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MOBILITÉ, TRANSPORT

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**mobil.TUM 2014**

**Sustainable Mobility in Metropolitan Regions  
Munich, Germany - May 19-20, 2014**



# How to build an alternative to sprawl and auto-centric development model through a TOD scenario for the Nord-Pas-de-Calais region? Lessons from an integrated transportation-land use modelling

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questions and objectives of research

land use and transport integration

*Transit Oriented Development*

Land Use and Transport Integrated modelling

*Tranus* model for Nord Pas de Calais (France)

# questions and objectives

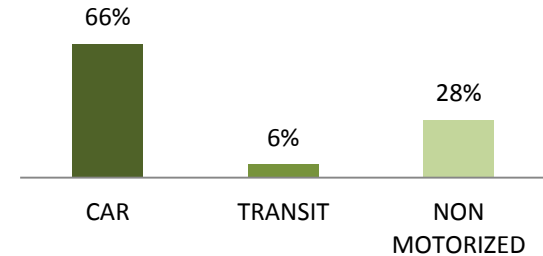


## issues

Urban sprawl

+ 1800 ha/y of urbanised land  
17% of total land in 2010 (France 9%)

Car dependency



## strategies

Land use and transport  
policies integration &  
coordination



*Transit Oriented  
Development*

## political objectives

+ 500 ha/y of urbanised land by 2020

double TER (regional railway service)  
rate of frequentation

## tool

LUTI  
Modelling  
(Tranus)

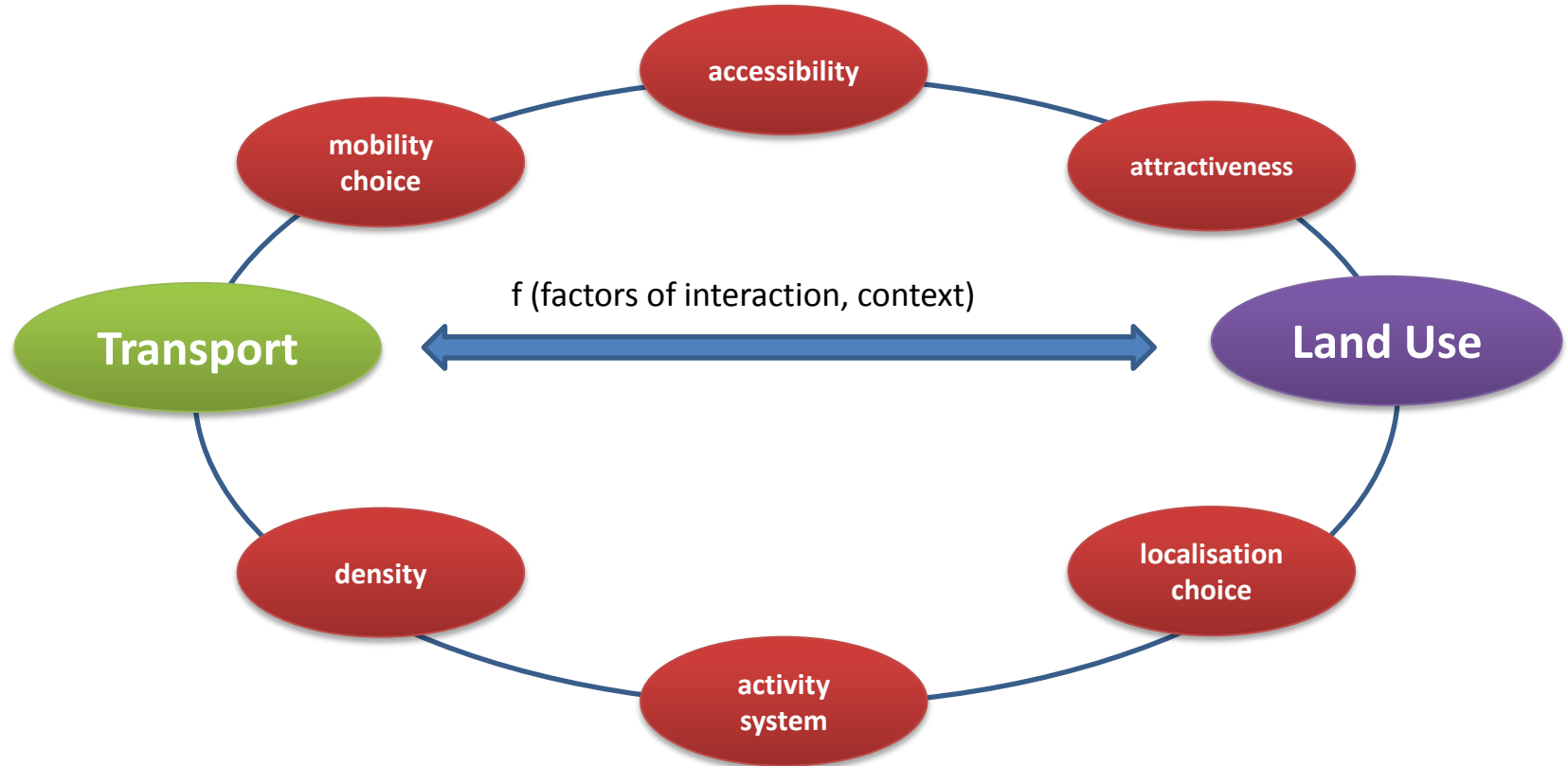
## research questions

does TOD make sense for the NPDC region?

does a TOD regional plan limit urban sprawl and car  
dependency?

# land use and transport interaction

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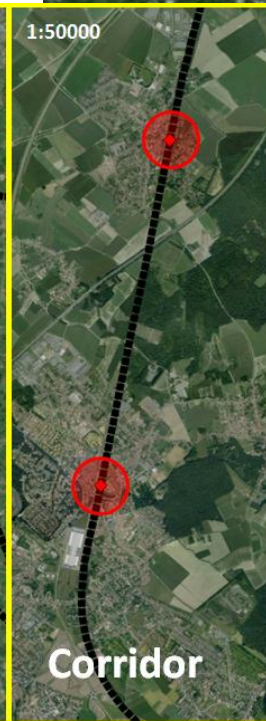
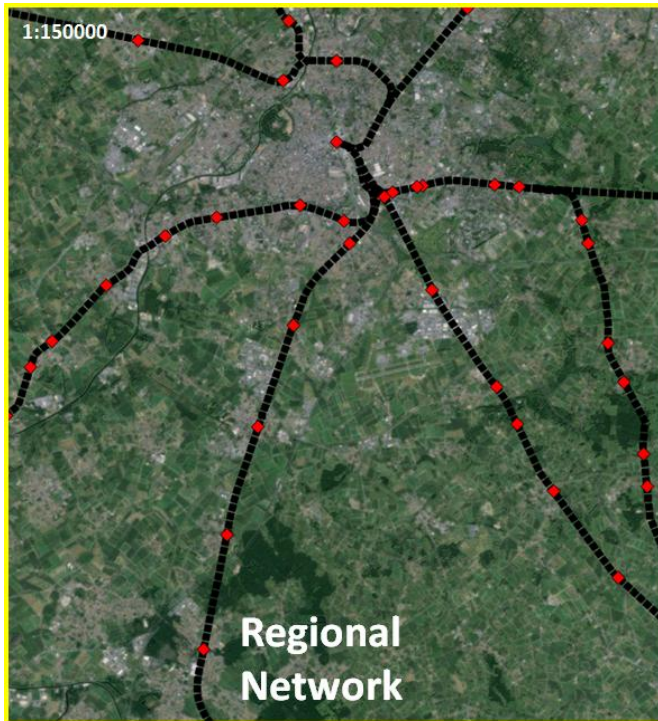
cumulative and synergic effect of interaction factors (Litman, 2012)  
various temporalities (Wegener, 1999)



# Transit Oriented Development

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- high density
- functional mixing
- priority to active mobility & PT
- urban design quality





# Transit Oriented Development

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from a car oriented paradigm to...

