

A woman with short brown hair and bangs, wearing safety glasses and a white lab coat, is smiling slightly. She is holding a small yellow vial. The background shows a laboratory with computer monitors, equipment, and a rack of test tubes. The lab coat has a logo on the left chest.

Presentation to Investors / Analysts – New Business Development and Opportunities in Emission Control Technologies

31st January 2013

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RIG 10 Johnson Matthey



Cautionary Statement

This presentation contains forward looking statements that are subject to risk factors associated with, amongst other things, the economic and business circumstances occurring from time to time in the countries and sectors in which Johnson Matthey operates. It is believed that the expectations reflected in these statements are reasonable but they may be affected by a wide range of variables which could cause actual results to differ materially from those currently anticipated.



RIG 10 Johnson Matthey



Introduction and Welcome

Neil Carson
Chief Executive



Johnson Matthey

RIG 10

Programme

11.00	Introduction and Welcome	Neil Carson
11.10	New Business Development <i>Q&A and coffee break after this session</i>	Nick Garner, Roanna Doe, Martin Green
12.10	Opportunities in Emission Control Technologies <i>Q&A after this session</i>	John Walker
13.10	Lunch	
13.55	Light Duty Aftertreatment Technology	Dr Chris Morgan
14.25	Emissions Control Catalysts for Heavy Duty Vehicles	Dr Andy Walker
14.55	Opportunities in Emission Control Technologies – Wrap Up and Summary <i>Q&A after this session</i>	John Walker
15.15	Tour – Emission Control Technologies Production Facilities and Technology Centre <i>Coffee after this session</i>	Dr David Prest
17.15	Closing Remarks and Final Q&A <i>Q&A after this session</i>	Neil Carson
17.45	Coach Departs for Drinks Reception and Dinner	

Purpose of the Day

Provide

an overview of our new business development activities



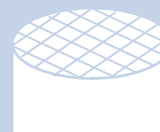
Outline

our progress in four new business areas: air purification, advanced packaging, water purification and battery technology



Update

on the drivers and opportunities in JM's Emission Control Technologies business



Explain

How we continue to add value through R&D and technology to leverage future growth opportunities



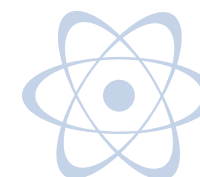
Introduction



A world leading
technology company



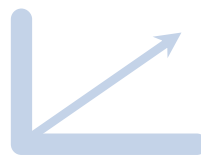
Success founded on
continued investment in
R&D and product
development



Differentiation through
technology



Proven strategy in place
to develop new business
areas



Well positioned in
growth markets



Delivers value



Strategy and New Business Development

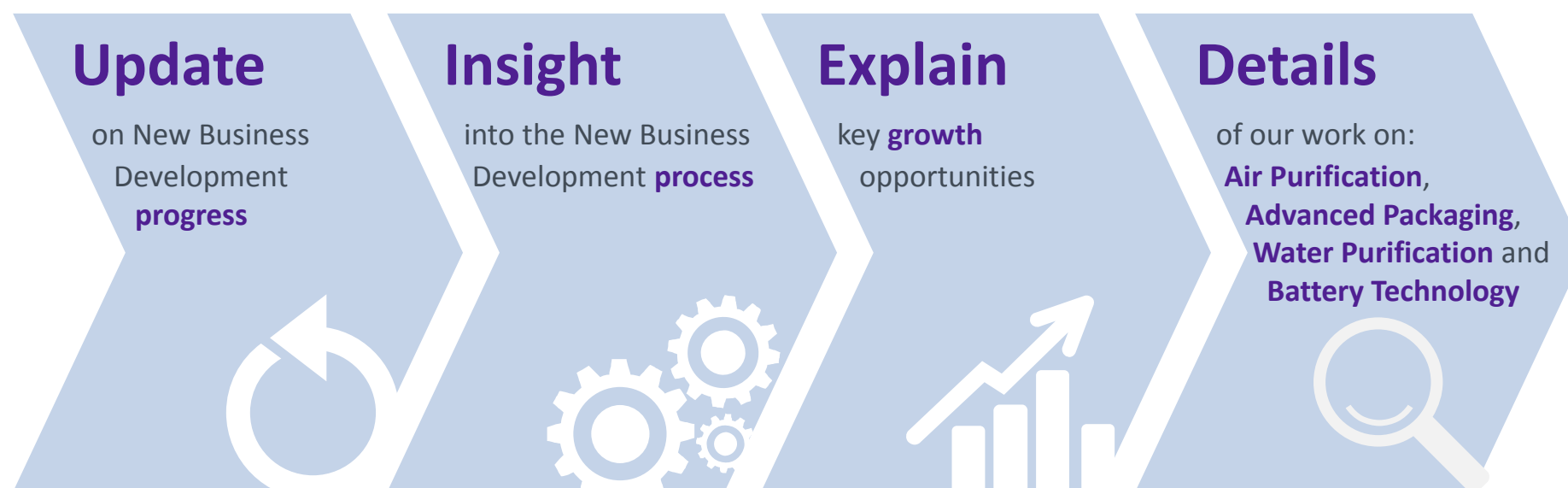
Nick Garner

Group Director, Corporate and Strategic Development

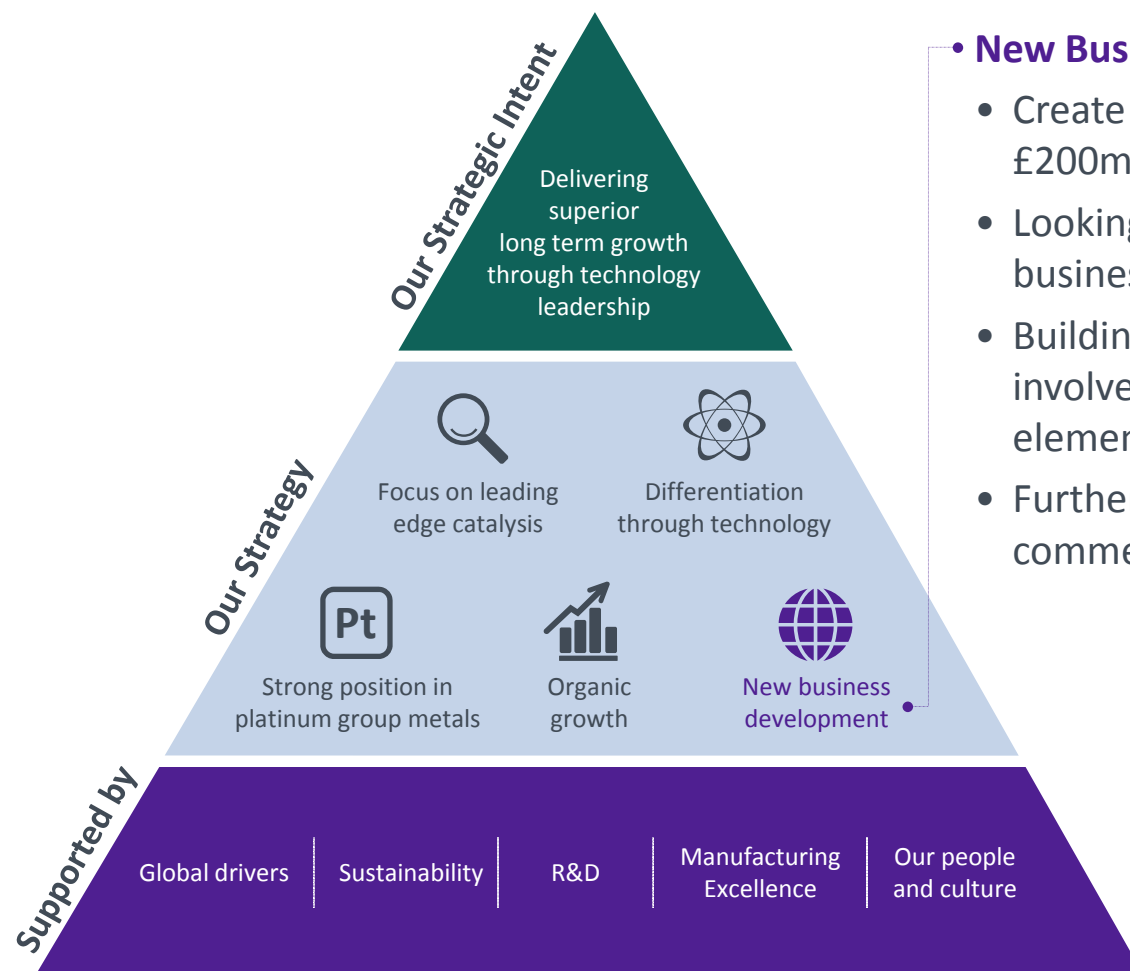


Johnson Matthey

Introduction to Johnson Matthey New Business Development



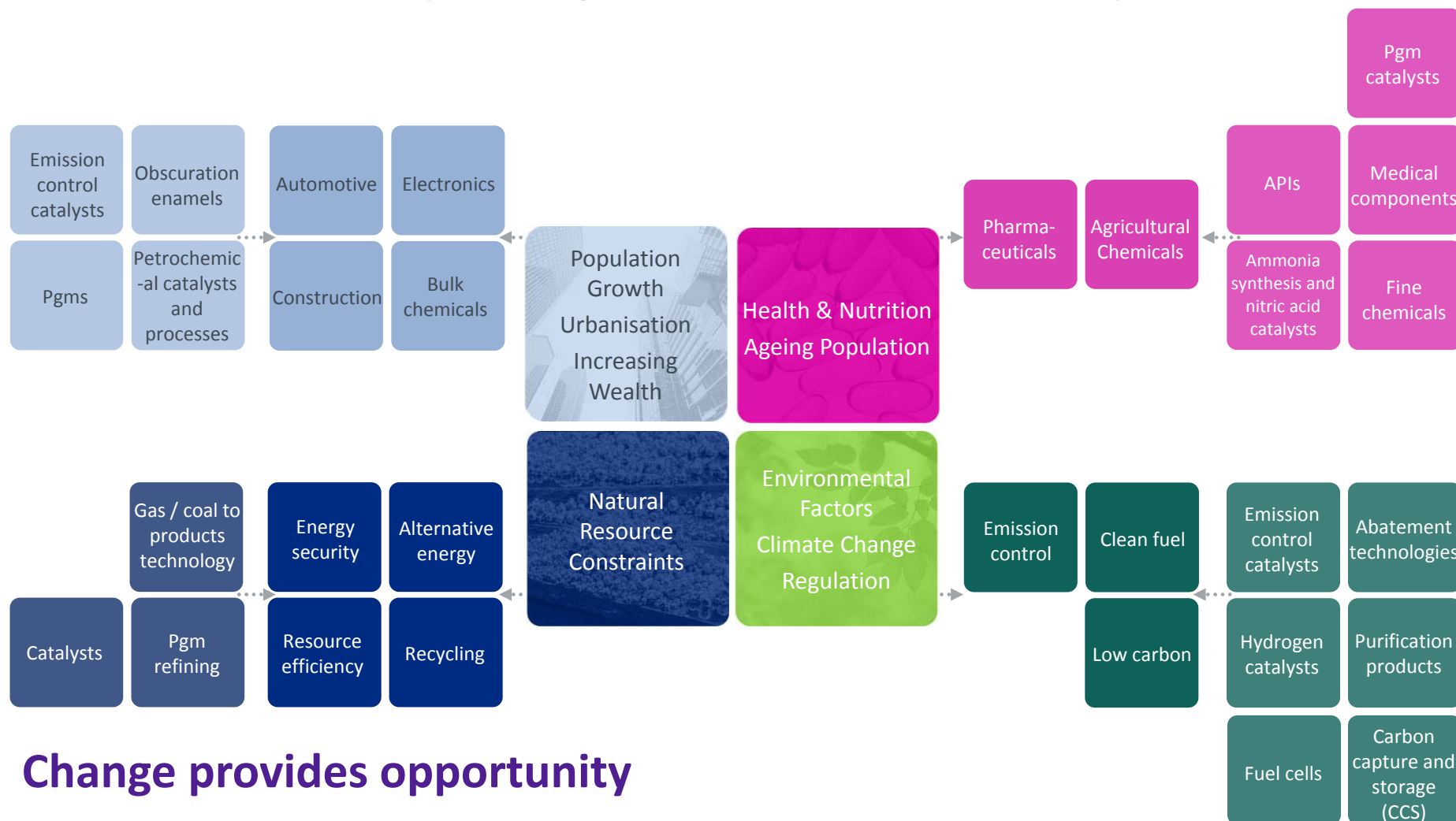
Strategic Direction to 2020



• **New Business Development Objectives:**

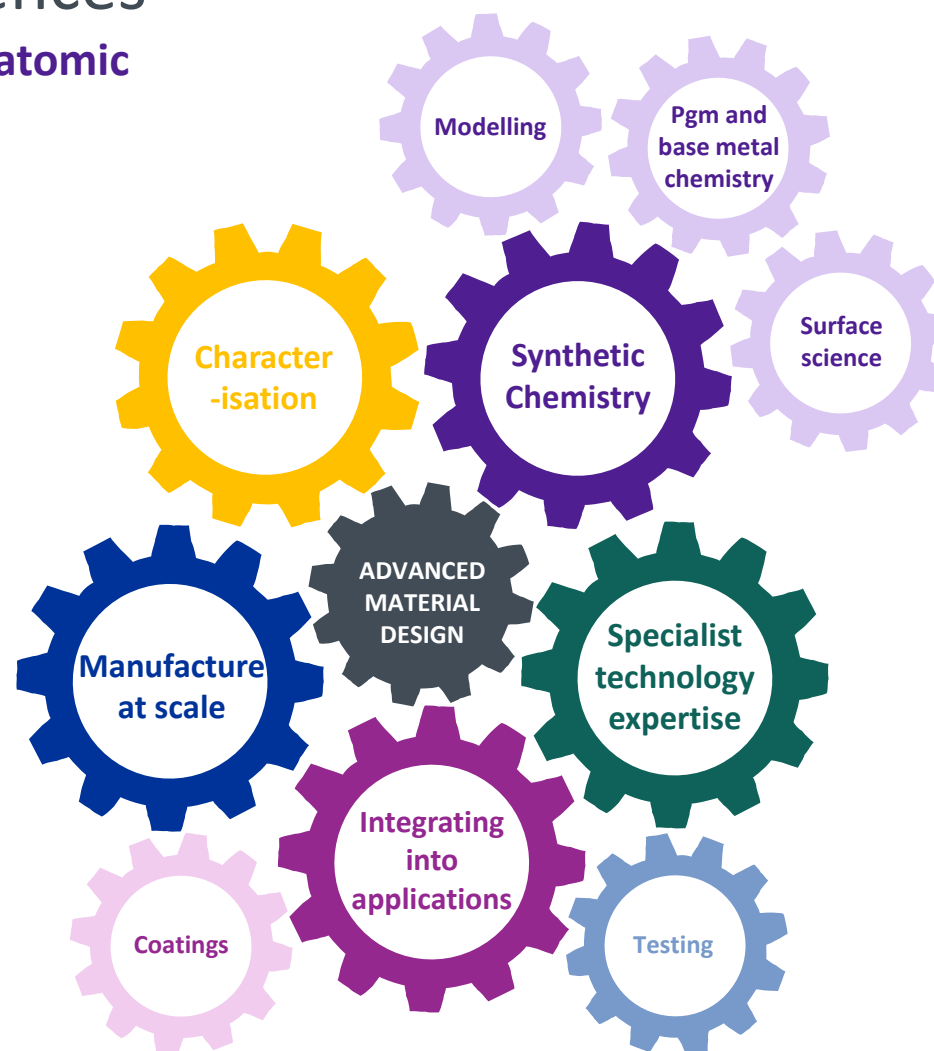
- Create new divisions with sales of more than £200m in 10 years
- Looking at areas peripheral to main operating business focus
- Building on core competences of JM but will involve development /acquisition of some key elements
- Further improve the generation and commercialisation of new products in JM

