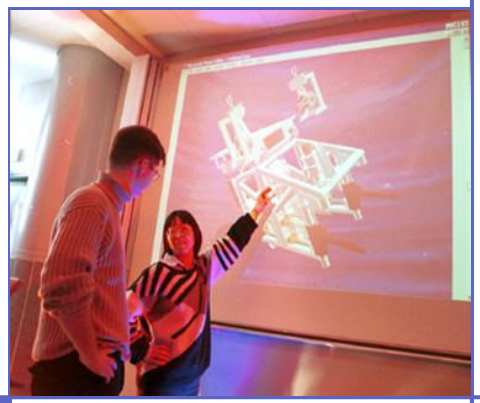
Lennart Swanström

ABB



Use of LC info in design and development of products within the ABB group

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1/12/2007

Facts about ABB

Power Products
Sales: $6.4 billion

Transformers, high- and medium-voltage switchgear, breakers, automation relays

Power Systems
Sales: $4.0 billion

Substations, FACTS, HVDC, HVDC Light, power plant & network automation

Automation Products
Sales: $5.9 billion

Low-voltage products, drives, motors, power electronics, and instrumentation

Process Automation
Sales: $5.0 billion

Control systems and application-specific automation solutions for process industries

Robotics
Sales: $1.7 billion

Robots, peripheral devices and modular manufacturing solutions for industry

- Core business organized into 5 divisions
- Headquarters: Zurich, Switzerland
- About 107,000 employees in around 100 countries (production in 45)
- Revenues in 2005: $22.4 billion

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LCA example 1 - DC Motor DMI 180kW

Material use (kg)

- Electrical steel	581
- Steel	125
- Cast iron	104
- Aluminum	2
- Copper	121
- Wood	35
- Epoxy resin	3,9
- Polyurethane	0,7
Total weight	972,6

Assembly

Electric en consumption (Sweden)	572 kWh
Combusted oil	34,2 kg

It is assumed that the product is transported 1500 km by lorry to the customer

Operation

Life time	25 years
Operation	6500 hours/year
Electric power losses	20,2 kW
Product used in Germany	

Recycling

It is assumed that 90% of the metals are recycled

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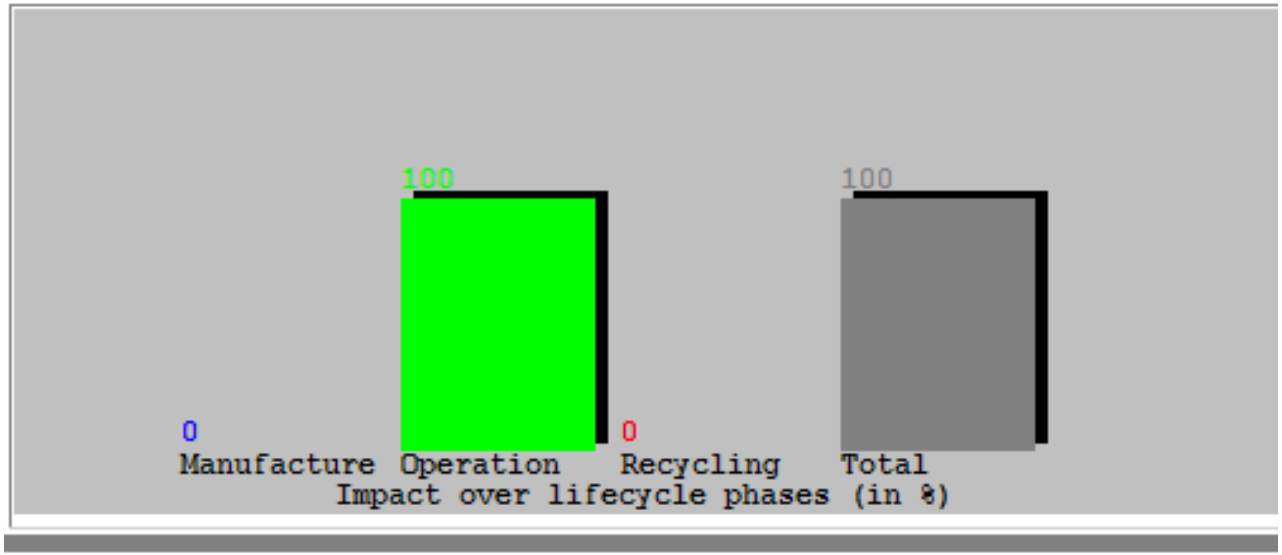
LCA example 1 - DC Motor DMI 180kW

Impact according to Global warming potential
in CO2 eqvivalents
Negative values for recycling are indicated with a red column.



