Presentation to Analysts / Investors

Johnson Matthey Technology Centre, Sonning Common

28th / 29th January 2009

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.

JM
Johnson Matthey

Overview and Trading Update

Neil Carson
Chief Executive

Johnson Matthey

JM Executive Board

- Neil Carson - Chief Executive
- John Sheldrick - Group Finance Director
- Larry Pentz - Executive Director, Emission Control Technologies
- Dr Pelham Hawker - Executive Director, Process Technologies and Fine Chemicals & Catalysts
- David Morgan - Executive Director, Corporate Development and Central Research

Other Senior Management

- Bill Sandford - Division Director, Precious Metal Products
- Neil Whitley - Division Director, Process Technologies
- Dr David Prest - Technology & Business Development Director, ECT
- Jeremy Coombes - Fuel Cell Today
- Dr Jack Frost - Director, Johnson Matthey Fuel Cells
- Dr Barry Murrer - Director, Technology Centre
- Sue Ellis - Manager, Low Carbon Research Group
- Martin Green - Strategic Development Director, Johnson Matthey Fuel Cells
- Ian Godwin - Director, Investor Relations
- Dr Sally Jones - Public Relations Manager

Strategic Opportunities for Environmental Technologies

- Existing regulations for transport and stationary source engines will continue to tighten globally
- Substantial market expansion in heavy duty diesel (HDD) expected over the next six years
- Increasing regulation for NOx control in other markets
- Clean fuels from coal and gas
- CO_2 is new pollutant – opportunities in fuel cells, carbon sequestration and low carbon technology
- Other pollutants – sulphur, mercury, nitrous oxide (N_2O), methane

Johnson Matthey

Programme

09.40	Overview and Interim Management Statement (Neil Carson)
	Opportunities in NOx Emission Control
09.50	Argillon Acquisition Overview (Larry Pentz)
10.00	Heavy Duty Diesel Emission Control (David Prest)
10.30	Future Opportunities in Stationary Emission Control (SEC) (Larry Pentz)
11.00	Coffee Break
	Fuel Cells
11.15	Fuel Cell Today (Jeremy Coombes)
11.20	Johnson Matthey Fuel Cells - Update (Jack Frost)
	Coal to Products and Low Carbon Technology
11.40	Coal to Products and Low Carbon Technology (Barry Murrer)
12.10	Low Carbon Technologies - Future Opportunities (Sue Ellis)
12.30	Tour of Technology Centre
13.40	Lunch
14.20	Wrap Up and Q&A
14.30	Depart for Reading Station

Johnson Matthey

Interim Management Statement

- Summary Results for third quarter of 2008/09

  - Sales excluding precious metals slightly ahead
  - Operating profit* 4% below last year
  - Profit before tax* 7% below last year
  - Cash flow positive

* Before amortisation of acquired intangibles

Estimated Light Vehicle Sales and Production

for the 3 months to 31st December 2008

		Quarter ended 31st December		
		2008 millions	2007 millions	Change %
North America	Sales	3.1	4.5	-31.1
	Production	2.7	3.6	-25.0
Total Europe	Sales	4.2	5.5	-23.6
	Production	4.2	5.7	-26.3
Asia	Sales	4.3	4.8	-10.4
	Production	6.6	7.3	-9.6
Rest of World	Sales	3.5	3.6	-2.8
	Production	1.5	1.9	-21.1
Global	Sales	15.1	18.4	-17.9
	Production	15.0	18.5	-18.9

Source: Global Insight

Interim Management Statement

- Environmental Technologies

  - Sales (ex pms) 6% below last year, 13% down on constant currency basis
  - Emission Control Technologies' sales well down. Global car production fell by 19% in third quarter compared with last year. Further action taken to reduce costs
  - OEMs taking extended shutdowns. Outlook for February / March difficult to forecast. Asian demand weaker. Global car production in fourth quarter could be 25% below last year
  - Process Technologies' sales up in third quarter. Energy security and environmental issues continue to support demand. DPT secured two further contracts with others in the pipeline

Johnson Matthey

Interim Management Statement

- Precious Metal Products
  - External revenue and profits up. Good demand for fabricated products and gold refining. Volatility offset some of the impact of lower pgm prices
- Fine Chemicals & Catalysts
  - Also up. Good sales of research chemicals and active pharmaceutical ingredients
- Results for all three divisions helped by exchange translation

Johnson Matthey

Outlook for Fourth Quarter of 2008/09

- Last year Precious Metal Products' fourth quarter was very strong as a result of record pgm prices. This year will be lower

- Environmental Technologies will also be lower with global car production projected to be 25% down

- On that basis our range for full year underlying eps (before amortisation of acquired intangibles) is now 85p to 90p (cf. 89.5p last year)

Opportunities in NOx Emission Control

Johnson Matthey

Agenda

1	Argillon Acquisition Overview
2	Heavy Duty Diesel Emission Control
3	Future Opportunities in Stationary Emission Control (SEC)

Argillon Acquisition Overview

Larry Pentz
Executive Director

Johnson Matthey

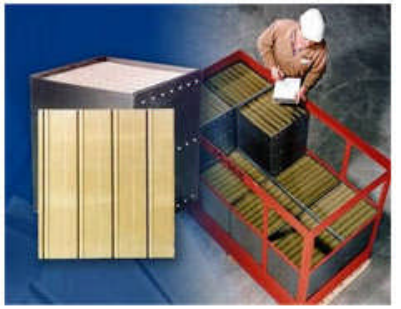
Key Facts

On 10th December 2007 announced purchase of Argillon from a KKR subsidiary for €214m

Completed on 7th February 2008

Headquarters and principal site at Redwitz, Germany. Sales offices in the US and Asia

Products – catalyst technology for the control of oxides of nitrogen (NOx). Engineered ceramics



Business Portfolio

(Continuing Businesses)

	Catalysts		
	Power Plants 	**Stationary** 	**HDD** 
	Selective Catalytic Reduction (“SCR”) of Nitrogen Oxide (NOx)		
Products & applications	Catalysts for power plants, industrial applications and waste incineration plants: • Plate-type • Honeycomb-type	Engineering and supply of catalytic systems for: • Stationary diesel engines • Waste incineration • Marine vessels • Gas engines	Used in diesel trucks: • Heavy duty vehicles
Customer base	• OEM (power generation) • Engineering suppliers	Broad industrial customer base	HDD OEMs

Strategic Rationale

HDD

- Adds sales in Europe
- Broader product / technology portfolio
- Combined extruded / coated technology development
- Product offering for BRIC

Power Plant

- New emission control market
- Significant growth opportunity in China
- Tightening regulations in US and EU
- Introduction of other JM technologies

Systems

- Fit with JM's existing business
- Critical mass and synergies
- Medium / long term new markets

JM adds

- Link with an experienced catalyst business
- Expanded global presence
- Broader technology base
- Catalyst systems

Johnson Matthey

Current Status

- Sales €59 million, operating profit €10 million in first half of 2008/09 for the continuing businesses
- Completed sale of Insulators and Alumina business to Lapp Inc. on 26th November 2008 for €21 million in cash plus €2 million vendor loan note
- Argillon fully integrated into ECT

Heavy Duty Diesel Emission Control

David Prest
Technology & Business Development Director

Johnson Matthey

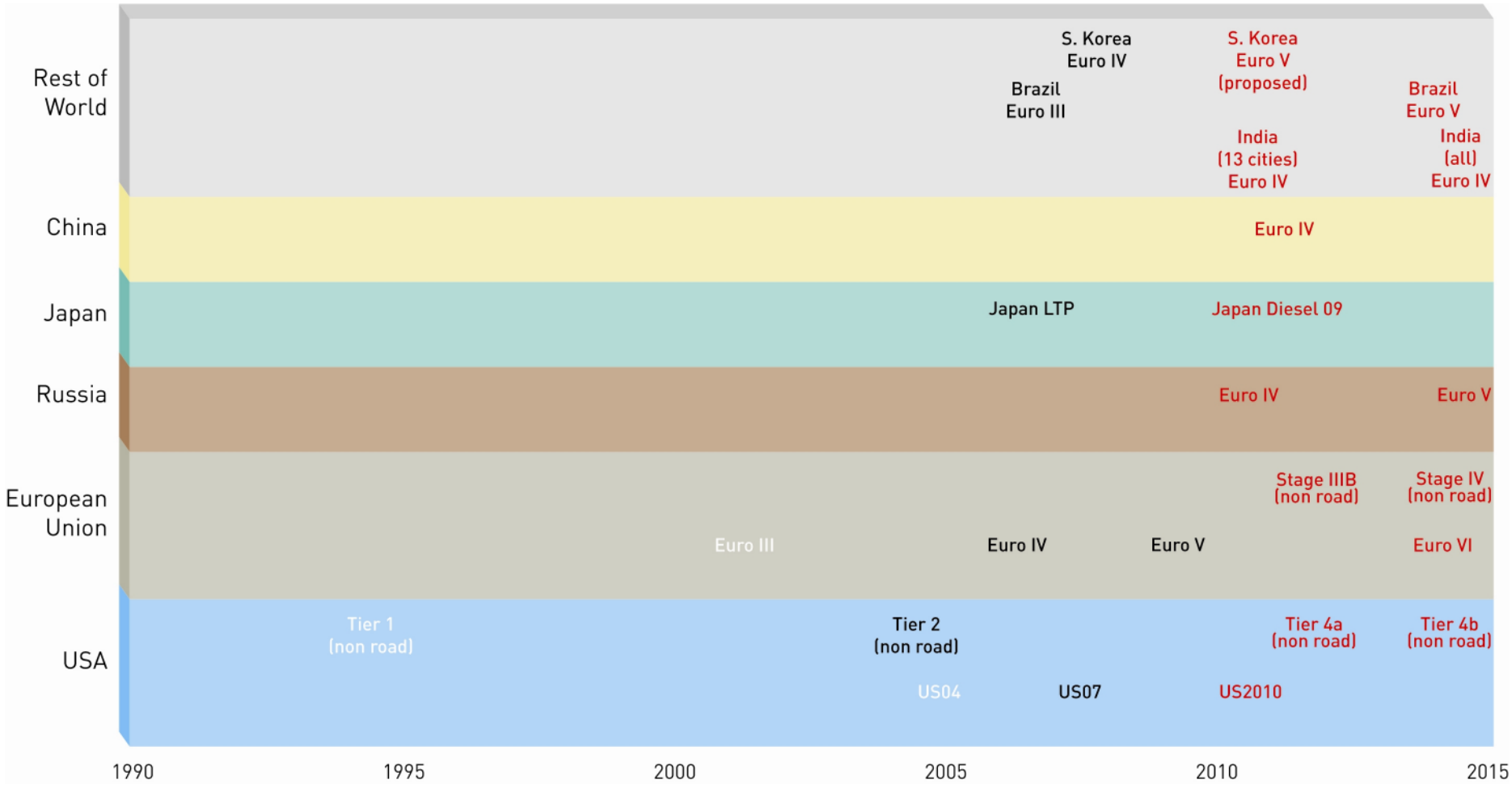
Agenda

1	Current Market Update
2	Developing Markets
3	Selective Catalytic Reduction (SCR)
4	Extruded and Coated SCR
5	Key Points

Johnson Matthey

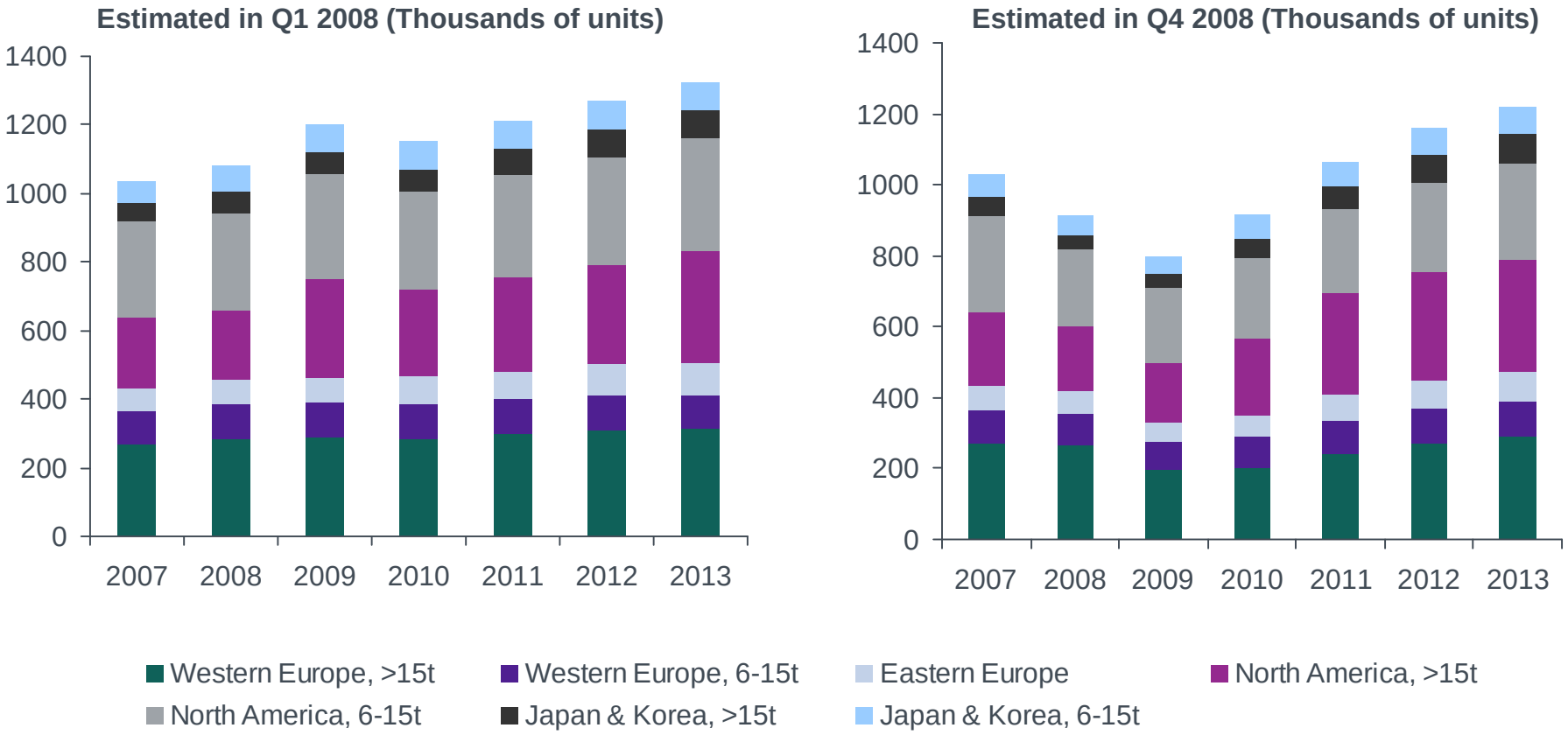
Emission Control Technologies

HDD Legislation Timeline



Market Update

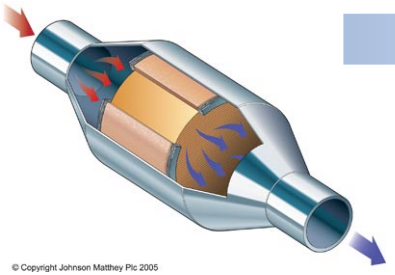
Current markets (HDD on road vehicles >6 tgvw)



