



# Assemblea ANITA – Transfrigoroute

The Next Generation of TRU

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**ONU W.P.11**

**CEN TC 413**



UNITED NATIONS  
ECONOMIC COMMISSION FOR EUROPE



Preamble:

- 40% of all foodstuffs must be transported under controlled temperature.
- 12% of fresh products transported by road are damaged due to lack of refrigeration. (bad storage or bad transport?).
- 15% of energy consumption from fossil sources is used for refrigerated transport.
- More than 4 million refrigerated vehicles in the world.
- A 3-axle truck fridge produces 50ton CO2 per year\*
- 2.5% annual reefer'vehicle increase up to 2030.

= disaster

\* Both for diesel consumption and for refrigerant leaks

## UNECE: Sustainable Development Goals (SDGs)

- Fossil energy reduction
- Support for renewable or "green" energy
- Efficiency in transport with alternative energies (electric, hybrid, hydrogen).
- Sustainable and safe transport
- I.T.S. (Intelligent Transport System)
- Recommendations for reducing food waste



### INTERNATIONAL CONFERENCE ON STANDARDS FOR THE SDGs

28 (pm) – 29 (am) NOVEMBER 2017 | ROOM VII | PALAIS DES NATIONS  
| GENEVA\*

#standards4SDGs



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BEST  
PRACTICE

*From today*

## ■ Environmental conditions of use

the large surface of the isothermal cell is attractive for marketing and advertising purposes, but the color and type of exterior surface of the van can affect up to 30% of the energy consumption of the refrigerator.

NO to Dark Colour



Summer 2019:

-Outside temperature +36°C

-Surface temperature in white Fiberglass  
**+45.6°C**

## ■ Door opening frequency



Air'curtains



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## Traditional reefer

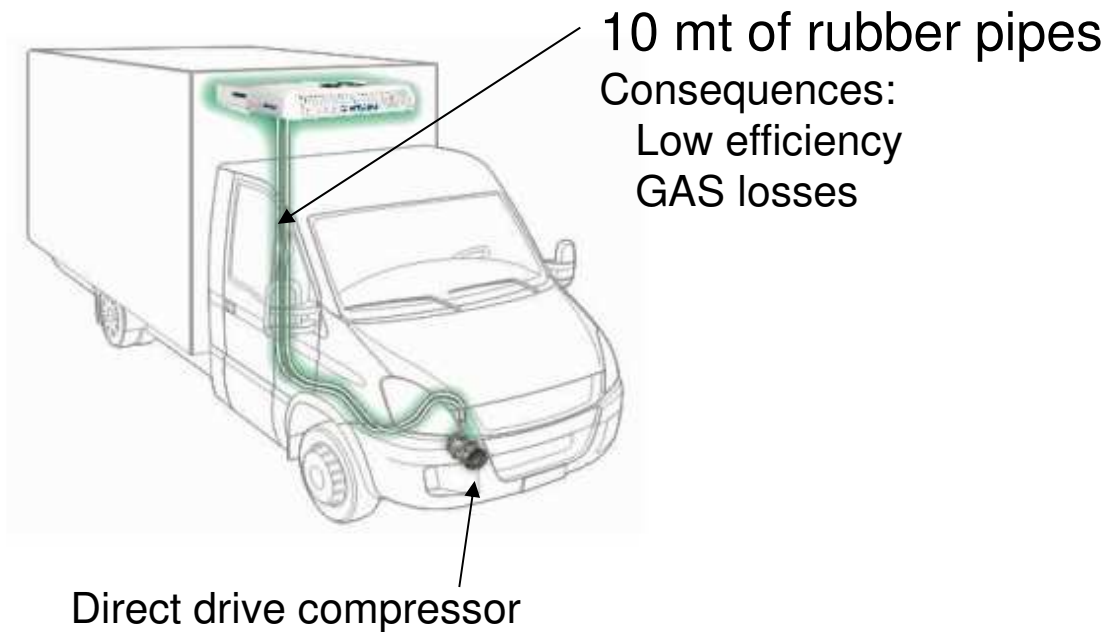


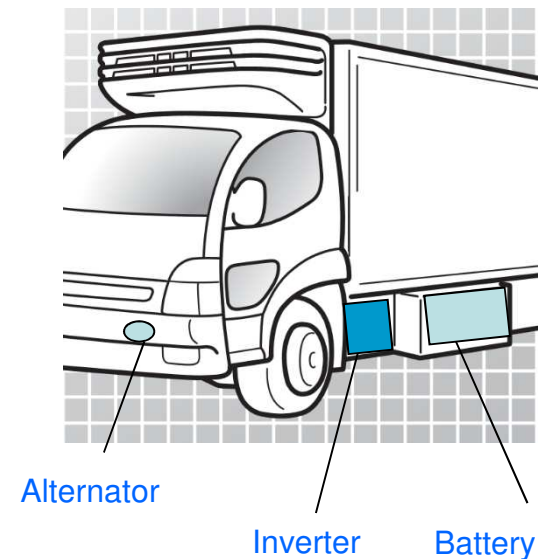
Table 2 — Reference temperatures for measuring the cooling capacity  $P_c$

| Inlet air temperature of the compressor/condenser unit $T_{IN\ CON}$ (°C) | Inlet air temperature at the evaporator unit $T_{IN\ VAP}$ °C |  |   |
|---|---|--|---|
| Normal conditions: 30   | Minimum temperature of the cooling device                     | Intermediate chosen temperature between minimum and maximum temperature <sup>a</sup> | Maximum temperature of the cooling device |
| Elevated conditions: 38   |   |  |   |
| Tropical conditions: 43   |   |  |   |

<sup>a</sup>For comparison a temperature from Table 3 has to be chosen. Additional information see Annex A.

