Promoting other means of transportation such as electric and hybrid cars with new structures

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Outline

- Motivation and background
- Infrastructures
- Vehicles
- Technologies
- Our project → HiQuad
- Our research activity
- Conclusions

Motivation and background

- Why? Where? When?
  - Why?
    - Reduce greenhouse gasses emissions
    - Reduce fossil fuel utilization
  - Where?
    - Everywhere → Both developing and developed countries → Modify way of thinking
  - When?
    - Now → We have to start as soon as possible to reach significant results

Motivation and background

- Reduce greenhouse emissions everywhere in the world

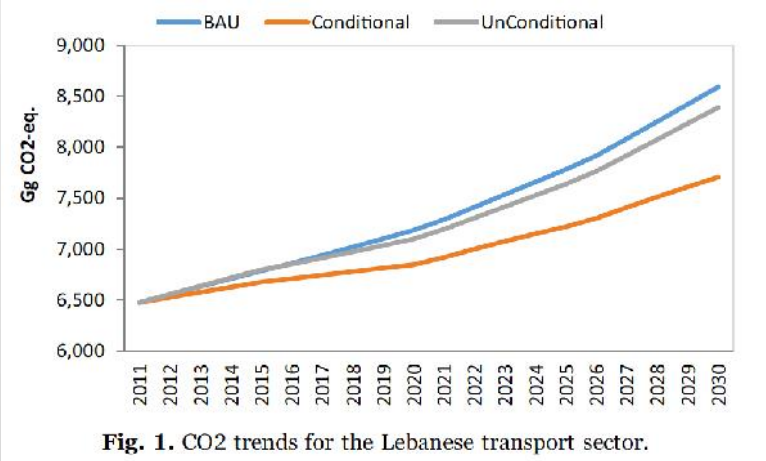
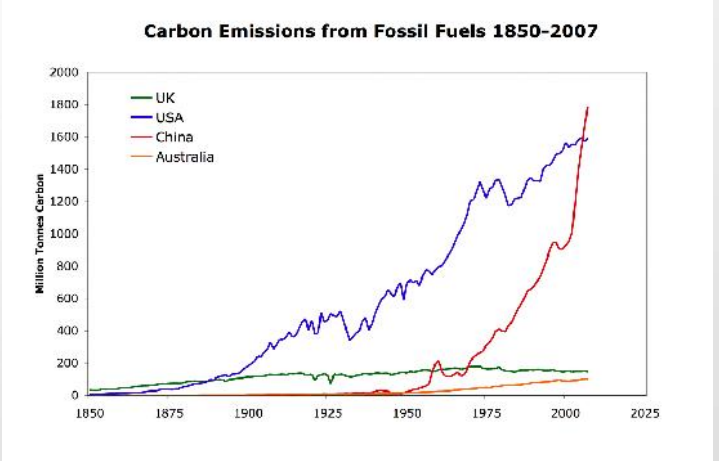


Fig. 1. CO2 trends for the Lebanese transport sector.

Well-to-wheel assessment for informing transition strategies to low-carbon fuel-vehicles in developing countries dependent on fuel imports: A casestudy of road transport in Lebanon, Charbel J. Mansour, Marc G. Haddad, Energy Policy, 2017



Motivation and background

- We have to re-think mobility idea:

Mobility: The movement of people and goods from place to place, job to job, or one social level to another (across bridges – physical or assumed).

Why? (…we do that)

- Reach a three zero approach:
  - ZERO emissions
  - ZERO accidents
  - ZERO stress

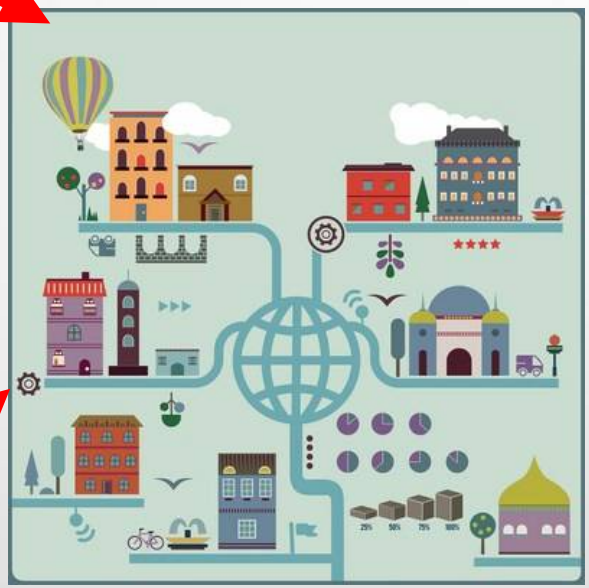
Infrastructures

E-governance and Citizen Services:

1. Public information
2. Electronic Service Delivery
3. Citizen Engagement
4. City's Eyes and Ears (video monitoring)

Waste and Water Management:

1. Waste to Energy & Fuel
2. Smart meters and management
3. Leakage identification (prevention)
4. Quality monitoring



Energy Management:

1. Smart meters and management
2. Renewable Sources
3. Energy efficient and green buildings

Mobility:

1. Smart Parking
2. Traffic management
3. Integrated transport

Others:

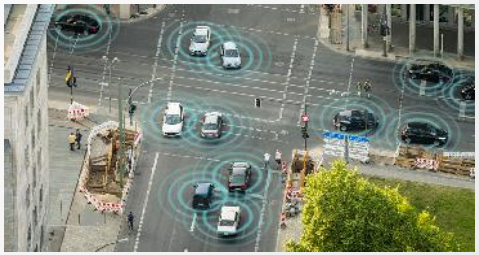
1. Cloud (haring data)
2. High speed internet
3. Tele-medicine

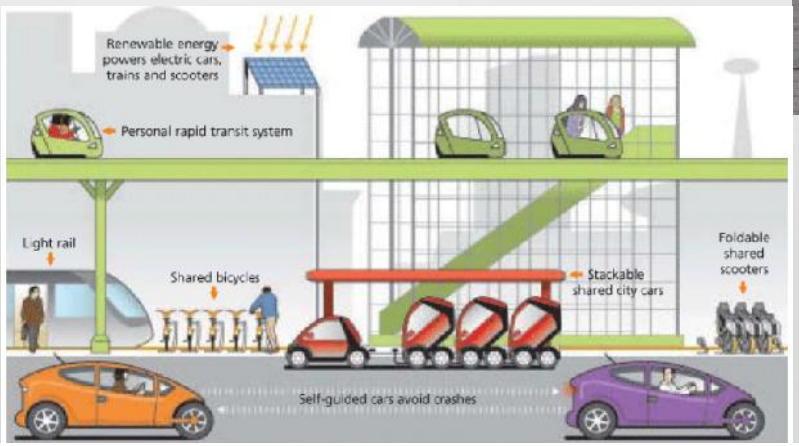
Infrastructures → Vehicles

- Personal vs. mass Transportation
- Car sharing
- Low-/zero-emission capability
- Growth of urban vehicles to cope with parking problems
- Increasing use of information systems
- Telecommuting and virtual presence

Vehicles

- Hybrid and Electric Vehicles
- Connected Cars
- Traffic Information
- Accident Prevention
- Driver Assistance





Infrastructures → Vehicles → Technologies

Connected Transportation Network

Integrated Data Exchange

Enhanced Human Services

Electric Vehicles Infrastructure

Our project → HiQUAD

- Project founded by Italian Government in the development plan "Industria 2015" promoted by MiSE (Ministero dello Sviluppo Econominco – Ministry of Economic Development)
- Example of Industry-University co-operation
- Development of an hybrid light car
- Implementation of integrated new technologies
- High connection capability

Our project → HiQUAD

Our project → HiQUAD

- *Mass 350 kg*
- *Electric Engines Power: 4 kW (each)*
- *Maximum speed: 45 km/h*
- *2 seats(driver + passenger)*
- *High safety light chassis*
- *Range extender for emergencies*
- *Air conditioning*

- *Electronic for stability control*
- *Nice aspect*
- *Interconnection (tablet-internet-wifi)*
- *Good habitability*
- *Good autonomy (batteries)*
- *Comfort on-board (suspensions).*