Global Drivers Impacting the Chemical Industry



JM Technology Competences

Designing advanced materials at the atomic scale to deliver real life solutions

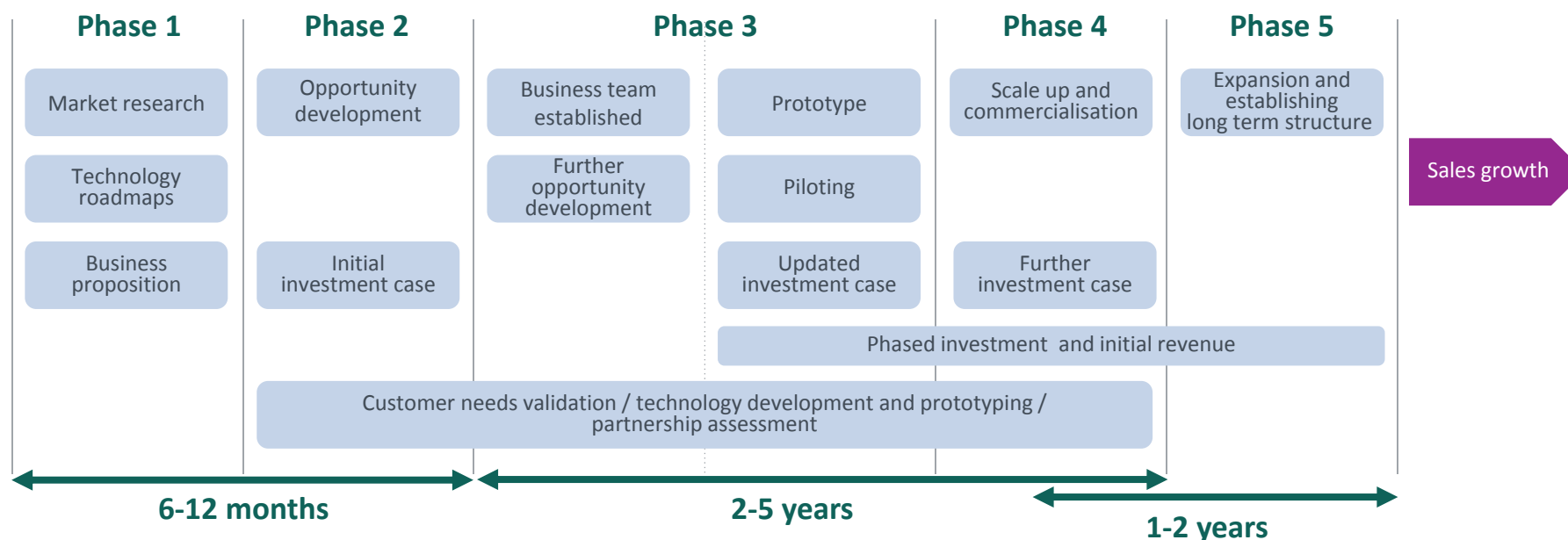


- Sustainable, **high technology**, **high margin** businesses need **clever** solutions

New Business Development Process

Market focused research in promising areas to identify opportunities that would allow JM to build on core competences and other capabilities

- Prioritise and scope out opportunities into JM-specific business propositions
- Product / market development through R&D, prototyping and commercial launch



Ongoing cost £6m p.a. to support the current levels of activities in market research and product development across a portfolio of opportunities

Developing a Portfolio of Opportunities

Aim is develop high tech, high margin, high growth businesses in developing niche markets

- Market research led process filters down a large number of opportunities to specific business propositions
- **Current** examples include:

Air Purification



Phase 2

Advanced Packaging



Phase 2

Water Purification



Phase 3

Battery Technology



Phase 3 - 5

- Potential businesses have a range of risk profiles but all have potential to be substantial business in 2020 timeframe



Opportunities in Air Purification, Advanced Packaging and Water Purification

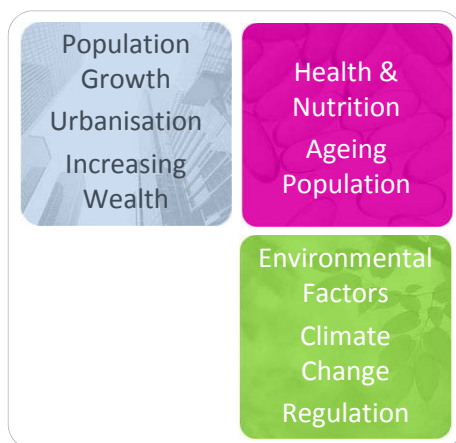
Roanna Doe

Group Corporate Development Director



Johnson Matthey

Opportunities in Air Purification

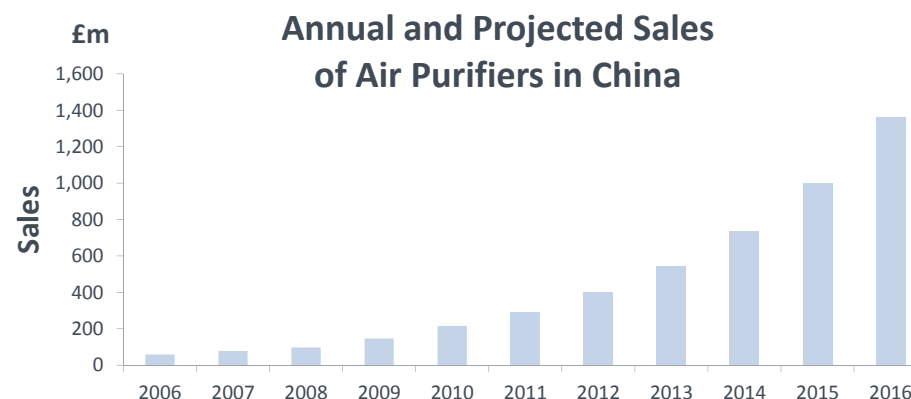


The Opportunity:

- Extension of JM’s existing air purification activities
- Driven by:
 - Increasing **air quality** concerns
 - Greater **energy efficiency** demands

The Market:

- Current technologies £1bn in sales
- **Consumer driven**, increasing regulation
- Immediate focus in **Asia**



Opportunities in Air Purification



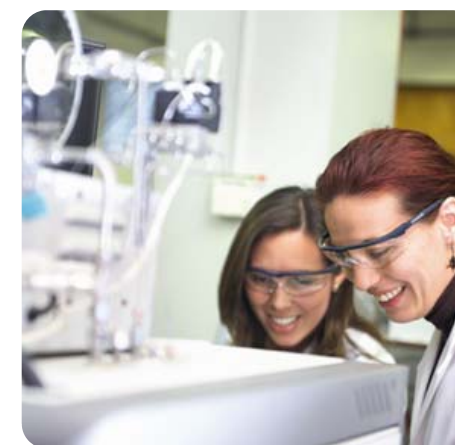
The Offering:

- Current technologies focus on trapping particles
- Demand for:
 - **gaseous pollutant** removal
 - reliability and **durability**
 - energy and price **efficiency**
- Potential for **advanced** solutions

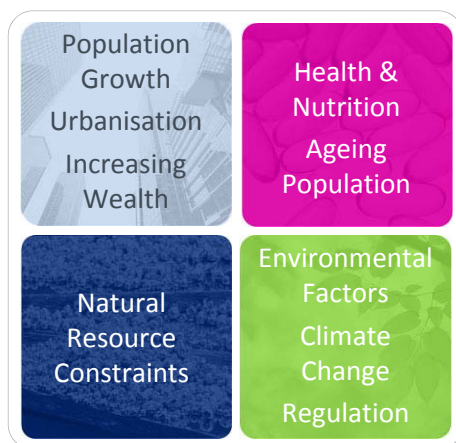


- **Business to business** approach
- Ongoing market research
- Establishing commercial links
- **Research and development** teams in place
- Ambient conditions and advanced adsorbents

Phase 2



Advanced Food Packaging

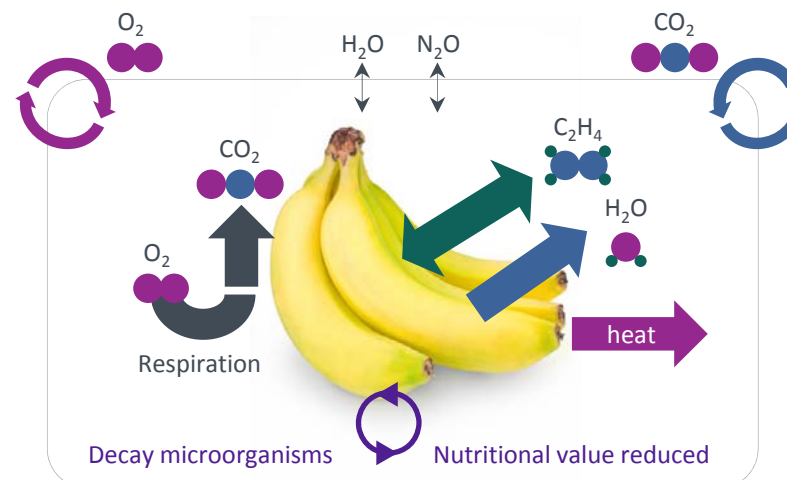


The Opportunity:

- Extension of JM's existing activities in this area
- Driven by:
 - **Consumer** demand
 - Need to **minimise** food loss levels
 - Desire to **reduce** use of chemicals
 - International transport – **longer life** required

The Market:

- **Ecosystem** control
- Active packaging worth £1.5bn in 2010
- **Evidence of demand** for advanced technologies



Advanced Food Packaging



The Offering:

- Technologies to manage **gas** levels
- Integrated solutions
- **Regulation** compliance
- **Extended range** of technologies, applications and market links

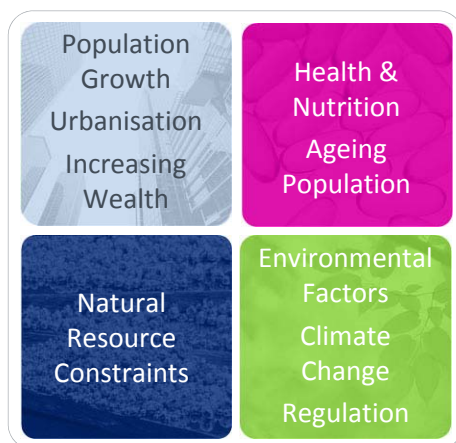


Phase 2

- **Business to business** approach
- Developing our market and applications knowledge
- Expanding our market links
- Technology workstreams established
- Focus on applications engineering, ambient conditions



Water Purification

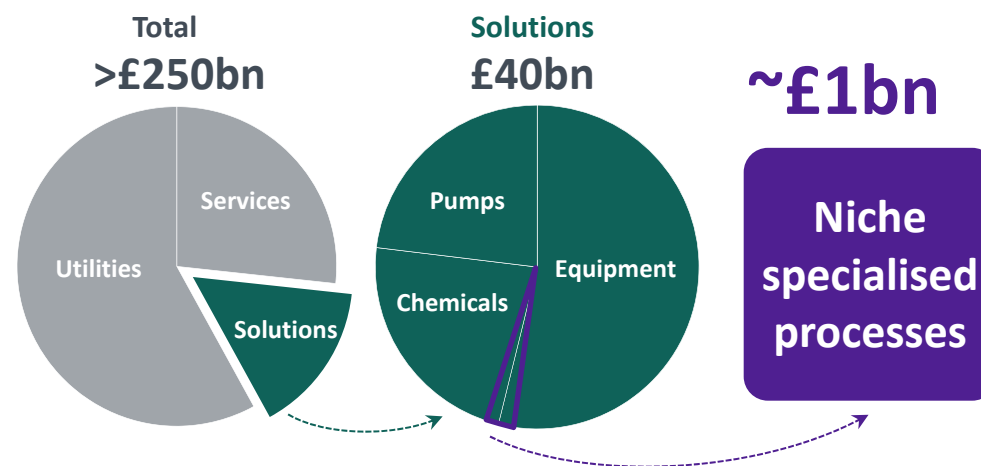


The Opportunity:

- Removal of **problematic pollutants** from water
- **Regulators** supportive of proven, cost effective technologies

The Market:

- Most of £250bn+ total spend not of interest to JM
- **Niche** advanced materials and specialised process sector ~£1bn
- Specific addressable demand worth **£200m today**



Water Purification

Initial focus



Toxic Metals:

- Remove to **lower levels** from **wider range** of sources
- Potential for JM to add value
 - Collect in non-hazardous form
 - Support regulatory requirements
- Adapt JM's **existing scavenging technologies**

Organic Chemical Pollutants:

- Limits to current technology applications
 - Space restrictions
 - Operating conditions
 - Cost effectiveness
- Develop JM's **catalytic** and **electrochemical** technologies



Water Purification



The Offering:

- **Advanced material solutions** for difficult to remove pollutants
- Initially adapt existing JM technologies
 - Supports **high margins**
 - No significant medium term capex required
- Short, medium and long term opportunities



- **Business to business** approach, focus on industry
- Business and technical teams in place
- Specific **commercial links** being established
- **Trials under way** on three continents
- Acquisition opportunities being assessed

Phase 3





Opportunities in Battery Technology

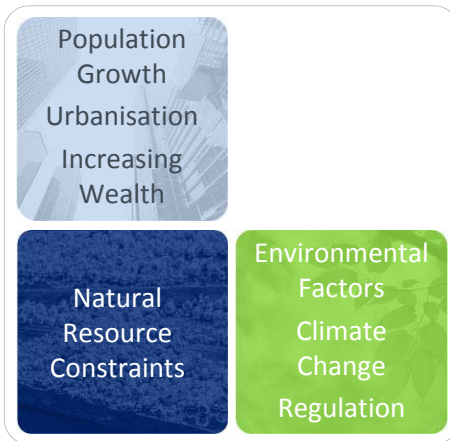
Martin Green

Group Strategic Development Director



Johnson Matthey

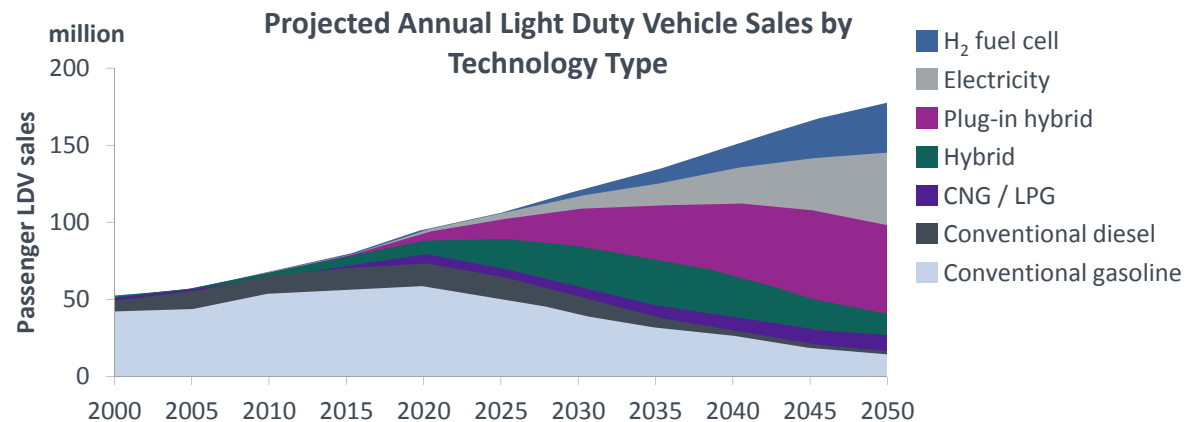
Batteries



- **Electrification** of vehicle powertrains a growing trend
 - Supported by major global drivers
- Electrification places new demands on the vehicle system:
 - Energy efficiency
 - Heat utilisation
 - **On-board energy storage**



- A key challenge – substantial improvements to current battery technology required



Source: IEA Energy futures, BLUE Map scenario

Battery Materials

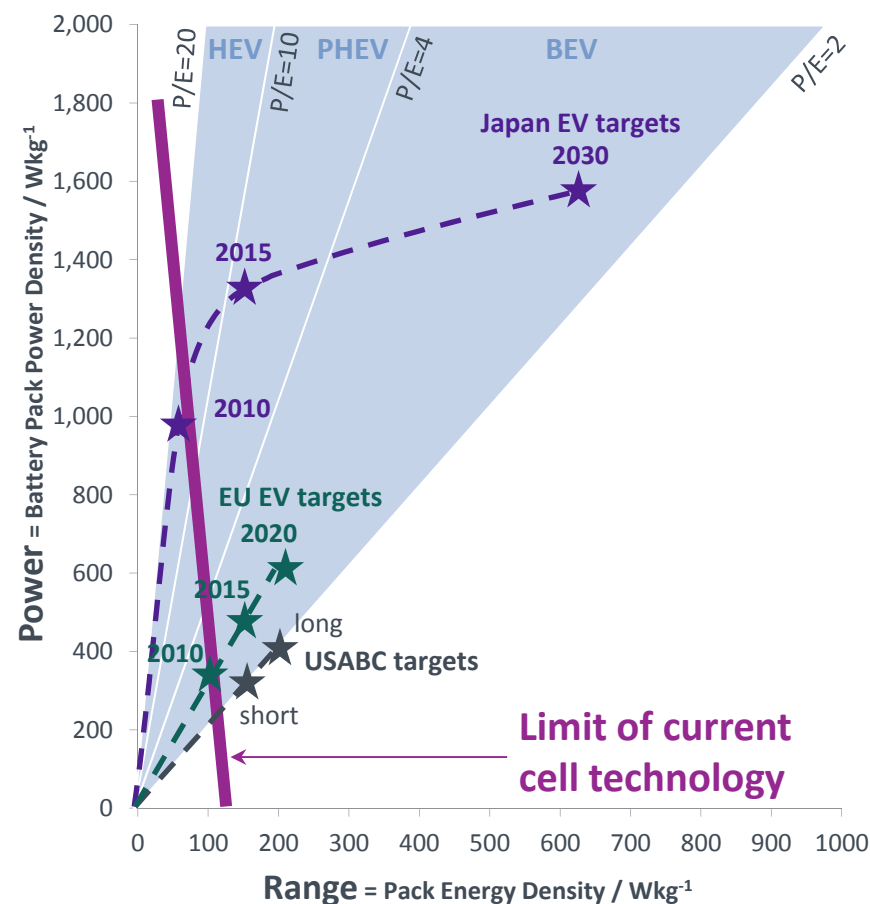
- **Many types of EV** from start / stop hybrid to fully electric vehicles
 - Each with different energy requirements
- Rapidly growing market for EVs
 - Expected to reach **10 - 15 million** vehicles by 2022⁽¹⁾
- Opportunities in automotive and other **high performance** applications
- Current battery technology **cannot deliver** the performance required



