SLEEPERS
COMPARATIVE LCA

SNCF, INFRABEL, CCB, QUANTIS

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WHY CONDUCTING AN LCA?

AVOID BURDEN SHIFTINGS

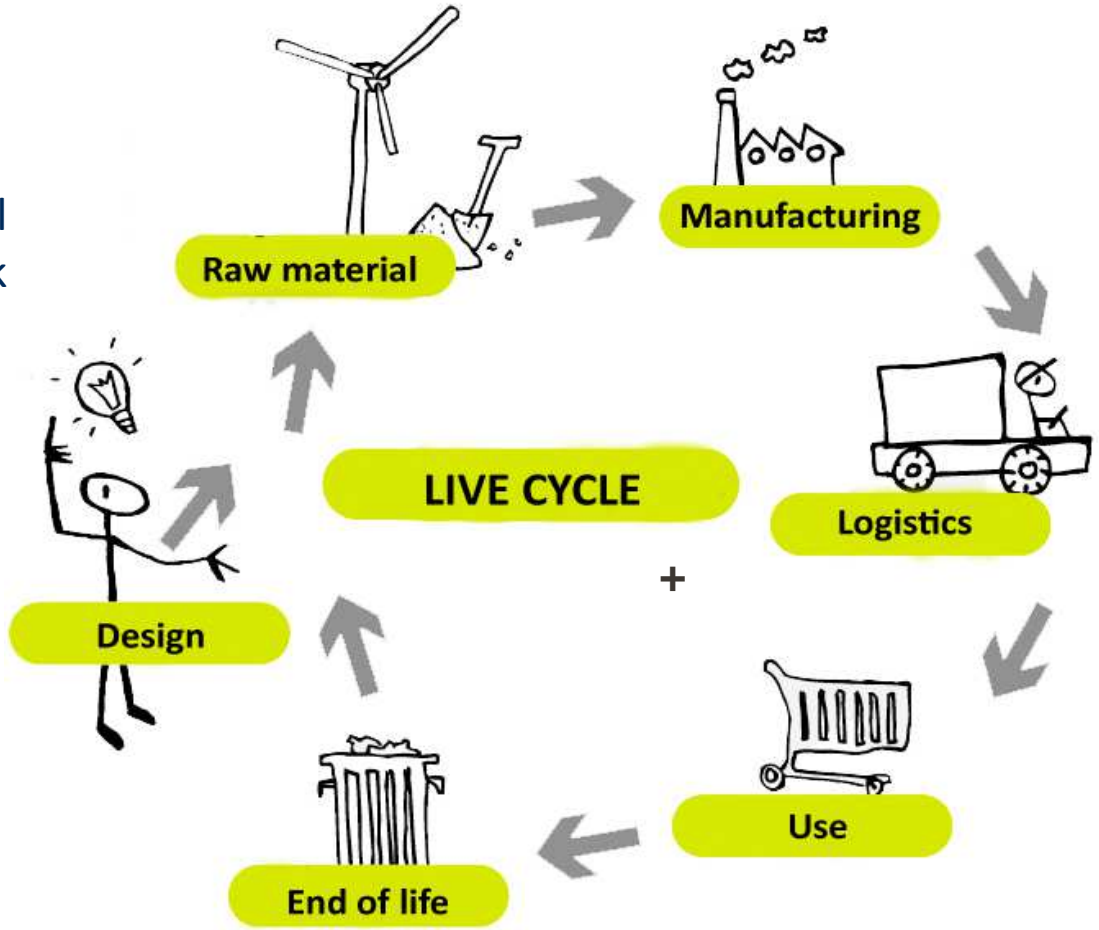
Zero emissions ?

Emissions « elsewhere » !

- From a life cycle stage to another
- From a region to another
- From an impact to another
- From a media to another
- From a generation to another

MAIN PRINCIPLES OF AN LCA

Methodological framework



ENVIRONMENTAL IMPACTS assessment for each life cycle stages

CARBON FOOTPRINT | WATER FOOTPRINT | ECOSYSTEMS | NATURAL RESSOURCES | HUMAN HEALTH

SNCF RÉSEAU

LCA WG Members

- SNCF specialists in:
  - Wooden sleepers
  - Concrete sleepers
  - Composite sleepers
  - Treatment industrial process
  - Waste recycling
  - Purchase
  - Environmental impact
  - Railway maintenance
- CCB
- Infrabel
- QUANTIS, LCA consultants

LCA WG Roadmap

1. **State of the art of the existing LCA (June 2016):** to refine the perimeter of the system and to evaluate the available data.
   Identification of alternatives :

• What are the alternative railway sleepers currently under study (both from a material and treatment substance point of view) ?

