Environmental labelling of mobile phones : LCA standardisation process

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***Abstract* — The mobile phone market is constantly evolving. Retailers and manufacturers offer a larger number of features to customers: a mobile network more and more efficient (2G, 3G then 4G), handsets with computer features, navigation, gaming, etc. This progress involves the use of more efficient and reduced electronic components: larger display panels with higher resolution, more powerful microprocessors and more memory available.**

One of today's most important problematic is the emergence of environmental consciousness. In this context, various studies based on LCA have been recently conducted by the mobile phones retailers and manufacturers to understand to which extend their product could contribute to the environmental issues. One of these studies goals is to provide information to consumers on the environmental impacts of mobile phones. These initiatives are supplemented by the French and European environmental labelling programs. Moreover, methodologies for LCA are also evolving. For example, the JRC, the European Union's scientific and technical research laboratory, advocated a series of recommendations in order to reduce uncertainty about the impact from LCA results [1].

However, there are two main constraints in the creation of an environmental labelling dedicated to mobile phones. Firstly, the time between designing a mobile phone and its marketing is very short. Time to perform LCA studies is thus limited. Secondly, mobile phones market share is large and submitted to an important turnover. The development of easy-to-use methodologies and tools with quick return on investment is necessary. In this context, how can we provide a reliable environmental labelling while meeting the criteria of cost and time?

This article deals with the environmental labelling scheme of mobile phones developed by SFR, a French telecommunications company. First of all, this article summarizes the LCA results uncertainties caused by two main aspects: the need to update life cycle inventories datasets (LCI datasets) faces the lack of availability of these data with the manufacturers and the need to develop the methodology to monitor the market and scientific advances. Secondly, the article will address various solutions that have been implemented in relation to these issues. Finally this article will detail the future challenges about methodological and standardisation.

***Index Terms* — Environmental labelling, ICT, mobile phones, LCA standardisation.**

I. Introduction

Mobile phones may be one of our smaller electronic possessions, but the environmental issues surrounding them are proving to be a sizeable challenge.

With the worldwide sales of handsets reaching 1.75 billion in 2012, the ecological footprint of creating a mobile phone may be small, but the cumulative effect is quite significant on a global scale. In 10 years, the worldwide sales of handsets were multiplied by 4. From 2007, smartphone sales extend considerably. In 2013, smartphones continued to drive overall mobile phone sales. The Q2 2013 numbers show the inevitable finally occurred: smartphones sales exceeded feature phone sales for the first time. Smartphone now occupies an essential place in many aspects of our lives. And it will become even more important with the development of connected objects.

Smartphone is a mobile phone with more advanced computing capability and connectivity than basic feature phones. The mobile phone market is constantly evolving. Retailers and manufacturers offer a larger number of features to customers: a mobile network more and more efficient (2G, 3G then 4G), handsets with computer features, navigation, gaming, etc. This progress involves the use of more efficient and reduced electronic components: larger display panels with higher resolution, more powerful microprocessors and more memory available. Therefore mobile phones we use have a larger ecological footprint.

In this context, various studies based on LCA have been recently conducted by the mobile phones retailers and manufacturers to understand to which extend their product could contribute to the environmental issues. One of these studies goals is to provide information to consumers on the environmental impacts of mobile phones.

France has been conducting a national experimentation on consumer product environmental information between July 2011 and July 2012. The trial covers the quantification of environmental impacts and the communication of environmental footprints to the consumer. 168 companies of different sizes have been selected. All sectors are represented. SFR, a French telecommunications company, participated to this initiative and continues to develop its environmental labelling.

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This article deals with the environmental labelling scheme of mobile phones developed by SFR with the technical support of Bureau Veritas CODDE. First of all, this article summarizes the LCA results uncertainties caused by two main aspects: the need to update life cycle inventories datasets (LCI datasets) faces the lack of availability of these data with the manufacturers and the need to develop the methodology to monitor the market and scientific advances. Secondly, the article will address various solutions that have been implemented in relation to these issues. Finally this article will detail the future challenges about methodological and standardization.