- Opportunity to apply **JM approach** to solving these problems

(1) Source: Electric Vehicles 2012 – 2022, ID Tech Ex Ltd

Electric Vehicle Battery Requirements⁽²⁾



(2) Adapted from Peter Lamp, BMW, AABC 2010

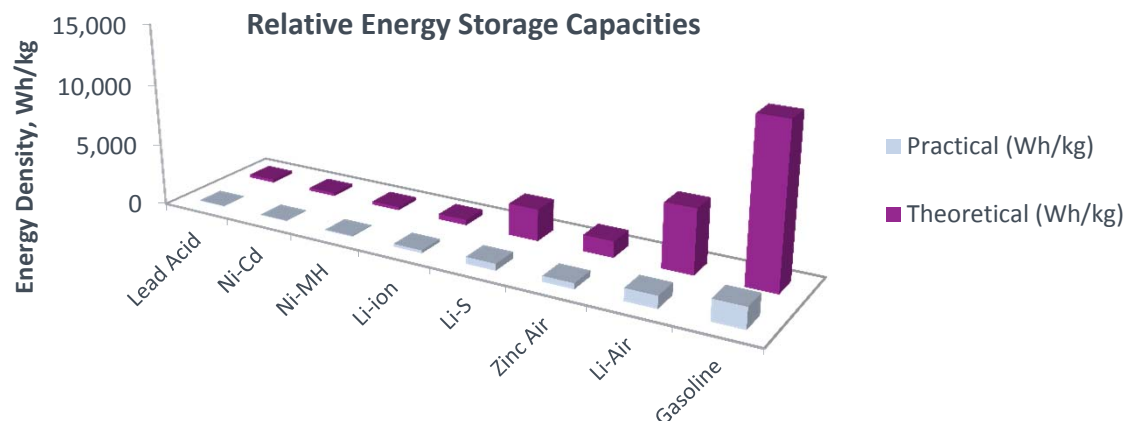
What is Johnson Matthey Doing?



- **Battery Technologies** group formed in 2012
 - Focus on **advanced materials** and **applications engineering** for high performance battery systems
- Building a new business grouping, through internal R&D and acquisitions
 - Acquisition of the **Axeon** Group in October 2012
 - Expanded internal **R&D programme** underway
- Excellent match with JM technology competences

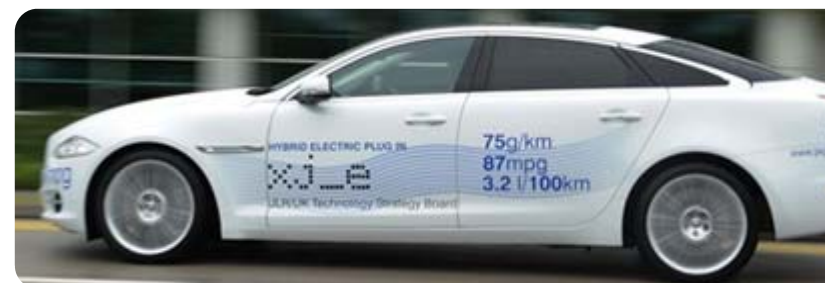
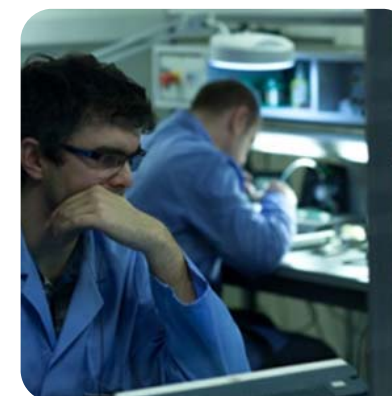


- Target **£300m** revenue from Battery Technologies group in 2020



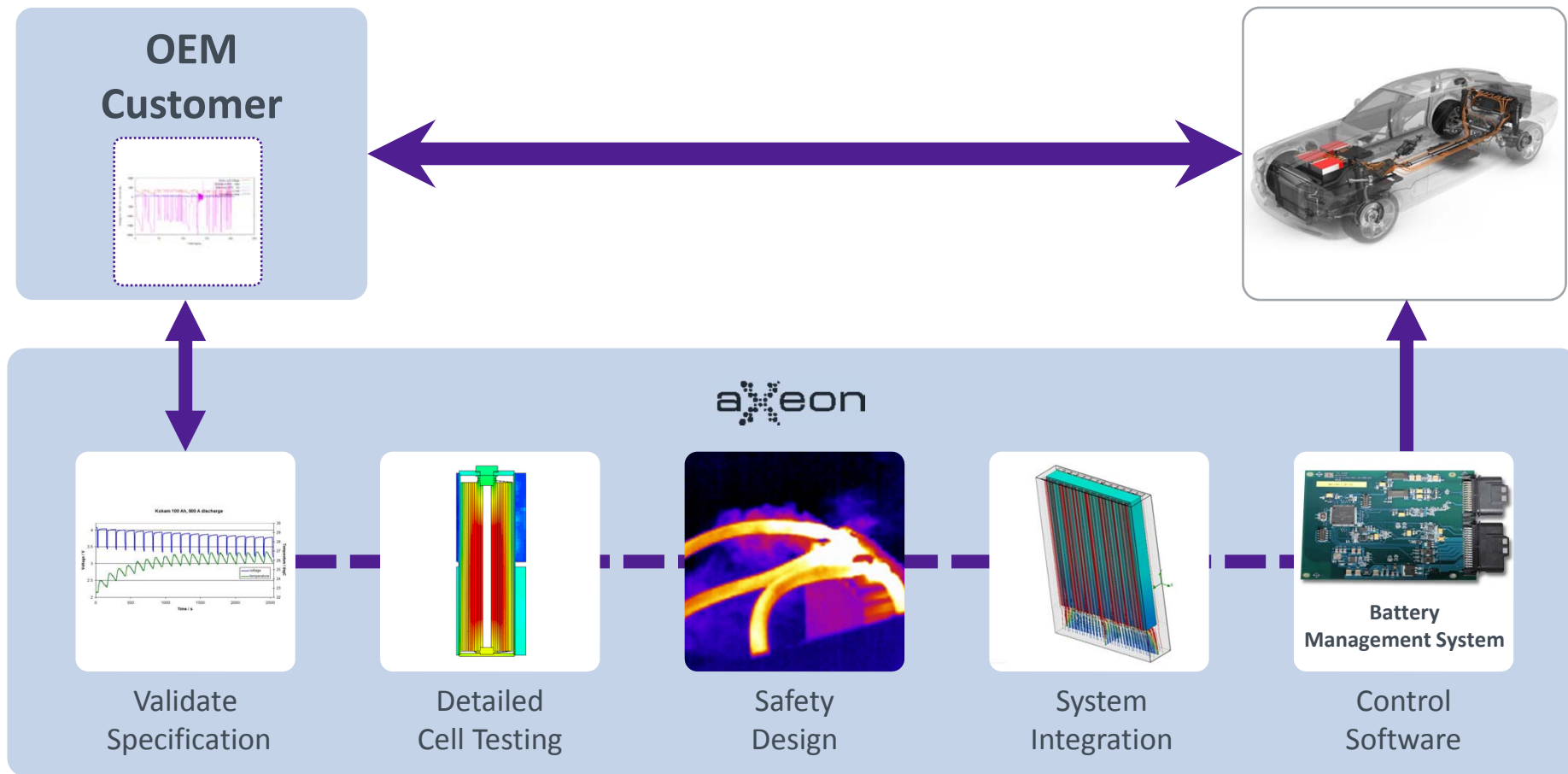
Acquisition of Axeon

- Leading developer of **battery systems** for high performance applications
 - Application analysis and design
 - Cell selection and pack engineering
 - Assembly and supply
- **Cell agnostic** strategy, working with many different cell chemistries and vendors
- Revenue of **~£60m** p.a., manufacturing in UK and Poland
 - Strong position in **portable power**
 - Developing position in **automotive**



- Over a million vehicle miles driven since 2007 = 20MWh of batteries shipped

Translating Vehicle Requirements into System Design



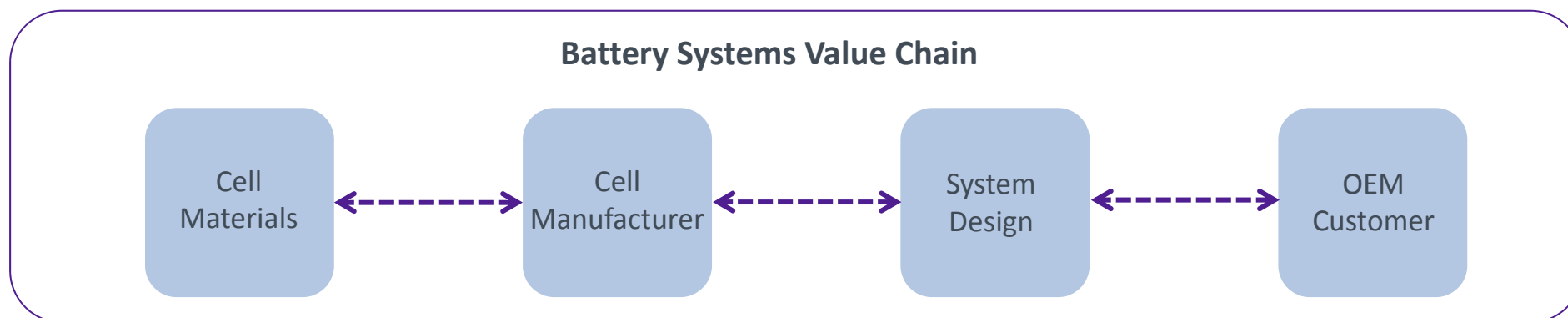
Axeon

Integration

- Initial integration programme complete
- Continuing to deliver on growth plan
 - Automotive and portable power
- Synergies already showing
 - Technology exchanges
 - JM materials characterisation capability
- Investment to support growth of the business
- Establishing materials testing and cell prototyping capability



Axeon is already accessing JM's world leading characterisation capabilities



Battery Technology Summary

Axeon has delivered:

- Existing revenue stream and good growth prospects in automotive
- Window on Li-ion technology landscape
- Deep understanding of battery applications engineering
- Strong synergies from JM characterisation and analysis capability

Next steps:

- Refine and developing the broader JM materials plan for batteries
 - Improved Li-ion technology
 - Next generation batteries
- Evaluation of further acquisitions underway



Strategy and New Business Development

Nick Garner

Group Director, Corporate and Strategic Development



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Developing a Portfolio of Opportunities

Aim is to develop high tech, high margin, high growth businesses in developing niche markets

- Market research led process filters down a large number of opportunities to specific business propositions. Examples discussed:

Air Purification



Total Market 2020
£1bn

Advanced Packaging



Total Market 2020
£3bn

Water Purification



Total Market 2020
£0.5bn

Battery Technology



Total Market 2020
£3bn

- Potential businesses have a range of risk profiles but all have potential to be substantial business in 2020 timeframe
- M&A is key to delivery



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Opportunities in Emission Control Technologies

John Walker
Division Director, Emission Control Technologies


Johnson Matthey

Agenda

-
- 01
Overview and Strategy
John Walker

 - 02
Introduction to Emission Control Technologies (ECT)

 - 03
Recap of Global Drivers for the Chemical Industry

 - 04

The Light Duty Catalyst Market

i. Vehicle Production	ii. Legislation	iii. Technology and Revenue Implications
iv. Powertrain Trends	v. Market Position	vi. Market Growth

 - 05

The Heavy Duty and Non-road Catalyst Market

i. Vehicle Production	ii. Legislation	iii. Technology and Revenue Implications
iv. Market Position	v. Market Growth	

 - 06
Light Duty Aftertreatment Technology
Dr Chris Morgan

 - 07
Emissions Control for Heavy Duty Vehicles
Dr Andy Walker

 - 08
Summary and Key Messages
John Walker

Overview

Showcase

the exciting **growth opportunities** in emission control catalysts



Detail

the market, legislative and technology **drivers** of the business



Highlight

the **expected growth** in our markets over the next **decade**

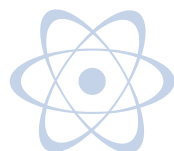


Explain

how **R&D** and strong **customer relationships** will drive our **future growth**



Emission Control Technologies' Strategy



Maintain differentiation through technology by investing in R&D

- High performance catalysts
- Materials science and manufacturing



A deep understanding of our markets and customers



Manufacturing Excellence

- Optimum efficiency
- High quality products

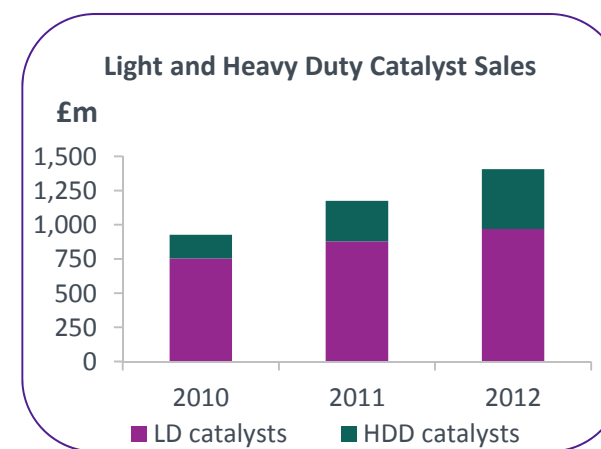
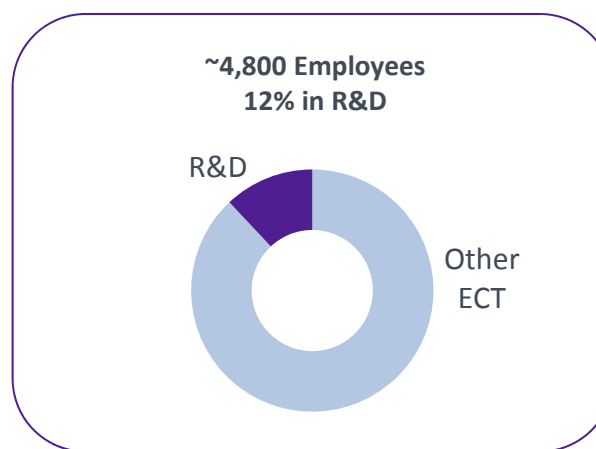
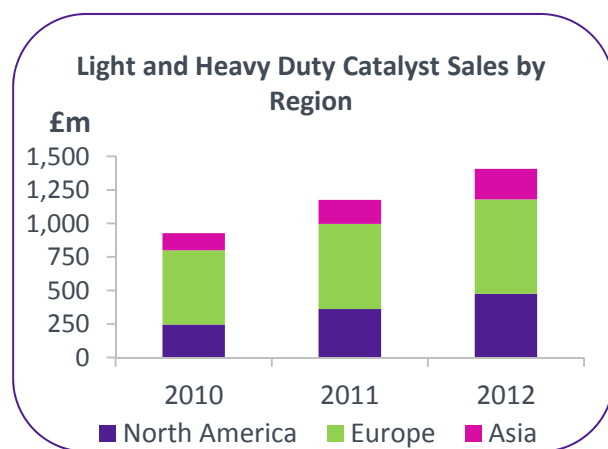


Deliver superior growth

- Markets driven by global trends and regulation
- Rates above industry baselines

Overview of ECT

- Global **leader** in emission control
- Extensive operations across the globe
- Sales growth of **187%** over 10 years to £1.5 billion (**11% CAGR**)
- HDD business now **33%** of sales
- Legislation drives **value growth** with more new opportunities

