Potential of national rail investments in France for mitigation of greenhouse gas emissions

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International Conference "Climate Change and Transport"
KIT / WCTRS, 9th October 2014

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France and GHG emissions

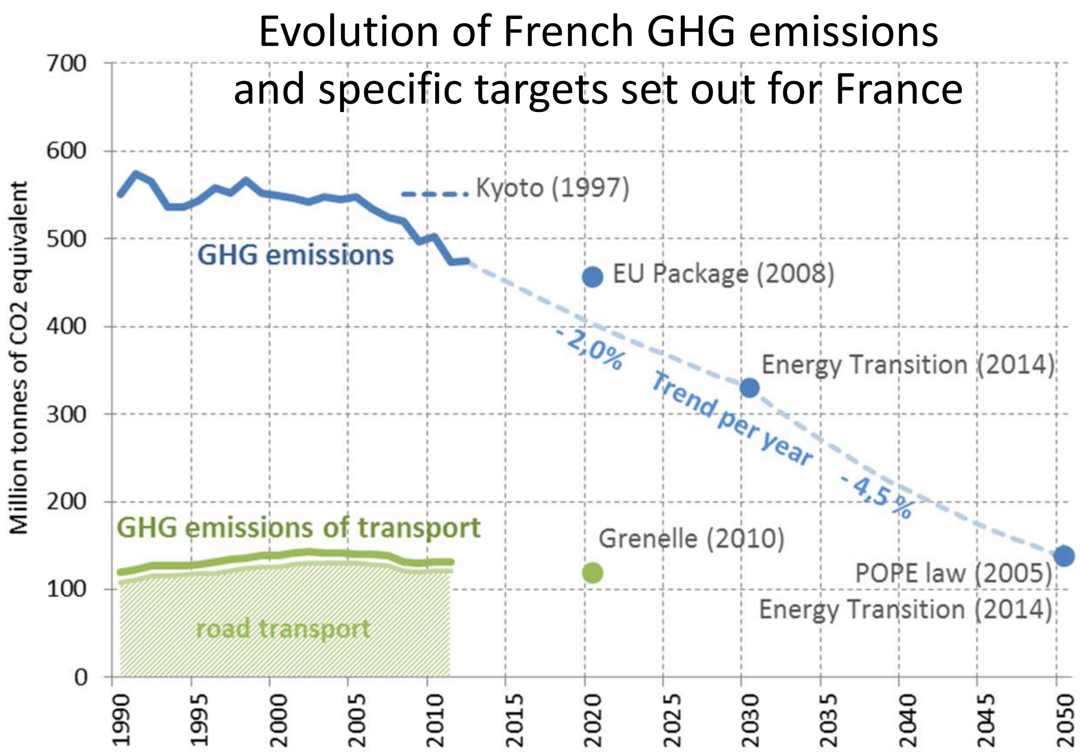
Targets for cutting French GHG emissions are ambitious: -75% 2050/1990 (« factor 4 »), but the country is on the right trend since 2006

Transports = 26 % of GHGE (sector nr 1), stable (≠ national trend)

GHGE mitigation is one of the few long term quantitative targets impacting the whole country and its activities

What contribution of the transport sector?

- ↳ Short / long distance transport?
- ↳ Rail and modal shift?
  - ↳ High speed rail?



Targets set out by the Kyoto Protocol (1997), the POPE law (French framework law on energy policy, 2005), the EU Energy and Climat Package (2008), the "Grenelle" Environnement legal framework (2010) and the Energy Transition Law draft (2014). Data sources: CITEPA, ADEME, CGDD. Réal. : RFF/DStrat/Séguret (2014).

High speed rail in France

2.036 km of HSL in operation (28 % of EU's total), starting 1981

+ 700 km in construction to be open until 2017

About 470 HS train sets running 139,5 M train-km
(2/3 performed on HSL)

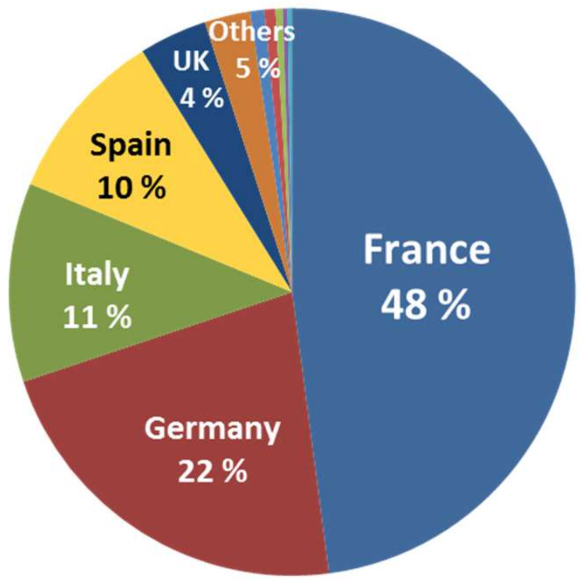
54 billion pkm (58 % of passenger rail transport in France)

Competitiveness of the HS system based on:

- The geographical structure of the French territory, generating a concentred and high demand of transport at the national scale and cutting costs per passenger
- SNCF's innovations (yield management applied to rail, low cost subsidies…)

⇨ **The most advanced high speed rail system in Europe**
… with still development potential (Toulouse, Côte d'Azur, etc.)

High speed rail transport in Europe (2012)



NB: Traffic in passenger-km with high speed rolling stock (on/out of high speed infrastructure).
Source: EU, SOeS ; Réal. RFF/Séguret 2014

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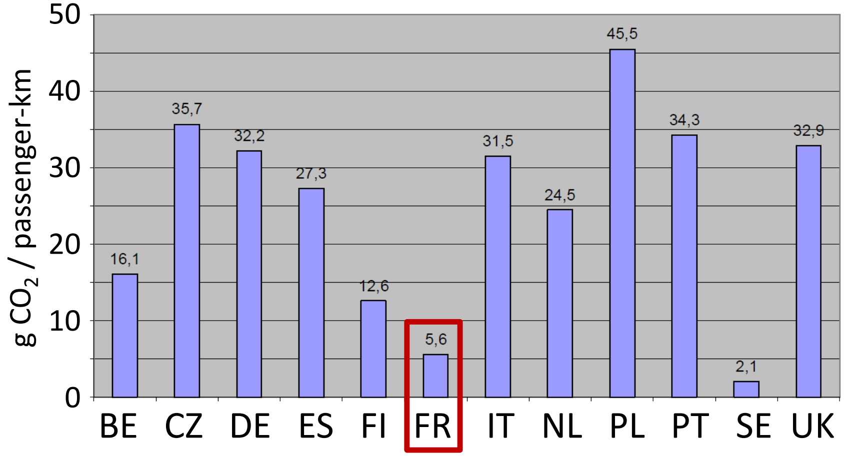
High speed rail as a mean of cutting GHG emissions

GHGE of HSR strongly varies from country to country, mainly depending on:

1) **GHG content of energy supplied to rail operators** (nuclear power: 80% of the French electricity supply)

2) **Energy efficiency of rail operation**. French HSR is despite speed as much as energy efficient per pkm than usual IC trains.

CO_2 emissions per HSR pkm in Europe (2005)



Source: Eur. Com., MVV, Tractebel (2009)

France is almost where HSR has the best advantage by GHGE on other transport modes

Mass transport system + Potential + Low carbon transport

=

France as a very good place to invest in HSR for cutting GHGE

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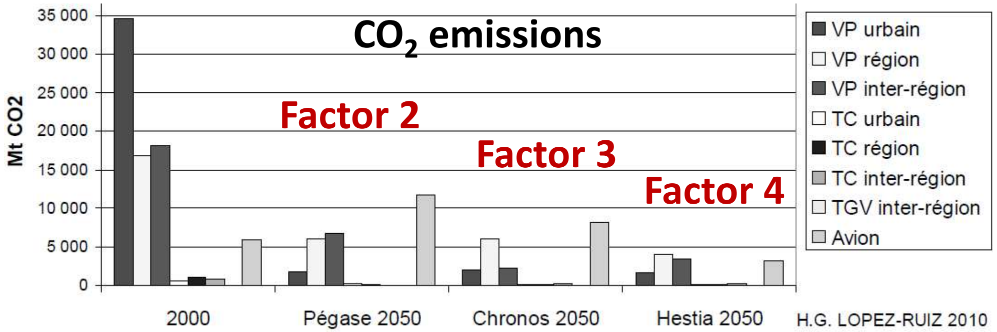
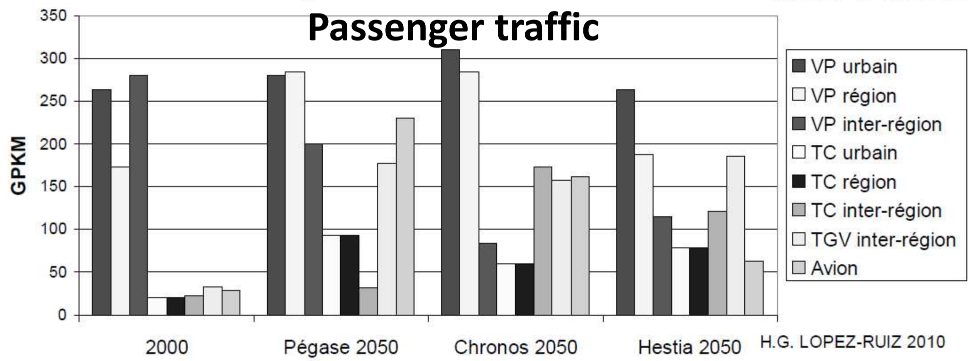
The contribution of high speed rail by mitigation of GHGE, backcasting methods

Key figures per mode in various mobility scenarios in the LET-Enerdata “Factor 4 study”





Investment in infrastructures

Investment / year bn€	Average 2008-2012	Pégase until 2050	Chronos until 2050	Hestia until 2050
Road	10,7	21	8	**3**
Rail	3,4	15	31	**20**

Source: Lopez-Ruiz, Crozet (2011)

LET-Enerdata “Factor 4 study” (H. Lopez-Ruiz 2009) about needed conditions to cut GHGE by 75% until 2050 in transport (passenger & freight together)

Scenarios varying according to macro parameters (value of time, regulations, innovations…)

- HSR ridership should reach 157 to 186 Gpkm => X 3
- Investment in rail should be increased 6 times

⇨ Is this sustainable?

