

**W**ASTE



**T**O



**O**IL



**CASSANDRA OIL** 

## From waste to oil with new ground breaking technology

### Environment.

The company's focus is :

- to reduce waste going into landfill
- to deliver cost effective and environmentally-friendly processes

### Market Leading Technology.

The CASO technology is based on a patented reactor, that enables production of oil from materials containing hydrocarbons. A proven market leading platform utilising catalytic cracking .

### Production.

These systems produces synthetic crude oil. Production rates of up to 2 tonnes of oil per hour, depending on specific feed-stock and other variables.



### Key Stats

Cassandra Oil was founded in 2011 and is listed on the Swedish stock market Nasdaq First North since 2012.

The founder, Anders Olsson is a holder of multiple patents prior to the CASO Technology invention.

CASO platforms are currently operational in: Sweden, Iraq and Spain

The company is based in Västerås, Sweden and has 20 employees and consultants. As well as field engineers on international sites.

## Key Recycling Markets

Tires/rubber



Plastics



Oil/sludge



# WASTE MATERIALS SUITABLE FOR THE CASO TECHNOLOGY



**PLASTICS**

90 million mt of plastic waste goes into land fill per year in the western world.

10 million mt – Europe  
1 million mt –Uk.

Within EU the regulations around the dumping of waste are constantly getting stricter.



**WASTE TIRES**

1 tire per person/year is disposed annually in the western world.  
=10 Million Mt. A fire in a tire mountain would be an environmental catastrophe. Certain areas of discarded tires are large enough to be seen from space.



**HEAVY OIL AND SLUDGE**

The heavy part of the crude oil has historically been dumped straight into the environment in many oil producing countries and this is an enormous source of raw material for Cassandra Oil

# LANDFILL STATISTICS IN EUROPE



No waste including more than 7% hydrocarbon allowed in landfill by 2020.

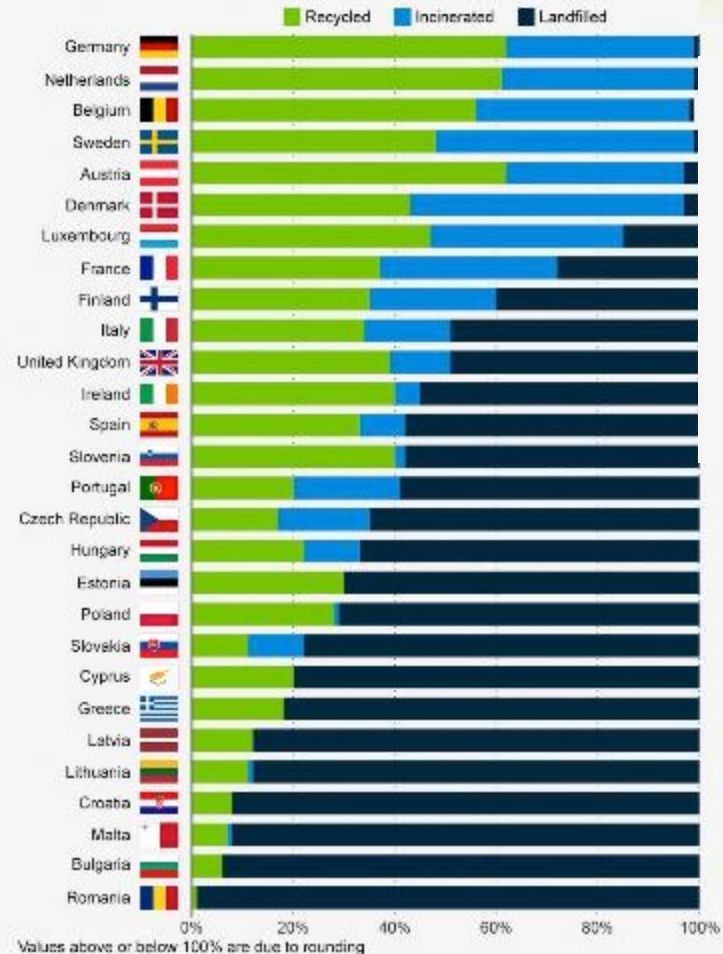
UK landfill deposit fee @ £ 82,50 per mt which is higher than most European countries.

