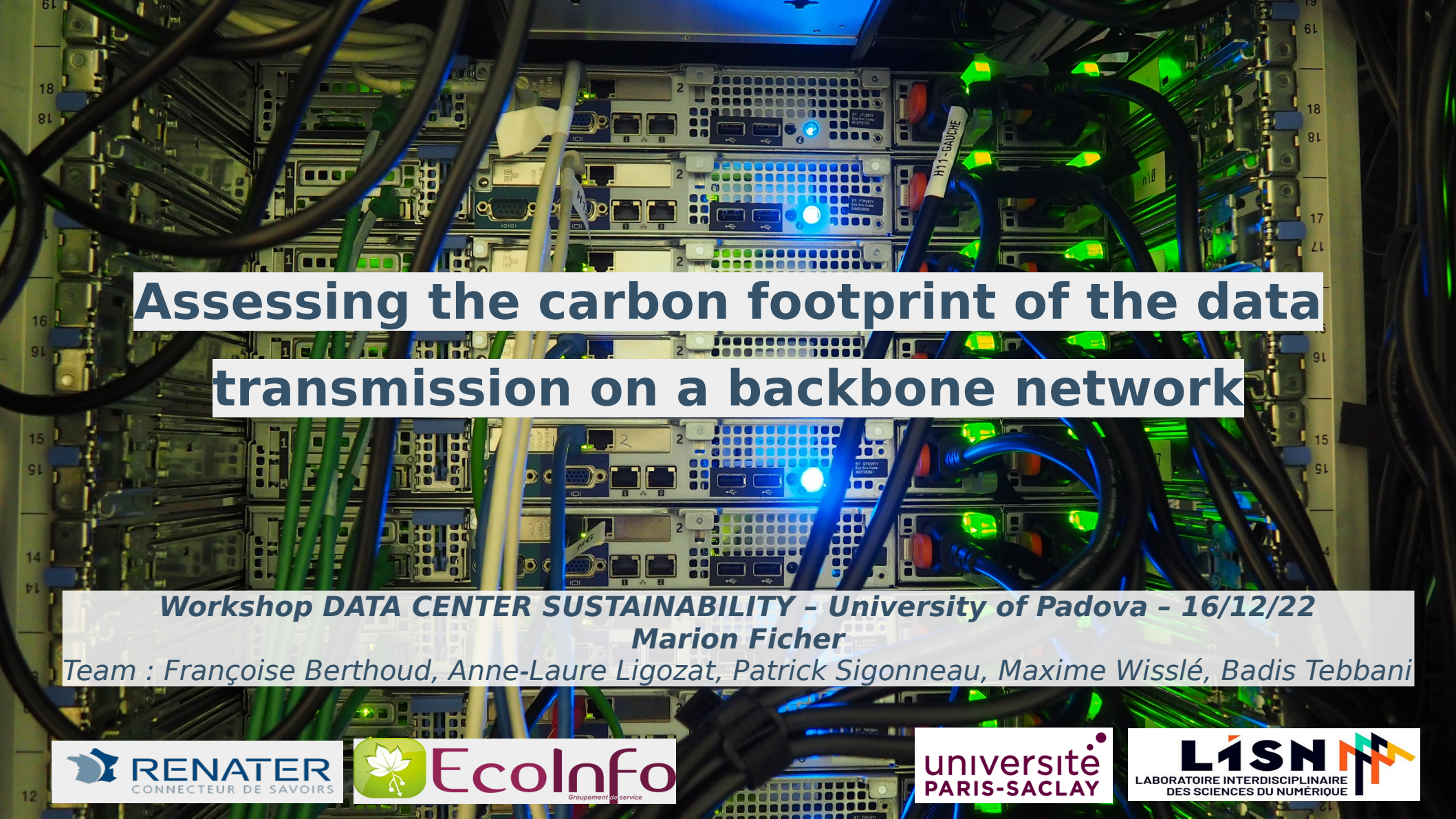

Assessing the carbon footprint of the data transmission on a backbone network

Workshop DATA CENTER SUSTAINABILITY – University of Padova – 16/12/22

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Our study

- **Context :** No known study of the assessment of the carbon footprint on a backbone with a **bottom-up approach**, most of the studies are about the energy intensity of internet
- **Goals :**

  1) What are the greenhouse gas (GHG) emissions of transmitting one GB of data from A to B on a backbone?

