

INTEGRATING SHARED MOBILITY AND TRANSIT TO ENHANCE OUR CITIES

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DIRK GREVINK

ESPEN STRAND HENDRIKSEN

ROB VAN DER BIJL

NIELS VAN OORT

JENNIFER GRAPER

JAN VAN SELM

WIJNAND VEENEMAN

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OBJECTIVES OF TRANSPORT



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<https://research.tudelft.nl/en/publications/innovations-in-the-appraisal-of-public-transport-projects>



THE OPTIMAL MIX

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<https://www.tudelft.nl/citg/smartptlab>



CHALLENGES?

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DUTCH PERSPECTIVE

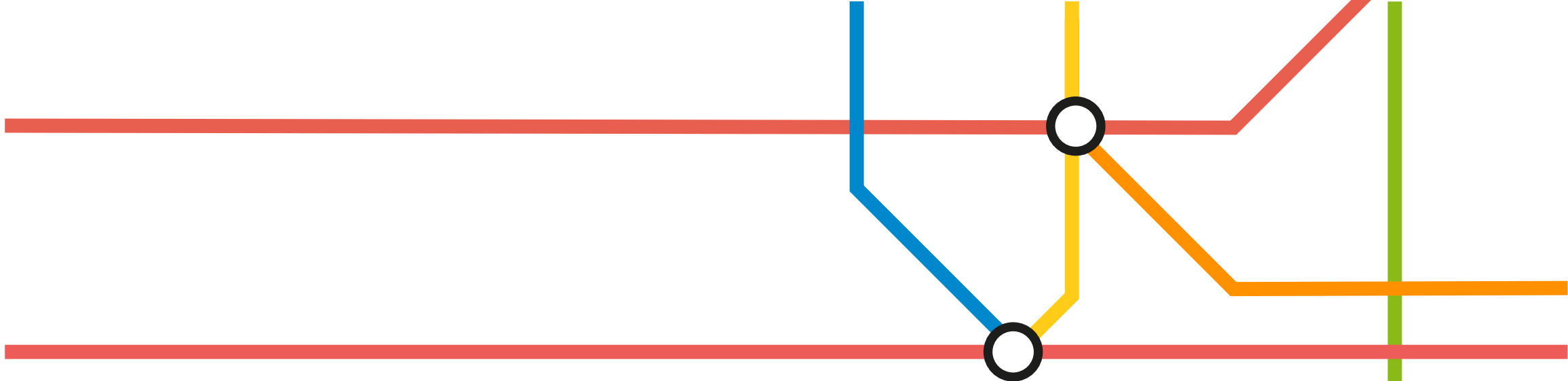
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Public Mobility



Ministerie van Infrastructuur
en Waterstaat



Dirk Grevink

607

naar Axel Sterrenpracht

Geldig vanaf: 08-01-2023

↓ haltes van deze lijn

- Hoek, Busstation
- Terneuzen, De Knol
- Terneuzen, Oostelijk Bolwerk
- Terneuzen, Scheldorado
- Terneuzen, Serlippensstraat
- Terneuzen, Zuidlandstraat
- Terneuzen, G.Gezelestraat
- Terneuzen, Alvarezlaan
- Terneuzen, Rooseveltlaan
- Terneuzen, Sloelaan
- Terneuzen, Zeldenrustlaan
- Terneuzen, Ziekenhuis
- Zaamslag, Busstation
- Axel, De Sterrenpracht

maandag t/m vrijdag

7 59

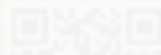
zaterdag

Rijdt niet op zaterdag

zon- en feestdagen

Rijdt niet op zon- en feestdagen

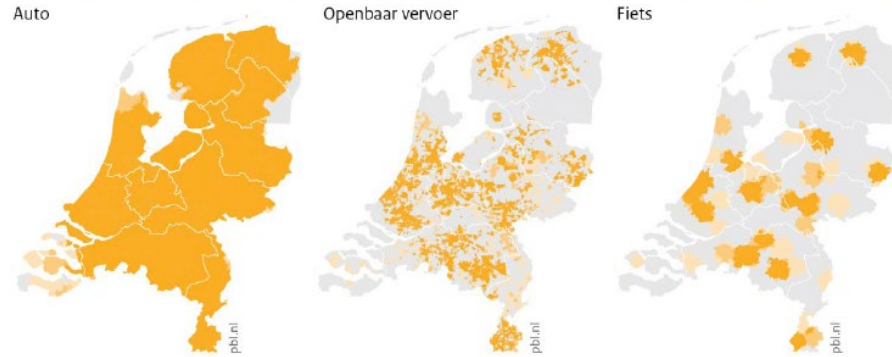
Actuele info
vertrektijd



Public mobility
Increases of accessibility services
same social cost

Analysis

Bereikbaarheid HBO/WO locaties (alle vestigingen) per vervoerswijze binnen 60 minuten reistijd, 2021



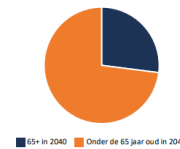
Services like education, work, health and shops are less and less accessible



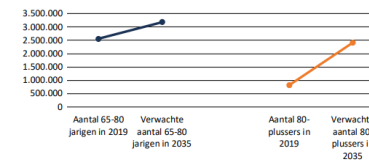
2019 – 2024 25% less stops; more expected

People are getting older, more indicated transport is needed which leads to increasing costs

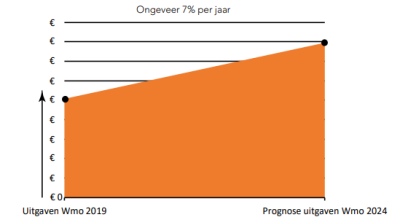
Prognose: In 2040 is meer dan 1 op de 4 Nederlanders 65+



Dubbele vergrijzing in Nederland: Binnen de groep 65-plussers neemt het deel 80-plussers toe.

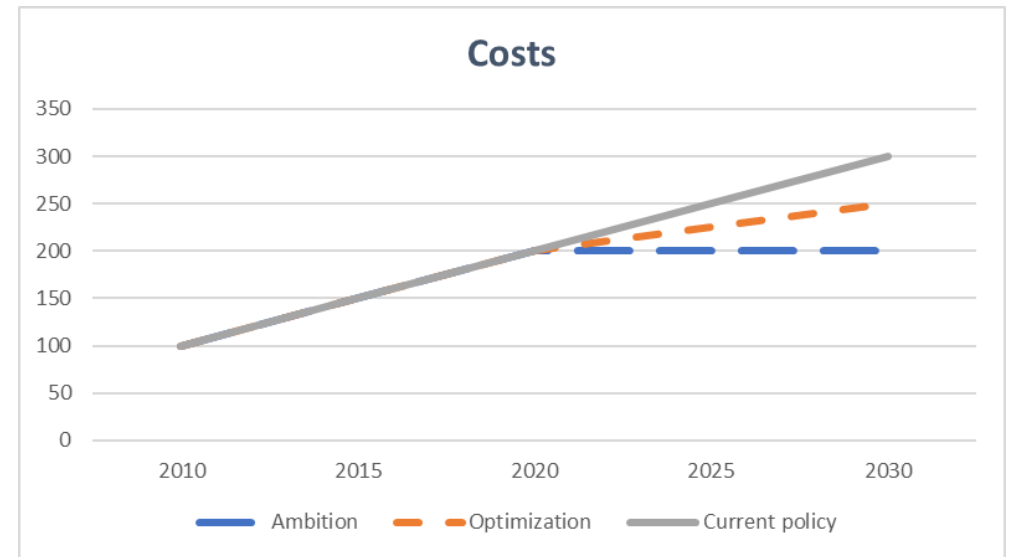
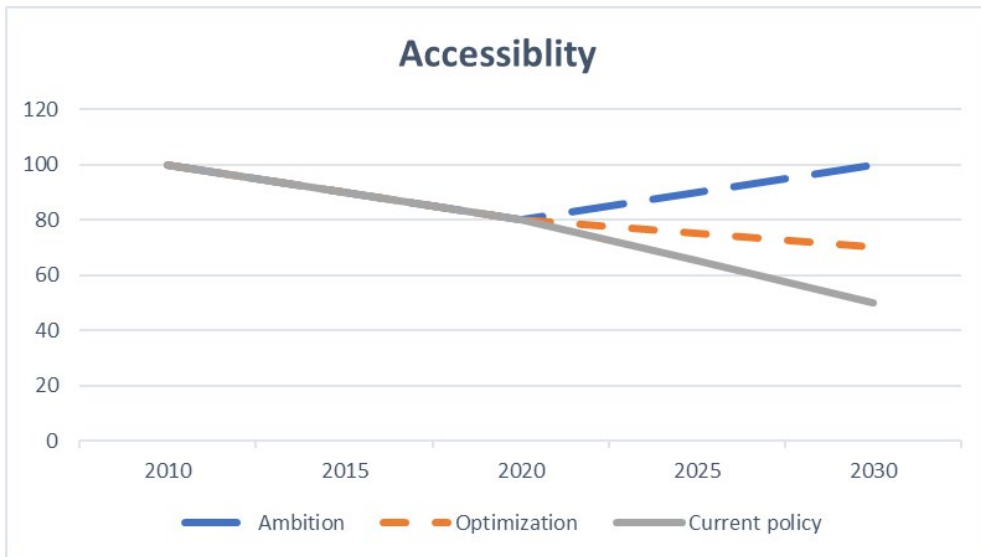


Verwachte stijging Wmo-kosten gemeenten





Trends



A paradigm shift is needed to change trends

DOVA Overview



Ministry IenW exploring one mobility system for all

- 1 Break down inter-governmental barriers
- 2 One integrated mobility system
- 3 Participation of community
- 4 Digitalisation
- 5 Adjustment legislation
- 6 Connect to area development
- 7 Change of behaviour

