

Transforming plastic waste into valuable low-carbon products

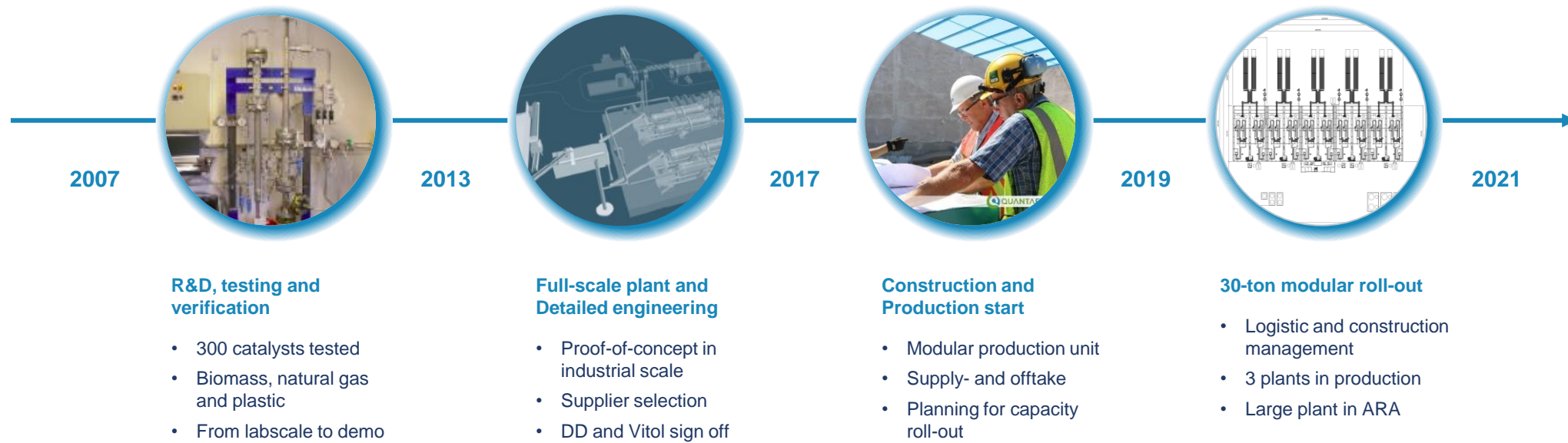
November 2019



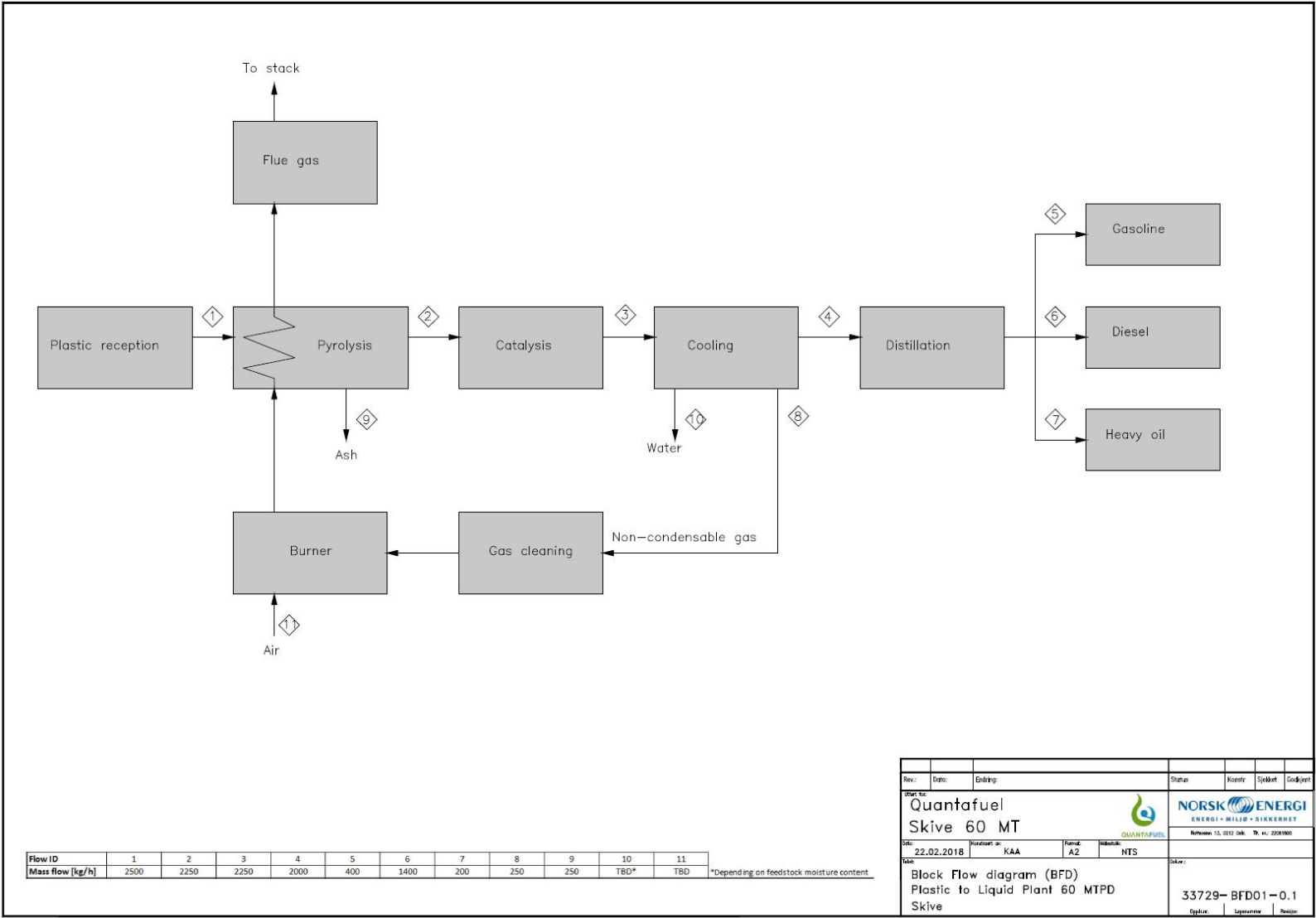
