Painel Brasileiro de Mudanças Climáticas

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COPPE UFRJ
Instituto Alberto Luiz Coimbra de
Pós-Graduação e Pesquisa de Engenharia

Disruptive Low Carbon Technologies Roadmap
A contribution to Brazilian Low Carbon Action Plan

Date: 11/11/2016

Local: Brazilian Pavillon, Marrakesh, Morocco

Suzana Kahn

GHG Emissions – Brazil – 1990-2012 (CO_2eq)

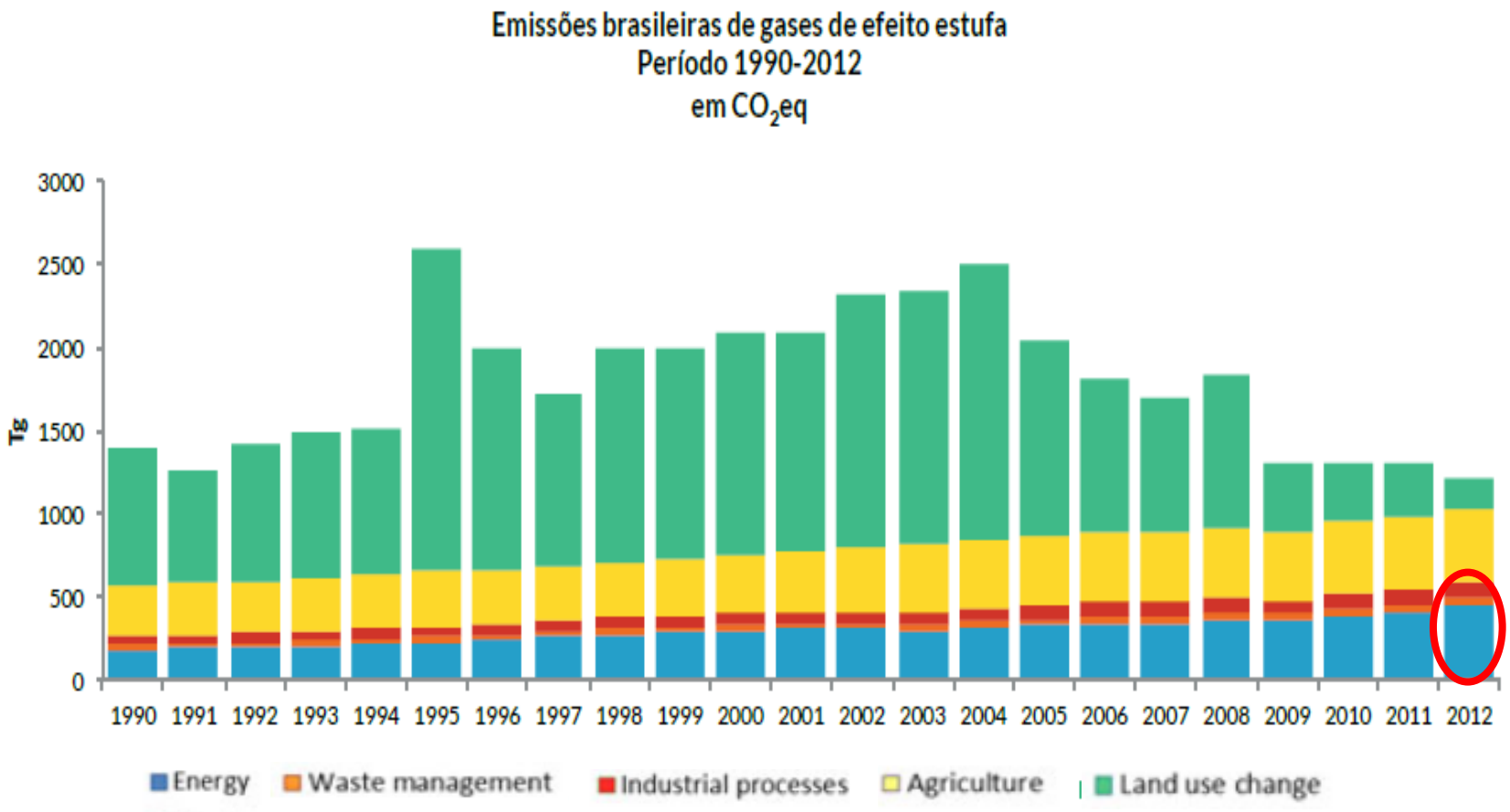
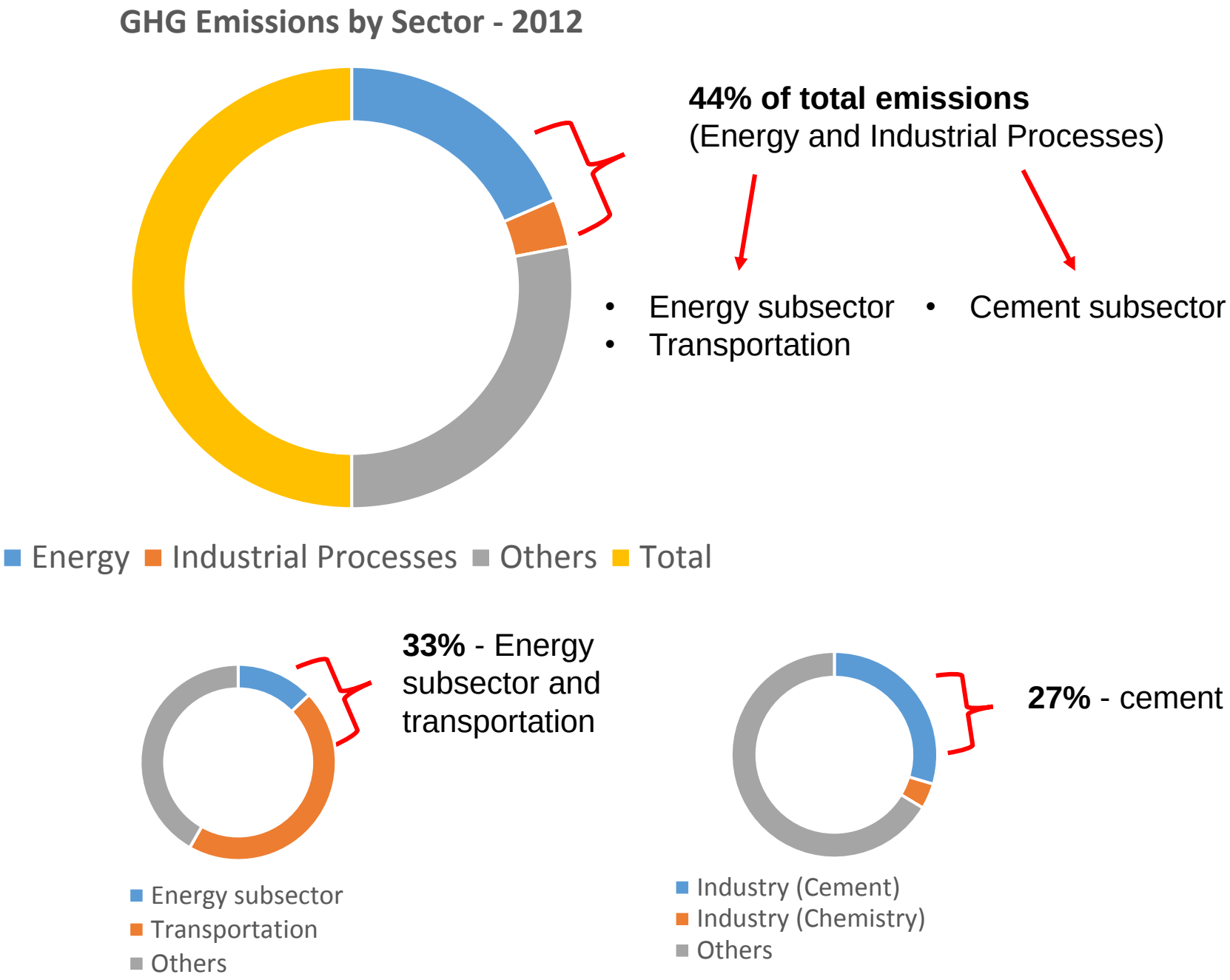
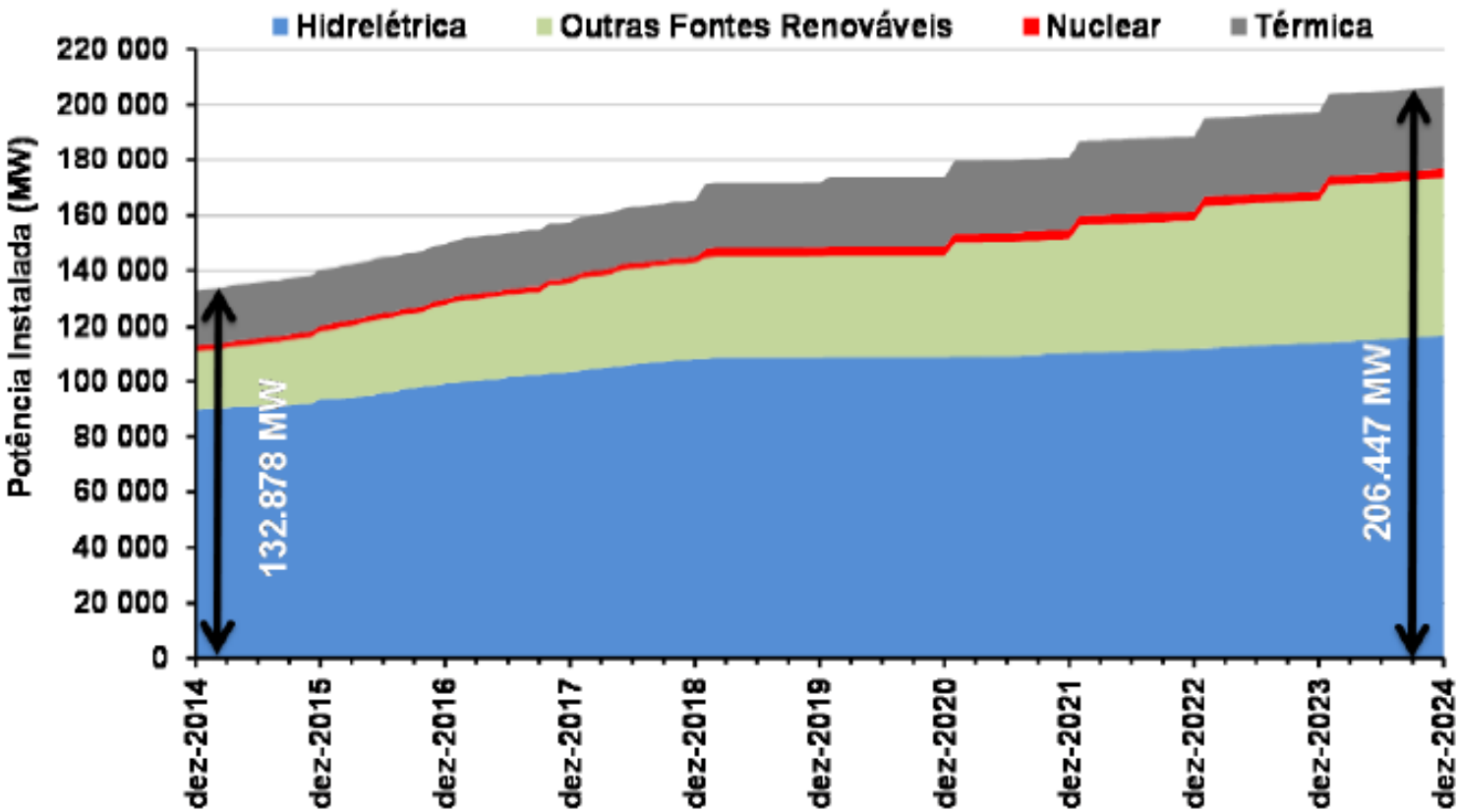