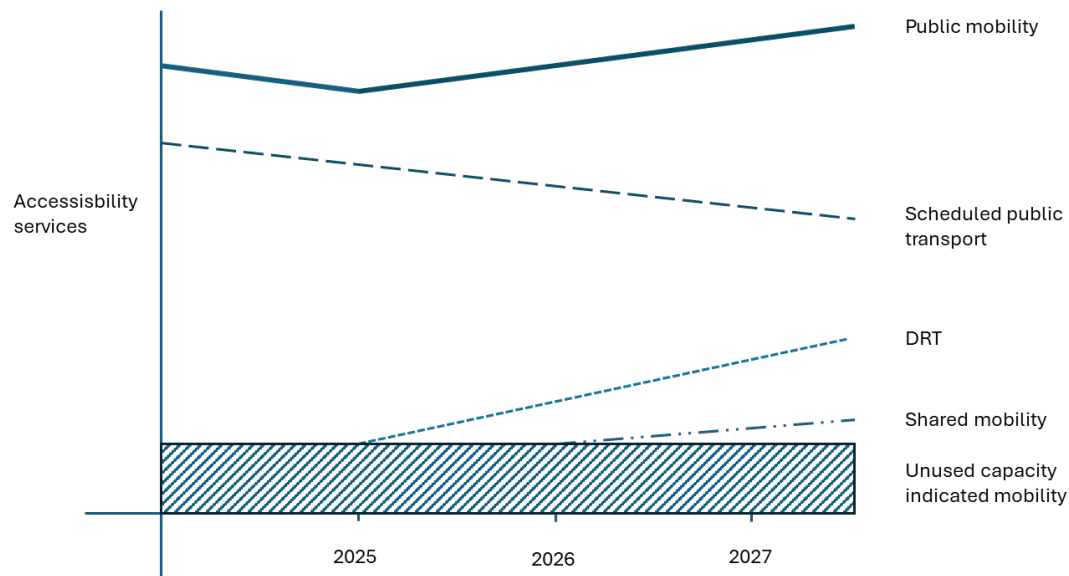


Ministerie van Infrastructuur
en Waterstaat

5 departments exploring needed adjustments mobility system
Regional pilot Zeeland



Pilot Zeeland



One service: scheduled services + flex (DRT) + shared mobility

6 am – 23 pm 7 days a week

PT pricing

Booking flex up to 1 hour upfront

Start service: January 2025

5 Years pilot in cooperation with ministry IenW

Objective cooperation is introduction of digital and scalable national DRT platform

NORWEGIAN PERSPECTIVE

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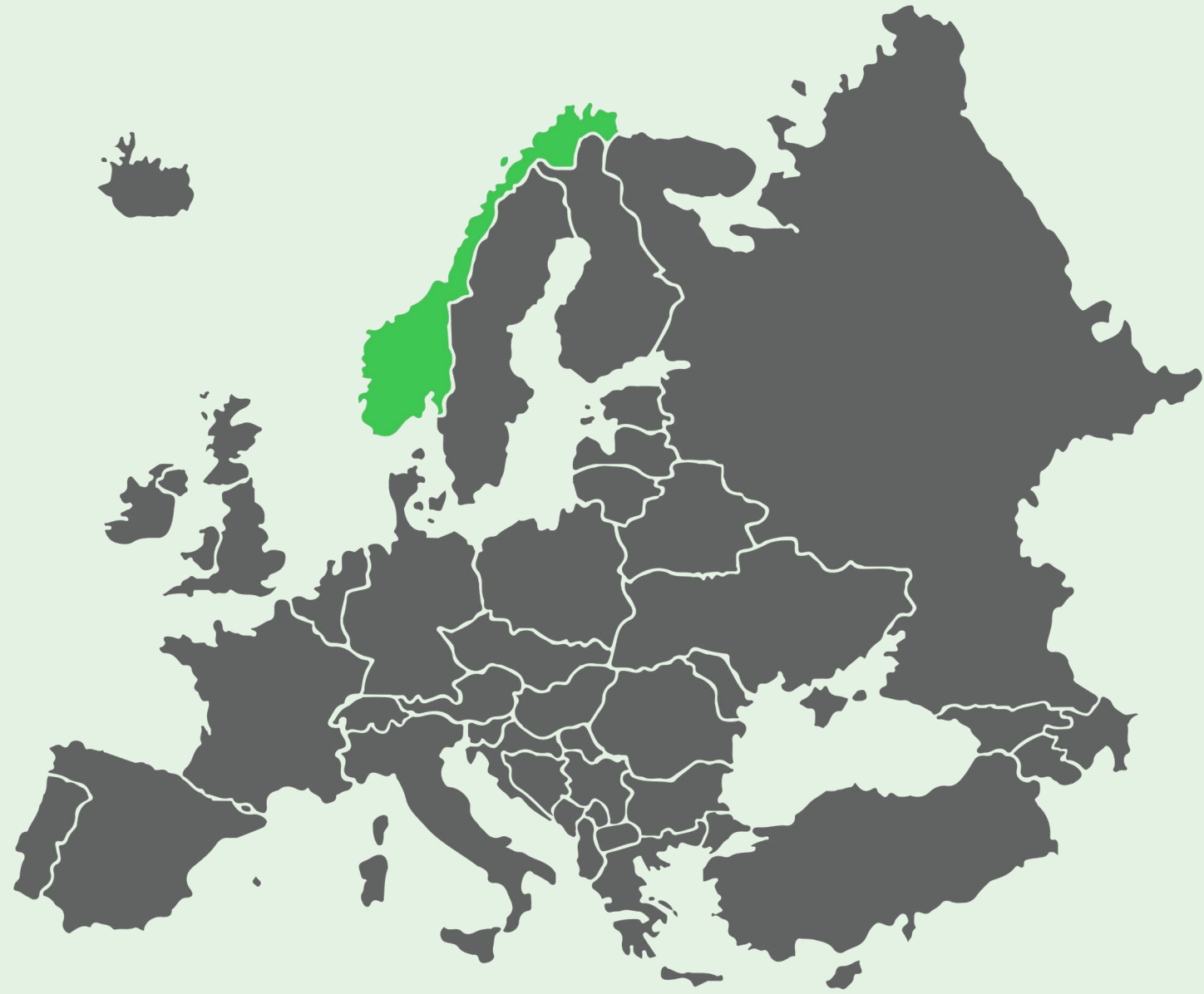
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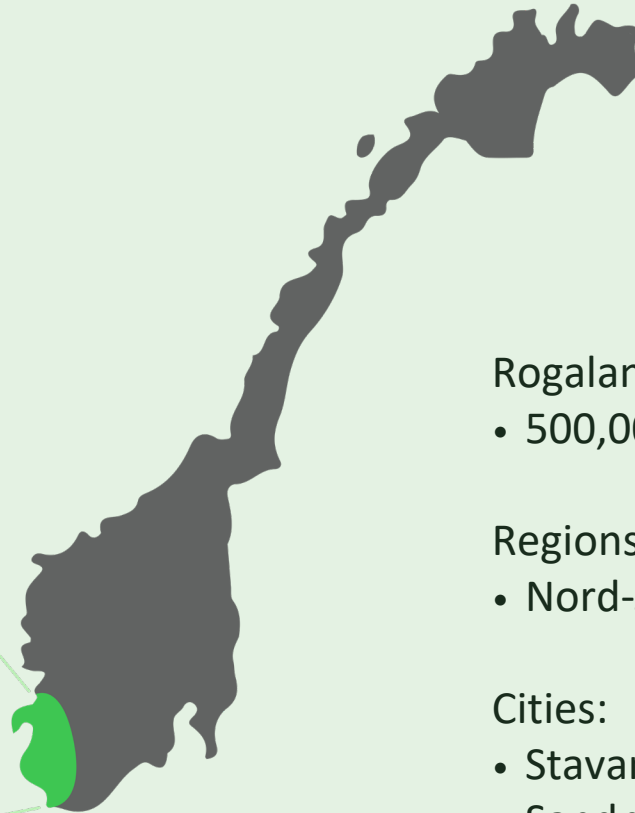
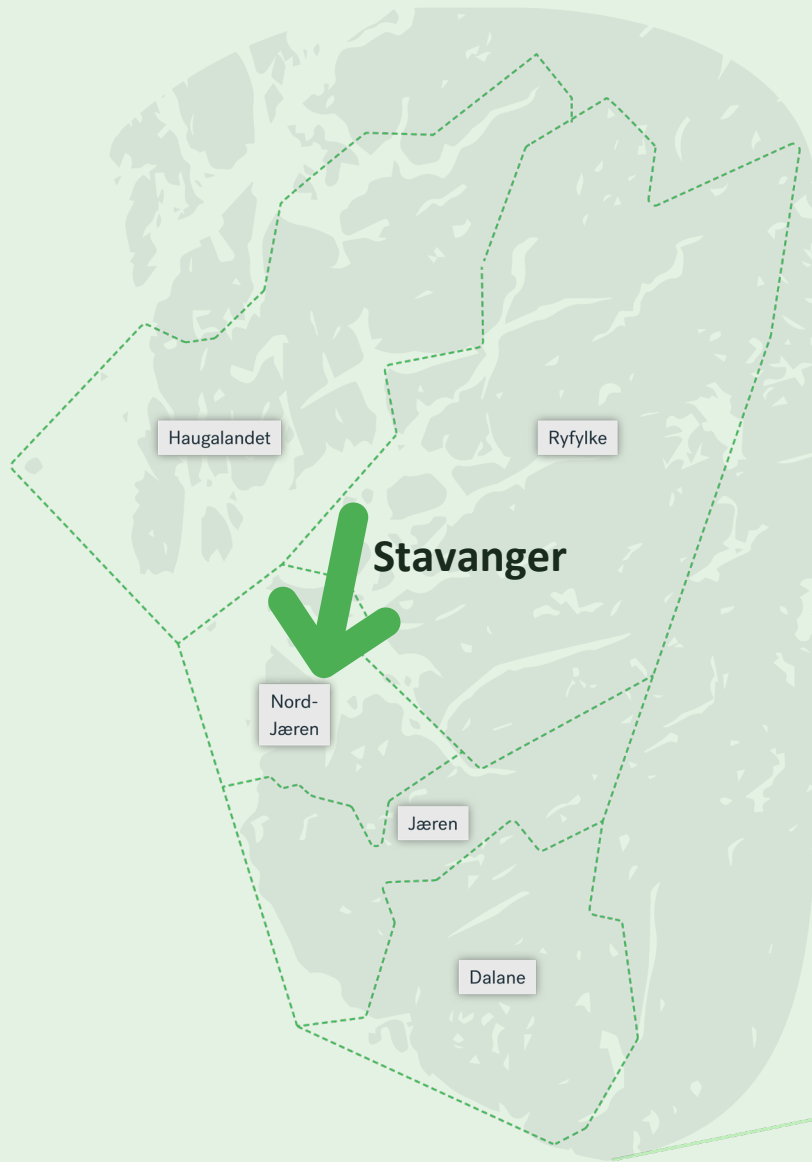