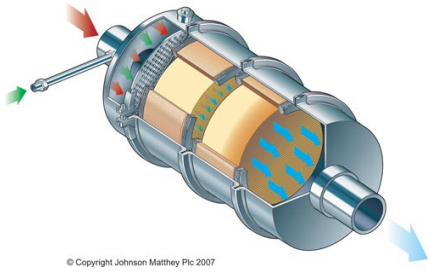
Sources: JD Power & Johnson Matthey
Scope: On road vehicles >6 tonnes gross vehicle weight (tgvw)

Evolution of Typical HDD Aftertreatment Systems

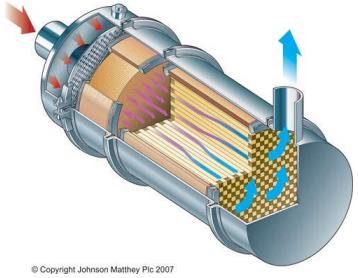
2003	2004	2005	2006	2007	2008	2009	2010…...



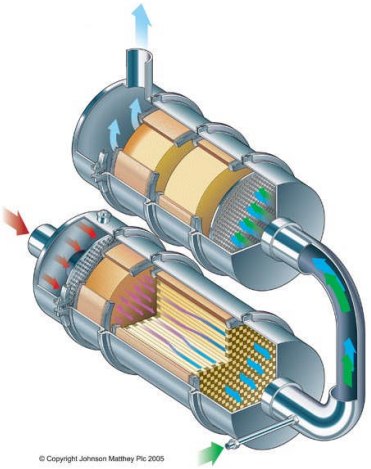
DOC



SCR

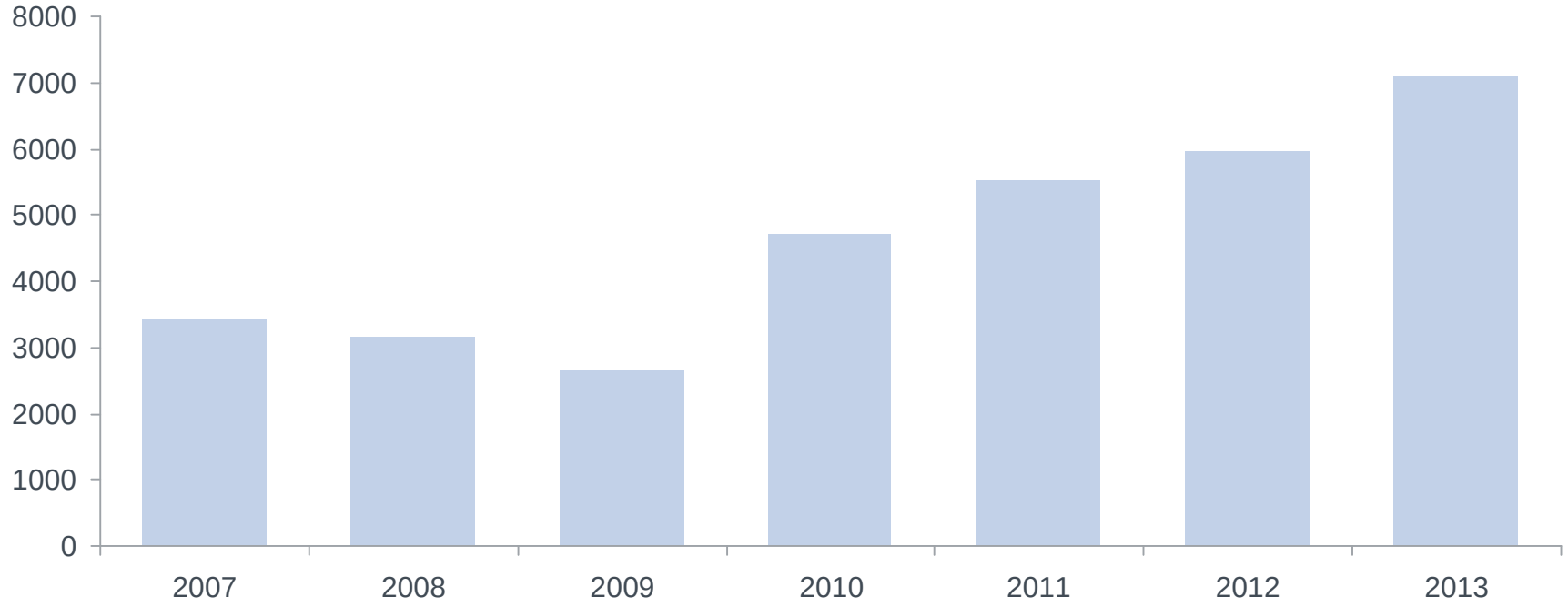


CRT®/CCRT®



SCRT®

Number of Catalyst Bricks (‘000s)



Source: Johnson Matthey estimates

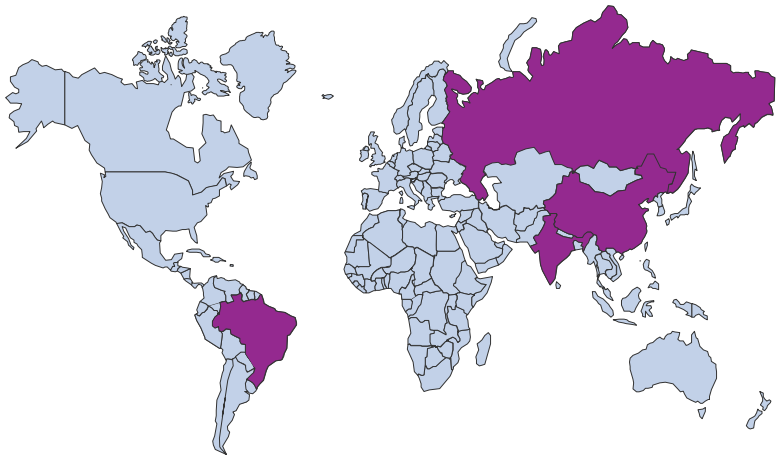
Estimated catalysts fitted to HDD vehicles >6 tgvw in current markets:

Western and Eastern Europe, North America, Japan and Korea

Includes Diesel Oxidation Catalyst (DOC), Selective Catalytic Reduction (SCR), Diesel Particulate Filter (DPF), Ammonia Slip Catalyst (ASC)

Developing Markets

New territories, on road market



Non-road market

Johnson Matthey

HDD Legislation in New On Road Markets

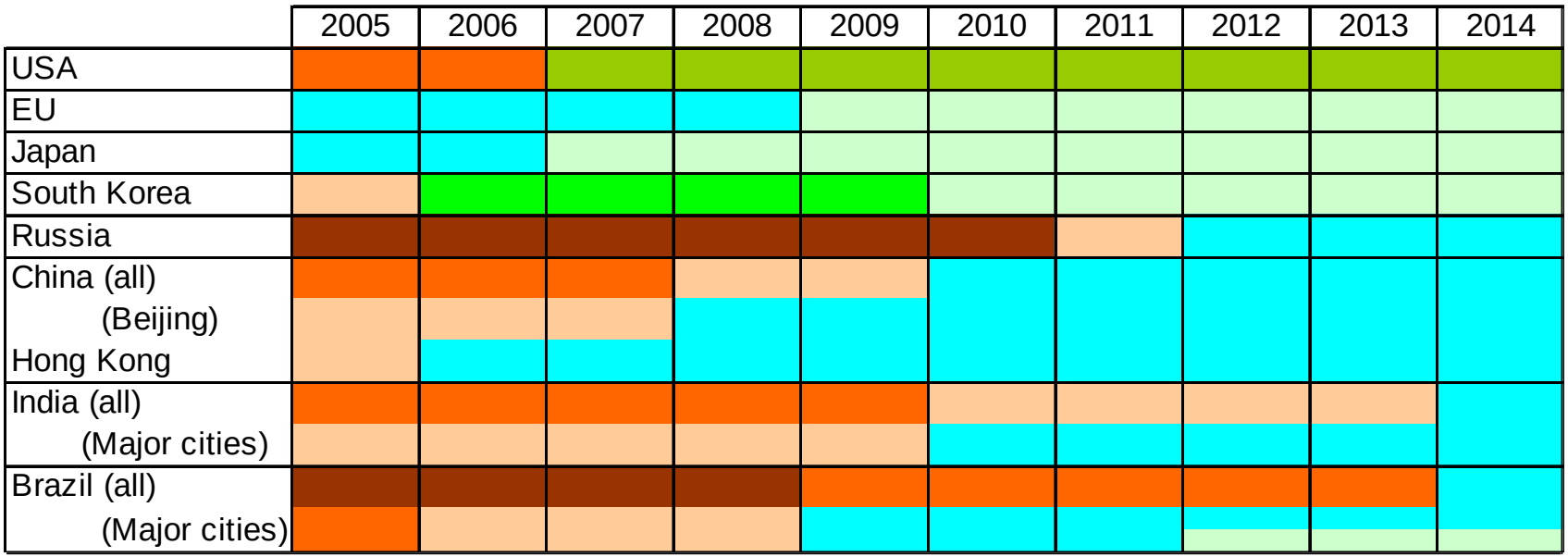
Territory & Application	Legislation	Timing
Russia (on road)	Euro IV	2010
China (on road)	Euro IV	New models: 2010. All sales: 2011
India (on road)	Euro IV	Major cities: 2010. Whole country: 2014
Brazil (on road)	Euro V	2012

- New territories are generally adopting EU standards
- SCR is expected to be prime path
- Some opportunities for other technologies

Johnson Matthey

Fuel Quality – Sulphur Content

Key Enabler for Catalytic Aftertreatment



>500 ppm S <500 ppm S <350 ppm S <50 ppm S <30 ppm S

<15 ppm S <10 ppm S

OEMs in On Road Developing Markets

Typical Annual Sales (‘000 units)

China

• DongFeng	180
• FAW	170
• CNHTC	110
• Shaanxi	75
• Beiqi Futian	65

Brazil

• MAN	45
• Daimler	35
• Ford	20
• Volvo	10
• Iveco	5

India

• TELCO	150
• Ashok Leyland	50
• Eicher	20

Russia

• KamAZ	55
• GAZ	25
• UralAZ	15

Estimated 2008 vehicle sales

Source: JD Power

Developing Markets: Non-Road

Scrapers

Telehandlers

Backhoes

Inland and Inshore Marine

Excavators

Johnson Matthey

HDD Legislation in Non-Road Markets

Territory & Application	Legislation		Timing
	North America	Europe	
Non-road (130 – 560 kW)	Tier 4a	Stage IIIb	2011
	Tier 4b	Stage IV	2014
Non-road (56 – 130 kW)	Tier 4a	Stage IIIb	2012
	Tier 4b	Stage IV	2015
Non-road (37 – 56 kW)		Stage IIIb	2013
(19 – 56 kW)	Tier 4a		2013

- Legislation in Japan is similar
- Transitional arrangements omitted for clarity