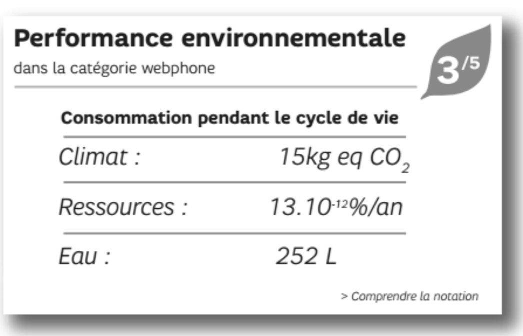

Fig. 1. Illustration of the SFR's environmental labelling in France (http://www.sfr.fr)

II. Environmental labelling of mobile phones: a sizeable challenge

A. SFR's requirements

For the development of its environmental labelling scheme, SFR identified 4 main requirements:

- **Accessibility of data**: The ecological footprint of mobile phones has to be assessed on simple access data for manufacturers.
- **Reproducibility of the method**: The development of easy-to-use methodologies and tools with quick return on investment is necessary.
- **Reliability of data**: Information provided to consumers has to be reliable and base the recommendations defined by the French European environmental labelling programs (general environmental footprinting methodology BPX 30-323). This ecological footprint should be based on the life cycle impact of mobile phone handsets including global warming potential.
- **Distinction of mobile phones**: The environmental labelling scheme has to help customers to compare mobile phones. For this the customer needs a simple eco rating scheme that presents him with a single value for the purpose of comparison and decision making.

B. State of the art of environmental labelling schemes

When SFR wanted to create its environmental labelling scheme in 2010, there was only one environmental labelling scheme dedicated to mobile phones. The table 1 list the environmental labelling schemes specific to mobile phones from 2008 to 2013.

TABLE I. State of the art of the environmental labelling schemes specific to mobile phones from 2008 to 2013

Scheme	Year of creation	Category/Environmental indicator rated
Orange/ France Telecom	2008	Global Warming
		Raw Material Depletion
		Eco-friendly design
SFR	2010	Global Warming
		Raw Material Depletion
		Water Depletion
Telefónica	2010	Corporate impacts
		Raw materials and manufacturing
		Substance
		Packaging/Delivery
		Use
		Disposal
		Functionality
UL 110	Unknown (<2011)	Materials
		Manufacturing and Operations
		Health and Environment
		Packaging
		Innovation
		EOL Management & Life Extension
Sprint	2011	Reduction of Environmentally Sensitive Materials
		Life cycle Management
		Energy Management
		Sustainable Packaging
		Eco-friendly applications
		Innovation

AT&T	2012	Hazardous Substances
		Environmentally Preferable Materials
		Energy Efficiency
		End of Life
		Responsible Manufacturing
Vodafone	2012	Green design
		Mobile phone life cycle (including global warming, raw material depletion, water depletion)
		Company performance
Apple	2013	Climate Change
		Restricted Substances
		Energy Efficiency
		Material Efficiency

All these eco-rating schemes are based on a life cycle approach and have developed questions and scoring systems to approximate and simplify the life cycle assessment process.

C. Usual LCA study: a no adapted approach

A mobile phone is a small electronic equipment but its architecture can be very complex. For example, the Apple iPhone 5S consists of more than 300 parts [2], from accessory (ex: USB cable) to electronic components (ex: SMD flat ship). To achieve a detailed LCA, it is necessary to ask at least the following questions for each part: What is it? What is the type of technology? What is the quantity? What are the physical characteristics? Where is it produced? How is it supply? In addition, is added the questions concerning the distribution phase, the use phase and the end of life phase. Thus, to achieve a detailed LCA of a mobile phone more than 2,000 questions are necessary. However, in the context of an environmental labelling, it is possible to take a few months of work per product. Consequently, achieving of detailed LCA of mobile phones is not an adapted approach.

D. SFR's methodological approach: LCA standardization of mobile phones

To meet the challenges of SFR, Bureau Veritas CODDE developed an environmental labelling methodology based on:

- **A simplified LCA**. A LCA model is built from a panel of mobile phones In accordance with ISO 14040 and ISO 14044 standards [3], this model is constitutes of two types of data: primary data and secondary data. Primary data are only the data that will have significant contribution to the results and that are available for manufacturers (example: surface of screen). Secondary data are the data that are not available for manufacturers (example: LCI of the production of a LCD) or that will have no significant contribution to the results (example: mass of plastics films).
- **Regular updating of the method**. Updating of the method focus on improvement of the LCA database used and on improvement of acknowledgement about significant contribution aspects to the results. Created in 2010, the SFR's labelling methodology has been updated in October 2011 [4] [5]. A third version is currently under discussion.

