origin to the hub. There the trucks meet and exchange loads. From the hub on each truck has freight for only one city.

The presence of less routes in the hub-and-spoke network allows to operate large trucks in the hub-and-spoke network. Alternatively, one could operate the same truck sizes in both networks, and use the presence of less routes in the hub-and-spoke network to increase the service frequencies.
If the network transport volumes are sufficiently large to run large trucks on the required frequency level in the direct network, then this is the best solution. But most often the volumes are not that large.

Locational impact: the hub is ideally located outside of a certain city on a distance, that matches the number of cities needed to fill large trucks on the required frequency level.

Illustration of organising transport scale by comparing the direct with the fork network



Source: on the basis of
Kreutzberger, 2008 and 2014

The figure shows transport from three origins (a city, factory or other shipper) to three different cities, in the left picture by means of direct bundling, in the right picture by means of fork bundling.
For simplicity, I assume the transport volume to be the same on all transport relations.

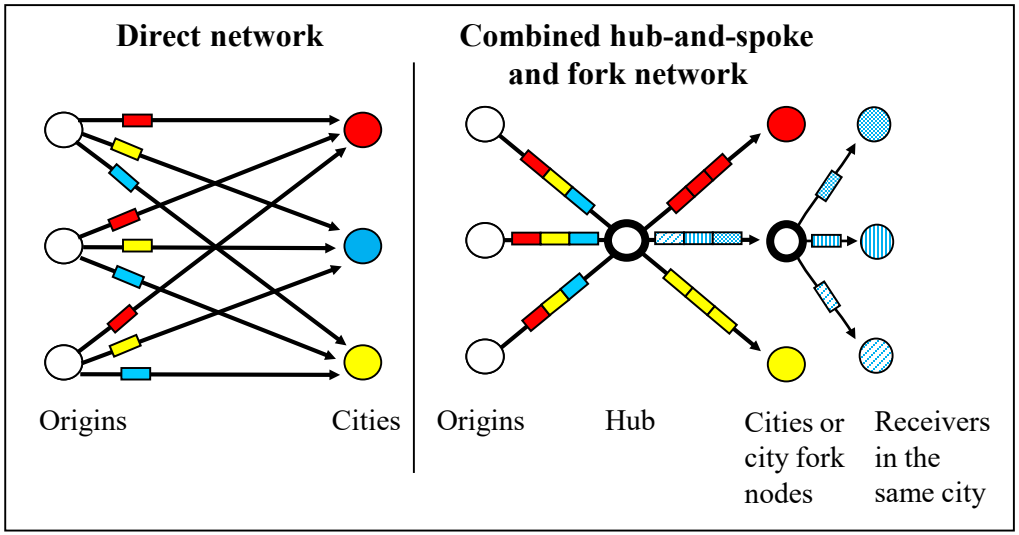
In the shown example the network transport volume is sufficient to – in the direct network - fill small trucks on the required frequency level.

What are the operations in the fork network? At the first fork node the relative small truckloads from each origin are combined to a large truckload. At the second fork node, they are split again, and also sorted. Each truck then has freight for only one city.

The presence of less (trunk) routes in the fork network allows to operate large trucks trunk connection in the fork network. Alternatively, one could imagine the flows on the trunk part to be very large, allowing to operate large trucks also on the routes from the second fork node to the cities. But in this case it would very likely be more economic to operate a hub-and-spoke network or a direct network, dependent on the flow sizes.

Locational impact: Given the rather small load size after the second fork node, the latter is ideally located close to the cities. In fact, the second fork node could by located at the edge of one city, serving only that city. The coloured nodes then represent different receivers in the same cities instead of different cities.

Illustration of organising transport scale by comparing the direct with the fork network



Source: on the basis of Kreutzberger, 2008 and 2014

Combining the hub-and-spoke network with the fork network may be a solution to organise optimal truckload sizes for different parts of the network. Large ones around the hub, and smaller ones between the fork node of a city and the receivers/shippers of goods in the city.
The fork node – better than the hub – can function as decouple point between flows outside and inside the city, not only in order to achieve the optimal scale of transport in different parts of transport chains, but perhaps also because of municipal limitations (e.g. maximal truck sizes, zero-emission zones) and future innovations (scenario of overhead electric power lines for heavy trucks; better results in planning roundtrips of electric vans and smaller trucks). However, this operation has two transhipment nodes in a city's region, which increase transport costs and time. So while it is of interest to introduce to differentiate truckload size in different areas, it is also of interest to minimise the number of intermediate road-road transhipment nodes.

At the end the (dis)advantages of alternative solutions need to be encountered, and – dependent on the network transport volumes involved, the aims of logistic operators, the municipal policies, and future technical solutions it can be reasonable to skip or include the hub or fork node, in the latter case concentrating the decouple function to the hub.

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Thank you!

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