Aftertreatment Systems for Non-Road

Very versatile duty cycles

Non-road may use

- DOC only
- DOC plus coated filter
- SCR

Depending on engine manufacturer, engine size and application

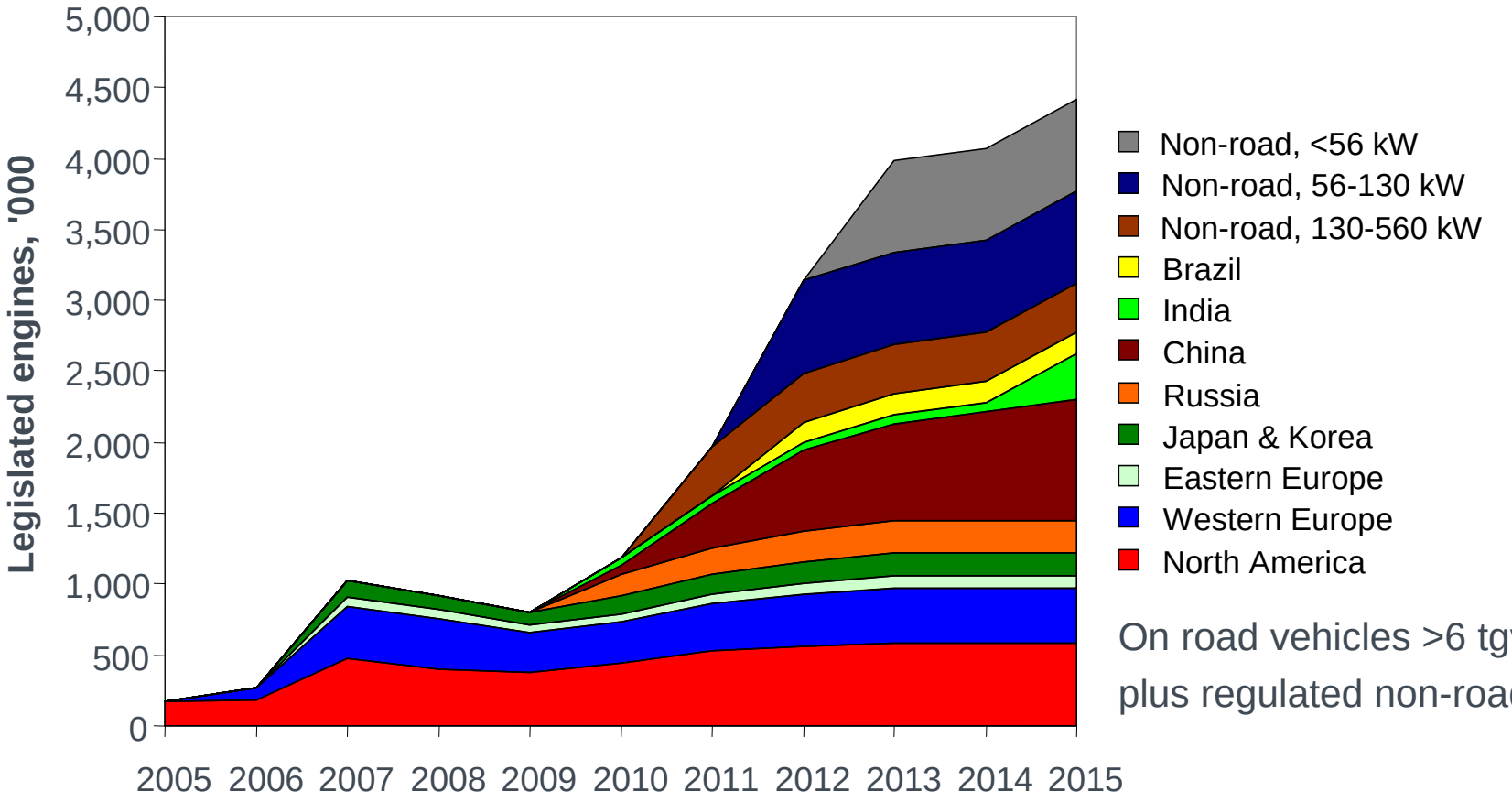
OEMs in Non-Road Regulated Markets

Typical annual production ('000)	
Kubota	300
Yanmar	200
Caterpillar / Perkins	200
John Deere	160
Case New Holland	150
Deutz	150
Isuzu	90

Typical annual production ('000)	
Komatsu	80
Cummins	70
Mitsubishi	70
JCB	40
SISU	40
Volvo (CE & Penta)	25

- Estimated total catalyst market value $500m (sales excluding pgms) by end 2014

Impact of Developing Markets



On road vehicles >6 tgvw plus regulated non-road

Sources: JD Power and JM estimates

Johnson Matthey

Market Values

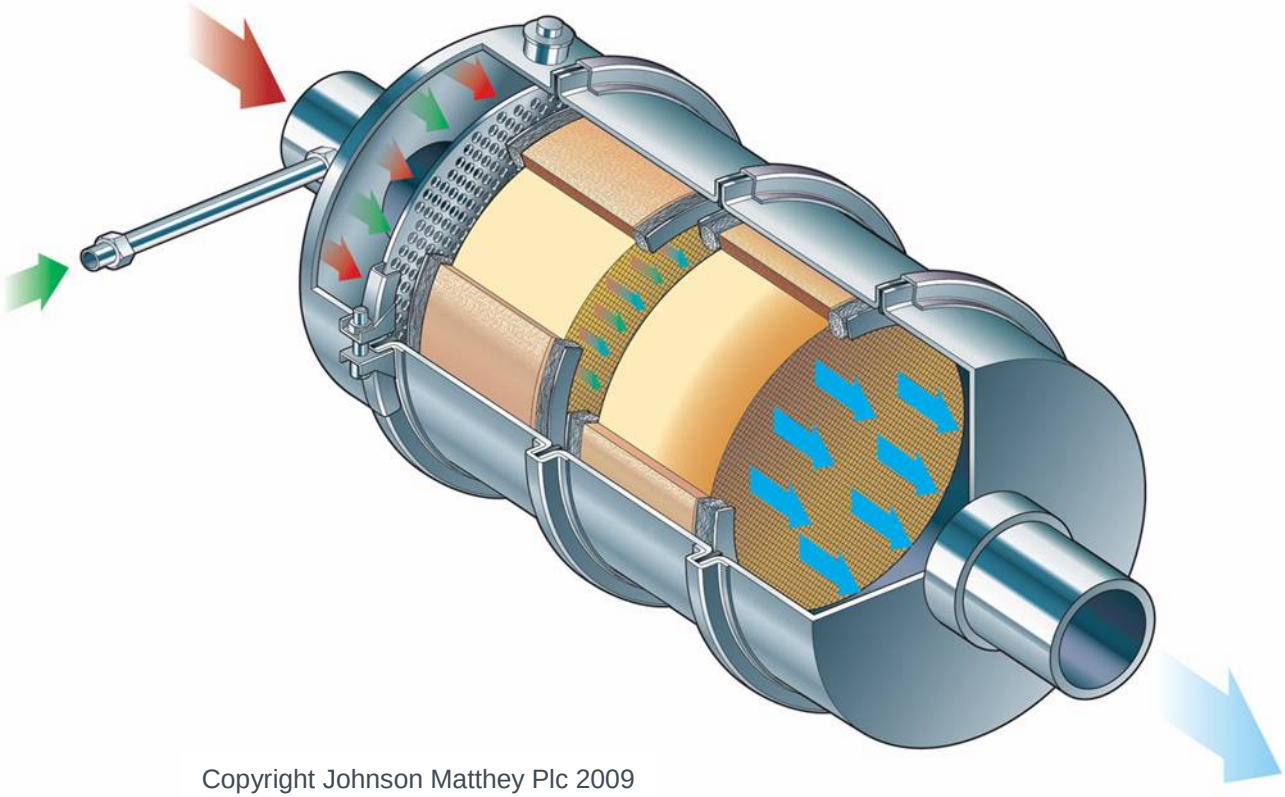
Estimated market value, 2014	$ billion
Developed markets	1.6
Developing markets	0.4
Non-road	0.5
Total	2.5

Catalyst values: sales excluding precious metals

Johnson Matthey

Selective Catalytic Reduction

$NO + NO_2 + 2NH_3 \longrightarrow 2N_2 + 3H_2O$

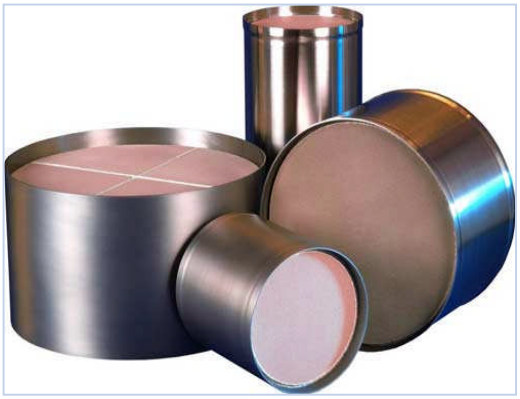


Features of SCR Aftertreatment

- SCR has the potential for improved fuel economy (typically ca. 5%) compared with alternatives
- SCR more tolerant to high S fuel than filters
- SCR requires urea e.g. AdBlue®
- SCR is mature, proven technology

Coated Substrate

Extruded



Complementary Features and Benefits of Extruded and Coated SCR…

Both perform the same NOx reduction

Extruded

- Improved low temperature activity
- Higher ammonia storage
- Superior resistance to coking
- Able to meet emissions targets with smaller catalyst volume
- Opportunities from technology combination

Coated

- Higher maximum operating temperature
- Can be used with metallic substrates
- Broad range of sizes, shapes and cell densities
- Opportunities from technology combination

…offer better options to the OEM

Key Points

The current on road market will grow with the introduction of new technologies, starting 2010

There are significant new market sector opportunities in new on road territories and non-road, starting 2010

SCR is a key technology for HDD NOx control, both on road and non-road

Extruded and coated SCR offer complementary benefits to OEMs

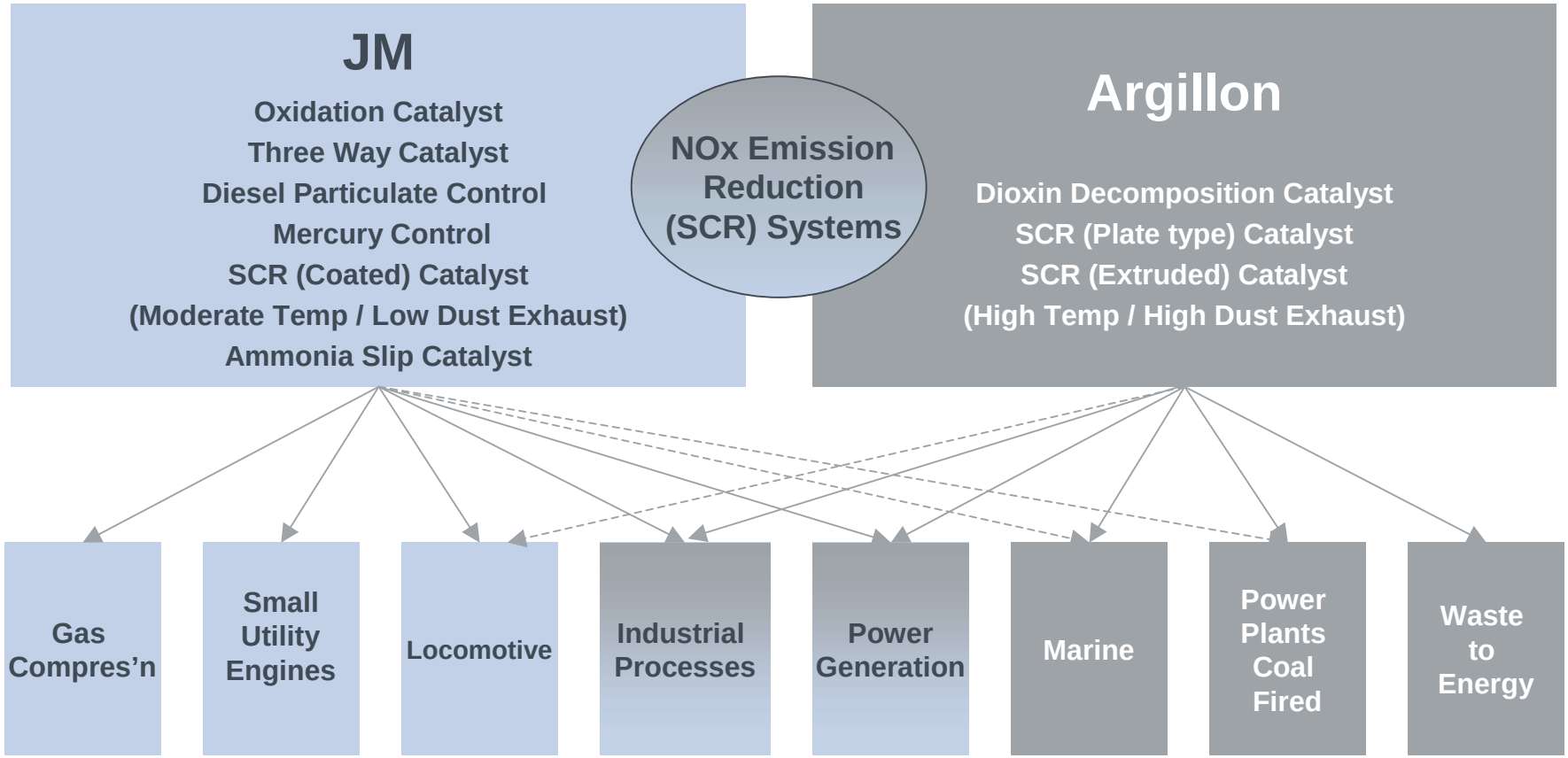
Future Opportunities in Stationary Emission Control (SEC)