III. Presentation of SFR's environmental labelling: methodology version 1

This part deals with the 1st version of the environmental labelling scheme of mobile phones developed by SFR in 2010 [4].

A. Studied products, Functional unit

Studied products for this environmental labelling scheme are mobile phones sold by SFR in France, from features phones to smartphones. Based on phone characteristics and technical features (including the ability to connect to the Internet) as well as due to market considerations, 3 mobile phone categories are defined:

- **Classic** (C.): mobile phone with no Internet access,
- **Multimedia** (M.): mobile phone which can connect to the Internet through the 2G network,
- **Smartphone** (S.): mobile phone which can connect to the Internet through the 3G network.

Abbreviation: these categories are noticed C. (classic), M. (multimedia), and S. (smartphone) in the article.

The goal of the functional unit is to enable comparisons between different products that provide the same service (call), and to provide a reference to which the inputs and outputs are related to. For the 3 categories, the chosen functional unit of this methodology is: **"5.5 hours of calls (incoming and outgoing) per month for 2 years in France"**.

In this study, the time use of a mobile phone (5.5 hours of calls per month during 2 years) corresponds to the average time in France. There is no sensibility analysis on this parameter.

Functionalities other than incoming & outgoing calls are not considered in this eco-rating scheme.

B. System boundaries: inclusion and exclusion

In accordance with ISO 14040 and ISO 14044 standards [2], the total life cycle is taken into account and includes the production, distribution, use and end of life phases of mobile phones. For each phase of the life cycle, we will consider the following steps: production of raw materials; logistics processes; water and energy consumption linked to the production processes; air emissions; water emissions; production cut-offs and waste; treatment of waste and production cut-offs. The impacts linked to the recycling of production cut-offs, we will only take into account the transport of production cut-offs to the site where they will be treated. The impacts linked to the actual treatment of the raw material will be attributed to the user of this raw material. This is known as the "stocks methodology".

The reference unit includes: mobile phone handset, battery, battery charger, user manual, packging box, plastic films.

Specifically in this study, the following flows have been excluded from the study:

– Building and running of a telephone network. These will be identical whatever the type of mobile phone. Hence they will have no influence on the comparison.
– Energy consumptions linked to data transfer on the network, since the available body of knowledge and current life cycle assessments are not robust enough to take this information into account.
– Energy consumptions linked to functionalities other than incoming & outgoing calls and data transfer: TXT & MMS, playing MP3's, digital photographs, etc. since the available body of knowledge and current life cycle assessments are not robust enough to take this information into account.
– Accessories like the hands free/car kit are not considered. Actually there is no consensus about how to take them into account as it would imply to change the functional unit.
– The production of the SIM card due to lack of available data.

C. Generic mobile phone evaluation model

The LCA generic model takes into account 18 variables (primary data): 7 for the manufacturing phase, 5 for the distribution phase, and 6 for the use phase. These variables have been defined thanks to the study leads by the ADEME/AFNOR [6]. The LCAs are conducted using the EIME v4 software, the EIME v11.0 database (July 2009), and data collected by SFR from its suppliers for the configuration of the 18 questions.

D. Environmental indicators and Application of the methodology V1

The set of environmental indicators chosen for SFR labelling has been selected among the 11 indicators recommended by the PEP ecopassport® program [7]. Tested on a panel of handsets, the three environmental indicators allowing the distinction of handsets are:

- **Global Warming Potential** (GWP) expressed in kg eq. CO_2 (IPCC methodology, 2007).
- **Raw Material Depletion** (RMD) expressed in Y^{-1} (US Geological Survey, 1998).
- **Water Depletion** (WD) expressed in litres.

The table 2 and the figure 2 show the results of the methodology applied to a panel of 19 handsets representative of the market in 2010 according to the life cycle steps (average of 6 C., average of 7 M. and average of 6 W.). In 2010, the average environmental impact of a smartphone is 1.97 to 2.54 times higher than a basic phone according to indicators analysed.