• Who are the stakeholders involved in the identification of these new alternatives?

Environmental impact :

• What are the environmental impacts associated with these alternatives ?

• What types of data are required to perform an environmental assessment (ecological footprint, carbon footprint, LCA, etc.) ?

2. **Comparative LCA between concrete and creosoted wooden sleepers (January 2018):**
   - to define the prevalent impacts,
   - to know the criteria with strong sensitivities on the results.
   - to be used as a basis for creation of an LCA tool.
3. **LCA critical review (Mai 2018)**
4. **Tool (in Excel format) of comparison between creosoted wooden sleepers and alternatives (September 2018):** to compare the environmental impacts of the various alternatives sleepers with the creosoted wooden sleepers to help to make a choice based on environmental issues of alternatives.

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LCA STATE OF ART
(STEP 1)

LCA STATE OF ART PROCESS

Identification and collection of information through:

- A literature review of scientific publications (30+ publications).
- A literature review of institutional, legislative and industrial publications (10+).
- Contact with key stakeholders (from industries).
- Specialized Internet websites (60+).
- Collection of information in existing life cycle assessment databases.

CONCLUSION OF THE LCA STATE OF ART

Disparity among available environmental assessments:

- ✓ The most contributing life cycle stages are: production, use and/or installation, end of life.
- ✓ **The considered alternative is most of the time favored – Pay attention to the assumptions and choices made in models**!
- ✓ These studies do not point out the issues of each treatment, but focus on the issues of treated wood (no comparison with other chemical alternatives, nor with creosote).
- ✓ Difficult to apply to the context of SNCF.
- ✓ Primary data sometimes available (useful for step 4, the tool)

Studied LCAs not ensure relevance and scientific validity of the studies and they do not have credible results.

COMPARATIVE LCA
(STEP 2)

TARGETS OF COMPARATIVE LCA

- ✓ To have elements allowing “to calibrate” a new alternatives comparative tool that we are going to create (in Excel format) to assess creosoted wooden sleepers alternatives.
- ✓ To identify the environmental impacts (hotspots) related to the use of railway sleepers for improving environmental performance of products and services at various stages of their life cycle;
- ✓ To have environmental information for comparison between creosoted wooden sleepers and concrete sleepers;
- ✓ To have elements to "calibrate" the comparative tool that will be put in place for comparing alternative sleepers;
- ✓ To facilitate decision-making;
- ✓ To serve as a marketing and communication medium.

LCA is crucial for the next creosote authorization and to homologate alternatives.

LCA FUNCTIONAL UNIT

Installation, maintenance and use of standard **railway sleepers** and their **rail fixation systems** as well as the quantity of corresponding **ballast** over 1 km (1666 sleepers) of conventional continuous welded rail (CWR) line.

The **rail** is excluded from the study because it does not change functionality or quality for wooden or concrete sleepers.

SYSTEM BOUNDARIES

Concrete sleepers

Sleepers production

Rail fixation system (Fast Clip)

Distribution

Installation

End life

Wooden sleepers

Logging

Sawmill

Delivery for treatment

Treatment

Distribution

Installation

End life

Rail fixation system (Nabla)

LCA METHOD

ILCD 2011 midpoint method,

also used in particular as part of the environmental footprint of products (Product Environmental Footprint, PEF), published by the Joint Research Center (JRC) of the European Commission in 2012 (EC 2012).