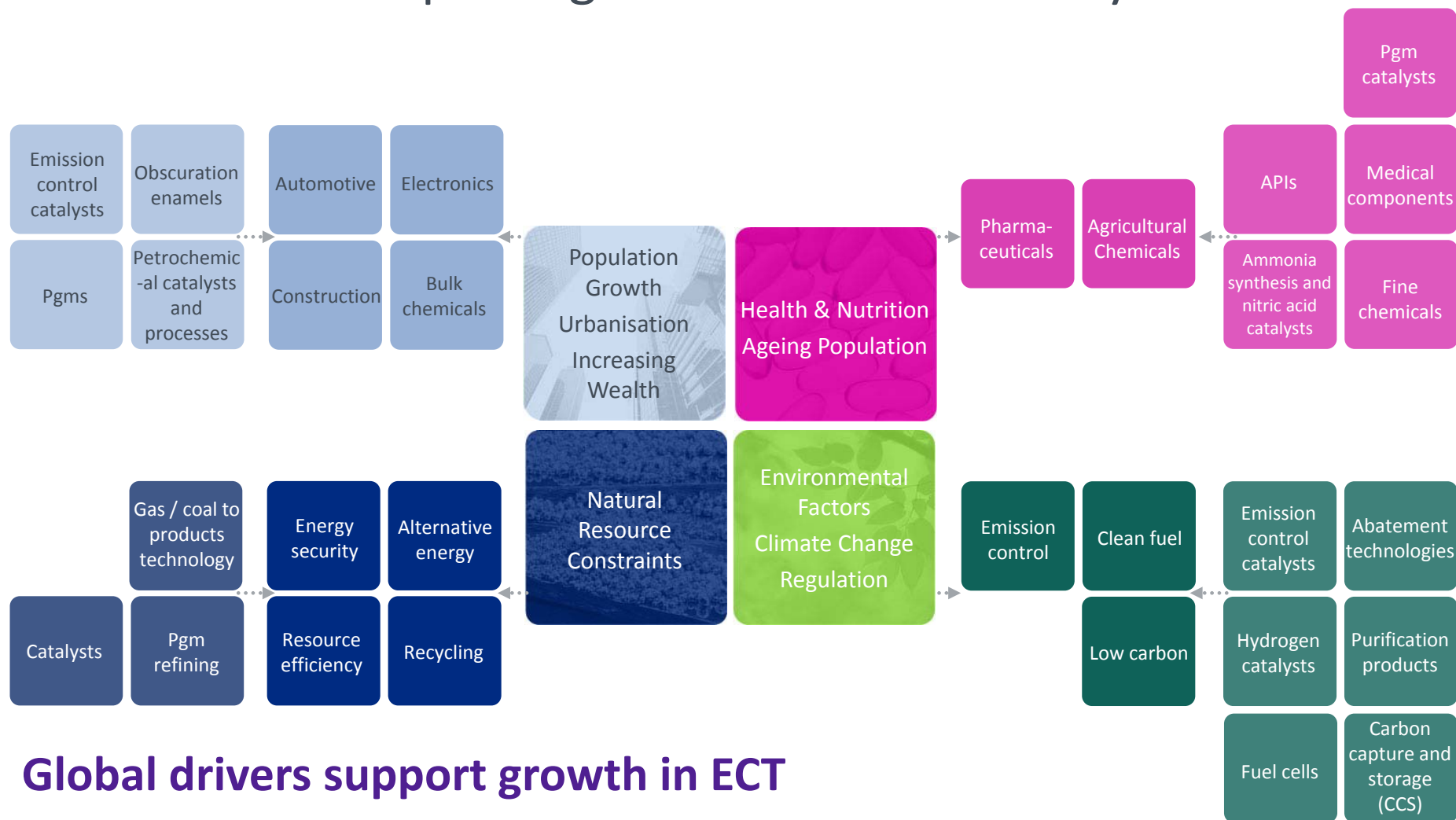


ECT's Global Network



● 15 Manufacturing Sites ● 10 Technology Centres

Global Drivers Impacting the Chemical Industry



Global drivers support growth in ECT

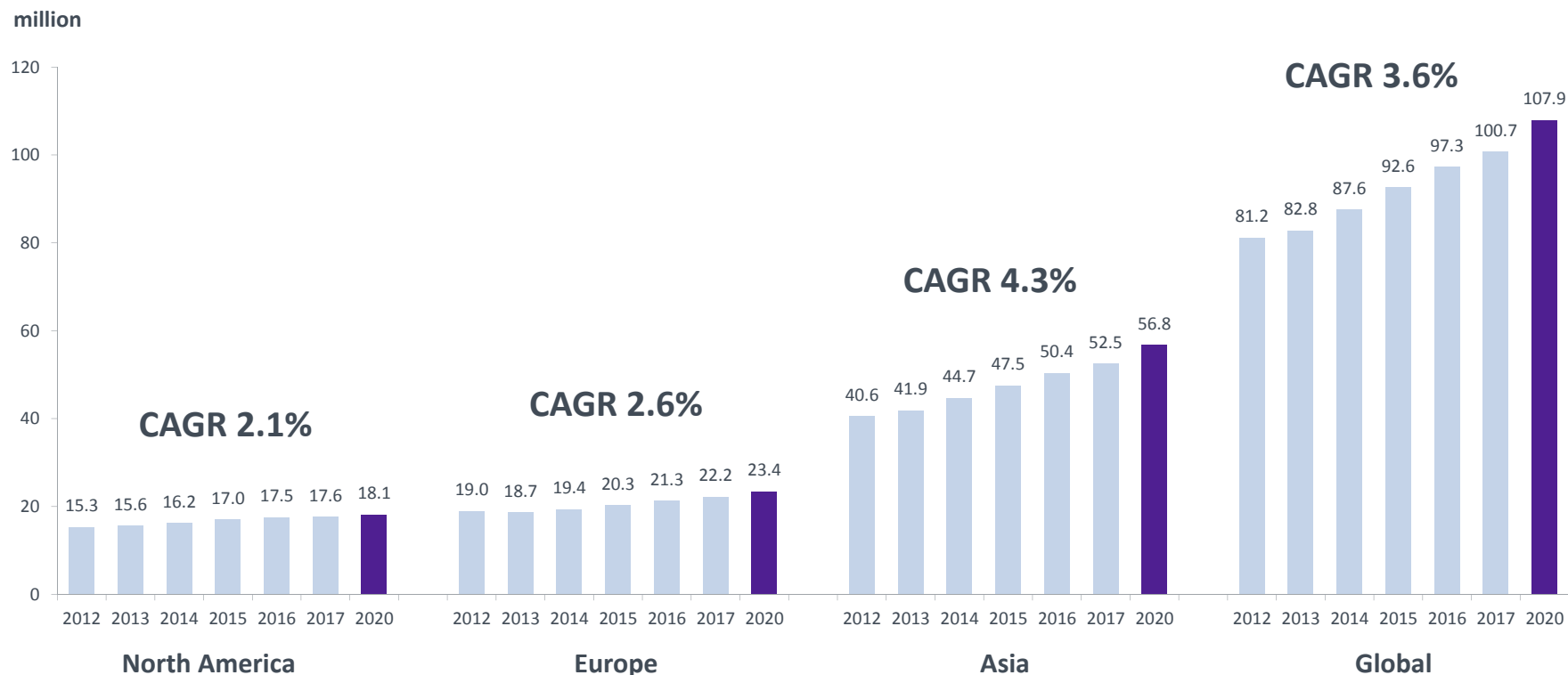
The Light Duty Catalyst Market

- **Market Growth Drivers**
 - i. Vehicle Production
 - ii. Legislation
 - iii. Technology and Revenue Implications
 - iv. Powertrain Trends
- **Market Position**
- **Market Growth**



Light Duty Vehicle Production to Grow – Shift to Asia

Global megatrends support increasing vehicle production



- Recovery 2010 to 2012, steady growth to 2020

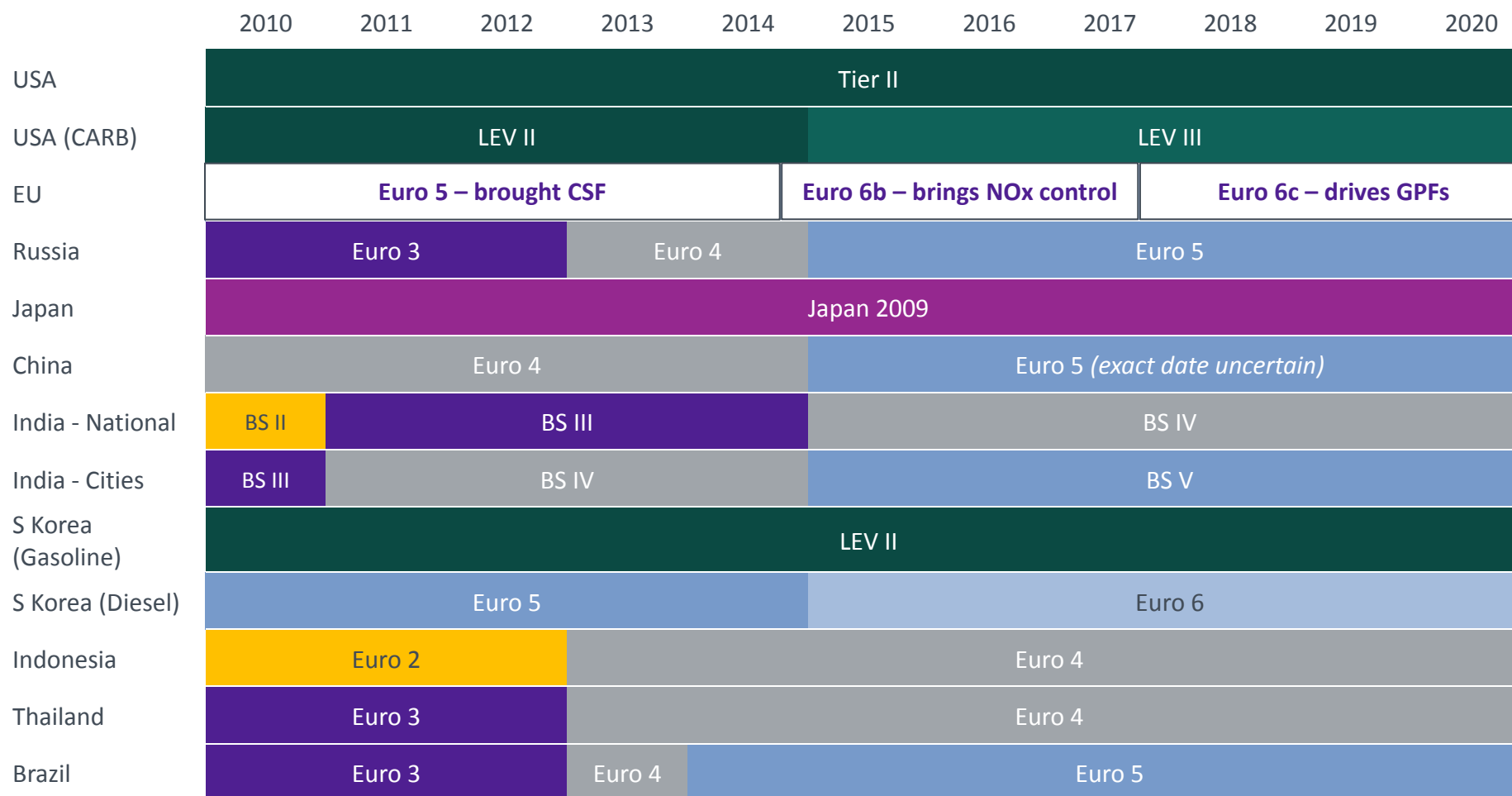
- Weakness in 2013, recovery from 2014 expected

- China slows but still fastest growing region

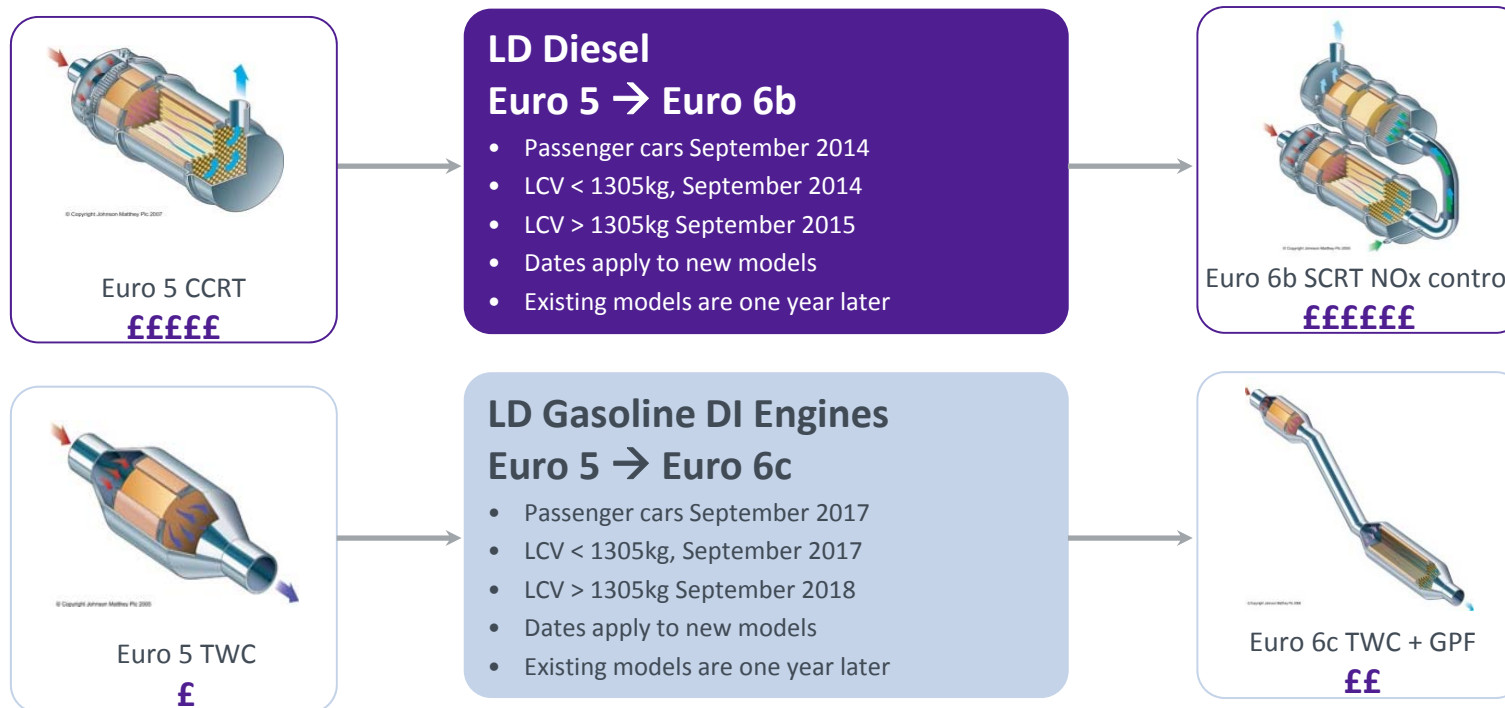
- JM growth expected at a few % ahead of market

Source: LMC (December 2012)

New and Tighter Regulations Across the World



Revenue Implications of New Legislation and Technologies



Trends in Powertrain Mix in the Medium Term

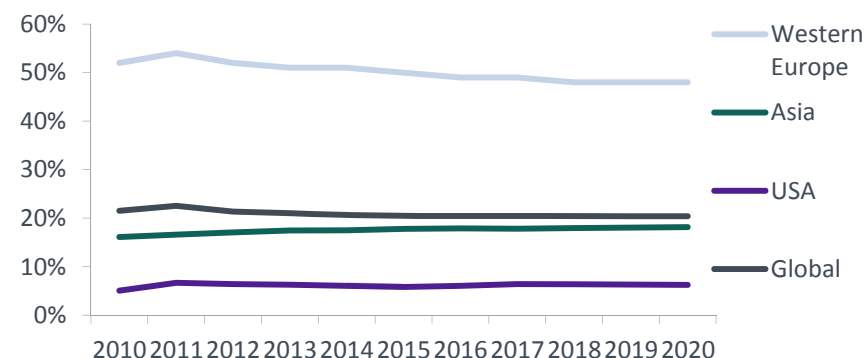
Diesel maintains high market share in Europe, ZEV share remains small

- Diesel remains a **European** phenomenon
 - Slight decline in diesel share as efficient small gasoline engines become more popular
- Alternative powertrains gain ground but **slowly**
 - Global penetration remaining below 1%
- Penetration of alternative powertrains **not sufficient** to reverse global growth in internal combustion engine sales