TABLE II. RESULTS OF THE SFR'S ENVIRONMENTAL LABELLING V1 FOR A PANEL OF 19 MOBILE PHONE REPRESENTATIVE OF THE MARKET IN 2010

LCA results for average mobile phones (Method V1)			
Indicators	***Classic (C.)***	***Multimedia (M.)***	***Smartphone (S.)***
GWP (kg eq CO2)	8,67E+00	1,40E+01	1,96E+01
	100%	161%	225%
WD (litres)	1,06E+02	1,69E+02	2,69E+02
	100%	160%	254%
RMD (Y-1)	6,31E-14	8,80E-14	1,24E-13
	100%	139%	197%

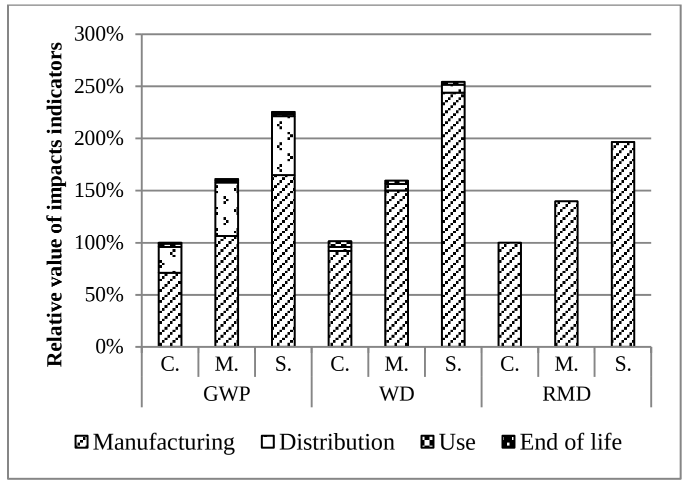

Fig. 2. Results of the SFR's environmental labelling V1 for a panel of 19 mobile phone representative of the market in 2010

IV. EVOLUTION OF SFR'S ENVIRONMENTAL LABELLING: METHODOLOGY VERSION 2

In October 2011, SFR developed the 2nd version of its environmental labelling methodology [5]. The goal of the 2nd version was to harmonize the SFR and ORANGE's methodologies.

A. Studied products, Functional unit, System boundaries

Because of the evolution of the mobile phones market, we decided to split LCAs for mobile phones into two categories:

- **Classic** (C.): mobile phone which can connect to the Internet through the 2G network,
- **Smartphone** (S.): mobile phone which can connect to the Internet through the 3G network.

Abbreviation: these categories are noticed C. (classic) and S. (smartphone) in the article.

The functional unit and system boundaries remain unchanged in the 2nd version of its environmental labelling methodology.

B. Generic mobile phone evaluation model

The method takes into account 50 variables (primary data) instead of 18 variables: 39 for the manufacturing phase, 5 for the distribution phase, and 6 for the use phase. The major modifications are:

- **Transports by aircraft**: all the transports by aircraft in the manufacturing phase are reported.

- **Production of the integrated circuits**: the surface of silicon chips included in integrated circuits is a primary data. In the 1st version of the method, the production of silicon chips is estimated thanks to the surface of integrated circuits with an average ratio.
- **Production of printed wired board**: the surface and the type of each printed wired board (PWB) are was required.
- **Production of electronics components, except integrated circuits**: the production of electronics components excluding integrated circuits is estimated according the surface of the main PWB. In the 1st version of the method, these components were estimated according the total surface of PWBs.
- **Production of screen**: The type of screen touchscreens (LCD or LCD touchscreen) is a new primary data. In the 1st version of the method, all screens are approximated by LCD screens. Surface of screen remains the primary data to estimate the impact of the production of the screen.
- **End of life scenario**: mobile phones are treated by a NGO in Belgium specialized in mobile phone recycling: 78% of handsets are recycled and 22% of handsets are refurbished. In the 1st version of the method, mobile phones are treated according to a generic WEEE procedure in France.
- **Updating of the LCA database**: The EIME v11.8 database (February 2011) is used. The major updates concern: production of the charger, production of electronic components excluding integrated circuits, production of integrated circuit. The new LCI are: production of a LCD touchscreen, production of 2 layers flexible PWB, production of 2-10layers FR4 PWB.

C. Application of the methodology V2

The environmental indicators (GW, RMD and WD) remain unchanged.

