Deployment of a Campaign to Measure the ICT Carbon Footprint

Experimentation in French-Speaking Europe

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***Abstract* — ICT Maturity Models are essential for any organization to improve the environmental footprint of its Information Technology (IT) operations and determine how its IT infrastructure, products, services, operations, applications and practices can be environmentally friendly. To combat global warming induced by greenhouse gas emissions, the IT industry is responsible for three to four percent of global carbon dioxide emissions. While organizations aiming for a green IT strategy should not only improve their environmental impact, but also their financial situation. IT hardware will never be absolutely sustainable, as its manufacturing process uses many non-renewable resources. However, its environmental impact can be reduced. There is only one way to do this: measure. This study explains how organizations can measure the impact of their IT systems and thus make decisions to reduce them using WeNR2021.**

Keywords-IT; Sustainable Information Systems; Literature Review; Environmental Awareness; Green Computing; eco-responsible; ecological impact; sustainable development; energy consumption; WEEE.Introduction.

I. INTRODUCTION

It is within a global framework that the Paris Agreement limits the global temperature increase to "well below 2°C" by 2100 and calls on states to continue working towards +1.5°C. To achieve this ambitious goal, the agreement calls for "a balance between human-induced emissions and the Earth's natural absorption capacity to play a role in carbon sequestration such as forests" [1].

While the text does not mention any quantitative reduction in greenhouse gas emissions, the Intergovernmental Panel on Climate Change (IPCC) states states in its latest report that in order to keep global warming below 1.5 degrees, greenhouse gas emissions must be reduced by 70% to 80% over half a century. Zero emissions will be achieved by 2100 at the latest [2].

At the same time, most households and businesses use Information and Communication Technologies (ICT) on a daily basis. These technologies integrate information technology, telecommunications and electronic products. Furthermore, attention to the environment is inevitable. These technologies are generally considered as "intangible", and their impact on the planetary ecology seems to be neglected [3][4].

Moreover, we have also discussed ecological responsibility at length. Green IT is one aspect of the relationship between ICT and sustainability. Understanding and measuring the environmental impact of these technologies allows us to take better measures to reduce them. Raising awareness of environmental issues and integrating information systems into an organization's environmental policy should encourage the development of environmentally friendly information and communication technologies [5].

Finally, although the number of studies is small [6][7], more and more companies around the world are integrating global corporate social responsibility projects into their green IT strategies, which include information to measure the environmental impact of their enterprise systems. In this article, we will describe the first major French study on the environmental impact of information systems. Then, we will present the rest of the research and extend it to French-speaking Europe, and present the different perspectives and expected benefits that it allows.

II. CONTEXT

First, the data center is big polluter. The electricity consumption of new technologies represents 8.5% of the world consumption, and one third of it comes entirely from data centers. In contrast, an "average" Facebook center consumes as much energy as the city of Strasbourg. There are 45 million data centers in the world [8].

Moreover, digital devices (cell phones, tablets, computers, etc.) [9] are also a huge source of pollution. Indeed, the production of these devices requires the exploitation of rare and non-renewable mineral resources. According to the French Agency for Ecological Transformation (ADEME), the greenhouse gases generated during the extraction, manufacturing and transportation stages of the final product represent 90% of the emissions linked to the life of electronic equipment. The remaining 10% is released during use, for example when the device is charging. In addition, the update

 ISBN: 978-1-61208-924-9

rate of electronic devices is quite high (cell phones can be used for 2 years on average) [10].

Since the Kyoto Protocol of 1998, tools are needed to accurately measure environmental impact. A software-based carbon calculator can be used to "predict and monitor the carbon emissions of everything we do" [11].

To this end, Life cycle assessment or LCA is one of the most accurate methods for estimating carbon footprint [15]. Since LCA takes more time than simply estimating the energy footprint, as part of the procurement process, the organization needs to obtain information on the emissions included in the potential procurement and the emissions associated with its disposal. This information can be added to the product's activity footprint estimate, and if possible, its recycling footprint can be added to estimate the product's life cycle footprint via LCA [12].

