dynamics according to several indicators to qualify the airport sustainability.

This study describes first the methodology for environmental evaluation of aircrafts, terrestrial logistics and airport buildings. The assessment of aircrafts is made through kerosene consumption and pollution emissions taking into account aircraft, engine and flight profile mission. The terrestrial catchment area of airport based on the trip duration between airport and user destination is also calculated to determine the regional influence of airport on environment, economy and society. The airport building impacts are also determined through their consumptions (heating oil, gas, electricity, drinking water) and their emissions. Consumptions and emissions due to aircrafts, passengers' logistics and buildings are then evaluated through a life cycle assessment and finally environmental impacts are calculated as functions of the passenger volumes.

In the second part of the study, social and economic considerations in relation with the traffic increase of an airport are introduced. Analyze of the impacts of air traffic will be performed through impacts on regional economy (Gross Regional Product, direct employment, impacts on key industry sector), social impacts (employment rates, types of jobs, Full Time Equivalent), development of cultural capital (tourism and migration flows), public and private services growth (number of firms in the regional area).

In conclusion, the most essential factors in the decision to expand an airport is the balanced and sustainable environmental management, including its economic, social and political dimensions . These studied aspects will carry to stakeholders a multicriteria support decision system.

Poster

LCM of large product systems: The case of the global passenger vehicle fleet

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The transition to a circular economy is complex, long-lasting process. To understand to what extent different possible transformation strategies may contribute to this transition, modelers use prospective or forward-looking assessment. Prospective assessment of industrial or end-user strategies such as renewable energy technologies or novel consumer products needs to take a life-cycle perspective to take into account the impacts of building and dismantling industrial capital and products. A life cycle perspective is also essential to studying the connection between different products or technologies and the cycles of the materials they are made of. Moreover, prospective assessment should be done at full scale to understand the system-wide consequences of different transformation strategies. The indeterminacy of future development is captured by a scenario analysis. Prospective modelling represents a scientifically credible implementation of consequential LCA.

We provide a case study for scenario-based prospective assessment. We focus on light-weighting of passenger cars using high-strength steel or aluminum to save emissions during the use phase. We provide a first estimate of the global impact of light-weighting by material substitution on GHG emissions from passenger cars and the steel and aluminum industries until 2050. We develop a dynamic stock model of the global car fleet and combine it with a dynamic material flow analysis of the associated steel, aluminum, and energy supply industries. We propose four scenarios for substitution of conventional steel with high-strength steel and aluminum at different rates over the period 2010−2050. We show that light-weighting of passenger cars can become a "gigaton solution": Between 2010 and 2050, persistent light-weighting of passenger cars can, under optimal conditions, lead to cumulative GHG emissions savings of 9−18 gigatons CO2-eq compared to development business-as-usual. Annual savings can be up to 1 gigaton per year. After 2030, enhanced material recycling can lead to further reductions: closed-loop metal recycling in the automotive sector may reduce cumulative emissions by another 4−6 gigatons CO2-eq. The effectiveness of emissions mitigation by material substitution significantly depends on how the recycling system evolves. This demonstrates the importance of managing global material cycles not only from a product but also from a systems perspective.

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Poster

Life Cycle Assessment approach in design of Airborne Inductive Electrical Equipment

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Today's trend in the aeronautical industry tends to reduce the aircraft weight by choosing wiser material solution. This trend has led, for instance, to the introduction of composite materials for aircraft structures.

In the field of electrical engineering, aircraft equipment manufacturers are replacing copper wires into aluminium wires. This conversion has been done by compromising density and electrical conductivity that is logically related to electrical losses. Indeed, if aluminium is known to exhibit a quite low density (2700 kg•m-3) compare to copper (8960 kg•m-3), its electrical conductivity (37,7×106 S•m-1) remains lower than copper (59,6×106 S•m-1). Consequently, designers have to compute these parameters to determine a relationship between cable sections, weight and electrical losses. In other words, this relationship would help to find a balance between energy efficiency and airborne load. This relationship may be introduced into a life cycle assessment model to provide an environmental foot-print optimisation tools for eco-design purposes. We rapidly came to the conclusion that the major part of the environmental foot-print of an aircraft electrical device is due to its use in flight. During this stage of the equipment life, electrical efficiency and airborne weight are the two critical parameters that both represent an extra fuel burn.

When it comes to inductive component, (such as alternators and transformers) this relationship becomes way more intricate. Indeed, the implementation of aluminium conductors implies necessarily an increase in terms of conductors section, which also implies an increase in volume of electrical windings. Consequently, bigger windings induces that the said windings have to be magnetically interconnected by a bigger magnetic material. This finally implies a severe increase in terms of weight of the global system.