# News

**Electric Fridge**  
**No rubber hose**  
**No loss of GAS**



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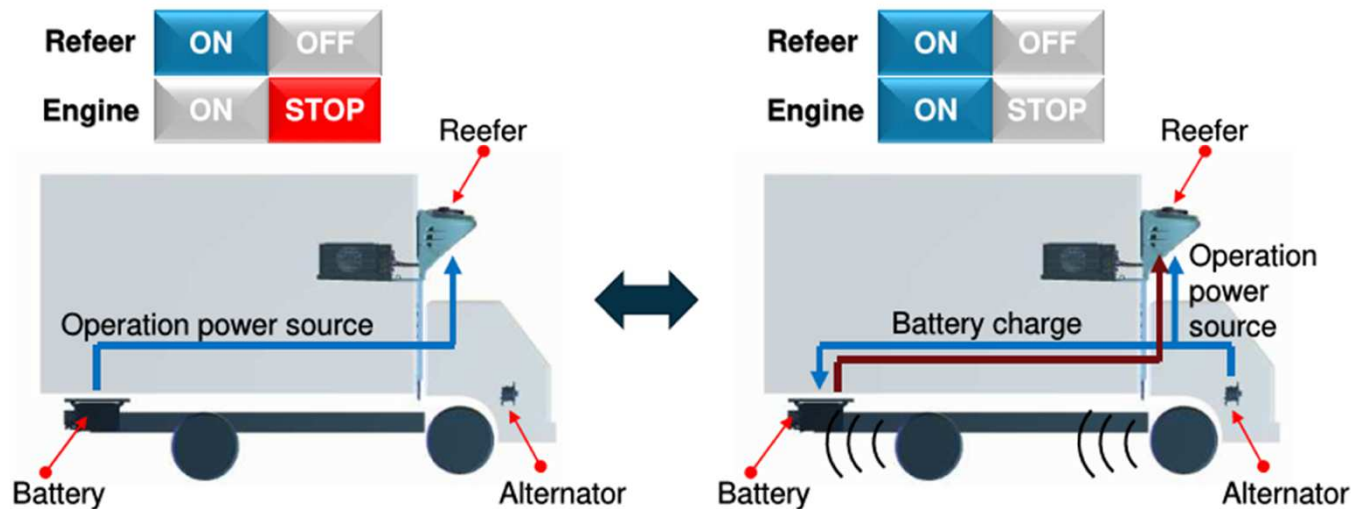
From tomorrow forwards.....



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## Electric Reefer

- Equipped with autonomous battery pack.
- When driving, use the alternator to charge the auxiliary batteries.
- Keeps the cold even when the vehicle is off, for 75 min. allowing delivery operations.
- During the night, with the 220V mains current, it recharges the batteries and pre-refills the compartment before the delivery cycle.