RECYCLED + COMPOSTED

INCINERATED

LANDFILLED

## Waste management in Europe



# EU LEGISLATIONS 20% by 2020

## Renewable energy directive



- The Renewable Energy Directive establishes an overall policy for the production and promotion of energy from renewable sources in the EU.
- It requires the EU to fulfil at least 20% of its total energy needs with renewables by 2020



# LEGISLATIONS



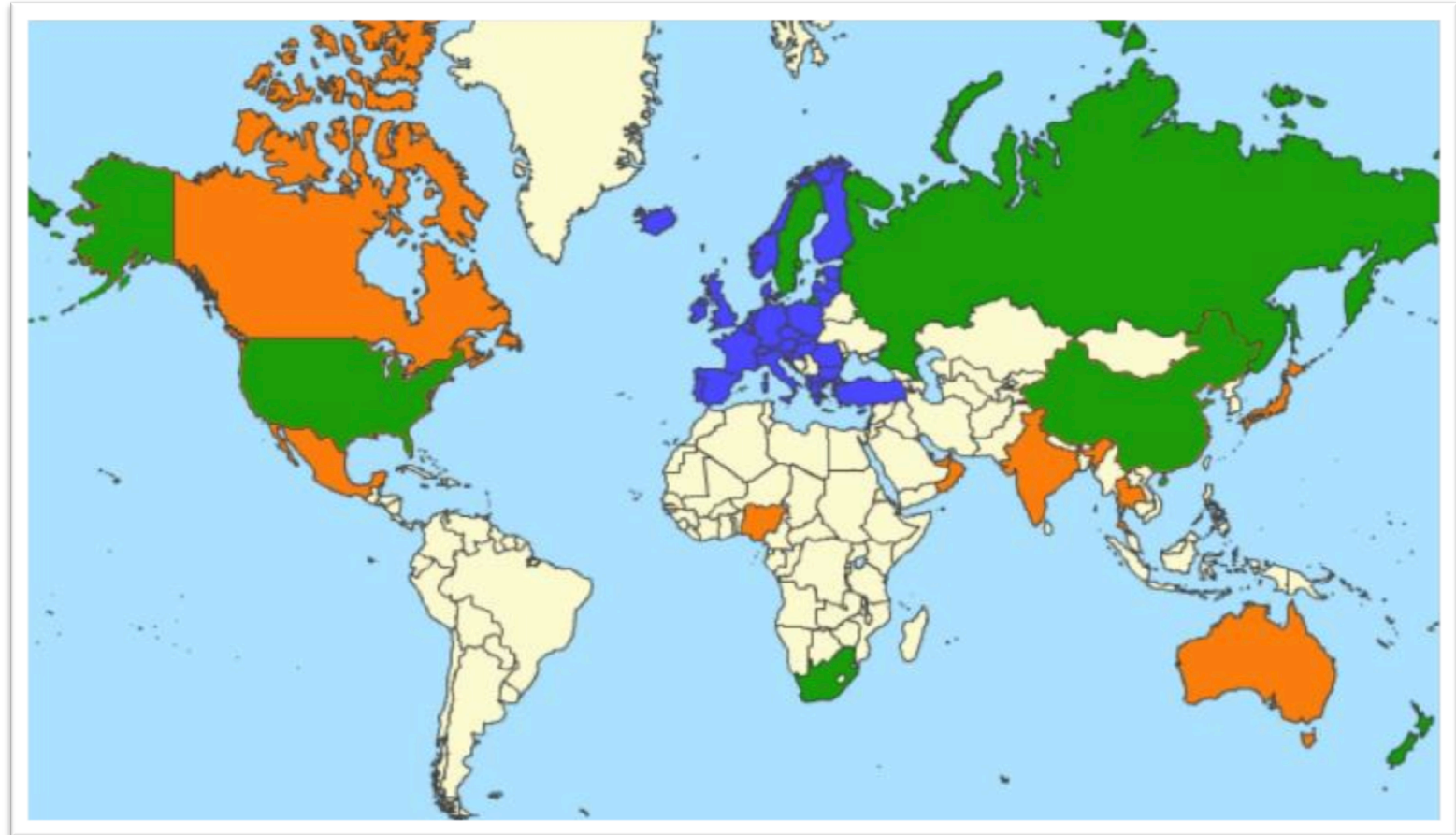
## **PRODUCER RESPONSIBILITY**

The law defines the legal framework and assigns the responsibility to the producers (tyre manufacturers and importers) to organise the management chain of end of life tyres.

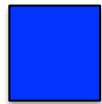
Countries with a Producer Responsibility regime: Belgium, Bulgaria, Czech Republic, Estonia, Finland, France, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden and Turkey.

By professionalising the service providers – collectors, sorters and re-processors – the goal is to significantly improve the recovery rate and traceability and develop applications with added value which utilise the full potential of the properties of rubber.