Our project → HiQUAD

- *Pressure sensor installed into the combustion chamber → real time monitoring of cylinder pressure.*
- *Data have to be analysed in real time.*
- *Develop and ECU which is able to maximize engine efficiency at every cycle:*
  - *Increase specific power*
  - *Reduce pollutant emissions*
  - *Adapt engine behaviour to the specific circumstances*

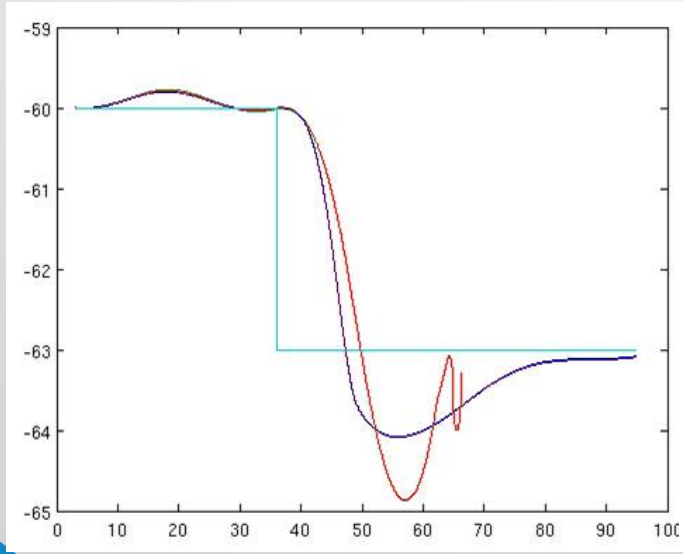
Our project → HiQUAD

- *Two wheel-engines installed on rear wheels*
- *Batteries:*
  - *Standard Equipment → Lithium Batteries 5kWh*
  - *Optional Equipment → Lithium Batteries 10kWh*

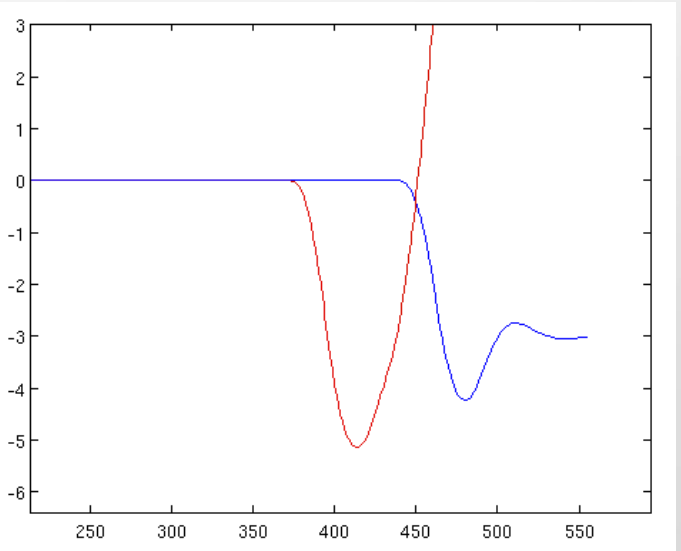
Our project → HiQUAD

- *Traction control with TORQUE VECTORING in order to increase safety and stability over all the driving conditions*

Driving on Ice



Driving on Snow



Our project → HiQUAD

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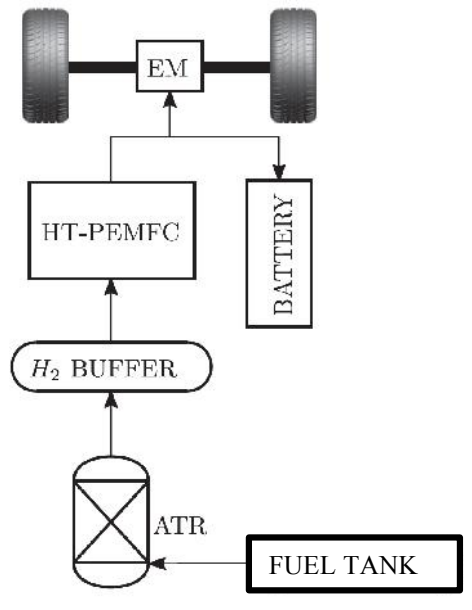
Our research activity

