

The carbon dioxide footprint of water reuse through membrane techniques

Easyfairs
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- Carbon assessment: philosophy
- Methodology of carbon emission calculation.
- Example of carbon footprint versus water footprint
- Carbon emission using RO technology.

WORLD LEADER IN ENVIRONMENTAL SOLUTIONS



Only group in the world able to cover the entire range of **environmental services** in:



Water

(Management of water cycles)



Energy

(Energy management)



Waste management

(Waste recovery)



Transport

(Transport of people and goods)

World leader in environmental solutions



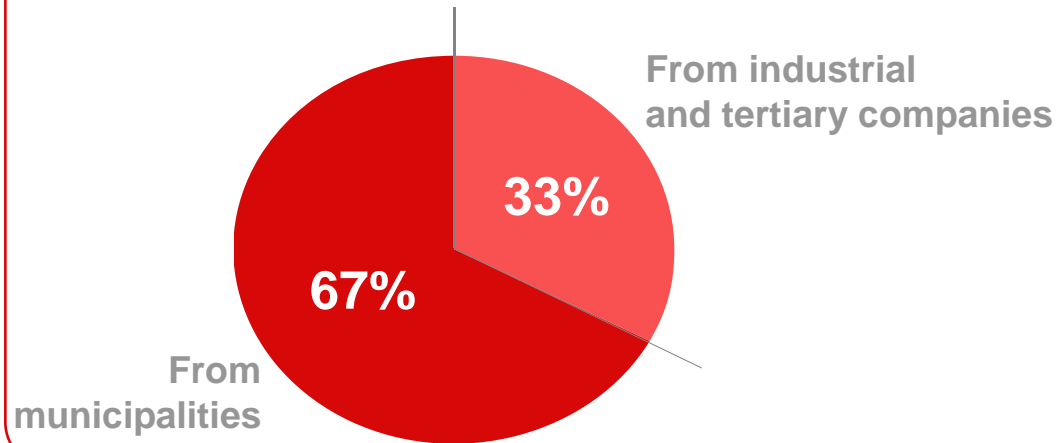
2007 consolidated revenue

€32.6 billion



319,502
employees

80% of revenue generated in Europe



A single business line: environmental services



Four sectors of activity

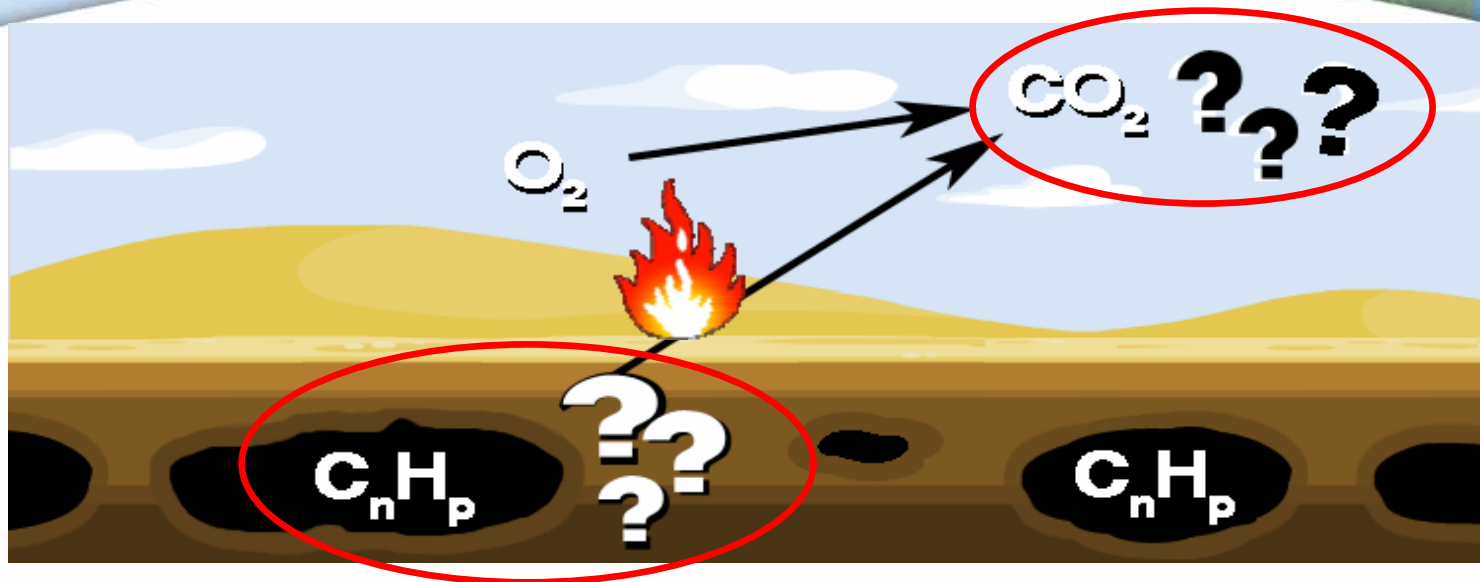


Is climate change for real?

Positive proof of global warming.



Energy and climate change: Two sides of the same problem



How long can I play « I extract more and more fossil fuels from the ground »?

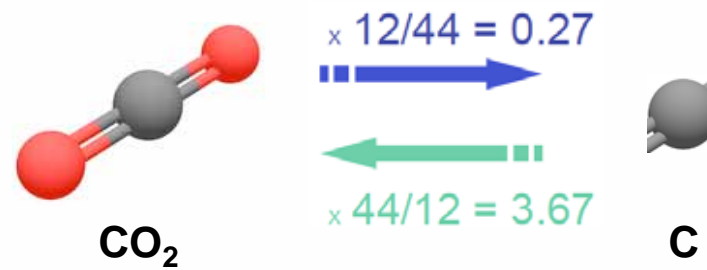
→ debate on resources: upstream side of the problem

How long can I play « I put more and more CO_2 into the air » before the result becomes a limiting factor on human activity?