# PATENTED TECHNOLOGY



Applied National



Applied EPO



Approved

# INVESTMENT/ OPERATION COST OF OIL EXPLORATION

Cost analysis published 30/12, 2013  
in Dagens Industri, Sweden by Olle Aronsson

Country or region	Project type	Cost of Investment \$000/ barrel / day	Operational Costs (\$/barrel )
Brazil	Ultra deep sea drilling	45-55	15-20
Canada	Oil sand	100-120	25-30
Iraq	Traditional exploration	10-15	2
Kazakhstan	Deep sea drilling	70-80	15-20
Saudi Arabia	Traditional exploration	15	2-3
USA	Oil shale	90-100	8
West Africa	Deep sea drilling	70-80	25-30

Cassandra Oil figures

Cassandra Oil

CASO 600

15-30

20-25



# IRAQ- OIL LAKES AND CONTAMINATED SOIL



**Cassandra Oil provides a tailor made solution that address a broad spectrum of customer needs.**

A specific solution is provided after an in-depth understanding of the unique project specifications and analytical tests.

The CASO Technologies have been developed to meet or exceed strict regulations regarding treatment of hydrocarbon waste materials.

**Cassandra Oil's temporary site situated by Bajwan crude oil trap on North Oil Company's territory in Iraq.**



**Iraq- plan of permanent site**

# MIXED WASTE FROM THE OIL INDUSTRY= RAW MATERIAL

Oil lakes- a threat to the environment



# W

Plastic oil barrels, a waste product from refineries which can be processed in CASO.



# SAUDI

Cassandra Oil and TECO (Tomorrow Environmental Company) have agreed to form a joint company based in The Kingdom of Saudi Arabia with the main intention to process oil waste products relating to TECO's licence with ARAMCO.

The JV will also process other hydrocarbon rich waste such as used tires.



# CASO SPAIN PROJECT



Sacyr group ([www.sacyr.com](http://www.sacyr.com))

Spanish company with 70,000 employees with operations in construction, real estate, energy and waste management.



Energy Plants



Waste Treatment



Electrical Installations



Oil & Gas

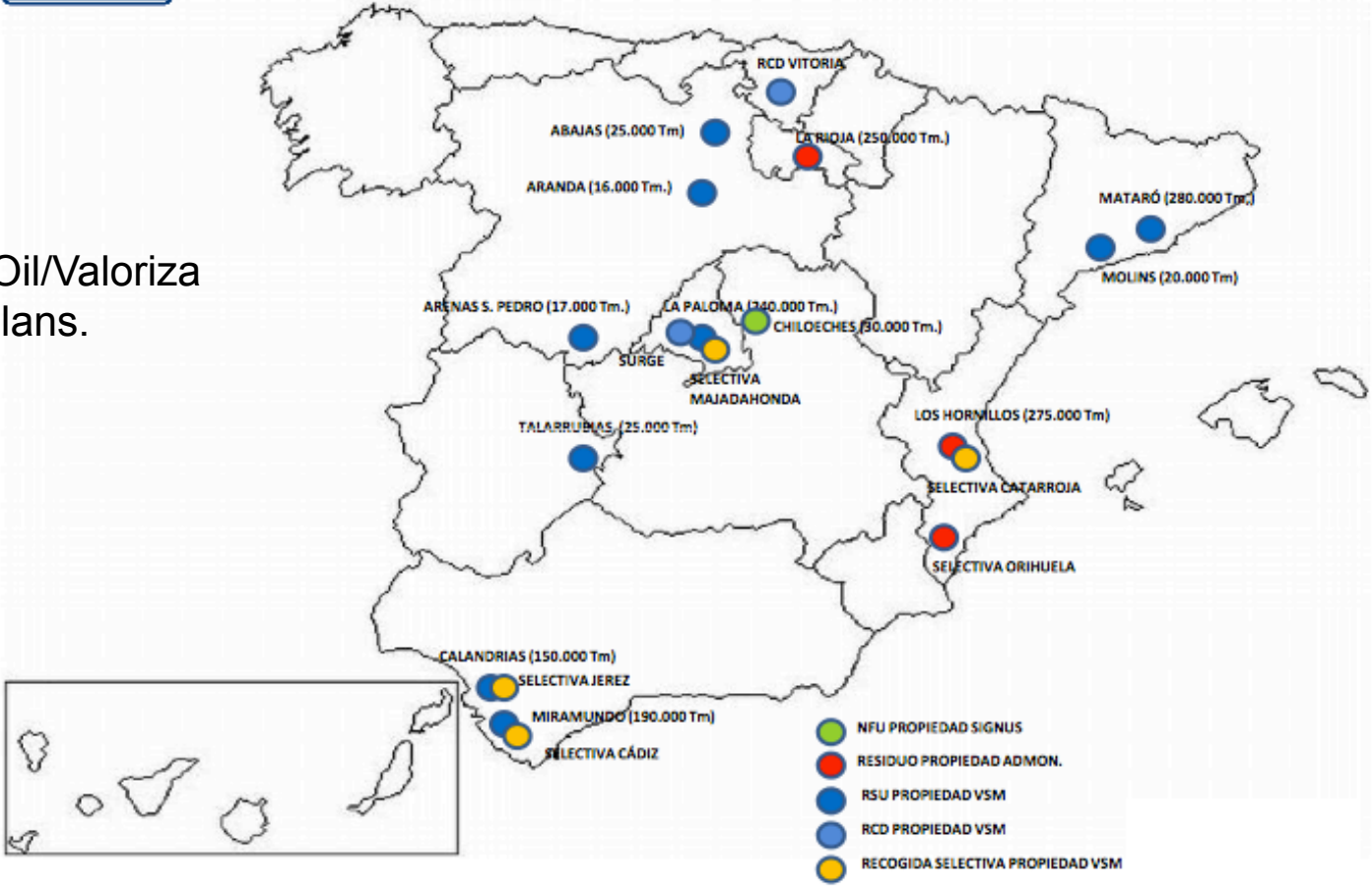
Sacyr and Cassandra Oil have joined forces to implement the first CASO WtE plant in Spain to process waste plastics and waste tires into energy.