- *Development of a hybrid electric-fuel cell vehicle with on-board hydrogen production*
- *Possibility of using standard fuels → no need of new infrastructures*
- *Low CO_2 emissions → there is no combustion*
- *High efficiency in a wide range of operating condition*
- *Possibility to charge batteries at home*

Our research activity



Energy management of a plug-in fuel cell/battery hybrid vehicle with on-board fuel processing, L. Tribioli, R. Cozzolino, D. Chiappini, P. Iora, Applied Energy 2017

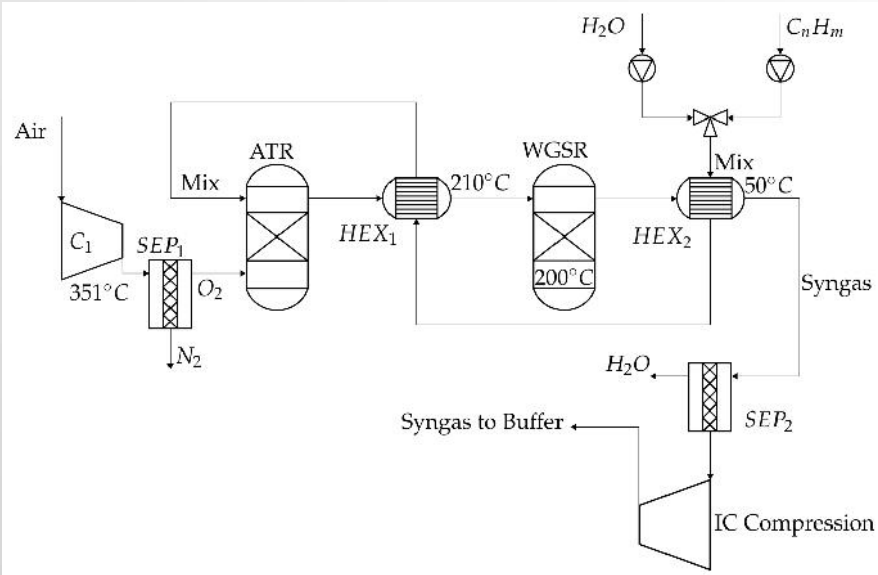
- *Electric motor can be driven both by HT-PEMFC and by Batteries*
- *Electric motor can work as generator as well (during brakes)*
- *Hydrogen buffer is needed in order to make the HT-PEMFC ready to operate at every load request*
- *ATR makes the conversion of standard-fuel to hydrogen*

Our research activity

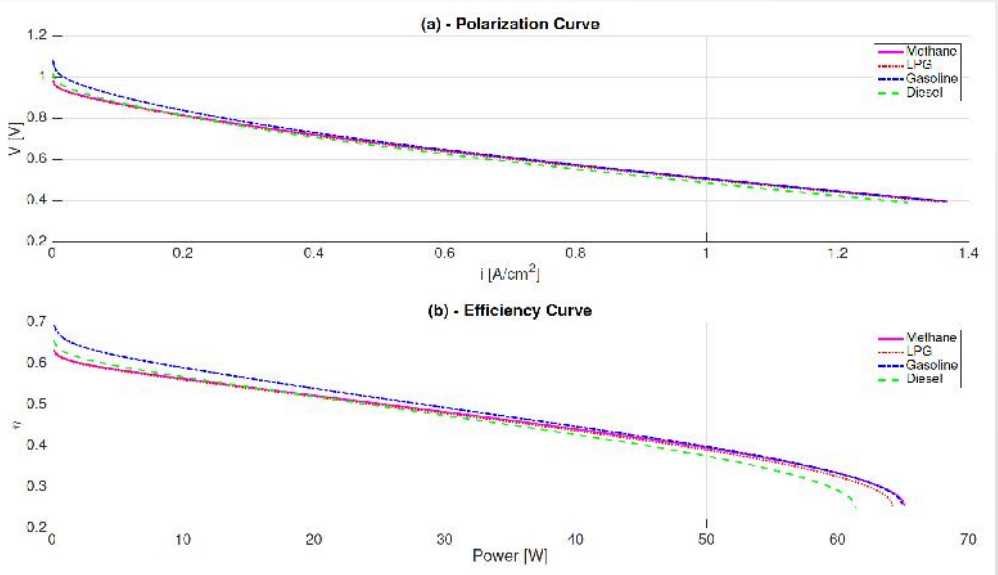
- *The ATR is simulated through commercial software (ASPEN Plus ™)*
- *A semi-empirical zeroth-dimensional model has been implemented for deriving the polarization curves of HT-PEMFC under different conditions of CO poisoning*
- *Vehicle and Control have implemented in Matlab-Simulink®*
- *We have realized a sensitivity analysis to different fuels in order to understand effectiveness of such a system*