Although, on June 10, 2021, the French National Assembly passed the first reading of a bill to reconcile digital and environmental issues. Its objective is to "guide the behavior of all digital actors, whether they are consumers, industry professionals, or public actors, to ensure sober and responsible digital technology and sound ecological development in France." Among the users targeted by the law, organizations obviously have a role to play [13].

Secondly, we need to gain unprecedented knowledge through an activity to measure the level of knowledge and commitment of the community to digital sobriety. The response will provide the initial foundation for the digital footprint repository that will enable digital and ecological transformations to be operationalized [14].

III. STATE OF THE ART

In order to address this issue, a first study has been set up called WeGreenIT2018. The WeGreenIT study, published on 11 October 2018, assesses the environmental footprint of digital technology. It is co-produced by WWF France and the Green IT Club, created in 2014 to lead green IT projects and at the origin of responsible digital methods [15].

First, the study came to a conclusion: even today, digital and sustainable development are still two areas where there is little overlap. Besides, as the first consumers of digital technologies, with the strengthening of national and international regulations, the company can play a central role in actively repositioning the digital revolution. Thus, in March 2018, 24 companies from all walks of life responded to the questions of this research, including: Caisse des Dépôts, Engie, La Poste, Pôle Emploi, Schneider Electric, or SNCF.

The results show that the main sources of environmental impact are the manufacture of IT equipment (accounting for 54% of greenhouse gas emissions), the user's work environment (computers, screens, etc.) and even the IT department. The study also highlighted that there are large differences in the maturity of companies in terms of responsible digital technologies, depending on their sector of activity. However, whatever the sector, WeGreenIt underlines that good digital management represents a kind of lever, both social, job-creating and environmental for the company [16].

In addition to the results of the survey, this document aims to promote the development of a corporate culture and common strategies more widely in order to better integrate digital with sustainable development. In particular, it makes recommendations and provides methods and tools adapted to their departments so that they can better identify the main sources of digital environmental impacts and solutions to reduce these impacts [17].

Finally, while there is still considerable room for improvement, WeGreenIt's research highlights the company's progress in certain areas. Especially with the new channels created within the framework of the Social and Solidarity Economy (SSE), the life span of equipment is now longer and should be reused more frequently, which is the case.

However, the study has many limitations:

- It takes place in 1 country.
- The study did not take into account the different entities that make up an organization.
- The sample studied is not large enough to create a reliable model.
- The level of granularity of the research is low.
- The local community is underrepresented.
- The Cloud part is not detailed.

Based on this observation, a new, more ambitious tool designed to reach the largest number of people was officially launched on March 31, 2021, namely WeNR.

IV. SPECIFICATION

This section focuses on the specification, design and implementation of tools designed to support the analysis process for quantifying the carbon footprint of an organization's ICT [18].

The objective of this study is to assess the carbon footprint of the target organization's IT equipment and to help the company understand the environmental impact.

The following research objectives achieve this goal :

- Define the scope and objectives of the survey.
- Conduct a literature review on current climate change and green IT issues.
- Conduct a survey of current IT audit methodologies to determine the most appropriate method.
- Conduct a survey to collect quantitative and qualitative data.
- Provide recommendations, with supporting evidence, on how the organization can reduce its overall carbon footprint and compare this footprint with that of other organizations.
- And finally, compare them with the company's current strategy to determine if they complement or reinforce the company's green IT strategy.

In order to achieve this different objective, the technical specifications must be clarified.