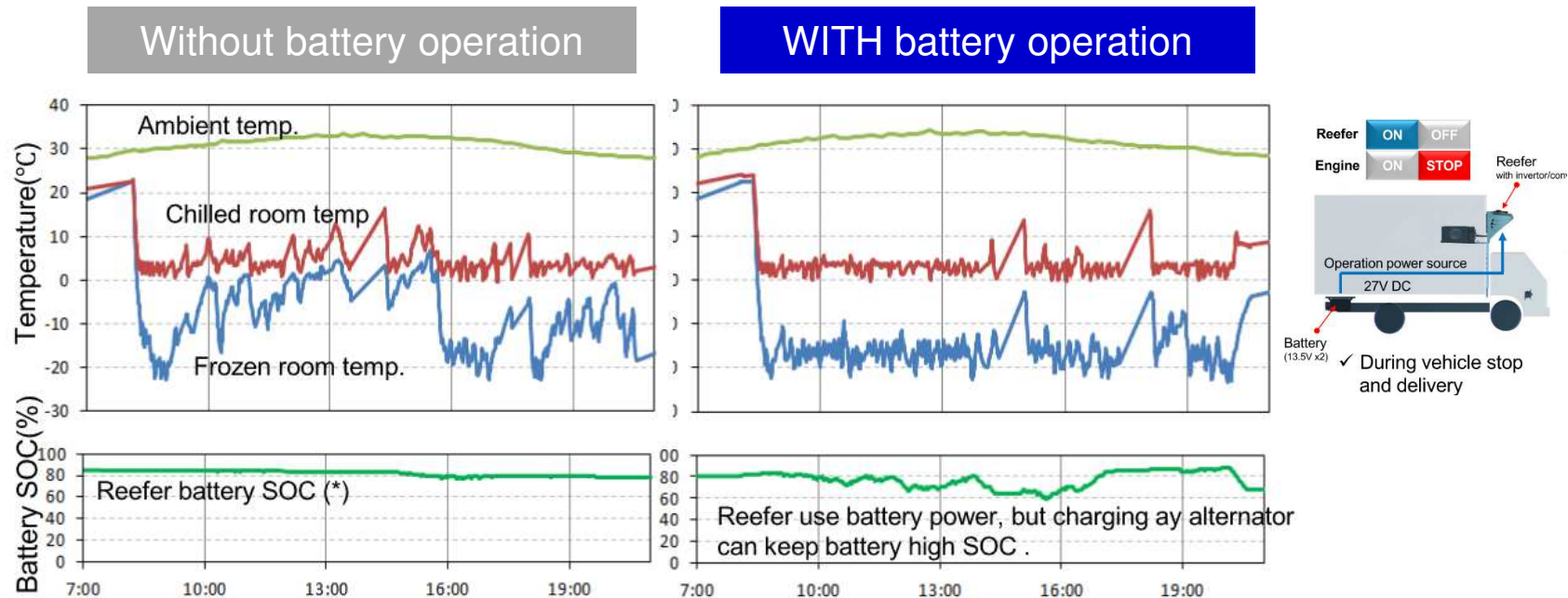
## Electric Reefer

- Equipped with an autonomous battery pack, the electric refrigerators allow full-capacity operation regardless of the number of engine revolutions, or even when the vehicle's Start / Stop system is active.
- Inverter technology allows efficient use of battery power.





- Comparative graph of a summer day (outside + 30°C / + 34°C) in urban distribution, with Multitemperature vehicle equipped with electric refrigerator and autonomous batteries.



Temperature fluctuated by door open and engine stop = cooling stop . . . **conventional home delivery problem**

Battery power/operation always keep the temperature During engine stop situation. . . . **solution for such home delivery problem**

The Battery power and its control achieved **ALWAYS COOLING** . **COOLING during engine stop!**

### Equipped with a diesel Undermounted GenSet.

- Outside the city center use the diesel engine in the fridge.
- In the center, the generator (Gen-set) undermounted. drives the electric motor of the fridge.



### Advantages:

- Noise reduction
- Clean engine
- Emissions reduction.

### Disadvantages:

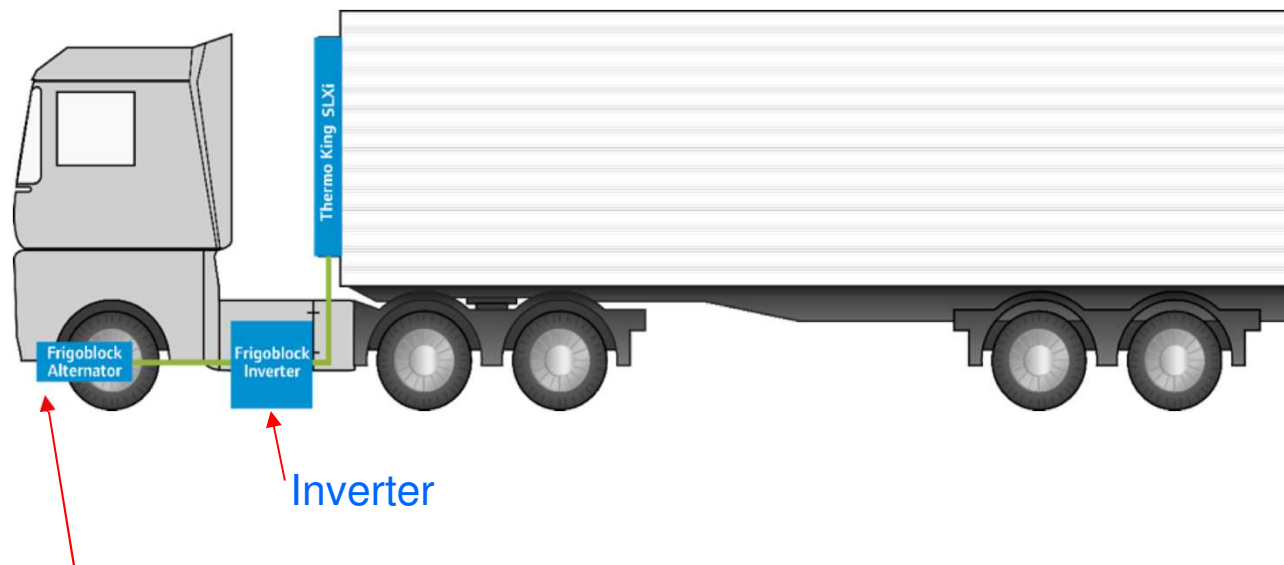
- Less temper. control
- Bigger use of the fridge

## With generator drive by the vehicle's engine.

- Outside the city center use the diesel engine in the fridge.
- In the city center, the generator via Inverter operates the electric motor of the fridge.