  2) What are the reduction factors for the GHG emissions of the data transmission?
- **Case study :** RENATER’s backbone
- **Segment studied :** Orsay - Montpellier

Method – carbon footprint methodology

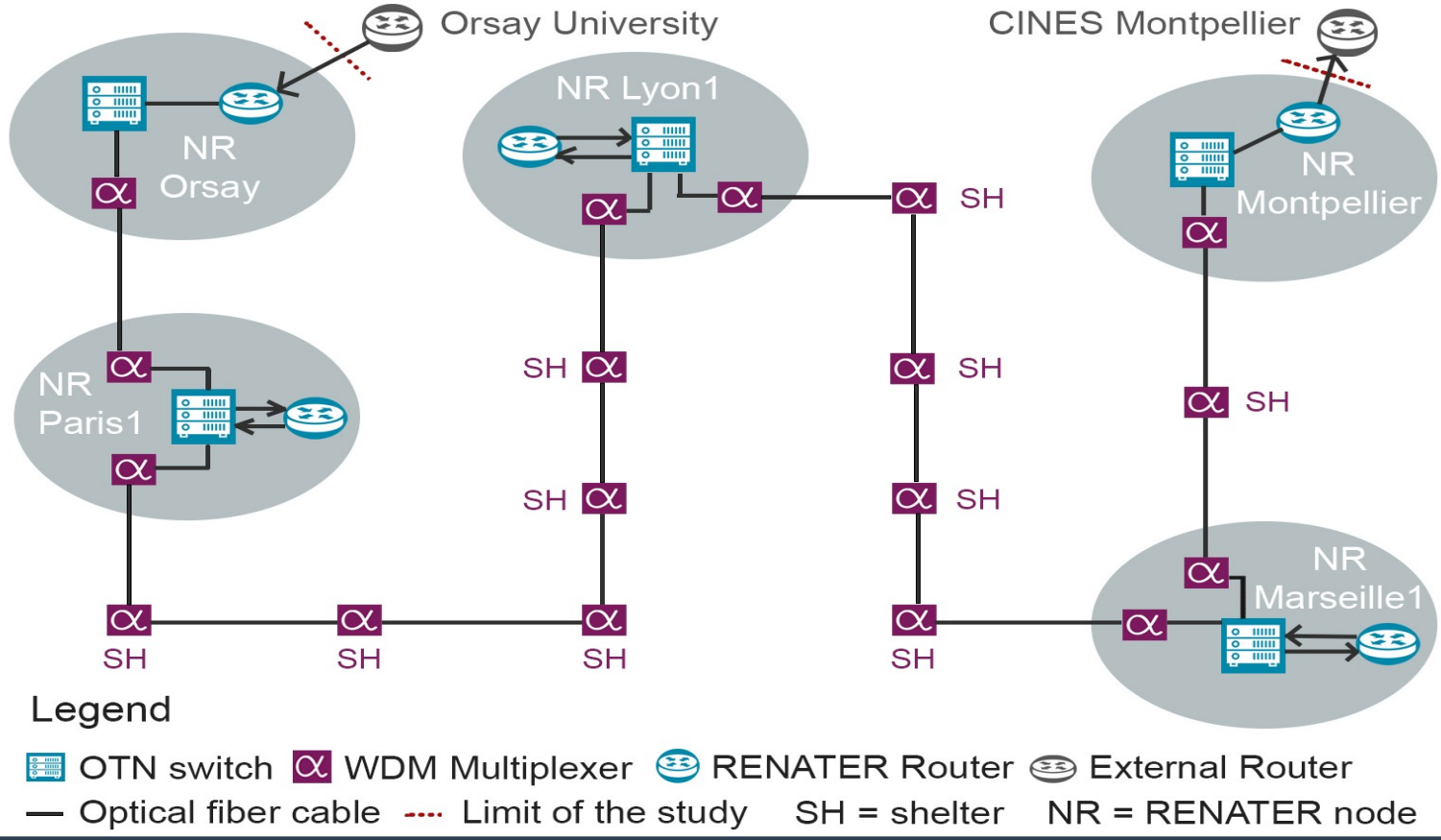
Functional unit :
To transmit 1 GB of data between Orsay and Montpellier via an optical fiber link