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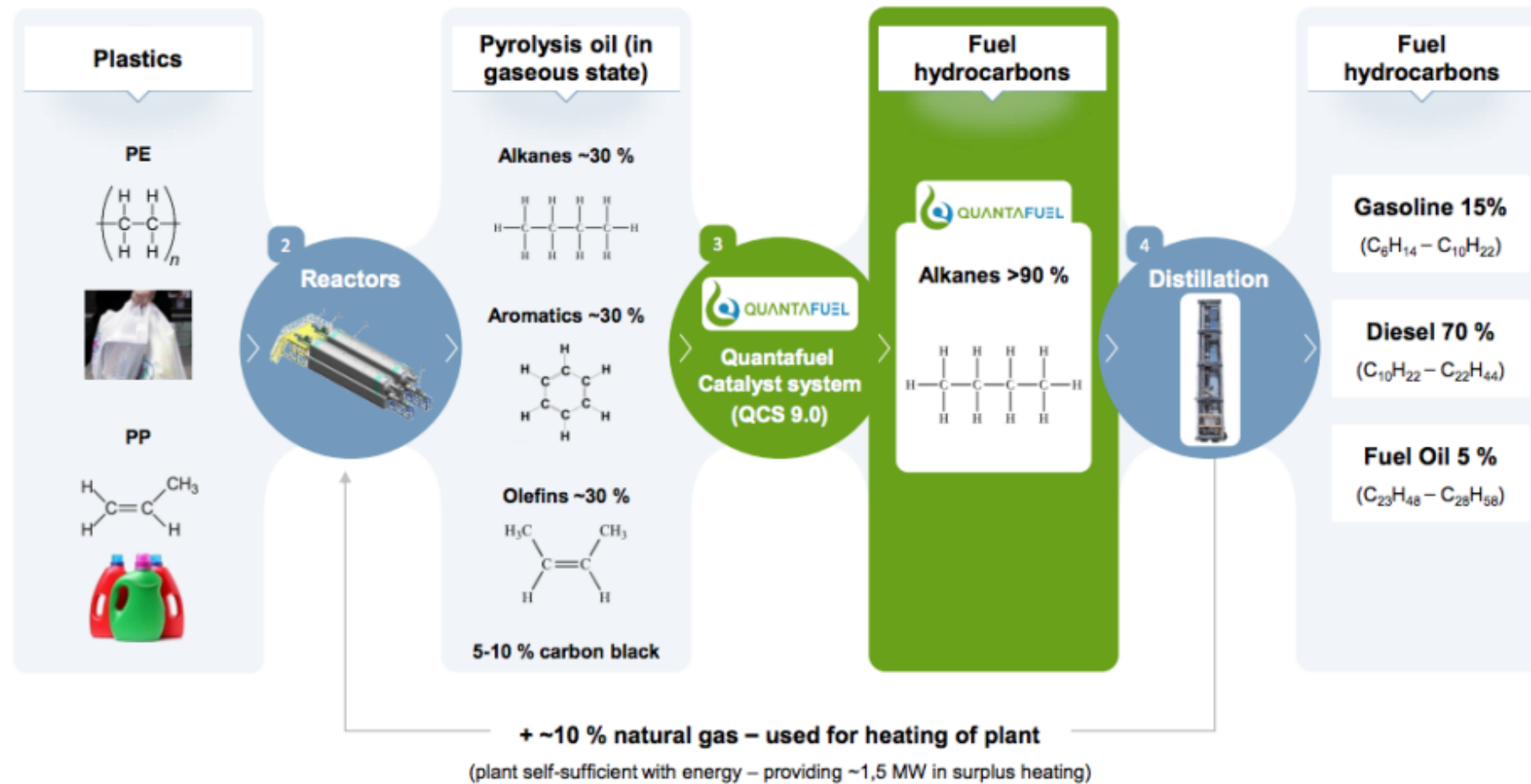
Tested equipment, standardised modular plant design lowers technical risk and enables fast roll-out