### Advantages:

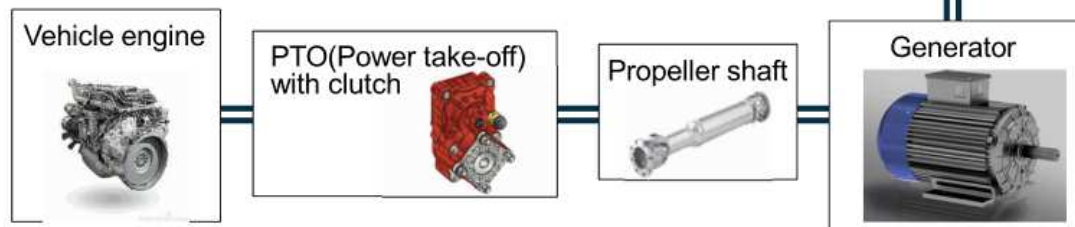
- Noise reduction
- Clean engine
- Emissions reduction.



Alternator/Generator on the vehicle's engine.

## Hybrid

The Hybrid system uses the energy generated by the hybrid vehicle, both during driving, with autonomous battery pack, and under braking, with energy recovery systems, to operate the refrigerator compressor.





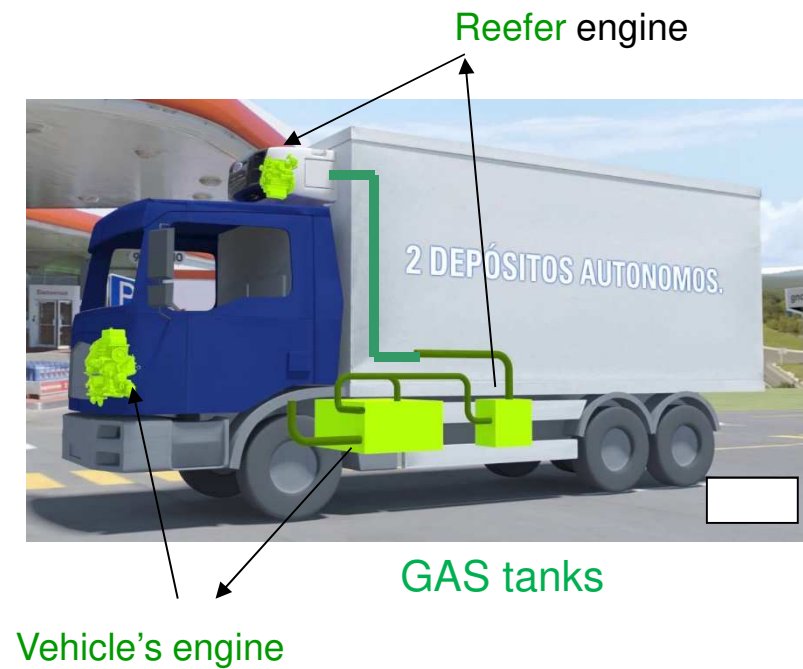
Prototypes of semi-trailers are already circulating in which the axles are "electrified" to produce energy during braking and release phases (neutral or descent).

Together with the battery packs they allow the use of the mixed Diesel-electric refrigeration machine to the full advantage of cost and emission savings ..