Our research activity

ATR system Layout



HT-PEMFC polarization and efficiency curves



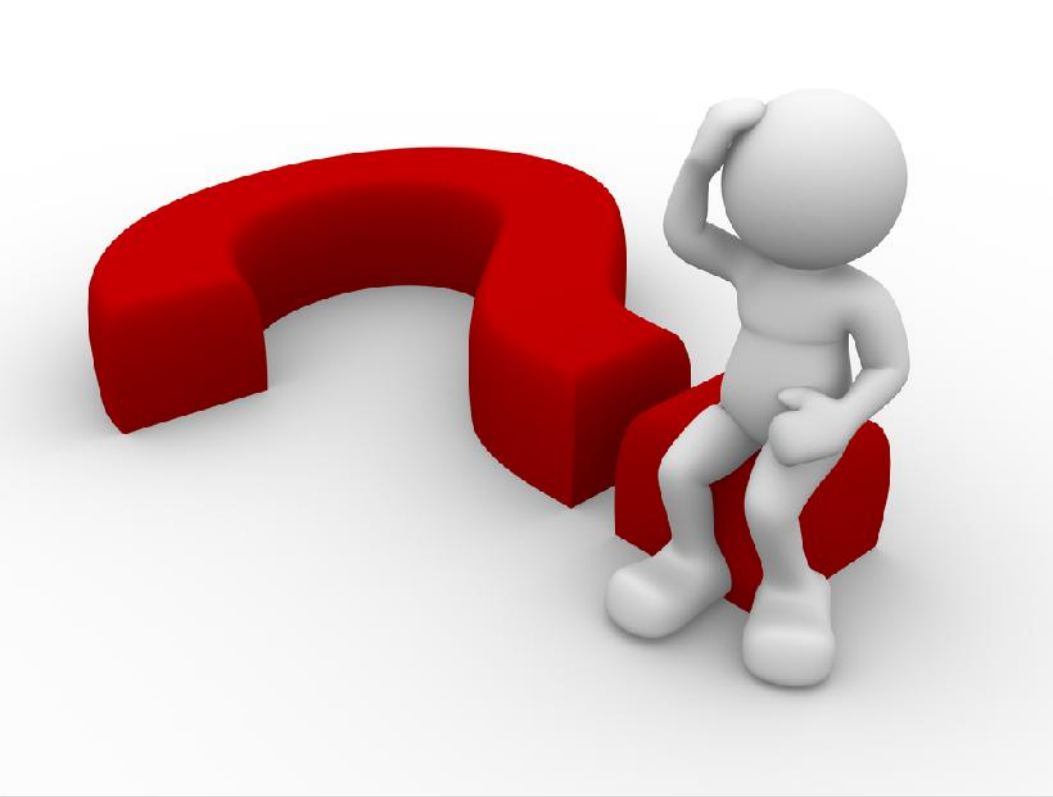
Our research activity

	Conventional Vehicle vs FCV		
	Diesel	Gasoline	LPG
Driving Cycle	%	%	%
Urban	172,1	209,8	284,0
Extra Urban	136,4	138,0	213,0
Mixed	234,5	330,7	403,4