Process steps



Innovation, Design and Working Principle



Feedstock specification

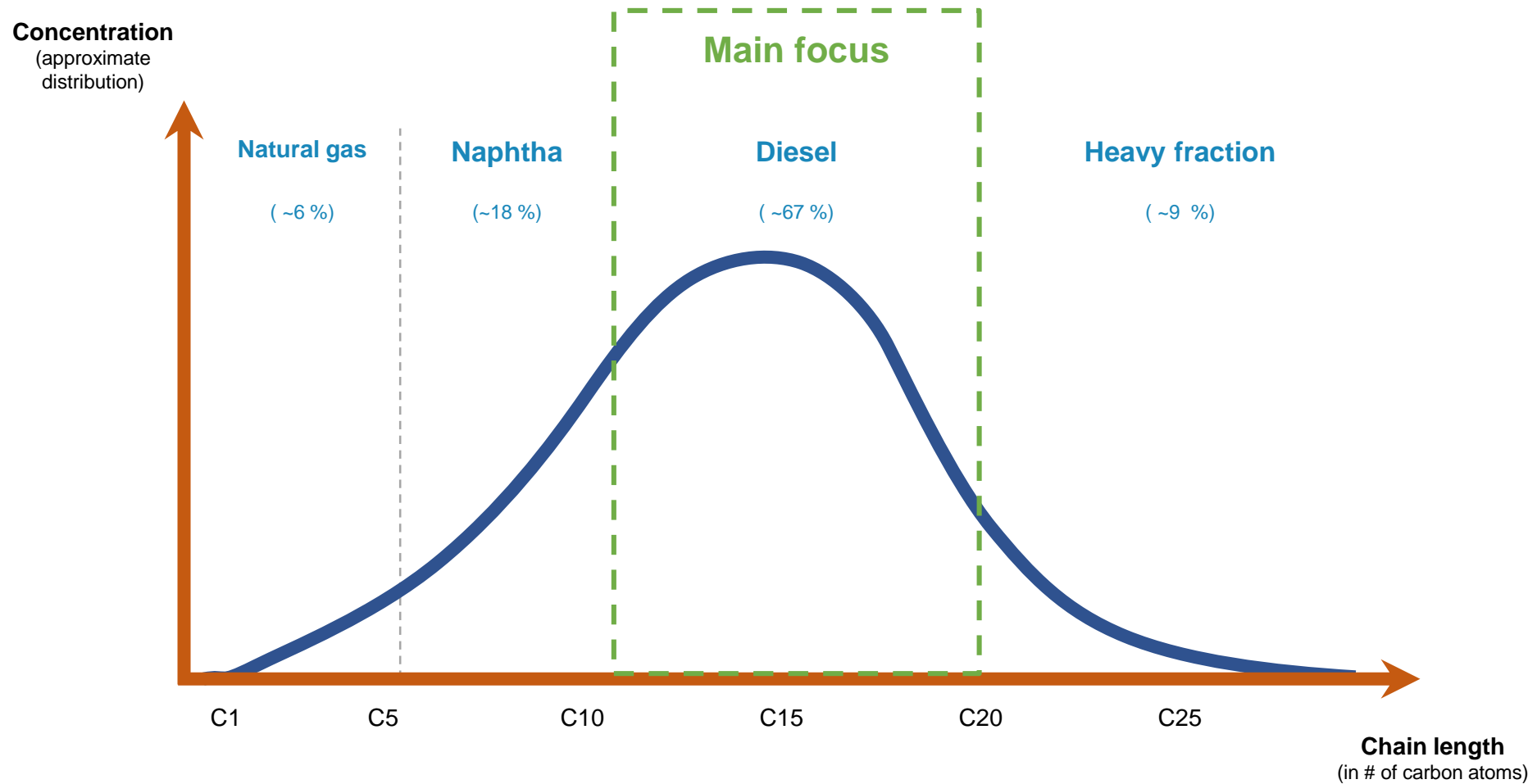
Symbol	Abbreviation	Name	Acceptable fraction [%]
	HDPE	High-density polyethylene	100
	LDPE	Low-density polyethylene	100
	PP	Polypropylene	100
	PS	Polystyrene	10
	PET	Polyethylene terephthalate	< 5
	PVC	Polyvinyl chloride	< 1
	Other	Other types of plastics	< 1
	ABS	Acrylonitrile butadiene styrene	< 1
	PA	Polyamide	< 1