⇨ Where investments should be done?

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Main rail infrastructure projects in France <u>before</u> *Mobilité 21* task force

Main rail infrastructure projects
proposed for the
National Transport Infrastructure
***Scheme** (SNIT, 2011)*

SNIT results directly from :

- Government's engagement ("Grenelle" 2009) to build 2500+2000 km of new HSL
- Local pressures leading to a new HSL in each region

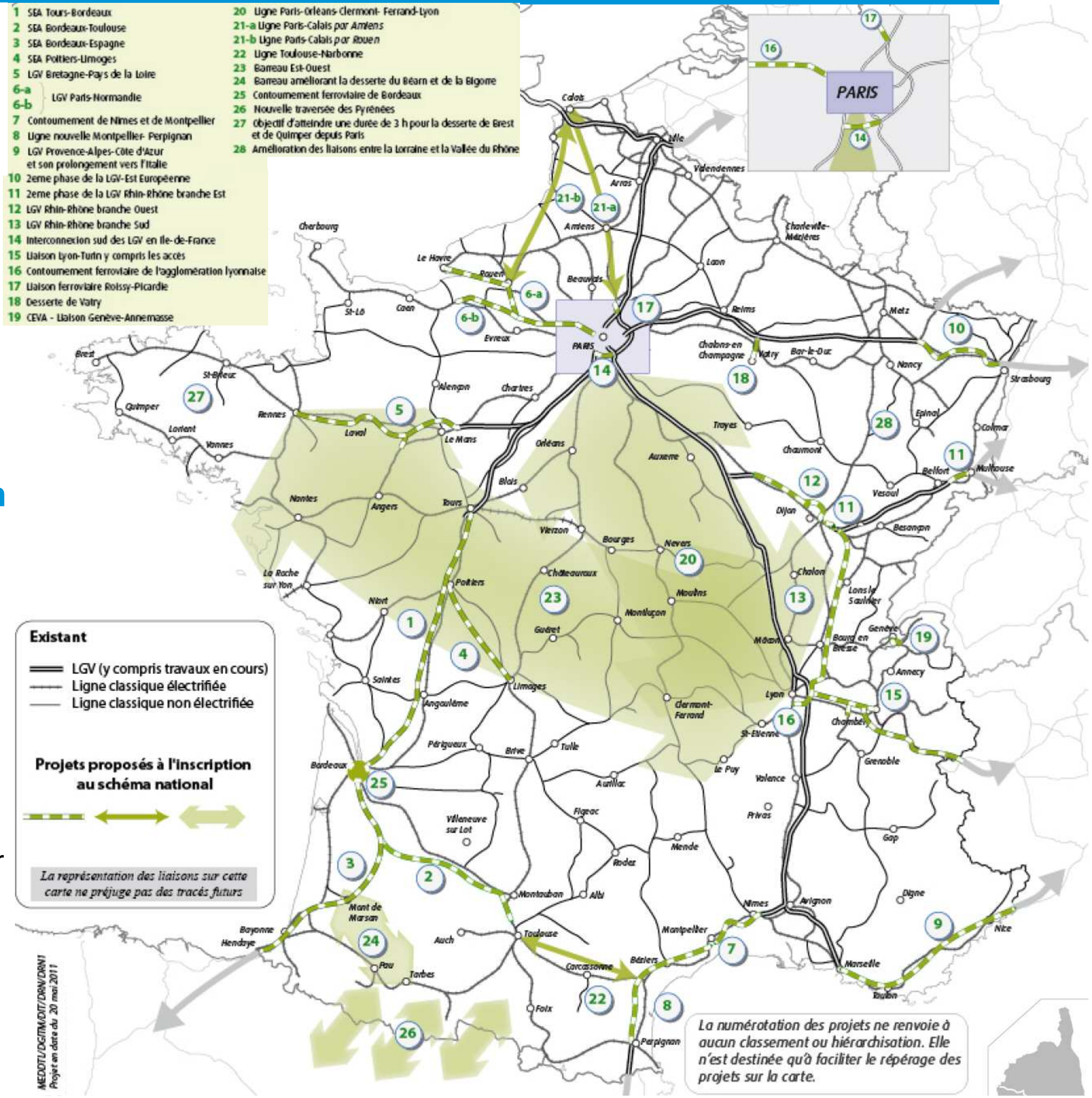
Over 110 bn€ investments in new rail infrastructures

(= 45% of investments in all planed transport infrastructures)

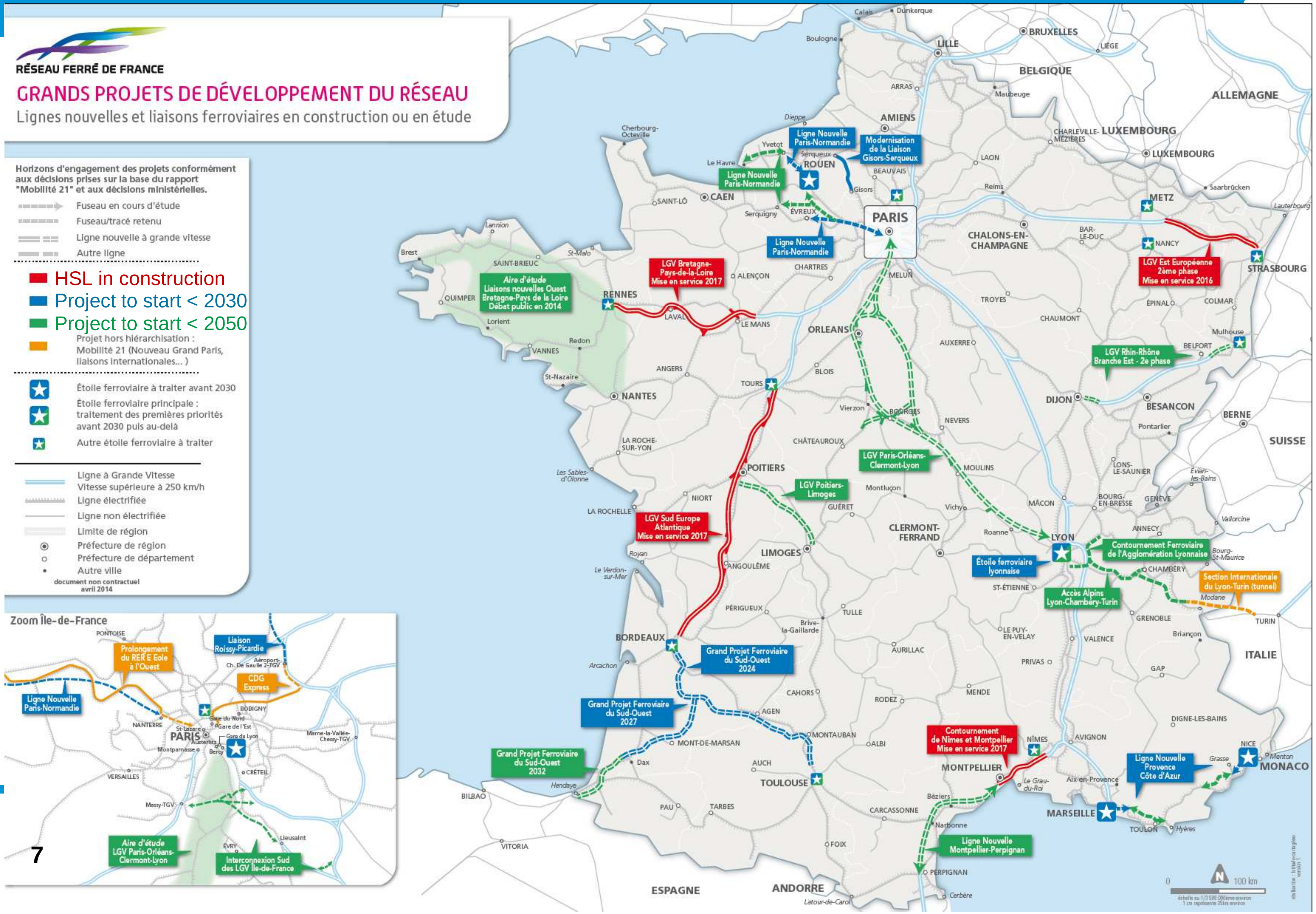
Seen as unrealistic scheme:

- RFF's debt was already close to 30 bn€
- Actual investments in HSL (2008-2012) only 1,3 bn€/year

⇨ ***Mobilité 21*** **task force to prioritize investments according to actual needs and available budget**



Main rail infrastructure projects in France <u>after</u> *Mobilité 21* task force and new government's orientations



Impact of various long distance rail investment strategies on GHG emissions in France