Figura I – Emissões de gases de efeito estufa no Brasil, por setor, de 1990 a 2012 (Tg = milhões de toneladas).

MCTI (2014)


GHG Emissions by Sector - 2012
44% of total emissions
(Energy and Industrial Processes)
• Energy subsector
• Transportation
• Cement subsector
Energy
Industrial Processes
Others
Total
33% - Energy subsector and transportation
Energy subsector
Transportation
Others
27% - cement
Industry (Cement)
Industry (Chemistry)
Others

Evolution Installed Capacity – SIN – 2014-2024



FONTE: EPE.

Potential Sectors for the Disruptive Roadmap

The objective of this study is to map how possible areas, technological ruptures might impact on Brazil's carbon emission scenarios.

•Sectoral Analysis

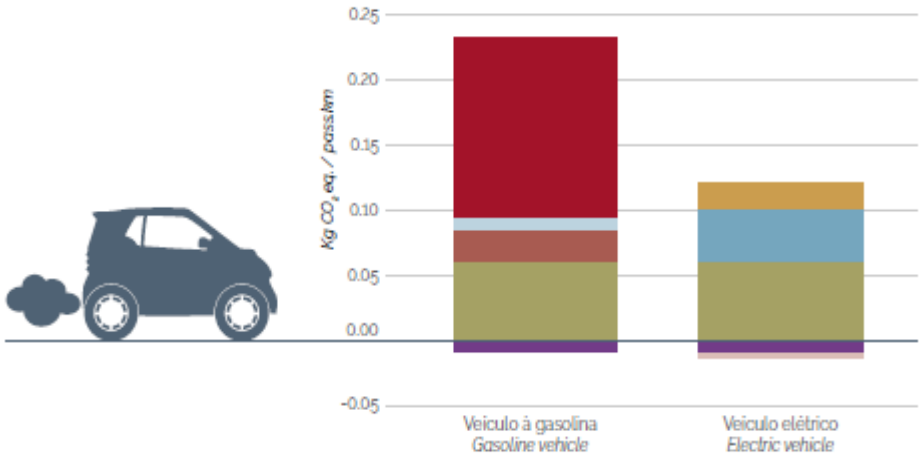
- Mobility – Fuels & Vehicles & Behaviour
- Industry – Cement
- Industry - BioChemistry
- Energy – Smart and Distributed Energy and Biofuels

Enabling Conditions Analysis:

•Regulation
•Legislation
•Investments
•Other instruments for support

Mobility

Electric vehicles represent a key alternative when we consider the expected expasion of car fllets in the coming years. Considering the CO2 balance between conventional and electrical vehicle, the last one presentes a much better result



Conventional and electric vehicles CO_{2eq}/pass.km emissions

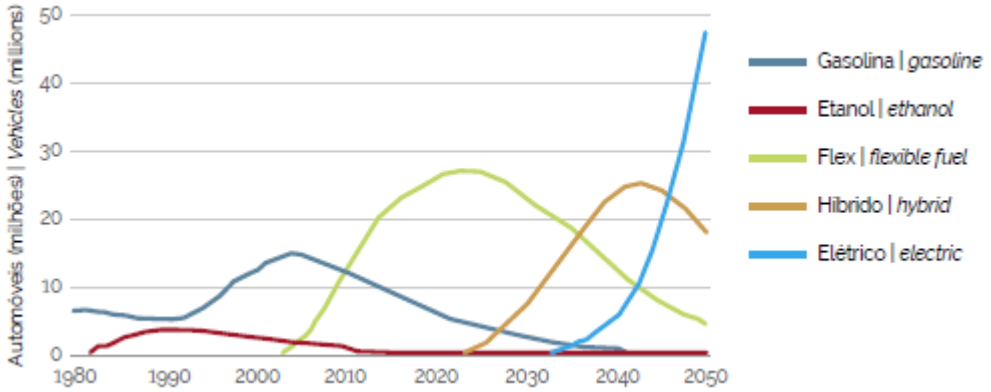
	Veículo a gasolina | *Gasoline Vehicle*	Veículo elétrico | *Electric Vehicle*
Reciclagem da bateria *Battery recycling*	–	-0.0041
Reciclagem do veículo *Vehicle recycling*	-0.0092	-0.0041
Produção da eletricidade *Power generation*	–	0.0177
Produção da bateria *Battery manufacturing*	–	0.0413
Uso combustível *Fuel use*	0.1368	–
Produção do Etanol *Ethanol production*	0.0090	–
Produção Gasolina A *Gasoline production*	0.0242	–
Veículo tipo *Vehicle-type*	0.0590	0.0590

Fonte: Elaboração própria com base nos dados de Sousa (2015).
Source: Adapted from Sousa (2015).

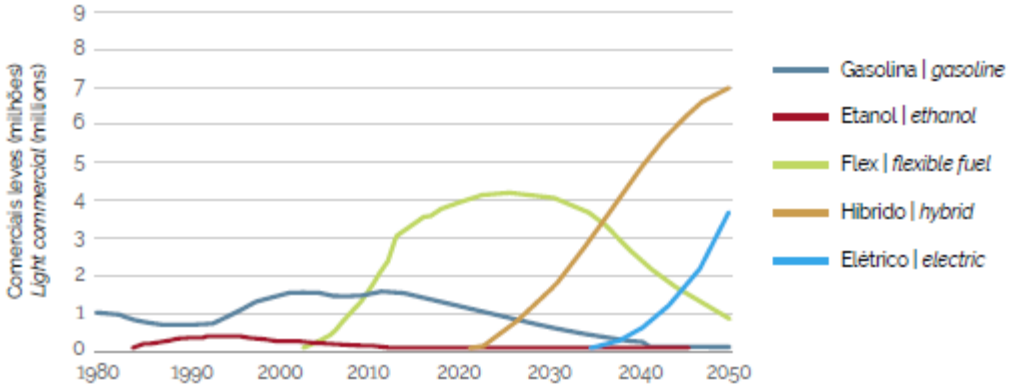
Disruptive Scenario – Electromobility

Different from conservative scenarios, it is pretty much possible that due to a massive economic globalizaion Brazil would follow the world´s electromobility trend. One of the reasons behind the widespread use of electricity is the fact that combustion engine is already at the eficiency limits, thus being no longer reasanable to keep investing in such technology.

The scenario estimates a car fleet for Brazil of 70 million vehicles and for light comercial vehicles a total of 11 million by 2050.