SENSITIVITY ASSESSMENT

Parameters:

Influence of LCA parameters on LCA results

- **Logging**: Emissions generated by root and branch degradation left behind during slaughter. They are not taken into account for this LCA; they are considered in the Sensitive Assessment.
- **Logging Area**: Change in per-hectare harvest during logging: it leads to a change in occupied area: in this LCA: 10m^3/ha; in the Sensitive Analysis: 20m^3/ha.
- **PAS 2050 method**: Accounting for storage and carbon emissions during the life time. It is not applied for this LCA; it is applied in the Sensitive Assessment.
- **End Life**: In this LCA, 100% of wooden sleepers are incinerated at the end of their life for energy recovery. For the Sensitive Assessment, 20% of wooden sleepers are re-used at end of life and 80% are incinerated .
- **Life Time**: In this LCA, life time for wooden sleepers is fixed to 40 years, for concrete sleepers 60 years. For the Sensitive Analysis, life time of concrete and wooden sleepers are both 40 years.

SENSITIVITY ASSESSMENT

influence of LCA parameters on LCA results

	Wood				Concrete
	SA Logging	SA Logging Area	SA PAS 2050	SA End Life	SA Concrete Life time
Climate change	86,4%	0,0%	-84,0%	-9,6%	29,4%
Depletion of the ozone layer	0,0%	0,0%	0,0%	-17,7%	18,3%
Human toxicity - carcinogenic effects	0,0%	0,0%	0,0%	-3,9%	32,2%
Human toxicity - non-carcinogenic effects	0,0%	0,0%	0,0%	-5,2%	27,8%
Particle emissions	0,00%	0,00%	0,00%	-5,83%	25,0%
Ionizing radiation (use of electricity)	0,00%	0,00%	0,00%	-28,37%	13,5%
Photochemical Ozone Formation	0,00%	0,00%	0,00%	-9,12%	23,7%
Acidification	0,00%	0,00%	0,00%	-6,87%	25,0%
Earth eutrophication	0,00%	0,00%	0,00%	-7,75%	24,3%
Aquatic eutrophication	0,00%	0,00%	0,00%	-5,55%	30,0%
Marine eutrophication	0,00%	0,00%	0,00%	-7,85%	24,9%
Aquatic Eco toxicity	0,00%	0,00%	0,00%	-5,90%	28,1%
Land use	0,00%	-39,20%	0,00%	-9,02%	17,9%
Exhaustion of mineral resources, fossils and renewables	0,00%	0,00%	0,00%	-1,01%	28,9%
Exhaustion of the water resource	0,00%	0,00%	0,00%	-12,59%	28,7%