Life cycle phase	Impact	Percentage of total
Manufacture:	2711,88	0,11 %
Operation:	2475755,45	99,95 %
Recycling:	-1393,24	-0,06 %
Total impact:	2477074,09	100 %

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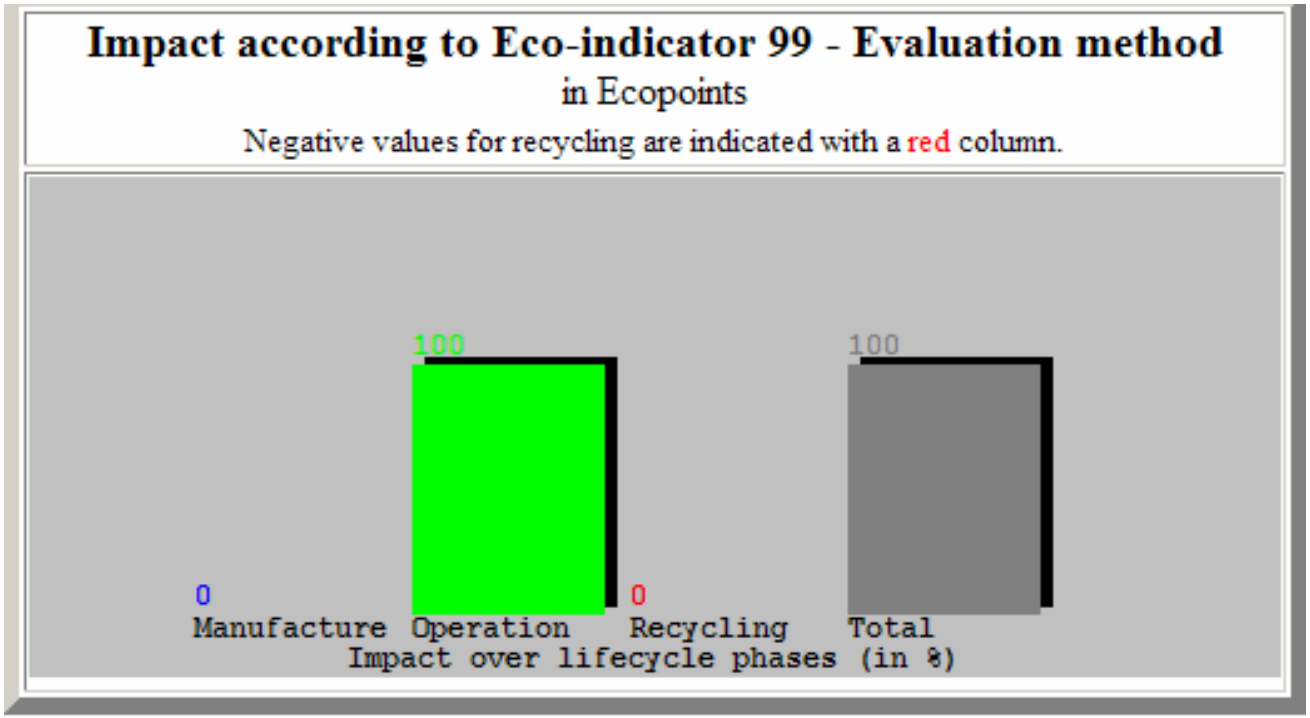
LCA example 1 - DC Motor DMI 180kW