- *physically transit oriented and not just adjacent (Cervero, 2012)*
- *multi-modal and polycentric development (Litman, 2012)*
- *tool to promote rail use (Nuzzolo 2010; Leysens, L'Hostis, 2011)*
- *TOD to reinforce node and place function (Bertolini, 1999)*

obstacles:

sharing and acceptance of TOD principles (*concept interpretation*)  
different solutions for different contexts (*transferability & adaptation*)  
institutional and operational barriers (*coordination*)  
time factor and gentrification (*equity*)

Source: ITDP Mexico

evaluate applicability and effects of a TOD regional plan in NPDC



implementation  
of a LUTI  
model

*a land use and transport integrated model is a theorized and formalized representation to analyze a territory in its spatial, economic and social aspects. (Laurent, 2012)*

base scenario  
(observed data)

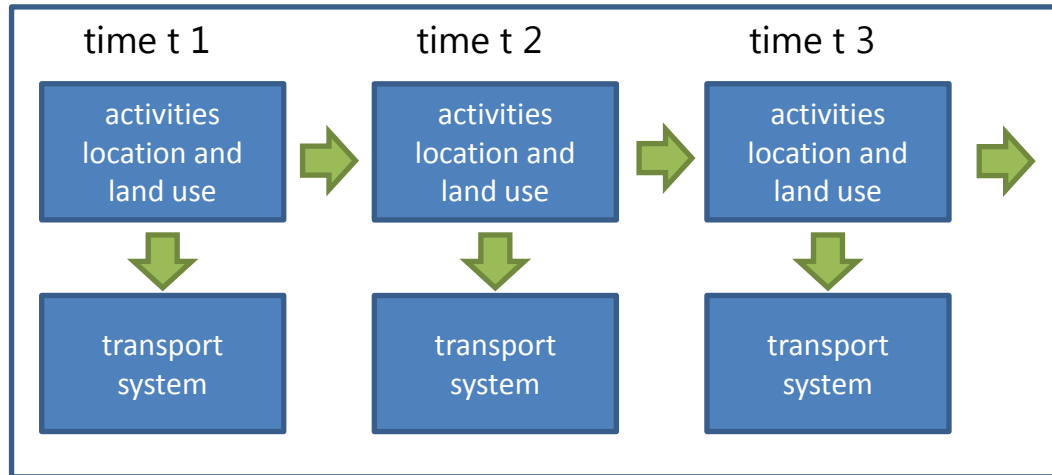
implementation (hypothesis)  
and  
execution

calibration

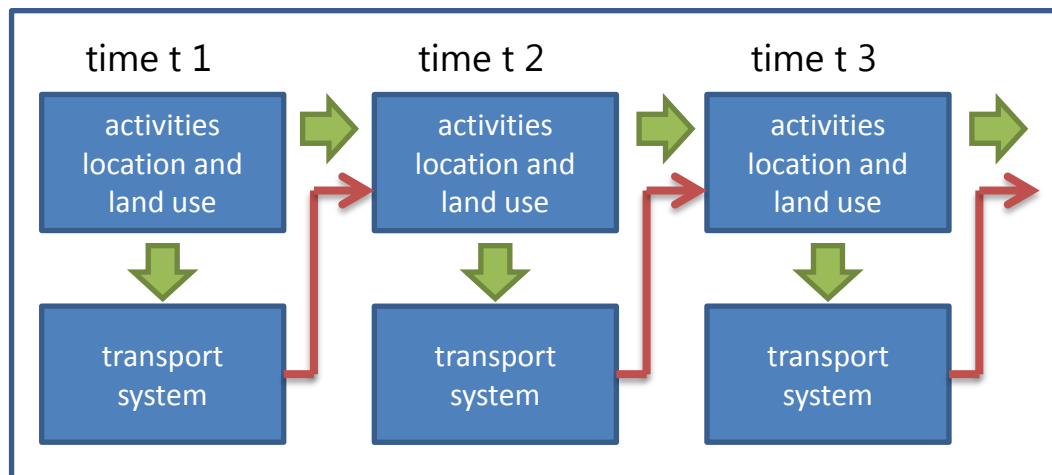
futur  
simulations

observed data  $\neq$  calculated data

## classic models: *exogenous land use data*



## LUTI models: *land use data generated by the model*





## integration of various theoretical approaches:

spatial macro economics (*Von Thunen*); gravity and entropy models (*Lowry*); input-output model (*Leontief*); random utility model (*McFadden*); path choice algorithm (*Dijkstra*)

**aggregated model - based on equilibrium between supply and demand**

### land use and activities

interactions  
between activities  
and economic  
sectors



equilibrium factor  
**PRICE**

### interface

conversion of  
economic flux in  
transport flux  
(input-output)



### transport

demand distribution,  
modal share and  
congestion



equilibrium factor  
**TIME**

**model hypothesis inspired by regional planning strategies**  
*promote urban densification near transit and rail network; improve territorial attractiveness; make the regional a railway European hub; promote transit use*

**base scenario: 2009 (national census data)**  
**time horizons: 2013 – 2017 – 2021 - 2025**

## **scenario A** «Trend Scenario»

## **scenario B** « Regional TOD Plan »:

progressive densification in selected rail corridors and nodes (TOD zones)  
improvement of PT frequencies: + 10% at 2017 and 2021; + 20% at 2025)

## **scenario C** « Regional TOD Plan + transit use incentives »:

progressive densification near selected rail corridors and nodes (TOD zones)  
improvement of PT frequencies: + 20% at 2017 and 2021; + 30% at 2025)

*Integrated tariff (bus and rail)*

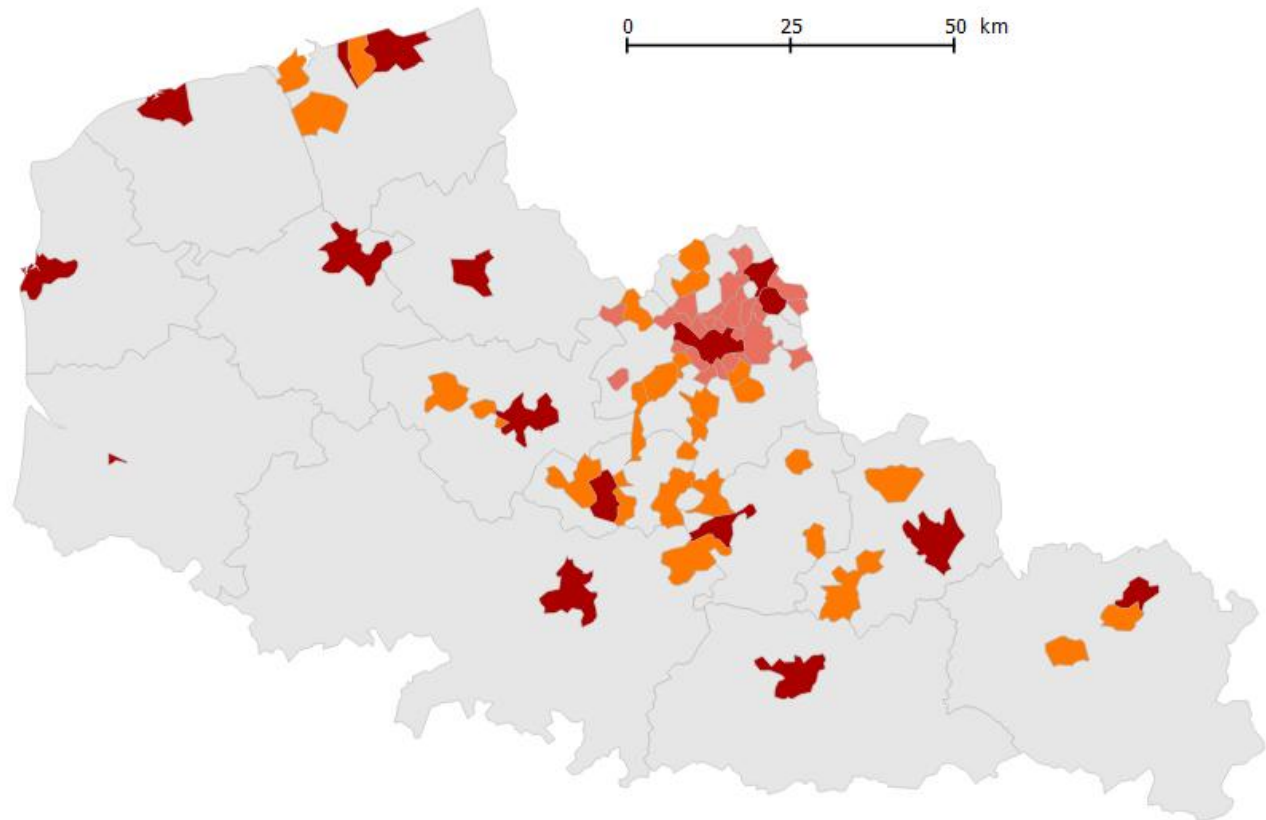
*Introduction of a toll for highways (0.08 €/km)*

# Nord Pas de Calais Transus model

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## Zoning

type	nr. of zones
Main cities	16
Municipalities of Lille agglomeration (LMCU)	24
TOD zones	21
Rest of regional territories (employment zones)	15