Evolution of car fleet - Scenario 4

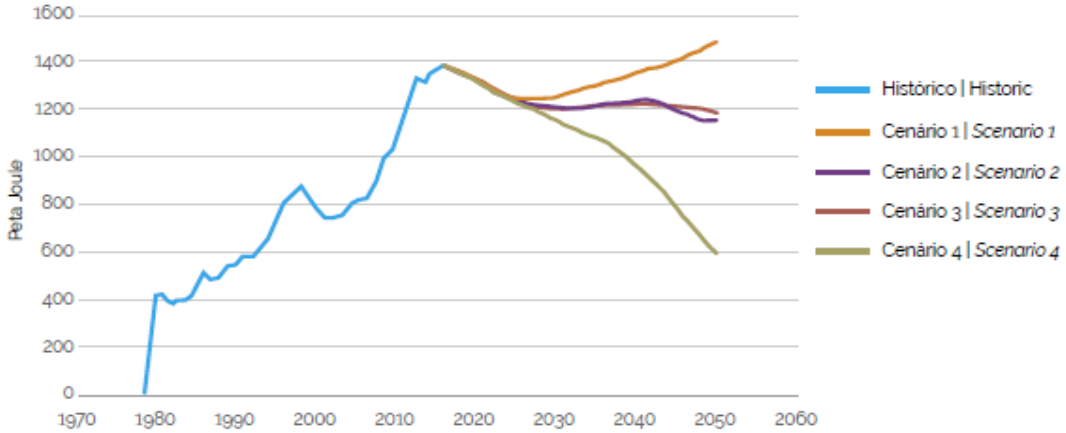


Evolution of light commercial vehicle - Scenario 4

Scenario Analysis

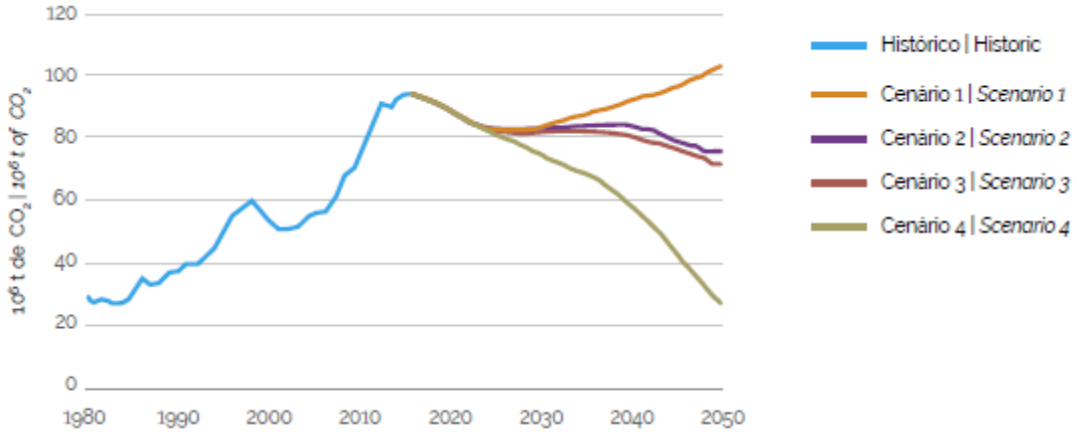
In order to be considered a low carbonon scenario, not only the vehicel has to be electric, but power generation must be from renewable sources. It is worth mentioning that the success of the large scale use of renewable energy is closely tied to the development of energy storage solutions.

It is also important to bring to attention that the current availability of battery charging infrastructure in cities to supply electricity to the fleet is a potential barrier for the implementation of eletromobility.

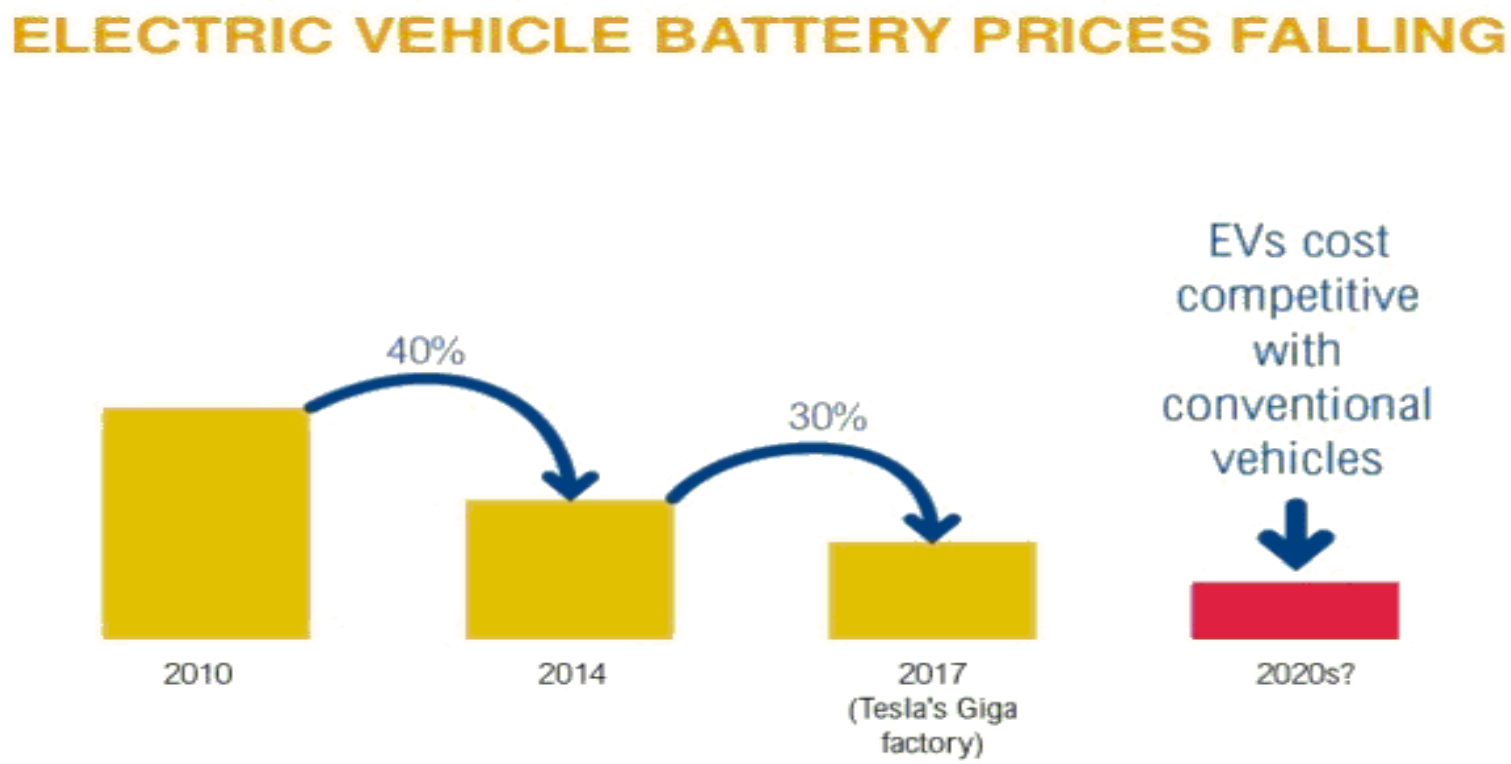


Energy demand in Peta Joule. (Scenarios 1, 2, 3, and 4)

