Polyolefins Technology for the New Millennium

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Vice President, M&S

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INEOS a 3 Act play

INEOS Technologies
a new beginning

Innovene™ G, S, PP
Act I

1998
Purchase of BP’s Antwerp facilities

1999-2004
Organic growth / efficiency improvement and ICI Assets

2005
BP Chemicals business acquisition

2008
Act II
INEOS growth in the new Millenium

Turnover - USD Millions

Act II

- 5,000
- 10,000
- 15,000
- 20,000
- 25,000
- 30,000
- 35,000
- 40,000
- 45,000
- 50,000


320 470 4500 5400 5800 7400 9800 35500 43600 47400 28900 36200 43000 43000 47000
INEOS, a 21st century company

INEOS at a glance

- **Turnover**: $54 billion
- **Employees**: 17,000
- **Production**: 60 million tonnes
- **Sites**: 65 sites in 16 countries

**Heritage**
AMOCO, BASF, BAYER, BOREALIS, BP, DEGUSSA, DOW, ENICHEM, ERDOLCHEMIE, HOECHST, ICI, INOVENE, LANXESS, MONSANTO, NORSK HYDRO, AND SOLVAY.

**Act III**

**Growth through strategic partnership**
- JV with PetroChina for refining and trading
- Former JV with BASF now wholly owned for Styrenic & PS
- Proposed JV with Solvay for the chlorine/PVC chain

**Entrepreneurial & Innovative**
ENTREPRENEURIAL THINKING... TRANSFORMING EUROPEAN BUSINESS BY SHIPPING SHALE GAS FROM THE US

BIG SHIPS THE MOVIE
A new millennium company
INEOS Technologies
A new millennium company

Licensees in 56 countries
384 licenses granted
Our polyolefins technologies

**Innovene™ G**
Clean loop gas phase
Swing LLDPE/HDPE

- Superior mLL and HAO LL products
- Unique C4-C6-C8 comonomer versatility
- Clean Loop Process
- High reliability / Low Maintenance
- Low Capex & Opex

**Innovene™ S**
Bimodal slurry loops
HDPE/Bimodal HDPE

- Superior bimodal HDPE products
- Unique swing monomodal/bimodal/Cr operations
- Quick transitions
- No wax generation
- Low Capex & Opex

**Innovene™ PP**
Plug flow gas phase
PP (homo, RCP, ICP)

- Superior ICP’s
- Highest product consistency
- Unique plug flow process
- Short transitions
- Low Capex & Opex
Our success, our clients

Leading licensor of Polyethylene and Polypropylene technology

Approximately 50% of our licensed capacity is in multi-platform projects

More than 20 million tonnes of polyolefins capacity awarded since 2005
## Innovene™ G

### Application

<table>
<thead>
<tr>
<th>Application</th>
<th>Type</th>
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<tr>
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<tr>
<td>LL C4</td>
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<tr>
<td>LL C6 or C8</td>
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<tr>
<td>mLL C6 or C8</td>
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<td>HDPE Cr</td>
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<tr>
<td><strong>Blow Molding</strong></td>
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<tr>
<td>Medium Mw Cr</td>
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<tr>
<td>High Mw Cr</td>
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<td><strong>Injection Molding</strong></td>
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<td>LLDPE</td>
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<td>HDPE</td>
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<td>PE80</td>
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<td><strong>Textile</strong></td>
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<td>Monofilament</td>
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<tr>
<td>Tape</td>
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<td><strong>Rotomolding</strong></td>
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<td>mMDPE</td>
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<td><strong>Others</strong></td>
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<td>W&amp;C</td>
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<tr>
<td>Extrusion coating</td>
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</tbody>
</table>

- **Commercial**

### Metallocene VLDPE, LLDPE & MDPE

- Superior processability, optical & ESCR properties

### Ziegler LLDPE, MDPE & HDPE

- Vast product & application coverage with C4-C6-C8 comonomers

### Chromium HDPE

- Vast product & application coverage
Innovene™ G

Built: 5,400 ktpa with 39 G Lines
Project: 4,720 ktpa with 13 G Lines

- INEOS Innovene™ G
- Innovene™ G built
- Innovene™ G in design
An advanced gas phase

