# SMART FRIDGE RECYCLING

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# The WEEE fundament

- The WEEE implemented high materials and hazardous waste recovery standards
- The recycling industry answered with high developed recycling technology and industrial processes
- The producers try to design for easy recovery and try to use recycled plastics

The result is:

- High recovery rate of recycled material
- High recovery rate of hazardous waste
- High reduction of CO2 Footprint
- Pressure on the OEM's for design to recovery and to use recycled plastics
- A lot of new standards and quality systems look for new business

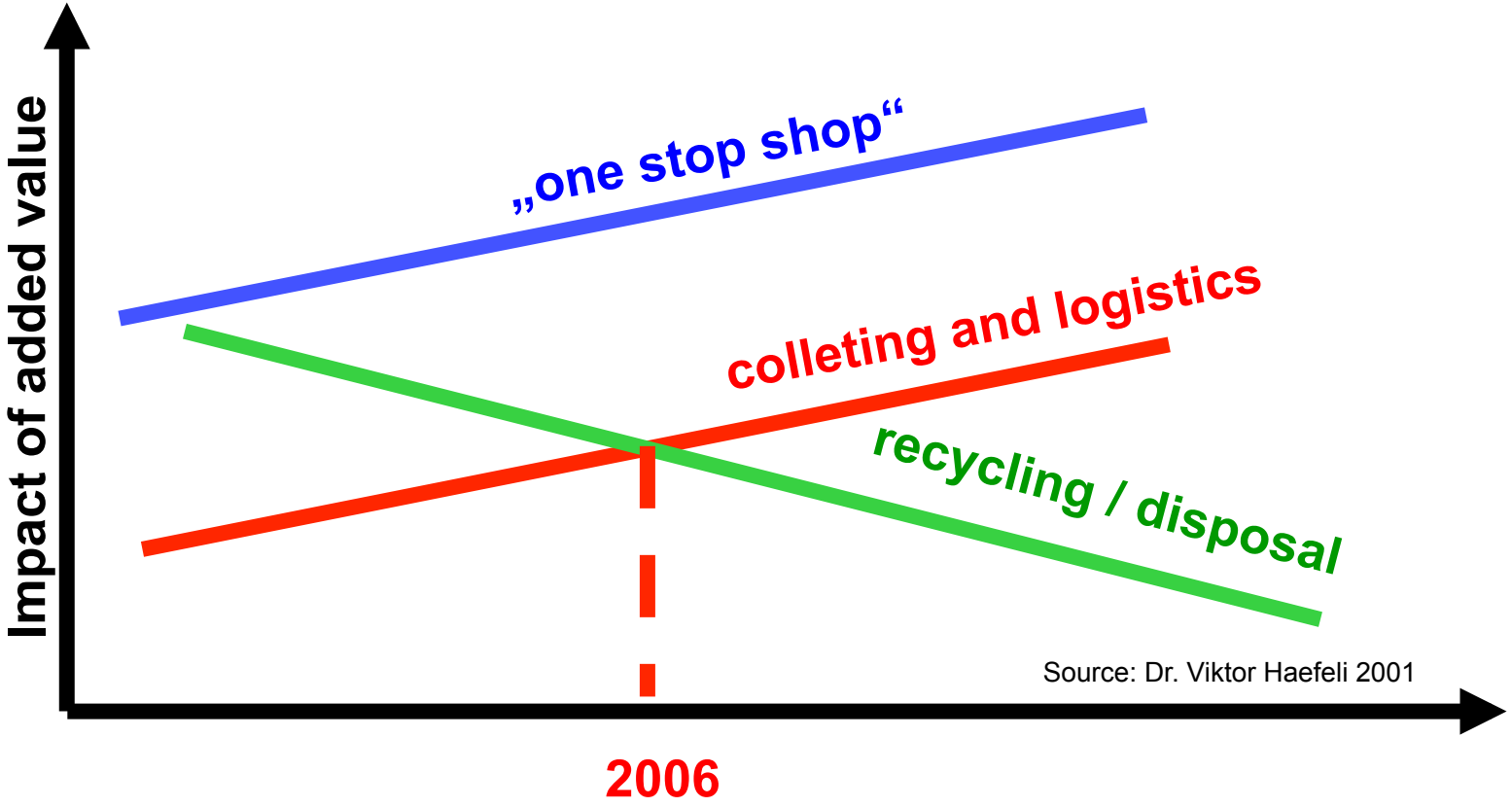
# The WEEE Improvement

**How to improve all these best available industrial technology?**

## What do you think?

- **Strict Enforcement of the WEEE legislation**
  - **Everybody must work strictly according the WEEE**
  - **Stop illegal export**
  - **Stop stealing the WEEE wastes from third parties**
- **Reduce logistics**
- **Reduce CO2 footprint**

# Slide IERC 2001 Davos
# Tendency of the benefit of added value




**Logistics becomes more and more important**

# Potentials

## Which WEEE materials have the most potentials in logistics efficiency?

# We transport air or gases

**Example lamp recycling**

- glass 80 – 90%, metals 7 – 14 %, fluorescent powder 1 – 3 %
- 1000 kg Fluorescent Tubes 5.7 m3
- 1000 kg pre processed lamps for optimal logistics 1.1 m3

**=> Efficiency potential in logistics over 80%**

**Example fridge recycling**

- Average Fridge 0.6 x 0.6 x 1.4 m 0.505 m3
- Volume fraction of fridge recycling 0.077m3
- Volume difference 0.428 m3