- **Environmental indicator :** only GHG emissions indicator (expressed in kg CO2e)
- **Impacts measured from the use and manufacturing phases** of devices, the supervision of the network and the optical fiber
- **End-of-life not taken into account**
- **Bottom-up approach** with direct measures on most of the devices involved in the transmission (except in shelters)

Method - scope

- **Core network** : routers, Optical Transport Network (OTN) switches and Wavelength Division Multiplexing (WDM) devices
- **Optical fiber**
- **Network supervision devices**, called NOC

Method – network model divided in nodes



Method – carbon footprint assessment

Carbon footprint of 1 GB transmitted

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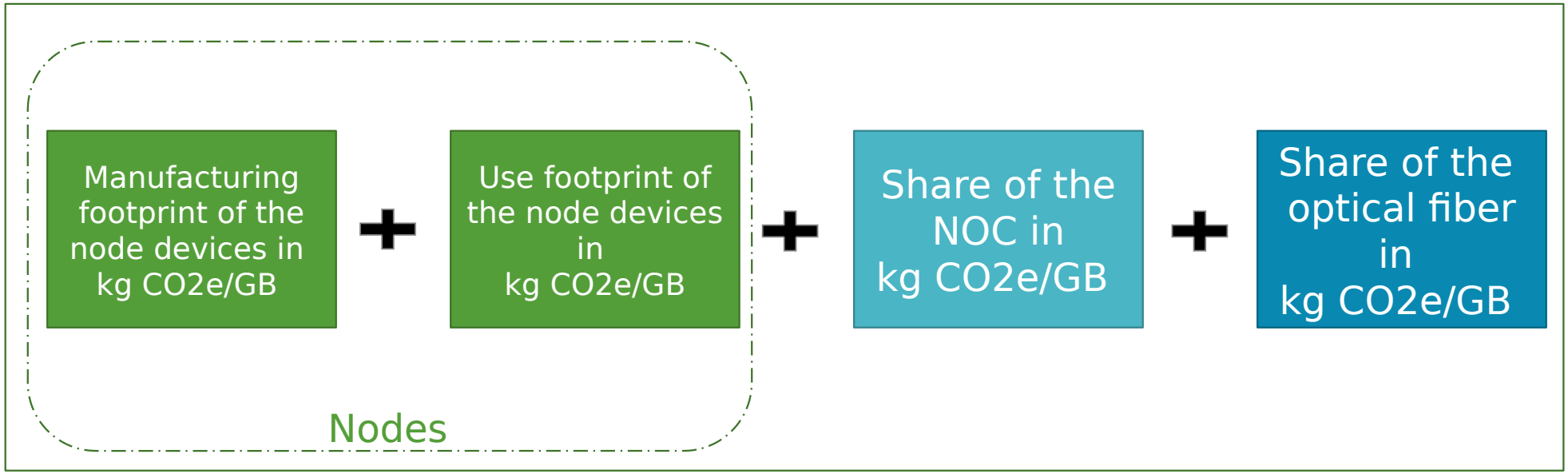
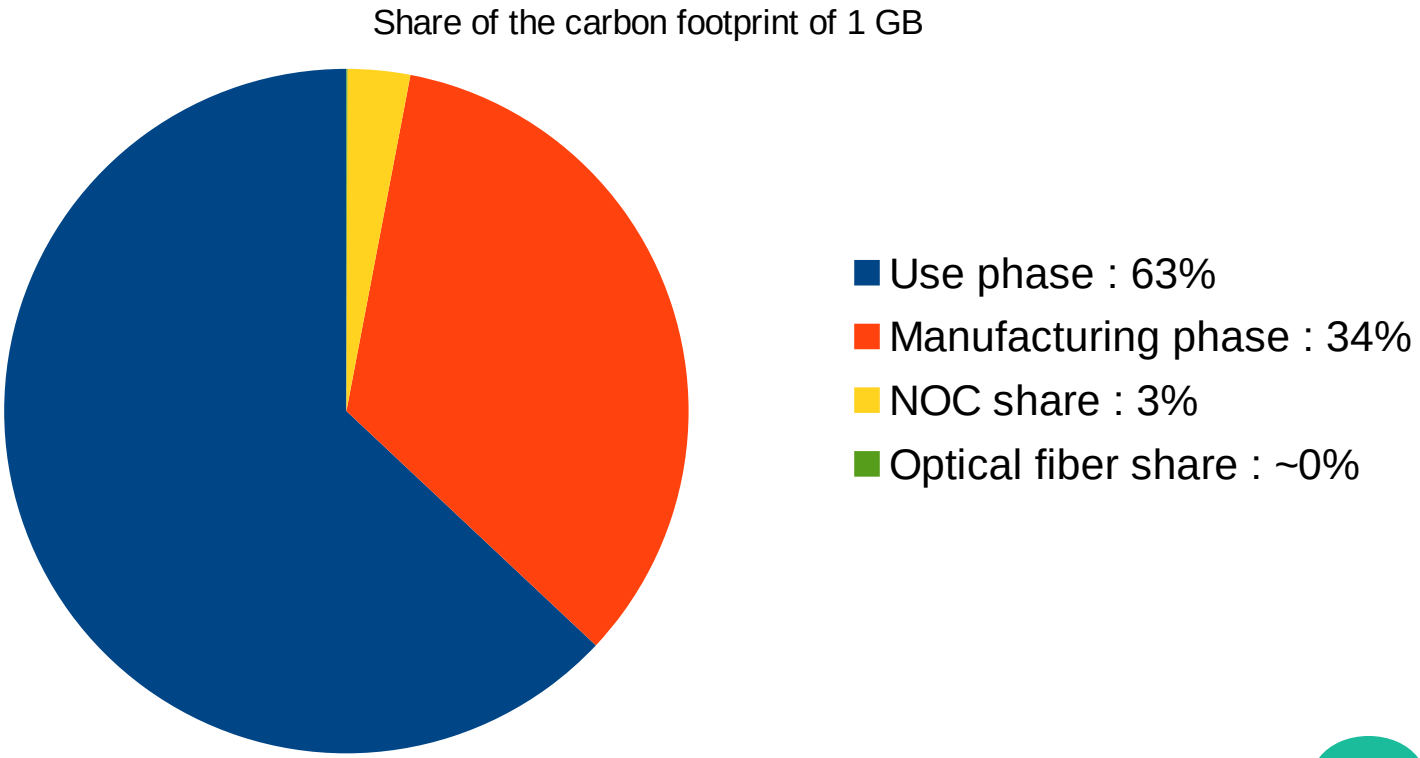