→ debate on climate change: downstream side of the problem

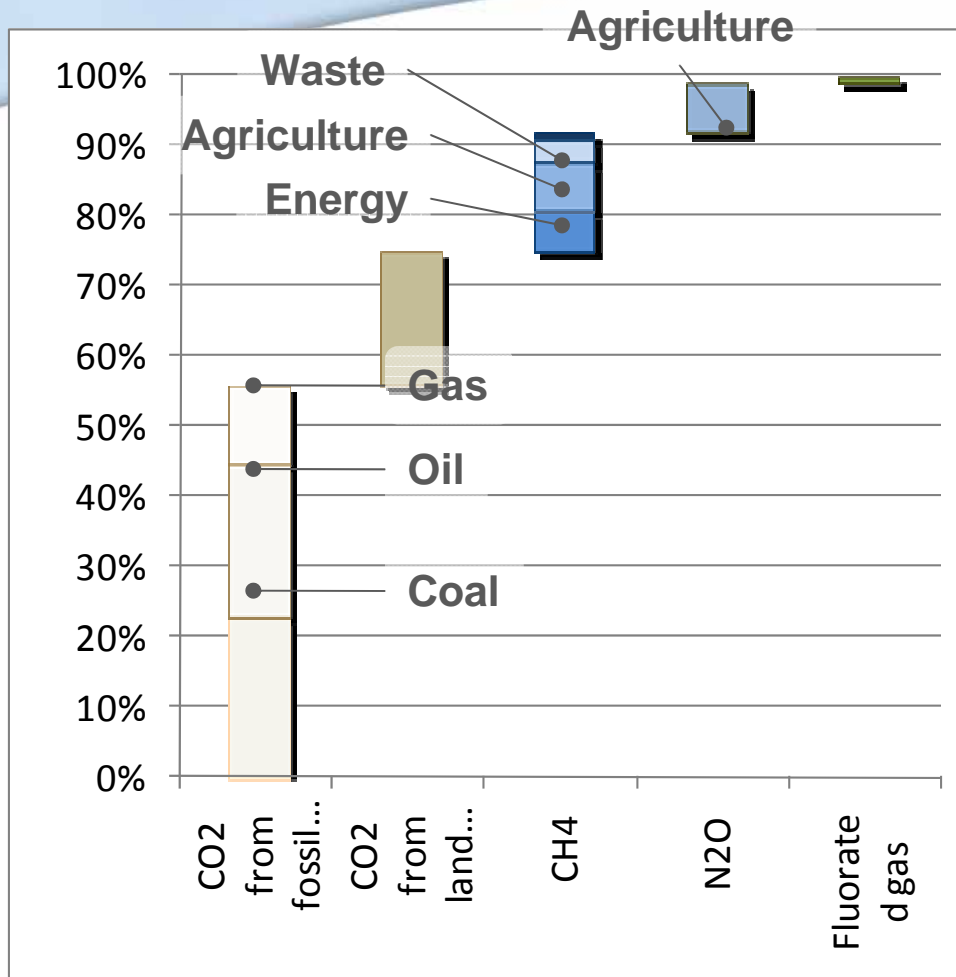
Carbon assessment philosophy

- ▶ A carbon assessment is the total set of greenhouse gas (GHG) emissions caused directly or indirectly by an individual, organisation, product, event, etc.
 - One single indicator: GreenHouse Gas (GHG) emissions in tons of Carbon equivalent (or CO₂ equivalent)



- A wide perimeter:
 - direct emissions (fuel combustion on site, transport, etc.)
 - indirect emissions (due to suppliers and customers)
 - Counting all the emissions needed for the studied activity

« Carbon » assessment? So it's just CO₂ from hydrocarbons combustion?



Breakdown of 2004 world emissions by gas, ozone excluded – Source: IPCC, 2007

Conversion factor: Global Warming Potential (GWP) over 100 years

Gas	GWP over 100 years (CO ₂ eq)
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	25
Nitrous oxide (N ₂ O)	298
Hydrofluorocarbons	12 to 12,000
Perfluorocarbons	5,700 to 11,900
Chlorofluorocarbons	4,600 to 14,000

► **One single unit, ton CO₂eq, reflecting the impacts of all GHG**

Defining the perimeter and using emissions factors

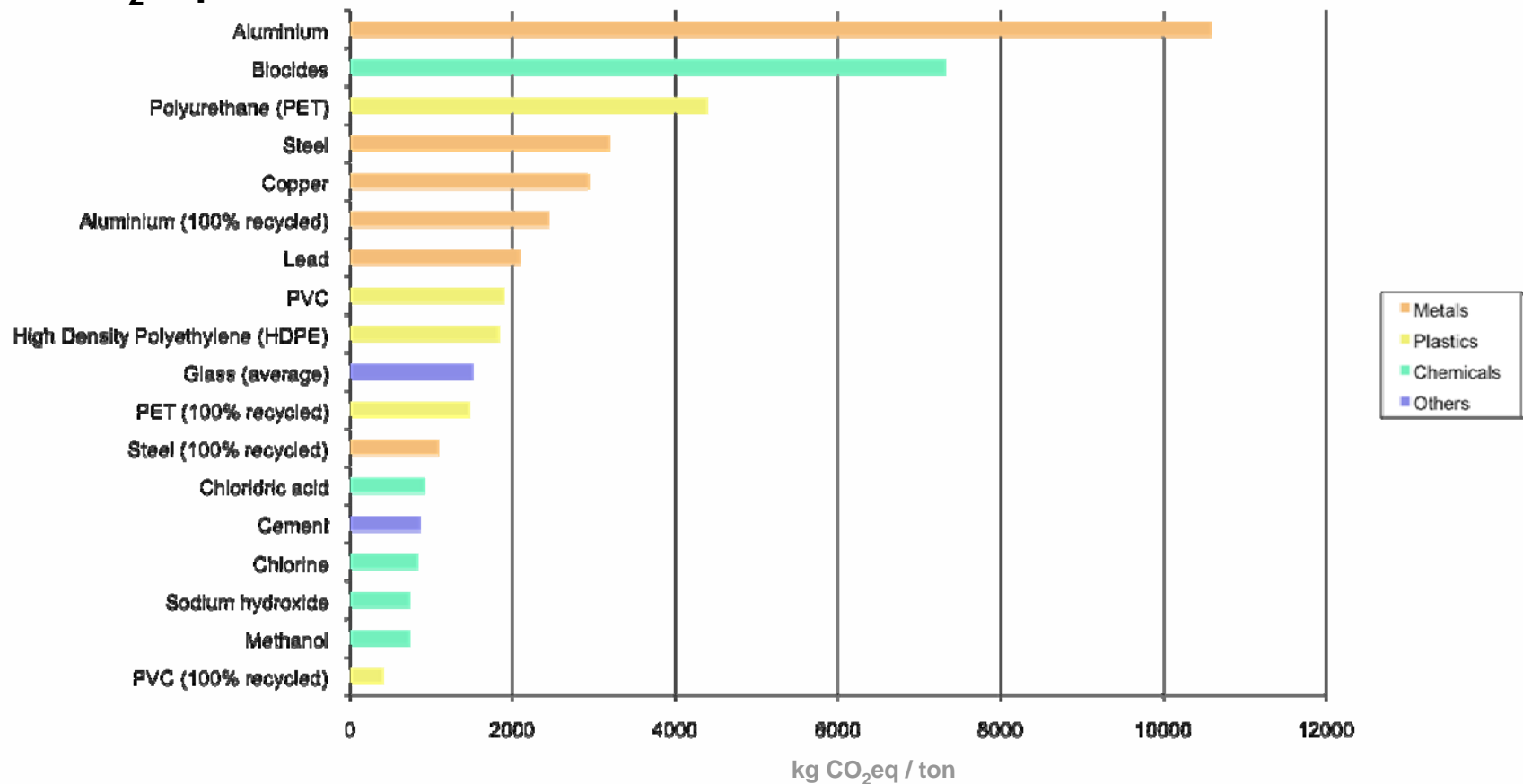
- ▶ In every kind of carbon assessment, all you do is:

$$\sum_{i=1}^n A_i * EF_i$$

- ▶ Where i is the perimeter, A_i is the activity data (kW.h of natural gas, tons of steel, tons.km of freight, etc.) and EF_i is the emission factor.

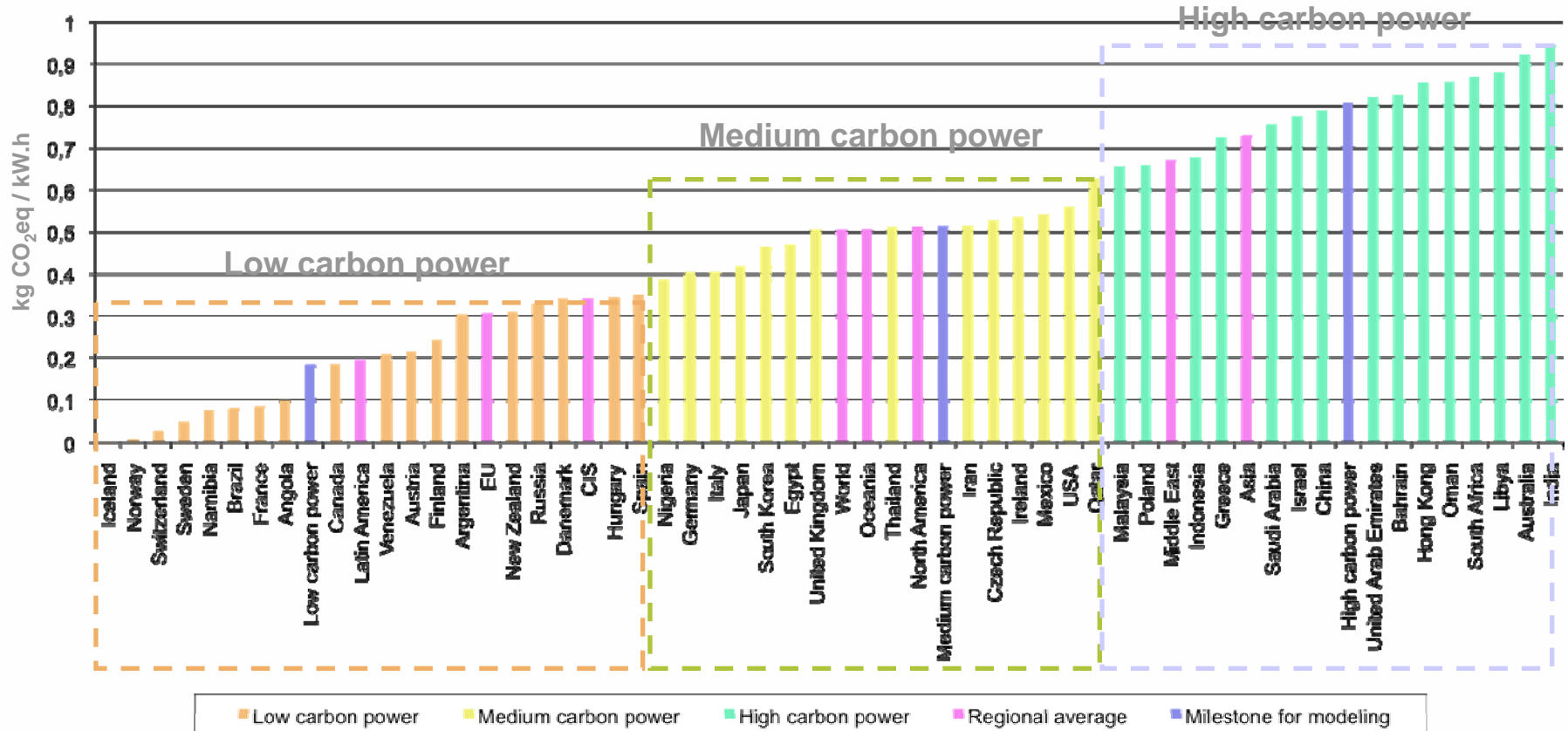
Examples of used emissions factors for materials production