Study by 3 independent experts Gérard MATHIEU, Jacques PAVAUX, Marc GAUDRY (2013)
for Réseau ferré de France / Strategy department (follow up: S. Séguret)
in association with

FNE, the national federation of environment associations in France
FNAUT, the national federation of public transport users
ADEME, the state agency for environment and energy saving

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Purpose and context of the study

Purpose:

- to set a global vision about the potential of GHGE mitigation of rail
  (≠ usual vision project by project)
- to calm down the debate about network development and new HSL
- to open strategic studies to stakeholders in need of objective information

Context:

- Study done between late 2010 to early 2013, after the government announced 4500 km of new high speed lines (Grenelle Environnement)

Title:

- « Evaluation de la contribution du réseau et de la politique ferroviaires à l'objectif du facteur 4 pour les déplacements des voyageurs à moyenne et longue distance »

Key features of the study

Scope: only long distance passenger traffic on the main interurban corridors

Massive data got from previous studies concerning infrastructure projects (mainly HSL) which have been never summed up together before

Study based on 4 contrasted scenarios of rail network development until 2050, determining in each scenario a HSL or a conventional line (with maximum speeds) for sections of 100 to 200 km of corridor

Only one macro-economic framework (transport policy and prices, competition, etc.), to point the impact of various investment strategies on the network
⇨ Main factor are the infrastructure features

Results per corridor have been anonymised, to focus attention on the development strategies and not interfere with project management

Methodology (1)

Socio-economic features:

- Energy price (oil barrel): 80 $ in 2010, 120 $ in 2020, 160 $ in 2050 (constant $)
- Costs of transport modes: air = rail ; road: < rail until 2025 than > rail
- Load of transport vehicles: car: 1,82 pass/veh in 2012, 2,15 in 2050
- GHGE of transport modes (electric cars, green fuels, etc.) and construction of rail infrastructure (see RFF carbon footprint of Rhin-Rhône HSL)

Hypothesis of GHGE per mode of transport ($geqCO_2/pkm$)			
Year	Air *	Car **	High speed train ***
2012	262	121	7
2030	220	96	7
2050 (1)	200	78	7
2050 (2)	200	71	7

** Including greenhouse effect of cirrus clouds and condensation trails (global warming potential => GHGE x 2)*
*** Including maintenance of infrastructure *** Excluding construction and infrastructure operation*
All other emissions included (life cycle emissions of vehicles, GHG content of energy, etc.)
1) Without electric car and with 75 % electricity from nuclear power or renewable energy
2) With 40 % of electric cars and 75 % electricity from nuclear power or renewable energy

Methodology (2)

4 « network orientations » representing various network development strategies:

- A1 : active development of the HSL network (≈ equivalent to SNIT)
- A2 : similar to A1 but with some mixed passenger/freight new lines
- B1 : performance upgrade of the core network (including existing HSL) + some of the most pertinent new HSL
- B2 : similar to B1 but with performance upgrade on all corridors mentioned in the national scheme SNIT 2011

Applying these network orientations on the 15 main corridors + 10 additional corridors or functionalities mentioned in the SNIT 2011

Traffic forecasts per corridor and mode related to scenario assumptions (main parameter: travel times)

Assessment of GHG emissions per corridor:

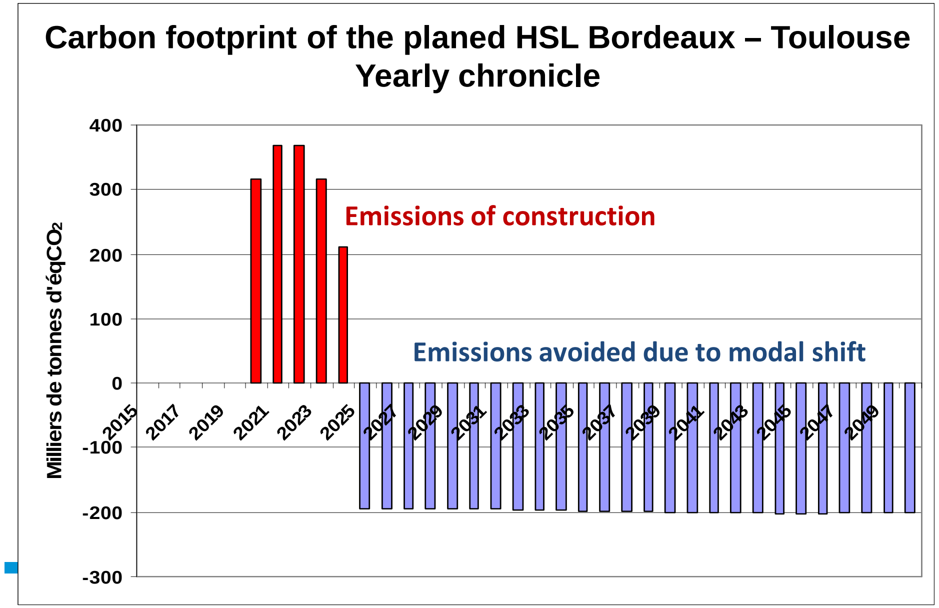
- of infrastructure works defined in the network orientations
- avoided thanks to modal shift from other modes to rail (including rail traffic induction)

Results

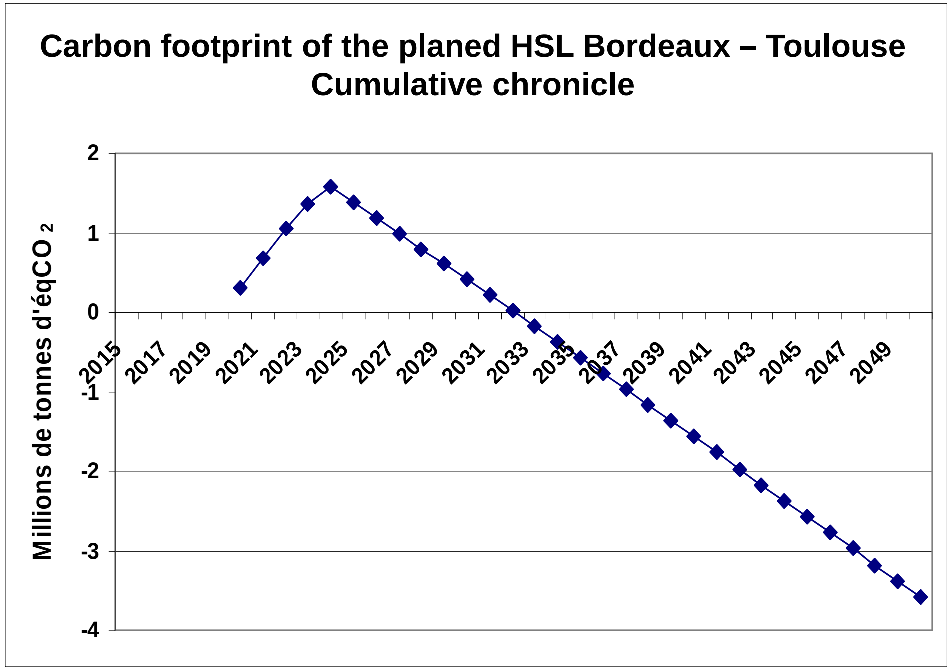
2 parameters to compare the GHGE efficiency of development strategies:

- Amortisation period of GHG emissions due to infrastructure works, i.e. time needed the avoided GHG emissions reach the emissions of construction
- Average cost of avoided GHG emissions (€ / tonne)

Example of corridor Bordeaux – Toulouse :



Réal. J. Pavaux, in Mathieu, Pavaux, Gaudry (2013)



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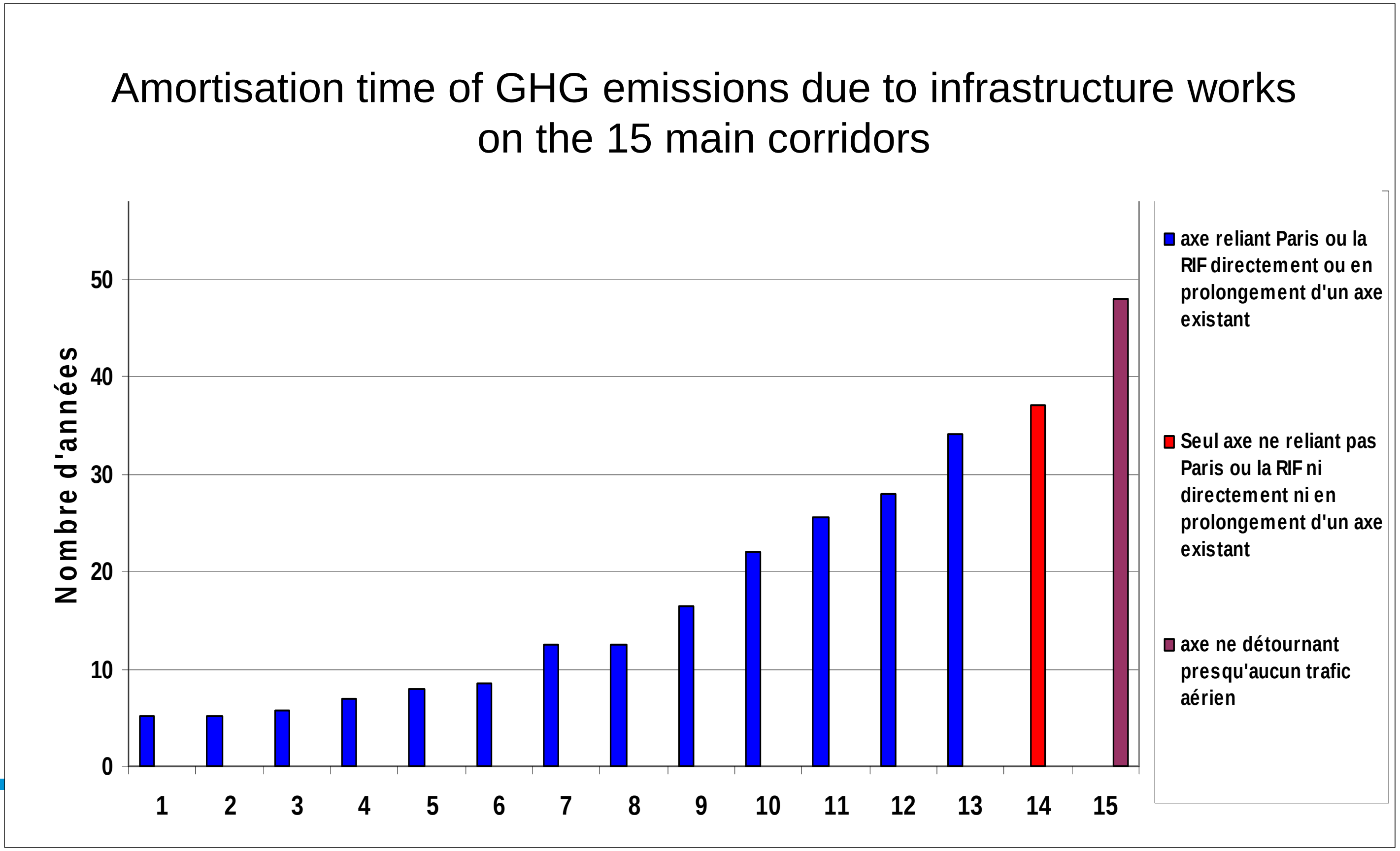
Results
Network orientation A1 (« full HSL »)