# CASO SPAIN PROJECT



## Dimensionamiento Plantas con presencia de VSM

Cassandra Oil/Valoriza expansion plans.



# CASSANDRA OIL- VALORIZA SITE IN JEREZ

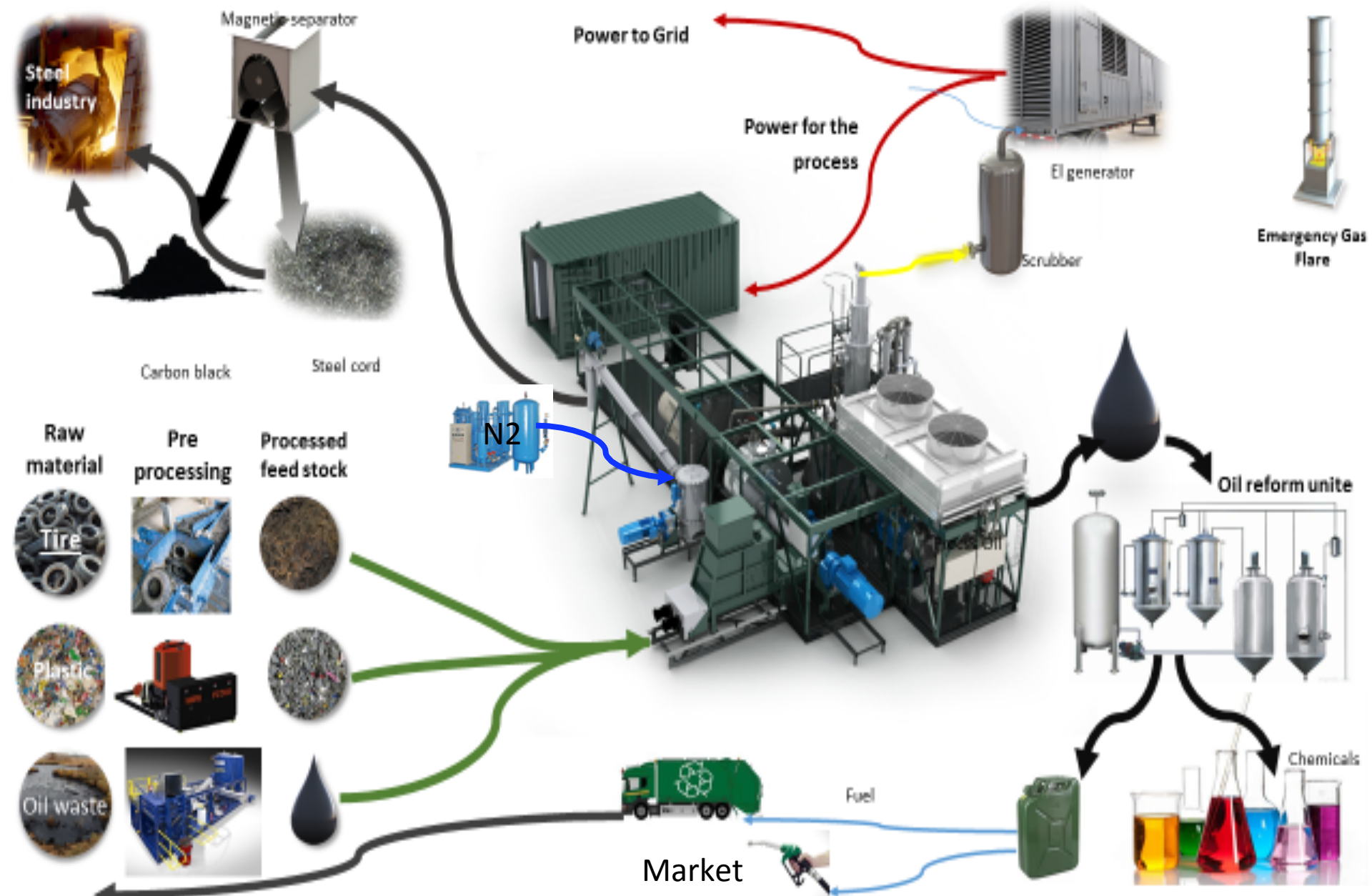


# CASO 600 @ JEREZ SITE



Plastic  
Tires

# CASO CIRCULAR ECONOMY WASTE RECYCLING FLOW





# CASO CIRCULAR ECONOMY WASTE RECYCLING FLOW

## **Raw material**

General requirement is a moisture content of less than 5%, which requires pre treatment or tailored handling.

Pollution in the form of sand, soil, paper and wood do not disturb the process.

## **Tires**

Shredding of tires to about 5x5 cm, no separation of steel cord is required

## **Plastic**

Crushing to about 5x5cm, sorted to remove PVC, iron and greater foreign objects

## **Oil sludge**

Ensure the sludge has a viscosity suitable for the process.

**”Process gas”, non condensable, a mixture of gases ranging from methane to pentane.**

- Possible applications of the process gas will depend on the market and the customer as well as the location of the processing plant.
- Heat and power generation of thermal power plants for district heating
- Own electricity and heat generation for operations of the facility as well as related processes on site
- Refine the gas to a commercial product, for example propane.

## **Carbon black and steel**

- Carbon black powder has several uses ranging from combustion, paint pigments as well as used for the manufacturing for new tires etc.
- Steel is recycled back into the steel industry.

# CASO CIRCULAR ECONOMY WASTE RECYCLING FLOW

## ”Process oil”

- We are actively working with various levels of applications and the choice will depend on the market and specific customer needs.
- The oil is a raw material for further production of products such as for example new tires or plastic products.

## Refineries

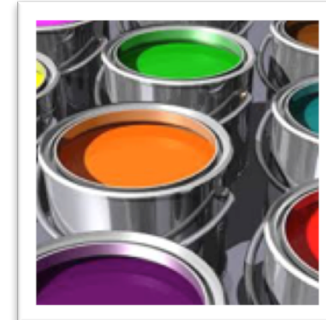
- The oil is comparable with Brent Crude and can be used for production of fuel and other chemical products.

## Marine diesel

- Refining of the oil to suit shipping or as a mixer in other products.

- **Petrochemical Industry**

The oil can be refined into a variety of products such as white spirit, specialty oils etc.