kg of CO₂ equivalent emissions for one ton of raw material



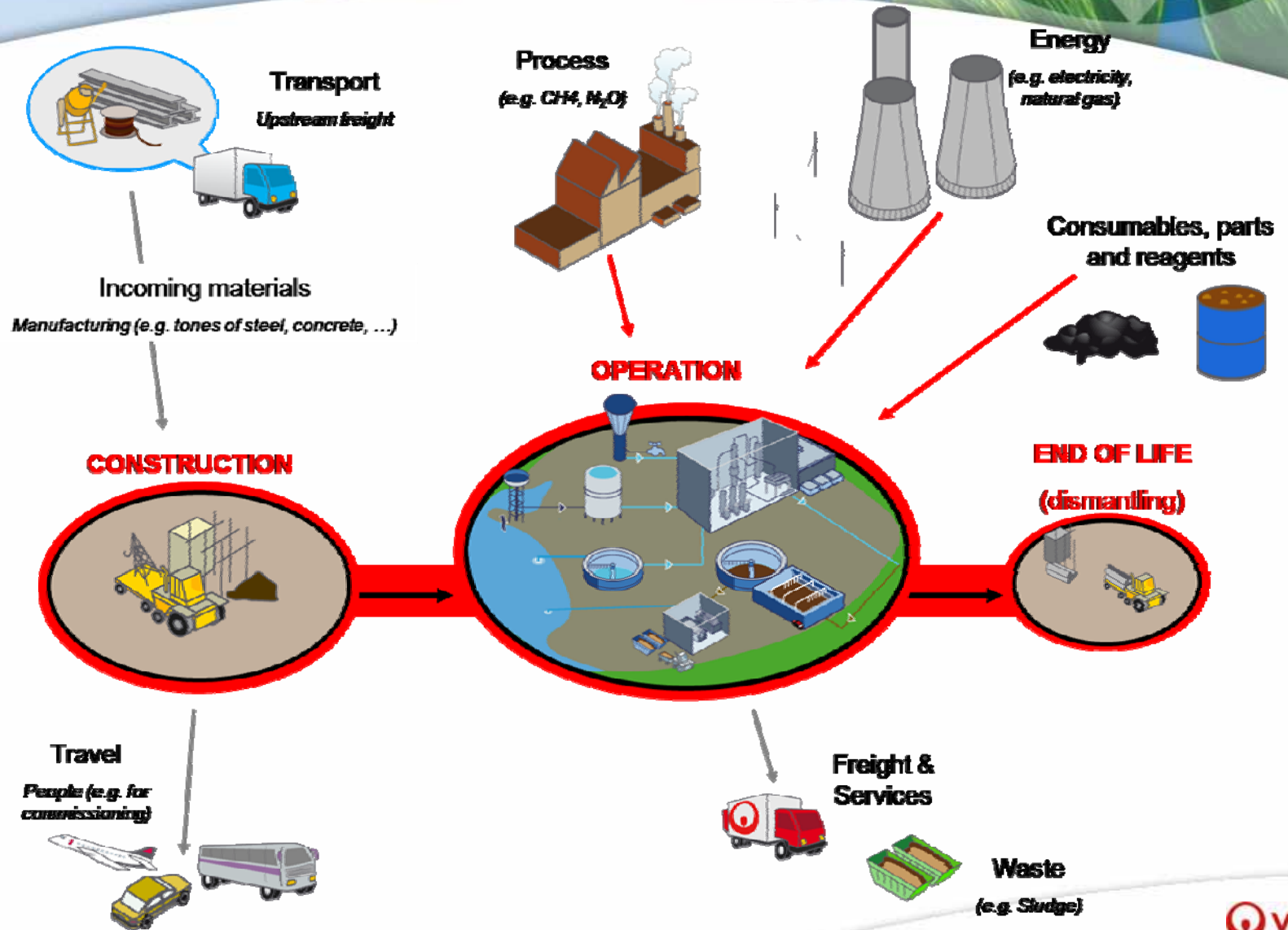
And electricity? That's a clean energy isn't it?

kg of CO₂ equivalent emissions for one electrical kW.h produced



Depending on how your electricity is produced (coal, wind, nuclear, hydro, etc.), you will have different emissions factors

What is included in VWS methodology? (1/2)



What is included in VWS methodology? (2/2)

Incoming materials, goods and services

- Main in flow (tons)
- Main in value (EUR)

Reagents

- Chemicals (tons/year)
- Activated carbon (tons/year)
- Microsand (tons/year)
- Resin (tons/year)

Process

- Water (m³/year)
- CH₄ (tons/year)
- N₂O (tons/year)

Freight

- (For reagents, consumables...)
- Air transport (t.km/year)
 - Road transport (t.km/year)
 - Ship transport (t.km/year)

Construction/ Manufacturing

Use/ Operating

Travel

- Air trip (km)
- Road trip (km)

Travel

- Air trip (km/year)
- Road trip (km/year)

Waste

- Sludge (tons/year)
- Plastics (tons/year)
- NonCombustible (tons/year)

Freight

- (Upstream/Downstream)
- Air transport (t.km)
 - Road transport (t.km)
 - Ship transport (t.km)

Energy

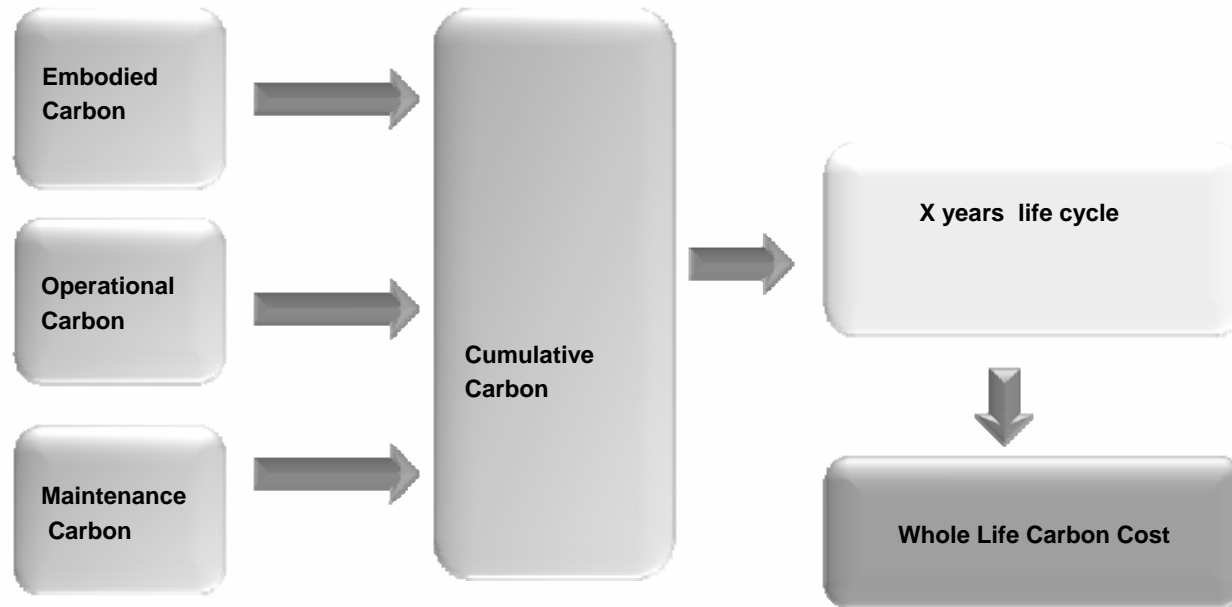
- Electricity (kWh/year)
 - Heat (kWh or liter/year)
- (Natural gas, Fuel, steam)