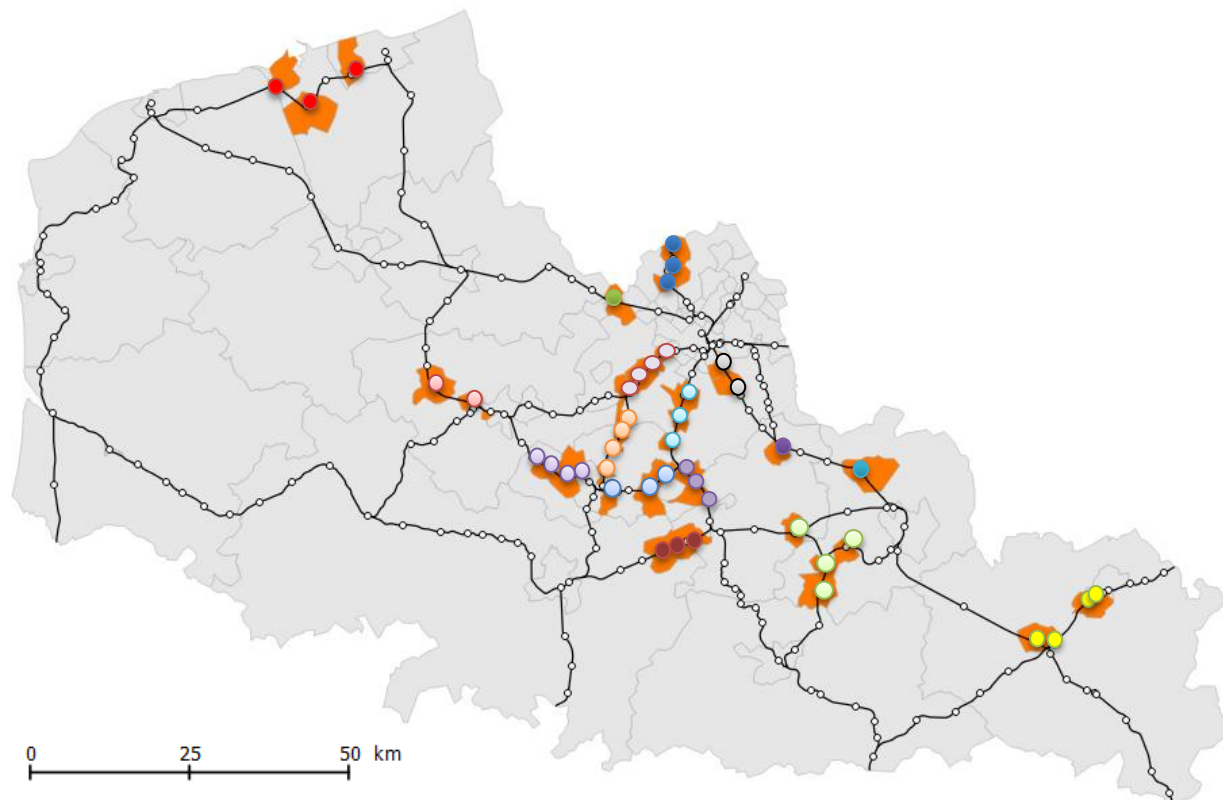
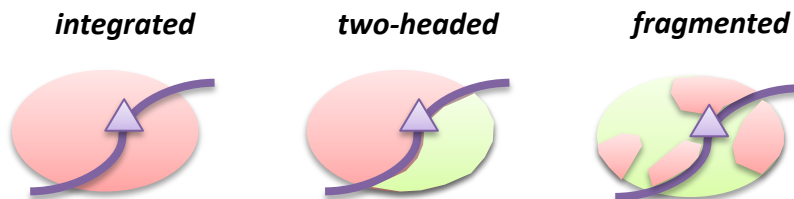
# TOD potential rail corridors

Armentieres	●
Fretin	○
Haubourdin	○
Lesquin	○
Seclin	○
Comines	●
Quesnoy-sur-Doule	●
Orchies	●
Saint Armand Les Eaux	●
Brébiere-Vitry-Corbehem	●
Lillers-Choques	○
Ostricourt	●
Dunkerque	●
Hénin Beaumont	○
Bauvin-Sanghin	○
Loos-Lievin-Bully	○
Santes-Wavrin	○
Phalempin-Libercourt	○
Hautmont	●
Aulnoye	●
Denain-Somain-Bouchain	●

## rail station district insertion in urban fabric

(Van der Poorten & Nedellec, 2013)

- ▲ rail station
- not urbanised
- urbanised





# structure of the model

## Households categories

High Income    Medium Income    Low Income

## Transport categories

Home to work    Home to service    Exogenous O/D matrix  
External trips    trucks

## Activity sectors

Industry/constructions    Tertiary service    Tertiary public

## Transport system

physical supply (infrastructures)    operative supply (PT services)    transport demand behaviours (preferences, value of travel & waiting time, ect.)

## Land Use types

available land  
monthly rental price  
(par type and zone)