EASY PEASY MOBILITY

Espen Strand Henriksen

 Kolumbus





Rogaland county (green)

- 500,000 inhabitants - 4th in Norway

Regions

- Nord-Jæren (235,000) - 3rd in Norway

Cities:

- Stavanger (150,000) - 4th in Norway
- Sandnes (80,000) - 7th in Norway
- Haugesund (38,000) - 12th in Norway
- Egersund (12,000) - 53rd in Norway

Agenda

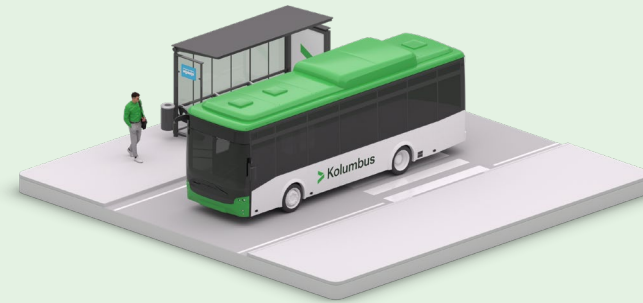
Green, shared
and seamless
mobility

Kolumbus at a glance

“Make it easier to move around in our region without being dependent on your own car”



- PTA, owned by the county of Rogaland
- 80 employees
- 35 million trips
- «PMA» since 2017
- Reducing the number of cars on the road



- Buses, boats and trains are **core**
- Digital infrastructure is **key**
- Innovation on existing services is **important**



- New services like city e-bikes, car sharing, DRT and B2B solutions are **necessary**
- Curiosity is free

The car has become both the glue...

- Car based urban sprawl over the last 40 years -> wider not higher cities
- The need for transportation and mobility has increased equivalent
- The car has become the glue in every day life
- In addition, public transport has not been prioritized and given competitive advantages
- Only 11%* of the trips in the region of Stavanger are with public transport



...and the syrup

- *Boom!* A new world with climate targets and a national *zero growth target** hit us
- Suddenly it's judgment day for political decisions and spatial planning for forty years
- This has created habits that are difficult to change
- *Can we wait until tomorrow to change them?*
- Well, yes, but it will be even more expensive, even more difficult, and we will have even less time to do it
- We are in the «*how-to-change-behavior*» - *business*



A little sample of

[Nju an kool
støff]

Meaning/translation:

- > DOWNSTREAM
- > GO WITH THE FLOW
- > WITH POWER

MEDSTRAUM

- Our boats / ferries account for around 3% of both our total fleet and the number of passengers
- ...but around 50% of our emissions!
- The EU project *TrAM* gave birth to the multi-award winning vessel *Medstraum*, the worlds first fully electric speed boat in operations
- Electrifying one boat, is equivalent to electrifying 30 buses (when talking CO² emissions)



Fastest way to reach CO² goals? Electrify the sea!



The key is to figure out how to increase carpooling

HENTMEG

Meaning/translation:
-> PICK ME UP

- OnDemand; the best from the taxi and bus world
- 2017: 1.5 passengers on average in Sauda
- Advanced system calculates the most efficient driving route, in real time
- We offer the service in Sauda and Egersund
- Exported to Vestland (Odda), Nordland (Bodø and Sandnessjøen) and Viken (Kongsberg)
- Still trying to find the balance between bus — taxi, rural vs urban, and how to increase carpooling
- The mobility service of the future (?), especially together with autonomy



Electric + Integrated = probably the world's best

CITY E-BIKE

- Experience with city e-bikes since 2014
- Brand new model in 2020 (our own)
- Integrated in our public transport ticket
- Strong relationship with our B2B concept
- +237% number of trips between 2020 - 2023
- Replaces up to 15,000 car trips a month (source: Opinion 2021 and 2023)
- Double the number of bikes in 2025



Over 6,000 e-bikes onto the roads in recent years

LEASING E-BIKE

- E-bikes to the people!
- Similar to leasing a car
- Kolumbus coordinate, but the different companies make an agreement with a bike supplier/financial partner
- Employees in businesses dispose of an electric bicycle for three years via a monthly salary deduction
- After three years, the employee chooses whether the electric bike should be returned or bought out



We coordinate the market, like we do in general

CAR SHARING

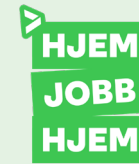
- After piloting for two years (with *Hyre*), we launched Kolumbus Car sharing in 2021
- A network of shared electric cars
- Collaborating with land owners and car sharing operators
- Why are we doing this?
 - 1 shared car can replace up to 15 private cars (according to [Bergen](#), [Bremen](#) and [Belgium](#))
 - Lift a very immature market in our region
- We still adapt, adjust and improve the concept, with the aim of making it more attractive



Priceless relationships and an unique positioning

B2B2E

->



Translation:
-> HomeWorkHome

- We started focusing on B2B in 2015 when we created the concept *HomeWorkHome (HWH)*
- More than 650 companies and almost 70,000 employees are a part of the HWH universe
- Inspire employees to change their travel behavior with activities like bike services, e-bike leasing, health projects and events
- Contributed to reduce the car share with 19% (7% points), from 53% to 46% (Source: NORCE, 2016-2018)
- Now we are scaling, and we are not restricting us to the HWH universe



Hinna Park - the most attractive area in the Nordics?

REAL ESTATE DEV.

- The region needs to reach climate targets
- The municipalities make new regulation, e.g. reducing the number of parking lots
- Property developers know they need to be more attractive
- All this make green, shared and new mobility solutions more and more relevant and desirable
- We are involved in a number of big, regional projects, both with municipalities and private developers



As easy as a sightseeing bus; hop on, hop off

APP

- “Tickets & zones” are based on old business models
- We are waving bye-bye to intricate ticket types and unfair zones
- Now you can travel by bus, boat or train without deciding what kind of ticket to buy
- Digital “travel friend” that stops the bus for you, confirms that you are on the right bus stop and the right bus, and tells you when to get off; very useful for visually impaired as well!

AUTONOMI

- Cutting emissions, economy, recruitment problems, safety requirements and passenger comfort are reasons for us to pilot, and not least, we also need to be an even better (innovative) purchaser
- First pilot in Norway (2017), first in Norway on an open road (2018) and in the city center (2020)
- Since 2022 we have had a bigger bus driving in the city center of Stavanger, together with our partners
- Driving on average 99,5% autonomous
- Next? More focus on UX, and remove the safety driver from the seat and vehicle



Apparently the most advanced pilot in the world

We are curious about

As long as it potentially can contribute to the Zero Growth Target («Nullvekstmålet»), we should be curious



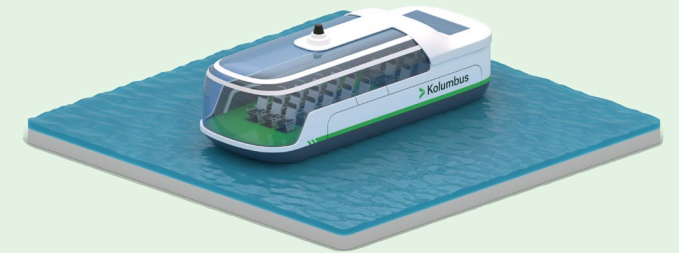
Ride sharing

- Potentially huge effect on queues and emissions
- For the price of nickels & dimes
- What if we defined car drivers as potential shared mobility drivers?



DRT and SAV

- OnDemand can be ride hailing, car sharing, ride sharing and goods delivery in one service
- Together with autonomous; boom! and you got yourself a new service; SAV.



Blue mobility

- Free infrastructure is floating around our biggest cities
- How can we exploit urban water ways better?



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GARTNERS HYPE CURVE

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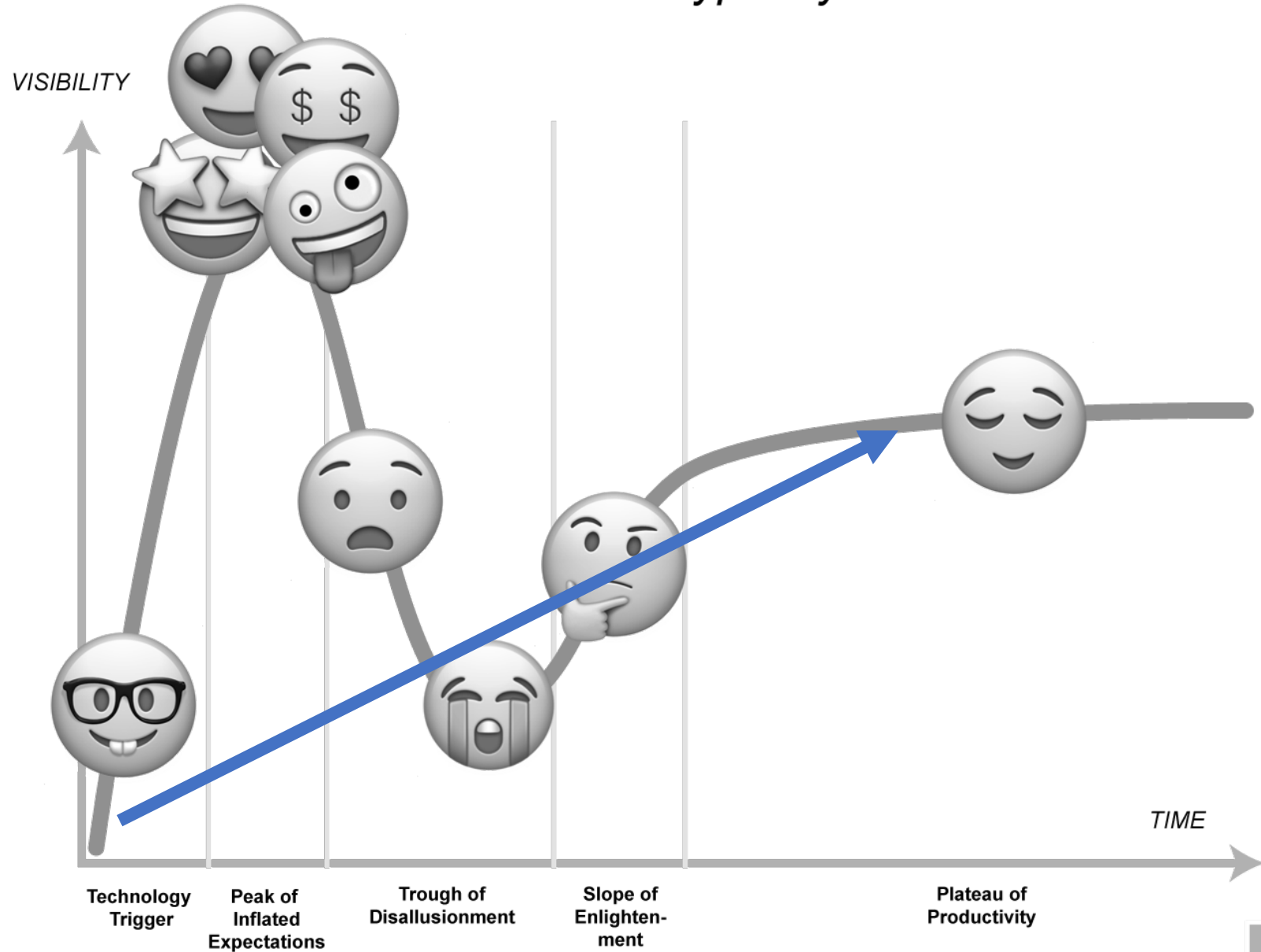