Consumables and parts

- Main in flow (tons)
- Main in value (EUR)

Useful life = x years
Use hypothesis = y%

Carbon accounting approach



Life Cycle Costs
(Capex + Opex)

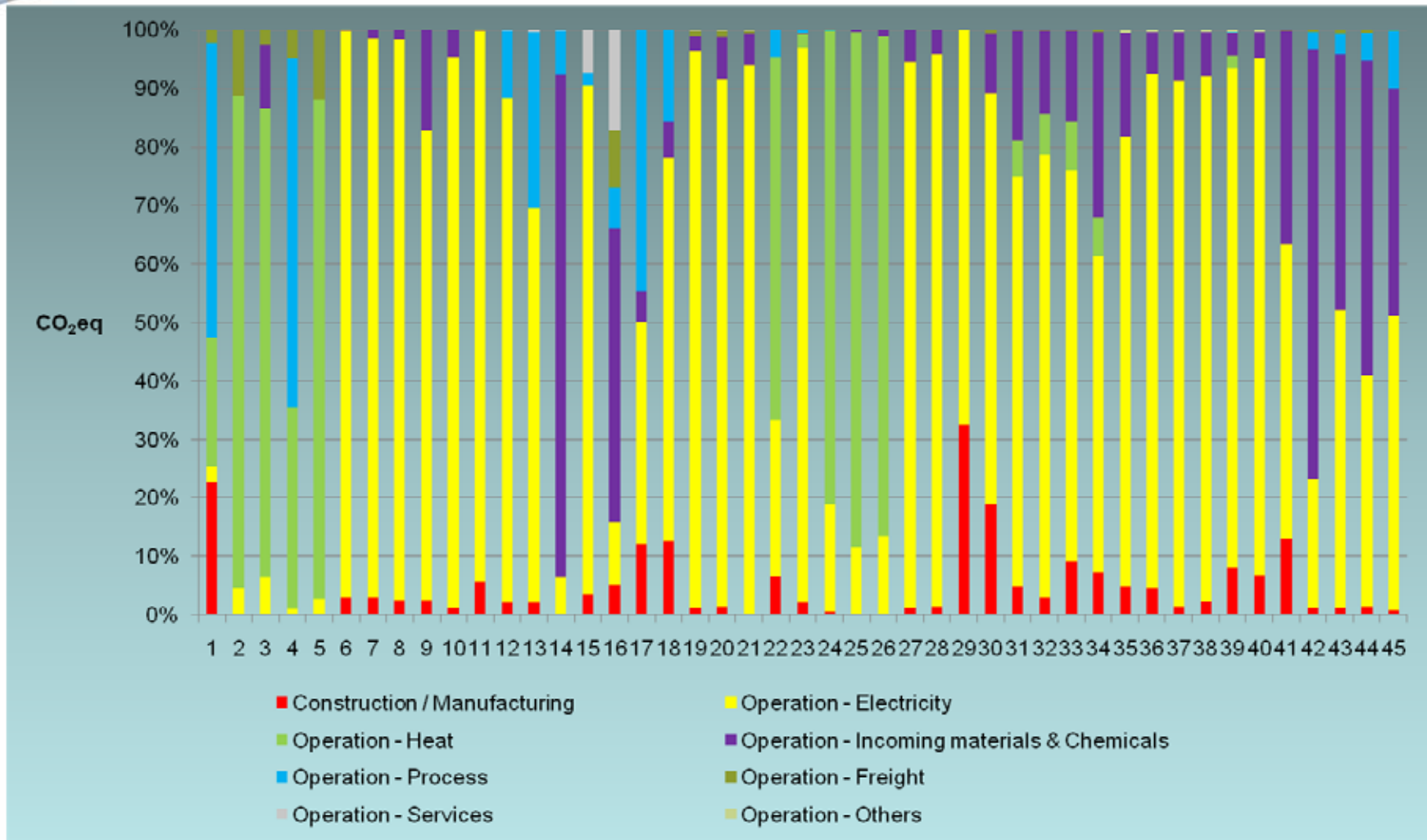


Whole Life Carbon Cost



Total Cost for Cost Benefit
Analysis

VWS carbon review - impact of embodied carbon





Example of calculating the Carbon Footprint

Cameronbridge Distillery

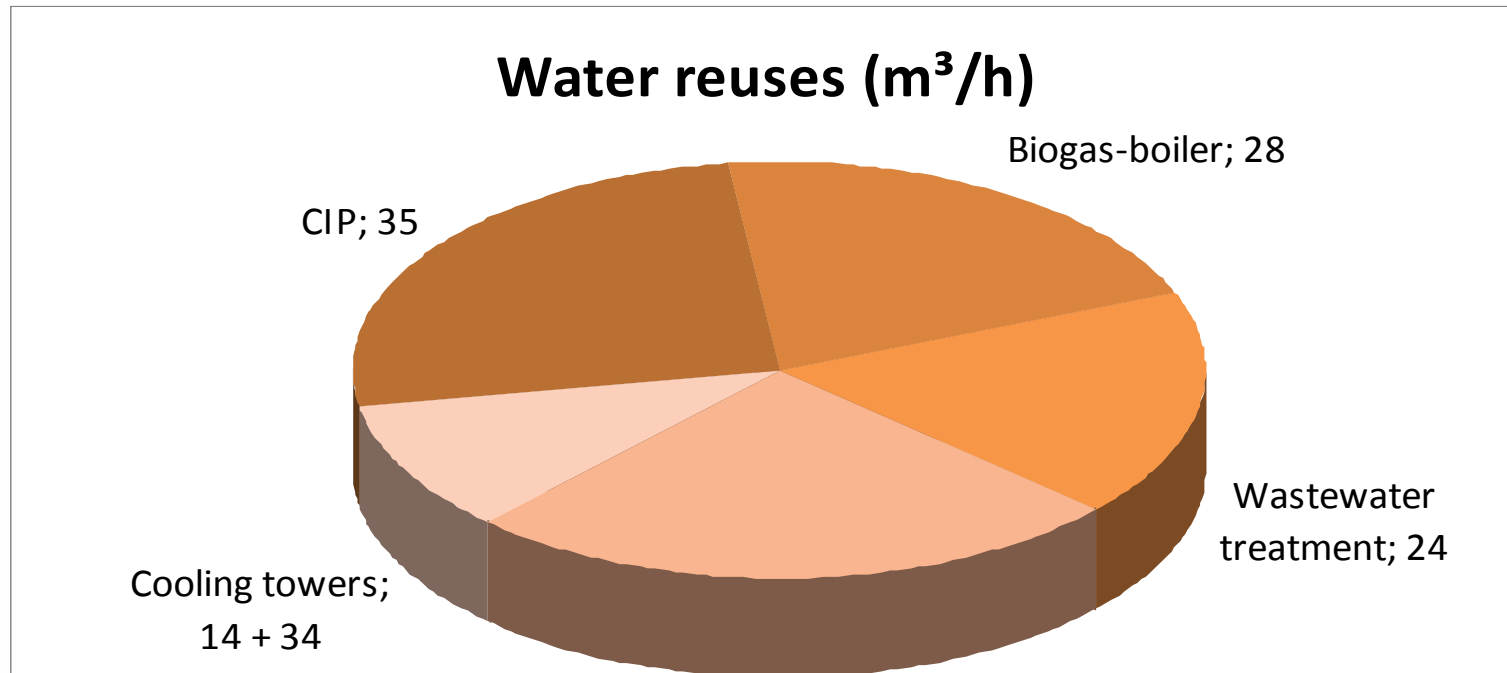


- ▶ Project involves treating wastewater and by-products,
 - creating energy and;
 - recovered water to reduce water and carbon footprint