Life cycle phase	Impact	Percentage of total
Manufacture:	184,36	0,17 %
Operation:	109715,73	99,93 %
Recycling:	-108,03	-0,1 %
Total impact:	109792,06	100 %

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LCA example 1 - DC Motor DMI 180kW

Supply material	Name	Quantity	Unit	Impact
	Electrical steel	581	kg	1170,62
	Steel	125	kg	360,03
	Cast iron	104	kg	442,5
	Aluminium	2	kg	25,84
	Copper	121	kg	429,52
	Wood	35	kg	1,68
	Epoxy resin	3,9	kg	26,04
	Polyurethane	0,7	kg	2,91
Electricity	Name	Quantity	Unit	Impact
	Electricity Sweden	572	kWh	29,66
Fossil fuel	Name	Quantity	Unit	Impact
	Combusted oil	34,2	kg	119,7
Transports	Name	Quantity	Unit	Impact
	Lorry 42 t	1470	tonkm	103,37

Operation				
Electricity	Name	Quantity	Unit	Impact
	Electricity Germany	3282500	kWh	2475755,45

GWP, Global Warming Potential

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LCA example 2 – Power transformer 500MVA

Material use (kg)

- Copper	39960
- Electrical steel	99640
- Steel	53618
- Transformer oil	63000
- Wood	15000
- Porcelain	2650
- Polyurethane	2200
Total weight	276068

Assembly

Electric energy consumption (Sweden)	750000 kWh
Combusted oil	26341 kg

Operation

Life time	40 years
Operation	Continual
Electric power losses	505 kW
Product used in Germany	

Recycling

It is assumed that 90% of copper is recycled

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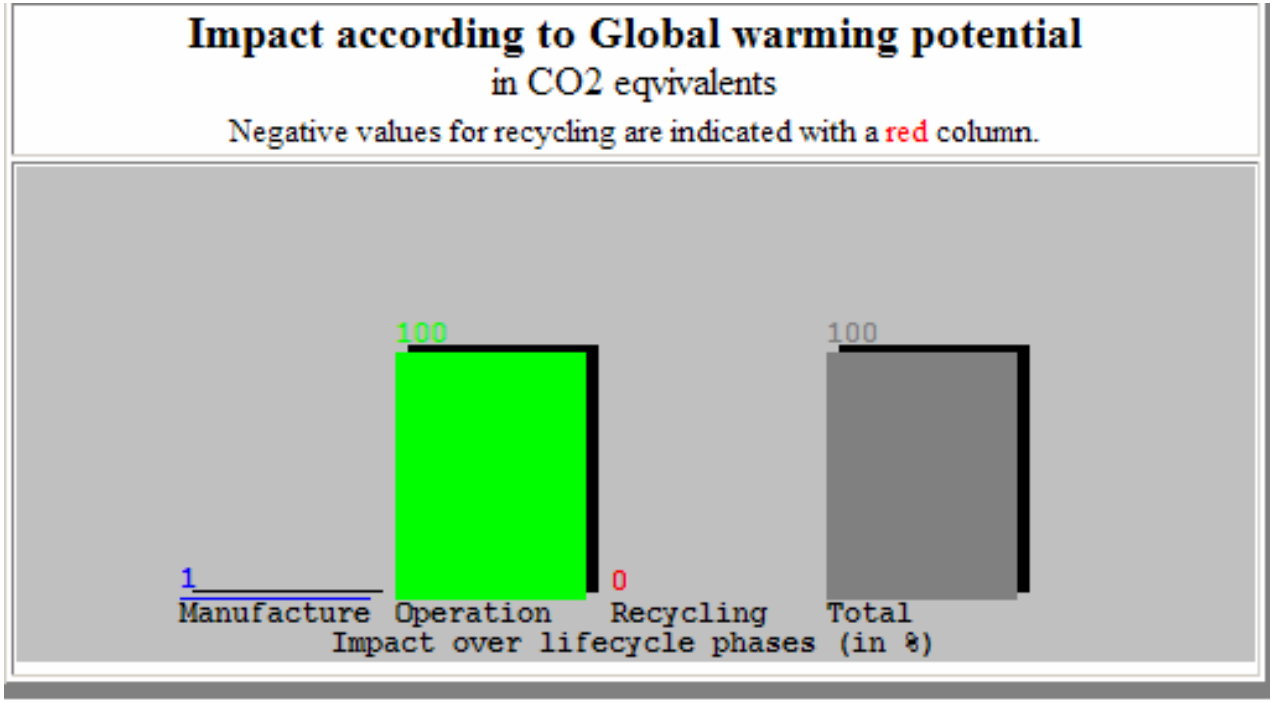
LCA example 2 – Power transformer 500MVA