The table 3 and the figure 3 show the results of the SFR's environmental labelling V2 applied to a panel of 23 handsets representative of the market in 2011 according to the life cycle steps (average of 7 C. and average of 16 S.). In 2011, the average environmental impact of a smartphone is 1.72 to 2.9 times higher than a classic phone according to indicators analysed.

TABLE III. RESULTS OF THE SFR'S ENVIRONMENTAL LABELLING V2 FOR A PANEL OF 23 MOBILE PHONES REPRESENTATIVE OF THE MARKET IN 2011

LCA results for average mobile phones (Method V2)		
Indicators	***Classic (C.)***	***Smartphone (S.)***
GWP (Kg eq CO2)	1,50E+01	3,77E+01
	100%	251%
WD (litres)	1,54E+02	4,47E+02
	100%	290%
RMD (Y-1)	1,20E-13	2,07E-13
	100%	172%

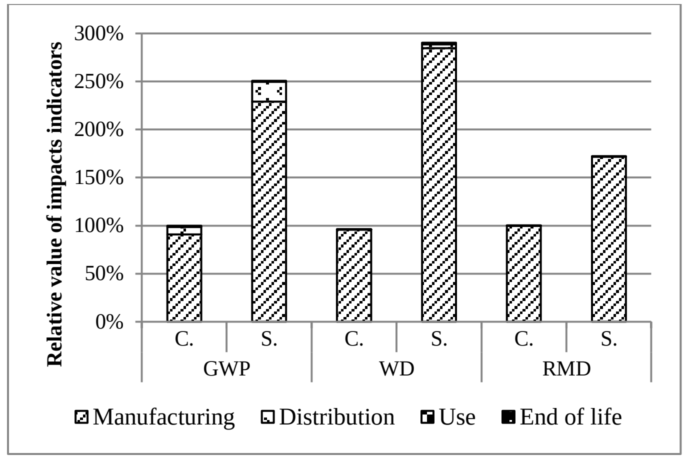

Fig. 3. Results of the SFR's environmental labelling V2 for a panel of 23 mobile phone representative of the market in 2011

In 2011, the difference of environmental impacts between smartphones and classic phones is mainly explained by the manufacturing phase (cf. figure 3). Smartphones require more electronic components (larger screen, more efficient semiconductors, larger printed wiring boards…).

D. Comparison of the 2 versions of the methodology

In this paragraph, we want to estimate the influence of the methodological update on LCA results. To do this, we analyzed a smartphone designed in 2013 [8] according to the two methodological versions (cf. table 4 and figure 4). The update of the method implied a significant increasing of the impacts on the 3 indicators: +86% for the GW, +36% for the WD, and +36% for the RMD. The production of LCD display panel is always the main contributor to the 3 indicators. The production of integrated circuits becomes a significant contributor to the 3 indicators. The charger has greater impacts on the RMD indicator. The production of electronic components, excluding integrated circuits, has lower impacts on the RMD.

TABLE IV. RESULTS OF THE SFR'S ENVIRONMENTAL LABELLING V1 AND V2 FOR A SMARTPHONE

LCA results for a smartphone (Method V1 vs. Method V2)							
Indicators		***GWP (Kg eq CO2)***		***WD (litres)***		***RMD (Y-1)***	
Method version		V1 (Ref.)	V2	V1 (Ref.)	V2	V1 (Ref.)	V2
Manufacturing	LCD display panel	69%	112%	93%	108%	77%	92%
	Printed wired boards	3%	3%	2%	1%	17%	1%
	Electronic components excluding integrated circuits		<1%		<1%		3%
	Integrated circuits (including silicon ships)	1%	35%	1%	22%	1%	8%
	Battery	9%	9%	2%	2%	<1%	<1%
	Charger	1%	2%	<1%	1%	4%	31%
	Upstream transport	1%	3%	<1%	<1%	1%	<1%
	Rest		1%		1%		1%
Distribution		12%	11%	1%	1%	<1%	<1%
Use		1%	1%	1%	1%	<1%	<1%
End of life		4%	1%	1%	<1%	<1%	<1%
Total		**100%**	**180%**	**100%**	**136%**	**100%**	**136%**