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Gartner's Hype Cycle



BETTER BUSES

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BETTER BUS

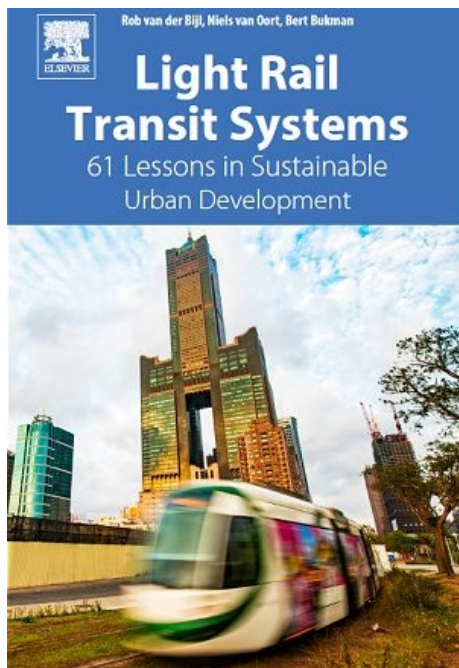
Varieties and roles of enhanced bus

Rob van der Bijl

Urbanism Next Europe, Amsterdam, October 10, 2024



Enhanced road-based public transport



Enhanced rail-based public transport

Elsevier, 2018

Acquire, 2024



English Summary at Lightrail.nl

<https://www.lightrail.nl/better-bus/>



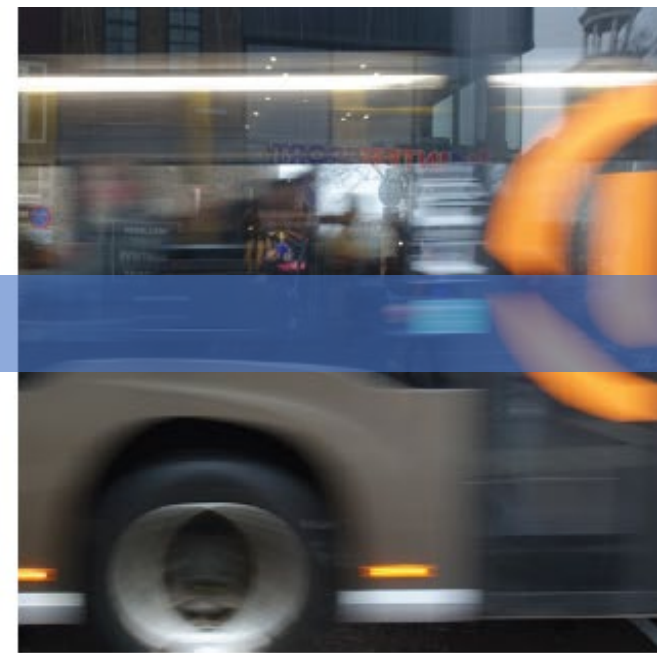
Based on our years of professional practice and applied science

159 cases & examples

22 case studies – elaborated examples: Amsterdam (Netherlands), R-net lines 300/397 (former Zuidtangent); Barcelona (Spain), RETbus & Cornellà-Castelldefels (BRT); Basel (Switzerland), line 50; Bogotá (Colombia), BRT (TransMilenio); Bangkok (Thailand), BRT; Cambridge (UK), Busway; Eindhoven (Netherlands), HOV4 (*project*); Groningen/Northern (Netherlands), Q-link; Hamburg (Germany), MetroBus; Hilversum-Huizen (Netherlands), HOV in 't Gooi (R-net line 320); Leiden-Zoetermeer (Netherlands), R-net line 400; Los Angeles (California, US), Orange Line / G Line (Metro Busway); Meierij (Netherlands), interurban bus / BRT (*project*); Metz (France), Mettis; Lahore (Pakistan), BRT; Nantes (France), Busway line 4 & Chronobus; Paris/Île-de-France (France), Tzen 3 & Tzen 4 (*projects*); Taichung (Taiwan), BRT (Blue Line) (*closed*); Vienna (Austria), line 1a/2a/3a. **33 described examples:** Almere (Netherlands), AllGo; Amsterdam (Netherlands), conventional bus (line 21) & flexbus (MokumFlex); Arnhem (Netherlands), conventional trolleybus (BrenGTrolley); Arnhem region (Netherlands), Trolley 2.0 (Rijnlijn) (*project*); Arriva-stations Netherlands, Butterfly (*Vlinder*), flexbus; Bocholt (Germany), improved bus; Bruchsal (Germany), improved bus (MAX); Chablais (Switzerland), MobiChablais; Curitiba (Brazil), BRT; Dornbirn (Austria), improved bus; Eindhoven (Netherlands), guided bus (Phileas) (*closed*); Fukuoka (Japan), conventional bus (line 3); Groningen/Northern Netherlands, Qliner; Istanbul (Turkey), long distance bus & Dolmuş/Minibus; León (Mexico), BRT (SIT Optibús); Mallorca (Spain), interurban bus; München (Germany), metrobus; Newcastle (UK), conventional bus; Osnabrück (Germany), metrobus; Paris (France), autonomous shuttle bus (*pilot/closed*); Paris/Île-de-France (France), TVM / line 393; Rotterdam (Netherlands), autonomous shuttle bus; Runcorn (UK), busway; Seattle (Washington, US), interurban bus (ST Express); Sevilla (Spain), long distance bus; Springfield (Virginia, US), busway; The Hague (Netherlands), conventional bus (line 23); Tilburg (Netherlands), T-bus (*closed*); Trondheim (Norway), improved bus; Uden (Netherlands), long distance / interurban bus (Interliner); Utrecht (Netherlands), U-link bus (line 28). **104 referenced examples:** Aalborg (Denmark), conventional bus; Aarau (Switzerland), conventional bus; Ahmedabad (India), BRT; Aidelaide (Australia), guided bus; Amsterdam (Netherlands), conventional bus (line 48); Amsterdam region (Netherlands), R-net various lines (e.g. 305, 314, 340, 382, 369) & Schipholnet; Arnhem/Nijmegen, flexbus; (BrenGTrolley) (*closed*) & BrenGDirect; Apeldoorn (Netherlands), conventional and interurban bus; Appelscha (Netherlands), autonomous shuttle bus (*pilot/closed*); Belfast (Ireland), improved bus; Bergen (Norway), improved bus; Berlin (Germany), metrobus; Birmingham (UK), guided bus (*pilot/closed*); Breda region (Netherlands), conventional and improved bus (Bravodirect); Bremen (Germany), long distance bus; Brugge (Belgium), conventional urban and regional bus; Brussels region (Belgium), improved bus; Caen (France), guided bus (*closed*); Castellon (Spain), optical guided bus; Clermont-Ferrand (France), guided bus; Copenhagen (Denmark), conventional bus (line 5A); Delft (Netherlands), conventional city bus (line 63); Den Bosch, (Netherlands), conventional bus; Douai (France), guided bus (Phileas) (*closed*); Drechtsteden region (Netherlands), Snelbuzz; Eberswalde region (Germany), improved trolleybus; Edinburgh (UK), guided bus (*pilot/closed*); Eindhoven (Netherlands), HOV1/2/3 (Bravodirect); Essen (Germany), Spur/Duo-Bus (*partly closed*); Figueras (Spain), conventional bus; Genève (Switzerland), improved bus; Göteborg (Sweden), improved bus; Guangzhou (China), BRT; Istanbul (Turkey), BRT; Heerhugowaard, (Netherlands), private community bus (HugoHopper); Heerlen (Netherlands), conventional bus; Jakarta (Indonesia), BRT (TransJakarta); Las Vegas (Nevada, US) optical guided bus; Leeds (UK), guided bus; Leeuwarden (Netherlands), conventional and interurban bus; Lelystad (Netherlands), conventional and interurban bus; Lens region (France), improved bus (TADAO); Liège (Belgium), conventional bus; Linz (Austria), improved bus; Los Angeles (California, US), Silverline Line / J Line (Metro Busway); Luxemburg (Luxemburg), improved bus; Maastricht (Netherlands), conventional and interurban bus; Maastricht-Aken (Netherlands/Germany), long distance bus (Limburgliner); Madrid (Spain), long distance bus; Malmö (Sweden), improved bus; Manizales (Colombia), conventional bus; Martinique (France DOM), improved bus; Melbourne (Australia), conventional bus (line 631); México City (Mexico), BRT; Middelburg (Netherlands), conventional bus; Nagoya (Japan), guided bus; Nancy (France), guided bus (*closed*); New Delhi (India), BRT (*closed*); Nîmes (France), optical guided bus (T1) & improved bus (T2); Oberhausen (Germany), expres bus (line SB98); Paris/Île-de-France (France), Tzen1 & T5/6 – guided bus; Padova (Italy), guided bus; Parma (Italy), improved bus; Pau (France), improved bus; Perpignan (France), conventional bus; Preston (UK), conventional urban, regional and long distance bus; Providence (Rhode Island, US), conventional bus (East Side Transit Tunnel); Rotterdam (Netherlands), improved bus (HOV 44) & FrequentNet; Rotterdam/Zuidplein-Zierikzee (Netherlands), long distance bus (line 395); Rouen (France), optical guided bus (TEOR); Rio de Janeiro (Brazil), BRT (Rio BRT); Schiermonnikoog (Netherlands), conventional bus; Seattle (Washington, US), conventional (bi-modal) trolleybus; Seoul (South Korea), BRT & autonomous bus (*pilot*); Singapore (Singapore), conventional bus; Sittard, (Netherlands), conventional bus; Shanghai (China), guided bus (*closed*); Sofia (Bulgaria), conventional trolleybus; Spijkenisse, flexbus (Spijkhopper); Stadskanaal-Sellingen (Netherlands), neighbourhood bus; Stockholm (Sweden), improved bus; Taipei (Taiwan), improved bus (Xinyi Trunk Line); Tilburg (Netherlands), conventional bus; Tokyo (Japan), BRT (*project*); Toronto (Canada), conventional bus (line 60); Toulouse (France), shuttle bus; Twente (Netherlands), improved bus (former AggloNet); Umeå (Sweden), conventional bus; Utrecht (Netherlands), conventional city bus (line 2); Utrecht-Breda (Netherlands), long distance bus (Brabantliner); Utrecht-Amersfoort (Netherlands), interurban bus (line 202/203); Vientiane (Laos), BRT (*project*); Vlissingen (Netherlands), conventional bus; Wageningen (Netherlands), autonomous shuttle bus (*pilot/closed*) & Valleilijn (*closed*); Zhuzhou (China), optical guided bus (ART) (*pilot*); Zutphen (Netherlands), conventional city bus (line 84); Zwolle (Netherlands), conventional, improved and interurban bus.