Life cycle phase	Impact	Percentage of total
Manufacture:	689054,71	0,51 %
Operation:	133462263,13	99,69 %
Recycling:	-270474,72	-0,2 %
Total impact:	133880843,12	100 %

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LCA example 3 – Low voltage circuit beaker TmaxT1

Material use (g)

- ABS	5,7
- Copper	134
- Steel	306
- Silver	2,8
- Polycarbonate	41,6
- Polyamide	17,7
- Polyester resin	446
Total weight	953,8

Assembly

Electric energy consumption (Italy)	9,7 kWh

It is assumed that the product is transported 1000 km by lorry to the customer

Operation

Life time	15 years
Operation	4380 hours/year
Electric power losses	9,4 W
Product used in France	

Recycling

It is assumed that 70% of the copper is recycled

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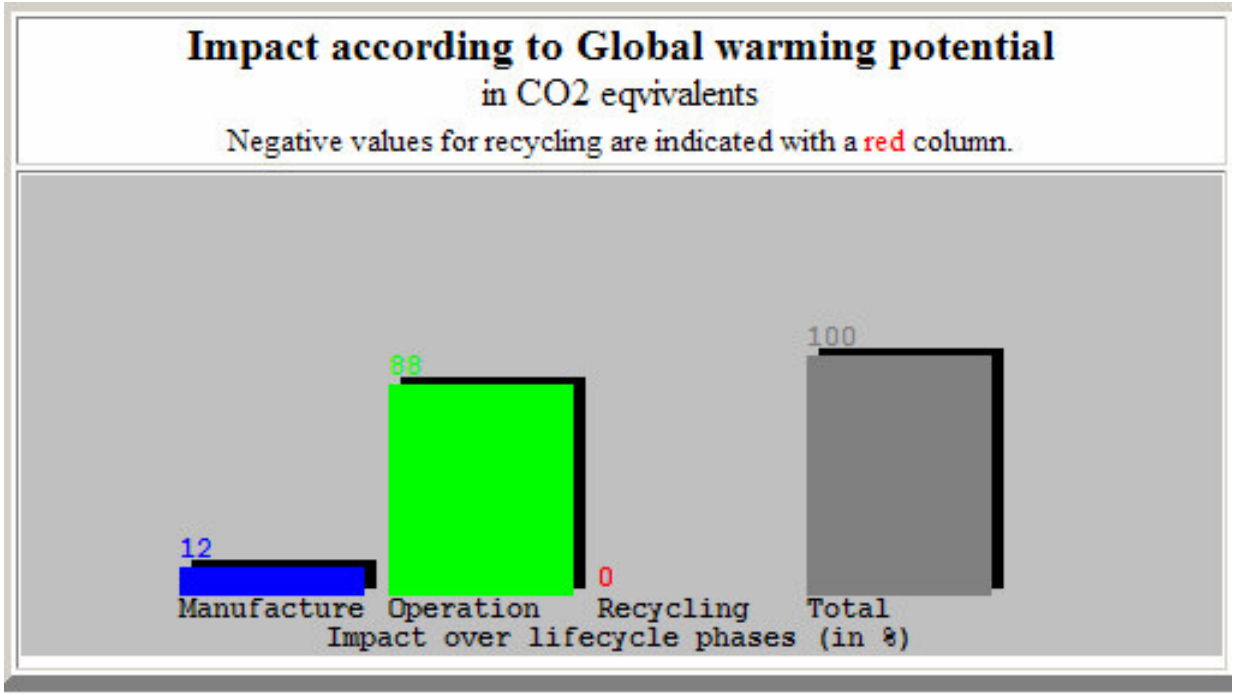
LCA example 3 – Low voltage circuit beaker TmaxT1