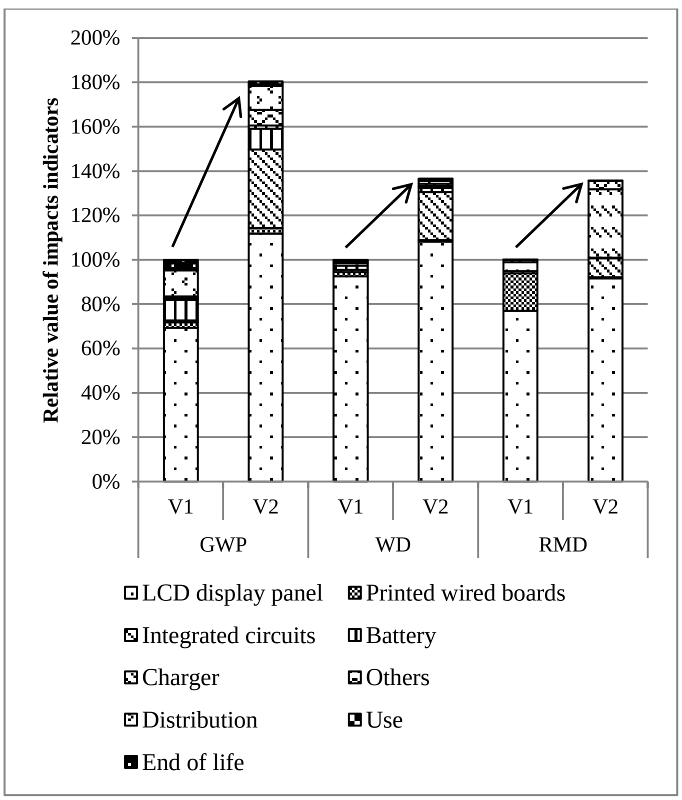

Fig. 4. Results of the SFR's environmental labelling V1 and V2 for a smartphone

A mobile phone assessed with the Method V2 will have greater impacts in comparison to the Method V1 because of:

- **Updating of the LCA database**: The update of LCA databases generally implies increased environmental impacts through more detailed data collection. For example, with the EIME v11.8 database the Method V2 allows to assess the impacts of the production of a LCD touchscreen. With the Method V1, we approximate an LCD touchscreen by an LCD screen. The environmental impacts of a LCD touchscreen are more important than those of a conventional LCD screen.
- **A more detailed generic model:** In the Method V2 we take into account 32 additional parameters. For instance with the analyzed smartphone (cf. table 4 and figure 4): in the Method V1 the surface of silicon chips is 0.89 cm² (fixed value depending of the EIME database) whereas in the Method V2 the surface of the silicon chips is 7.89 cm².

The updating of the methodology confirms that the main environmental impacts of a mobile phone come from the manufacturing phase. Moreover this is especially true for smartphone which have larger display panels and more integrated circuits. Many other LCA studies confirm this conclusion (cf. table 5).

TABLE V. ANALYSIS OF LCA STUDIES OF MOBILE PHONES BETWEEN 2004 AND 2013: IMPACT OF THE MANUFACTURING THROUGH THE LIFE CYCLE

Author	***Date***	***Indicators analysed***	***Impact of manufacturing through the life cycle***
Nokia [9]	2013	Global Warming	50% to 70% of the life cycle impacts
Apple [10]	2013	Global Warming	65% of the life cycle impacts
Apple [11]	2013	Global Warming	73% of the life cycle impacts
Apple [12]	2013	Global Warming	81% of the life cycle impacts
Nokia [13]	2011	Global Warming	74% of the life cycle impacts
WRAP [14]	2010		Environmental impacts are heterogeneous. Various technologies, from basic hones to smartphones with various components such as cameras, screens or touchscreen of various sizes and resolutions, speakers, high storage capacity, etc. This impacts significantly the power consumption of the phone.
Apple [15]	2010	Global Warming	57% of the life cycle impacts
Nokia [16]	2010	Energy Depletion Global Warming	66% of the life cycle impacts
Ericsson [17]	2008	Global Warming	~75% of the life cycle impacts
ADEME [18]	2008	Raw Material Depletion; Energy Depletion; Global Warming; Ozone Depletion; Air Acidification; Water Eutrophisation; Hazardous Waste Production	75% to 99% of the life cycle impacts
International Journal of LCA [19]	2006		The environmental effects of the use phase do not dominate those of the production phase.
Nokia [20]	2005	Energy consumption	40% to 60% of the life cycle impacts
Bachelor of Engineering (Electrical and Electronics) [21]	2005		The impact assessment reveal that the fabrication of Integrated Circuits and of PWB components dominate the environmental effects of mobile phones
The WEEE Man Electronics Goes Green 2004+ [22]	2004	Energy depletion	~60% of the life cycle impacts