Typology of enhanced bus

Small bus – Classic bus – Bus Plus - BHLS - BRT - Long distance bus



Specifications

Usage

Performance

High quality factors



Speed



Accessibility



Reliability



Capacity



Cost



Sustainability

Justice

Ease

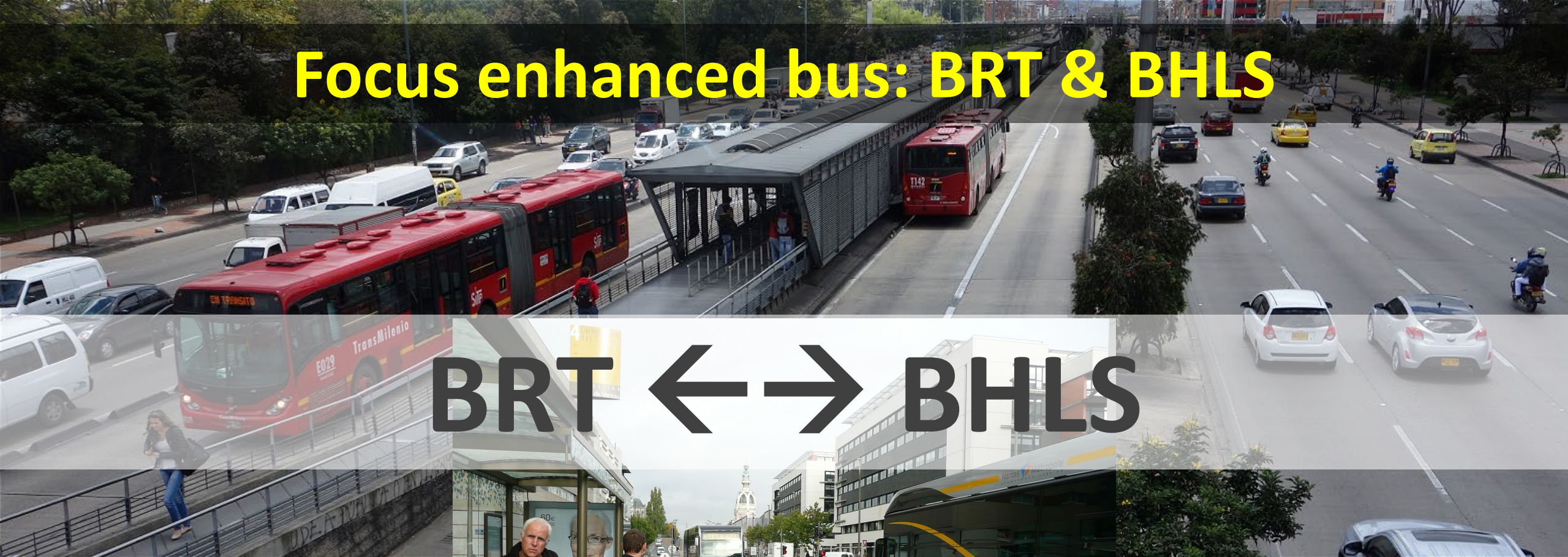
Comfort

Experience

Safety

Frequency

Focus enhanced bus: BRT & BHLS



Bogotá (Colombia)

BRT:
Bus Rapid Transit



BHLS:
Bus with High Level of Service

BNHS:
Bus à haut niveau de service

Nantes (France)

Variety and roles of enhanced bus

BRT – BHLS



5 interfaces

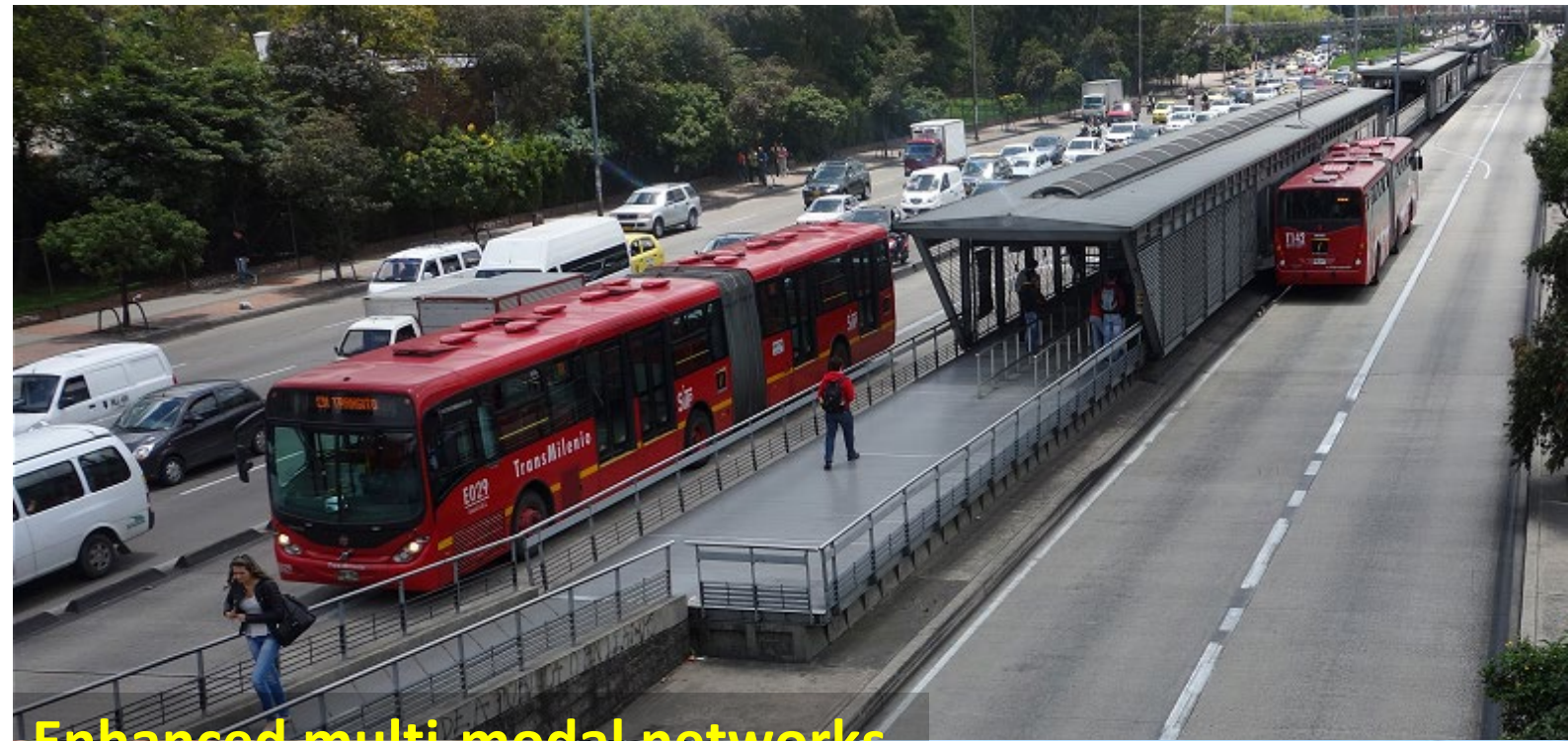
- > Transport E1
- > Space E2
- > Prosperity E3
- > Sustainability E4
- > Welfare E5