**=> Efficiency potential in logistics over 85%**

# Smart Fridge Recycling Idea

**CO2 Foot Print Reduction and save money with an innovative, mobile and efficient recycling technology**

- Secure and industrial VHC/VFC detection process (already successfully tested in Italy and Switzerland)
- Industrial and efficient mobile plant with best available technology
- Transport reduction potential in Switzerland over 1‘000‘000 km/a
- Cost reduction (logistics, labour, place, energy)
- CO2 foot print reduction in relation to conventional technology
- High recycling quote and good quality of produced materials

# SFR IDEA CO2 Foot Print Reduction
# Fridge logistics Switzerland 2013




**The way of most swiss fridges (400‘000 fridges per year)**

- 100% to plant 1 => 705‘000km/a
- 100% to plant 2 => 982‘000km/a
- Mixture with others => over 1‘200‘000km/a

# SFR IDEA CO2 Foot Print Reduction
# Potential fridge logistics Switzerland

- SFR mobile plant => 20‘000 km/a
- VFC fridge logistics 40 % VFC => 250‘000 km/a
- VFC fridge logistics 20 % VFC => 125‘000 km /a

**Potential of reduction in Switzerland 1‘000‘000km per year**

# Smart Fridge Recycling
# ...a new idea?

**Is the mobile fridge recycling plant a new idea?**

**No**

**Is the separate treatment of VFC and VHC fridges a new idea?**

**No**

# Smart Fridge Recycling
# What is new?

**1. Weight optimisation**

The mobile fridge recycling plant is below 25t and has the same shredding capacity and output quality as a stationary plant. This plant is without any restrictions mobile and flexible like all trucks

**2. Energy efficiency**

Energy consumption more than 60% lower

**3. First secure industrial VFC and VHC measurement**

With this technology, your are able to detect and sort out in a industrial secure process all the VFC from the VHC fridges