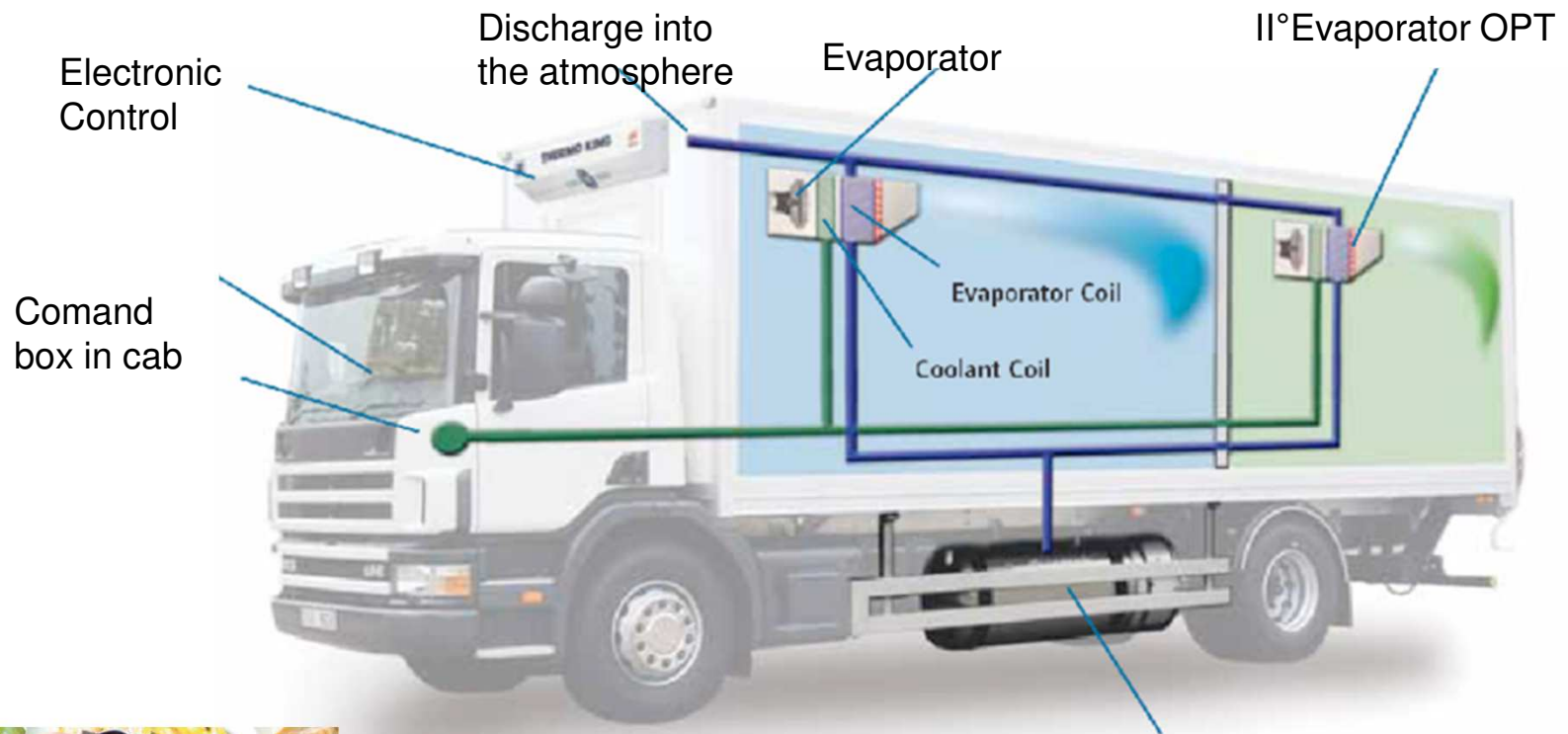
## LPG or CNG vehicle

Use CNG tanks to feed the refrigeration unit as well





## CRYOGENICS A CO2 (Carbon Dioxide) or N2 (Nitrogen)



### ATTENTION

Danger for driver - 44 ° C

A lot of cleaning is needed

Forbidden stops in closed or hold areas



Tank Cryogenic

**A.D.R.**

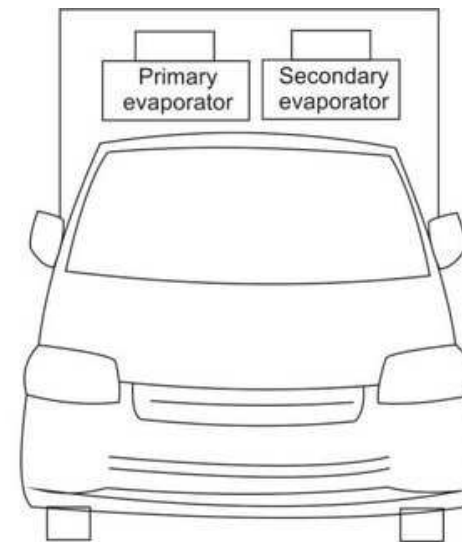
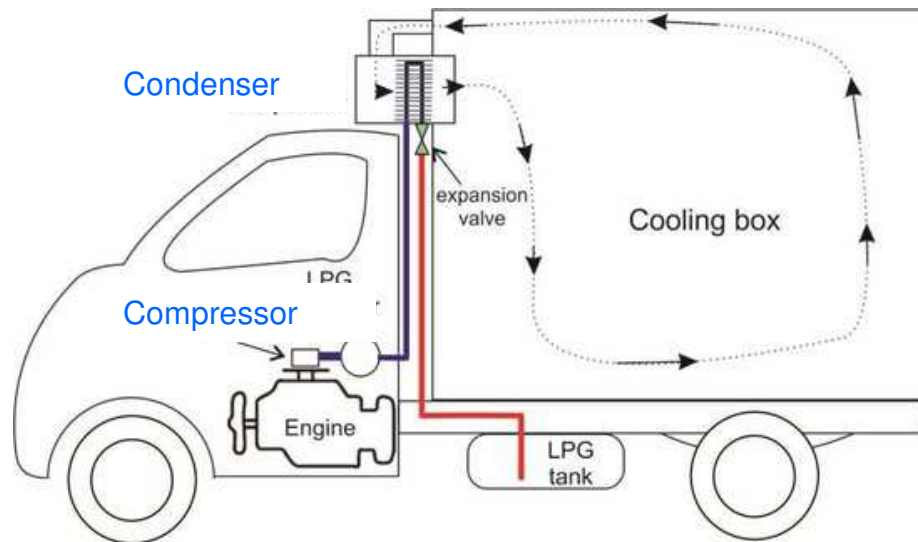
Dangerous goods

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## Dual Refrigeration Cryogenic + Traditional.

- Cooling the room deep/frozen with CO2 o N2
- Cooling the chilled room with **direct drive compressor** by the vehicle engine

Or:  
Cryogenic to pull-down, and **traditional** to maintain the temperature during trip.