**Clean loop technology with cyclones**

**Benefits**: no circulating fines, no cleaning shutdown requirement

⇒ Unique on-stream time capability

**High Performance Condensation** for injecting condensation liquid into the reactor

**Benefits**: Effective liquid vapourisation directly into the reactor. No fluidisation issues, no liquid pooling

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**Diagram elements**:
- **Gas & Polymer @ T (poly)**
- **Gas & Condensate @ T (cold)**
- **Clean Gas @ T (poly)**
- **Clean Gas @ T (cold)**
- **Liquid @ T (cold)**

**Provides outstanding operability and reliability**
HPLL™ High Performance Linear Low

Based on a proprietary Constrained Geometry metalloocene Catalyst

LCB

Reverse Comonomer Distribution

Extrudability

Bubble Stability

Mechanicals

Optics

Sealability

- INEOS HPLL
- Solution C8 Metallocene
- Conventional Gas Phase Metallocene
### Innovene™ S

#### Application Types

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<td><strong>Injection Molding</strong></td>
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- **Commercial**
- **Development**

#### Bimodal HDPE
- Superior ESCR/impact balance, access to leading products like PE100RC

#### Chromium based HDPE & MDPE
- Vast product & application coverage with popular grades

#### Ziegler based HDPE & LLDPE
- Vast product & application coverage
Innovene™ S

Built: 2,090 ktpa with 13 S Lines
Project: 7,100 ktpa with 18 S Lines

Map: INEOS Innovene™ S (multiple lines), Innovene™ S built, Innovene™ S in design

3 units Confidential
Streamlined process

Catalyst
Monomer
Hydrogen

Twin Reactors In Series

Bimodal Intermediate Treatment

Slurry Heater

High Pressure Separator

95% of hydrocarbon directly recycled

To extruder

Low Pressure Diluent Recovery

Nitrogen

FL

To extruder
PE100RC

« PE100 designed for alternative installation techniques »

PE100
Requires sand bed protection

PE100RC
Sandless Laying

Sand protection might represent up to 50% of the total cost!
## Innovene™ PP

### Best in class stiffness / toughness performance balance

**Impact Copolymers**
Superior clarity and optical properties

**Random Copolymers**
Tailored to perform at most demanding applications, e.g. BOPP film, fibers and injection molding

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<td>Caps &amp; Closures</td>
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<td>Thermoforming</td>
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<td>Pressure pipe</td>
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<td>Foam</td>
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Built: 4,160 ktpa with 19 PP Lines
Project: 7,350 ktpa with 20 PP Lines
A plug flow process

1. Catalyst is fed to the first reactor
2. Powder grows as polymer forms on catalyst particle
3. Plug flow of powder in reactor with gentle agitation
4. Reactor offgas condensed and recycled - condensed monomer provides reactor cooling
5. Powder transfer section keeps reactor compositions separate
6. Second reactor for impact copolymer
7. Powder goes to degasser for monomer removal and recycle
8. Powder is deactivated in purge column - purge column close coupled to finishing building for capex savings
9. Powder is melted with additives, extruded and pelletized

Simple and straightforward to operate
Homogeneous ICP’s

INNOVENE™ ICP

Rubber segment through particle; (well-dispersed) “marbled”
Excellent ICP properties (Impact and Stiffness)

BACK-MIXED ICP

Rubber segment on surface; (not well-dispersed)
Less ICP properties (only Impact or Stiffness)

10-20% less ethylene required
Concluding remarks

**Innovene™ G**
Clean loop gas phase
Swing LLDPE/HDPE

**Innovene™ S**
Bimodal slurry loops
HDPE/Bimodal HDPE

**Innovene™ PP**
Plug flow gas phase
PP (homo, RCP, ICP)

3 premiere platforms
Single point of contact
Project & engineering synergies
Wide market recognition

Solutions for the new millennium
Solutions for the new millenium

INEOS
Technologies

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