E. Ways of improvement

To improve the reliability of the LCA results, the next main works of the SFR's environmental labelling are divided into 3 improvements:

- **LCA database issues**: improve the reliability of the Life Cycle Inventories (LCIs) on the screen production and the integrated circuits production which are the main contributor to the impacts.
  Actions should be launched to collect information from manufacturers of AMOLED and OLED display panels. AMOLED and OLED display panel are more and more used in the mobile phone sector.
  The type of ship should become a primary data in order to make the difference between silicon chips and AsGa chips. The EIME database shows significant difference on the GW indicator [23].
- **Data collection issues**: ensure that the data provided by the suppliers are reliable, specially about the surface of screen and the surface of silicon chips.
- **Methodological and standardisation issues**: SFR are studying the European environmental labelling [24] (choices in terms of LCA specific rules, database, and environmental indicators). The ILCD plat-form recommends using the CML method to assess the RMD indicator. Instead of the US Geological Survey method, the CML method take into account tantalum and indium, 2 metals used for the production of mobile phones.

V. DISCUSSION ABOUT THE LCA STANDARDIZATION APPROACH

A. Origins of uncertainties

Data uncertainty is closely related to lack of knowledge on the true value [25]. According to Björklund, the following types of uncertainties can be recognized:

- **Data gaps**: missing values in the model.
- **Unrepresentative data**: data from non-representative sources, i.e. data from similar processes, but not from a representative geographical place, age, or technology.
- **Model uncertainty**: due to simplification of aspects that can't be properly modeled in LCA, e.g. temporal of spatial characteristics.
- **Uncertainty due to choices**: e.g. allocation rules, system boundaries, weighting methods, etc
- **Spatial variability**: e.g. fluctuations in the real world, geographical sites, etc.
- **Temporal variability**: variations over time e.g. dispersion of emissions.
- **Variability between sources and objects**: differences in sources of inventoried system e.g. variation in comparable technical processes, and in objects determining the impact on the environment e.g. preferences in weighting of impacts.
- **Epistemological uncertainty**: due to lack of knowledge on the system behavior.
- **Mistakes**: easy to make, difficult to find.
- **Estimation of uncertainty**: estimation of the type of uncertainty is itself a source of uncertainty.

The table 6 presents a qualitative estimation of uncertainty for the SFR's environmental labelling methodology.

TABLE VI. ANALYSIS OF UNCERTAINTIES

Type of uncertainty	***Estimation of uncertainty***	***Actions***
Data gaps	Basic	All primary data are accessible for manufacturers. A missing value is replaced by a penalty value in the model.
Unrepresentative data	Basic	In the LCA model, secondary data are based on a panel of handsets representative of the market. Bureau Veritas CODDE develops its own LCI database in compliance with ELCD recommendations. The EIME database is constituted of LCI build on several sources.
Model uncertainty	Basic	All relevant contributors are identified and quantified. The estimation of these impacts is based on continuous improvement of the generic LCA model.
Uncertainty due to choices	Basic	These uncertainties are common to all LCA studies. Bureau Veritas CODDE apply international recommendations about LCA methodologies.
Spatial variabily	High	Specific data on the production of new electronic components are difficult to collect for confidentiality reasons. Bureau Veritas CODDE develops its own LCI database in compliance with ELCD recommendations. The EIME database includes LCI of electronic components produced in China (primary data or extrapolation from european manufacturing).
Temporal variability	High	Specific data on the production of new electronic components are difficult to collect for confidentiality reasons. These uncertainties are hard to solve in a context where mobile phone market is constantly evolving. Bureau Veritas CODDE develops its own LCI database in compliance with ELCD recommendations. EIME database is updated every year.
Variability between sources and objects	Unknown	
Epistemological uncertainty	Low	Bureau Veritas CODDE experts follow the technological developments in ICT sector. These technological evolutions are integrated in the annual updating of the EIME database.
Mistakes	Low	Each methodology version is subjected to an internal review. Each simplified LCA is validated by an internal reviewer.
Estimation of uncertainty	Unknown	

The figure 5 shows the distribution of LCA results between the methodology V1 and the methodology V2 according to the origin of the data (primary or secondary data).