The tool must specifically :

 ISBN: 978-1-61208-924-9

- Use eco-friendly design and development practices (restricted exchanges, lean web pages, optimized transmission, etc.)
- Be attractive to influence the perceived ease of use and usefulness of the tool.
- With contextual help, e.g. a user guide accessible to all.
- Ability to compare searches against previous benc hmark.
- Flexible, with basic, simple and detailed views.
- Use filters to display only partial results, e.g. filtering by equipment type (Desktop).
- Sort by role category, customized results for each decision maker. Example: System and network administrator or accountant.
- Possibility to quantify carbon emissions by integrating behavioral aspects of energy consumption (time use).

V. STUDY

To begin, WeNR [23] is an Institute for Sustainable IT (ISIT) project based on work conducted during the 2014-2018 period: the ISIT (then called Club Green IT) conducted three consecutive benchmarks in 2016, 2017 and 2018 to calculate the environmental footprint of large French companies. In 2018, this benchmark facilitated the dissemination of research on responsible digital.

In addition, WeNR is more ambitious than WeGreenIT and contains more indicators. The questionnaire (see figure 1) is accessible online, then the data will remain confidential. The tool should therefore allow any organization to understand the impact of the "People-Planet-Prosperity" triptych and to measure its level of responsible digital maturity.

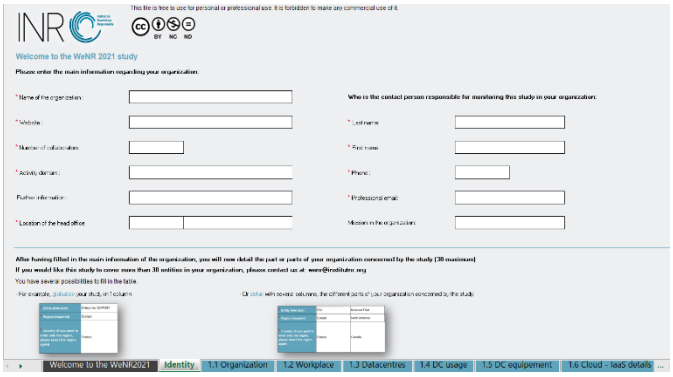

Figure 1 : Homepage of the questionnaire.

Consequently to the previous WeGreenIT study, the objective of the WeNR2021 study is to cover most of the French speaking European countries, including France, Belgium and Switzerland. There is also Luxembourg, but there is currently no responsible sustainable it institute attached to this country.

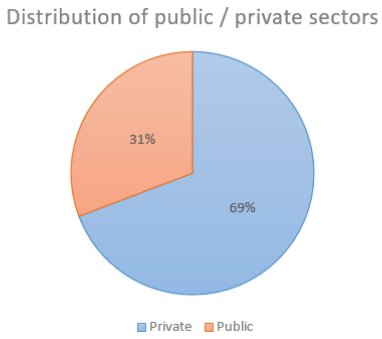

Figure 2: Distribution by sector.

On the other hand, as shown Figure 2, the distribution of public organization types is 31%. For private organizations, this proportion is about 69%. This means that most of the organizations participating in WeNR are private, although there are large cities, public corporations, etc. WeNR has collaborated with the University of La Rochelle and EIGSI, based on thesis work funded by La Rochelle and scientific collaboration between ISIT France, ISIT Switzerland, ISIT Belgium and the University of Leuven (UCLouvain).

Also, WeNR takes the form of an online questionnaire that all organizations (large and small) can use and access free of charge, so that as many people as possible can assess the footprint of their information system.

To this end, ISIT is providing an open access tool based on open and public data, and we hope to publish its method in a peer-reviewed journal to ensure that the method is fully transparent. Thus, this questionnaire allows you to evaluate your equipment, your data center and its uses, your use of the cloud, and to assess the maturity of your organization in responsible digital.

To date, more than 75 organizations have responded to WeNR, covering more than one million employees, including MICHELIN, ENGIE, CGI, EDENRED and many more. The responses provided free of charge to participants will allow them to quantitatively and qualitatively assess IS greenhouse gas emissions and maturity in many areas of digital business [21].