- ▶ Bio-energy plant will produce 98% of thermal steam and 80% of electrical power for the distillery
- ▶ Reduce distillery annual CO₂ emissions by 56,000 tonnes (equivalent of taking 44,000 cars off the road)
- ▶ Field and lab work performed to fine tune the design
 - Anaerobic trials of settled spent wash,
 - Characterisation of distillery waste streams,
 - Lab trials on dewatering spent wash,
 - Site trials with screw press and belt press,

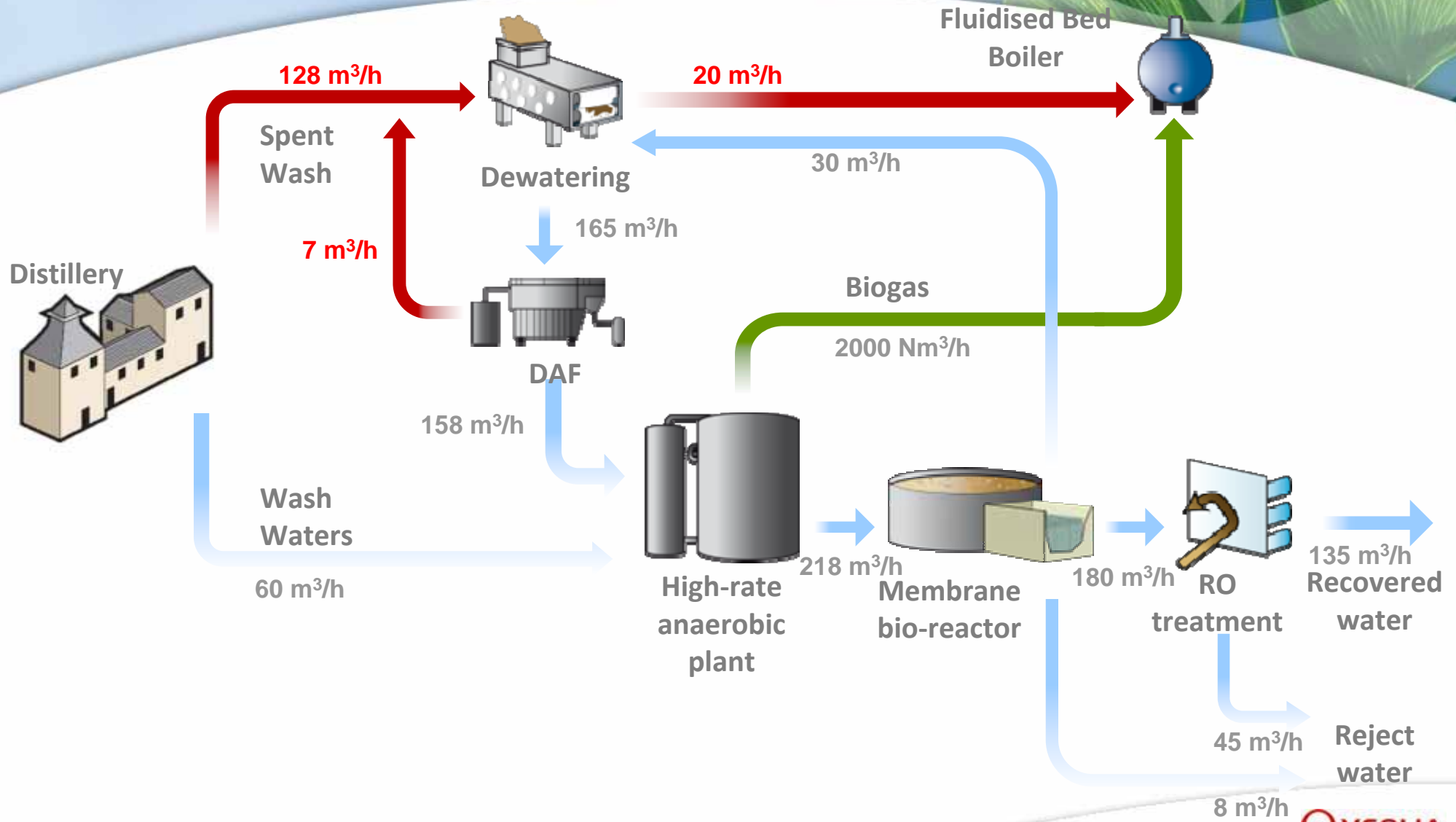
Cameronbridge: 72 % of Reuse

▶ Water reuse performances....