Mixed

residential

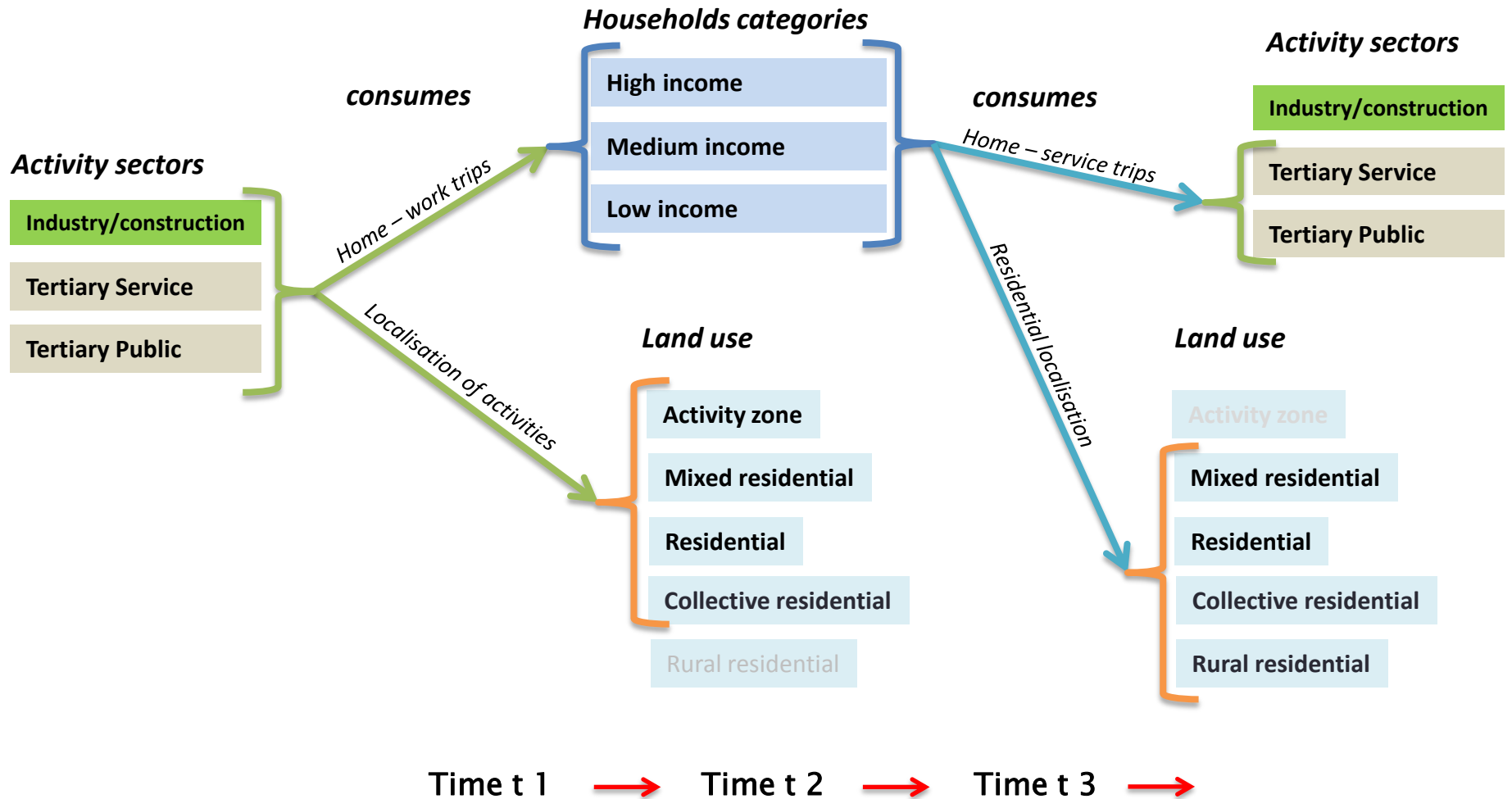
collective

Activity

Rural/detached

brownfield

# structure of the model



# hypothesis *TOD* scenario

## Progressive densification

5% in 2017	15% in 2021	20% in 2025
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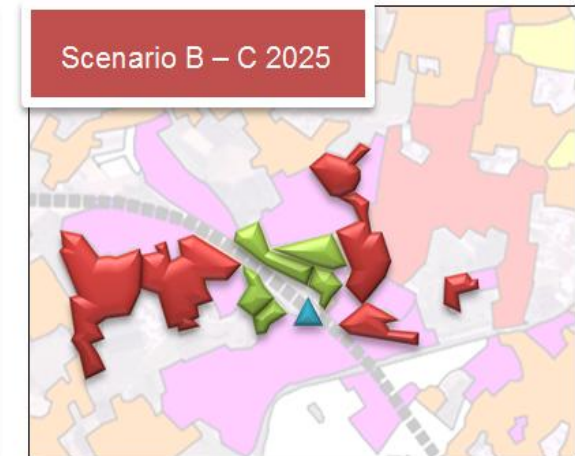
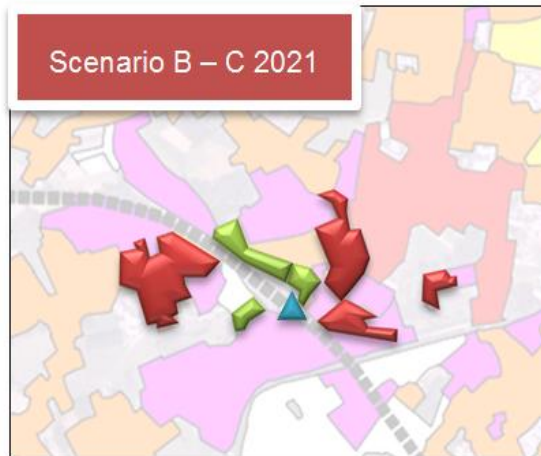
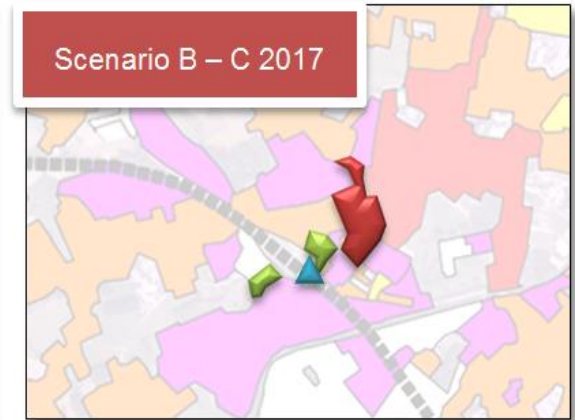
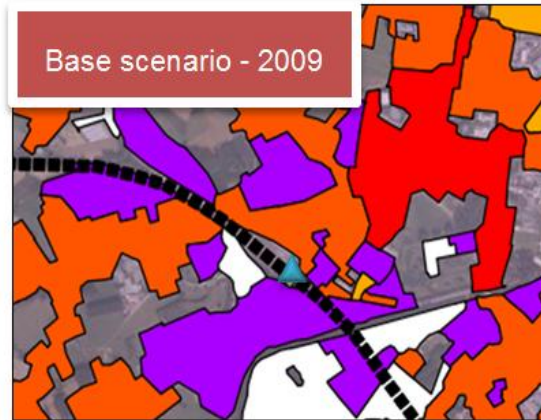


5% in 2017	10% in 2021	15% in 2025
---------------	----------------	----------------



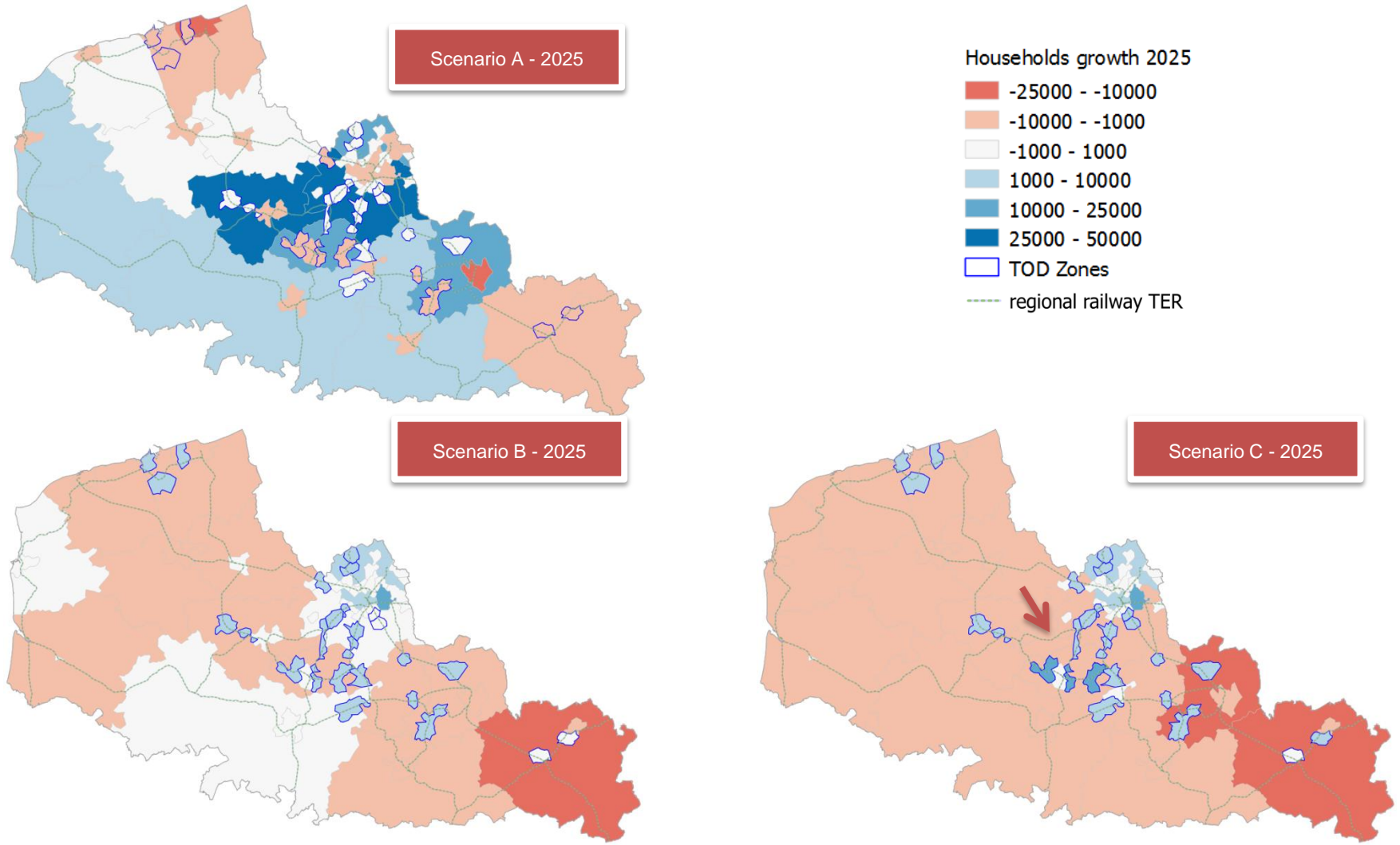
15% in 2017	25% in 2021	35% in 2025
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density TOD land = + 10/15%  
higher than urban mixed land



▲ rail station (Saint Armand les Eaux)