A recent report by the Californian Air Protection Agency evaluated the greenhouse gas emissions of cryogenic systems.

The results show that the emissions of cryogenic systems are twice those of diesel. due to the higher energy required to produce the cryogenic liquid compared to diesel. However, the overall emissions for cryogenic systems are 50-60% lower than those of diesel refrigerators due to the intake of zero emissions from the use phase of cryogenic fluids.

The operation of cryogenic refrigeration transport systems using CO<sub>2</sub> or N<sub>2</sub> is very similar. A large insulated tank, mounted under the chassis with a capacity of between 420 and 700 kg, with controlled pressure of:

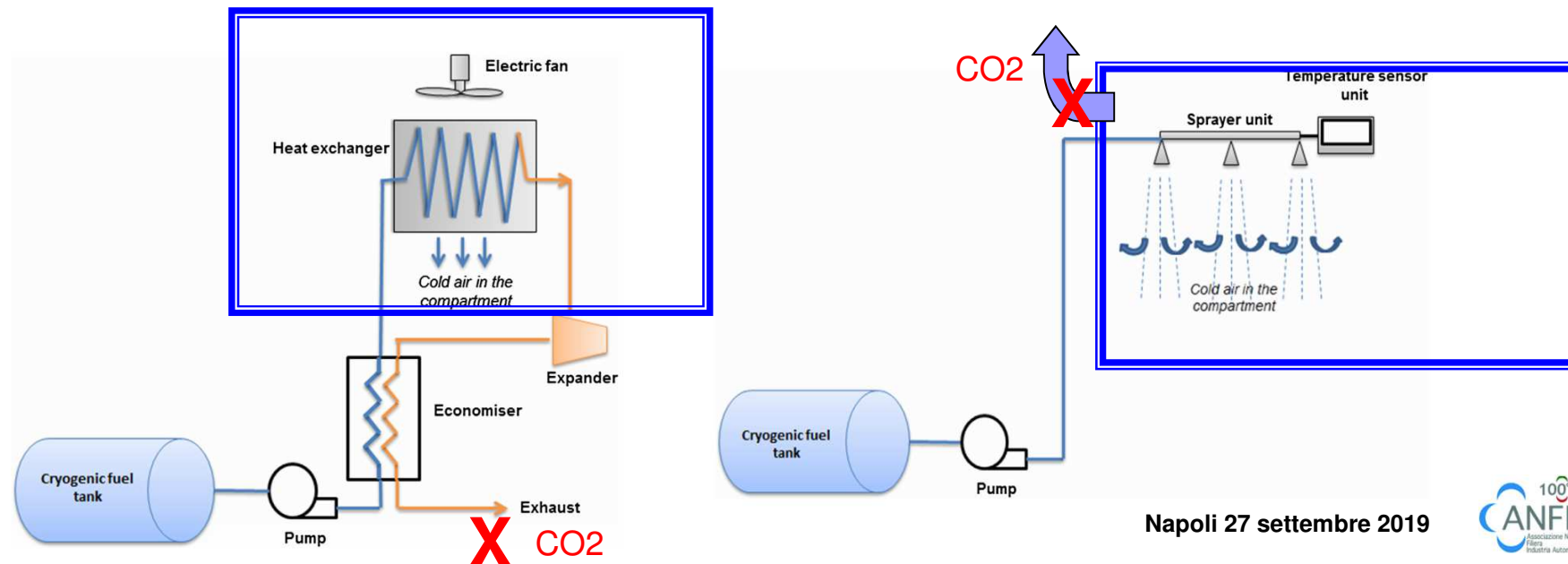
CO<sub>2</sub> pressure is 8,6 bar while N<sub>2</sub> pressure is 3 bar

The fluids in the tanks are at a very low temperature:

N<sub>2</sub> aprox **-185 ° C**

CO<sub>2</sub> aprox **-44 ° C**

There are some variants of the system, direct type, indirect and hybrid type.