Larry Pentz
Executive Director

Johnson Matthey

Johnson Matthey

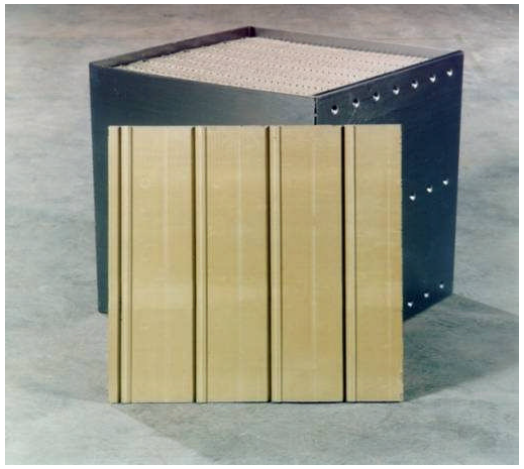
Technologies and Markets



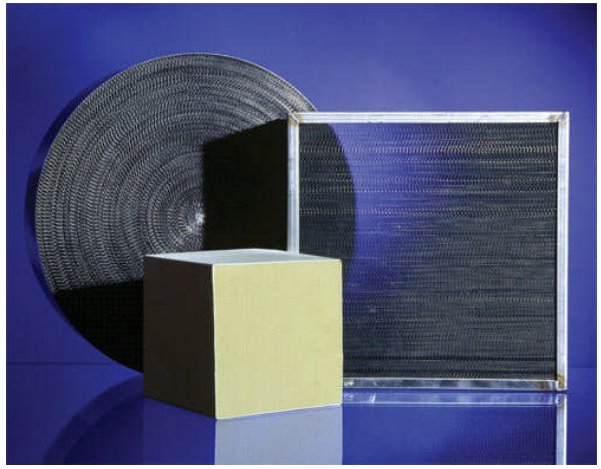
Johnson Matthey

Products

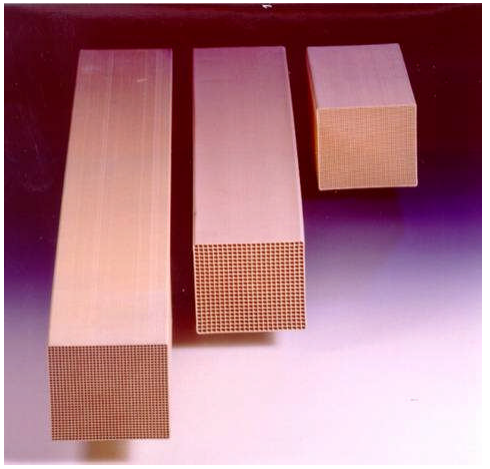
Plate SCR Catalyst



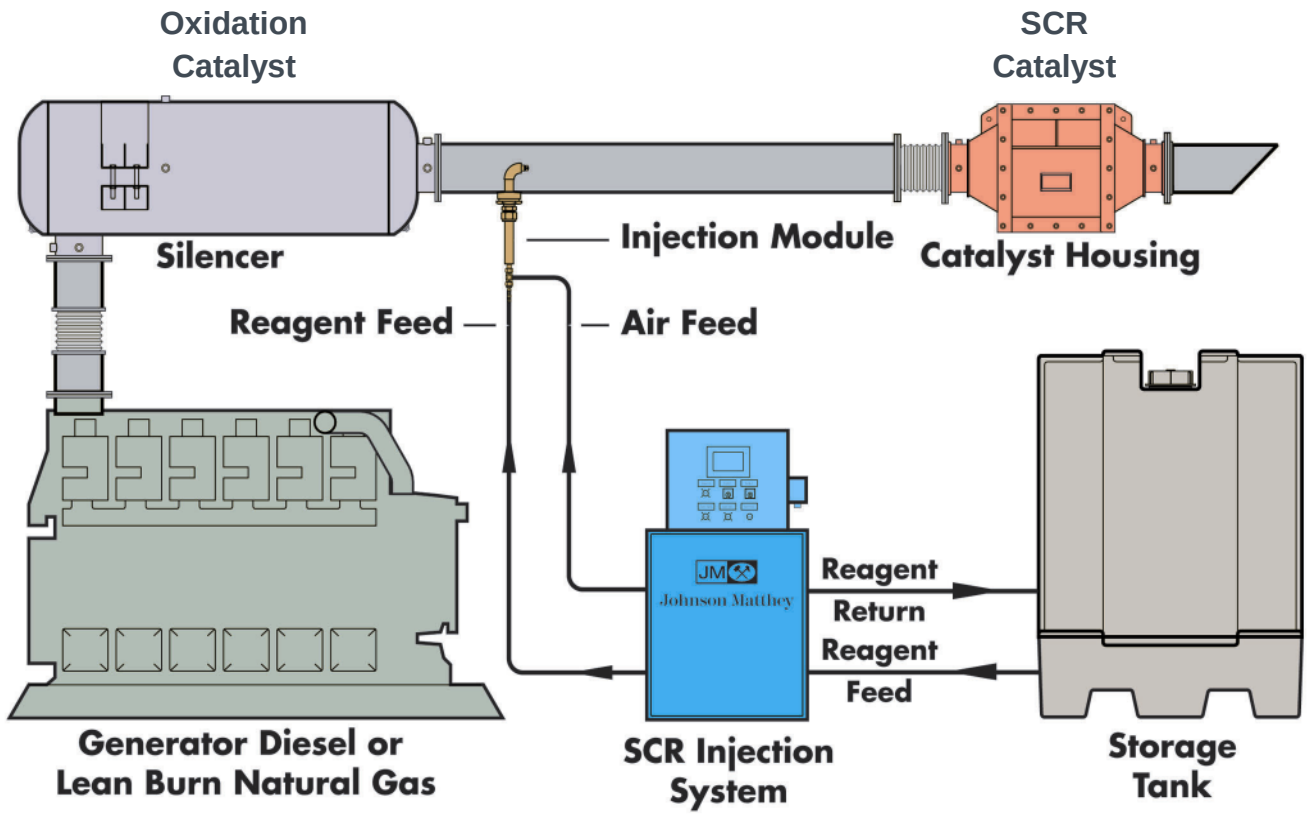
Coated Catalyst



Extruded SCR Catalyst



Products – Engine Emissions Control System



Installations

Markets

Current Markets

Power Generation

Industrial Processes

Coal Power Plants

Future Markets

Marine

Locomotives

Small Utility Engines

Power Generation SCR Systems Market

- Market Drivers:
  - Engines (all fuels) – increased requirement for NOx control
  - Diesel Generators – increased requirement for PM and NOx controls
  - Gas Turbines – demand to rise until new coal plants are installed
- Current market size ~$200 million, JM share 9%
- Gas Turbine competitors – Cormetech and Haldor Topsoe
- Engine competitors – HUG / Miratech, Steuler and H&H

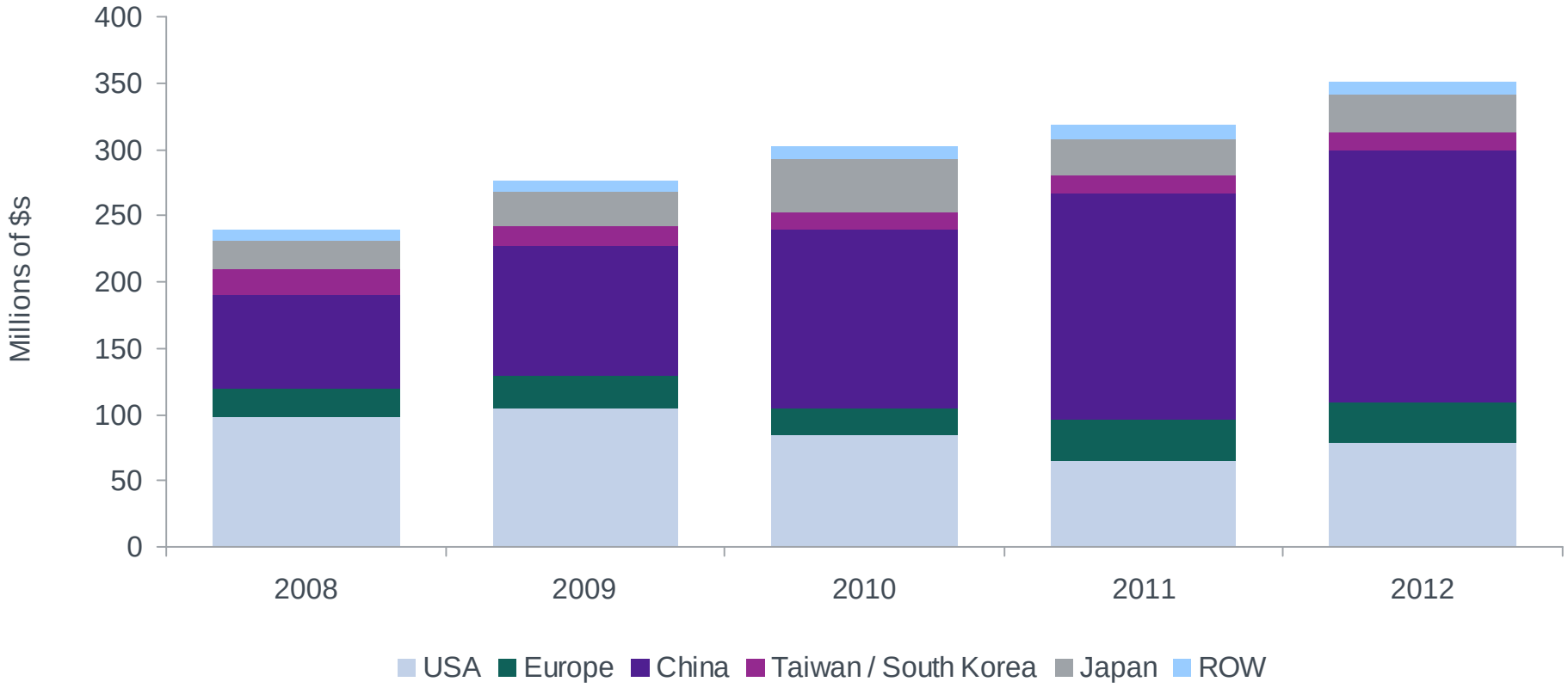
Industrial Process Emissions Control Market

- Industrial Process Applications:
  - Waste to Energy
  - Cement kilns
  - Nitric acid manufacture
  - Steam methane reforming plants
  - Glass manufacture

- Current market size ~$30 million with potential to grow to around ~$80 million by 2012, JM share 15%

- Competitors – Cormetech, Haldor Topsoe, HUG and Steuler

Coal Power Plant SCR Catalyst Market



Source: Boston Consulting Group

China Coal Power Plant SCR Catalyst Market

- Market Drivers:
  - China is the world's largest producer and consumer of coal
  - Coal power plants produce 75% of China's power
  - The installed coal power plant capacity is ~535 GW
  - ~100 GW of new power to be installed by 2015
  - ~100 GW of replacement power to be installed by 2015

- Environmental Drivers:
  - SEPA (State Environmental Protection Administration) regulations require power plants to adopt SCR
  - Official regulations to be effective by 2011

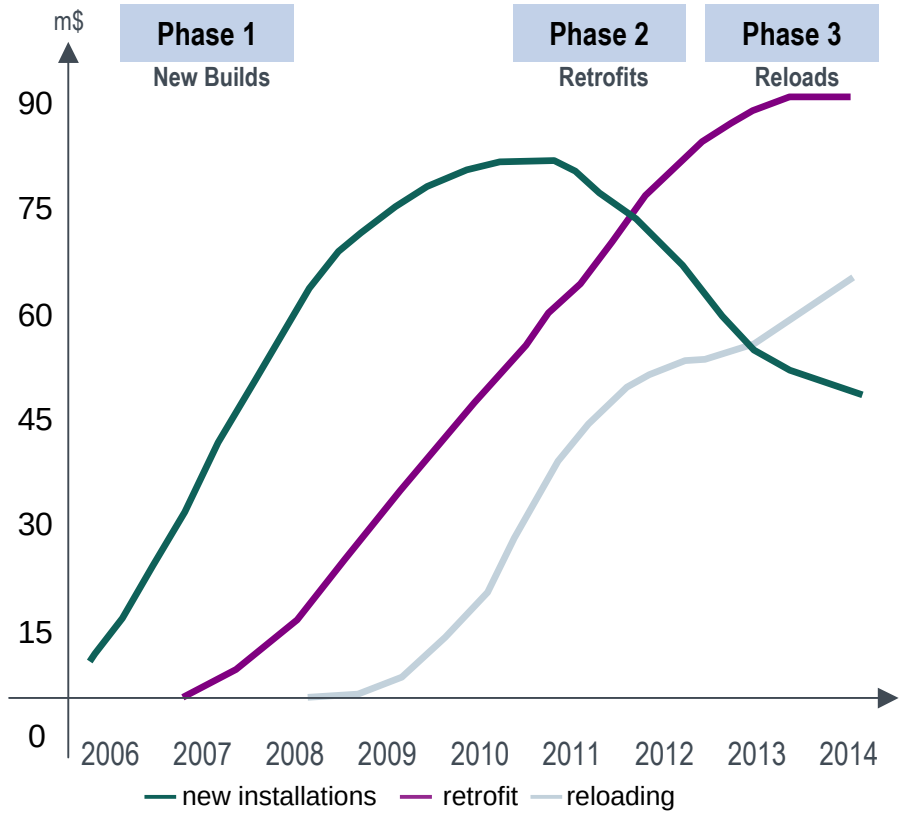
- Competitors – Cormetech, Haldor Topsoe, Frauenthal and Babcock Hitachi