## Why is this essential?

# Importance of VFC Fridge Recycling

1 VFC fridge => 2800 kg CO2 eq

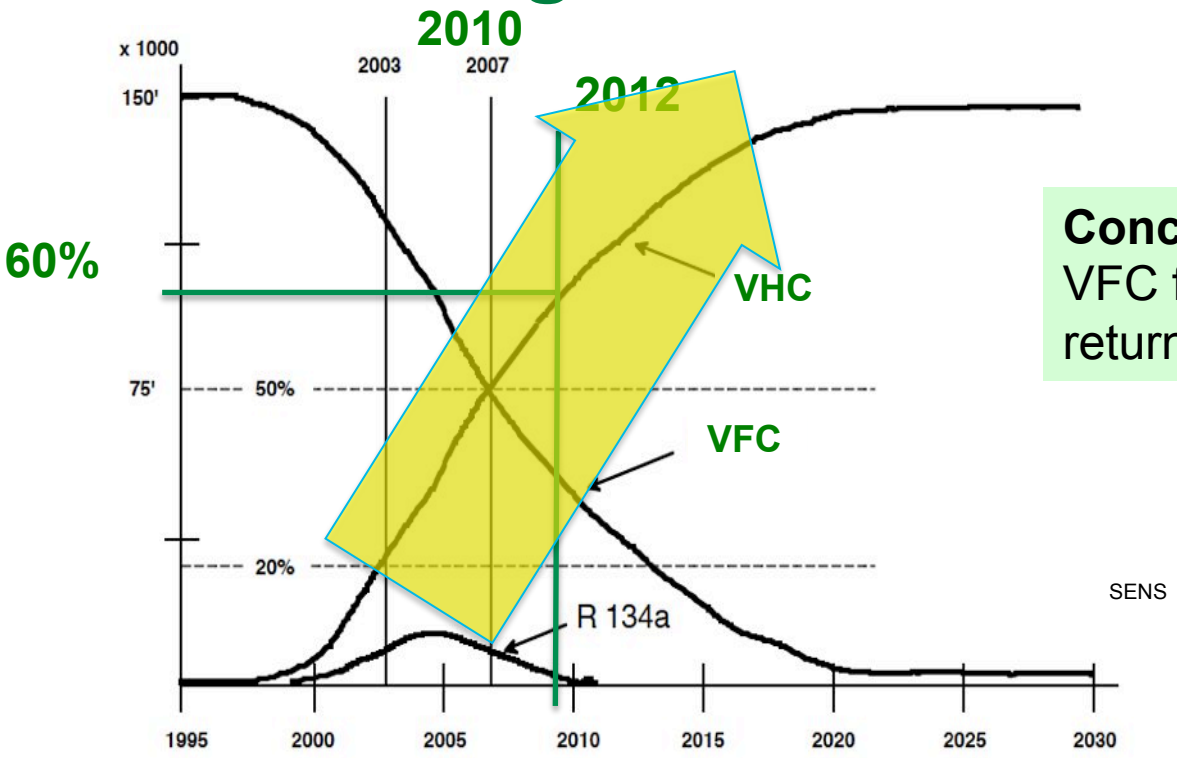
1 VHCFridge => 1 kg CO2 eq.!

=> 15'000 km

=> 5.4 km

* 15'000km/a and 8l/100km and gasoline 2.36kgCO2/l

# Development of the return of VHC and VFC fridges in Switzerland




**Conclusion 1:**
VFC fridges will be in the return stream for several years

**Conclusion 2:**
The part of the VHC fridges in Switzerland was in 2010 about 50% and in 2012 already 60%. This trend will increase strongly.