1. MAXIMUM TOLERANCES FOR IMPURITIES

Tolerances for other plastic types are as follows:

- **Maximum 5 wt% of PET** (or 50 kg per ton)
PET may be at 5% even if it gives the possibility to form alcohols and acids in the pyrolysis oil.
- **Maximum 1 wt% of PVC** (or 10 kg per ton)
PVC will give rise to emission of chlorine compounds, which needs to be removed during the conversion process
- **Maximum 5 wt% water** (or 50 kg per ton)
Water present in the plastic will be separated out in the process but reduces the yield in manufacturing.
Contaminants mixed with water, will also reduce the capacity and give rise to the formation of chemical components other than alkanes.
- **Maximum 5 wt% organics** (or 50 kg per ton)
Contaminants such as organics (oil, food, etc) reduce capacity and bind hydrogen leading to formation of unwanted compounds.
- **Maximum 1 wt% of PA and ABS together** (or 10 kg per ton)
Both fractions contain nitrogen that may increase the formation of NO_x during combustion of non-condensable gases and can lead to the formation of toxic substances.
- **Maximum 5 wt% inerts** (or 50 kg per ton)
Inert material such as stone, glass, sand and metals reduces capacity, and will be located in the ash/carbon fraction.
- **Maximum 10 ppm or 0.001 wt% of Sulfur** (or 0.001 kg per ton)
Sulfur will give rise to emission of sulfuric compounds and in worst case contaminate the end products.

Quantafuel has focused on producing diesel due to majority fraction and expected market price premium