- Wastewater production = 188m³/h
- Total water reuse = 135 m³/h



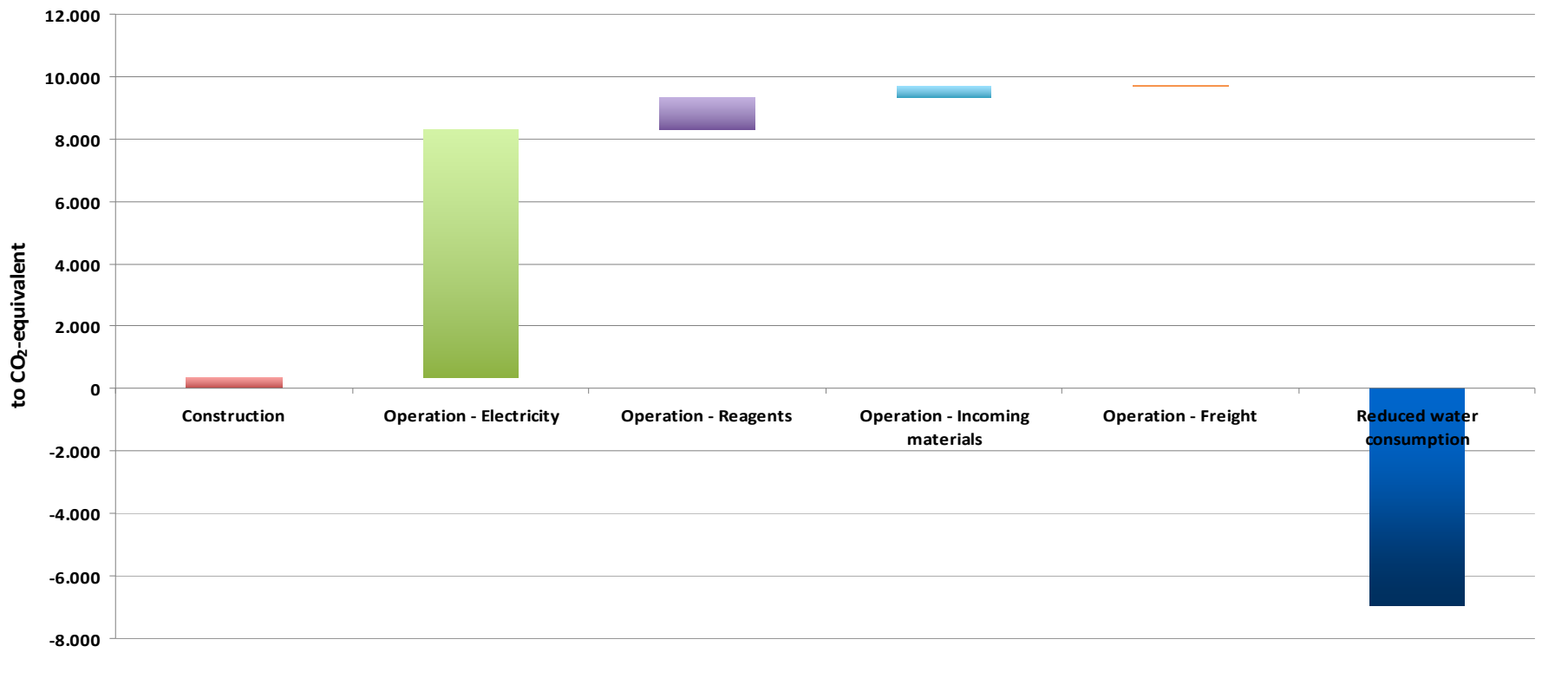
Cameronbridge: Process Scheme



Cameronbridge: CO₂-Calculation



Cameronbridge: Carbon Footprint MBR-stage



AQUAFAB – MegaRO

Reverse osmosis systems producing high purity water, removing up 98% of dissolved inorganics and organics, colloids and particules.

Flow rates from 3.5 to 30 m³/hr.

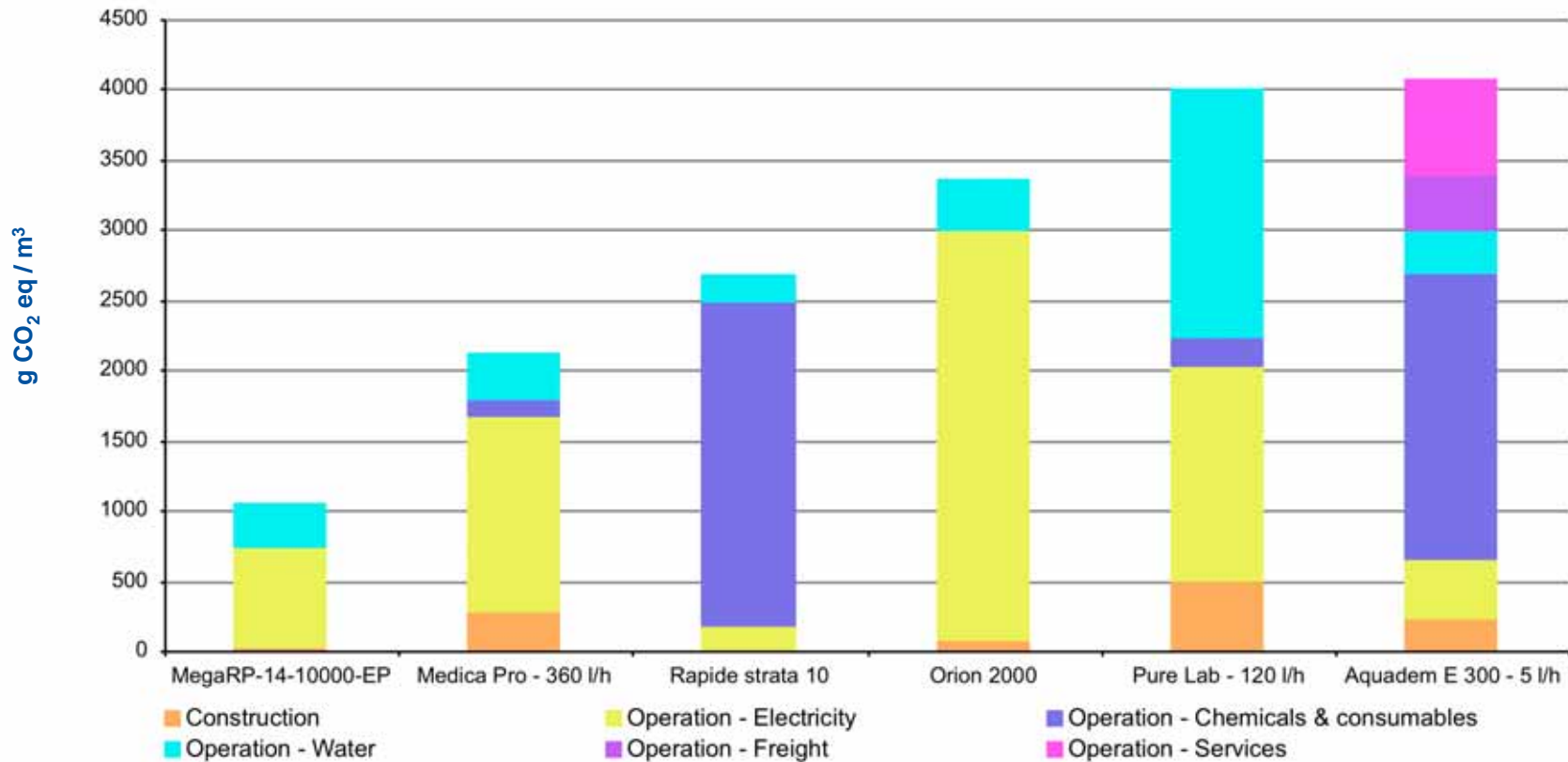
Applications :