# CASSANDRA OIL - REPLACING FOSSIL OIL

**OIL FROM THE GROUND IS REPLACED WITH OIL FROM WASTE**

**1mt of plastics = 0,9 mt of oil**

**1 mt of tires= 0,45 mt of oil**

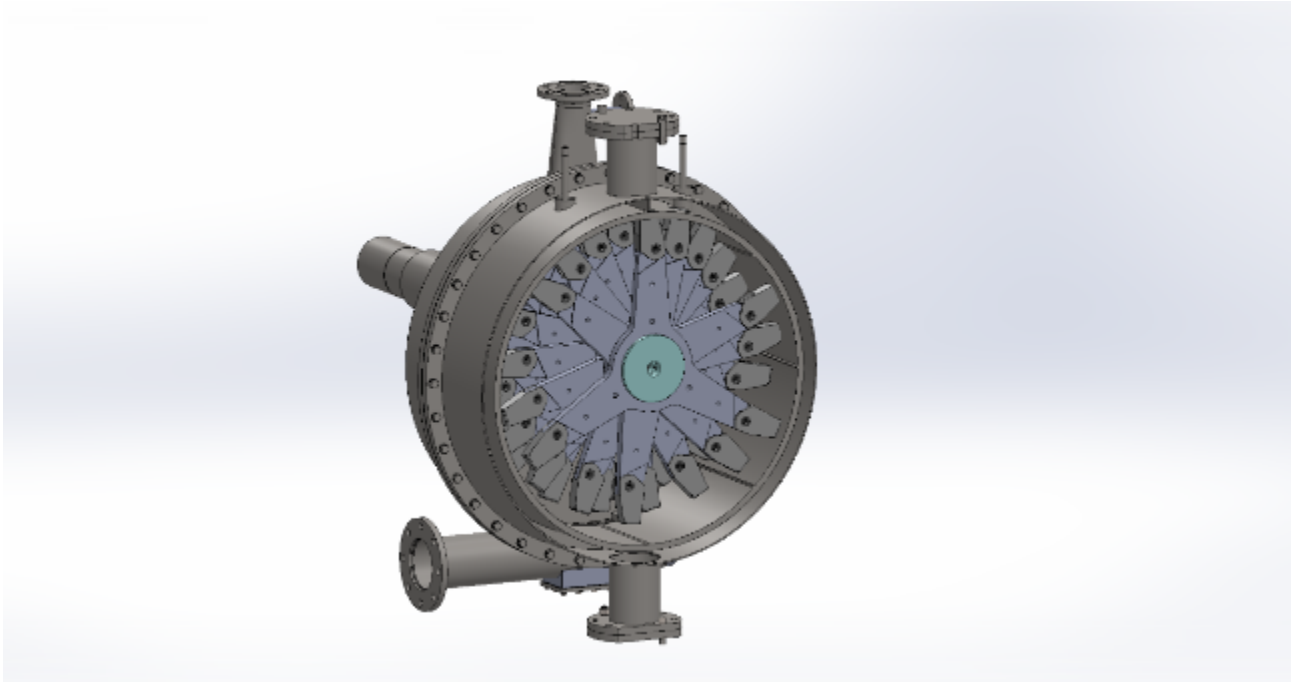
**1 mt of oil sludge= 0,8 mt of oil**

# CASO TECHNOLOGY



Process oil out

# WHAT IS CRACKING?



## 5 basic mechanisms

Initiation

Hydrogen abstraction

Radical decomposition

Radical addition

Termination



# MECHANISMS

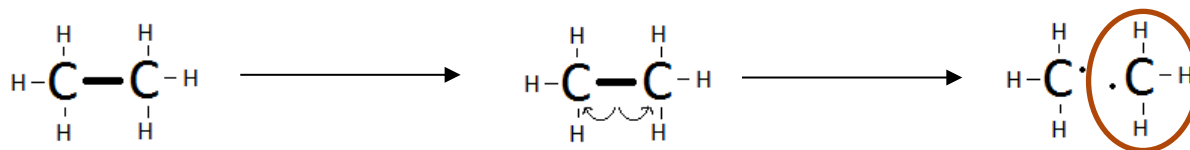
## Initiation

– The heat energy breaks the bond between the carbon atoms.

Ethane

Bonds break

Two free radicals