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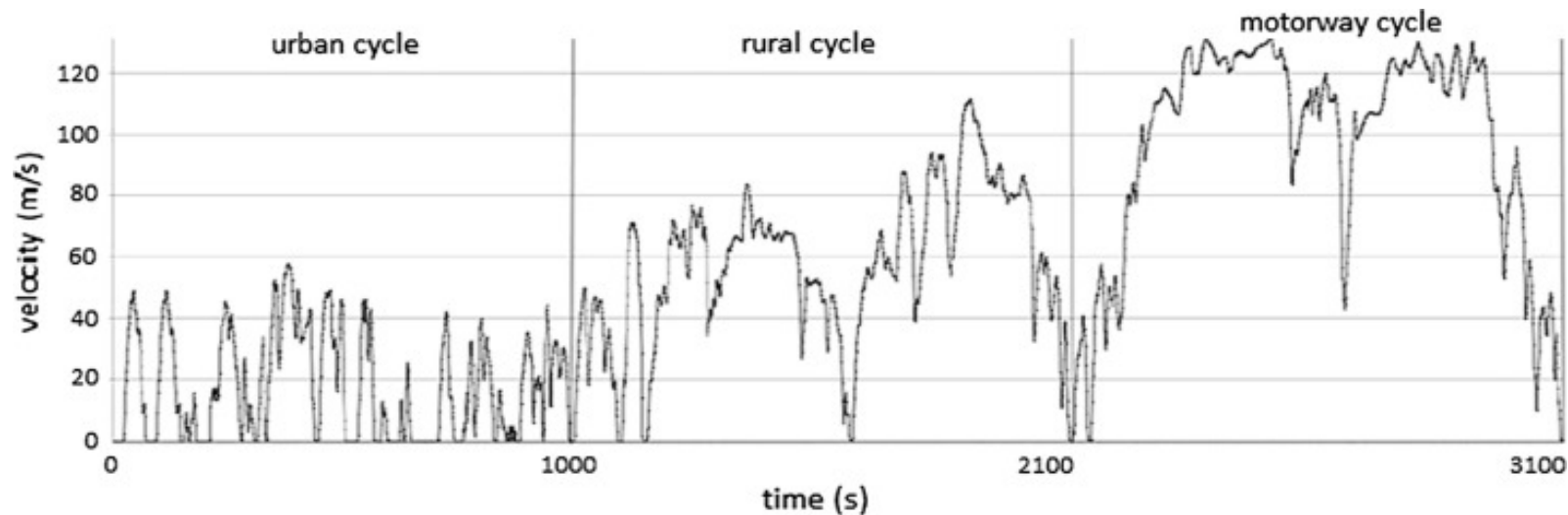
## Economic Considerations

Comparing prices; diesel at 1.10 Euro/L, CO<sub>2</sub> at 0.12 Euro/kg and N<sub>2</sub> at 0.08 Euro/Kg.

The study shows that there are no differences between the cost of using the traditional refrigerator unit and the cryogenic one. The latter then has the barrier due to poor distribution of recharging infrastructure.

The fuel quantity of diesel refrigerators (2.0–4.0 l / h) is much lower than the mass of the CO<sub>2</sub> and N<sub>2</sub> cryogenic units (20–60 kg / h) taking into account the different ambient temperatures, the different types of products and the distribution paths studied.

However, the authors recognize the need for financial support from research compared to cryogenic systems, as they have advantages for NO<sub>x</sub> and fine dust emissions.

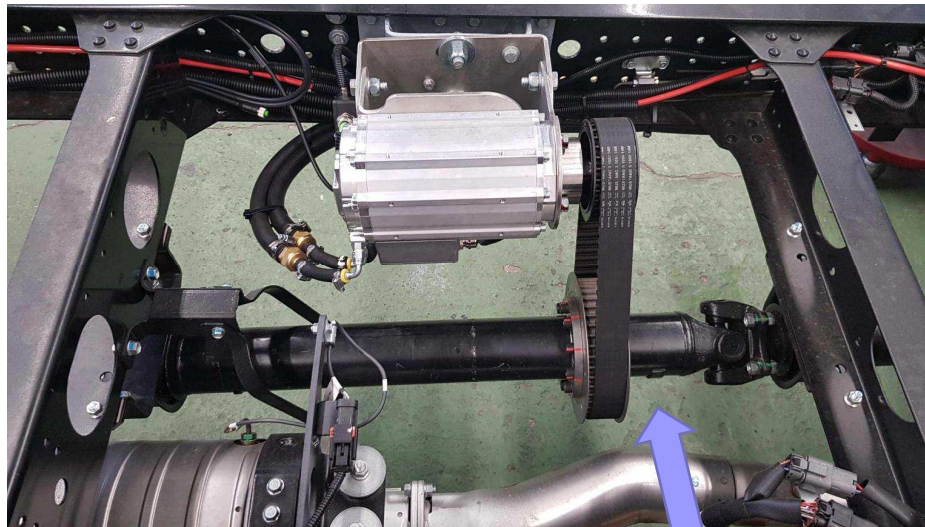




## 5° wheel

Alternator connected to an independent axle:

- The wheel at the center of the vehicle drives an alternator that produces energy to partially recharge the battery pack that powers the electric fridge



Trasmission shaft

Disadvantages:

Disomogeneous sforce on the shaft

Increased friction and need for unformed road surfaces



## Solar Panels

They have two advantages:

Keep vehicle batteries charged (stressed by intensive use)

Also feed the fans of the fridge for a period of 20/30 min during stops to move the indoor air preventing the stratification of the hot air.



