TIFFE.
Thermal Systems Integration For Fuel Economy

ATMOsphere 2010
faster to market
natural refrigerants

# EDUCATION

## How to quantify the environmental impact of refrigeration / heat pumping systems?

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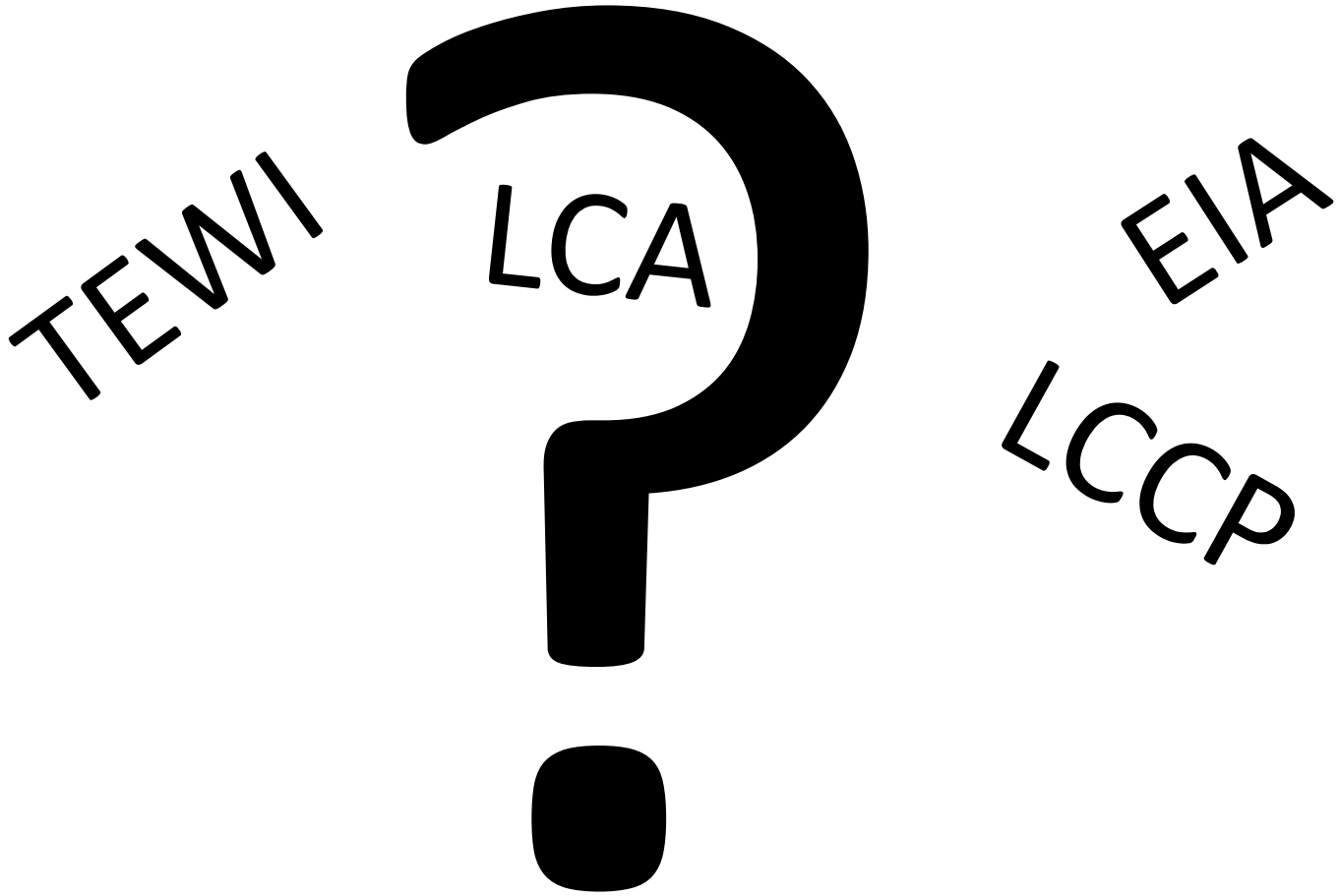
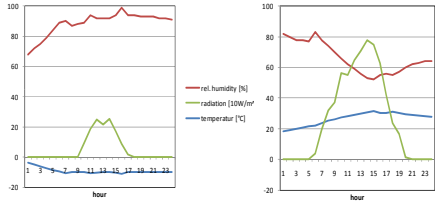
# Which tool?