Finally, what characterizes the WeNR2021 study is that the scale of the participating organizations varies greatly . To illustrate this point, we can see the number of employees in about 60 companies in the image above. We have a small organization with 15 employees to a large organization with 120,000 employees. Figure 3 shows the great homogeneity of WeNR2021.

 ISBN: 978-1-61208-924-9

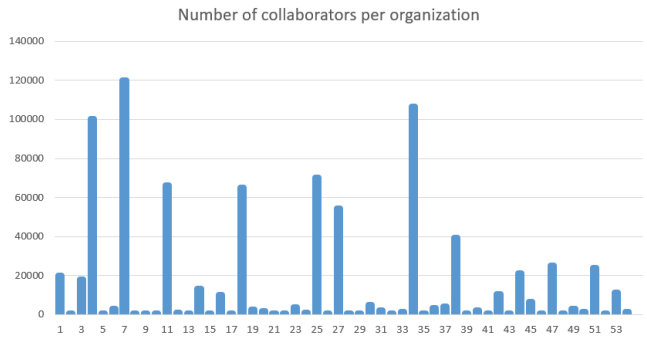

Figure 3 : Number of employees per organization.

Table 1 illustrates the differences that may exist between the old and new studies.

TABLE I. COMPARISON OF THE TWO STUDIES.

Comparison of the two studies: :

	WeNR2021	WeGreenIT2018
Country concerned :	*France, Belgium, Switzerland*	*France*
Language of Rendering :	*English, French*	*French*
Participating Organization :	*75*	*24*
Collaborator involved :	*1 200 000*	*775 000*
Transparent methodology :	*Yes*	*No*
Individual Report Rendering :	*Yes*	*No*
Global Report Rendering :	*Yes*	*Yes*
Predictive System (AI) :	*Yes*	*No*
Creation of a web-based tool :	*Yes*	*No*

VI. PERSPECTIVE

WeNR tools can be developed in a variety of ways. The need to expand and improve the data sources used is critical.

In the future, the WeNR tools will be developed in different ways. The data sources used will be expanded and optimized. But this is just the first step. In the future, WeNR will incorporate continuous monitoring over time. Monitoring is needed to highlight changes that can be made to reduce the carbon footprint. To that end, two future projects, WeNR Light and WeNR Plus, are planned. Users of the WeNR Light solution will be able to quickly and fairly accurately understand the environmental impact of their IT assets and their NR maturity directly online.

WeNR Plus will use WeNR models and calculation methods to provide more comprehensive and detailed reports in terms of quantity, quality and comparison with the same industry organization, but most importantly to analyze the impact of strategic decisions.

Also, the analysis tools provided will help determine the action plan for the formulation of a responsible digital strategy.

Finally, with the liberalization of the carbon impact of different cloud providers, the next version of WeNR will include the implementation of APIs to quantify the greenhouse gas emissions of cloud systems.

VII. CONCLUSIONS

A number of conclusions can be drawn from the WeNR.

First, it can be seen that there are few solutions for estimating an organization's ICT carbon footprint, and the solutions that have been implemented are primarily focused on households and transportation, and rarely provide accurate information. The transparency issues discussed are partially addressed by WeNR, through a broad exchange of sources and factors used [23].

Second, our research related to green computing recognizes that ICT needs to pay more attention to its energy consumption. While most large data center manufacturers and vendors are aware of this need and are adopting varying degrees of emissions reduction, the study also found that there are few solutions available for smaller organizations. However, the results of this study confirm that there is still much work to be done in this area and that services are needed to help companies reduce their expenses and emissions [22].

In carbon reduction efforts, communication is as important as the policies and actions themselves. In order to reach as many of the organization's stakeholders as possible, publicity activities should be conducted. Such activities should help increase the number of people affected by the activities, and help trigger self-reflection, which can reduce carbon emissions.

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 ISBN: 978-1-61208-924-9