# SFR
# Smart Fridge Recycling

# Comparison industrial fridge recycling

**SFR mobile fridge recycling**

Step 1a Cooling circuit

Step 1b VHC and VFC positiv separation

Step 2 Corpus Recycling

CP for decomposition in atmosphere

Fe
Al
Cu
PS
PUR /CP

Compressor, oil, glas, waste, gas, (R12/ R600A) Polystyrol

VFC fridges 2012 40% strong reduction

**State of the art recycling**

Step1 Cooling Circuit

Step 2 VFC/VHC Corpus Recycling

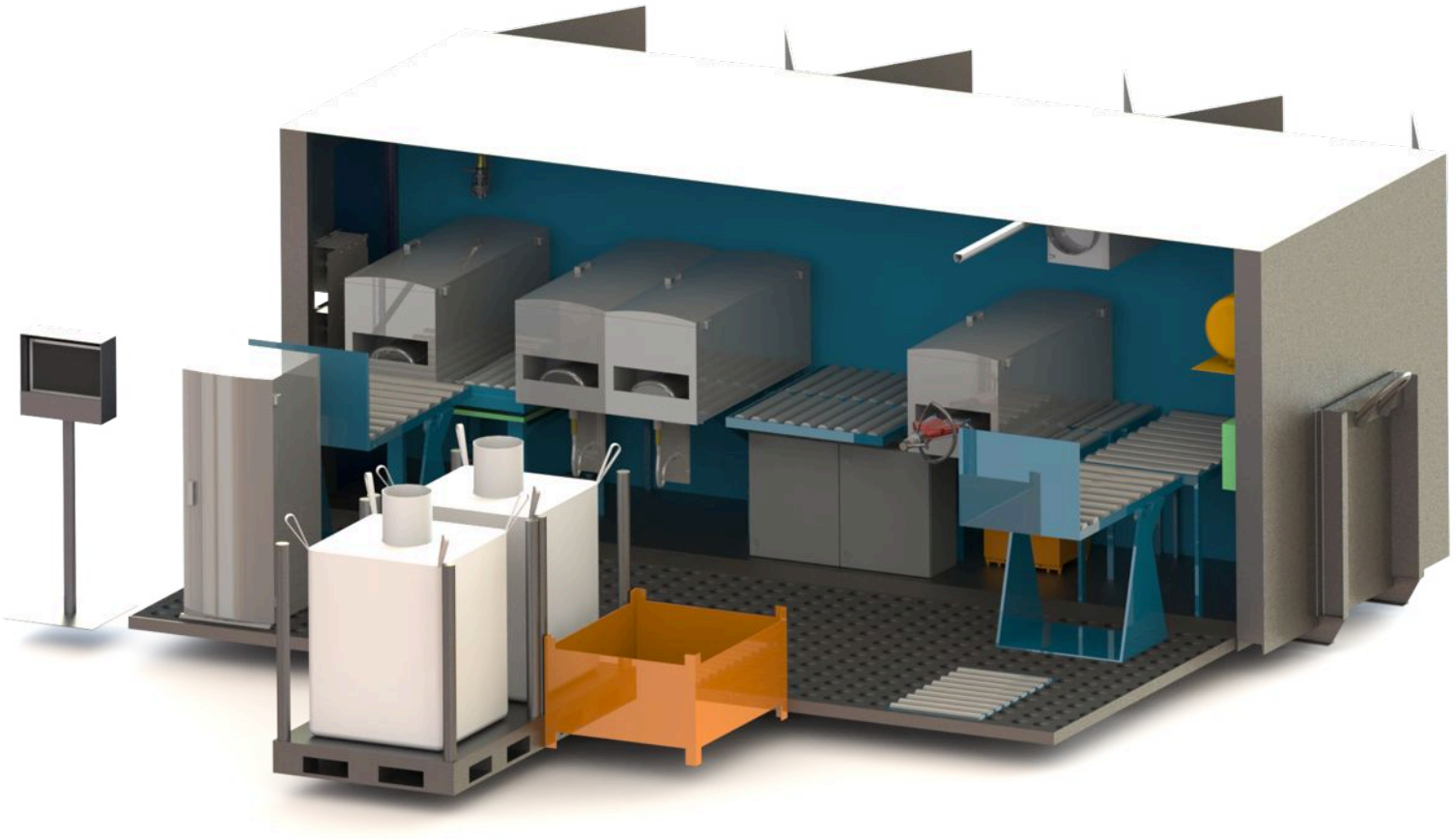
VHC/VFC Gas Treatement

Fe
Al
Cu
PS
PUR

HT combustion for decompo-sition

# SFR Mobile Fride Recycling Plant

## Step 1a/b:
## Drain the gases and the oil from the cooling circuit



# SFR Mobile fridge demanufacturing

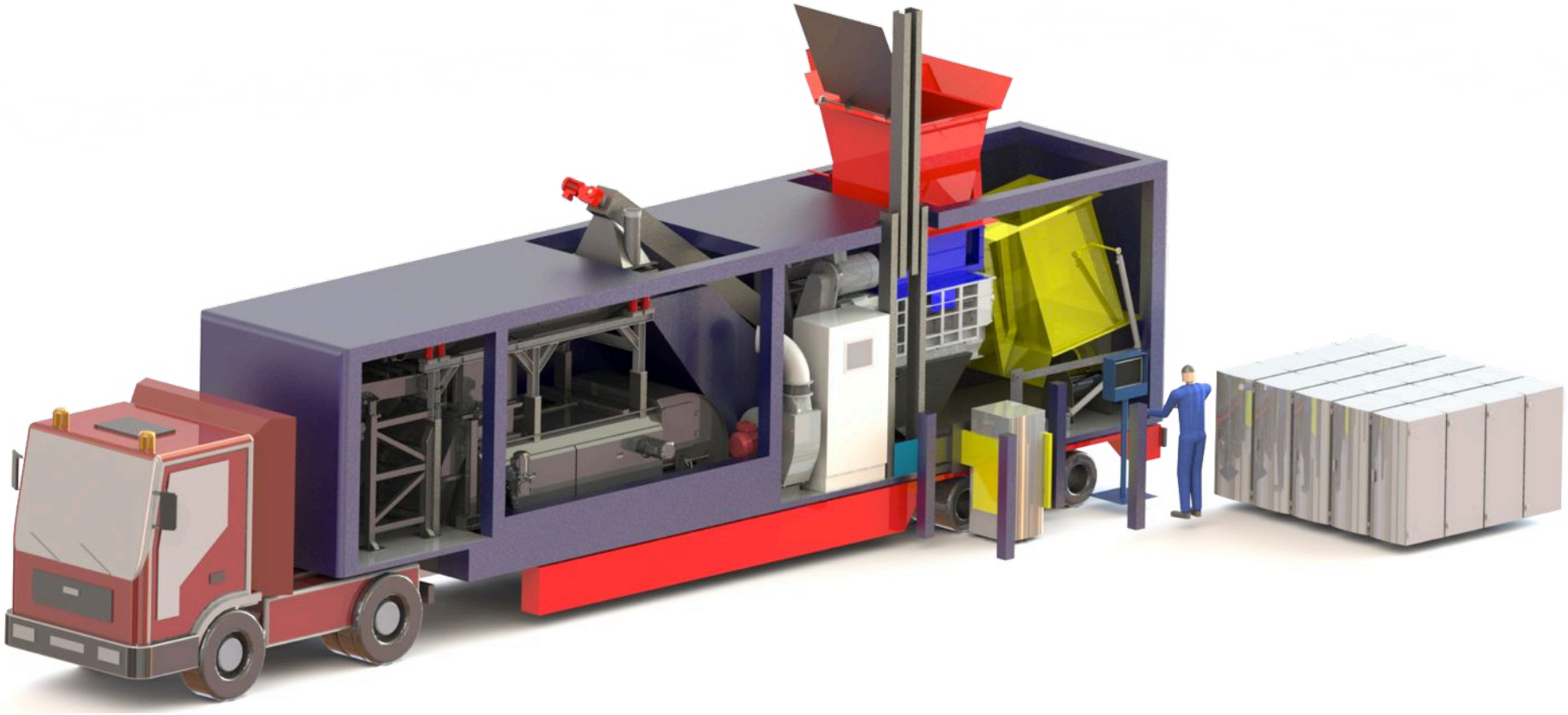
## Step 1b: VHC positiv sorting


1. IR spectrometric analysis of the body and the door
2. Positiv sorting
   1. VFC verified
   2. VHC verified
   3. EPS or glass wool