Results – carbon footprint of 1 GB

Average carbon footprint assessed between Orsay and Montpellier :

1,5 g CO2e/GB



Reduction factors (1/2)

- **To increase the lifetime of devices :**
  - To increase the warranty time of the devices
  - To fight against planned obsolescence of the devices
- **To improve and reduce the over-sizing of devices and network infrastructure :**
  - To reduce time between the insertion of new cards in a device and their activation
  - To control the energy consumption when there is a redundancy of supply power and/or devices
- **To reduce the over-consumption of energy during off-peak periods :**
  - To encourage the production and the acquisitions of devices in which the energy consumption is proportional to the transiting traffic
  - To encourage the transfer of voluminous data during these periods

Reduction factors (2/2)

- **To improve the accessibility of data in different levels :**
  - To systematically integrate modules which provide the energy consumption of devices
  - To systematically ask to the suppliers the carbon and environmental footprints of purchased devices, with a transparent methodology assessment : especially for the manufacturing, transportation and end-of-life phases
- **To sensitize the users and the decision-makers to the environmental impacts of network**

Conclusion

- **1 GB = 1,5 g CO2e** in average between Orsay and Montpellier in 2019
- **1.342.465 GB / day** in average on RENATER's backbone in 2019
- Volume of data generated on internet in 2020 [2] :
  60 zettaoctets which is **60.000.000.000.000 GB**

- **Our carbon footprint result is lower than the reality**

Perspectives of our study

- **Improvements :**
  - To reproduce the study in different segments
  - To create a study from **end-to-end** (by including users terminals and users network)
  - To include the carbon footprint of the **end-of-life of devices**, of the **buildings** and of the development and installation **teams**
  - To perform a complete environmental footprint assessment which is **multi-criteria**
  - To estimate the **uncertainties**

Thank you for your attention
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[2] Mallarino, Didier et al. " Les impacts environnementaux et sociétaux des données : un défi pour l'avenir " (2022), https://conf-ng.jres.org/2021/document_revision_2468.html?download

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