CO_2 Emissions



Evolution of Battery Costs



Source: Seeing Is Believing: Creating a New Climate Economy in the United States

WORLD RESOURCES INSTITUTE

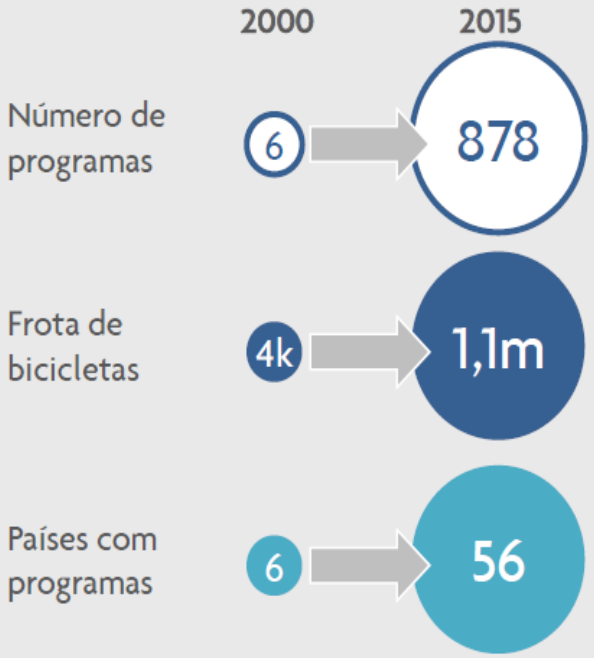
Mobility – Information Technology

Fonte: Catavento, 2015

Mobility: New Business & New Behaviour

- *Round trip*: usuários pagam pelas horas utilizadas do veículo e precisam retorná-lo
- *One-way*: mesmo modelo, mas usuários podem deixar o carro em outros pontos
- *Peer-to-peer*: pessoas cedem seus veículos para empresa terceira que conecta usuários e proprietários
- *Peer-to-peer*: serviço semelhante ao de taxi, mas sem exigência de licença
- *Ride sharing*: compartilhamento de carona para destinos em comum

Compartilhamento de bicicletas



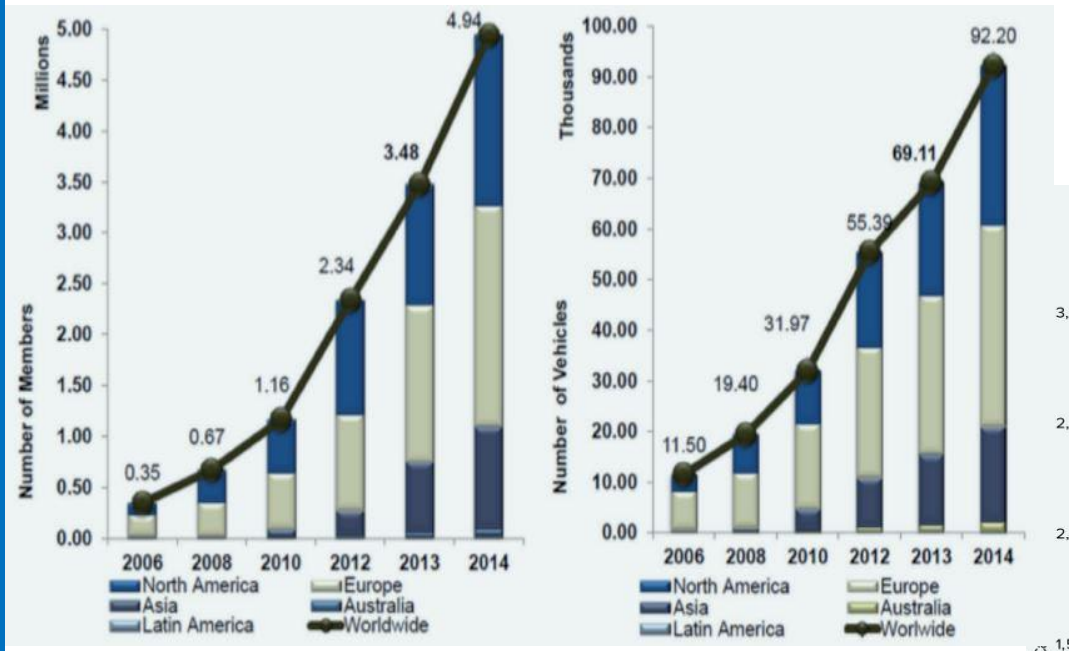
Fonte: IHS Forecast 2014; Bill Ford charts a course for the future –McKinsey interview, 2014; A roadmap to the future for the auto industry – Mckinsey, 2014; ITF Transport Outlook 2015, OCDE Publishing/ITF; www.earth-policy.orgThe Future of Urban Mobility 2.0 Arthur D. Little, 2014; Catavento, 2016