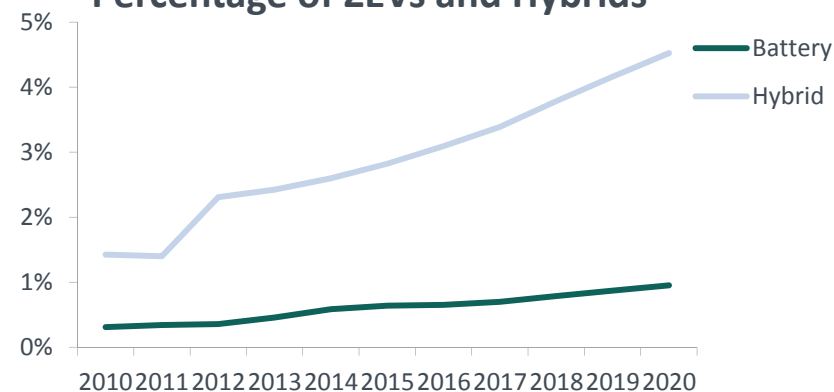


- Mix remains **positive** for ECT technologies
- Hybrids **require catalysts**

Percentage of Diesel



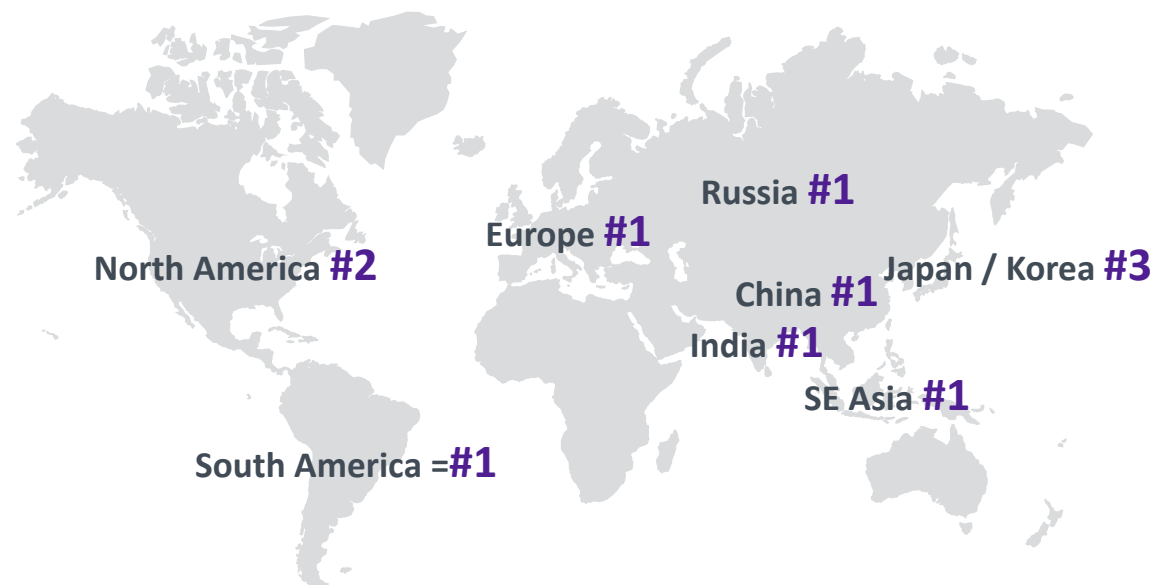
Percentage of ZEVs and Hybrids



Source: LMC

JM Global Market Position

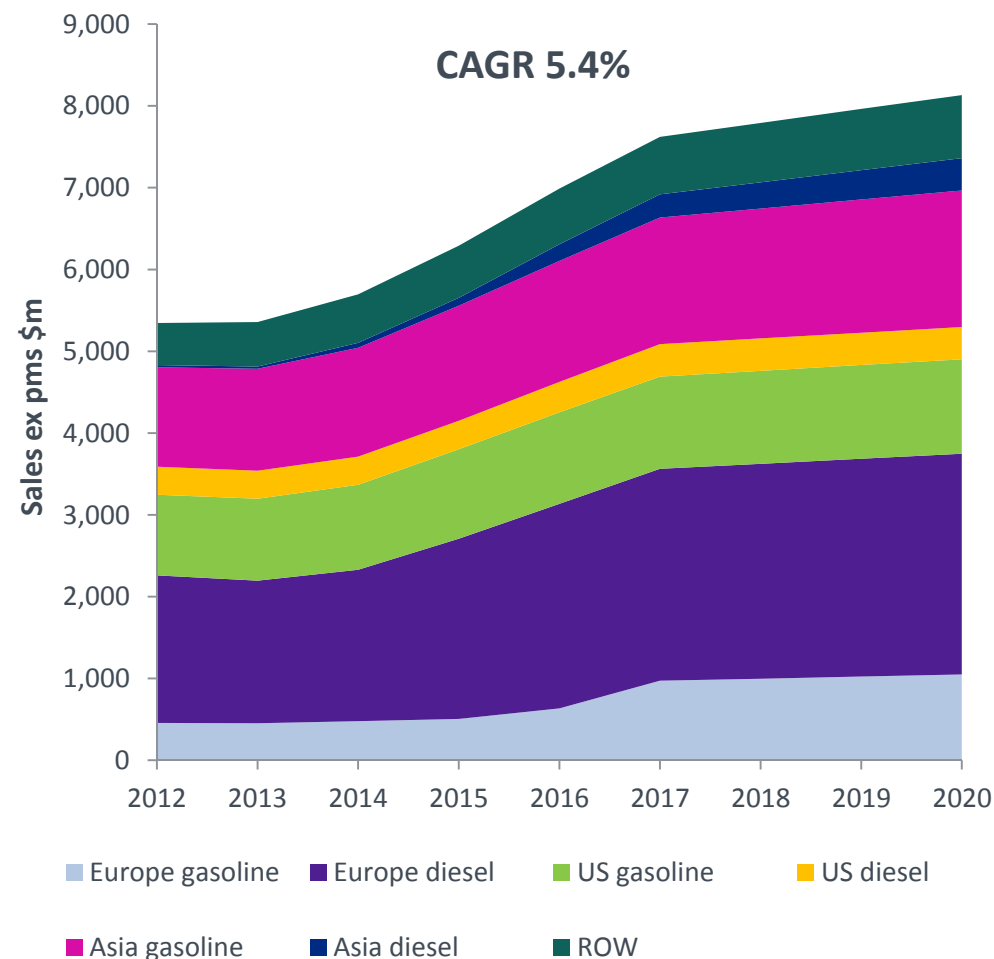
JM global share of supply stable at circa 30%



- #1 position in **highest value** European market
- #1 in **China** – 47% of forecast global growth over next five years
- #1 in **new growth areas** inc. SE Asia and Russia
- Weaker in Japan and Korea – **competitor JVs** and **Cataler**

Strong Sales Growth Continues in Light Duty

- Market size **\$6bn** by 2015 and **\$8bn** by 2020
- European diesel remains the main **value driver**
- Euro 6 and GPFs provide **opportunities** in Europe
- **Asian car sales** growth adds further opportunity



- Light duty market continues to offer **significant growth** potential
- JM sales growth expected at **2 to 3% ahead** of growth in global vehicle production

The Heavy Duty and Non-road Catalyst Market

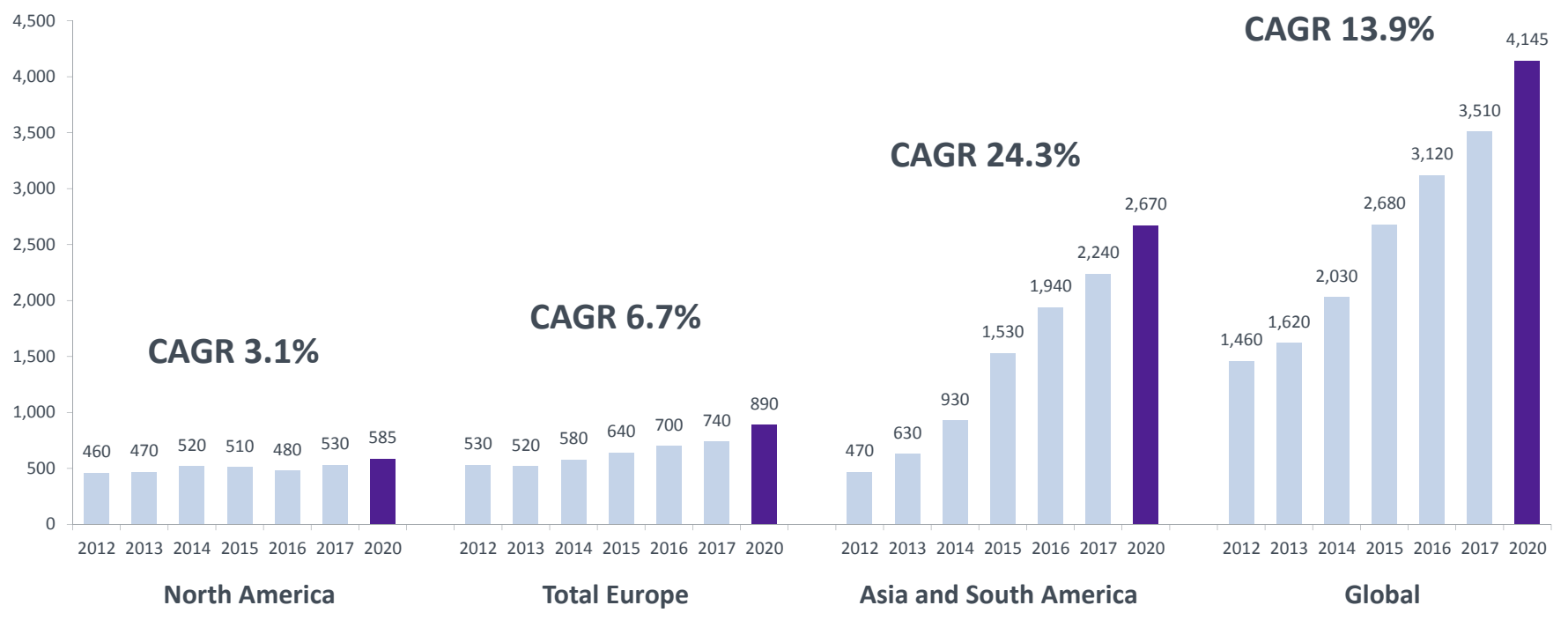
- **Market Growth Drivers**
 - i. Vehicle Production
 - ii. Legislation
 - iii. Technology and Revenue Implications
- **Market Position**
- **Market Growth**



Heavy Duty Vehicle Regulated Engines

Volatile, sensitive to global economy. Asian regulations imminent

Thousands



- Pent up demand drives growth in next few years

- Good growth expected from 2014

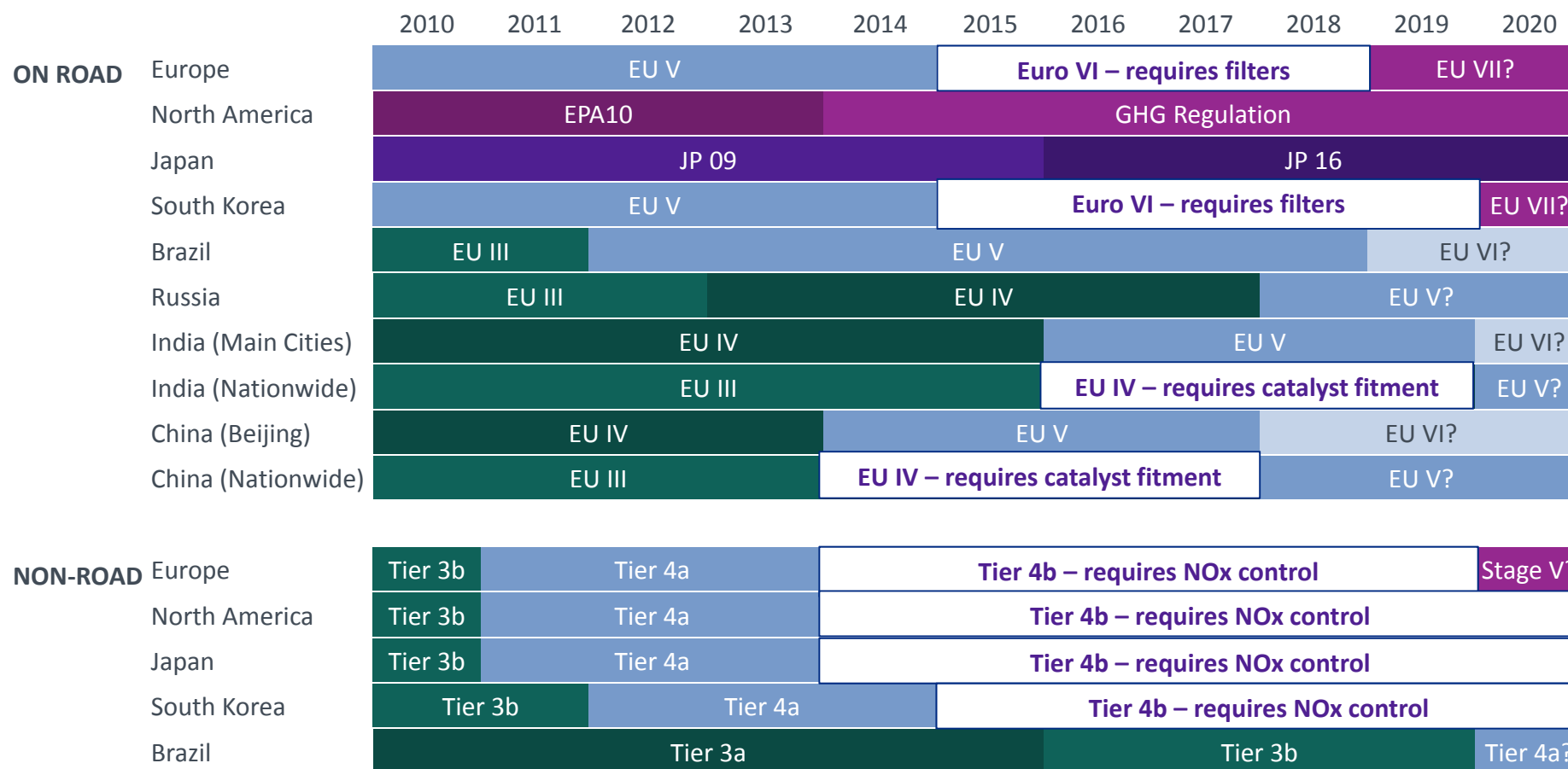
- Emerging markets become regulated

- Good growth with JM maintaining very strong market position

Source: LMC (December 2012); JM estimates for proportion regulated

Heavy Duty Diesel: Global Regulatory Introductions

New and tighter regulations will continue to drive catalyst demand

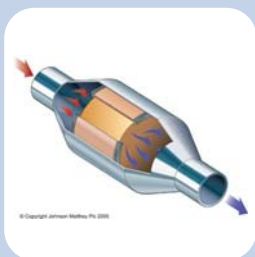


Increased Value with Tightening Regulations

Engine management and emission control trade offs



Alternative choices but increasing catalyst value per vehicle



DOC

US 04
Retrofit
Tier 4a

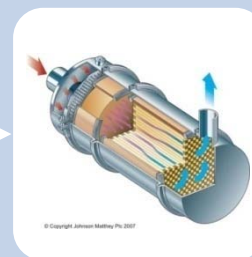
£



SCR

Euro IV, Euro V
Tier 4a, Tier 4b
Emerging Markets

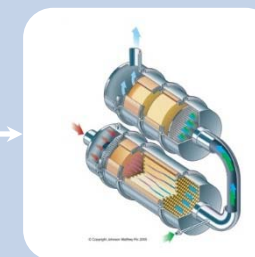
2-3x £



CRT[®]/CCRT[®]

US 07
Tier 4a

5x £



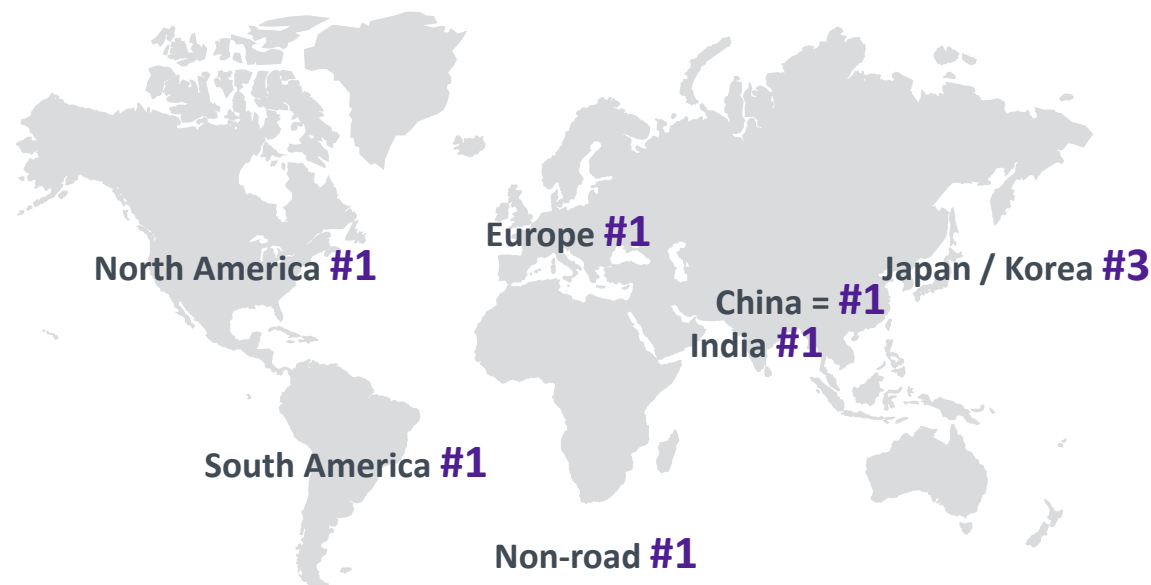
SCRT[®]