PART OF THE SOLUTION

Quantafuel turns a global environmental problem into low-carbon products





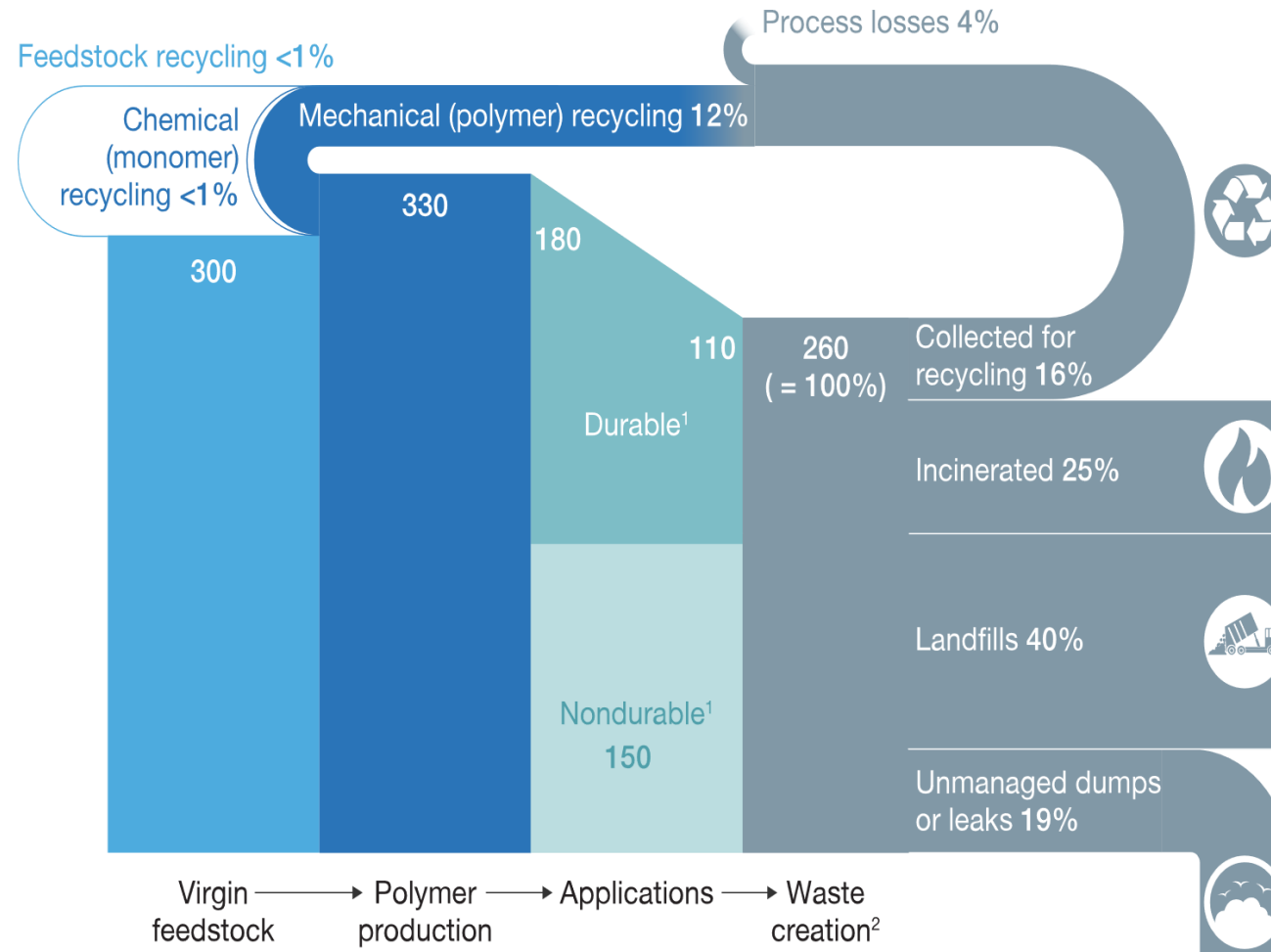
- **Problem**

- Global demand for plastic is set to grow to 460M tons per year by 2030
- 5-13M tons of **plastic leaks into the oceans** each year causing enormous **environmental- and health issues**
- plastic waste **kills over 100.000** sea turtle and birds every year
- micro-plastic contamination can be **found in 83% of tap water** samples from more than a dozen nations



The majority of plastics waste currently goes to landfills and incineration

Global polymer flows, millions of metric tons per annum, 2016¹



Source: McKinsey&Company

Plastic production grows steadily – fastest growing man-made material

Why are Plastics valuable?