Today the efficiency of the panels per m2 is insufficient to power the fridge independently

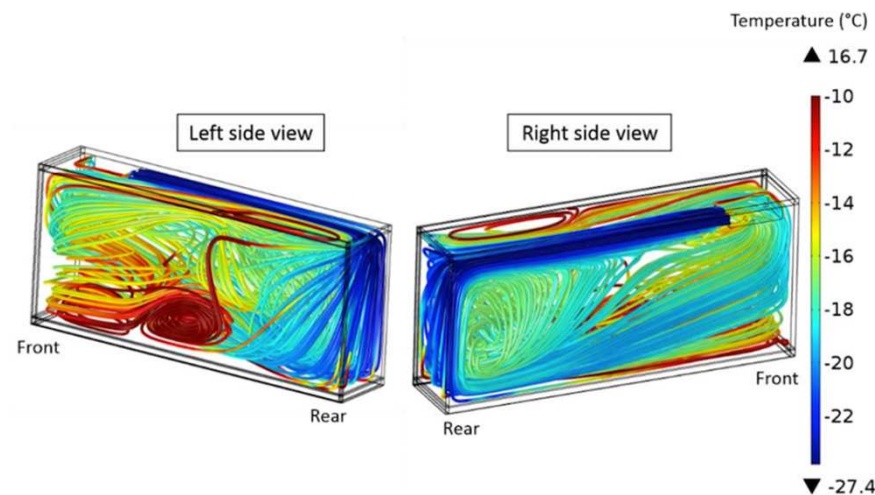
Disadvantages:

Dirt affects the performance of the panels



## Good practice:

All pallets must be positioned in such a way as to allow air circulation from back to front of the compartment.  
If even **one pallet is badly positioned**, this can limit it considerably the passage of the recirculated air.

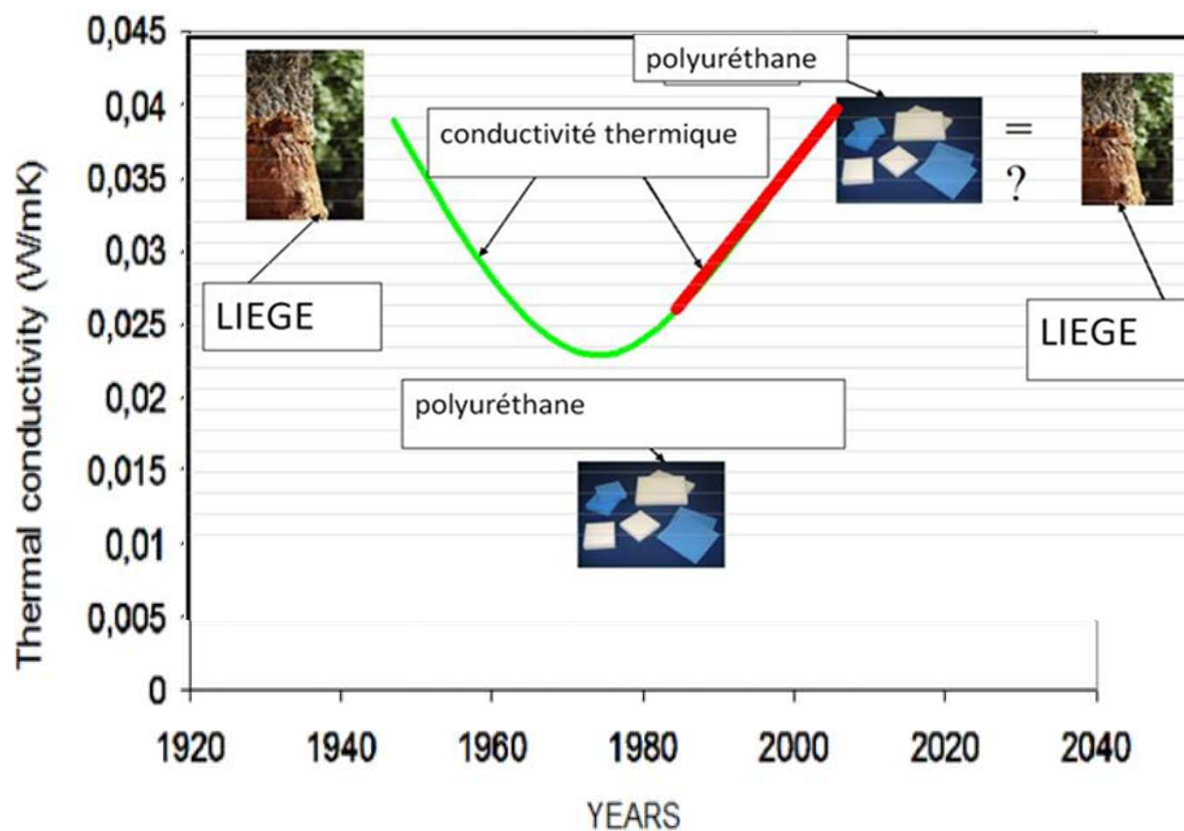


Right

Wrong

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## Insulation conductivity (the technological involution)





Diesel engines for vehicle refrigerators must be equipped with Stage V engines (similar to the Euro5 standard)  
*(today Euro 0 !)*



The refrigeration units will have to use gases that are less harmful to the environment (2015 = GWP 3900 while from 2020 GWP <2500 tons of CO<sub>2</sub>. Finally in 2025 the GWP <150 tons of CO<sub>2</sub> equivalent)



Every component of the vehicle (refrigerator, lift, locks, bumpers must emit less than 65/60 dB during night-time operation or sensitive environments (hospitals ...)



Vehicles for drug distribution must be certified for controlled temperature transport (+ 2°/+ 8°C) or (+ 15°/+ 25°C) or -20°C



# Thanks for attention

plastoblok



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**THERMAL TRANSPORT EUROPE**