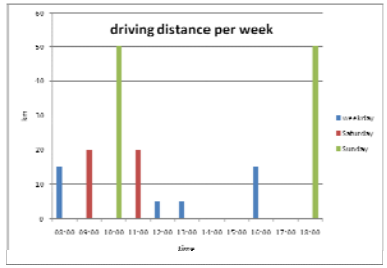
# Example MAC

ATMOsphere 2010 faster to market natural refrigerants

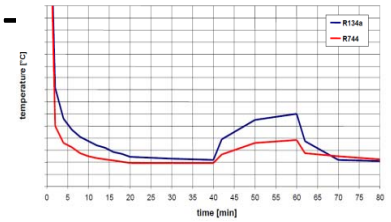
- **Annual Climate data**: hour by hour
  - Ambient temperature
  - Rel. Humidity
  - Solar (global) radiation



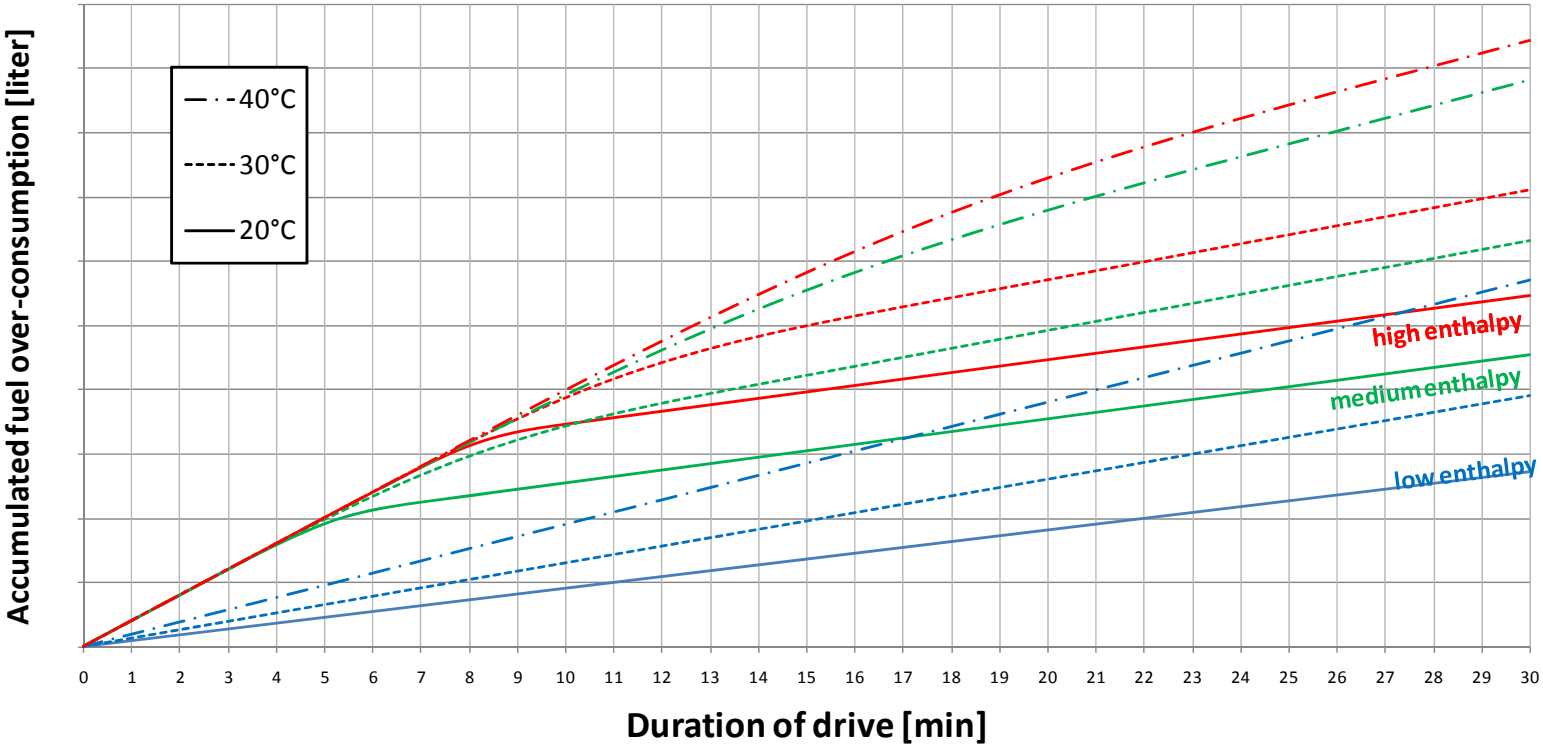

- Define **driving routine** of user
  - Daily / week based
  - Parking habit : sun / garage




- Understand the **performance of the MAC**
  - Fuel consumption also during pull-down / heat-up



- **Measure** fuel overconsumption during pull down (minute for minute) to calibrate the simulation tools
-



# Environmental Impact Result (equ. $CO_2$ emissions)



+ During production of vehicle
+ Lifetime -> when driving the vehicle
+ EoL (end of life)

= Total impact related to $CO_2$ emissions

Others?

# Issues

- Other **reference values** than $CO_2$ equivalents
  - kWh electricity (production, usage, EoL)
  - No. of Fluor atoms in a molecule (& GWP)
    - Impact of decomposition products like TFA
    - -> Deposit like 10€/F