Environmental Innovations in the Nordic Mobile Phone Industry

Green Markets and Clean Technologies
- A project for the Nordic Council of Environmental Ministers

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The environmental impacts of mobile phones are related to the use of resources, process chemicals and energy consumption in all production stages, and especially during production of chips, LCD and PCB. Energy consumption during use phase is another impact area due to the chargers standby consumption as well as the energy use of the whole communication system. Furthermore, the mobiles phones are complex devices with huge amounts of components with potential hazardous substances, which also can cause problems in the waste treatment and recovery of materials. The production of one mobile phone causes 75 kg of waste.

Figure 1: Environmental Impacts of Mobile Phones

High resource and energy consumption during manufacturing
- Especially some components: Chips, LCD and PCB

Use of chemicals
- Process chemicals in production and additives in the products
- Several suspected to be hazardous

Energy consumption during use
- Standby of charger (left in the socket)
- Energy consumption in the network (strongest effect in the LCA that include these aspects)

Limited knowledge about waste treatment
- Production of one mobile phone causes 75 kg waste
- Mobile phones are small and might go into household waste,
- Difficult to recycle other than precious metal

The mobile phone industry is globalised with six major brands. Nokia has more than 1/3 of the market share, and Sony Ericsson is one of the other six brands. Ericsson is the leading supplier of network equipment. Nokia and Ericsson have become global players due to an early involvement of the Nordic countries in the creation of a mobile communication system with the first international standard in 1982.

Figure 2: Nordic Mobile Phone Industry

- First international mobile communication standard: NMT
- Nordic dominance with Nokia as leader in handset and Ericsson in network equipment.
- Provide a "community" with several suppliers, sub-suppliers, design houses, etc. for global brand holders
- Presence of several foreign "big players" such as Motorola and Texas Instrument
- Strong competences e.g. electrical design, communication standards, communication protocols, modularization

The global character of the market and the leading brands is corresponding to a globalised and fragmented supply chain. A mobile is made all over the globe with specialised components produced in USA, Japan, Taiwan, Korea and EU, and assembled by contract manufactures in China, Thailand and increasingly India.

The dilemma between mass production and customisation has been reduced by making basic platforms and modularisation of the phones – in this way, it is possible to keep the prices down, make phones to specific consumer segments and reduce the time to the market for new designs. Recent innovation dynamics

are characterised by: convergence with other consumer electronics and introduction of new features (radio, MP3 player, camera, GPS, etc.) as well as increased data transmission.

Figure 3: Global Supply Chains and Innovation Dynamics

Global supply chains

- R&D and production is carried out by many companies in the supply chain around the world
- Specialised suppliers supplying several of the brand holders
- High use of Contract Manufacturers also design and supply chain management

Innovation process split

- R&D on new features
- Integration of new features to existing concepts

Use of technology platforms and modular product architecture

Platform:

- Broad product portfolio but on few basic platforms
- Combine differentiation (customers segmentation) with cost reductions and mass production

Modularisation:

- Optimising each component on standard criteria instead of designing components together (still necessary in the basic chipset)
- Possible with multi-sourcing instead of dependence on supplier

Easier to produce phones: take platform and add different modules

New players

- Design-houses (Texas Instrument moved from chipmaker to platform design)
- Contact Manufacturers (CM) creates brands (BenQ),
- Operator branded phones on CM (Vodaphone on phones produced by Flextronic)

Constant introduction of new features and improvement of existing

- Messages (SMS), e-mail, Camera (pixel improvement), mp3 (sound improvements), Video-, TV streaming and gaming (low quality), text processing programs (Word, PDF reader etc.)

Converging of phones with other ICT and consumer electronics

- PDA Phone (HP), Music Phones (IPhone and Walkmann phone), Camera Phones, gaming and picture streaming phones (Nokia N91)
- New players (HP, Apple)
- One gadget covering all features is unlikely at the moment

Increased data transmission

- From below 50 kb/s in GSM to over 300 kb/s in WCDMA and improving
- 3G beyond / 4G expected to go to MBit/s (Wlan e.g. 108 Mbit/s)

The energy trap:

- Increased data transmission and improved features put high pressure on energy consumption
- Need to focus on energy and space efficiency in the mobile phones because of all the new features / product integration

These innovation dynamics and market trends, where consumers change their mobile phone in average every 18 months, are some basic characteristics that environmental policy has to consider, when making a mix of different policy instruments.

