Greening California: Supply Chain Life Cycle Implications of Shipping Goods from Mexico vs. China

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Justification

- **California** is constantly increasing the trade of goods from all over the world. This trade represents economical benefits for the State. In addition, the Government tends to be on the leading edge of environmental awareness in several areas, such as transportation, production, energy supply among many others.
- The environmental burden related to the trading of goods is not only composed by the materials and energy expend in their production. In fact, this may only represents a small fraction of the total (Matthews et al, 2008). Significant improvements can arise if we take into account the whole supply chain, including manufacturing operations, transport, distribution to the final trade point and end of life.

Motivation

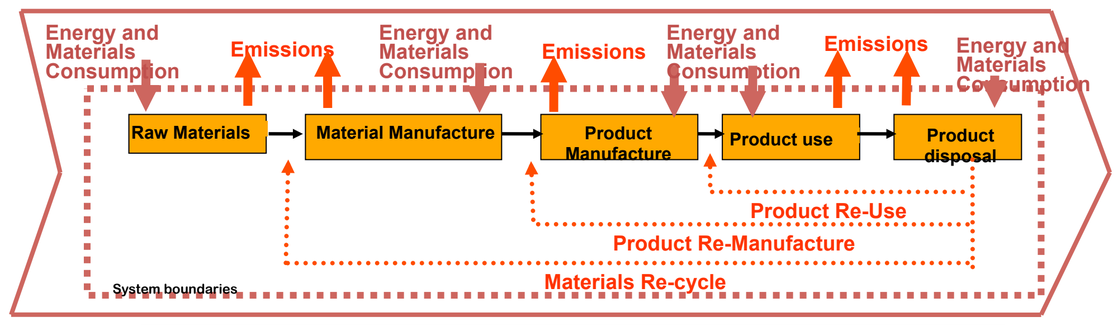
- The differences among countries and the complexity of global supply chains require an extensive evaluation and analysis of the issues associated with global reverse flows. Reverse flows can be managed in a supply chain mainly in two ways: reverse logistics or closed loop supply chain.
- In reverse logistics the reverse flows may be done independently of the original manufacturer, meaning the system was not designed and managed for forward and reverse flows; in contrast to the closed loop supply chain, which is explicitly designed and managed for both flows. This is why frequently the reverse logistics process is much more difficult to operate and it's rarely unchallenging to develop a viable value stream

The Problem

- Shipping goods to the Californian market (e.g. LA area) from different manufacturing sites

Air cargo - 1.7739 lbs CO_2 per Ton-MileTruck - 0.3725 lbs CO_2 per Ton-MileTrain - 0.2306 lbs CO_2 per Ton-MileSea freight - 0.0887 lbs CO_2 per Ton-Mil