China Coal Power Plant SCR Catalyst Market

Comments

- New power station, catalyst contracts by boiler manufacturers and EPC companies
- Retrofits of existing power stations, catalyst contracts mainly by EPC companies
- Reload of existing SCR plants, catalyst contracts by utility companies or original EPCs
- After 2020 business is mainly driven by reloads and replacement catalysts

Market Development by Phases



China Coal Power Plant SCR Catalyst Market

- Supply Drivers:
  - Installed global capacity for catalyst production can not meet growing Chinese demand
  - Chinese utility companies are interested in locally supplied catalysts
  - Plate type catalysts are especially suitable for China's high ash content coal
  - JM is the only supplier of both plate and honeycomb type catalysts

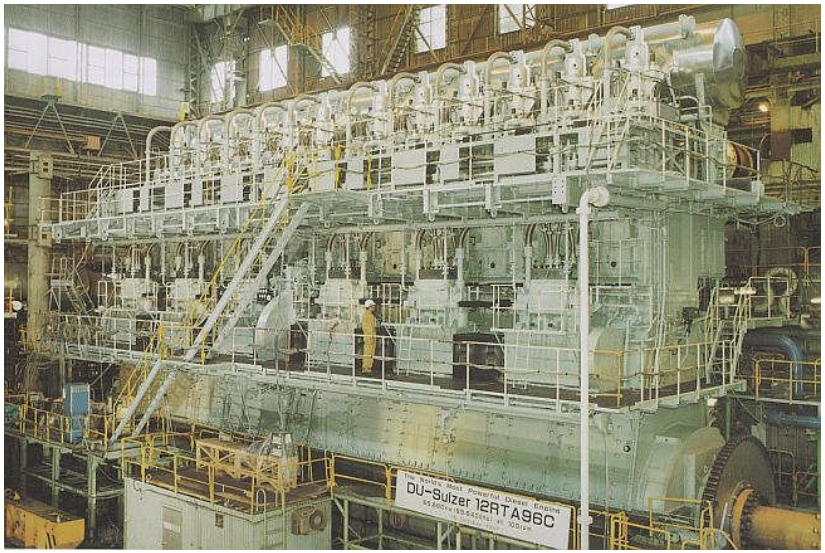
- Current global market size ~$230 million, JM share 19%, growing to $350 million by 2012

Johnson Matthey

Marine SCR Systems Market

- Current Market Drivers:
  - Norway NOx Tax and Sweden Fairway Dues
  - Commercial cargo customers demanding “Green” ships
- Future Market Drivers:
  - IMO (International Maritime Organization) designated ECAs (emission control areas) to be established in 2009:
    - US / Canada, Japan, Singapore, Australia, New Zealand, Baltic and North Sea
  - Tier 3 new engines to require SCR systems in 2015
- JM has 150 SCR systems installed on ocean going vessels
- Competitors – HUG, H&H, Haldor Topsoe and Ceram

Marine SCR Systems Market



Source: Maritime equipment supplier

Johnson Matthey

Locomotive SCR and PM Systems Market

- Market Driver – US EPA New Source Performance Standards:
  - NOx and PM controls
  - New Tier 4 (MY 2015) locomotive engines
- Estimated US Market Size (2015):
  - Line Haul engines - $240m/year
  - Switcher engines - $34m/year
- Major Locomotive Engine Companies – GE, EMD, Cummins, Caterpillar, MAN
- Competitors – BASF, Tenneco and HUG
- Global market is anticipated to follow EPA approach

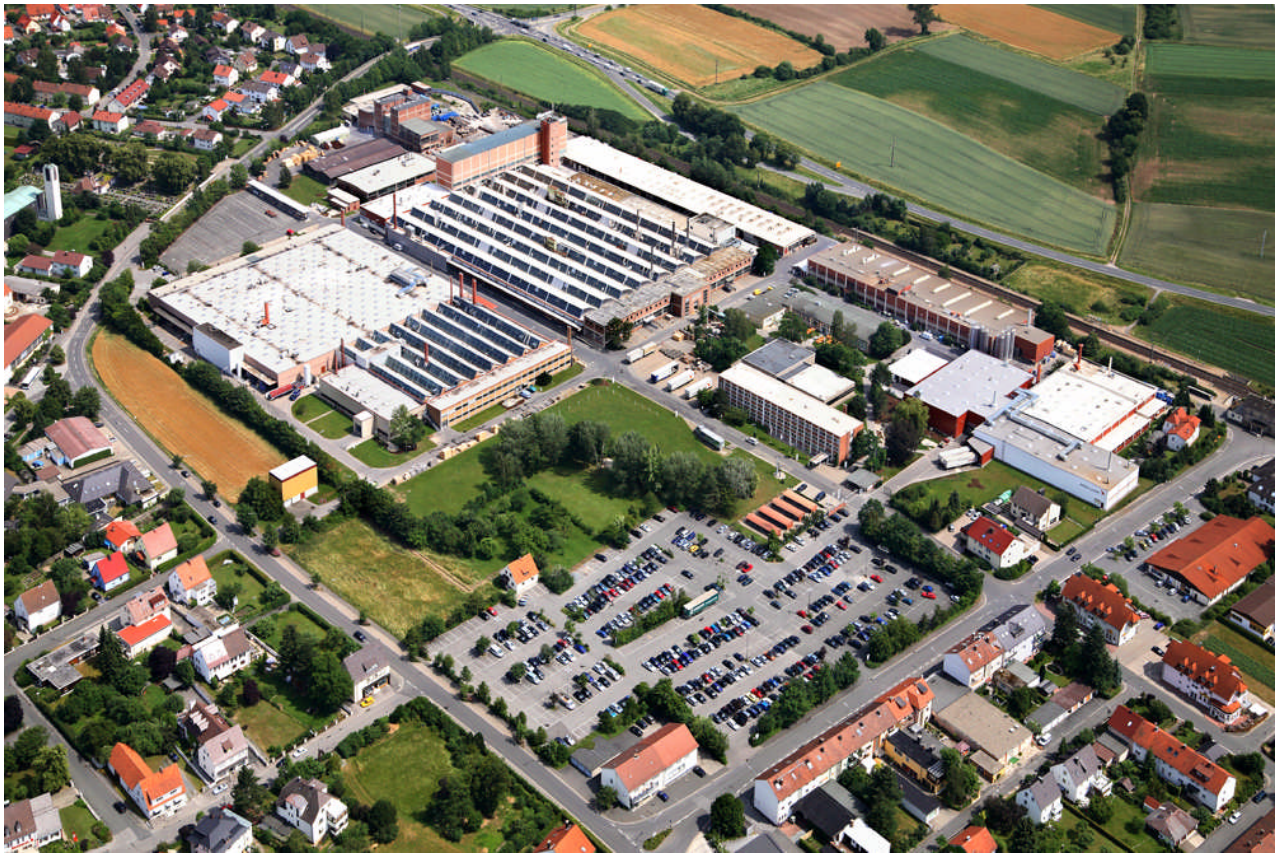
Johnson Matthey

Small Utility Engine Catalyst Market

- Market Driver:
  - CARB Tier 3 (2008) and US EPA Phase 3 (2011 MY) non-handheld lawn and garden equipment, portable electrical generators and gasoline marine inboard and outboard water craft
- Estimated US Market Size:
  - $100m/year in 2011
- Competitors – BASF, Heraeus and MemPro

Johnson Matthey

Catalyst Manufacturing at Redwitz



Conclusions

NOx control is an established and growing global market

Beyond on road and non-road HDD, new market opportunities exist in SEC:
China coal fired power plant | Locomotives | Marine | Small utility engines

Currently the total SEC market is worth around $500 million (sales excluding pms).
By the end of 2016 we expect this market to have grown to around $1.2 billion

JM is well positioned, as only supplier of coated, extruded and plate type SCR catalyst technology, to succeed in these emerging NOx control markets

FuelCellToday®
Informing the fuel cell industry

Fuel Cell Today

www.fuelcelltoday.com

Jeremy Coombes

FuelCellToday®
Informing the fuel cell industry

Fuel Cell Today – an Independent Resource

FCT Consulting

Three main types of analysis undertaken:

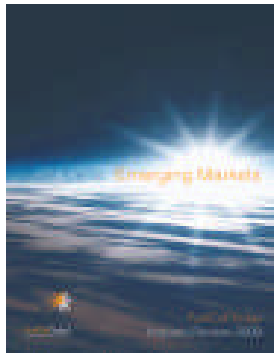
1. Can we use a fuel cell to power product 'X'?
2. We want to use fuel cells but what are our risks?
3. What are the future markets going to look like?

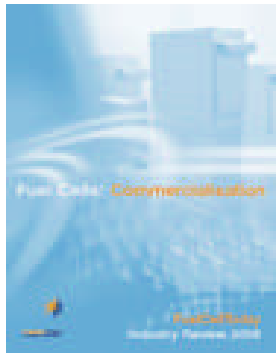
Website

www.fuelcelltoday.com :

1. 15+ free reports - analysis on developments in the industry over the past year
2. Reports on potential future developments in the industry (application and region)
3. News, directory etc. etc.

Fuel Cell Today Annual Review





Fuel Cells are ALWAYS ten years away

"The Hype About Hydrogen"

Fuel Cells are still in the lab

There is not enough Pt in the world for a fuel cell industry

With hybrid technology fuel cells are not needed

The Reality (2009)

- 2008 shipments of fuel cells increased to 18,000 with a growth rate of 50% from 2007
- A conservative estimate of current manufacturing capacity is 180 MW (up from around 100 MW in 2007)
- In 2008 a number of new products became commercially available
- Globally, new policy and legislation increased the market pull for the technology
- The issue of codes and standards is being increasingly addressed






Fuel Cell Types and Characteristics

	Operating temp. ^{0}C	Power (typical)	Catalyst	Target applications
AFC	60 - 90	up to 20 kW	PGM	niche transport, small stationary
PEMFC	80	up to 250 kW	PGM	transport, residential, UPS
DMFC	60 - 130	<1 kW	PGM	portable, APU, personal electronics
PAFC	200	>250 kW	PGM	power stations, CHP
MCFC	650	>300 kW	base metal	power stations, CHP
SOFC	1000	>200 kW	base metal	power stations, APU, portable

FuelCellToday®
Informing the fuel cell industry

Fuel Cell Today is:

Dr Kerry-Ann Adamson, Principal Analyst, kerry-annadamson@fuelcelltoday.com

Lisa Callaghan Jerram, Senior Analyst (North America), lisacallaghanjerram@fuelcelltoday.com