1/3 of food globally ends up as waste; plastic packaging is a likely solution



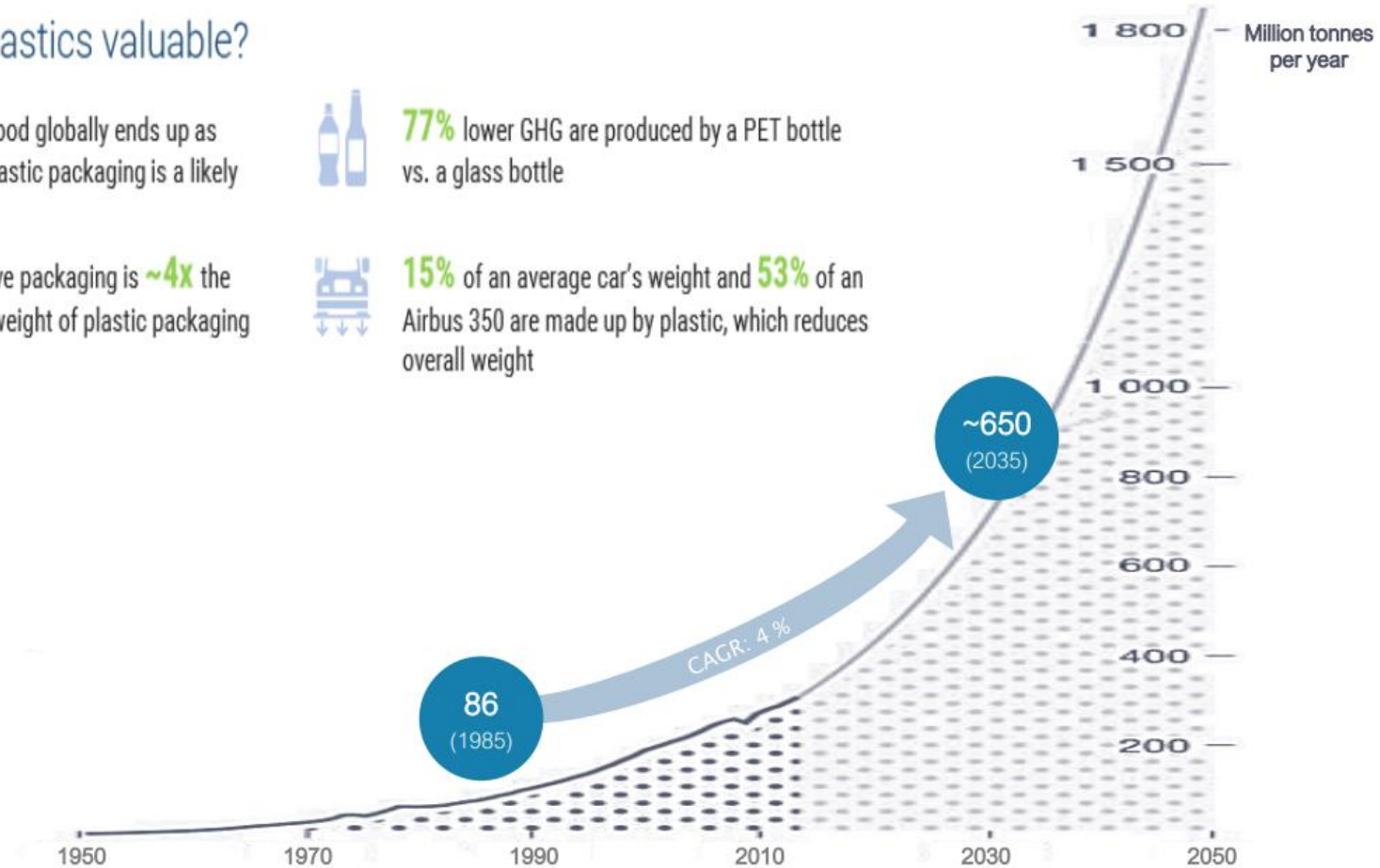
77% lower GHG are produced by a PET bottle vs. a glass bottle









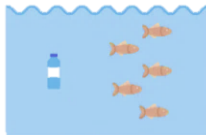
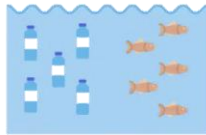
Alternative packaging is **~4x** the volume/weight of plastic packaging



15% of an average car's weight and **53%** of an Airbus 350 are made up by plastic, which reduces overall weight



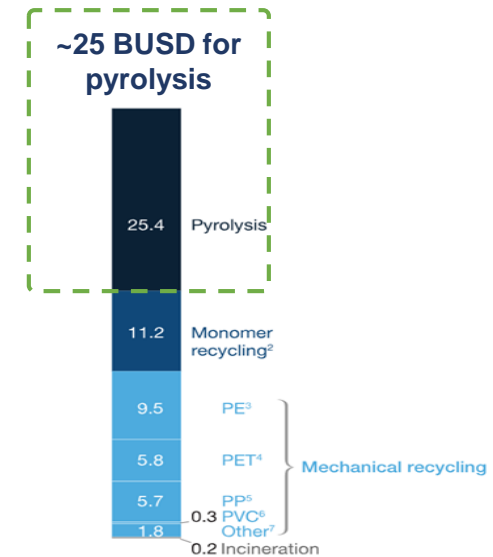
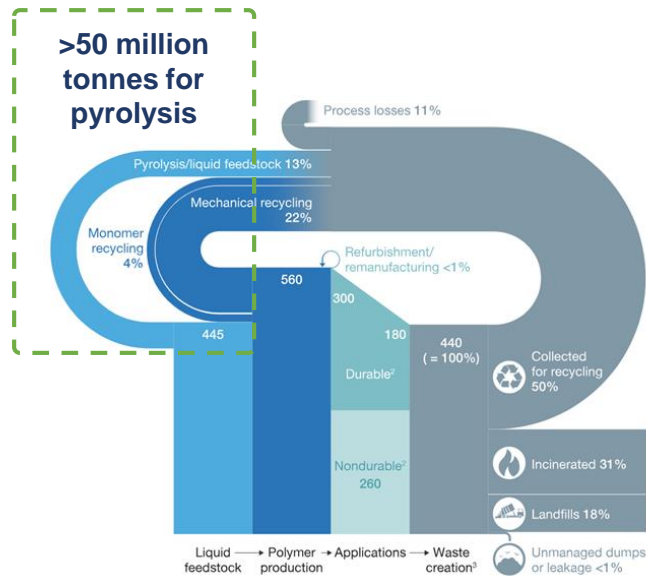
Increasing environmental problem from plastic waste