5E Model

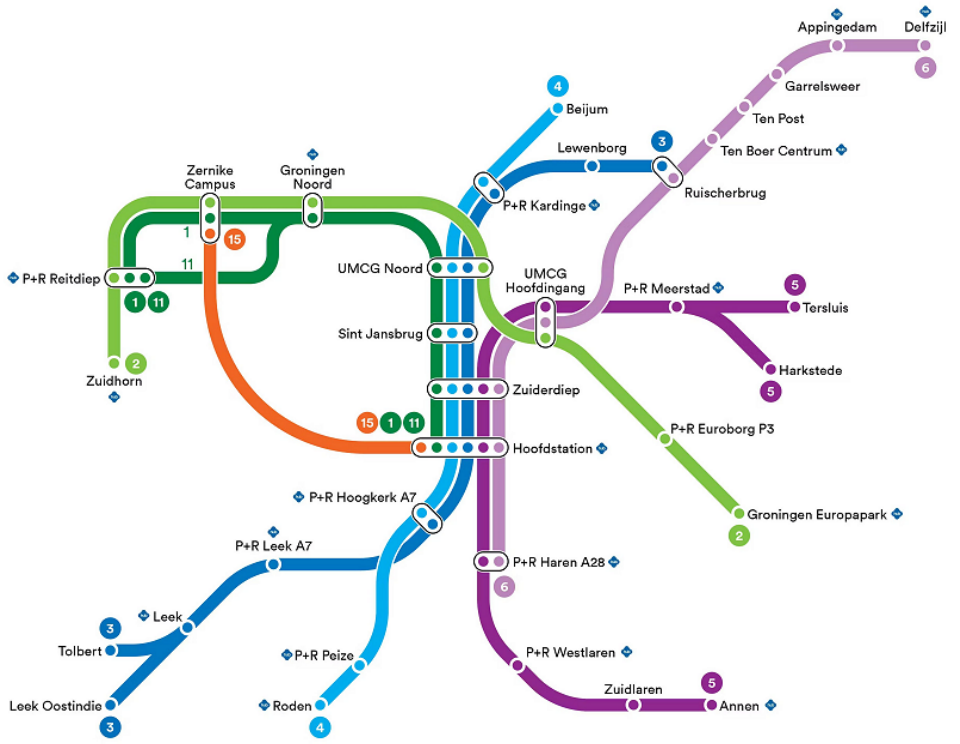
Van der Bijl & Van Oort, 2016

Effective & high capacity public transport

Bogotá, Colombia **BRT**



Enhanced multi-modal networks

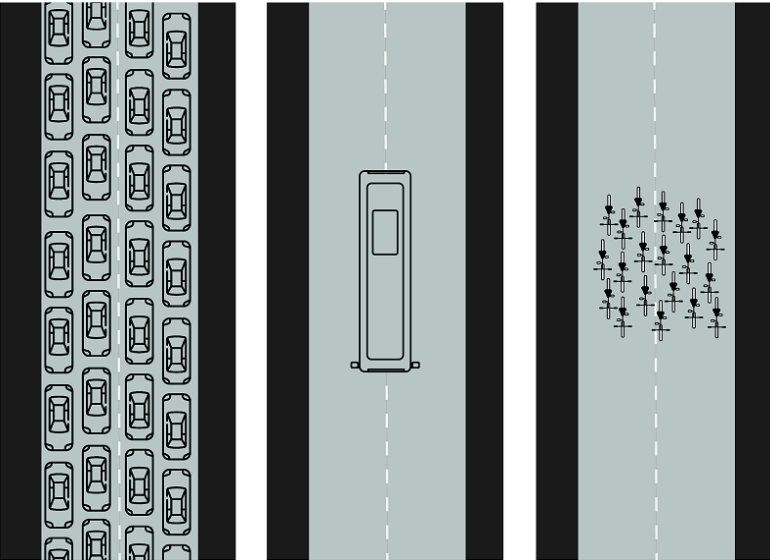


Europe **BHLS**



Efficient & improved public space & cities

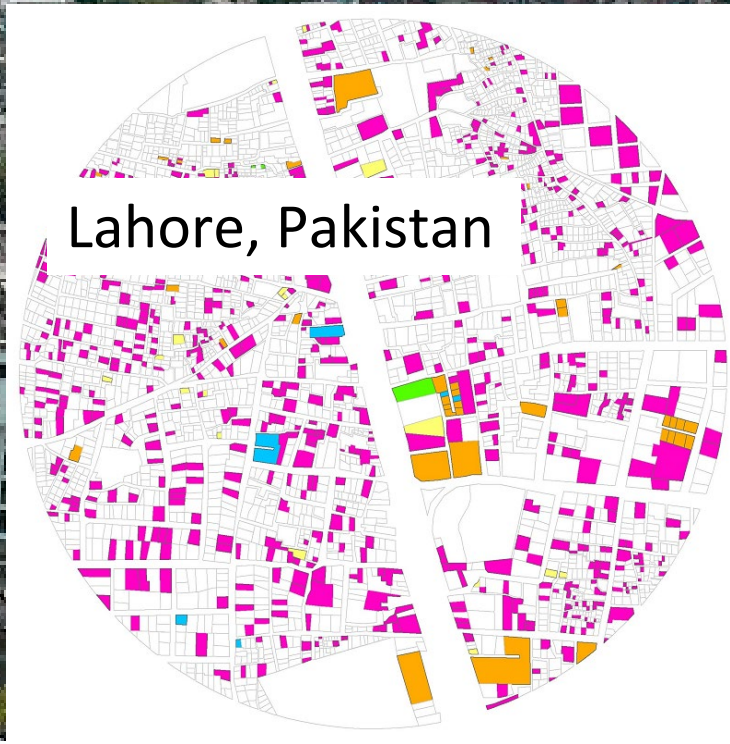
Lahore, Pakistan **BRT**



Greater Paris, France **BHLS**

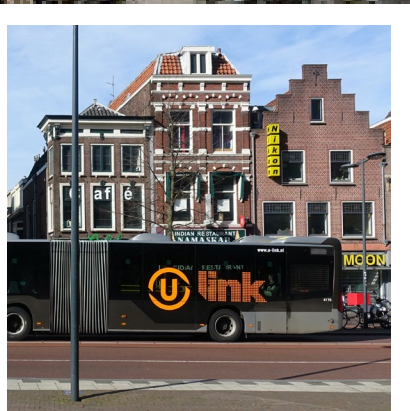


Economic effects & property development



BRT

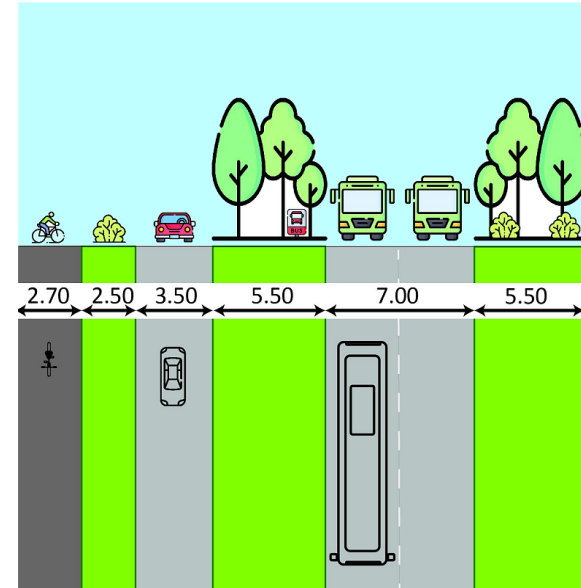
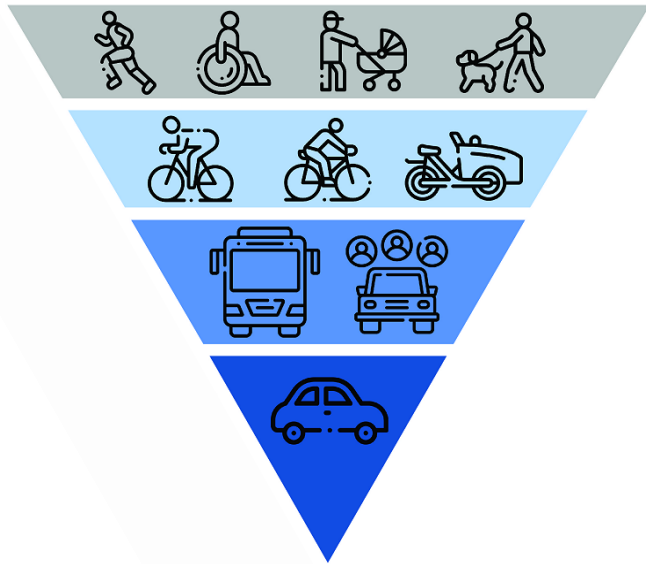
- Landuse Change
- New Development
- No Change
- ReDev./Storey
- Redevelopment
- Storey Addition



BHLS Europe

Environmental enhancement & sustainability

BRT



BHLS

Equity & social sustainability

BRT



BHLS

Contact & questions

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INTEGRATED BICYCLE AND TRANSIT

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The Bicycle-Transit combination