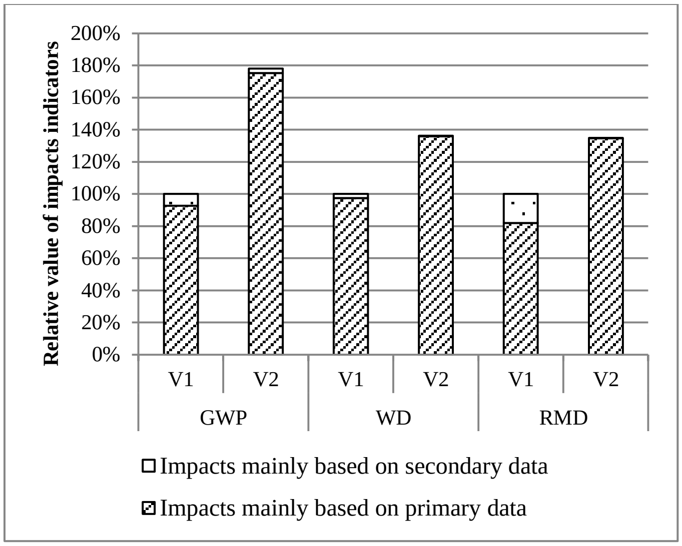

Fig. 5 Distribution of LCA results between the methodology V1 and the methodology V2 according to the origin of data (primary/secondary data)

In the methodology V2, more than 98% of the impacts are based primary data. Consequently, it makes sense that improvement efforts are focused on manufacturing phase.

B. Evolution of mobile phone market: influence about environmental impacts

22 smartphones have been assessed in 2011 and 55 smartphones in 2012. The distribution of these LCAs is presented in the following box plots.

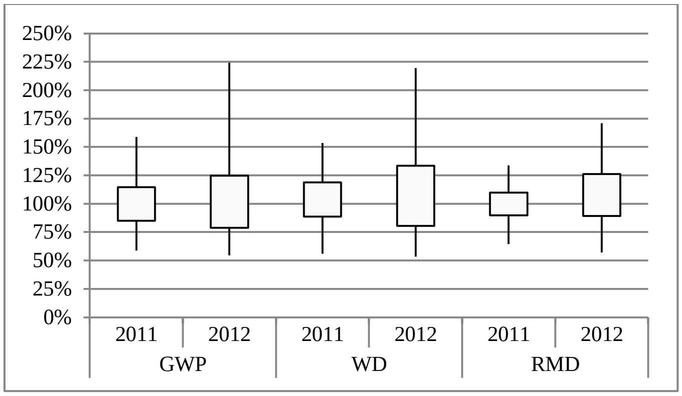

Fig. 6 Distribution of LCA results for smartphones analysed in 2011 and in 2012 with the methodology V2 (Box plot)

Between 2011 and 2012, we notice that the distribution of impacts for smartphones is becoming wider. This is due to the arrival of a new type of mobile: micro-tablets. The impacts of micro-tablets mainly depend on the size of the screen and the surfaces of silicon chips. These new devices bring into consideration the parameters chosen for the generic model.

VI. Conclusion

. SFR's environmental labelling enables customers to compare the environmental performance of different mobile phones so they can make an informed decision in choosing a more sustainable phone. The completion of the variables taken into account in the LCA generic model and the update of the LCA database are necessary to make the SFR's environmental labelling perennial. The update of the method in 2011 implied a significant increase of the impacts. The next main works of the SFR's environmental labelling are divided into 3 improvements:

- LCA database issues: improve the reliability of the Life Cycle Inventories (LCIs) on the LCD production which is the first contributor to the impacts; collect information from manufacturers of AMOLED and OLED display panels.
- Data collection issues: ensure that the data provided by the suppliers are reliable.
- Methodological and standardisation issues: SFR are studying the European environmental labelling (choices in terms of LCA specific rules, database, and environmental indicators).

Currently this label has limited influence on consumer choice behaviour. In decision making, pricing and mobile phone features explain the tendency to select a mobile phone. Environmental taxes based on this label could help to change consumer behaviour.

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