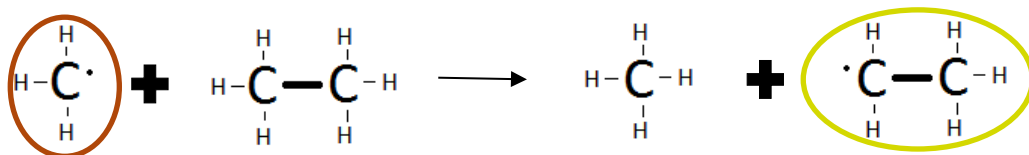




# MECHANISMS

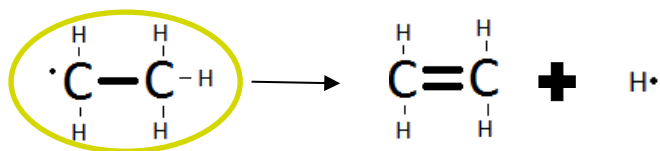
## Hydrogen abstraction

– The radical moving a hydrogen atom from another molecule



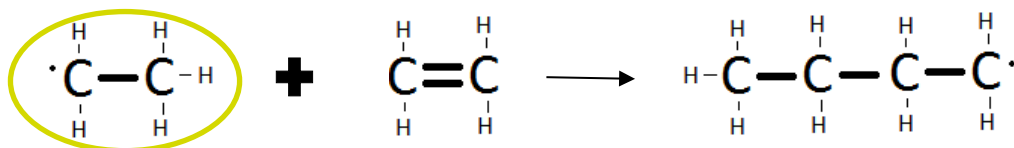
## Radical decompositions

- One free radical is split in to two molecules, a alkene and a reformed free radical



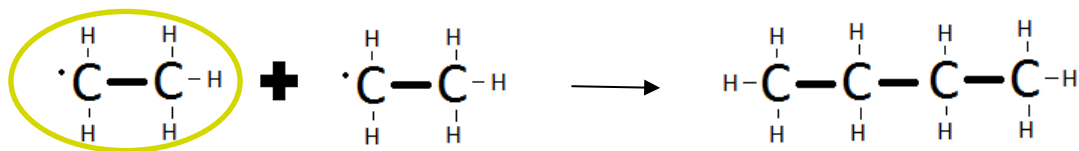
## Radical addition

- Inversion of radical decomposition.
- A larger free radical is created
- Resulting in heavier products



## Termination

- Two free radicals merge
- The cracking stops.