dr. ir. N. van Oort

Associate professor Public Transport and Shared Mobility

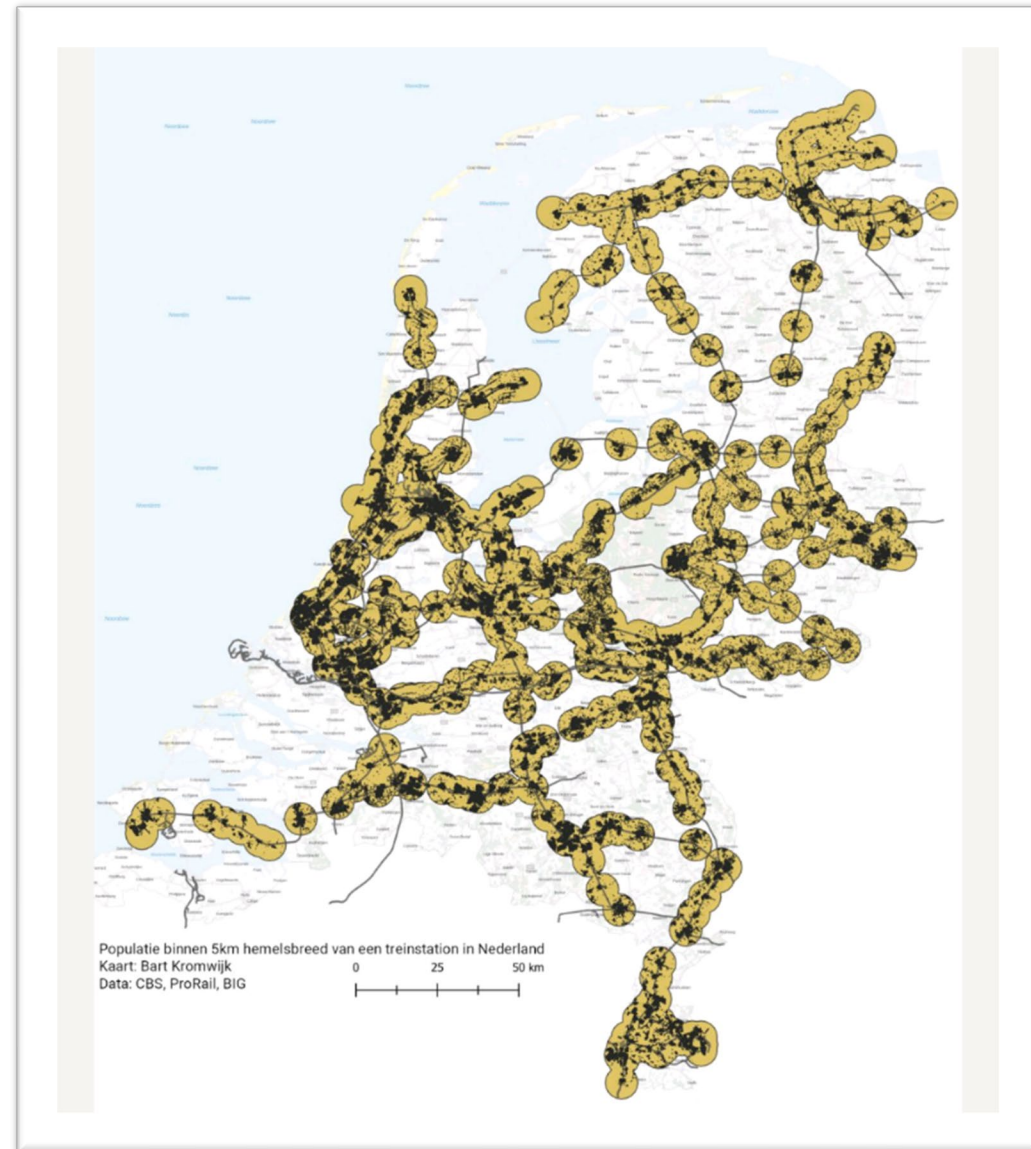
October 2024





- Two-Thirds of Dutch People (11.7 million) live < 15 Min. Cycling of a Train Station

(BUAS, 2021; Bart Kromwijk, 2021)



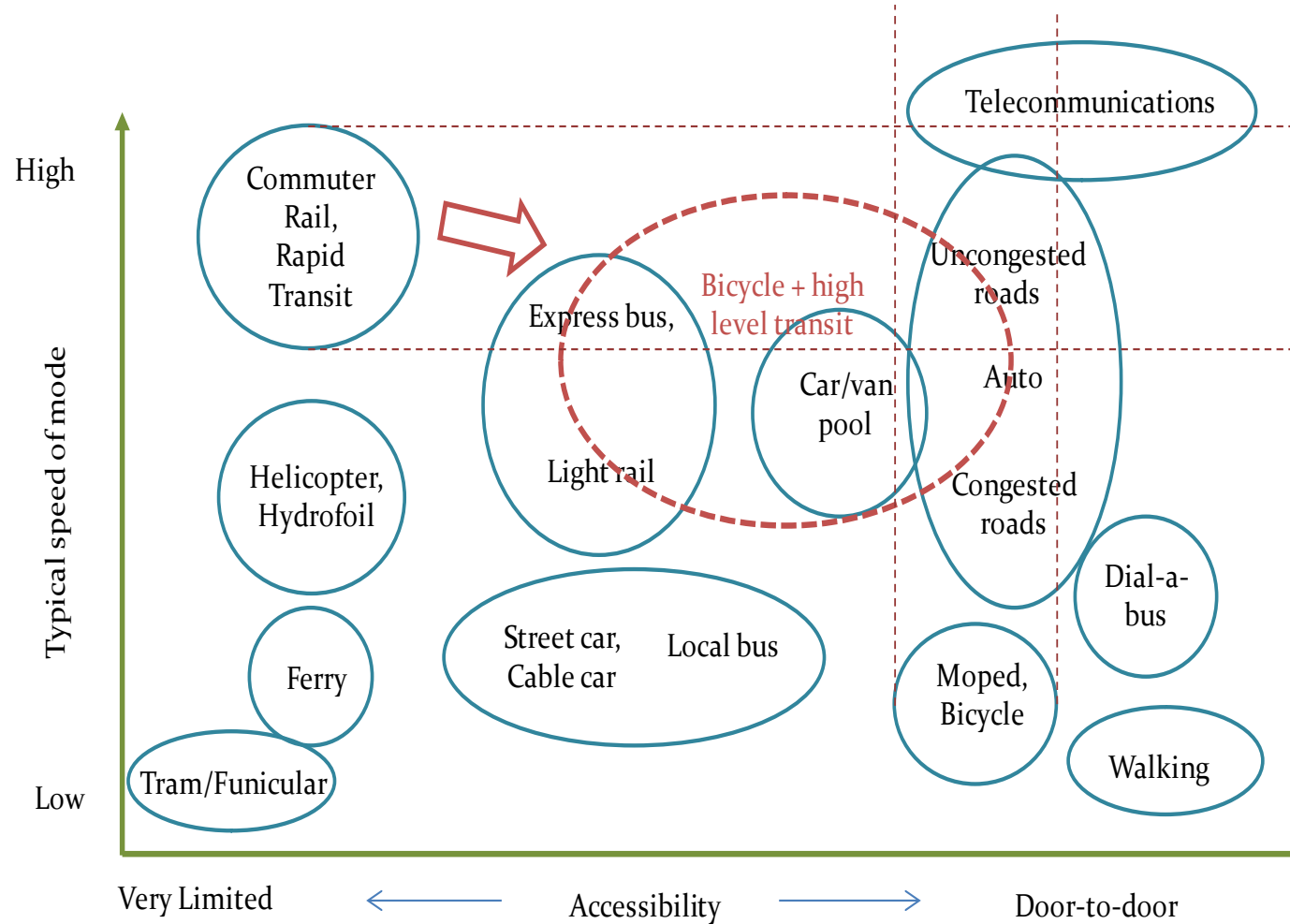
Numbers

- ~ 50% of the train passengers in NL uses the bike as access mode
- 500,000 parking spots at Dutch stations
- Powerful combination, also much interest internationally



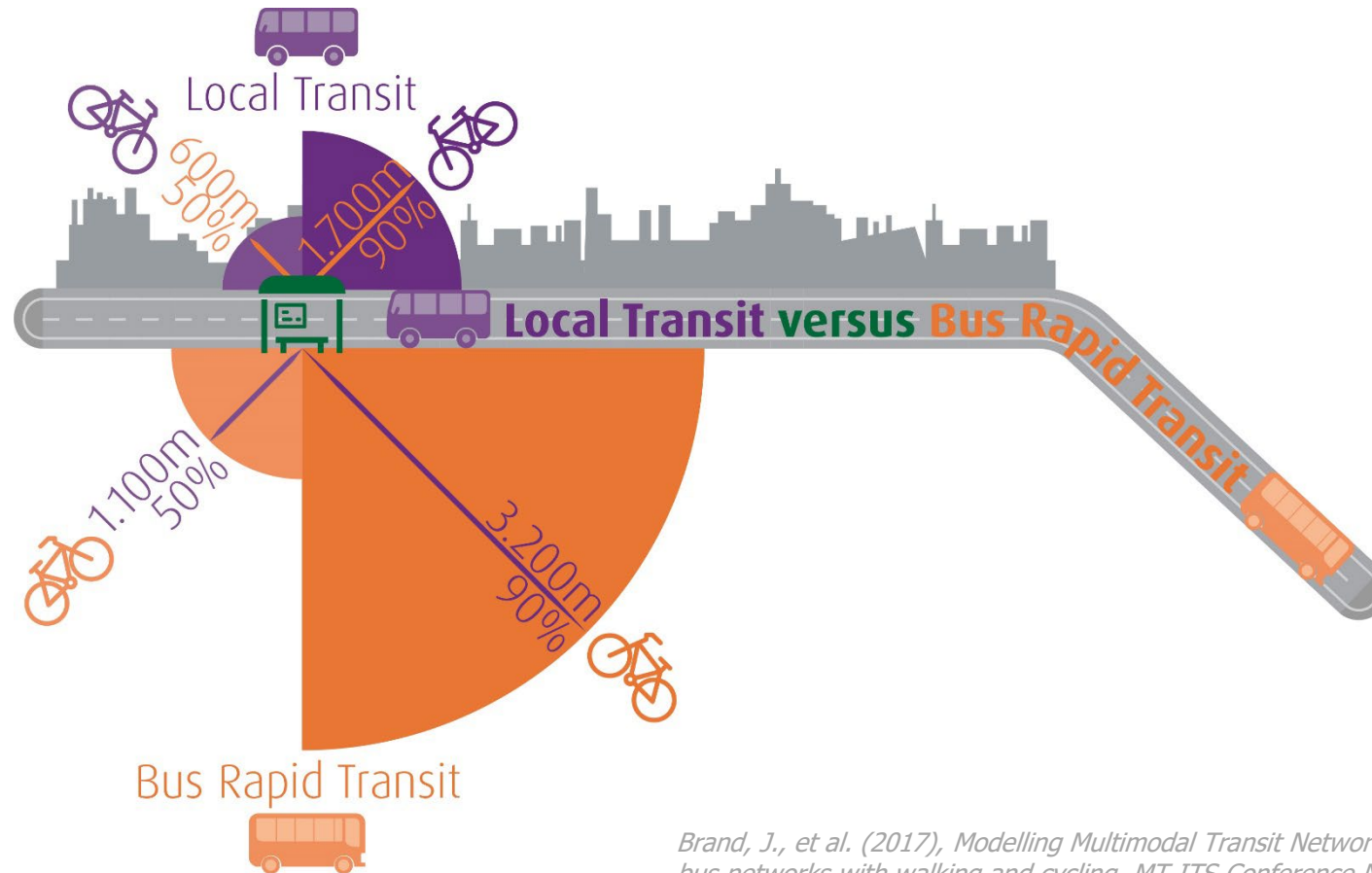
<https://www.youtube.com/watch?v=ilwu6EKS3Po>