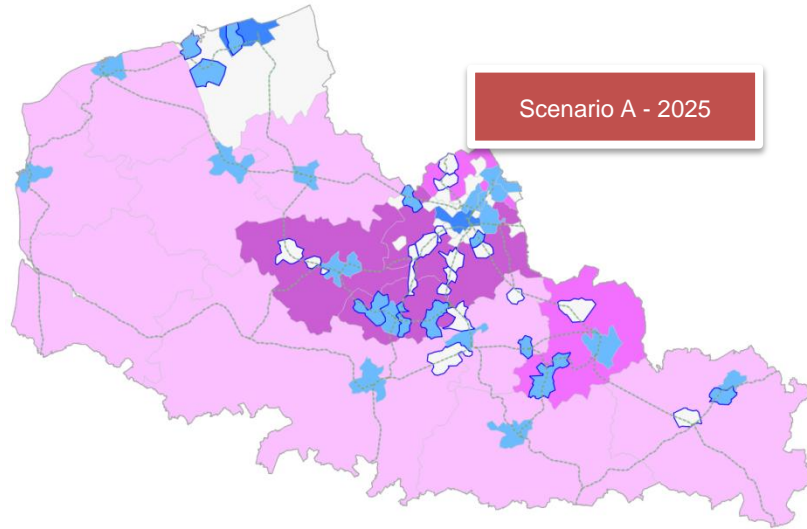
# land use results - households



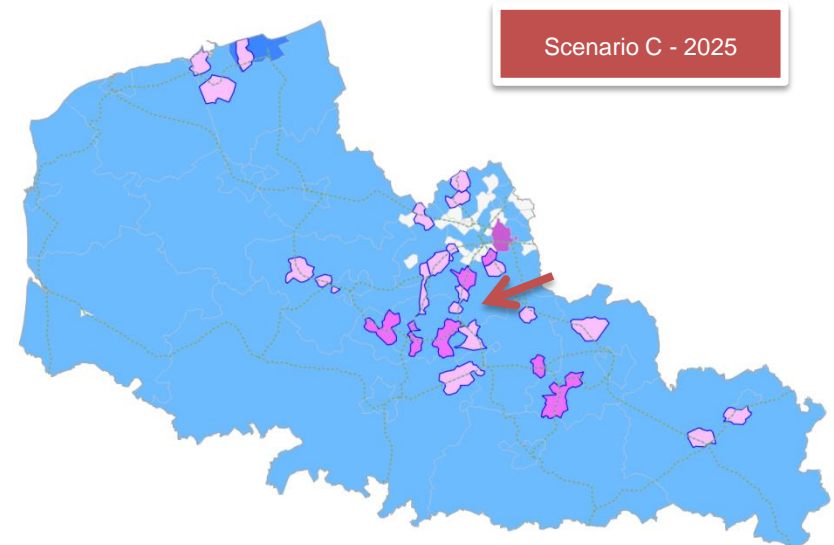
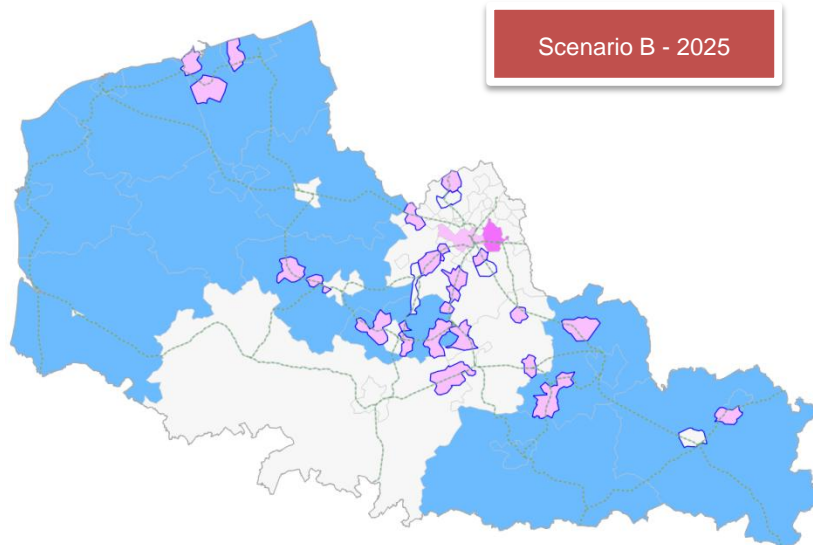
Scale 1:750000



# land use results - jobs

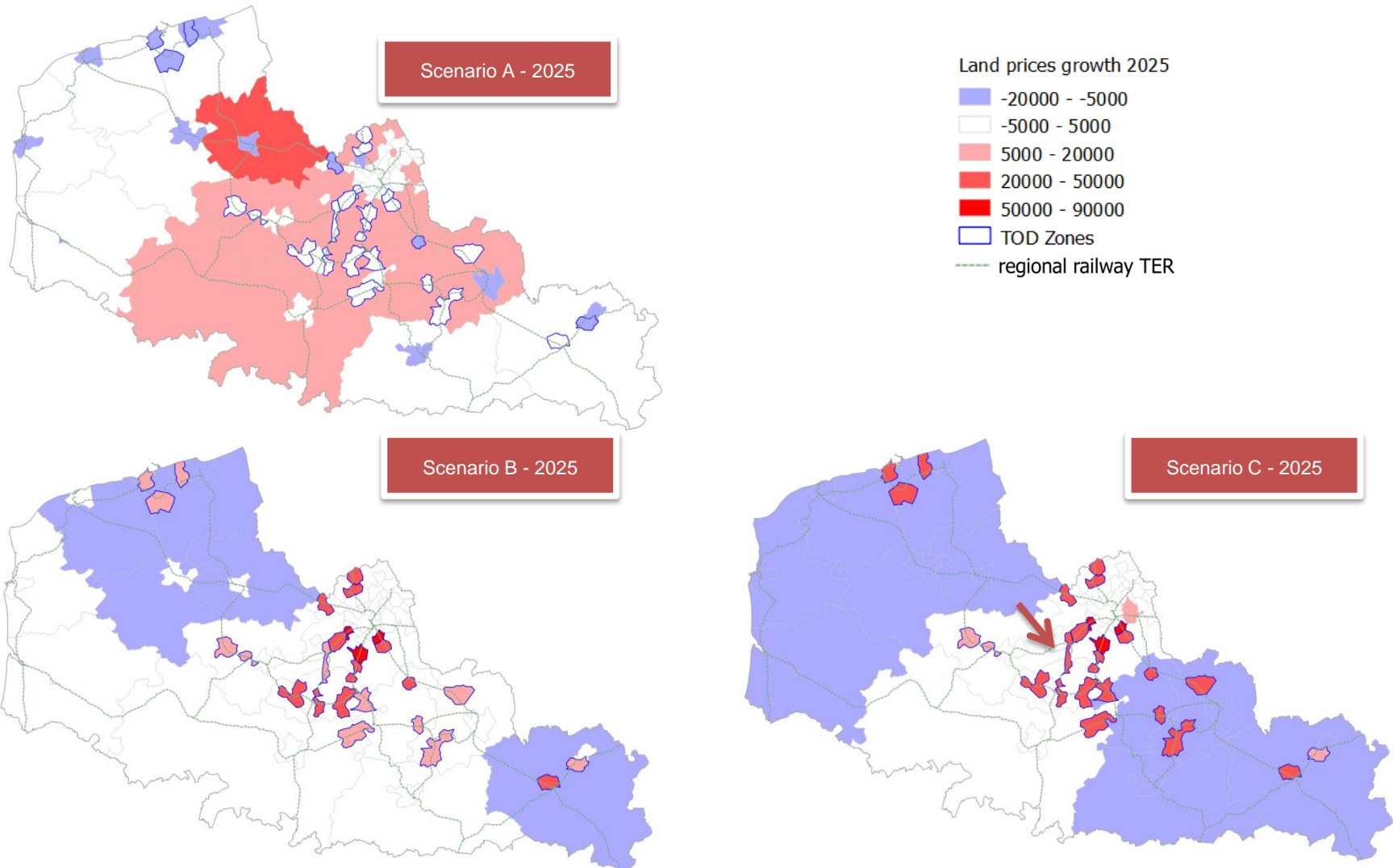


## Job growth 2025



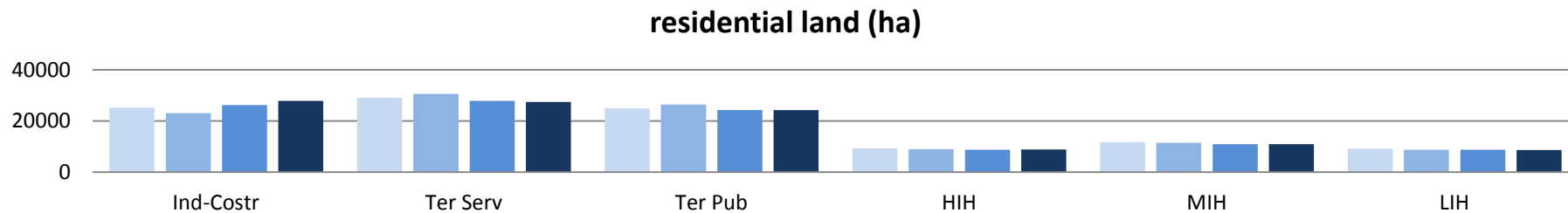
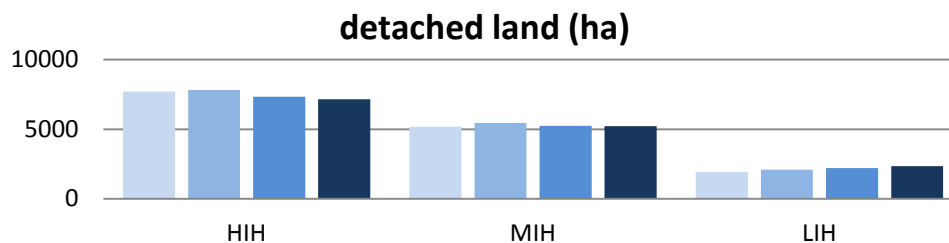
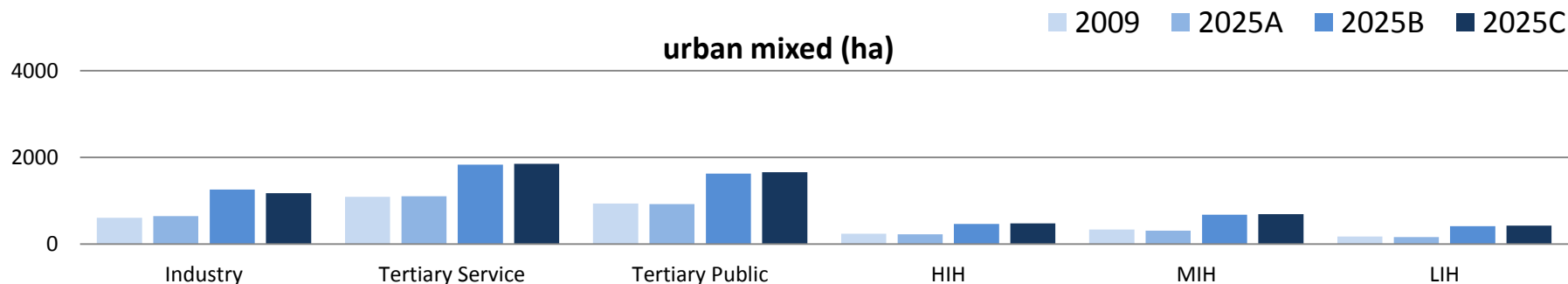
Scale 1:750000