Dr Jonathan Butler, Analyst (Asia), jonathanbutler@fuelcelltoday.com

Dr Ben Todd, Consultant, bentodd@fuelcelltoday.com

Dr Mike Hugh, Consultant, mikehugh@fuelcelltoday.com

Tel: +44 (0)1763 256326

Johnson Matthey Fuel Cells - Update

Jack Frost
Director, Johnson Matthey Fuel Cells

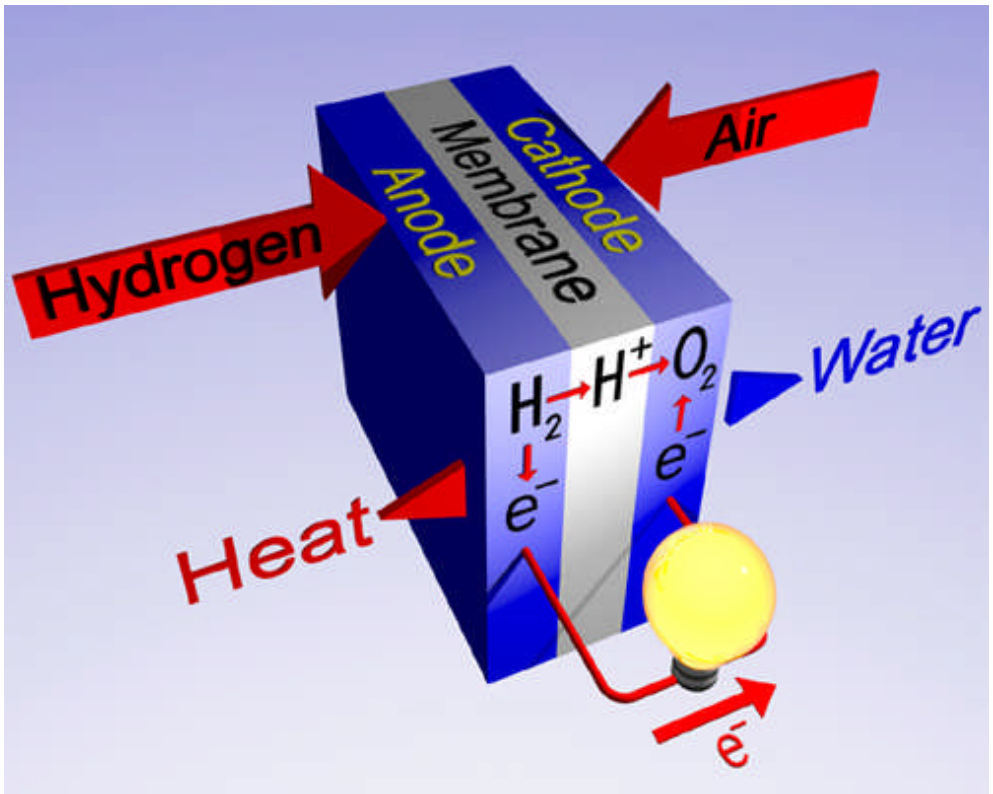
JM
Johnson Matthey

Outline

1	Johnson Matthey Fuel Cells' product positioning
2	The markets JMFC operates in
3	The progress the business is making

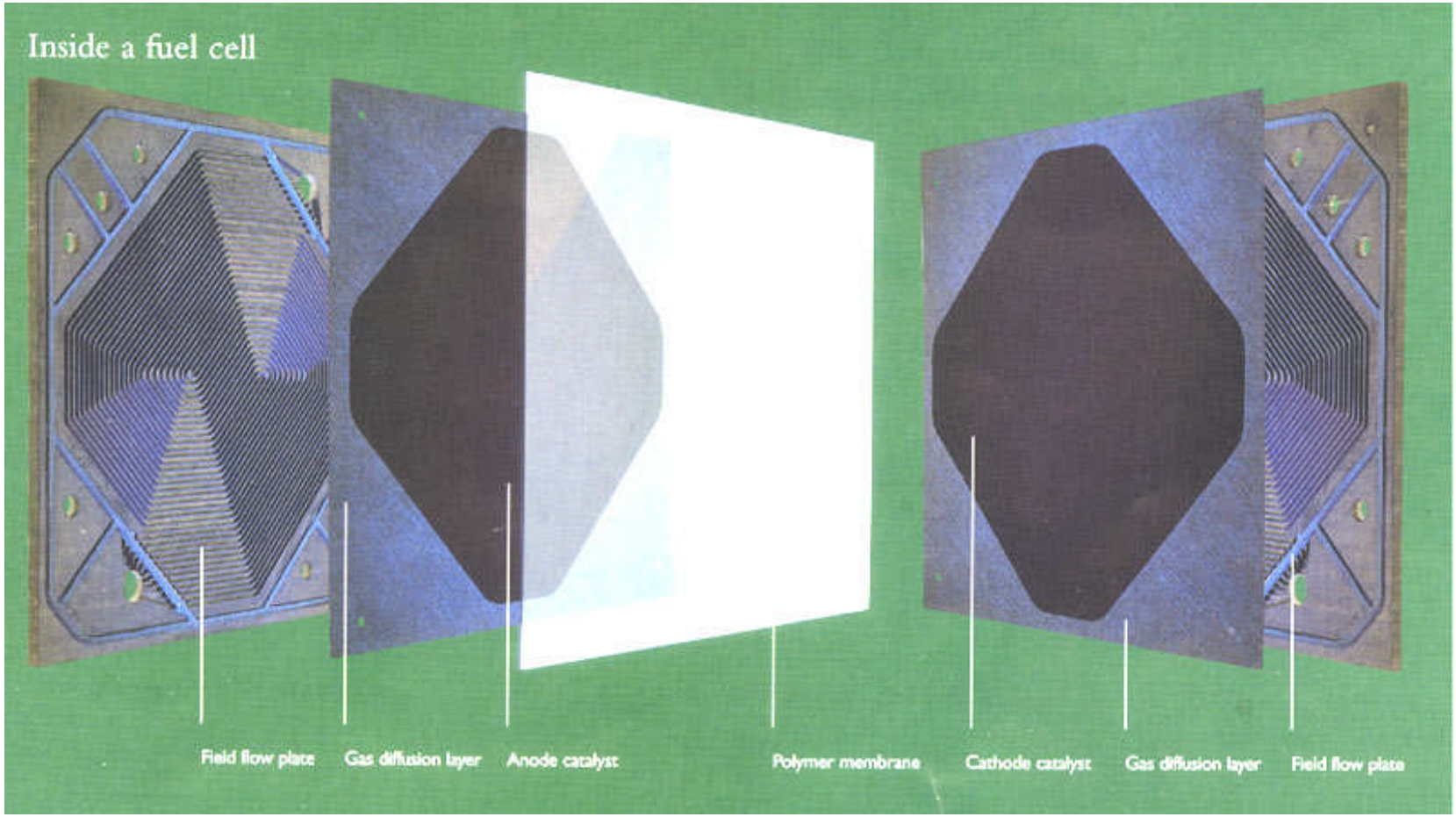
Johnson Matthey

The Fuel Cell and Membrane Electrode Assembly (MEA)



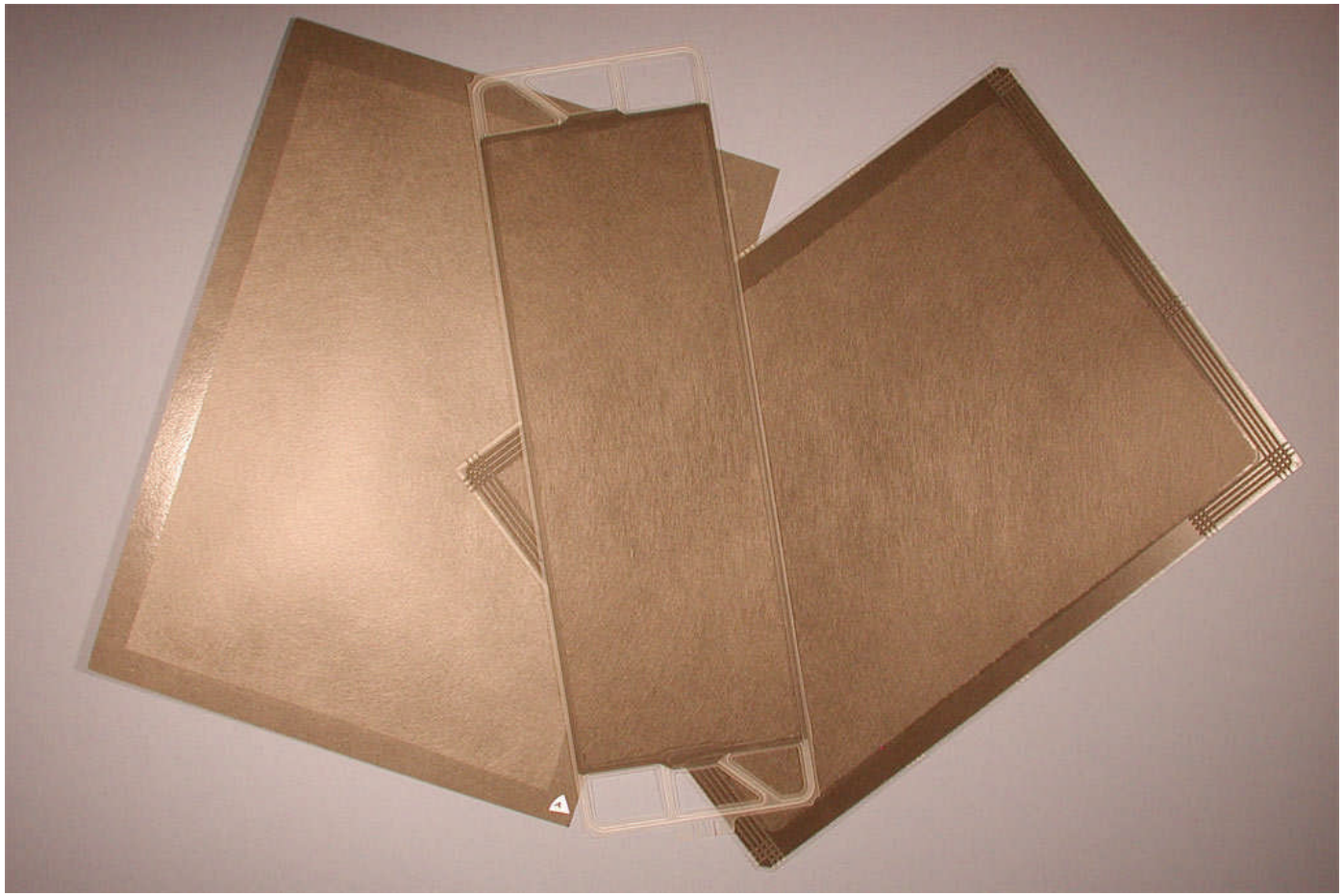
Johnson Matthey

The Components of a Polymer Electrolyte Membrane (PEM) Fuel Cell



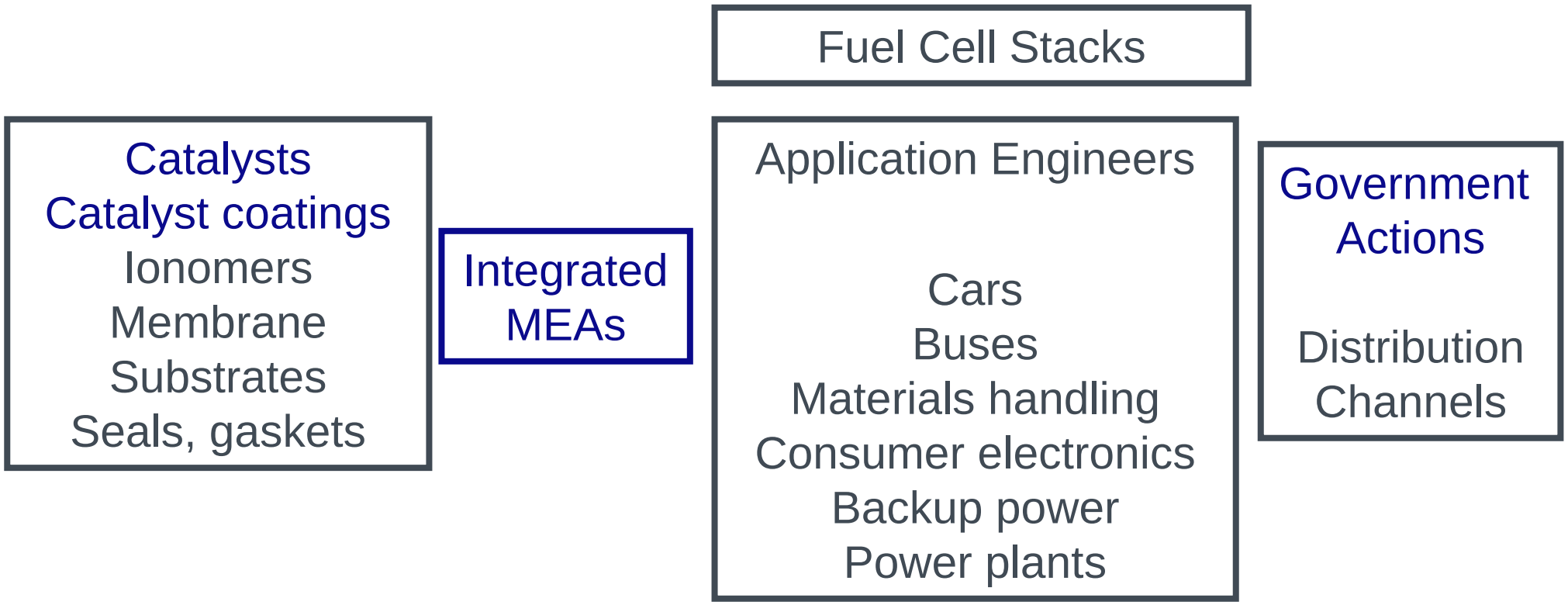
Johnson Matthey

Johnson Matthey Fuel Cells' Products



Johnson Matthey

Product Positioning

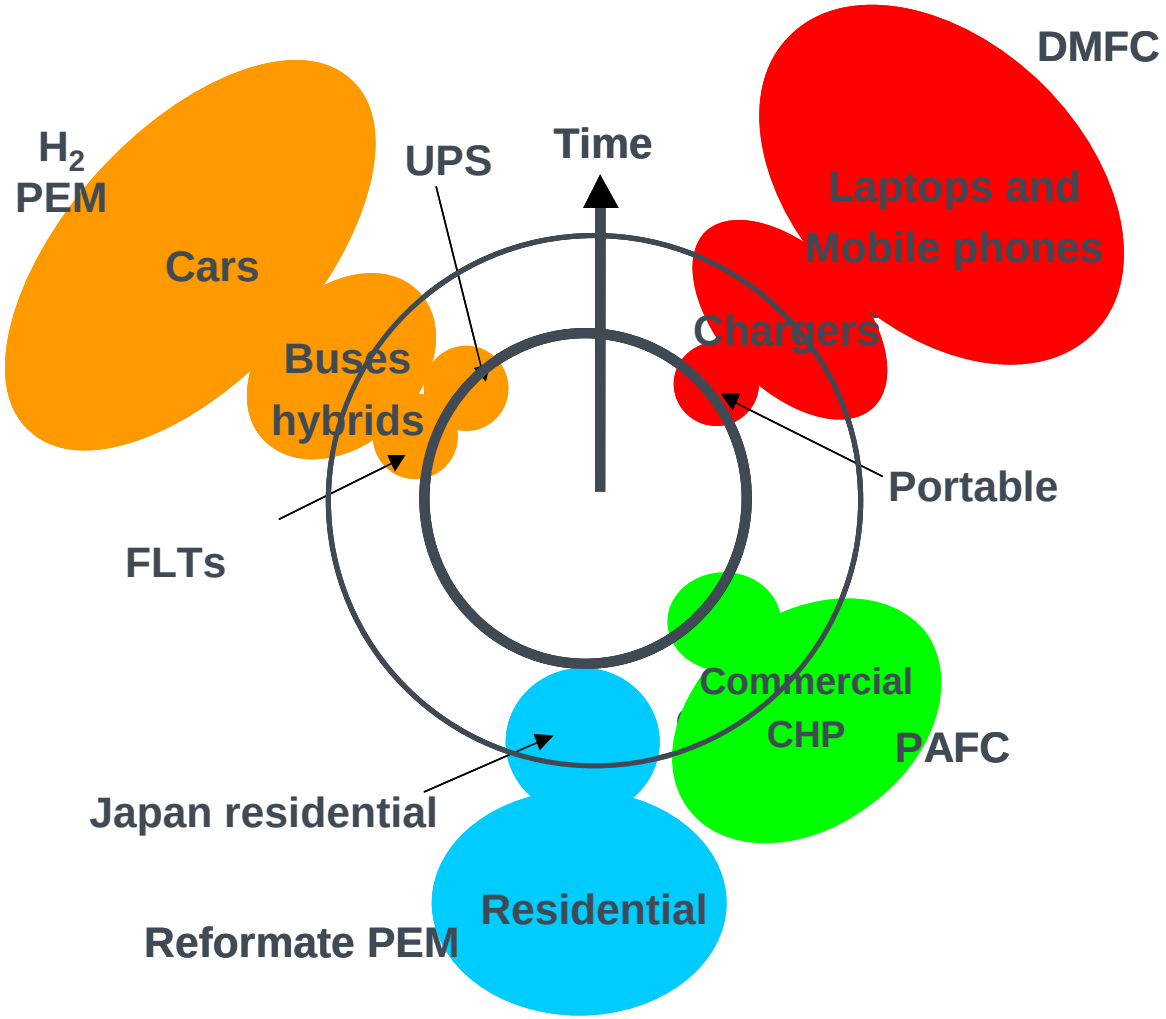


Johnson Matthey

Johnson Matthey Fuel Cells' Markets

Current applications are commercial now, replacing inadequate conventional technology