Life cycle phase	Impact	Percentage of total
Manufacture:	10,04	11,81 %
Operation:	75,08	88,36 %
Recycling:	-0,14	-0,17 %
Total impact:	84,97	100 %

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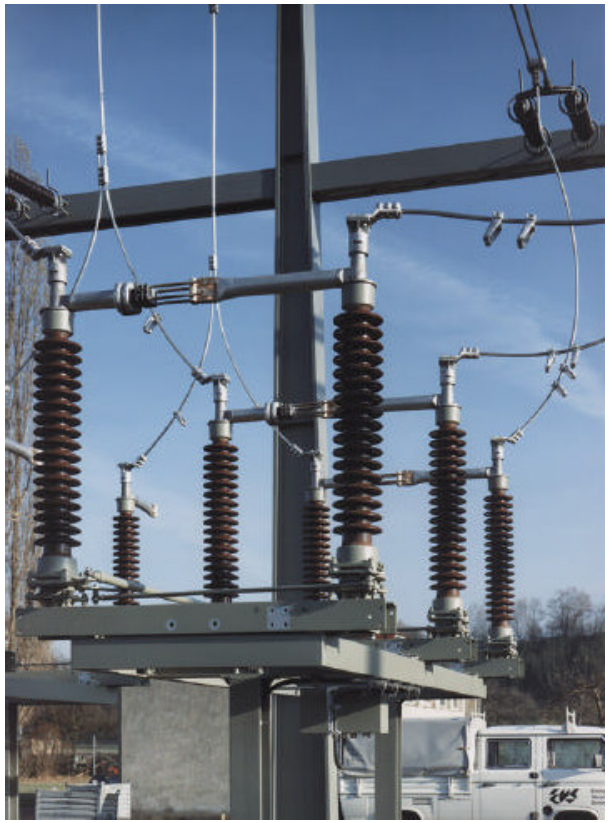
LCA example 4 – Disconnector 245kW



Material use (kg)

- Steel	525
- Aluminum	147
- Copper	63
- Wood	165
- Porcelain	540
- Polybutadiene	9
Total weight	1449