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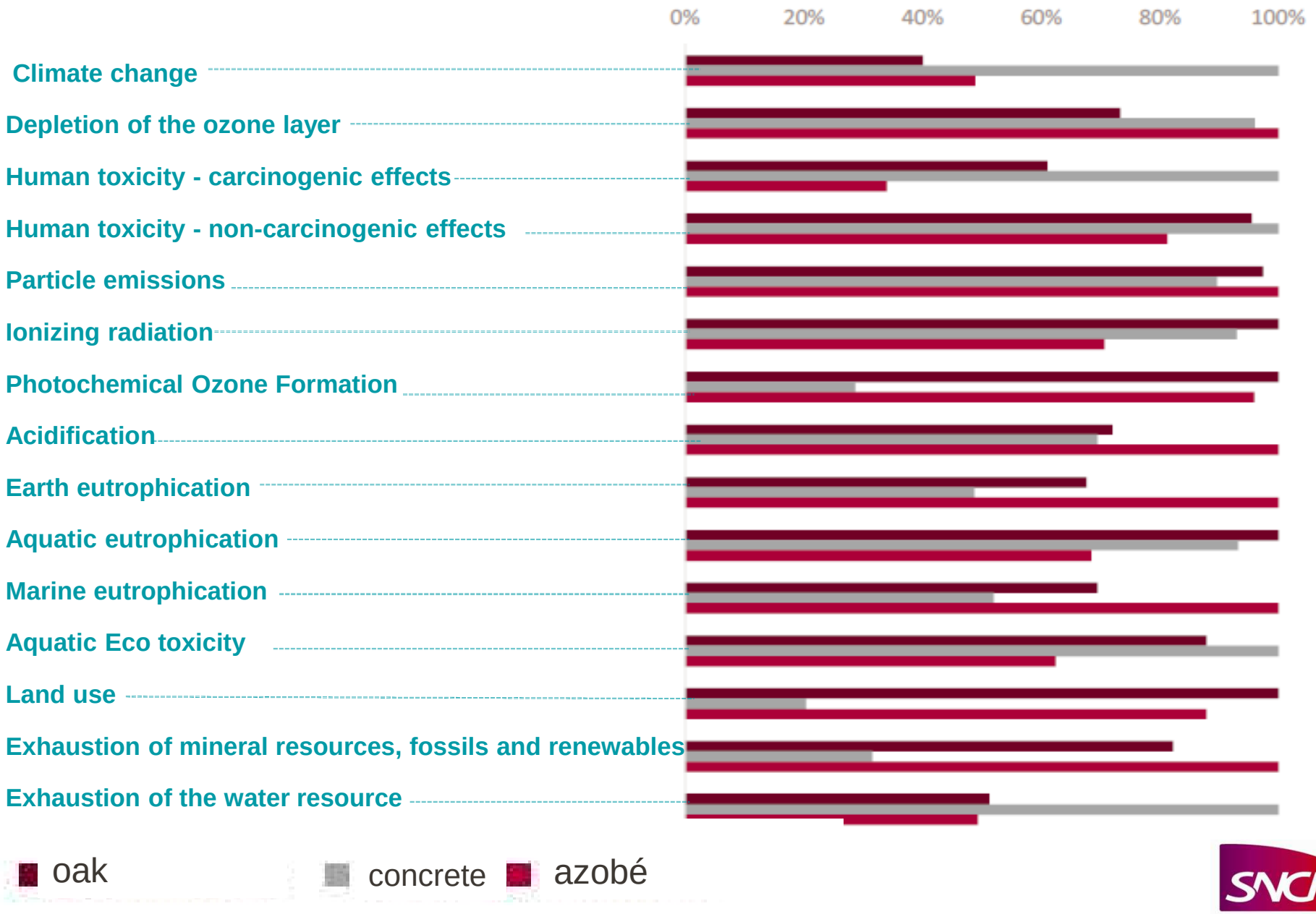
CONTRIBUTION ASSESSMENT: COMPARED RESULTS



CONCLUSION

The comparative results of the LCA of the three alternatives (concrete sleepers, oak wood and azobé wood sleepers) are not consensual on the whole studied indicators.

If we focus only on the indicator "**Change climate change ", concrete sleeper has a significantly higher impact** compared to the functional unit (24% to 60% higher) under the baseline scenario.

The **main contributors to environmental impacts** are:

- for wood and concrete sleepers: **rail fixation system**.
  - ✓ 30 to 87% of the values taken by 8 of the 15 indicators for wooden sleepers;
  - ✓ 19 to 56% of the indicators for the concrete sleeper;
- for concrete sleepers: the **production of concrete material**, for 28 to 72% of the indicators;
- for azobé sleepers: the **transport**,1 to 19% of the values taken by the indicators.

The **creosote impregnation step represents less than 11%** of the values taken by all the indicators, except for the "photochemical ozone formation" indicator for which represents about 65% of the value taken by the indicator.

To reduce the infrastructure impact on environment, the ban of creosote appears to be a less effective lever than the change in support material or rail fixation system.

LCA CRITICAL REVIEW (STEP 3)

TARGETS OF THE CRITICAL REVIEW

This LCA is the subject of a critical review.
It is necessary to use it for public communications.

- ✓ To ensure relevance and scientific validity of the study;
- ✓ To reinforce credibility of the LCA results;
- ✓ To ensure consistency and transparency in the report;
- ✓ To ensure compliance with ISO 14040 and 14044 standards (mainly validity of the methods, representatively of data, adequacy between interpretations and limitations and objectives).

Experts:

- LCA expert & Chairperson of the review panel: Jérome PAYET / Cycleco
- Rail industry expert: Salome SCHORI / SBB - QSE
- WWF wood expert: Jean BAKOUMA

LCA TOOL
(STEP 4)

LCA TOOL

Tool of comparison between creosoted wooden sleepers and alternatives (September 2018):

The tool is fully compatible with PC (Excel 2010 version). The results provided are estimations, which cannot be treated as LCA results, especially concerning the alternatives.