So far, consumers do not take environmental impacts into account, when buying new mobile phones. Therefore, the companies do not believe that they can gain competitive advantages by adopting environmental labels – and for this reason the labels have not influenced development of 'cleaner phones' in the front-runner companies.

The effect of voluntary agreements such as the EU Code of Conduct (CoC) on external power supplies can be difficult to measure. Energy efficiency of chargers has been put on the agenda, and main brands such as Nokia apply chargers with a standby consumption less than 0,3W as required in the CoC and the US Energy star label.

The EU directive on Energy-using Product (EuP) is setting minimum requirements to the environmental performance of products. However, the current drafts to implementing measures have requirements to energy efficiency in focus, and the ambition level is rather low (1W) compared to the voluntary agreements and best available technology.

In contrast, the RoHS directive, which restricts the use of six hazardous substances, has influenced the mobile phone industry not only in the EU but globally. Specific requirements with clear goals and time frames have an effect even in global and fragmented supply chains.

The WEEE directive is improving the waste handling of electronics, but has not so far had any influence on the product development of phones towards eco-design – even though this was the ambition in EU. Waste minimisation, increased recycling and use of recycled materials are still a challenge to the mobile phone industry and governments.

Figure 4: Policy instruments related to electronics

- RoHS has affected electronic industry to phase out six chemicals
- WEEE has put waste treatment on the agenda, but fails to foster design improvements of the products (eco-design)
- NO use of energy or eco-labels for mobile phones – no market pull at the moment
- Voluntary agreements have an effect, but limited to what rather easily can be achieved
- IPP pilot on mobile phones with Nokia as project leader. The outcome related to environmental improvements is unclear
- EuP will push for improvements of energy consumption in external power supplies and reduction of stand-by consumption, while other environmental impacts are not included.

The first case study shows that standby consumption of chargers can be improved with a factor 10 compared to the best performing chargers on the market today. However, neither consumer interests nor the EU directive on Energy-using Products (EuP) give incentives to such radical improvements. Competitive advantages can not be gained by providing new phones with more efficient chargers as this is not an issue for the consumers, and the draft for implementing measures for chargers in EuP is not that ambitious and can be achieved with existing technologies.

The case study on 4th generation mobile networks (4G) illustrate the 'energy trap' that increased data transmission and new features put high pressure on energy consumption both in the network and the handsets. In other words, the relation between energy consumption and data rates has to be detached in order to create a successful 4G system. However, the transmission capacity can be expanded by organising the

system so users "share" common data from the base station via more energy efficient short-range wideband connections (e.g. Bluetooth and Wlan). This is called cooperation and requires only limited new technologies, but mainly new ways of structuring the network systems

Both case studies illustrate that significant energy-efficiency can be reached. If best available technology is introduced in chargers of mobile phones, the stand-by consumption will be close to zero. The introduction of new and improved features to the phones, increased data transmission, higher penetration on the market, etc. are increasing the energy consumption in the communication system – and call for another paradigm for 4G communication in order to reduce what has been called the "energy trap" in the communication system.

Besides, the analysis of the innovation dynamics as well as the case studies calls for improved connections and synergy between the applied policy instruments. So far, no connections have been established between the different policy instruments that are applied separately. The scope of EU directive on Energy-using Products is being expanded to Energy-related products (ErP) including e.g. windows and insulation and the minimum requirements especially on energy efficiency will exclude some products from the European internal market. In product groups with energy labelling, the ErP minimum requirements will be connected to the already defined levels of energy efficiency from A to G.

Policy instruments such as eco-labels, green public procurements, etc. are especially aiming at giving a competitive advantage to front-runner companies that produce products with a superior environmental performance. These policy instruments have had some impact in specific product groups, but in general significant improvements can be implemented especially related to green public procurement.

In the EU action plan for Sustainable Production and Consumption & Sustainable Industrial Policy from July 2008 most of these issues are stressed together with the proposal to establish a common information platform for these different policy instruments. This can (perhaps) be seen as a first step to create better connections between the applied policy instruments as indicated in the figure below.