	2015	2050
Plastic production (million tonnes)	 322	 1,124
Share of oil for plastic production	 6%	 20%
Plastic's carbon budget share	 1%	 15%
Plastic to fish ratio in the ocean	 1:5	 >1:1

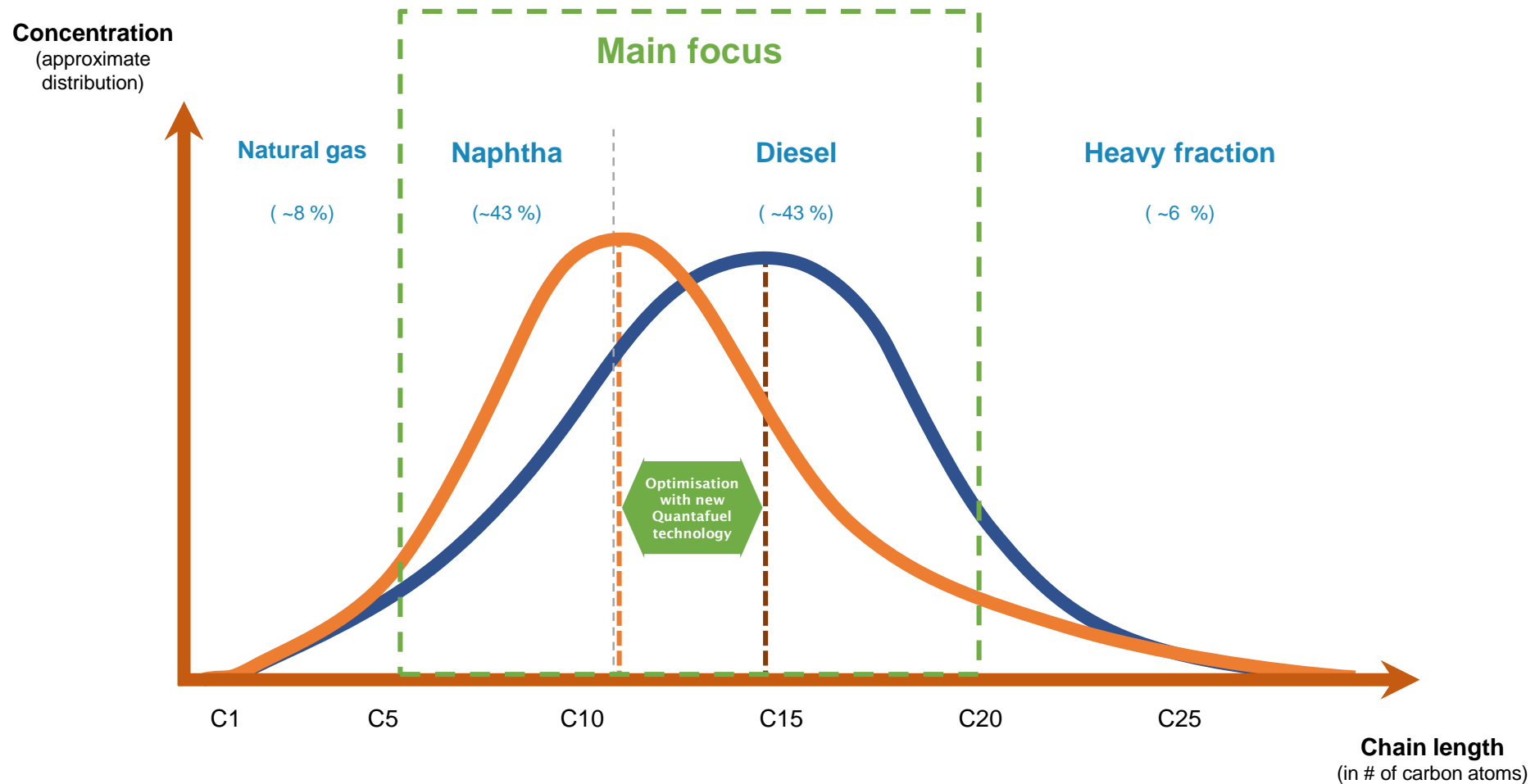
Need a rise of structured plastic waste management and recycling