They are on technology pathway to longer term, higher volume applications



Markets – Direct Methanol (DMFC)

- Readily available fuel, especially at small scale enabling commercial portable devices now

- Leisure
  - Recreational vehicles, leisure craft, remote cabins
  - Dissatisfaction with batteries and intermittent solar and wind alternatives
  - Noise and pollution of IC generators
- Military
  - Infantry men, unmanned craft
  - Batteries are heavy and have low energy density
  - US infantryman carries >20 kg batteries
  - Reduce weight to be carried, long run times, fast “recharging”, well suited to long stand-by times

Johnson Matthey

Markets - Direct Methanol (DMFC)

- Stand alone chargers offering mains autonomy. These are near to commercial launch
- Possible future products have significant potential
- Integrated ‘media bay’ units - hybrid operation to continuously recharge existing battery at low power
- Battery replacement fuel cell to provide majority of energy with small battery for peak loads
- Laptops, portable electronics, cellphones

Johnson Matthey

Markets – Hydrocarbon Fuels

- Combined heat and power (CHP) is the most cost effective way to reduce carbon emissions from power generation quickly
- Conventional CHP difficult / unattractive to deploy at local scale
- Fuel cells enable deployment of CHP at small scales e.g. residential and commercial buildings
- Phosphoric Acid Fuel Cells (PAFC) technology ready
- Commercial buildings particularly attractive

Johnson Matthey

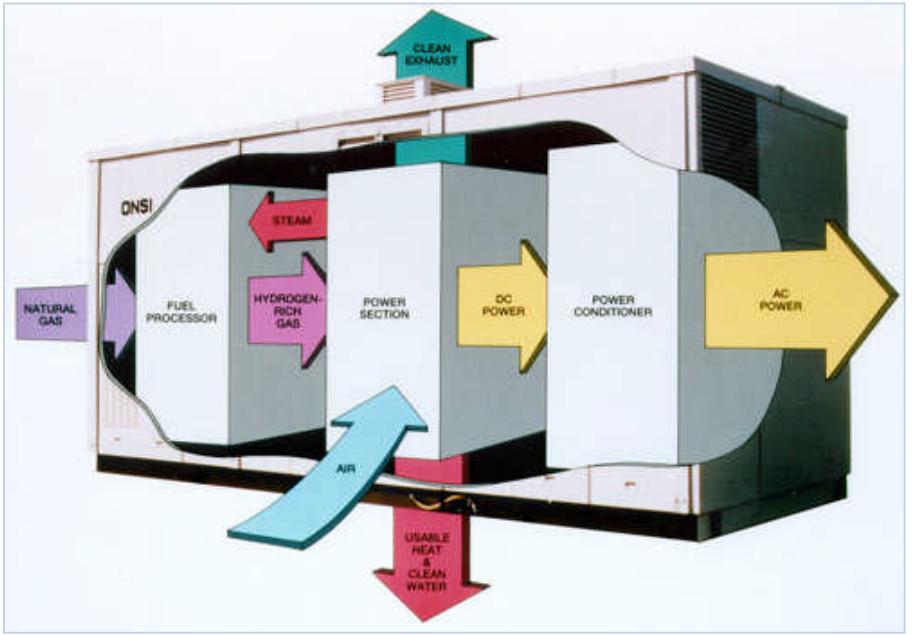
PAFC for Commercial CHP

- Over 7 million operating hours
- New lower cost unit released 2009
- 400 kWe, 500 kW heat / cooling
- Freedom Tower, NY
- Quiet, clean, efficient

- Suitable for distributed power

- CHP; substantial CO_2 savings

- 5,000 units would save as much CO_2 as the proposed Severn Barrage or four nuclear power stations



Johnson Matthey

Markets – Hydrogen

- Today's markets are for the replacement of costly and inadequate conventional alternatives

- Backup power for grid failure
  - Telecoms masts, data and security systems
  - Low maintenance, low noise, low emissions
  - Replaces battery packs and diesel generators

- Materials handling
  - Battery performance and cost
  - Fuel cell or fuel cell hybrid configuration
  - Economically viable on whole life basis

Johnson Matthey

Hydrogen PEM for Buses and Cars

- Buses: continue to attract interest
  - Hybrid configuration demonstration fleets around the world
  - Wider deployment from 2015

- Cars: largest potential market
  - 10,000 cars p.a. = 2 - 5 million MEAs
  - 60 million cars = 5 - 10 billion MEAs

- Climate change and urban pollution
- Consumer preferences
- Competition between OEMs

- Uncertainty over fuel supply options and new technology cost and capability

- Confusion around power train evolution and timescale

Johnson Matthey

Vehicle Power Train Evolution

- Efficient petrol and diesel engines
- Mild hybrids – regenerative braking for auxiliary power
- Parallel hybrids – mechanical drive, battery support
- Series hybrids – electric drive with on board generator, plug-in hybrid
- All electric vehicle – batteries only

- Key factors supporting all electric vehicles:
- Security of fuel supply
  - Electricity can be made from any fuel
- Carbon content of fuel and especially electricity
  - Use of renewables provides low carbon electricity
- Energy storage technology and especially battery technology
  - Breakthroughs in battery technology anticipated

Johnson Matthey

Electricity as the Future Fuel - Issues

- Current grid electricity generation is carbon intensive
- Decarbonising grid electricity requires investment in renewables, carbon capture and storage and nuclear
- GM's Chevrolet Volt battery provides 5.5 kWhr of usable energy. Sufficient for 40 miles. It weighs around 180 kg and takes 3 - 8 hours to recharge
- While 60 - 80% of car journeys are less than 20 miles return these only account for 20 - 30% of total car mileage (DfT)
- The chemistry and physics of batteries makes it difficult to envisage a step change in energy density

Hydrogen as a Future Fuel

- Like electricity, hydrogen can be generated from many sources and is zero emission at the point of use
- Low carbon hydrogen available in the near term from waste to hydrogen
- Decarbonising electricity generation means producing huge quantities of low carbon hydrogen as an intermediate from the carbon capture and storage process
- A tank of compressed hydrogen in the Honda Clarity stores around 4 kg of hydrogen, sufficient for 280 miles and takes a couple of minutes to refill

Summary

- Today's commercial markets are in portable power, backup power and commercial CHP
- These markets on their own will enable Johnson Matthey's Fuel Cells business to achieve profitability in the next few years

- Fuel cells for consumer electronics is a huge potential market
  - Further progress in demonstrating consumer acceptability is needed
- Cars remain the biggest market opportunity
  - Fuel cell power trains will be produced in small but meaningful numbers post 2012 - 2015
- Johnson Matthey Fuel Cells is well positioned for these larger markets. Even small market penetration by fuel cells into these markets presents a major opportunity for Johnson Matthey

Coal to Products and Low Carbon Technology

Barry Murrer
Director, Johnson Matthey Technology Centre
Sue Ellis
Manager, Low Carbon Research Group

Johnson Matthey

Johnson Matthey

Topics

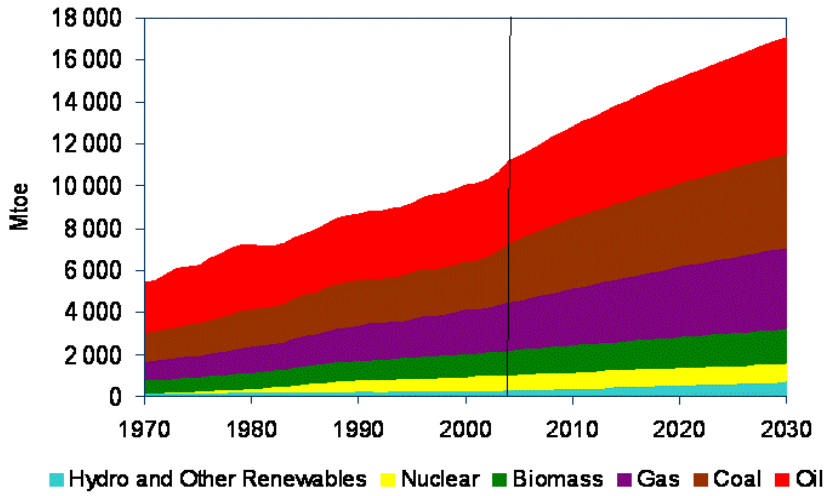
Coal	Barry Murrer, Director, JMTC
Greenhouse Gas Mitigation Hydrogen Generation and Storage	Sue Ellis, Manager, Low Carbon Research Group

Johnson Matthey

Energy Demand and Supply

- Oil supply nearing the peak
- Oil is more difficult and costly to extract
- ‘Dirtier’ oil requires more refining
- Gas and coal forecast to grow

World Primary Energy Demand by Fuel



Source: IEA 2006

Presented during Billingham / Stockton visit Jan 2008

Johnson Matthey

Increasing Use of Gas and Coal

- Gas (Syngas) to Products

Traditional Applications

• Methanol	-	Wood preservative, vinyl paint, resins, adhesives, MTBE
• Hydrogen	-	Desulphurising fuels, chemical processes, fuel
• Ammonia	-	Fertiliser, pharmaceuticals, chemical intermediates

New Energy Sources

• Gas to Products	-	Methanol (direct, biodiesel, DME, MTO)
	-	Fischer-Tropsch diesel
• Clean Coal	-	CO_2 sequestration
• Low Carbon	-	Syngas from biomass
	-	Carbon sequestration and flare elimination

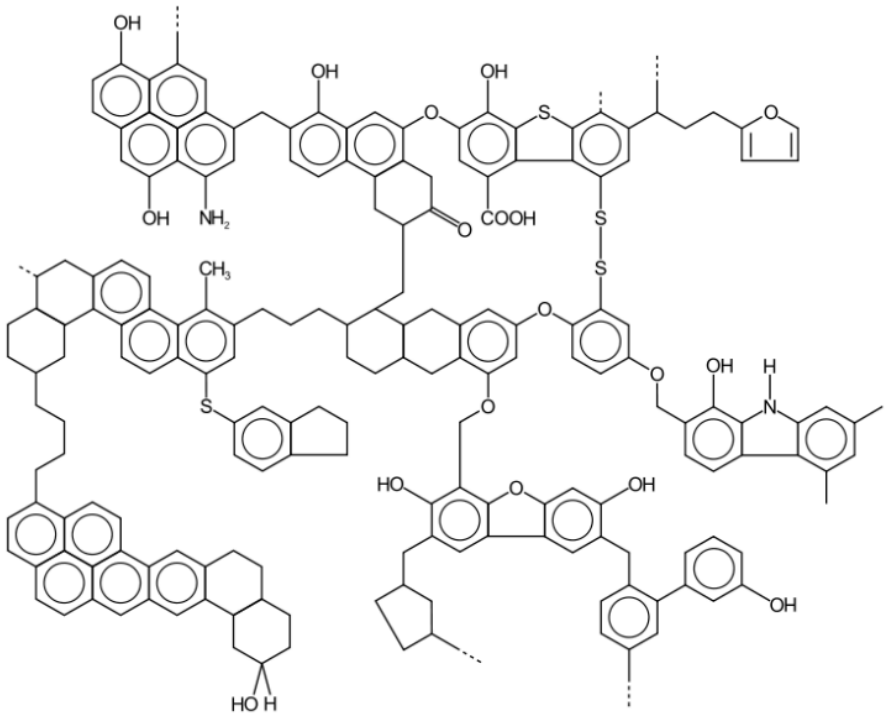
Presented during Billingham / Stockton visit Jan 2008