Industrial process water /
Electronics / Boiler feed

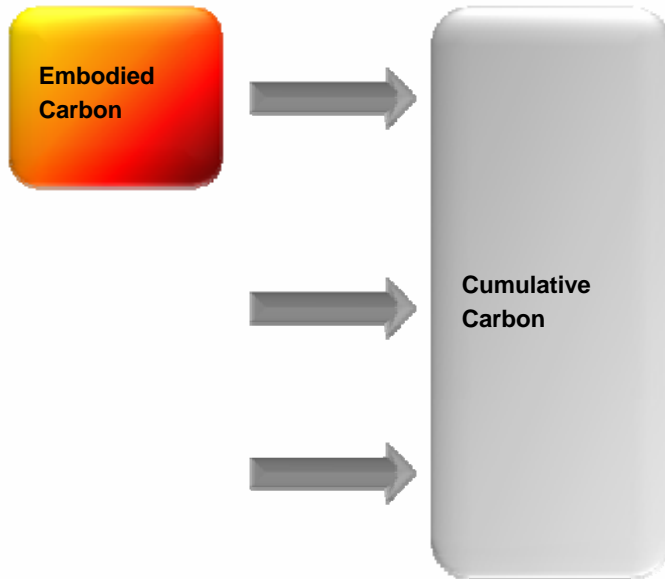


Various Water technologies

GHG emissions per m³ of water



Carbon optimized RO



New Steel production = 3.828 ton CO₂/Ton

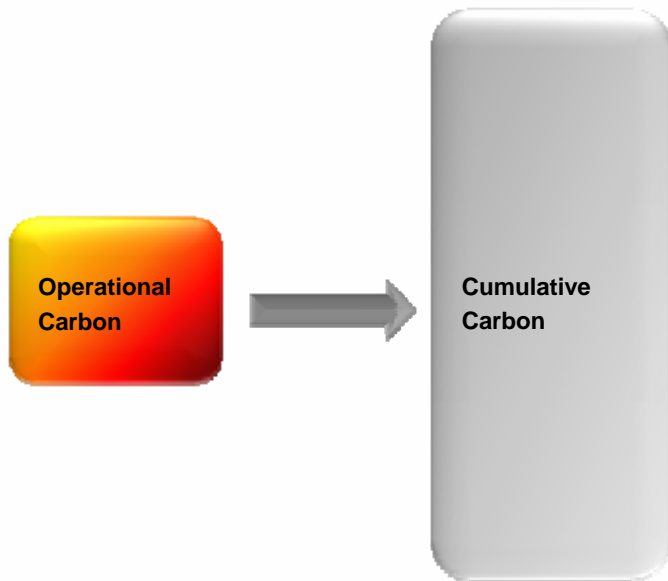
100% Recycled steel = 1.320 ton CO₂/Ton

New HDPE production = 2.200 ton CO₂/Ton

100% HDPE recycled = 1.110 ton CO₂/Ton

- ▶ The embodied carbon is having very little effect on the total carbon footprint but can be optimised by choosing recycled materials.

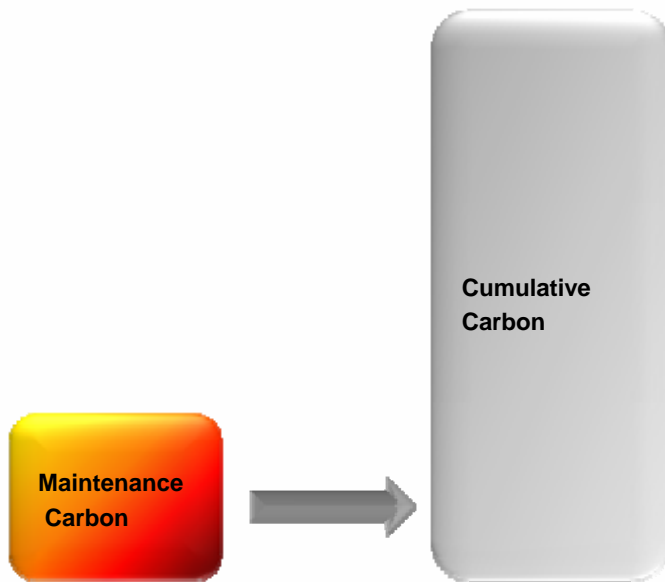
Carbon optimized RO



- ▶ Low-Energy membranes,
- ▶ VFD,
- ▶ Green anti-scalant (CO₂ neutral),
- ▶ More preventive cleaning,
- ▶

- ▶ The operation Carbon is the largest component in the total Carbon Footprint and can be optimised by following above mentioned actions

Carbon optimized RO



- ▶ Green cleaning chemicals,
- ▶ Better planned service trips to minimize km's,
- ▶ More preventive cleaning???,
- ▶

- ▶ The maintenance carbon is having the smallest contribution to the total Carbon Footprint.



Questions ?