Amortisation period varies strongly across corridors

From 5 to 50 years for passenger HSL



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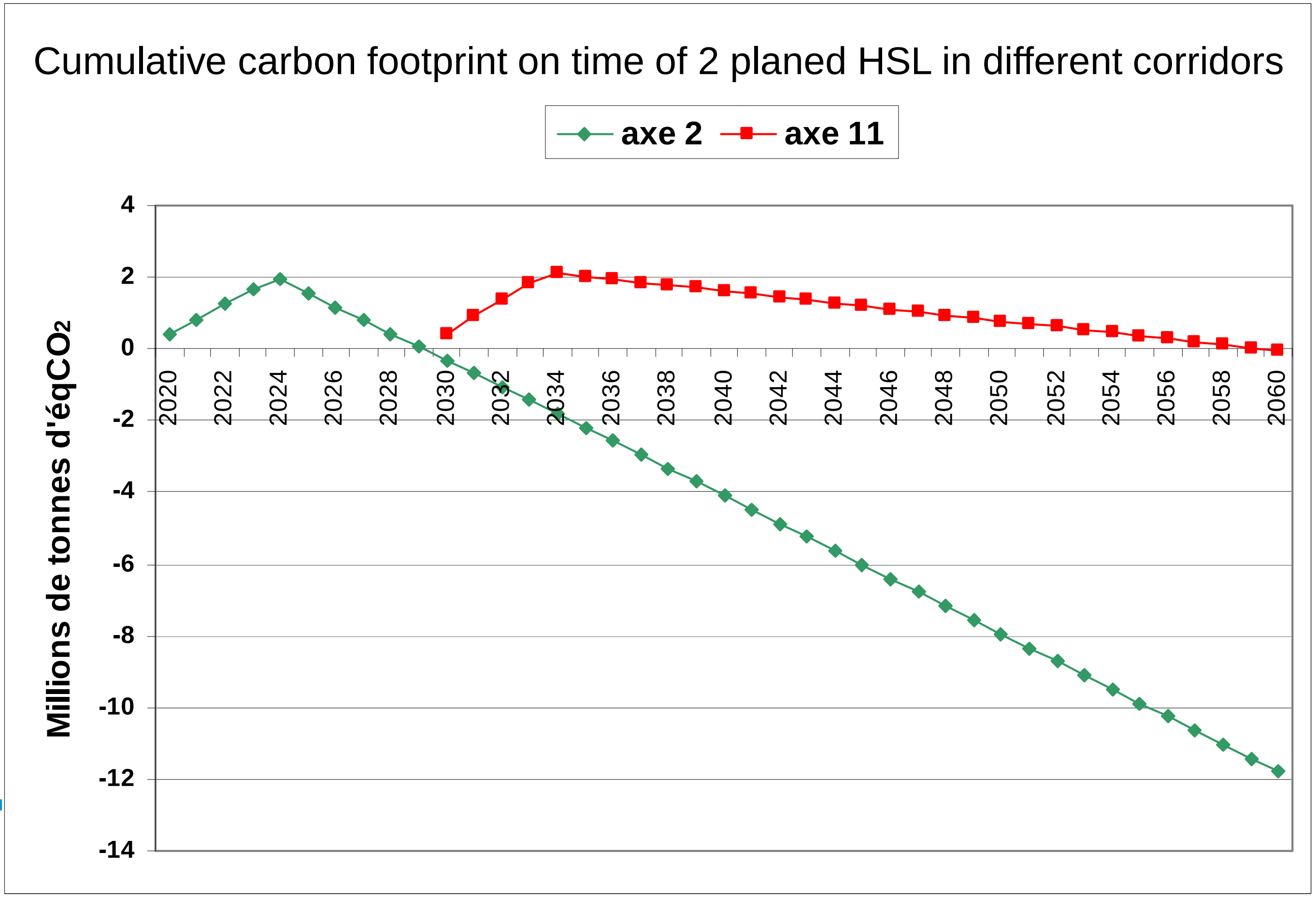
Results
Network orientation A1 (« full HSL scenario »)

The point of carbon neutrality depends on when operation starts and on the carbon efficiency of the project



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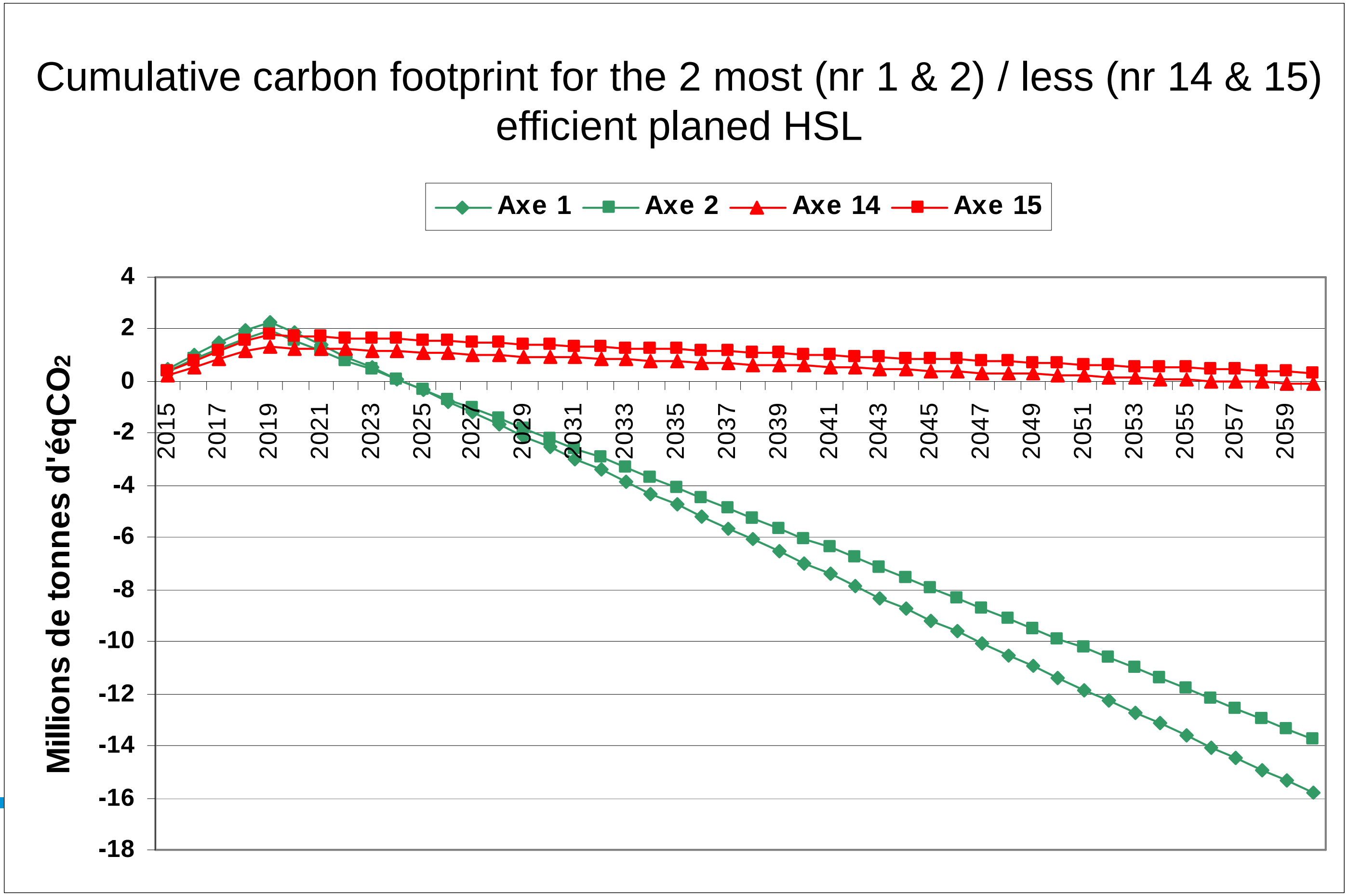