US 2010
Euro VI
Tier 4b
JP 09

10x £

JM Global Market Position

Expect >50% share of global supply (inc. China and India) to be maintained

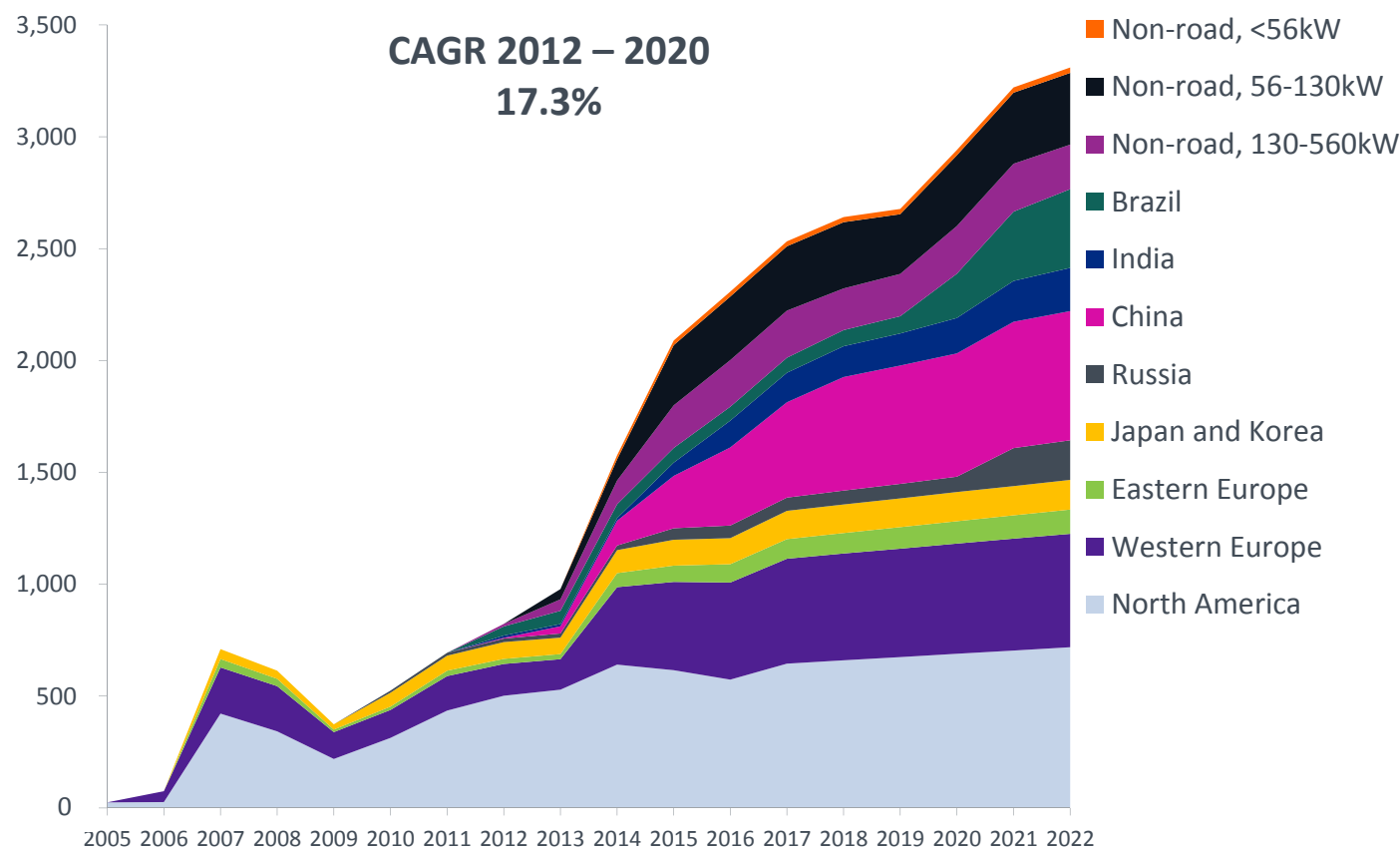


- **Clear #1** position in North America and Europe
- **Japan** and **Korea** dominated by competitor JVs
- Significant **share won** in India
- China more closely fought with **local catalyst makers** – may change as systems become more complex
- **Leading position** carried over into non-road

A \$2.1bn Market by 2015, Growing to \$3.0bn by 2020

- **Euro VI** major contributor
- Growth in **China** as more vehicles become regulated
- **Non-road** sector adds value
- JM prior estimate revised:
 - Reduction in European truck sales
 - 18 month delay in Chinese legislation

Sales ex pms
\$m



- Heavy duty market continues to offer **significant growth potential**

Source: JD Power and JM estimates

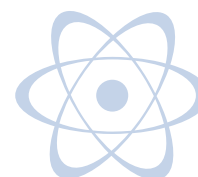
Key Takeaways...



Growth in all our markets



Legislative tightening continues to deliver value



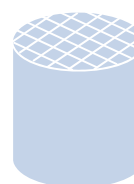
Many opportunities develop and derive value from innovative technologies



JM continues to invest ahead of growth opportunities. ECT's capex reduces to around 1x



Strong position in HDD to be maintained



Margins stable to growing



Double digit growth on average for the foreseeable future



Light Duty Aftertreatment Technology

Dr Chris Morgan
Technology Director, Emission Control Technologies, Europe



Johnson Matthey

Agenda

Light Duty Aftertreatment Technology

01 Opportunities for New Technology

02 Diesel

- i. Selective Catalytic Reduction (SCR)
 - ii. NO_x Adsorber Catalysts (NAC)
 - iii. SCR on a Filter (SCRF[®])
-

03 Gasoline

- i. Gasoline Particulate Filters (GPF)
 - ii. LEV III
-

04 CO₂ Regulations

05 Real World Emissions

Key Legislation Changes in Light Duty

- **Lower Diesel NOx limit for Euro 6 (2014/15)**
 - Reduces from 180 to 80mg/km
- **Gasoline Particulate Number Control for Euro 6**
 - Limit reduces from 6×10^{12} to 6×10^{11} /km in 2017/18
- **Real World Driving Emissions (RDE)**
 - Proposed to reduce off-cycle emissions in Europe
 - Details being finalised: portable emissions measurement system (PEMS) or random drive cycle?
- **LEV III forces lower fleet average emissions**
 - More vehicles to be certified as SULEV 20 and SULEV 30
- **Tightening rules in emerging markets e.g. China, Indonesia**



- Plays to ECT's **global** footprint

New Product Opportunities

Diesel NOx control

- Widespread adoption of SCR and NAC
- Integration onto particulate filter – SCRF®
- Multifunctional filters – ammonia (NH_3) slip, hydrogen sulfide (H_2S) attenuation

Gasoline particulate number

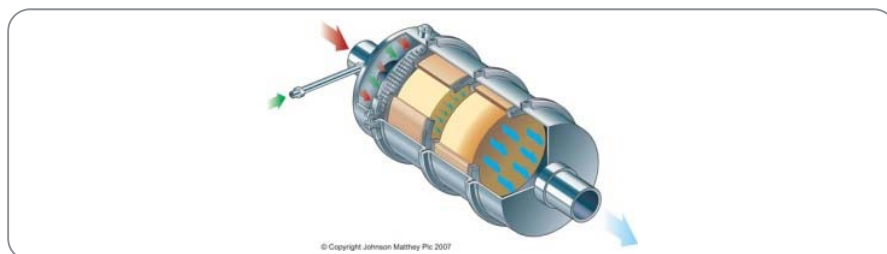
- Introduction of coated gasoline particulate filters – Three Way Filters (TWF™)

More robust catalyst systems for real world emissions control

- Increased thermal durability
- Emissions control at low temperatures
- Emissions control at high speed / high exhaust gas flow

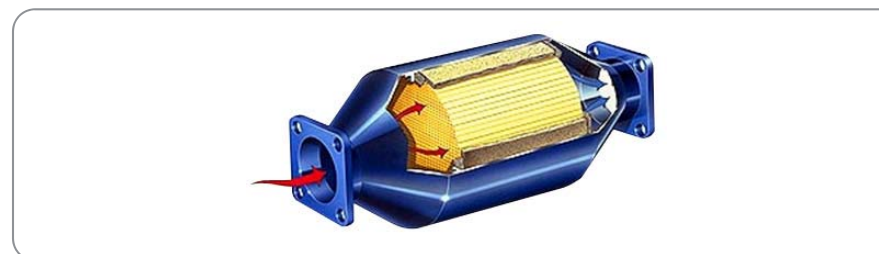


Diesel NOx Control



Selective Catalytic Reduction (SCR)

- Metal-zeolite based catalyst
- Low pgm loading (slip catalyst only)
- Requires urea injection system, with tank, doser and injector systems
- Favoured on larger vehicles



NOx Adsorber Catalysts (NAC)

- Pgm based catalyst
- Requires fuel addition, hence penalty on fuel consumption
- Favoured on smaller vehicles



- JM **well positioned** with both technologies

- Trend moving to **SCR for all** engine sizes

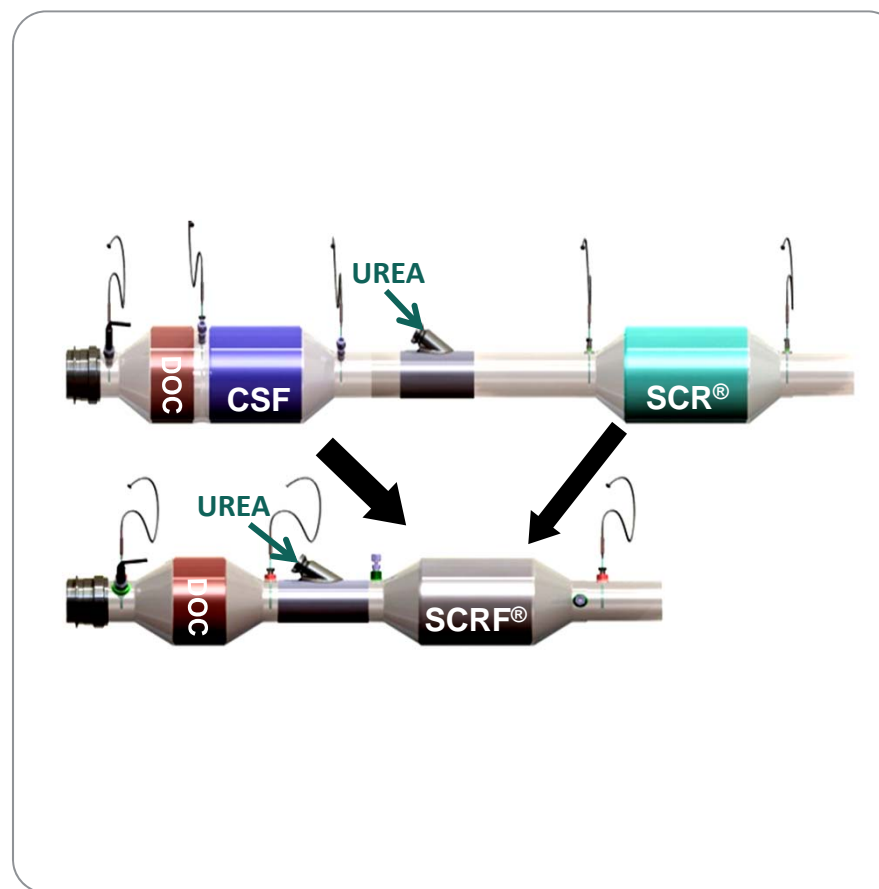
Integration of SCR and Soot Filter – The SCRF®

The next step for diesel NOx control

- SCRF® allows improved thermal management of catalyst on vehicle
- Technically very demanding system
- May require additional SCR / ammonia slip catalyst (ASC) to maximise NOx conversion
- Delivers **performance improvements** and **cost benefits** to customer



- Higher technology product **adds value**

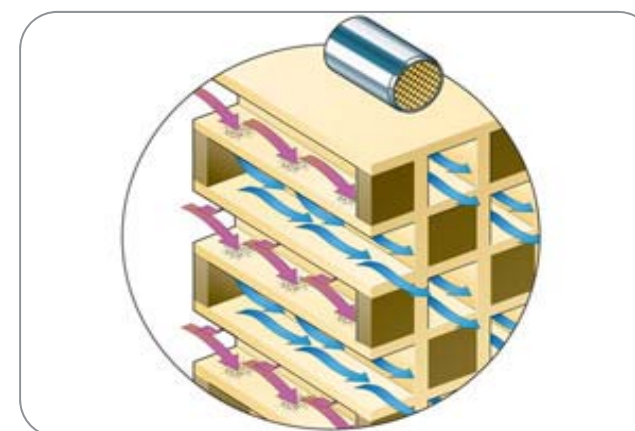
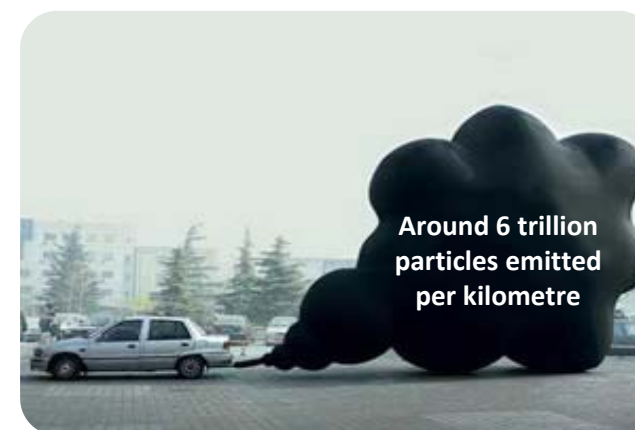


Gasoline Particulate Filters

- Alignment of Euro 6 **particulate number legislation** for gasoline and diesel
 - Expected introduction with **Euro 6c in 2017/18**
 - Not expected outside Europe until post 2020
- Ultrafine particles can penetrate deep into the lungs
- JM's **Three Way Filter (TWF™)** technology can reduce particle number by 50 - 90% on gasoline direct injection engines
- Development **partnerships** with major European OEMs



- GPF **doubles catalyst value** for JM



Key Legislation Changes Outside Europe

In US LEV III forces lower fleet average emissions

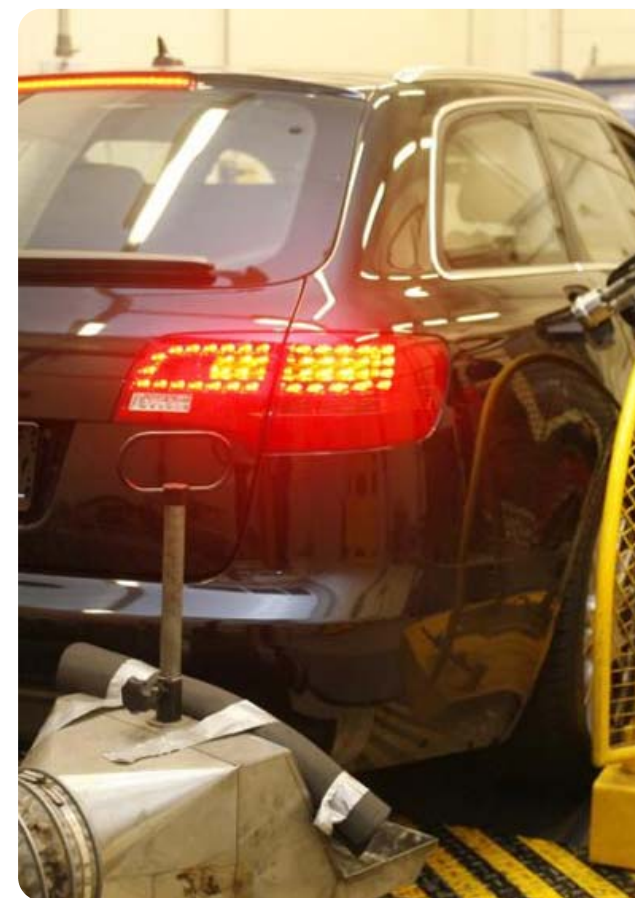
- More vehicles to be certified as SULEV 20 and SULEV 30
- Little change to catalyst system in next five years