# land use results – land prices

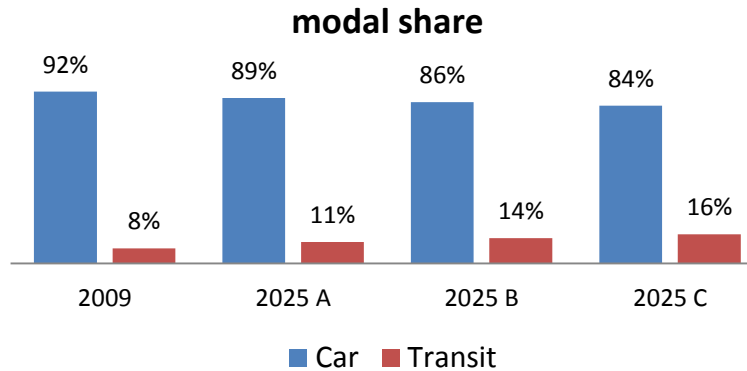


# land use results – land consumption

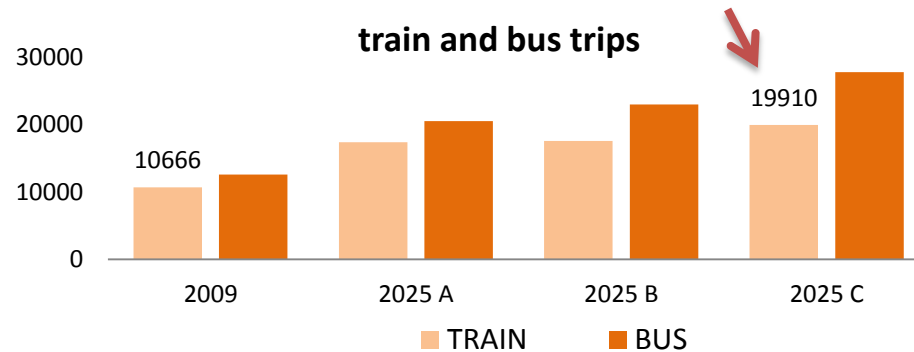
## CONSUMED LAND



# transport results – modal share



Rush hour Simulation 7h – 9h  
*Home – Work*  
*Home – Service*

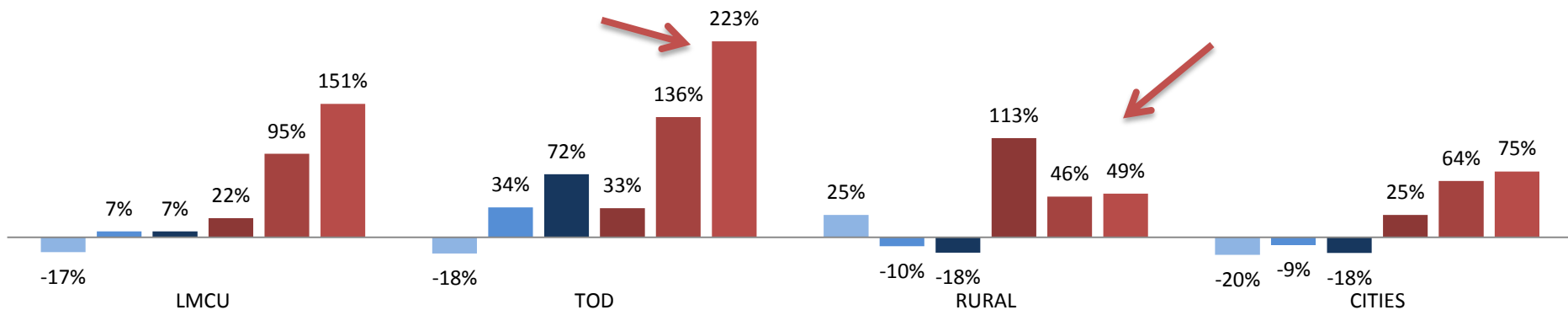




# transport results – modal share

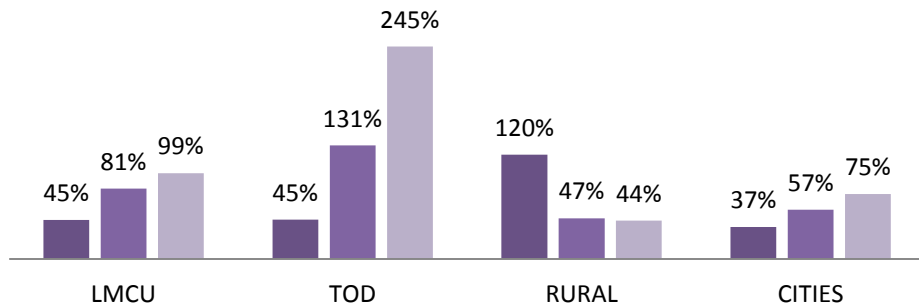
## evolution of car and PT number of trips