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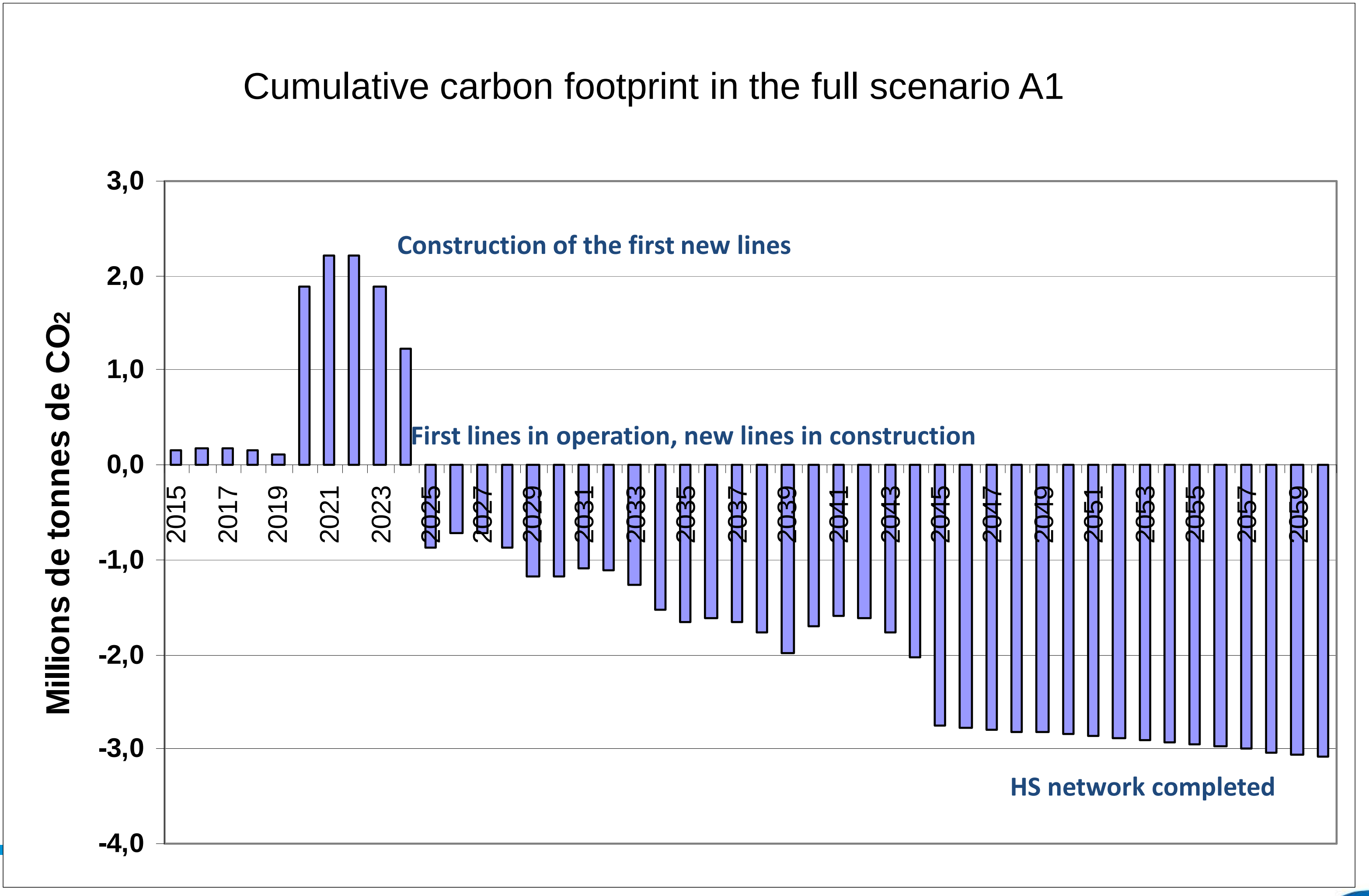

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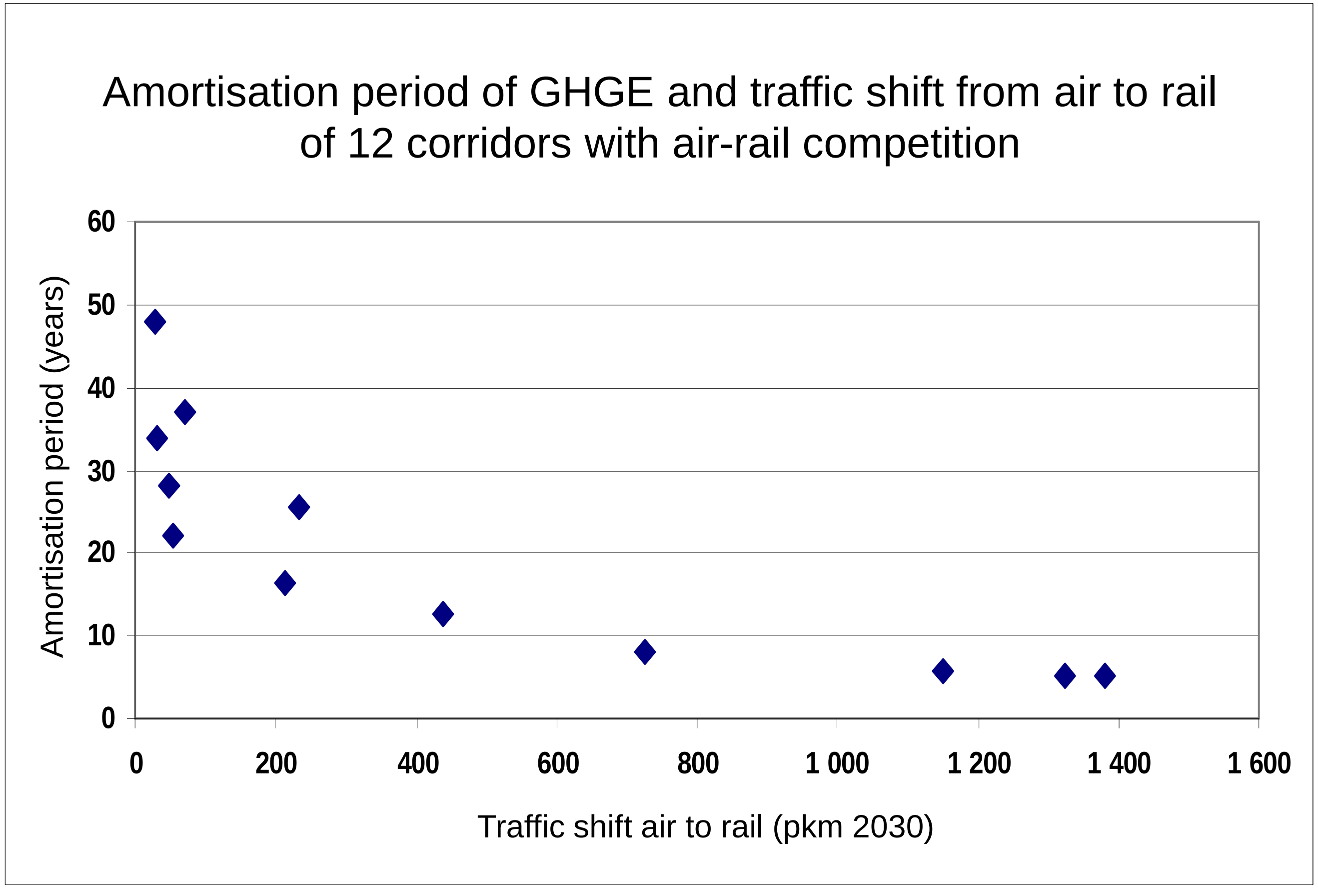
Results
Network orientation A1 (« full HSL scenario »)

Traffic shift from air have a major impact on the carbon footprint of the planed HSL