US 'Clean Diesel' is an opportunity for growth

- Especially due to close partnerships with key European OEMs

Main growth effect in Asia is vehicle sales rather than legislation

- Carry over of existing Euro 4/5 gasoline products from Europe



CO₂ Regulations Provide Further Opportunities

- **CO₂ – indicative of fuel efficiency**
 - EU: 130g CO₂/km by 2012; 95g CO₂/km by 2020
 - USA 233g CO₂/mi by 2012; 131g CO₂/mi by 2025
- A product of combustion
- Cannot be catalytically transformed
- Can be reduced by:
 - Consumer decisions – smaller powered engines
 - Powertrain development

Powertrain Development	Additional Catalyst Value
Smaller powered engines	✗
Hybrid	✓
Direct injection	✓
Lower operating temps	✓
Battery electric vehicles	✗



- Will require **emission control** modifications
- Will **maintain** or **grow** margins

Real World Emissions

- **Confirmation of European legislation expected in 2013**
- Will require more **robust catalyst systems** to ensure emissions compliance over wider window of operation

Key challenges:

- High speed diesel NOx control
 - Passive SCR behind NOx adsorber catalyst?
- Low speed emissions
 - Cold Start Catalysts, hydrocarbon (HC) traps
- More **thermally durable** gasoline systems



Further Improvement of Current Technologies

Key to continue development of existing TWC and DOC technologies

- Increased durability
- Reduced light-off temperatures
- Reduced pgm content and optimised pgm ratios
- Reduced rare earth content

Enables JM to supply better value products to OEMs

- Protecting margin and market position



Emissions Control for Light Duty Vehicles

- Vehicle production **continues to grow** particularly in Asia
- Tighter legislation will necessitate **advanced** and more **complex** catalyst systems
 - In particular in Europe and USA
- Penetration of **diesel in Asia**
- CO₂ / fuel efficiency requirements and control of new pollutants:
 - Additional challenges and **opportunity** for new catalyst technologies
- Exciting opportunities in **diesel NOx control**
 - SCR, NAC and SCRF®
- Exciting opportunities in **gasoline particulate control** with TWF™
- Real world driving emissions testing
 - Demand for **new technologies**
- New and **improved** technologies



- Continuing **growth** opportunities underpinned by **vehicle** growth, **legislation** and new **technologies**



Emissions Control for Heavy Duty Vehicles

Dr Andy Walker
Technology Director, HDD



Johnson Matthey

Agenda

Emissions Control for Heavy Duty Vehicles

01 Heavy Duty Diesel (HDD) Technology Trend

02 Key Legislative Changes and Implications

03 CO₂ and Fuel Economy Regulations

04 Potential Future Regulations

05 New Product Opportunities

06 Other Powertrains

HDD Technology Trend: Multifunctional Systems

Complex systems with multiple catalyst components required to meet advanced legislation

■ DOC – Diesel Oxidation Catalyst

- Removes CO and HC
- Oxidises fuel to drive active filter regeneration
- Converts some NO into NO₂

■ CSF – Catalysed Soot Filter

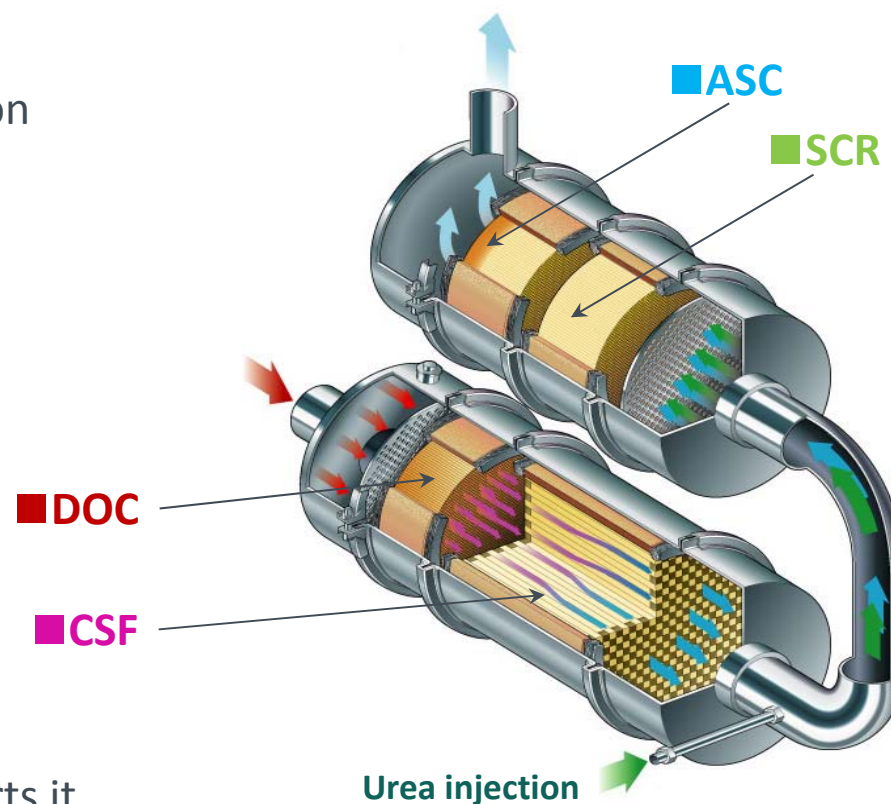
- Traps particulate matter (carbon)
 - For subsequent removal by NO₂ and / or O₂
- Enables particle number (PN) compliance

■ SCR – Selective Catalytic Reduction

- Removes NO_x via reaction with NH₃

■ ASC – Ammonia Slip Catalyst

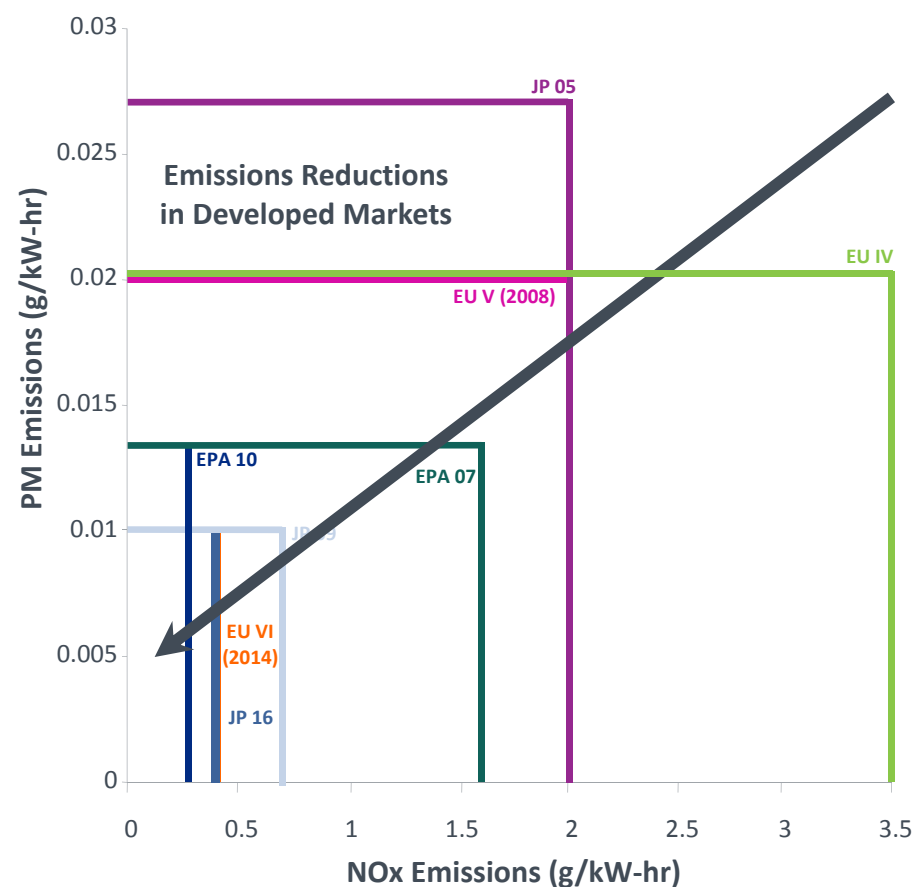
- Removes any ammonia (NH₃) slip and converts it to (predominantly) nitrogen (N₂)



Key Legislative Changes and Implications

On road

- 80% reduction in NOx limit + introduction of particle number legislation for Euro VI (2014)
 - DOC ■ CSF ■ SCR ■ ASC on all HDD on road vehicles
- Introduction of GHG-based regulation in North America (2014) requires higher NOx conversion systems
 - DOC ■ CSF ■ SCR ■ ASC on all HDD on road vehicles
- Japanese Energy Saving Law (2015) and lower NOx limit (JP 16) require increased NOx conversion
 - DOC ■ CSF ■ SCR ■ ASC on all HDD on road vehicles
- Brazil Euro V (2012), China Euro IV (2013), India Euro IV (2014/15) drive
 - SCR requirement
- Brazil Euro VI (circa 2018) drives
 - DOC ■ CSF ■ SCR ■ ASC requirement



Key Legislative Changes and Implications

Non-road

- Aligned standards in Europe, North America and Japan
- **80%** reduction in NOx limit for Tier 4b (2014)
 - Optimised **SCR systems** required
- No particle number limit
- Filters **not required** to meet the non-road Tier 4b regulations
- **SCR** is required; typical systems:
 - **SCR** + **ASC**
 - **DOC** + **SCR** + **ASC**
 - **DOC** + **CSF** + **SCR** + **ASC**

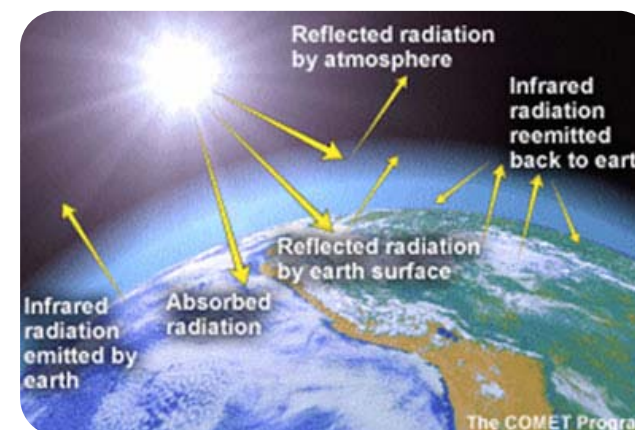


CO₂ and Fuel Economy Regulations

- Japan **tax incentives** for fuel efficient vehicles
- North America's EPA recently announced **GHG** and **fuel economy** regulations
 - Introduces CO₂, CH₄ and N₂O regulations for the first time – targeting global warming
- Active discussions on **CO₂ regulation** for HDD in Europe
- Major **future focus** will be on GHG and fuel efficiency



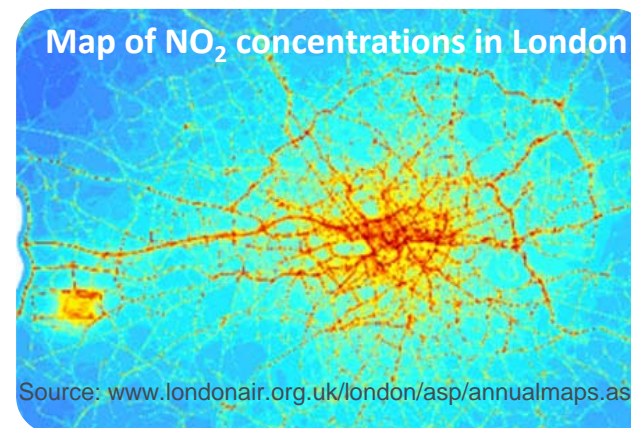
- **Catalyst systems** will play a major role in enabling fuel efficiency improvements and GHG reductions



Source (top image): University Corporation for Atmospheric Research

Potential Future Regulations

- Potential introduction of **N₂O and CH₄** regulations outside North America
- Potential introduction of NO₂ regulations
 - Major **focus in urban areas** to improve urban air quality
- Expected introduction of particle number regulations
 - In non-road Stage V European regulations around **2019/20**
 - Would drive filter fitment on all non-road engines
- Increased focus on **Black Carbon** emissions
 - Major contributor to GHG emissions (40% of current warming)
 - Short lived in atmosphere – can achieve **immediate benefits**

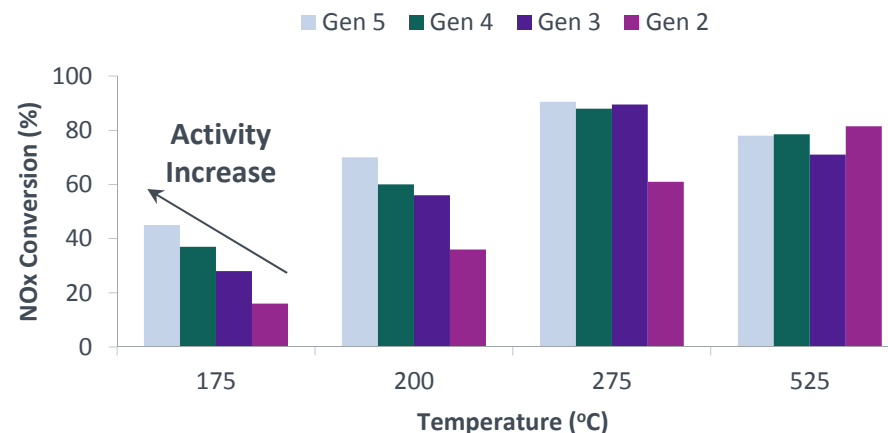


Current R&D Priorities and Focus

New product opportunities

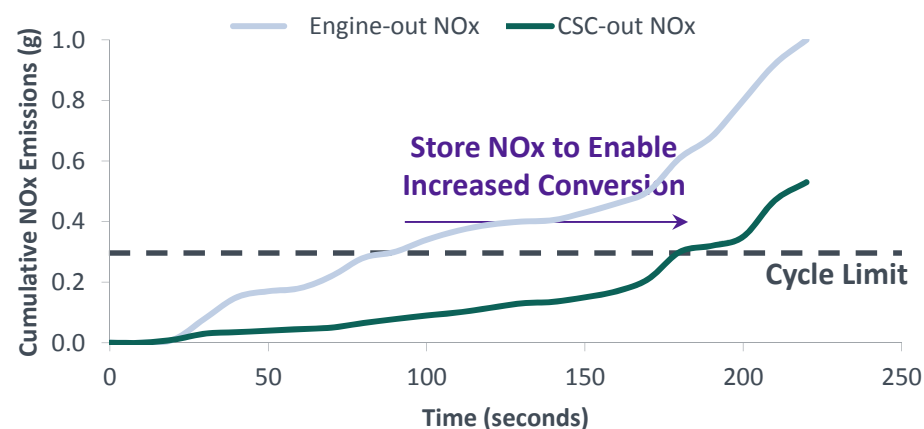
Extruded catalysts for optimised low temperature performance

- Enables performance increase and / or volume reduction



Cold Start Catalysts (CSC)

- Engine-out emissions exceed cycle limit in 80 seconds
- CSC gives extra time to get SCR catalyst hot enough to convert NOx



Other Powertrains

Natural gas and hybrids

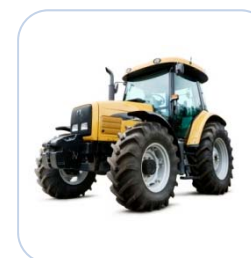
- Potential of natural gas (NG) powered HDD vehicles, especially in North America
 - NG currently lower cost than diesel
 - Potential concerns include higher truck prices, future pricing of NG, methane losses leading to GHG concerns
- NG powered vehicles **require catalysts** to meet regulations
- Hybrids offer fuel economy advantages for in-city stop-go driving
- Hybrids use the **same catalyst systems** as diesel trucks



Top image courtesy of Clean Energy
Bottom image source: Digital Trends, Inc.

Emissions Control for Heavy Duty Vehicles

- **Vehicle** and **engine production** continues to grow worldwide
- **Tightening legislation** in the developed markets (Europe, North America, Japan) moves all on road and non-road engines to **complex catalyst systems**
- Incoming **legislation** in very large Chinese and Indian markets
 - Will **require emissions control** on HDD vehicles for the first time
- CO₂ / fuel efficiency requirements and control of new pollutants
 - Offers additional challenges and opportunities for continued **development** and **innovation**





Opportunities in Emission Control Technologies

John Walker

Division Director, Emission Control Technologies



Johnson Matthey

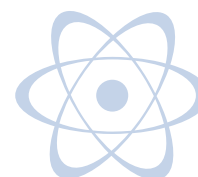
Key Takeaways...