3. VHC body/door goes directly in the 2. Step
4. VFC body/door goes to a VFC Recycling Partner

# SFR Mobile Fride Recycling Plant

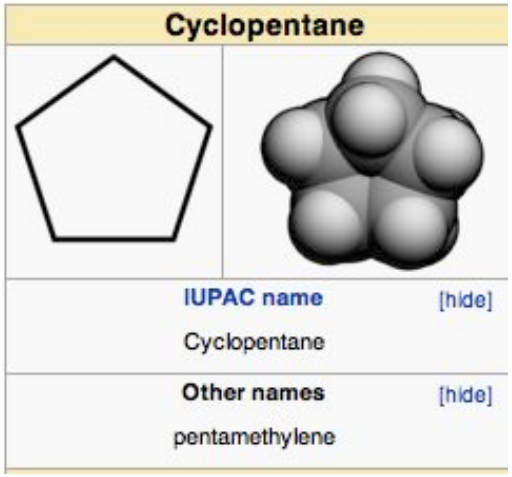
## Step 2: Recycling



# Is it reasonable to blow Cyclopentan in the atmosphere?

# Blowing agent for PUR isolation Cyclopentan

- Cyclopentane is a  Cycloalkane  => Alkane




- Cyclopentane (CP) has no Ozone Depleting Potential (ODP)
- Cyclopentane has a very low Global Warming Potential (GWP)
- Cyclopentane in in the atmosphere not stable and is decomposing in 24 to 48 h

# Comparison daily emission

**Daily emissions of the SFR plant in comparison to the transport to a state of the art plant.**

**SFR Reproduction**

| | | |
|---|---|---|
| Average in fridge | 220 | g/fridge |
| Capacity SFR Plant | 35 | fridges/h |
| Daily hours /2 shifts) | 16 | h |
| Daily Capacity | 560 | Fridges |
| Daily VHC quantity | 123.2 | kg/day |
| VHC lost in atmosphere | 40 | % |
| | | |
| **eff. VHC blow out** | **49.3** | **kg/day** |
| **eff. VHC blow out** | **49.3** | **kg/day** |