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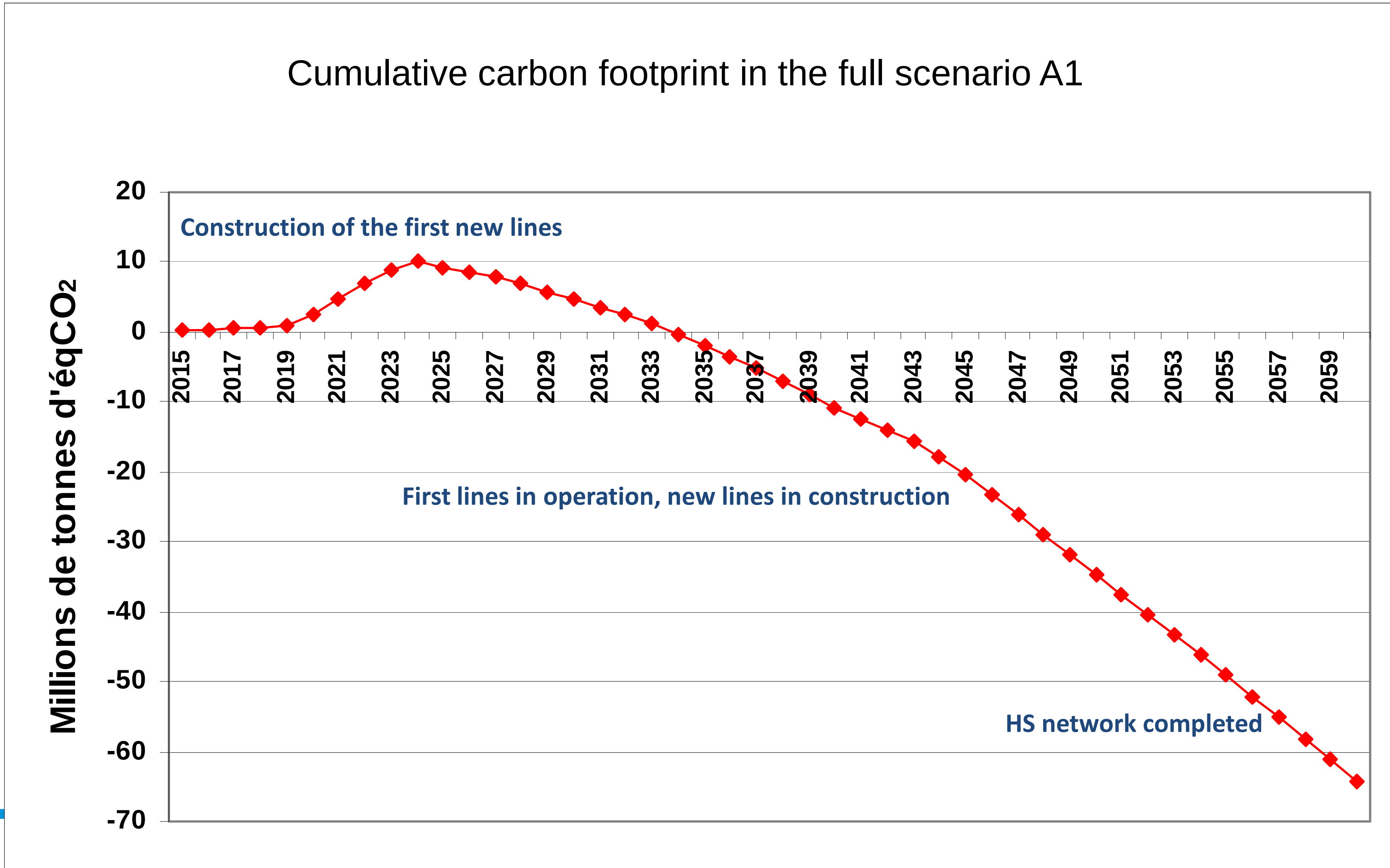
Network orientation A1 (« full HSL scenario »)



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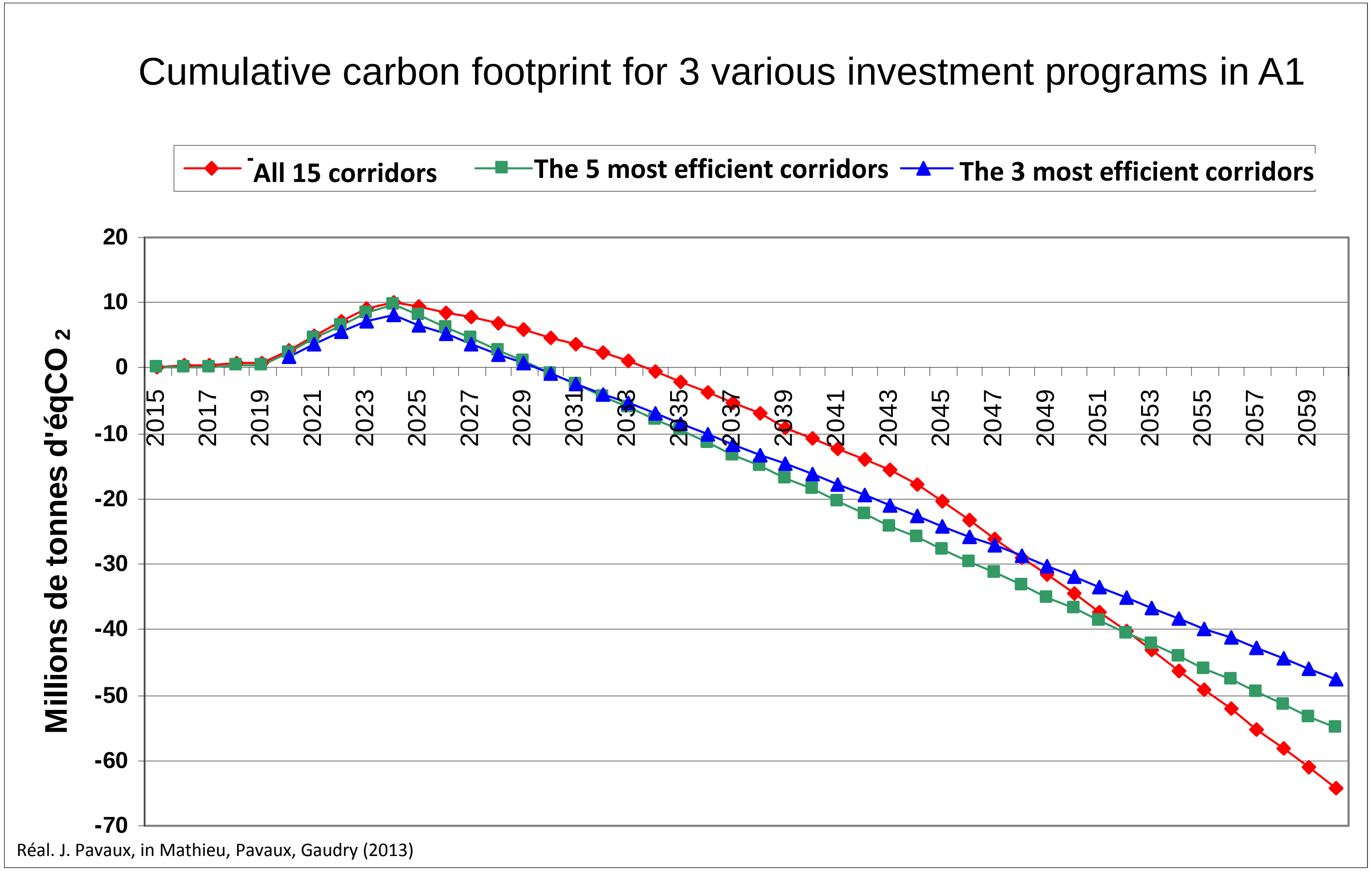

2048 : balance of the 3 most efficient corridors = all 15 corridors

2052 : balance of the 5 most efficient corridors = all 15 corridors

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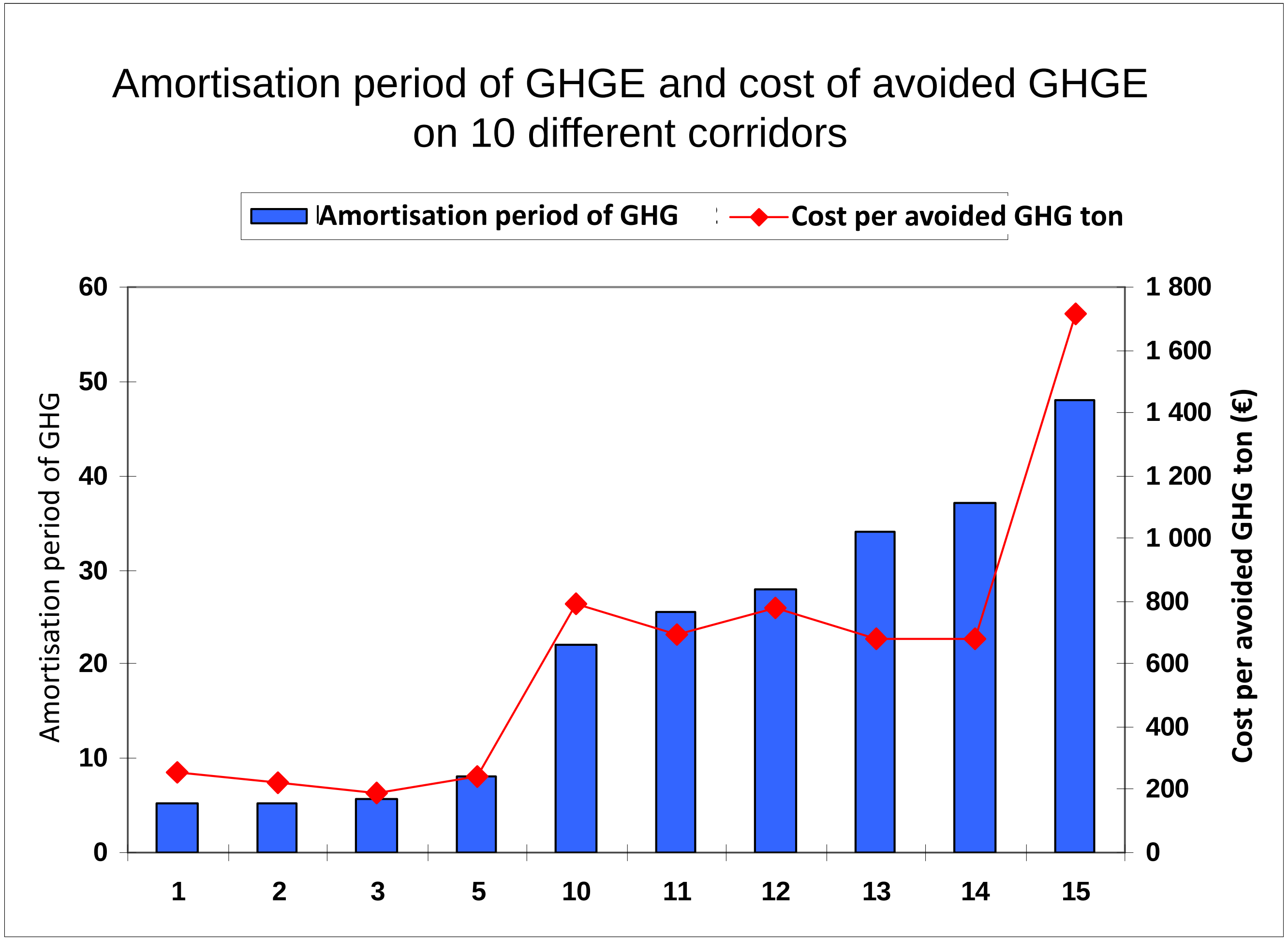
Results
Network orientation A1 (« full HSL scenario »)



