



Chemical Recycling with Cat-HTR™

Rushlight Show
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1. Plastic Pollution & Recycling Rates

Manufacturing rates are outstripping disposal rates

- 350 million tonnes of plastic is generated world wide every year
- Approximately 8 million tonnes of plastic enters the world's oceans annually
- If current plastic trends continue, there will be 12 billion tonnes of plastic in the natural environment and landfills by 2050
- In the UK, 414,000 tonnes of "single use" film is used each year – most of which goes to incineration



2. Background & Cat-HTR™ Technology

Over ten years of development, trialling and testing

- 2007 University of Sydney. First patents filed.
- 2008 Licella. First pilot plant commissioned.
- 2011 Pilot plant upscaled.
- 2012 Large pilot plant commissioned.
- 2015 Waste plastic feedstock trialled.
- 2017 Global Joint Venture signed and first licences sold to ReNew ELP.
- 2020 Construction of the first commercial plant in Teesside, for operation 2021.



3. Pilot Plant Facility

New South Wales, Australia



4. Cat-HTR™ - Hydrothermal Liquifaction

Using water as the “agent of change”

- Will convert any plastic to shorter chain hydrocarbons
- Higher temperatures are employed when breaking stronger chemical bonds
- Using supercritical water provides:
 - A source of hydrogen to complete the broken chemical chains
 - A means of rapid heating that avoids excessive temperature that would lead to excessive cracking
 - Ability to scale the process
- Over 85% (d.a.f) of the mass of plastic is converted to hydrocarbon product that could be used to make new plastic or other hydrocarbon products.

5. Cat-HTR™ Process

A conversion process that takes just 20 minutes



WASTE PLASTIC
CLEAN & SHRED



MELT &
PRESSURISATION



MIX WITH
STEAM



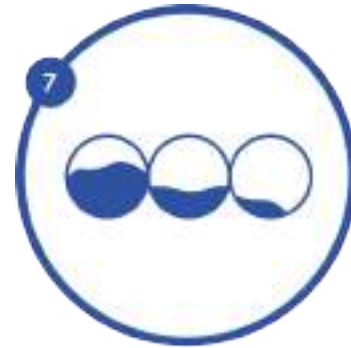
HEAT



CAT-HTR™
REACTOR



DEPRESSURISE



PRODUCT
SEPARATION



PRODUCT
STORAGE

6. Capacity & Optimisation

Optimisation and Advancement

- Site will comprise four processing lines:
 - Line 1 – will accept all polymer types within agreed specification, optimising process parameters before Lines 2-4 commence build
 - Lines 2, 3, 4
 - remaining lines built following line 1 completion and optimisation
- Each line will process 20,000 tonnes per annum
- 80,000 tonne site capacity.



7. Target Feedstock

Plastic material currently considered "unrecyclable"

- PE (HD/LD), PP, PET, PS
- End of life post-consumer plastics (multi-layer films and rigids)
- Agricultural, EfW/ MRF and AD residual material
- Material which cannot be mechanically recycled
- Processing of mixed plastic streams (films and rigids) without the need for segregation
- Processing of contaminated materials (organics & paper etc)
- No need to dry feedstock
- Processing of uncommon materials (polystyrene and polyethylene terephthalate)