Growth in all our markets



Legislative tightening continues to deliver value



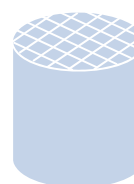
Many opportunities develop and derive value from innovative technologies



JM continues to invest ahead of growth opportunities. ECT's capex reduces to around 1x



Strong position in HDD to be maintained



Margins stable to growing



Double digit growth on average for the foreseeable future



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Tour of the Royston Facility

Dr David Prest

Managing Director, Emission Control Technologies, Europe



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ECT Royston Operations

Plant Location:

- Royston, Hertfordshire, England

Operating Region:

- European

Start of Operations:

- April 2001

Accreditations:

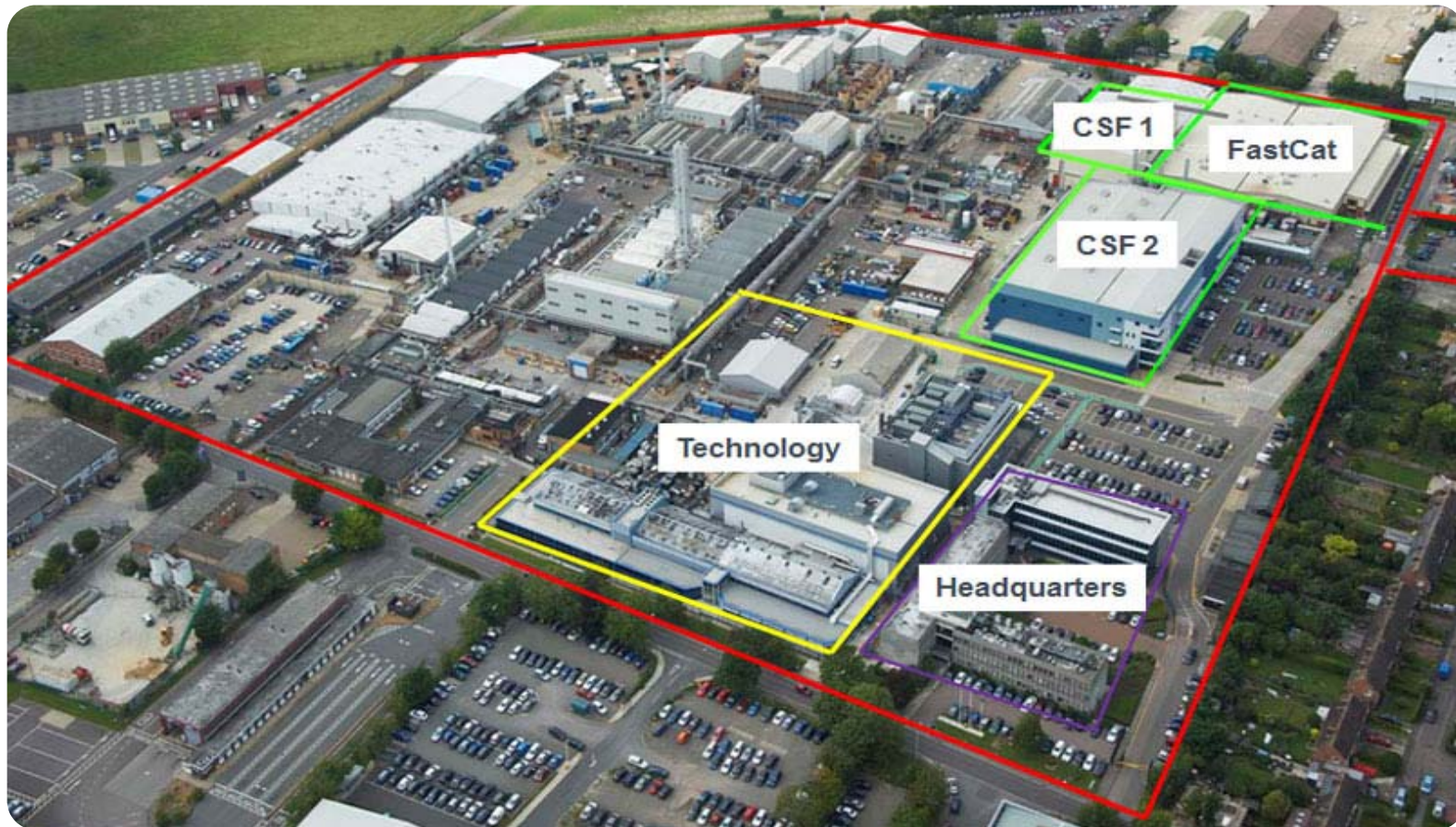
- ISO/TS 16949 / ISO 14001

Site Capacity:

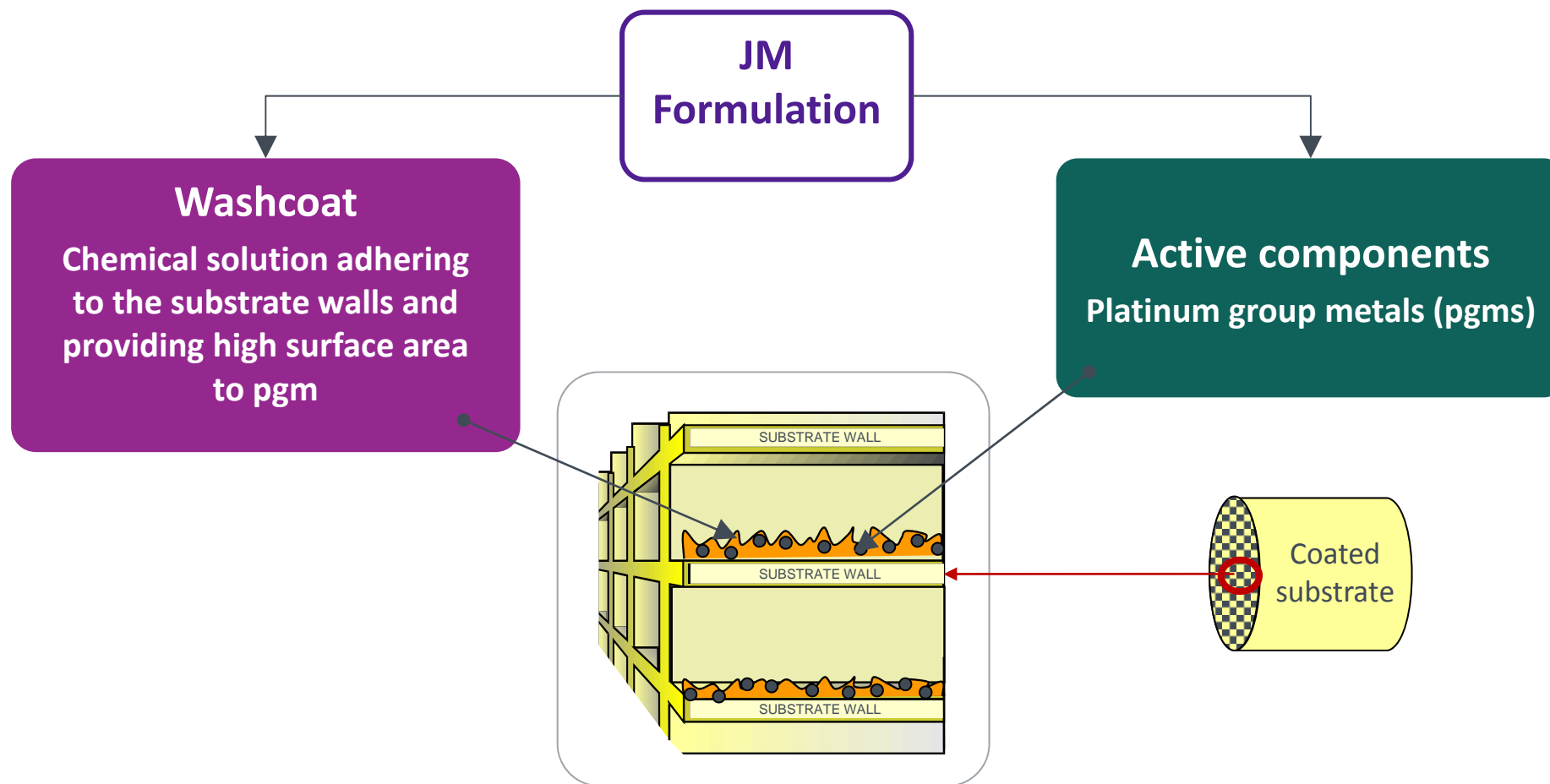
- CSF + flowthrough catalysts



Site Overview

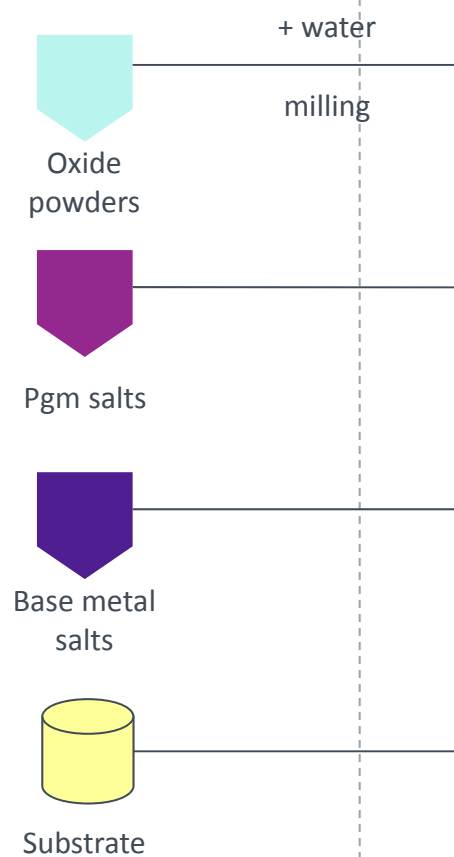


The Structure of an Autocatalyst



Process Overview

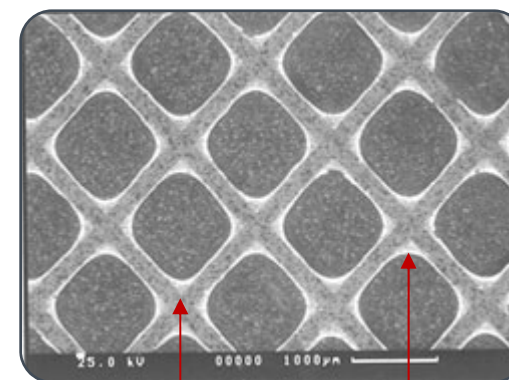
Raw Materials



Washcoat Preparation



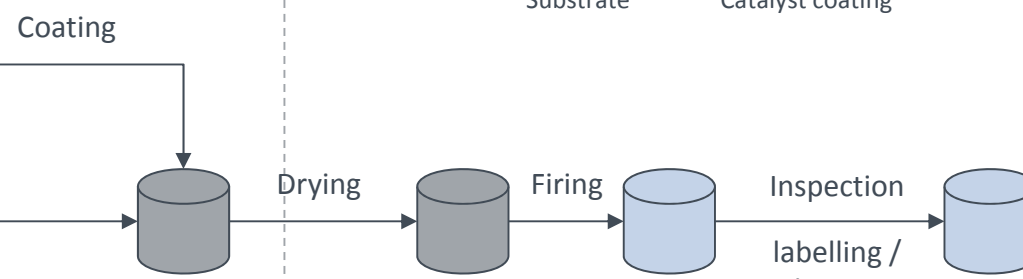
Coating Process



Substrate Catalyst coating

PROCESS 1

PROCESS 2



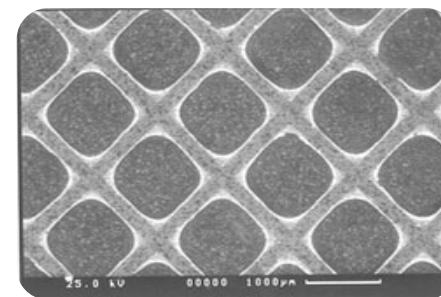
Technology Centre



Product Development



Catalyst Assessment



Catalyst Characterisation



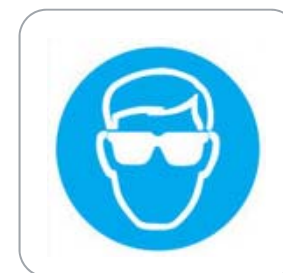
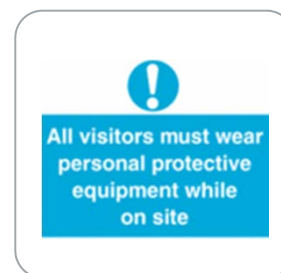
Vehicle Testing



Engine Testing

Plant Tour

Safety instructions



To ensure your safety please stay on the green routes when touring the factory

If the fire alarm rings continuously please follow your guide to the **FIRE ASSEMBLY POINT**

Security

Request that phones and other recording devices are left in the conference room



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Closing Remarks

Neil Carson
Chief Executive



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RIG 10

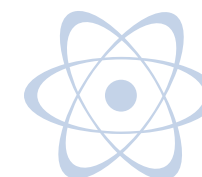
Summary



A world leading technology company



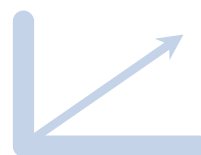
Success founded on continued investment in R&D and product development



Differentiation through technology



Proven strategy in place to develop new business areas



Well positioned in growth markets



Delivers value

Conclusions

Well positioned for future growth

New Business Development

- Developing a **portfolio** of opportunities
- Good fit with JM **technology competences**, supported by **global drivers**
- Targeting **high tech, high margin, high growth** businesses in developing niche markets
- Potential to create new divisions with sales **>£200m**

Emission Control Technologies

- Good growth **opportunities** in all our markets
- **Legislation** and **technology** continues to drive business around the world
- Continued **investment** to support growth
- **Double digit** growth on average for foreseeable future



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JM Executive Board

Neil Carson
Chief Executive

Robert MacLeod
Group Finance Director

Larry Pentz
Executive Director
Environmental Technologies

Bill Sandford
Executive Director
Precious Metal Products

Presentation Team

Nick Garner

Group Director
Corporate and Strategic
Development

Roanna Doe

Group Corporate Development
Director

Martin Green

Group Strategic Development
Director

John Walker

Division Director
Emission Control Technologies

Dr Chris Morgan

Technology Director
Emission Control Technologies
Europe

Dr Andy Walker

Global Technology Director
Heavy Duty Diesel

Other Senior Management

Lawrence Berns

Managing Director
Axeon

Simon Christley

Division Finance Director
Environmental Technologies

David Clark

Business Development Director
Emission Control Technologies

Kevin Donegan

Commercial Director
Light Duty
North America

Alan Myers

President
Emission Control Technologies
North America

Don Newton

Global Technology Director
Axeon

Dr Allan Paterson

Senior Electrochemist
Axeon

Dr David Prest

Managing Director
Emission Control Technologies
Europe

John Zubrickas

Managing Director
Emission Control Technologies
Asia

Ian Godwin

Director
Investor Relations

Dr Sally Jones

Group Corporate
Communications Manager

Glossary

API	Active pharmaceutical ingredient	EU	European Union
ASC	Ammonia slip catalyst	EV	Electric vehicle (HEV, PHEV or BEV)
BEV	Battery electric vehicle	GHG	Greenhouse gas
C ₂ H ₄	Ethylene	GPF	Gasoline particulate filter
CAGR	Compound annual growth rate	H ₂	Hydrogen
CARB	California Air Resources Board	H ₂ O	Water
CCRT [®]	Catalysed continuously regenerating trap	H ₂ S	Hydrogen sulfide
CCS	Carbon capture and storage	HC	Hydrocarbon
CNG	Compressed natural gas	HDD	Heavy duty diesel
CH ₄	Methane, natural gas	HEV	Hybrid electric vehicle
CO	Carbon monoxide	JM	Johnson Matthey
CO ₂	Carbon dioxide	JV	Joint venture
CRT [®]	Continuously regenerating trap	LCV	Light commercial vehicle
CSC	Cold start catalyst	LD	Light duty
CSF	Catalysed soot filter	Li-Air	Lithium-Air, a type of battery cell chemistry
DOC	Diesel oxidation catalyst	Li-ion	Lithium-ion, a type of battery cell chemistry
ECT	Emission Control Technologies	Li-S	Lithium-sulfur, a type of battery cell chemistry
EPA	US Environmental Protection Agency	LPG	Liquefied petroleum gas

Glossary

N ₂	Nitrogen	PN	Particle number
N ₂ O	Nitrous oxide	R&D	Research and development
NAC	NOx adsorber catalyst	RDE	Real world driving emissions
NG	Natural gas	ROW	Rest of the world
NH ₃	Ammonia	RSA	Republic of South Africa
Ni-Cd	Nickel-cadmium, a type of battery cell chemistry	SCR	Selective catalytic reduction
Ni-MH	Nickel-metal hydride, a type of battery cell chemistry	SCRF®	Selective catalytic reduction on a soot filter
NO	Nitrogen monoxide	SCRT®	Selective catalytic reduction + CRT®
NO ₂	Nitrogen dioxide	TWC	Three way catalyst
NOx	Nitrogen oxides	TWF™	Three way filter
O ₂	Oxygen	ZEV	Zero emission vehicle
OEM	Original equipment manufacturer		
p.a.	Per annum		
PEMS	Portable emissions measurement system		
Pgm	Platinum group metal		
PHEV	Plug-in hybrid electric vehicle		
Pms	Precious metals		



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