Electromobility: New opportunities EV Battery Re-use

Re-use of EV car battery

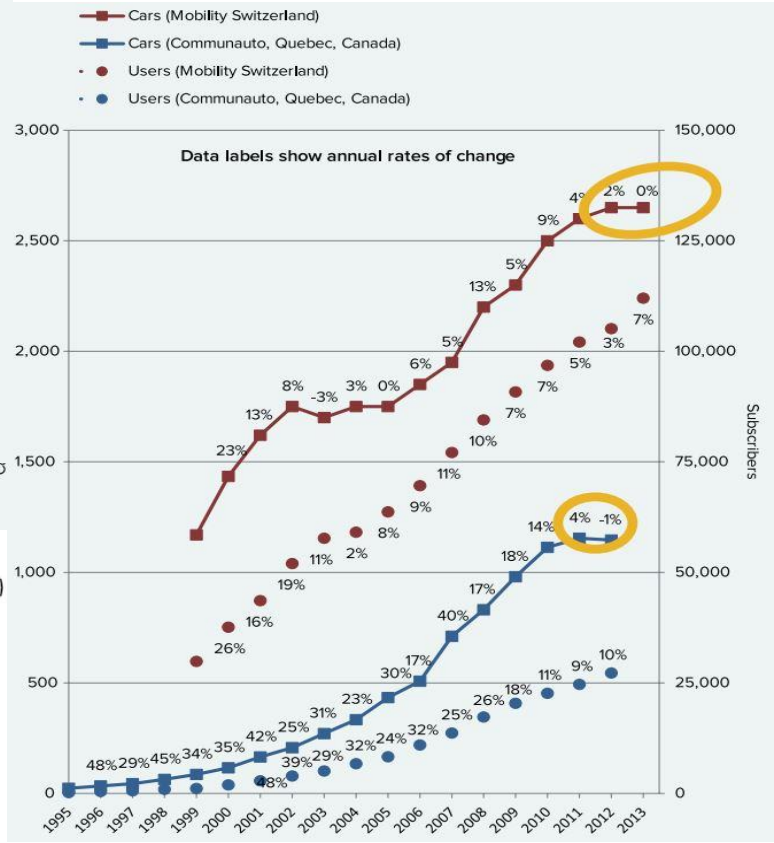
Energy storage

New Behaviour: Car Sharing Market Evolution



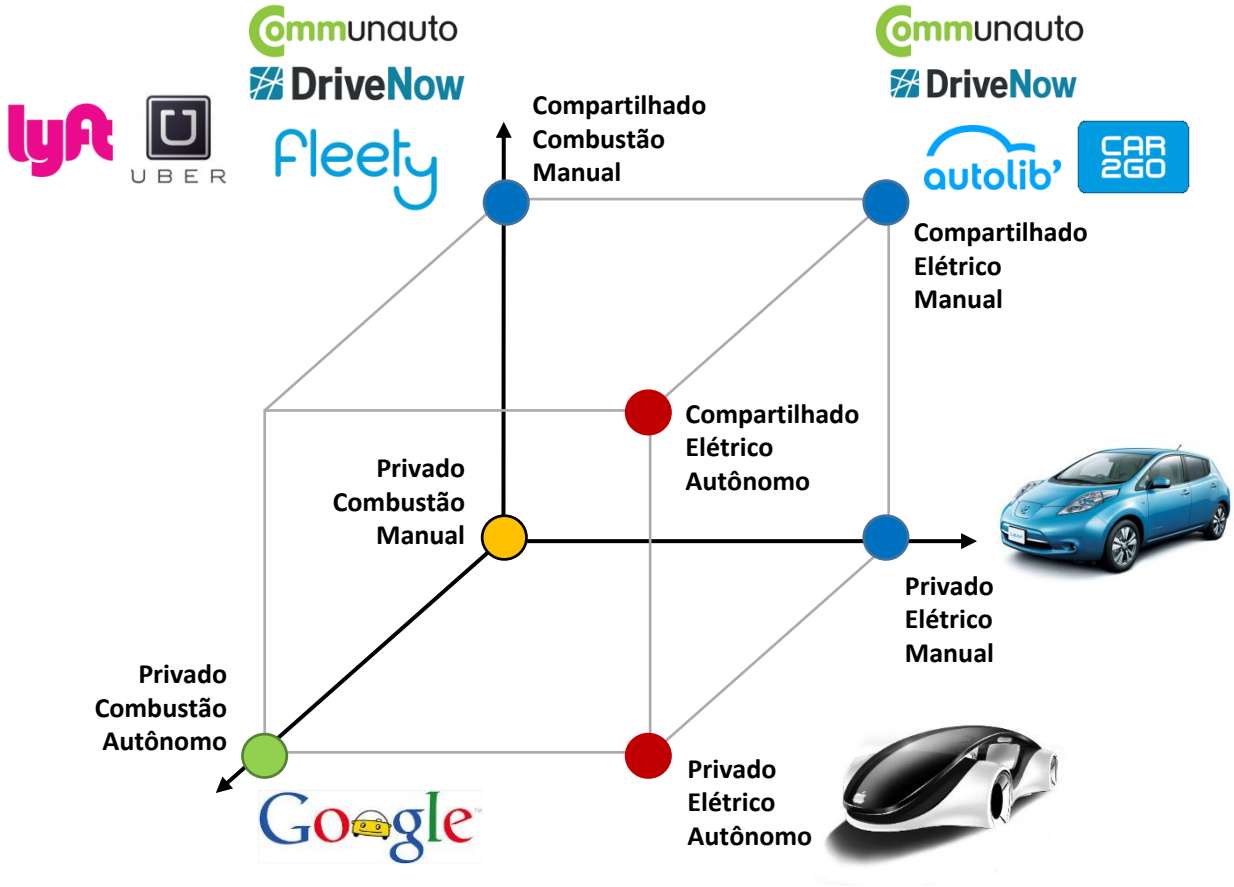
Source: ACEA, 2014

Source: Vulog, 2015



Source: ACEA, 2014

Mobility Trends



Industry - Cement

Cement Production accounts for about 9.6 EJ of Energy Use

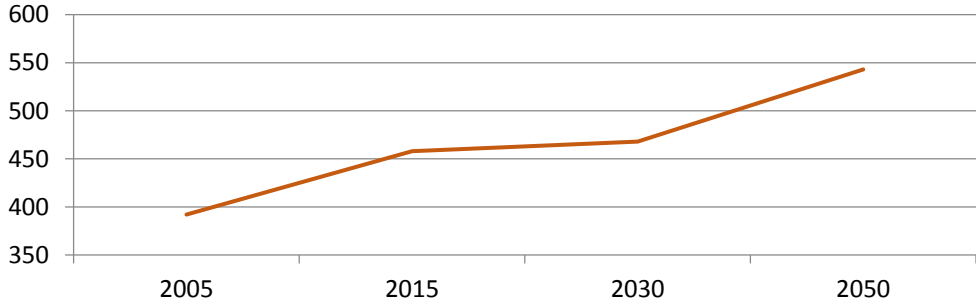
Total direct CO_2 emissions from cement production amounted to 1.9 Gt CO_2 in 2006

0.8 Gt CO_2 emitted from fuel combustion

1.1. Gt CO_2 from process emissions

World Cement Demand Scenario Projections – High Demand Case

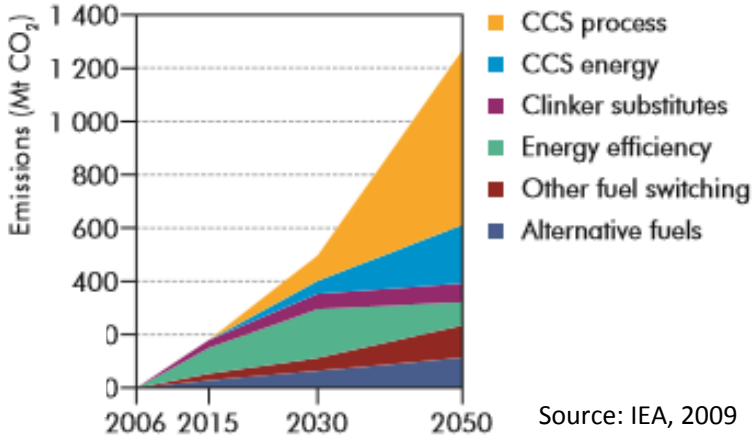
(kg per capita)



By 2050, the cement industry's CO_2 emissions could be reduced by 18%[2] through a combination of:

Improved energy efficiency
Increased use of alternative fuels
Clinker substitutes
Application of CO_2 capture and storage (CCS)

CO_2 emissions reductions below the Baseline 2006 to 2050



Source: IEA, 2009

[2] *Considering IEA High Demand Blue Scenarios*

Industry – Biochemestry Biofuels

Applying green chemical technologies to the transformation of typically low value and widely available biomass feedstocks, including wastes, we can build up new environmentally compatible and sustainable chemicals and materials industries for the 21st century.