Type of sleepers available:

- ✓ Wood
- ✓ Concrete
- ✓ Composite
- ✓ Resin (recycled plastic)
- ✓ Exotic wood

The Database table will allow to add, if needed, environmental impact factors related to an alternative not yet identified

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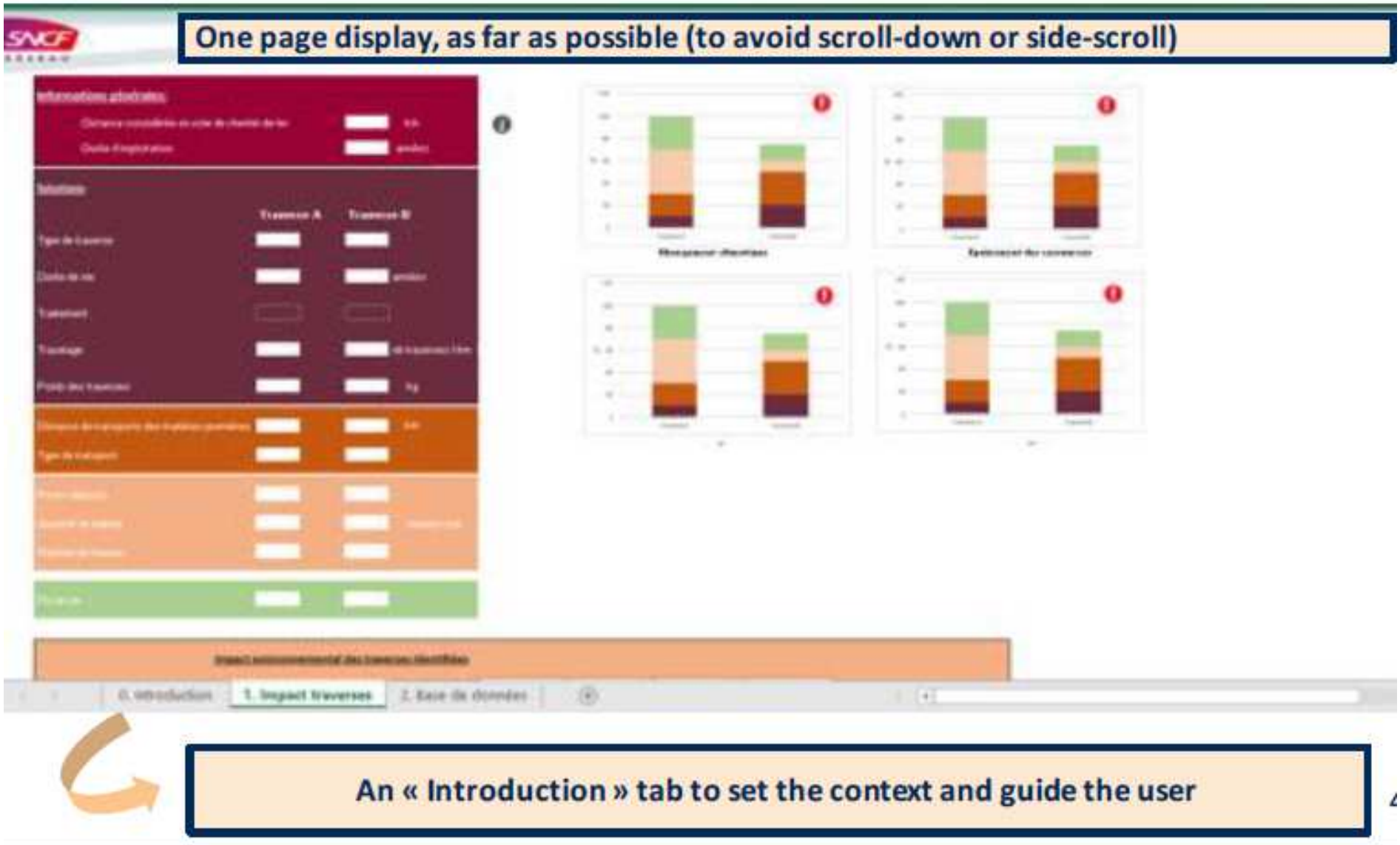
TOOL MOCK-UP – GLOBAL OVERVIEW



TOOL MOCK-UP – AREA DEDICATED TO GRAPHS OF RESULTS

Thank you

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