Therefore, we developed a novel eco-design approach that aim to provide, in an industrial context and based on practical examples, a design guidance to reduce the environmental foot-print of inductive electrical equipment introducing aluminium into their composition.

Poster

Life Cycle Assessment in Magneti Marelli

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Magneti Marelli considers LCA as one solution to the ever-higher environmental expectations of stakeholders and a way to distinguish in the market. Magneti Marelli started in 2012, taking as references ISO guidelines and a “from cradle to grave” approach. The studies follow CML 2001 standard, adding to the traditional Impact Categories the “Primary Energy Demand”, useful to monitor the energy consumption of our manufacturing phase. Since 2012, Magneti Marelli has been involved on eight LCA projects; some of these LCAs were comparative, that is, a component whose life cycle, resulting wastes and consumptions are known and are subsequently compared with innovative solutions, in order to gather more information for strategic choices. This is obtained integrating LCA results with internal assessments about technical and economic feasibility. In other cases the projects are not comparison and focus mainly on the importance of the supplier chain, making them aware about the added value coming from LCA application. To optimize its organization, Magneti Marelli established an internal LCA Operational Team, that supports and coordinates teams within the Business Lines. Magneti Marelli teams receive scientific support even through the cooperation with the University of Florence and the University of Bologna. Additionally, in order to quantify its results, in 2014 Magneti Marelli used a KPI to measure each Business Line’s performances, calculating the percentage of revenues represented by vehicle components that underwent LCA projects. In the next few years, the aim is to gradually involve all Business Lines, applying LCA to more and more components while they are still being designed. In conclusion, more employees are expected to be trained to use the tools and methods aimed at consolidating this approach in the company, thus changing the mindset and reducing the impact of products and processes. The higher goal is to become the most environmentally-conscious company in the eyes of its stakeholders.

Poster

Life Cycle Assessment of Electric vehicles - the size and range effect

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The transport sector is responsible for approximately 25% of global greenhouse gas emissions. Light duty vehicles for personal mobility is the sector’s largest contributor to these emissions. To reduce light duty vehicle emissions, many governments have introduced favourable policies to ensure market uptake of electric vehicles (EVs) as these offer potential to reduce GHG emissions. Since the introduction of fully battery powered electric vehicles, the population of BEVs have grown significantly, and so has the vehicle size and driving range. So far, LCA studies on EVs are limited to small to medium sized vehicles and batteries. The objective of our study is to assess how increasing size and range influence the environmental impact of EVs and compare these impacts to those of conventional vehicles.

The study will be carried out as cradle-to-grave life cycle assessment comparing different sized EVs powered by Li-ion nickel-cobalt-manganese batteries. In addition, a sensitivity analysis will be performed to show the importance of the electricity source in all life cycle phases. Characterization of environmental impact will be performed using the ReCiPe characterization method for midpoint indicators from the hierarchical perspective. Emphasis will be placed on greenhouse gas emissions.

We expect to see a significant difference in life cycle impact between smaller and larger EVs. Much of the life cycle greenhouse gas emissions is likely due to the use phase, but a significant share will also be due to the production. Regarding production impacts, a large share will be due to the manufacture of batteries. Particularly for EVs with larger battery packs and thus longer driving ranges, production impact is likely to play an important role. The impact gap between smaller and larger EVs will increase in the use phase, as larger EVs consume more energy. We expect that disposal will not contribute with large impacts. Impact from disposal are likely to be small. Depending on the electricity source, EVs can be both better and worse than conventional vehicles.

Our findings will show that reducing production impact of traction batteries becomes increasingly important as we move towards larger EVs with larger battery packages and driving ranges. Reducing the carbon-content of electricity mixes is important if EVs are to reduce the carbon footprint of the light duty vehicle fleet. Our findings may have implications for future policies on light duty vehicles.

Poster

Life cycle assessment of transportation fuels based on lignocellulosic biomass – Comparison of selected fast pyrolysis conversion technologies

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Limitation of fossil resources, the strive for energy security and the goal of greenhouse gas emission reduction led industries, policy makers and society to search for alternative, non-fossil based, fuels. Fuels derived from lignocellulosic biomass represent a promising alternative to conventional fossil transportation fuels, as well as to other biofuels derived from crops targeted for food production. Several fast pyrolysis conversion technologies have currently been developed and have not been evaluated yet and thus, environmental and monetary implications need to be assessed to contribute in decision-making for a sustainable development of transportation fuels. Strengths and weaknesses for different production pathways of lignocellulose-derived fuels will be discussed. The investigation will be carried out for alternative transportation fuel options in 2014 and will give a future outlook.

Life cycle assessment addresses environment and economic impacts. A set of indicators will be defined that help to quantify effects of producing biofuels by the discussed production routes. Environmental impacts of technologies or products are evaluated and the results can indicate whether a