Combining best of both worlds

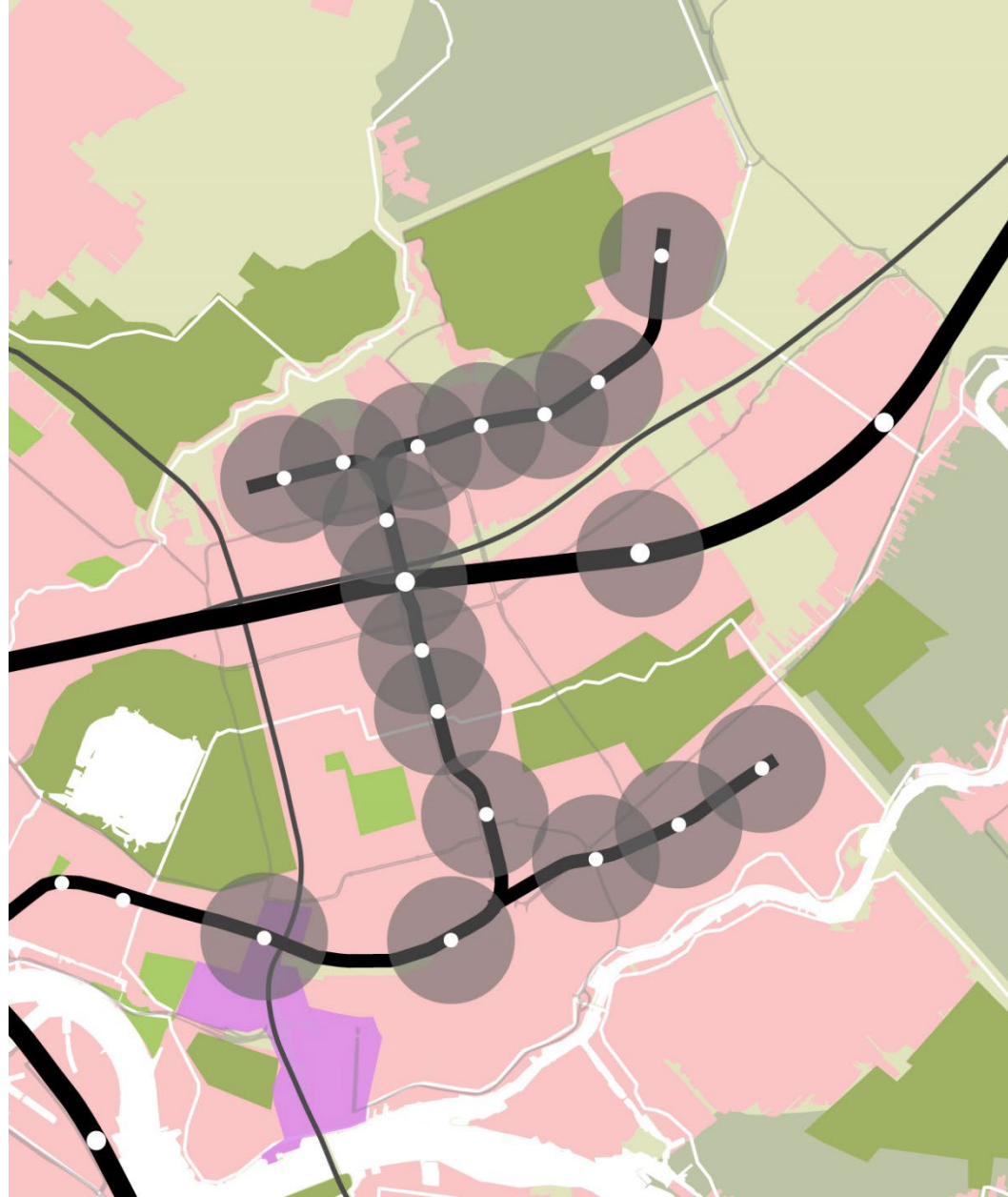


[Kager et al. (2016), Shelat et al. (2017)]

Impact of PT quality on catchment areas



Brand, J., et al. (2017), Modelling Multimodal Transit Networks; Integration of bus networks with walking and cycling, MT-ITS Conference Napoli.

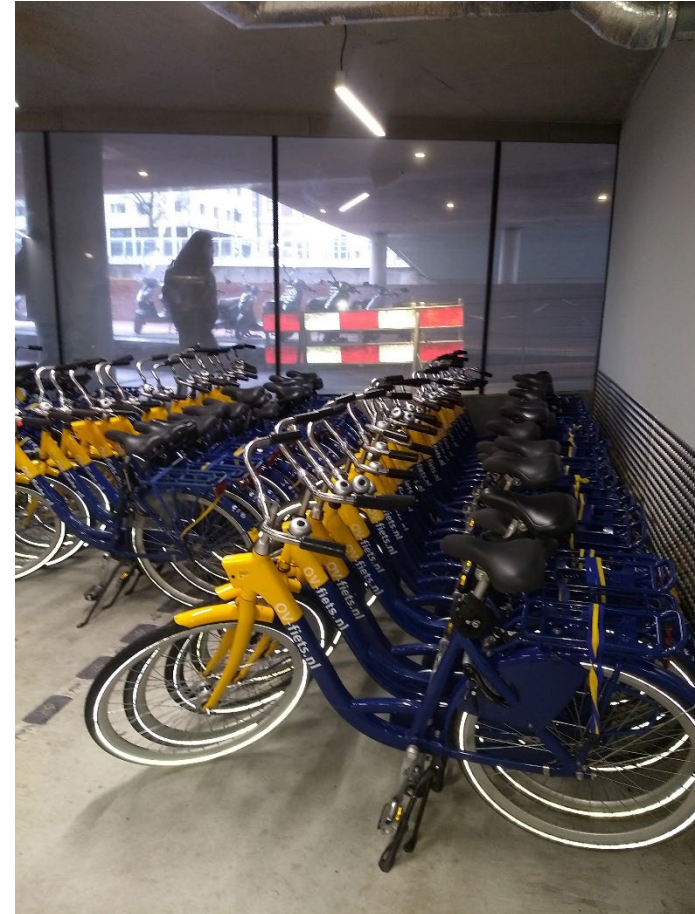




OV Fiets (PT-Bike)

- Started in 2003
- Docked system
- 2003: 800 bikes ; 100,000 trips
- 2017: 14.500 bikes ; 3,200,000 trips
- 2023: 22.000 bikes ; 5,900,000 trips

- ~300 locations in NL





▲ Ook in Breda is de ov-fiets populair. © Ron Magielse/Pix4Profs

Wie een ov-fiets wil, grijpt in Breda regelmatig mis: 'Het is helaas een succesverhaal'

BREDA – Van jaarlijks honderdduizend ritten in 2004 naar vijf miljoen ritten nu: de ov-fiets is ook in Breda mateloos populair. Reizigers grijpen daarom regelmatig mis. Een snelle oplossing lijkt echter niet in zicht: „Het blijft een lastige puzzel.”

Freek de Swart 16-08-23, 07:00 Bron: BN DeStem



HOME BUS TREIN METRO TRAM DOSSIER CORONA SPECIALS VACATUREBANK



Eén miljoen extra OV-fietsritten afgelegd in 2019

Gepubliceerd op 18-12-2019 om 17:06

Het aantal ritten dat is gemaakt op een OV-fiets stijgt dit jaar met ruim 23 procent in vergelijking met 2018. Waar vorig jaar nog 4,2 miljoen ritten werden afgelegd, verwacht de vervoerder dat dit er in 2019 5,2 miljoen zijn. Woensdag werd de vijf miljoenste rit afgelegd en de maand december heeft nog twee weken te gaan.

More?



Podcasts:

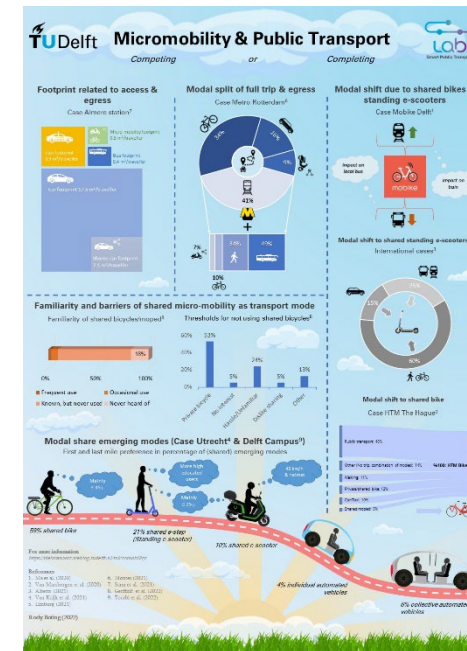
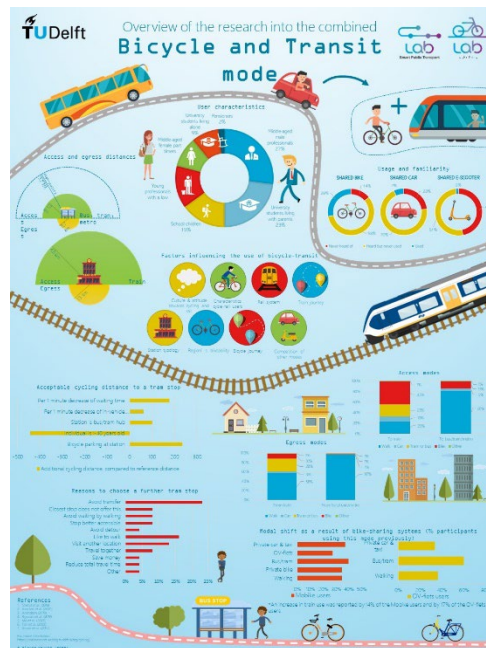
<https://geertkloppenborg.nl/niels-van-oort-on-the-bike-transit-combination/>

<https://nielsvanoort weblog.tudelft.nl/podcast-mobility-innovators/>

Infographics

<https://nielsvanoort weblog.tudelft.nl/overview-bicycletransit-research/>

<https://nielsvanoort weblog.tudelft.nl/micromobility/>



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