# MECHANISMS

Spontaneous throughout the process.

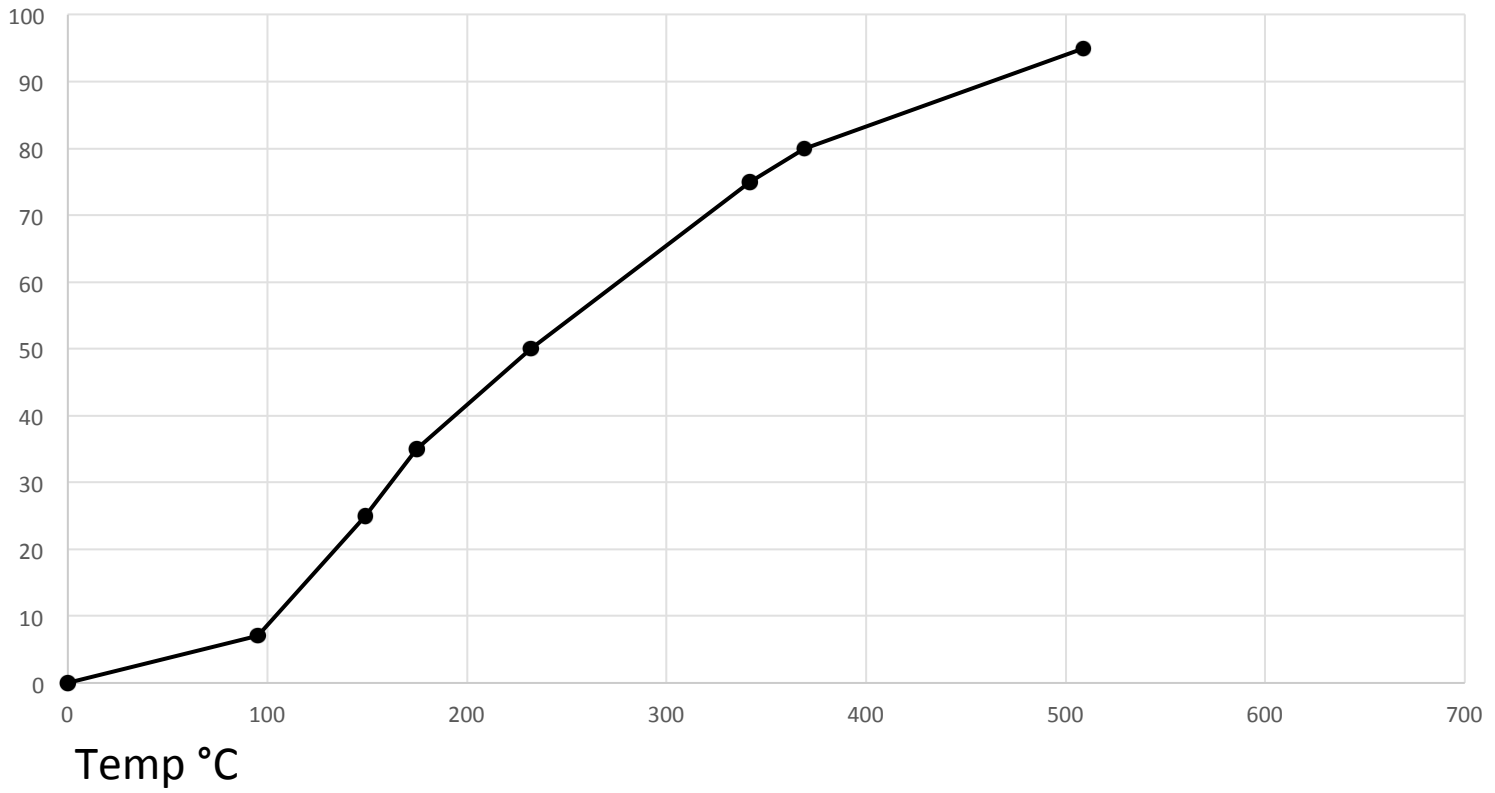
Aim to cut the long carbon bonds to suitable length.