x VHC => Cyclopentane from PU foam

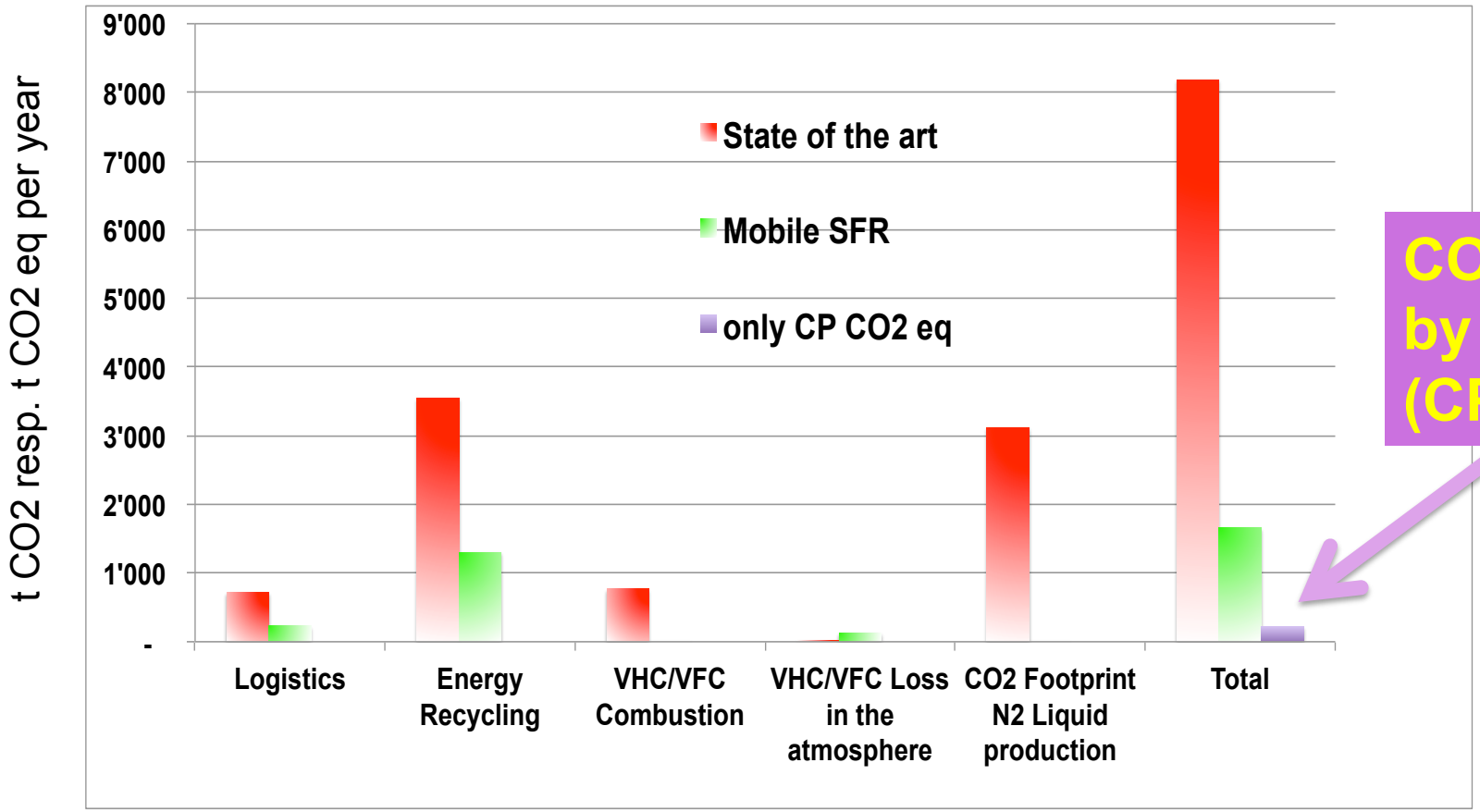
**Transportatiion**

| | | |
|---|---|---|
| Truck capacity | 100 | fridges |
| Average way Swizerland | 100 | km |
| Daily Capacity | 560 | Fridges |
| Daily way | 560 | km |
| Truck diesel consumption | 33 | l/100km |
| Eff. Diesel consumption | 184.8 | l |
| Density Diesel | 0.83 | kg/l |
| **Weight Diesel** | **153.4** | **kg/day** |
| **Weight Diesel** | **306.8** | **kg/day** |

**Transportation way 100km => 3 times better**

**Transportation way 200km => 6 times better**

# Comparision CO2 Emissionen
## 400‘000 F/y mobile SFR vs conventional fridge recycling



# CO2 foot print reduction for 1 plant

**Switzerland 400‘000 fridges per year**

| | |
|---|---|
| CO2 emission state of the art | 8‘200 t/a |
| CO2 emission SFR mobile plant | 1‘650 t/a |
| **CO2 reduction** | **6‘550 t/a** |

➢ **CO2 Foot Print Reduction > faktor 5**

**Good to know...**
**CO2 Footprint per person in Switzerland: 12t/a**
**CO2 Footprint SFR 140 persons in Switzerland**

# Smart Fride Recycling
# Situation of the regulations in Europe

**Switzerland**

The Smart Fridge Recycling is according the Swiss regulations

**Europe**

The Smart Fridge Recycling is according the WEEE and the DIN EN 50574

**European Country Standards**

In Europe are different regulations for emissions. This can reduce the throughput.

**CENELEC**

The In the Draft Technical Specification 50574-2 for comments (27.11.2013) CENELEC, describe the mixed VFC and VHC fridge recycling treatment. This is very important to understand the recovery of the VFC.

The VHC input in the SFR plant is 100%. About 40% of the VHC in the foam, in this case Cyclopentane, goes in the atmosphere and is fully decomposed in 24 - 48 h.

The rest of the VHC is in the foam and goes directly as substitute fuel in the incineration plant. Therefore is a recovery rate of Cyclopentane not meaningful and brings no additional value, information or better environmental impact.

# Smart Fride Recycling
# Conclusion for Switzerland

- Material recovery and VHC decomposition in one step
- Same capacity as stationary plants
- Same output fraction quality
- Huge distance reduction in logistics
  > 1‘000‘000km per year in Switzerland
- High energy reduction
  > 350 kWh per year or 60%
- CO2 Foot Print reduction 6550 t per year or 80%
- Massive reduction of total cost of ownership

# Smart Fride Recycling
# Conclusion for Europe

- EU has over 16 Mio fridges per year
- EU Potential 40x
  - 40 x 6‘550t/a CO2 eq => 262‘000t/a CO2 eq
  - 40 x 1‘000‘000 km/a => 40‘000‘000km/a
- In each EU Country are different regulation

**Europe has a huge efficiency potential in Smart Fridge Recycling!**

# Thank you