2030: >200 million tonnes plastic reused

2030: “Alternative reuse” of plastic
biggest profit growth



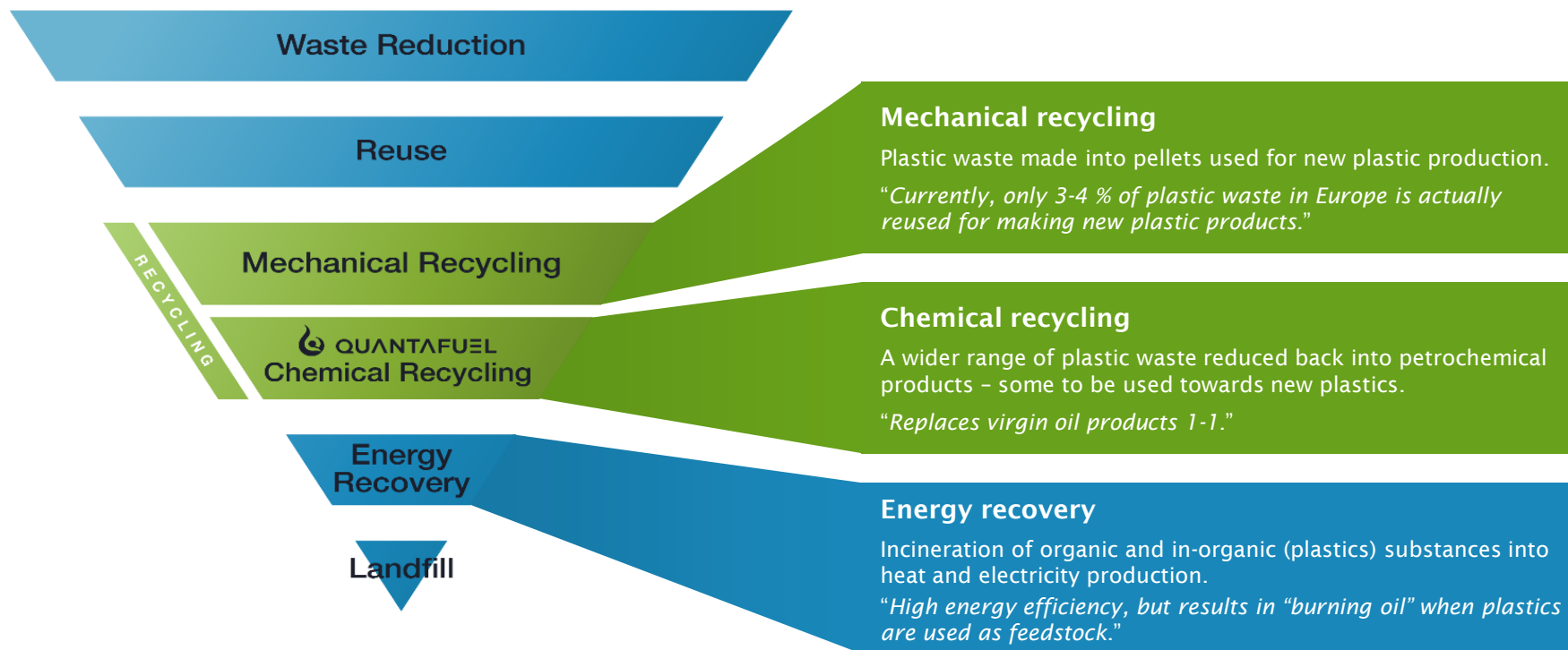
Development of Quantafuel's technology together with market expectations for chemical recycling of plastic waste opens naphtha as high potential












We want to make the world free of plastic waste



Quantafuel's position in the waste pyramid – chemical recycling included



The most difficult material to recycle mechanically

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Global players scrambling for developing their position

Oil majors

Company examples



Stated ambition:



"Neste targets to process more than one million tons of plastic waste annually by 2030."

See major opportunities in alternative fuels

Chemical majors

Company examples



Stated ambition:



"BASF is working on recovering and recycling of plastics through our ChemCycling project."

Expect chemical recycling to become a major factor

Recycling majors

Company examples



Stated ambition:



"REMONDIS has initiated a project to develop and operate so-called chemical recycling facilities."

Need to increase recycling – require chemical recycling

Feedstock handling system



4 Pyrolysis reactor



Unique catalyst solution



Distillation column and storage



To the beginning of
a partnership



Hanne Risgaard
Environmental Director
Quantafuel AS
Phone: +45 22444666
E-mail:
Hanne.Risgaard@quantafuel.com



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