Key drivers for the adoption of biorefinery technologies will come from all stages in the chemical product lifecycle, from the renewable energy industries and also from the food industries

Energy – Renewables, Decentralized Generation and Smart Grid

Figure 27. Global New Investment in Renewable Energy by Technology, Developed and Developing Countries, 2014

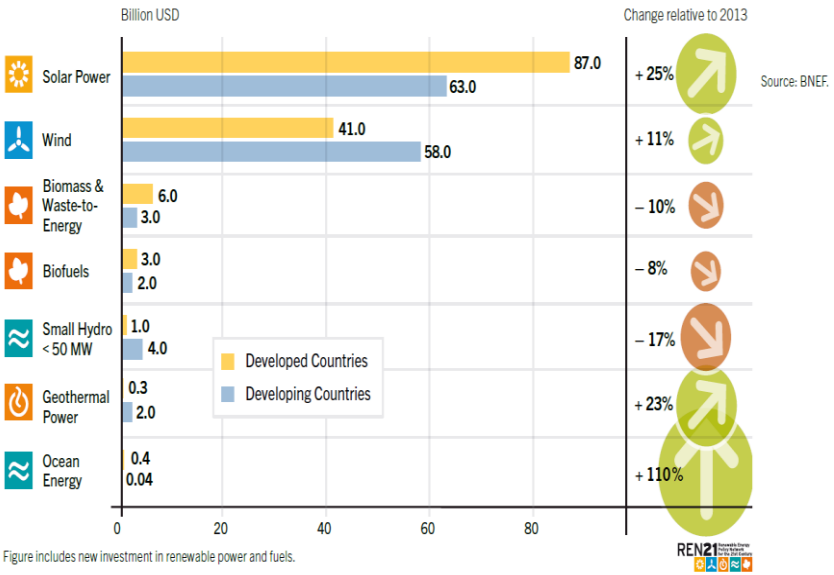
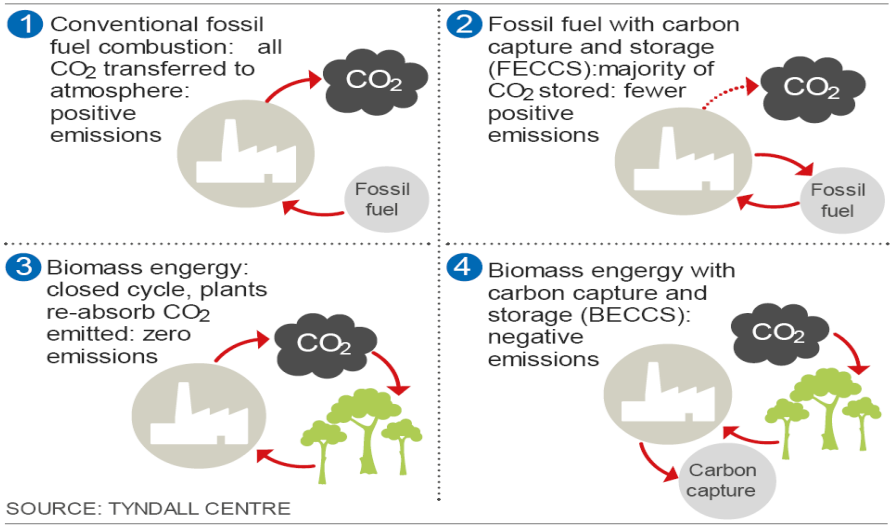


Figure includes new investment in renewable power and fuels.