Assembly

Electric energy consumption (Poland)	1996 kWh
Combusted oil	113 kg

It is assumed that the product is transported 1000 km by lorry to the customer

Operation

Life time	20 years
Operation	Continual
Electric power losses	328 W

Product used in Italy

Recycling

It is assumed that 90% of the metals are recycled

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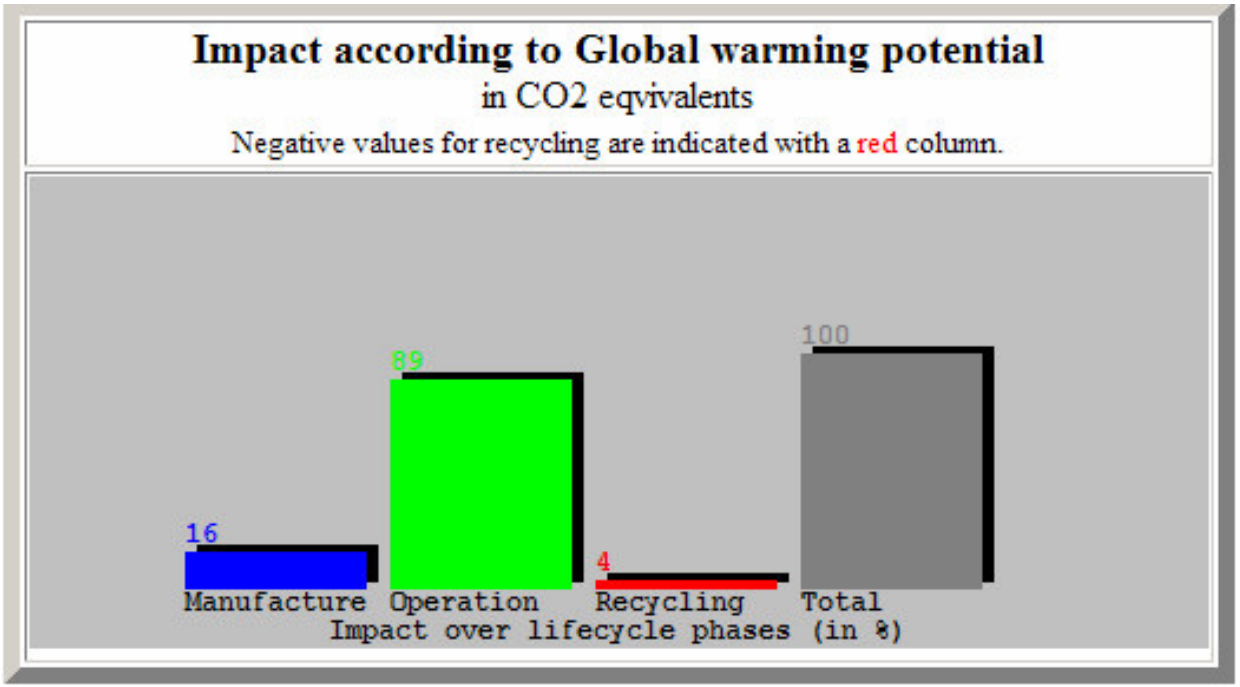
LCA example 4 – Disconnector 245kW



Life cycle phase	Impact	Percentage of total
Manufacture:	7428,08	15,59 %
Operation:	42222,5	88,62 %
Recycling:	-2006,19	-4,21 %
Total impact:	47644,39	100 %

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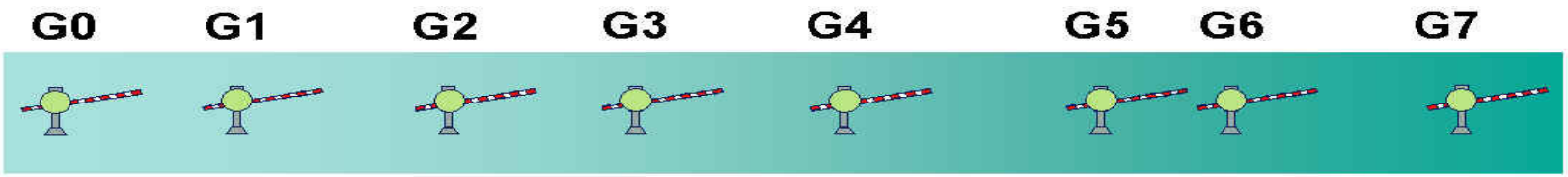
Environmental aspects in product development

- The ABB Gate Model
  - A common framework for management of product development projects within ABB
  - The aim is to ensure that projects are driven by business objectives and executed with full management commitment
- The ABB Gate Model is mandatory in ABBs product development projects
- Environmental aspects is included in the ABB Gate Model



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Environmental aspects in the ABB Gate model