When the produced gas leaves the reactor the cracking mechanisms stop.



# DISTILLATION CURVE

vol%



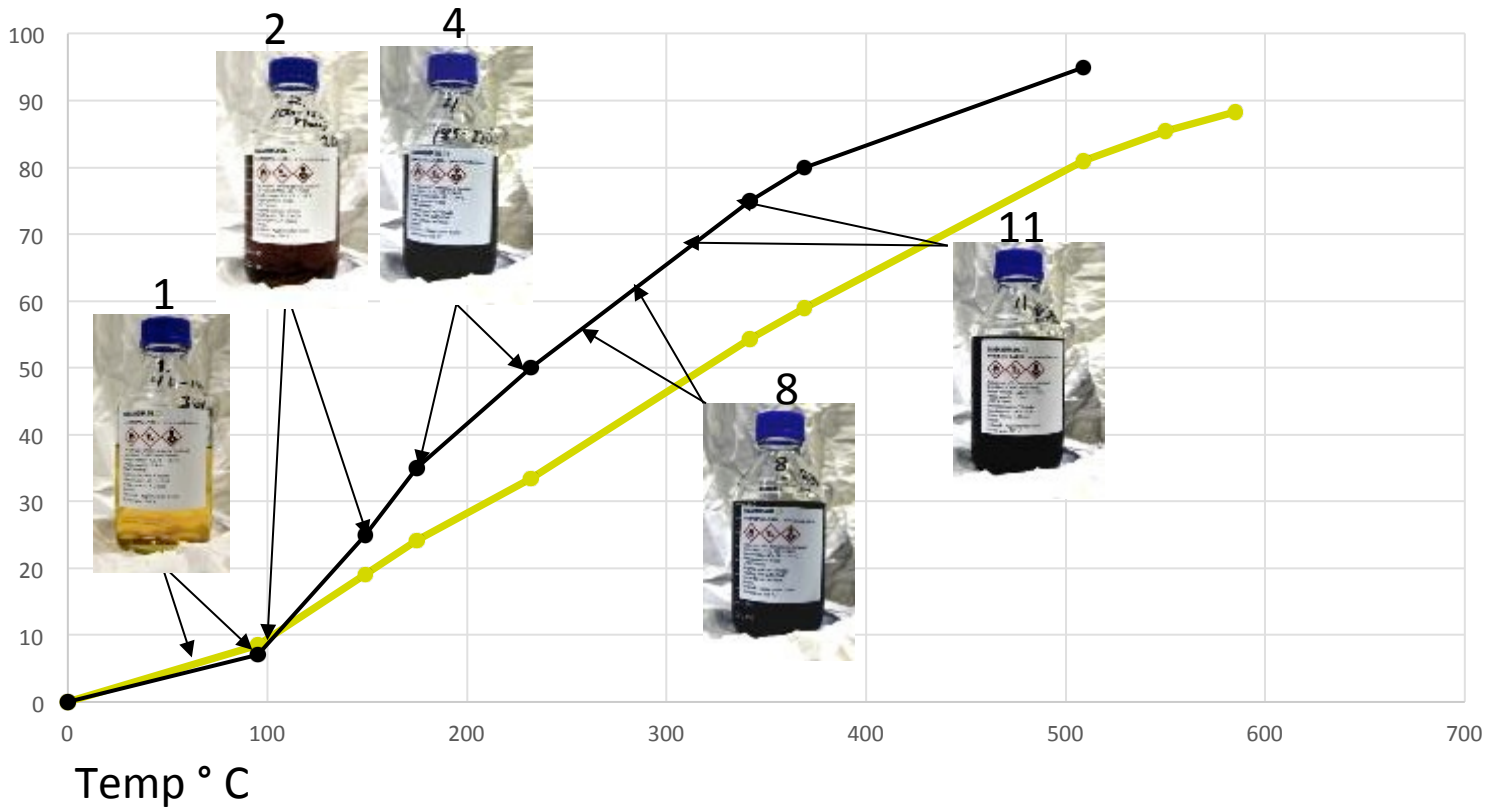
—●— CASO Plastic Oil Saybolt

# DISTILLATION CURVES

## Distillation Curves

Comparing CASO waste plastic oil with,  
Brent Crude (BP Assay), CASO oil from tires  
(SAYBOLT test),

Vol%



—●— Brent BP    —●— CASO Plastic Oil Saybolt

# CASSANDRA OIL



Oil from pine tree

**VS**



Oil from plastic  
Christmas tree



- Circular community
- 20% by 2020
- Replace fossil raw material