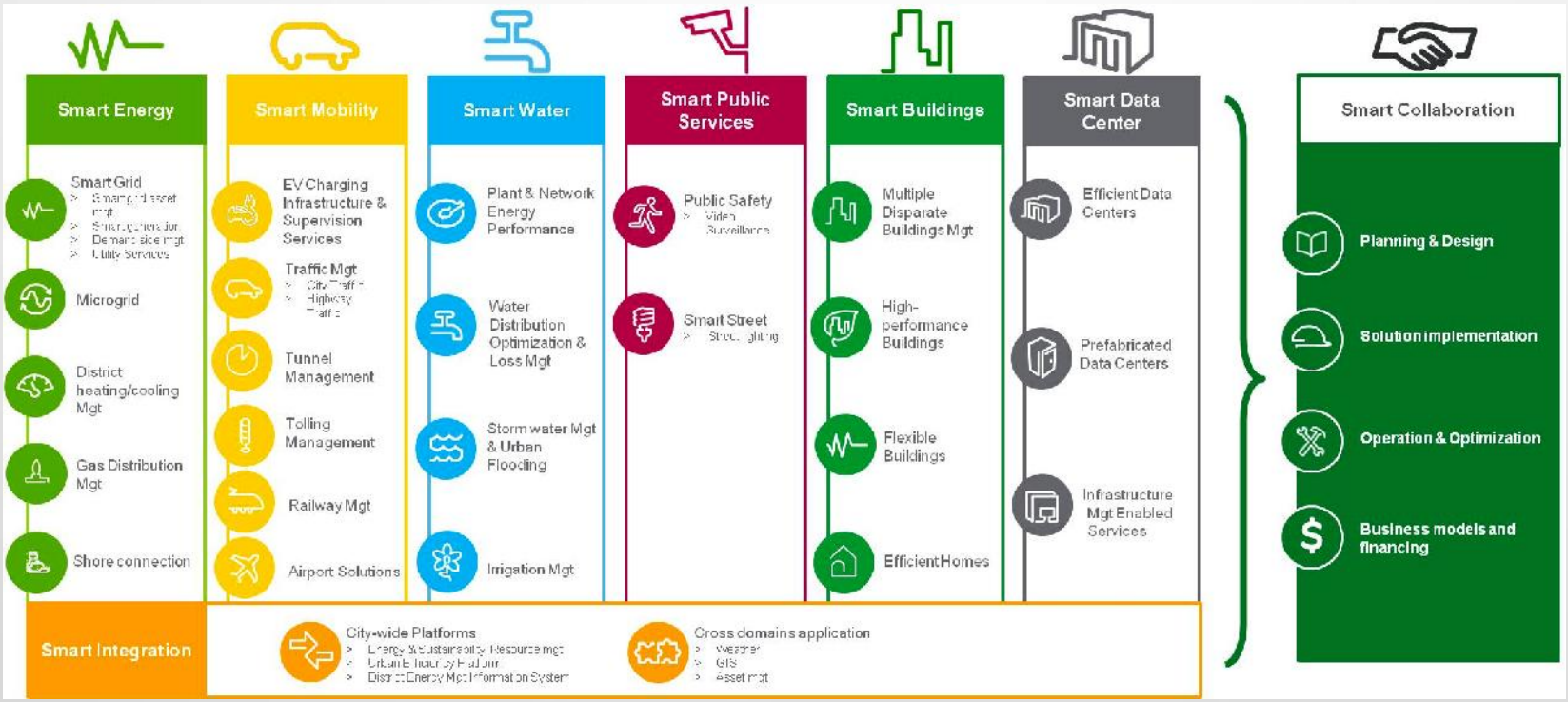
Conclusions

- We have to rethink to city concept
- We have to push towards technical improvements in some critical aspects
- We have to change way of thinking mobility
- Improve “sharing sense”
- Improve vehicles and infrastructures design

Thanks for your attention!



Towards a smart way of thinking



Technologies

- Fast Internet Connection
- Cloud Sharing
- Big Data Servers
- Online monitoring
- Batteries
- Tele-medicine

Our project → HiQUAD

- *Sinopoly Cells LiFePO4 66Ah 3.2V*
  - *High safety and stability*
  - *Low discharge current (0.8%moth vs 10% of standard LiPO)*
  - *Long lifetime cycle (>2000 vs 500 of standard LiPO)*
  - *Good Charge/Weight Ratio (115Wh/kg vs 167Wh/kg of standard LiPO)*