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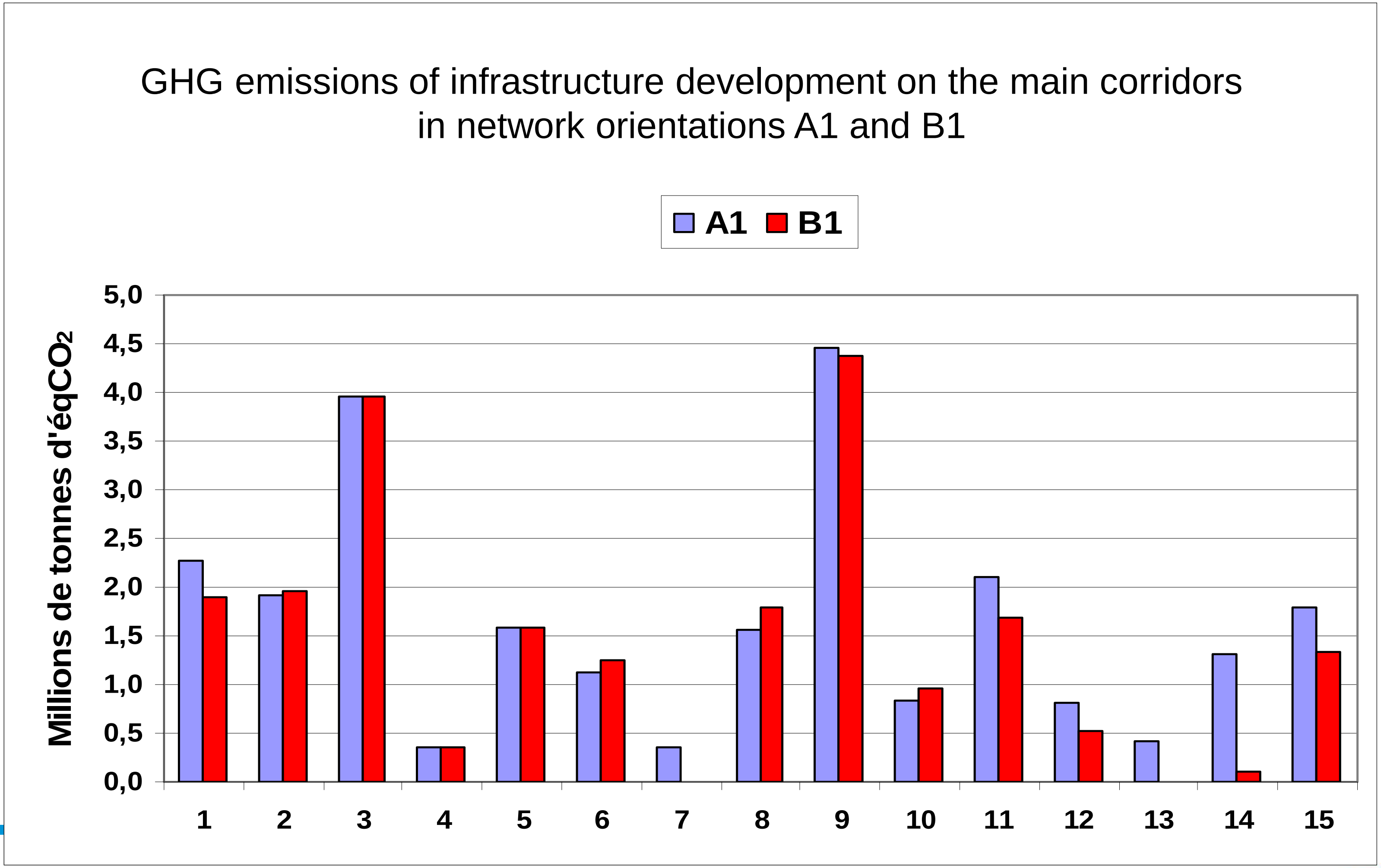
Results
Key figures about network orientations A1 (« full HSL ») and B1 (the most likely scenario)

		A1	B1
Number of corridors	units	15	13
Total investment	bn€	82,6	75,4
GHG of construction	Million tons CO_2 eq.	24,9	21,8
Carbon footprint 2030	Million tons CO_2 eq.	4,6	5,2
Carbon footprint 2050	Million tons CO_2 eq.	-34,6	-30
Carbon footprint 2060	Million tons CO_2 eq.	-64,3	-57,3

Results
Key figures about network orientations A1 (« full HSL ») and B1 (the most likely scenario)



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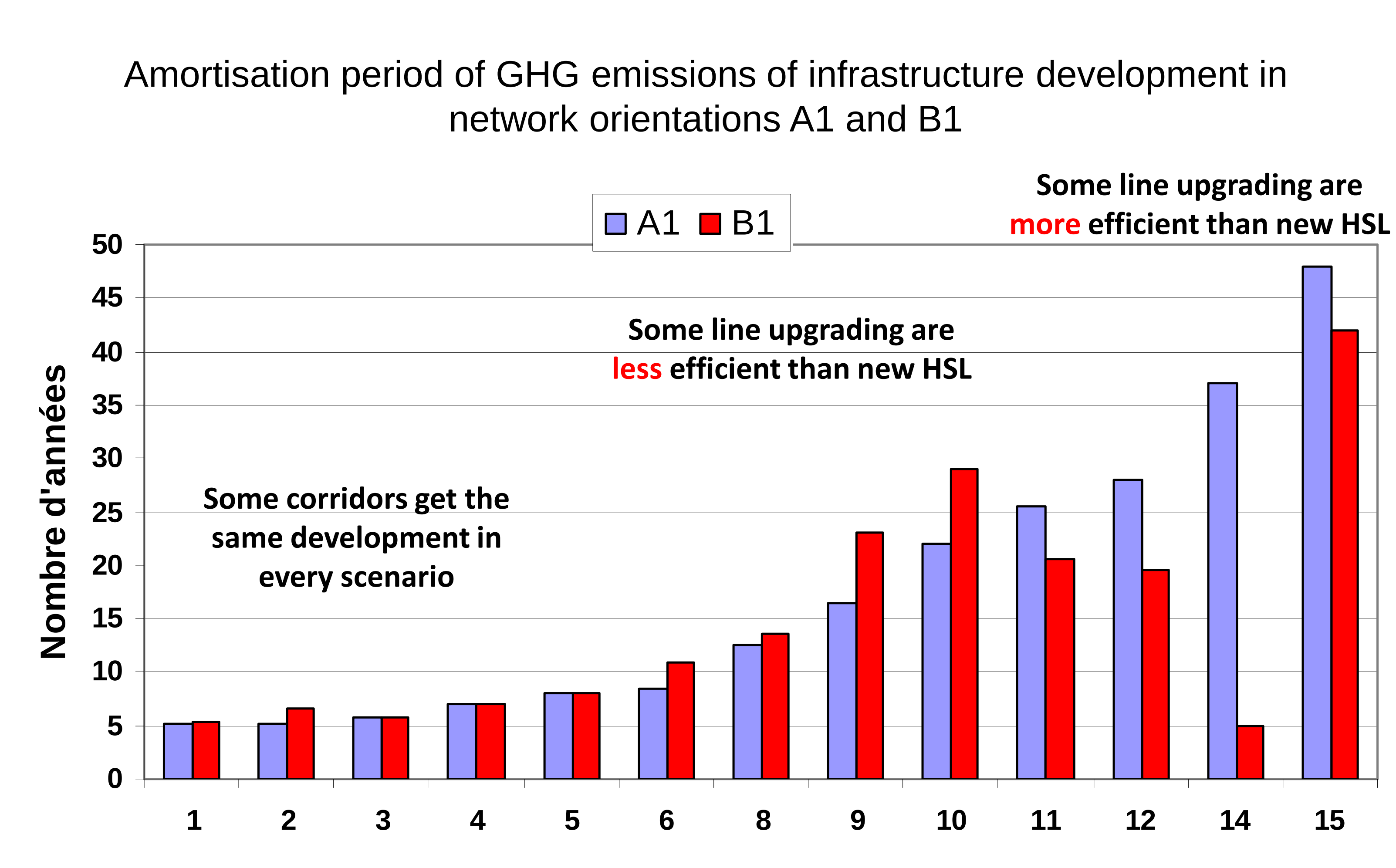
Results

Key figures about network orientations A1 (« full HSL ») and B1 (the most likely scenario)