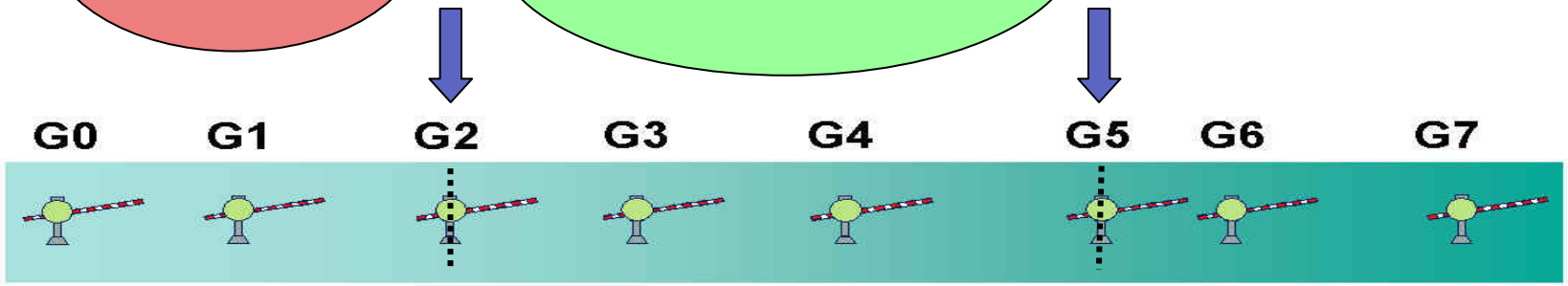
Assessment in two steps

Identify potential problems

Conduct screening LCA and take care of problems from checklist control

Checklist control

Screening LCA
Improvement work



Conducted checklist control?

Conducted LCA?
Taken care of problems from checklist control?

Two environmental check points in the ABB Gate model

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GATE 2 environmental checklist

- Check ABBs list of prohibited and restricted substances
- Check environmental related legislation that could have impact on product design, e.g. the coming EU-directive concerning Eco-design requirements for Energy-using Products, EuP, that will embrace electrical motor systems.
- Is it possible to improve energy efficiency during product operation?
- Are risks for emissions, leakage of oil, noise, EMF, explosion, fire and other local effects identified?
- Are there any occupational health and safety (OHS) risks related to the product?
- Are possibilities to reduce product weight and material use identified ?
- Is it the possibility to improve the products recycling and scrapping properties and increase the product life time (e.g. improving repairability and upgrading)?
- Are environmental aspects identified and included in the project plan?

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Gate 2- 5 screening LCA & improvement work

- Improve product in relation to the identified environmental problems and aspects at G2.
- Conduct a screening Life Cycle Assessment, LCA, to quantify the products' environmental life cycle performance, but do not overwork the LCA. Instead add the major amounts of materials into the LCA tool and the indirect impact from energy losses during operation since these stand for the dominating part of the environmental impact for many ABB products. Use the default evaluation, i.e. GWP (Global Warming Potential) as a first choice. GWP and CO2 are critical for ABB since the climate change issue is in focus today. If relevant also use other evaluation principles available in the LCA Light tool.

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LCA tools & databases

- Easy to use LCA Light tool accessible for all ABB employees through ABBs Intranet
  - Can also be found free of charge on http://www.dantes.info/ under Tools & methods/ software/ calculation tools
- LCI database developed and based on ABBs products and needs LCI database (e.g. much data for construction materials but not many for chemicals)
- LCI database maintenance is critical and conducted by LCA specialists at Corporate research in close cooperation with CPM/IMI at Chalmers Technical University
- The SPINE format is used in the underlying LCA database

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Lessons learned

- Environmental aspects must be integrated in the product development management/control model
  - Separate ecodesign projects can be a way to build competence in methodology and tool use but not a realistic organizational model on a long term basis
- LCA is a good tool to see the “big picture” but must be used in combination with other tools, e.g. list of restricted substances and checklists
- It is enough to conduct a screening LCA in a product development projects since the added value of conducting a comprehensive LCA study is mostly small
- An easy to use and direct accessible tool makes it possible for product development people to conduct the screening LCA themselves

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More information..

- Sustainability management in product development projects – the ABB experience, *Journal of Cleaner Production, Volume 14, Issues 15-16, 2006, Pages 1377-1385, Johan Tingström, Lennart Swanström, Reine Karlsson*
  - This article describes how ABB worked with environmental considerations when they developed their new capacitor. The sustainable development priorities are now integrated within their mainstream product development process model. The fact that ABB started a mandatory use of their GATE Model, including the sustainability considerations, verifies that ABB considers it to be a commercially sound methodology. The studied project resulted in a product with considerably better environmental performance than the traditional technology. One key factor is that the sustainability interest was truly advocated and supported by the management of the project.
- http://www.dantes.info/
  - LCA Light tool under: Tools & methods/ software/ calculation tools
  - ABBs working procedure and experiences under:
    - Strategies/R&D
    - Publications/Other publications/Surveys

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