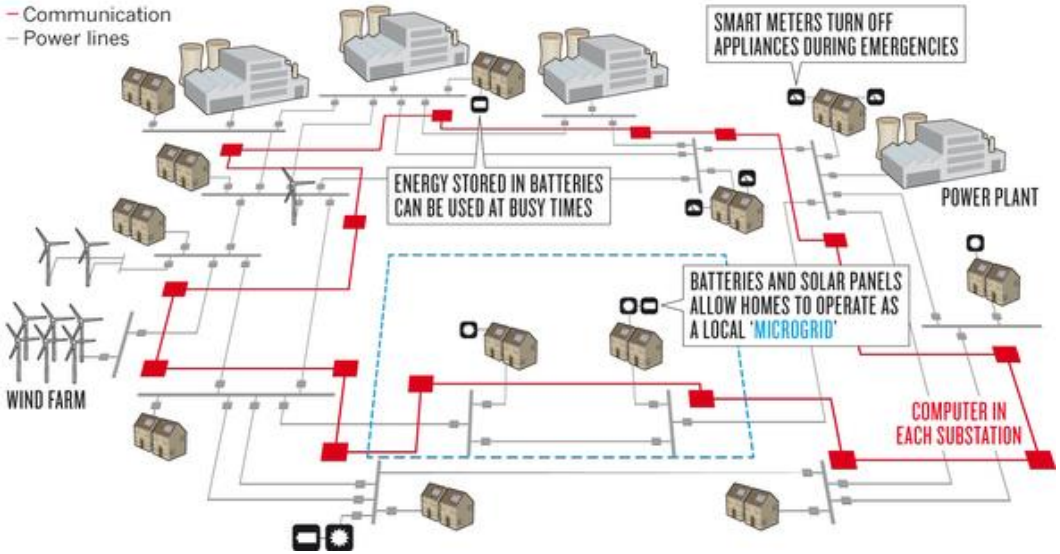
Negative emissions concept



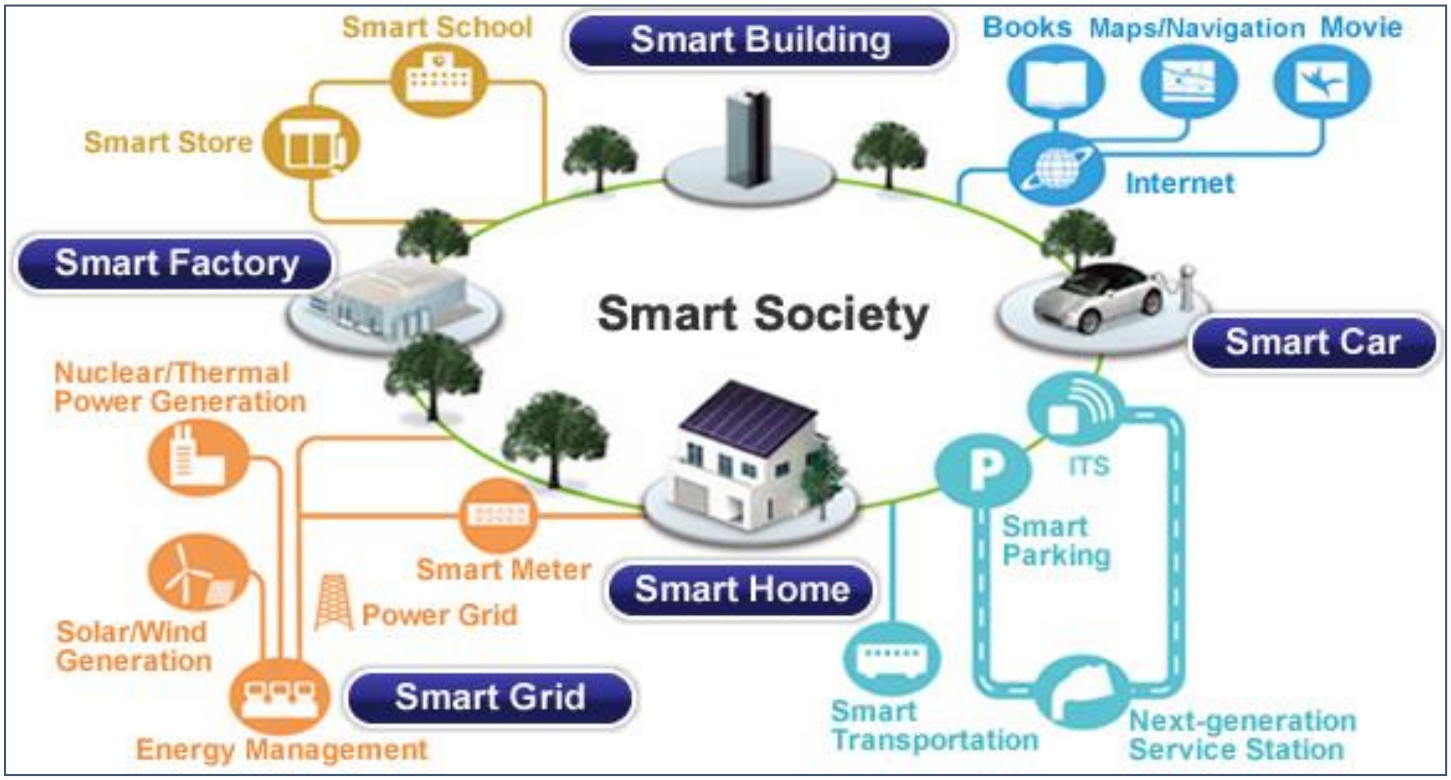
SOURCE: TYNDALL CENTRE

SMART GRID

Digital and communications devices installed throughout a power system can track usage and minimize and manage disruptions.



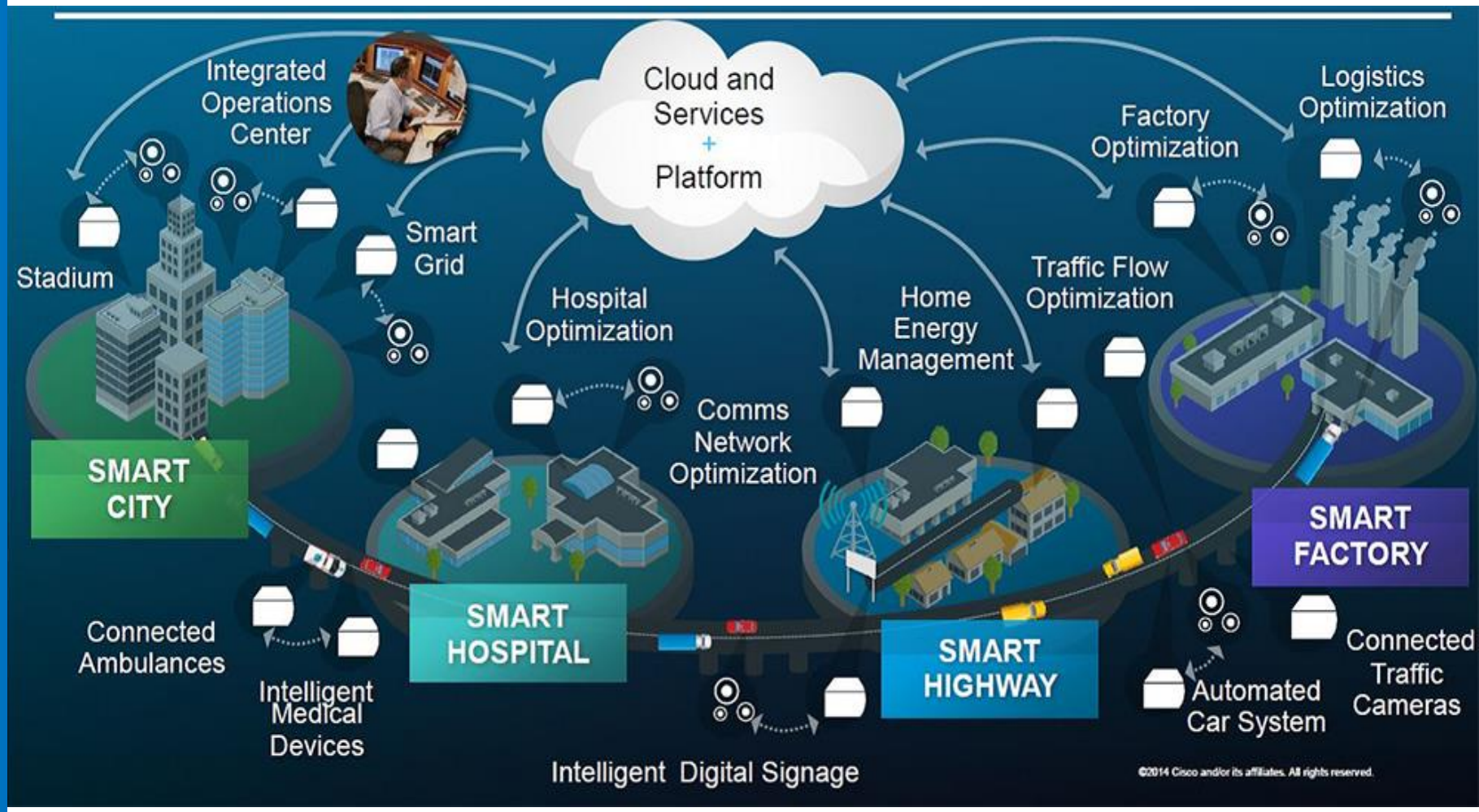
Using Inteligency as Mitigation Strategy



- ***Inteligency*** ***as*** **combination of:**

1. Data Mining (**Technology**);
2. Shared Economy (**Behaviour**)
3. Data Analysis, problems identification and solution proposals (**Inovation**)

The Internet of Thing



Source: Cisco, 2014

Potential Sectors

Final Remarks

- **Infrastructure development that lock societies into GHG intensive emissions pathways may be difficult or very costly to change**
- **Behavior lifestyle and culture have a considerable influence on GHG emissions**
- **The chance to develop and grow in the same fashion as developed nations is no longer a reality. The transition to a low carbon economy is inevitable and soon, it will not be an option.**
- **The developing world cannot use an outdated model to drive its growth and must consider the potential of disruptive technologies in their action plans.**