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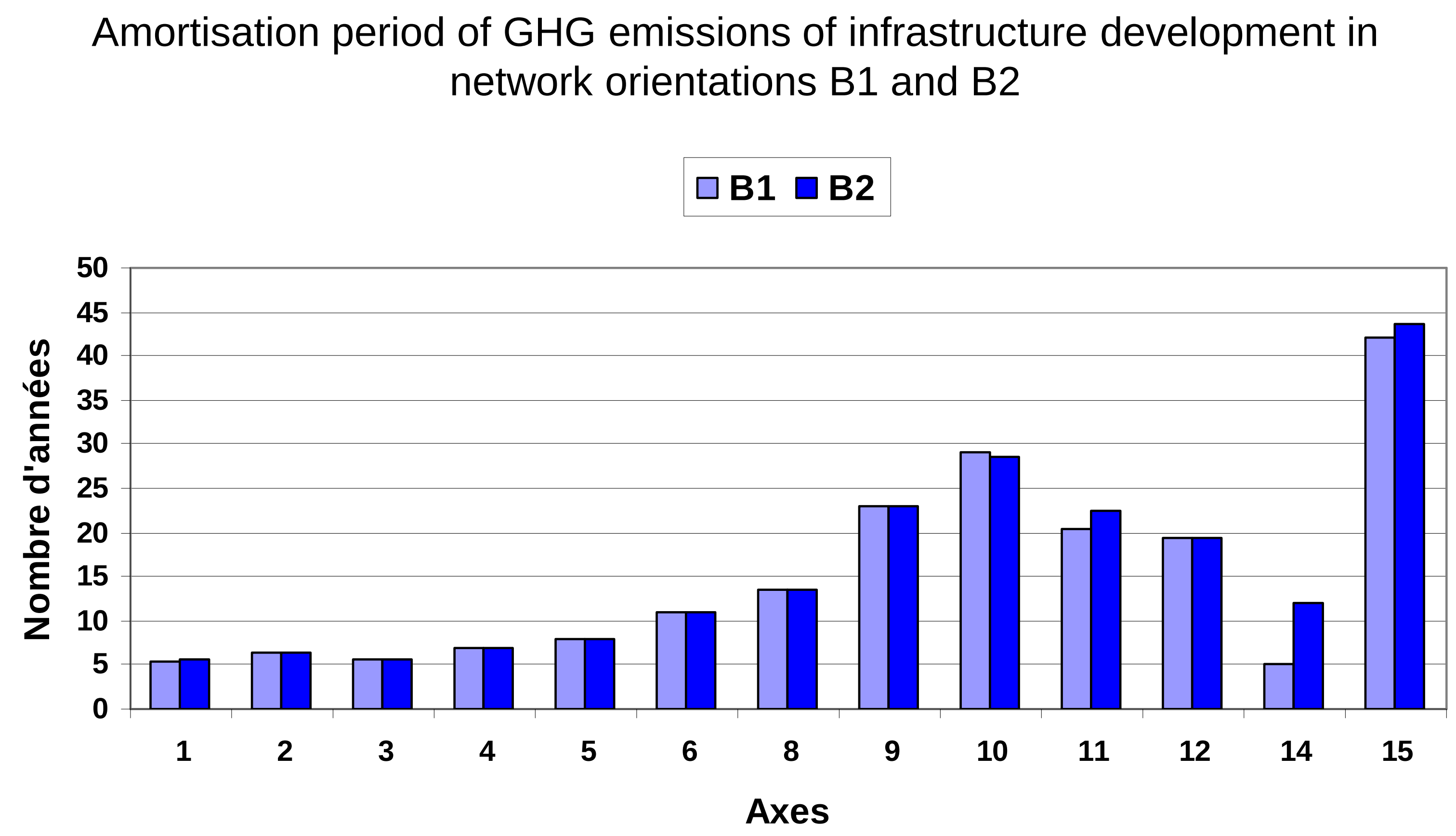
Results
Key figures about network orientations B1 (the most likely scenario) and B2 (B1 upgraded)



Réal. J. Pavaux, in Mathieu, Pavaux, Gaudry (2013)

⇨ **Disparity is much stronger among corridors than among network development strategies**

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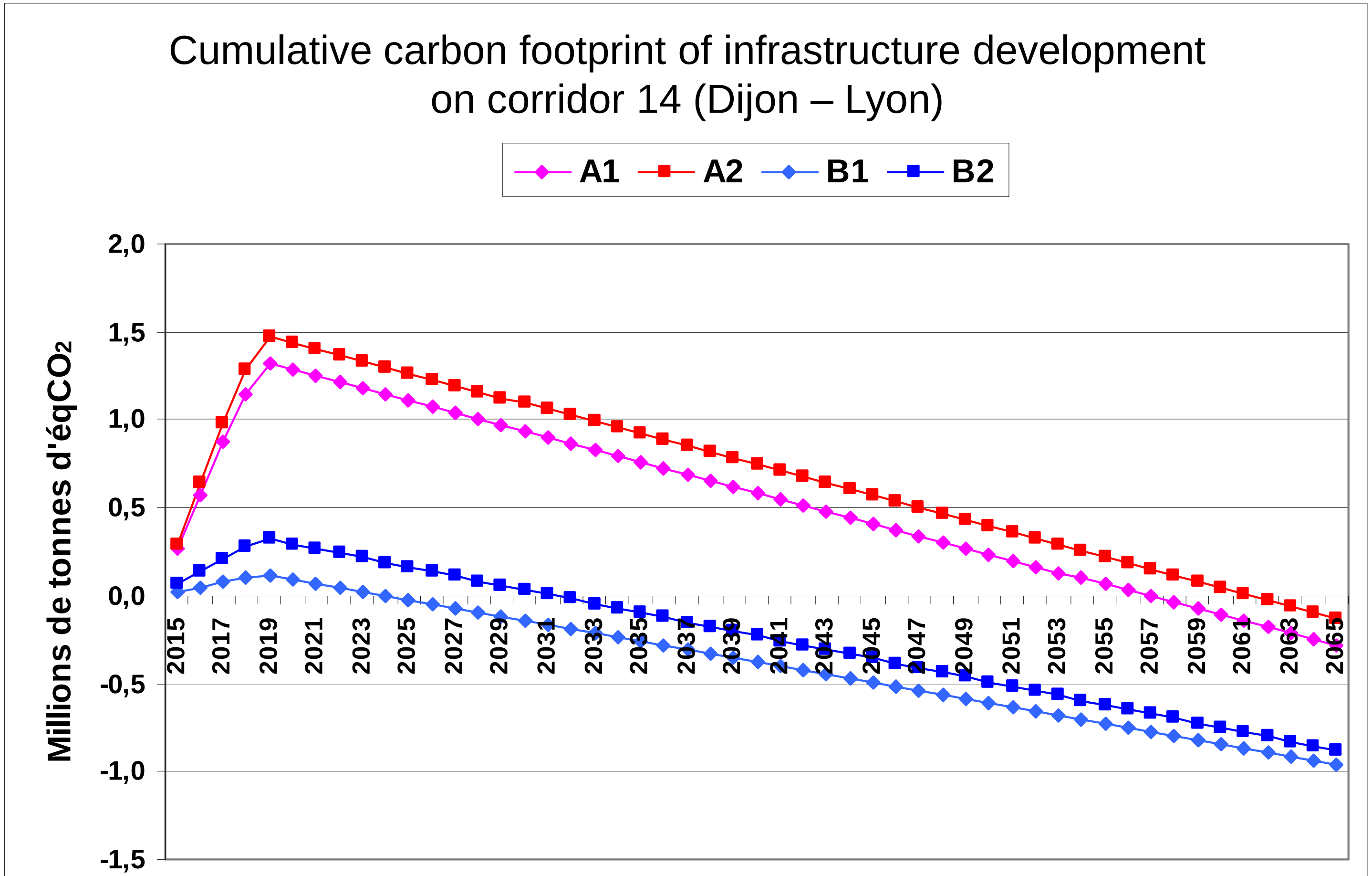
Results
Comparison of the 4 network orientations



Réal. J. Pavaux, in Mathieu, Pavaux, Gaudry (2013)

⇨ **In some cases, carbon amortisation can be shorter by optimising the existing line than building a new HSL**

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Conclusions, some key figures

For comparable journeys within the study's scope:

- Each air passenger-km contributes 36 times more to climate change than with HSL
- In 2030, the same ratio air / HSL will still be of 1/30
- For car, actual ratio of 1/16, will be 1/13 en 2030

By every network orientation, no positive cumulative balance before 2035/2040

Between 2015 and 2050, 30 to 35 MtCO_2eq can be saved by building new HSL and upgrading the rail network, i.e.:

- ≈ 1 Mt par an (about 1% of the emissions of the total sector of transport in France)
- ≈ 0,2 % of French GHG emissions

After 2050, the net balance of the network development reaches about 3 MtCO2éq avoided every year, i.e. :

- ≈ 0,5 % of total GHG emissions of France in 2012
- ≈ 2 % of total GHG emissions of the transport sector (25 %)
- 200 % of actual GHG emissions of HSR

Conclusions, some key figures

New HSL are mainly more GHG efficient than optimising existing infrastructure but not in all cases, depending mainly on the among of traffic and the modal shift from air

The 5 corridors with the best carbon footprint in every network orientations are:

1. Marseilles – Italy
2. Montpellier – Perpignan
3. Lyon – Turin (passenger & freight)
4. South Paris bypass (2)
5. Bordeaux – Toulouse

HSR investments in France cut massively GHGE

… but less than people usually think (this is not THE solution for mobility)

… and at a very high cost per avoided emissions compared with over solutions (optimise rail network use, urban planning, non motorised transport, low GHGE activities…).

Don't burn all the cash on building HSL!

Thank you for your attention