CAR 2025 A CAR 2025 B CAR 2025 C PT 2025 A PT 2025 B PT 2025 C



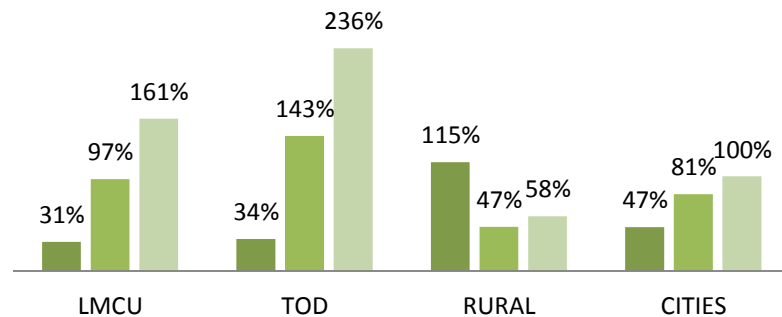
## evolution number of trips by trains

2025 A 2025 B 2025 C



## Evolution number of trips by bus

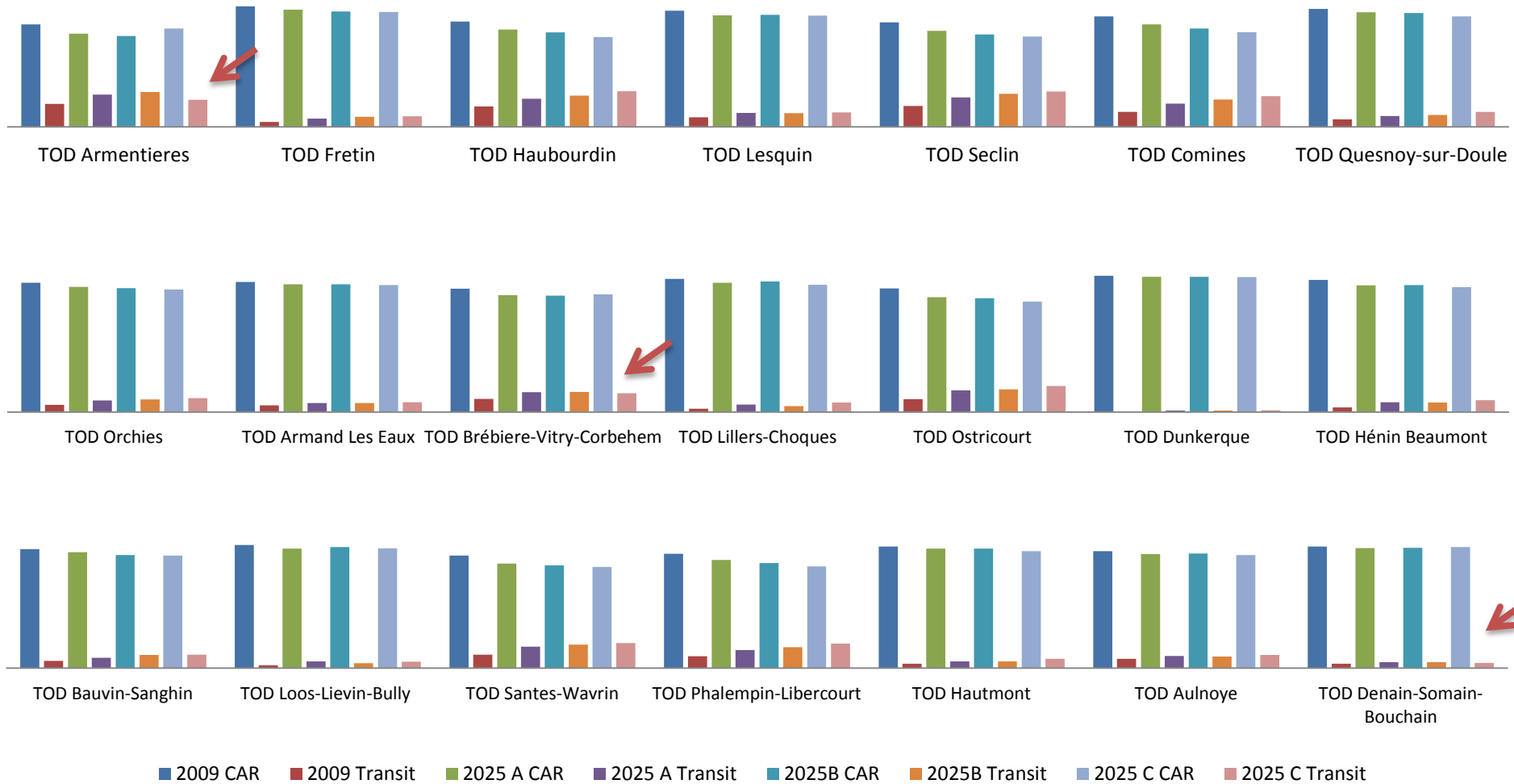
2025 A 2025 B 2025 C



# transport results – TOD zones

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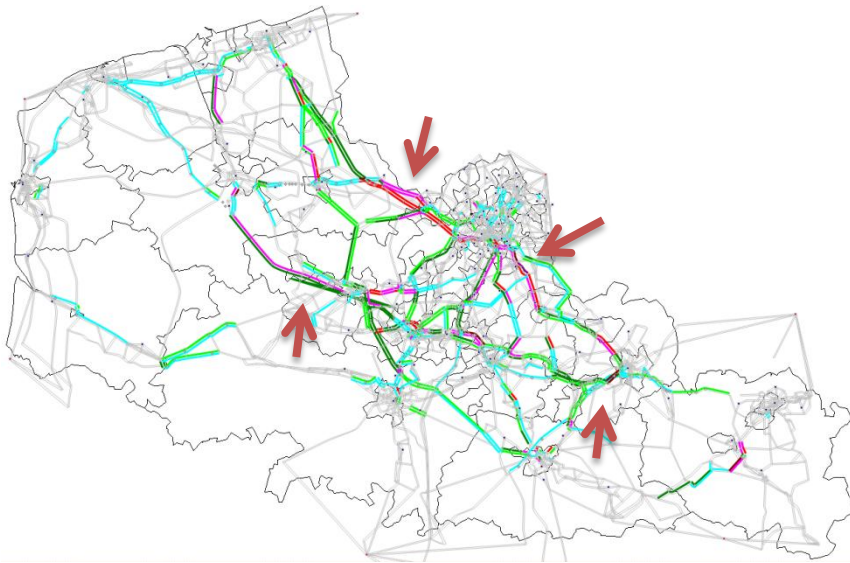
## modal share in TOD zones



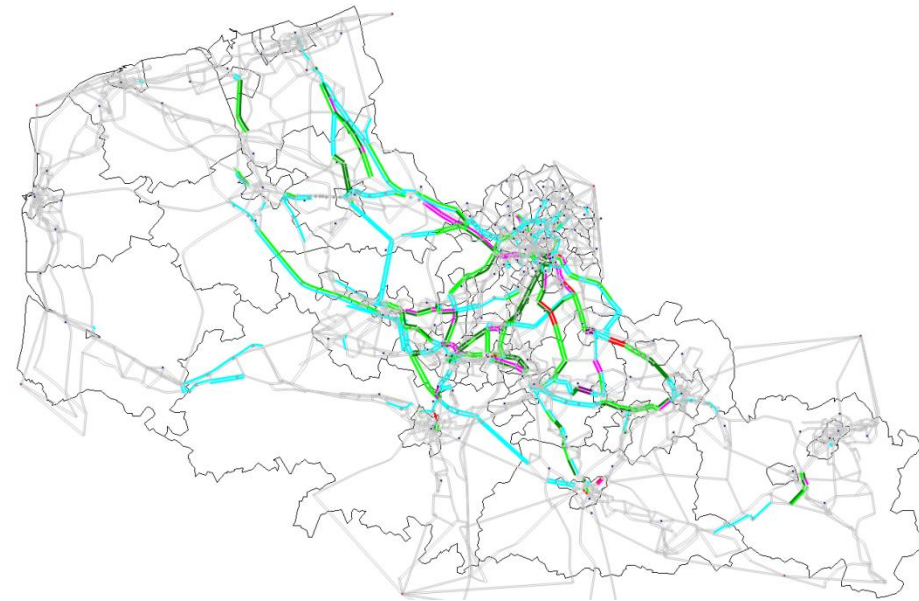
# transport results – level of service

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Base scenario 2009



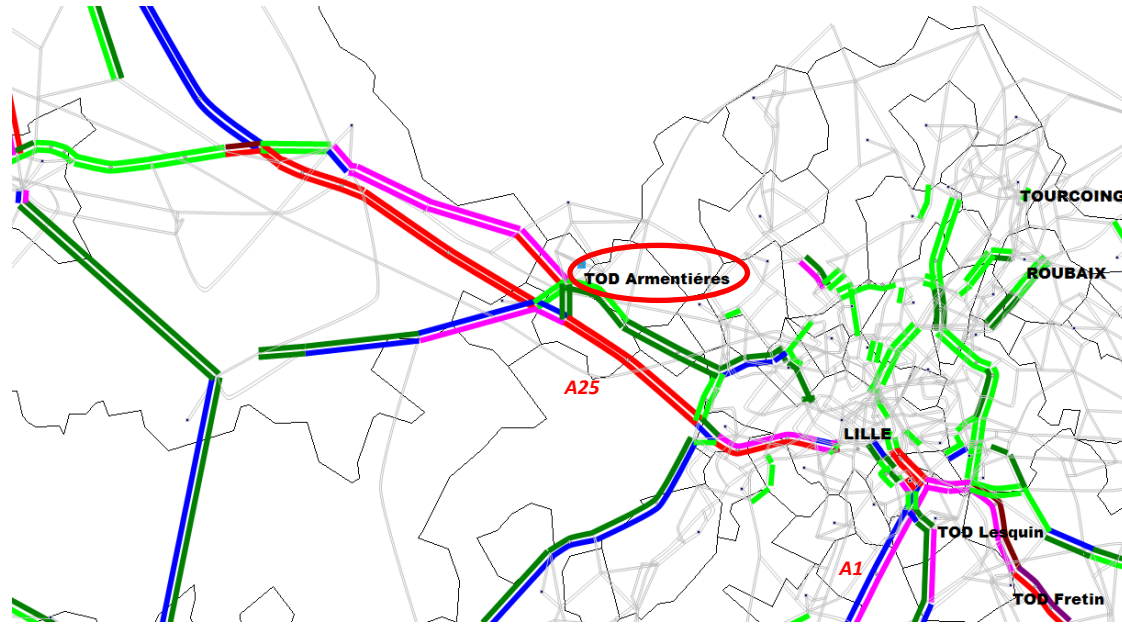
2025 scenario C



- |                          |   |         |
|--------------------------|---|---------|
| <input type="checkbox"/> | A | Level A |
| <input type="checkbox"/> | B | Level B |
| <input type="checkbox"/> | C | Level C |
| <input type="checkbox"/> | D | Level D |
| <input type="checkbox"/> | E | Level E |
| <input type="checkbox"/> | F | Level F |
| <input type="checkbox"/> | G | Level G |
| <input type="checkbox"/> | H | Level H |