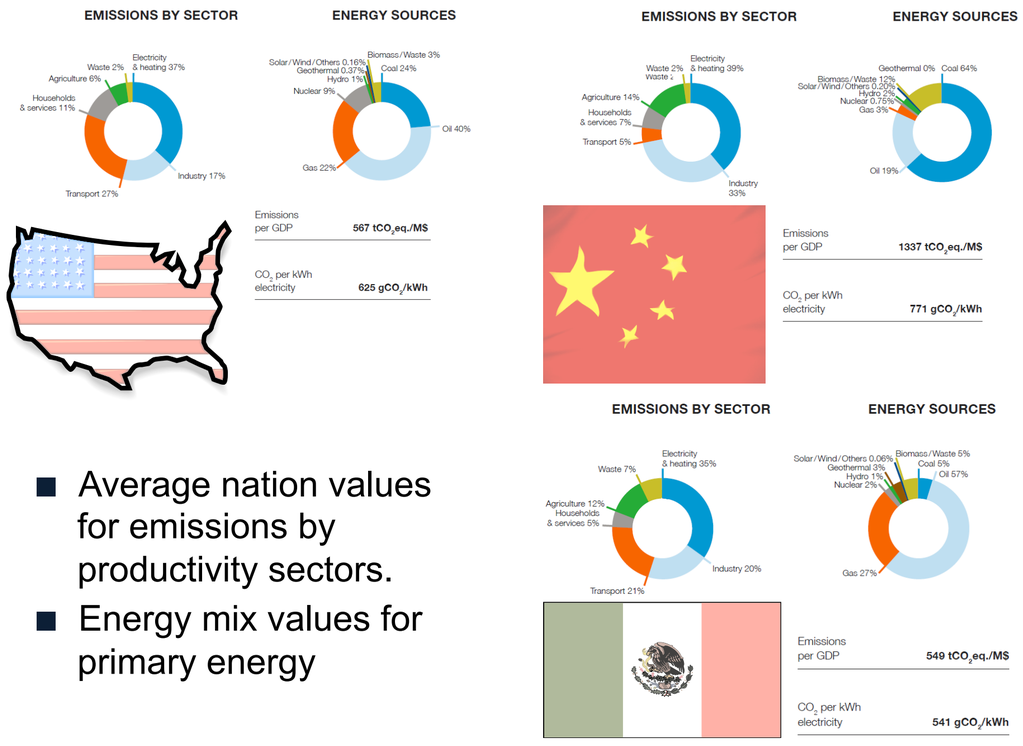
LCA methodology



ENVIRONMENTAL PERFORMANCE IN THE SUPPLY CHAIN

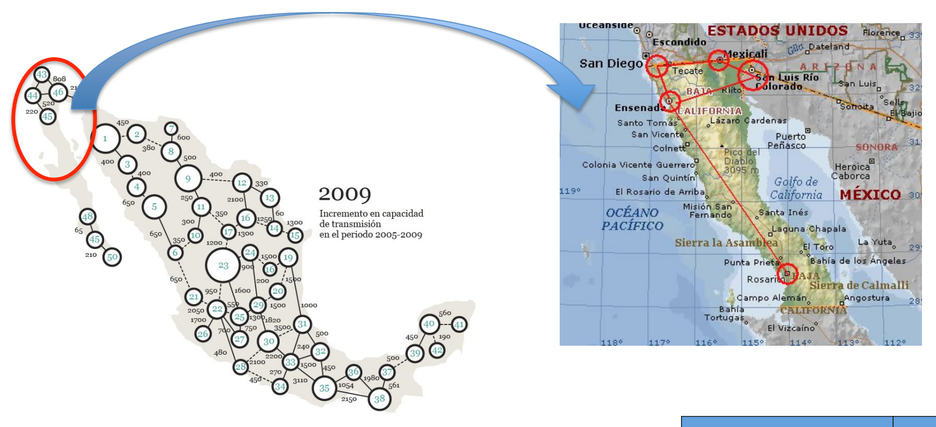
- Inventory analysis: identification and quantification of energy and resource use and environmental releases to air water and land.
- Impact analysis: the technical qualitative and quantitative characterization and assessment of the consequences on the environment
- Improvement analysis: the evaluation and implementation of opportunities to reduce environmental burdens

Regional Energy Comparison



- Average nation values for emissions by productivity sectors.
- Energy mix values for primary energy

The Mexican Energy Case



- The Mexican northwest electrical sub-grid is separated from the national grid and has it´s own energy mix.
- The main manufacturing center for the Californian market is located in the Tijuana-Mexicali Region

TECHNOLOGY	No UNITS	CAPACITY [MW]
Geothermal	91	805
Combined Cycle	13	985
Turbo Gas	15	326.86

Transport Processes for Mexico

Vehículo Gas LP

Name	Vehículo LPG	CONFORME A LA NOM-042-ECOL:
	0.0614 kg	equivalente a (MJ): 3.06693
Emissions to air		g/bhp*hr
NOx	**0.81** g	**0.709288** NOx
CO2	166 g	
CO	**1.1** g	**0.96323** CO
soot	0.01 g	
N2O	0.06 g	
VOC	**0.35** g	**0.306482** HCT
non methane VOC	0.34 g	
methane	0.01 g	

ITAM EXCELENCIA ACADEMICA

TRAILER I

ITAM EXCELENCIA ACADEMICA

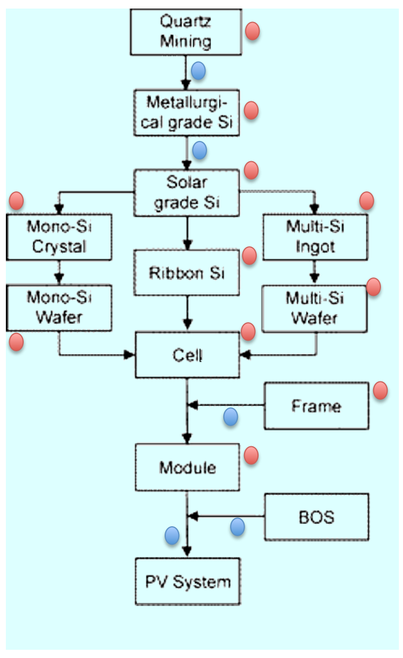
ACCORDING TO MEXICAN ESTANDARDS:

Datos actuales según Tabla 1:

	g / bhp*hr	Sima Pro
NOx	**4**	4.01
CO	**15.5**	0.88
HC	**1.3**	0.78
PST	**0.1**	0.31

Results of other transport vehicles have also been developed as part of ITAM's database. A couple of them appear in the electronic file of these LCA projects and in the open literature while results of (various) other transportation vehicles can be available upon request.

Test Case and Future Work



Transport
Energy

- The test case of Si-PV-panels is analyzed
- The regionalization of the LCA depends on the usage of transport and energy.
- Identify "hot spots" along the supply chain and actions for improvement
- Provide guidelines for business leaders interested in the NAFTA.

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