The current option for these streams is SRF or RDF production, or landfill



PET



HDPE



LDPE



PP



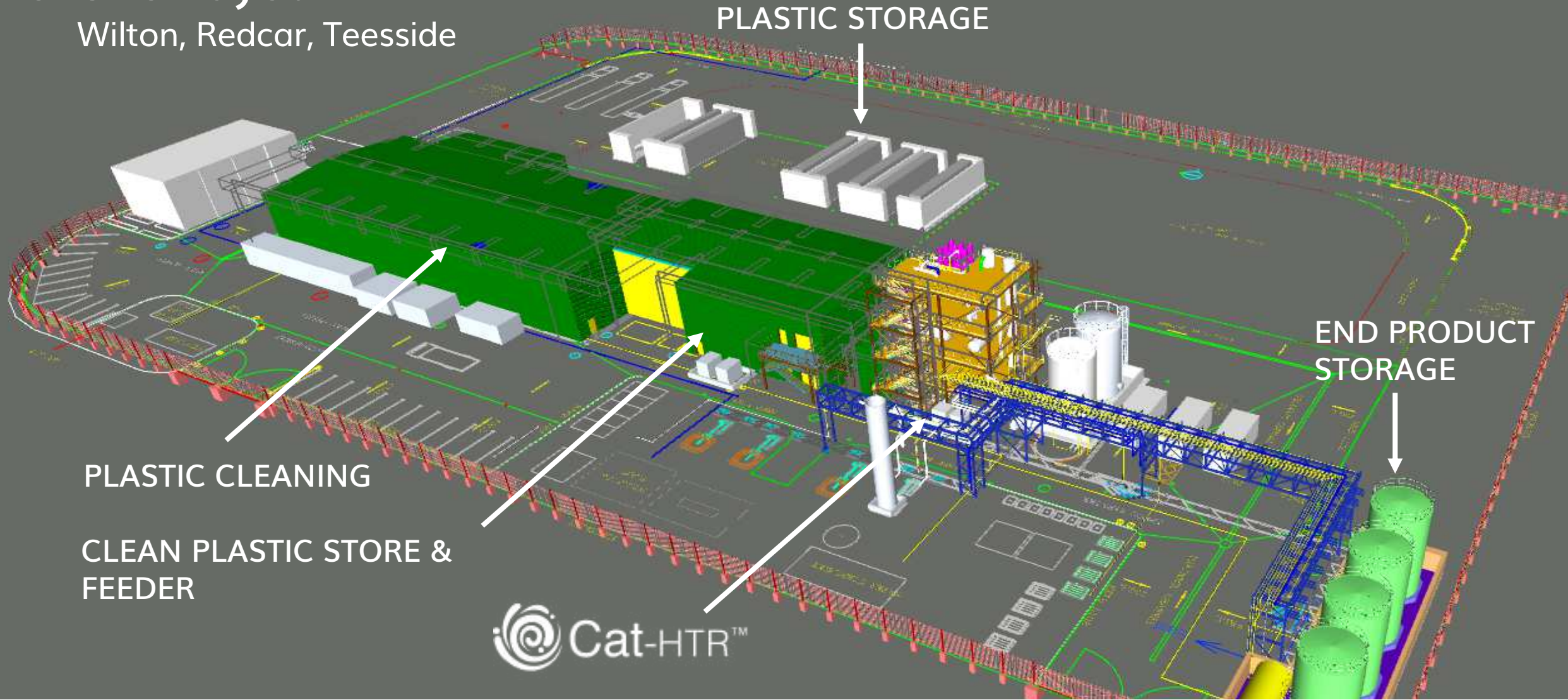
PS



OTHERS

8. Site Layout

Wilton, Redcar, Teesside



PLASTIC STORAGE

END PRODUCT STORAGE

PLASTIC CLEANING

CLEAN PLASTIC STORE & FEEDER



9. Offtake Products

Liquid hydrocarbon products - versatile chemical intermediates with many applications:

- Four commercial products will be produced by flash distillation, each with established, stable and growing markets:
 1. Naphtha oil - petrochemical feedstock for new plastic production
 2. Distillate gas oil - petrochemical feedstock, industrial solvent, marine and road fuel improver
 3. Heavy gas oil - petrochemical feedstock, base oil and wax production, marine fuel blendstock, hydrocracker feed
 4. Heavy wax residue - asphalt production, wax and base oils and coker feedstock

In addition a process gas (Refinery gas) is produced which will be re-used to fuel the boilers.

All of the products are being currently being registered under REACH to allow export into the EU.



10. Technology Differentiators

Cat-HTR™ is unique amongst conversion technologies

- Cat-HTR™ involves direct heat transfer between the plastic and the heating medium. More efficient and scalable than other technologies which heat from the 'outside in'
- Controllable temperatures mean no charring of feedstock; water acts as a buffer and provides free hydrogen to enable stable product generation. No additional hydrogen is required.
- Process can tolerate mixed plastics and PET which has proven to cause problems in other conversion techniques
- Product optimisation is possible by varying reaction parameters including residence time and reaction temperature
- Low chloride content of product oils, majority of chlorides report to water phase
- All of the above contribute to a high yield of stable products



11. Environmental Benefits

Supporting a circular plastics economy

- Diversion of plastic from landfill or incineration - each processing line will process 20,000 tonnes of end of life plastic
- Scope of plastic feedstock - can process currently unrecyclable, composite, multi-material and flexible waste plastic.
- >70% Greenhouse Gas Emission saving compared to production of hydrocarbons from a fossil source (based on a Life Cycle Assessment (LCA) undertaken for the Teesside plant)
- Reduces the dependency on fossil fuels – production of sustainable feedstocks.
- Broadened scope for recyclable plastic contributes to increased circularity



12. Partnering

Recognition in the environmental sector

- Plastic Oceans UK:
 - Experts in plastic pollution, with the aim of seeing zero plastic entering all natural environments in the next decade.
 - Their documentary 'A Plastic Ocean' (available on Netflix) was described by Sir David Attenborough as "one of the most important films of our time".
 - The partnership allows for the sharing of research and an alignment of strategy, and ensures a long-term relationship and scientific link between those looking to protect the natural world from the effects of waste plastic, and those that hold the technology to prevent plastic pollution, as we push towards a plastic-neutral future.



Many Thanks