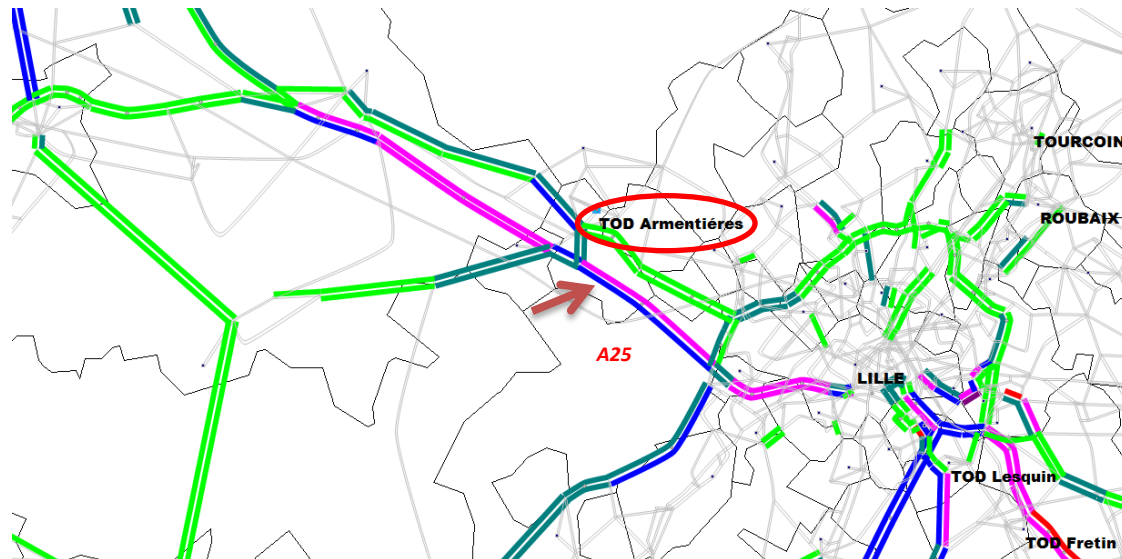
# transport results – level of service

Base scenario 2009



- |     |         |
|-----|---------|
| □ A | Level A |
| ■ B | Level B |
| ■ C | Level C |
| ■ D | Level D |
| ■ E | Level E |
| ■ F | Level F |
| ■ G | Level G |
| ■ H | Level H |

2025 C



Car became again  
more attractive  
than PT



## about results:

- show an increase of sprawl without specific contrasting policies
- TOD regional plan (scenario B and C) induces a limitation of sprawl and of car use
- TOD effects increase if associated with policies that discourage car use and improve transit performance (scenario C)
- land prices evolution confirms TOD capacity of value capture
- TOD effects are more evident in zones with a basic economic and productive dynamism with significant initial land and transport demand (rail corridors *Lille – Douai*; *Lille – Lens - Bethune*)

## about modelling:

- complexity about the *multi – scalar* and regional approach (different densities and land uses for different territorial scales)
- complexity about modelling TOD
- Limits related to aggregated zoning (good for global analysis, less for punctual analysis)
- calibration and output analysis (need of time and of a multidisciplinary approach)
- Tranus confirms its consistence in *multi - scalar* and regional modelling



Sustainable Mobility  
in Metropolitan  
Regions

**thanks a lot  
for your attention!**

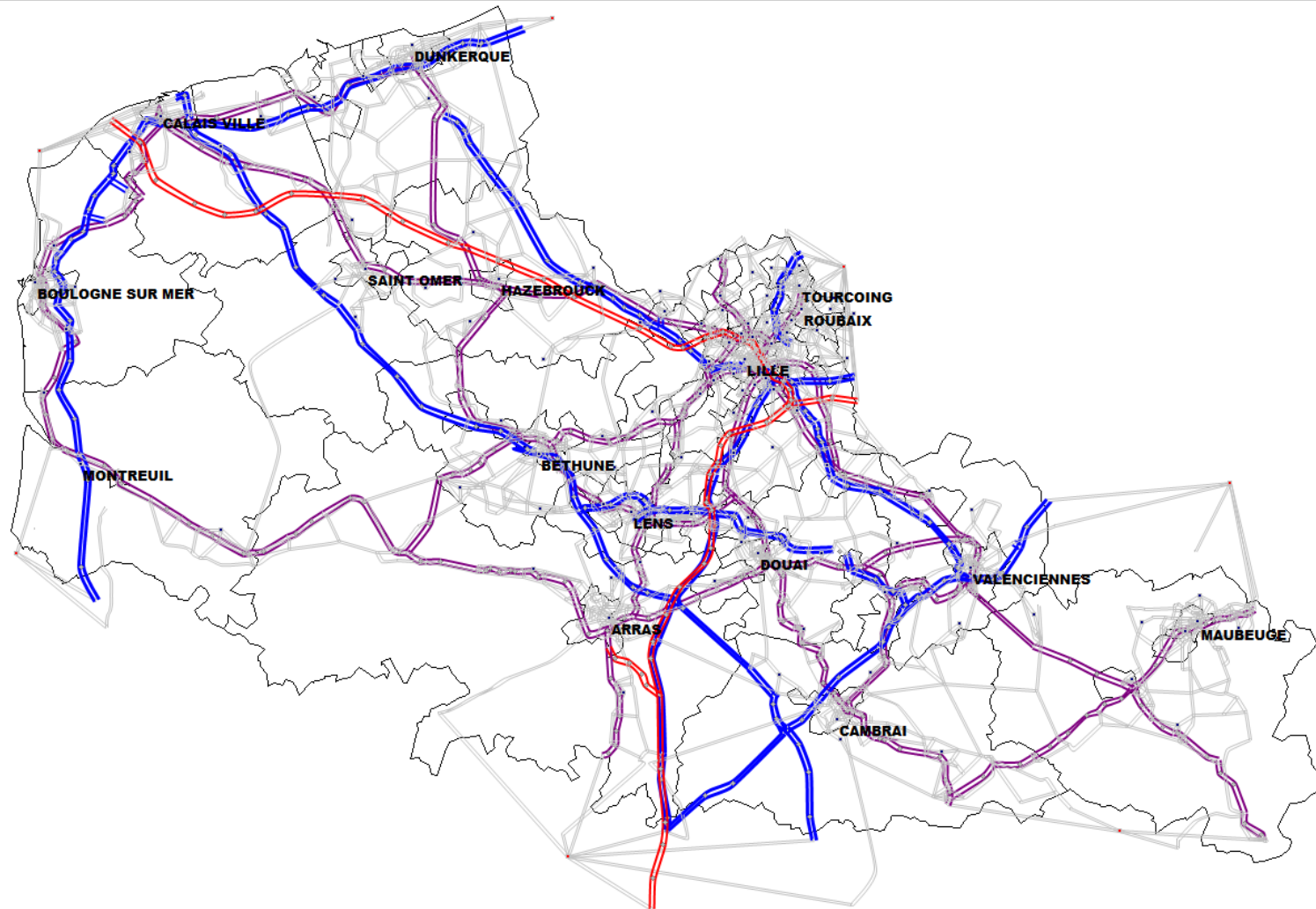
Contact: *[fausto.lofeudo@ifsttar.fr](mailto:fausto.lofeudo@ifsttar.fr)*

May 19-20, 2014  
Oskar von Miller Forum  
Munich, Germany

# Nord Pas de Calais Transus model

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Id	Name
1	REGIONAL RAILWAY
2	HIGHWAY
3	NATIONAL ROAD
4	LGV NPDC
5	VAL LILLE
6	TRAMWAY
7	STATION CONNECTIO...
8	EXT CONNECTORS
9	URBAN ROADS
10	CONNEXION TRAMW...
11	CONNEXION METRO
12	ZONE CONNECTION
13	ZE CONNECTION
15	EXT CONNECTORS T...
16	EXT CONNECTIONS A...



# Nord Pas de Calais Transus model

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Id	Name
71	CAMBRAI LIGNE A
72	CAMBRAI LIGNE B/ P...
73	CAMBRAI LIGNE E/AR...
74	CAMBRAI LIGNE D
75	CAMBRAI LIGNE C
76	TGV 1-1/1-3
77	TGV 1-2
79	TGV 1-4/1-5/1-6
82	Eurostar 1
83	TGV 2 / Eurostar 2
85	_TER-E-1
86	_TER-3
92	_TGV AUT-1
93	TER-GV 2
94	TGV 6-7-1
95	TGV 6-7-2
96	TGV 8-1 /TER-GV 8-1
97	TGV 8-2
99	TGV 11-12-1
100	TGV 11-12-2 / TER-GV...
101	TGV 11-12-3 / TER-GV...
104	_TER 2/19/22
105	_TER 2-1
106	_TER 2-2
107	_TER 2-3
114	_TER 4
115	_TER 5
116	_TER 6-7-1
118	_TER 6-7-3
119	_TER6-7-2/ 8-1
120	_TER 8-2/12
121	_TER 8-3/12
122	_TER 9
125	_TER 11
128	_TER 13
129	_TER 14-1/2/3
132	_TER 15-1
133	_TER 15-2
134	_TER 15-3/23
135	_TER 16/18
136	_TER 16/17/18
137	_TER 16/17/19/20
139	_TER 17-1
141	_TER 18
143	_TER 19/21
144	_TER 20
145	TER 21