Johnson Matthey

Coal

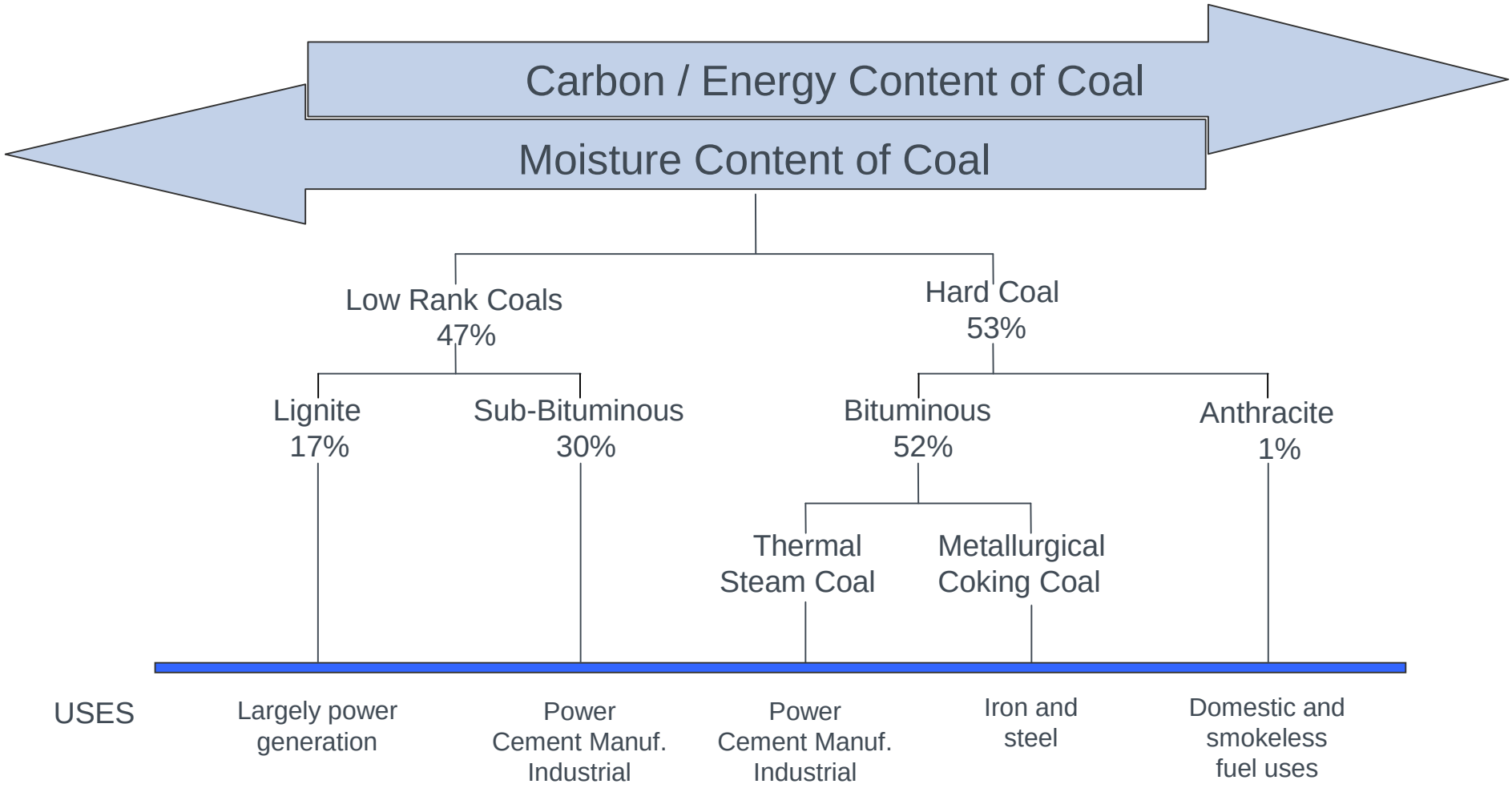
- Use of coal will increase for chemicals, fuels and power generation
- Coal is dirty and these applications all generate more CO_2 than comparative oil / gas based technology
- We need to use coal cleanly and eventually capture and sequester CO_2

Coal

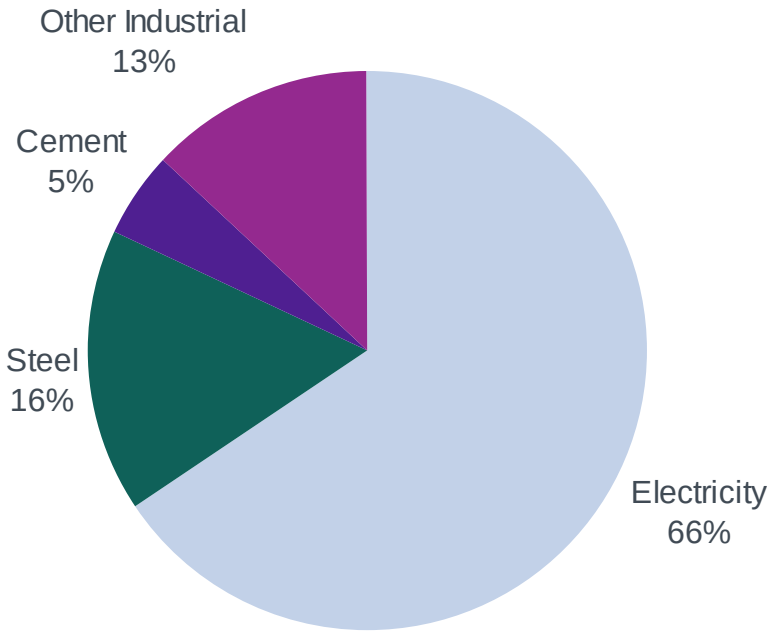


http://en.wikipedia.org/wiki/File:Struktura_chemiczna_w%C4%99gla_kamiennego.svg

Coal is a Variable Feedstock…..



Coal – What is it used for?



Total estimated demand 2008 = 5.9 billion tonnes

Data source: Energy Information Administration

www.eia.doe.gov

Johnson Matthey

A Tonne of Coal Contains…

Coal Types	Average Energy Content		Carbon Content	CO_2 / tonne coal	Moisture	Ash
	MJ/tonne	kWhr	wt. %	tonnes	wt. %	wt. %
Anthracite	33,000	9,170	86 – 97	3.2 – 3.6	<3	
Bituminous	27,900	7,750	45 – 86	1.7 – 3.2	3 – 13	7 – 14
Sub-bituminous	20,000	5,550	35 – 45	1.3 – 1.7	28 – 30	5 – 6
Lignite	15,000	4,170	25 – 35	0.9 – 1.3	30 – 34	7 – 16
Average Chinese Coal	19,000-25,000	5,280-6,950	48 – 61	1.8 – 2.2	3 – 23	28 – 33
Average Indian Coal	13,000-21,000	3,610-5,830	30 - 50	1.1 – 1.8	4 - 15	30 - 50

...and some unpleasant trace elements

Johnson Matthey

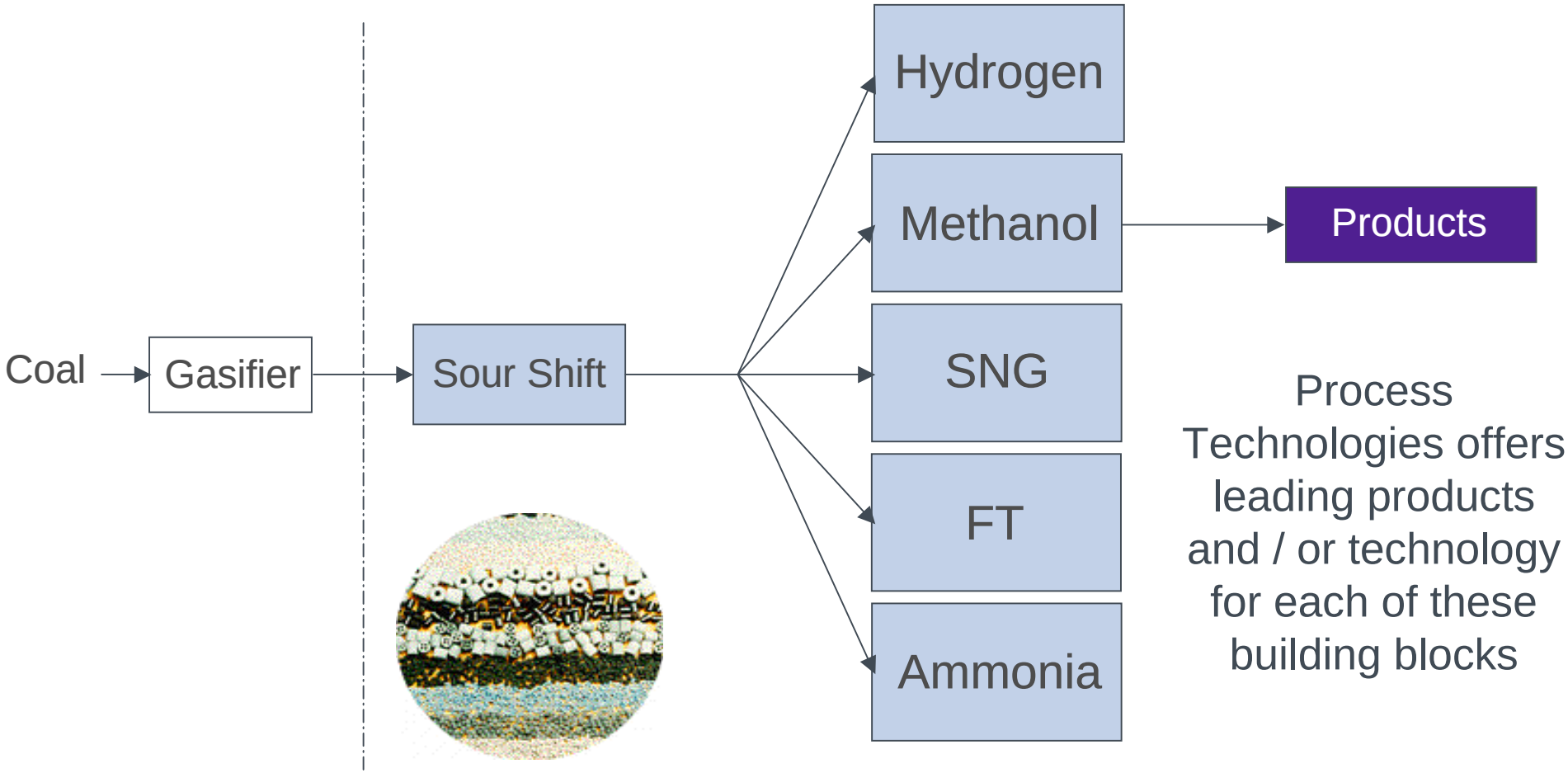
Potentially Harmful Components in Coal

Element	Global Average Range (g/tonne)	Element	Global Average Range (g/tonne)
Mercury	0.02 – 0.19	Sulphur	2,000 – 40,000
Arsenic	0.3 – 13	Cadmium	0.01 – 0.31
Selenium	0.1 – 5	Antimony	0.02 – 1.4
Chlorine	100 – 1,500	Fluorine	<20 – 340
Lead	<1 - 22		

Johnson Matthey

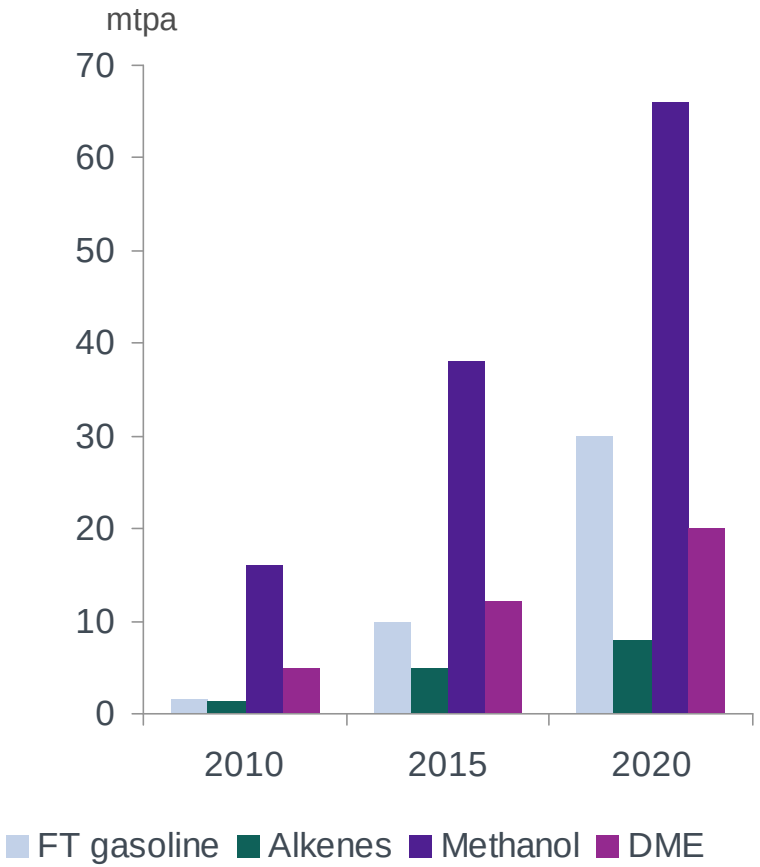
Process Technologies

Coal to Chemicals



Process Technologies offers leading products and / or technology for each of these building blocks

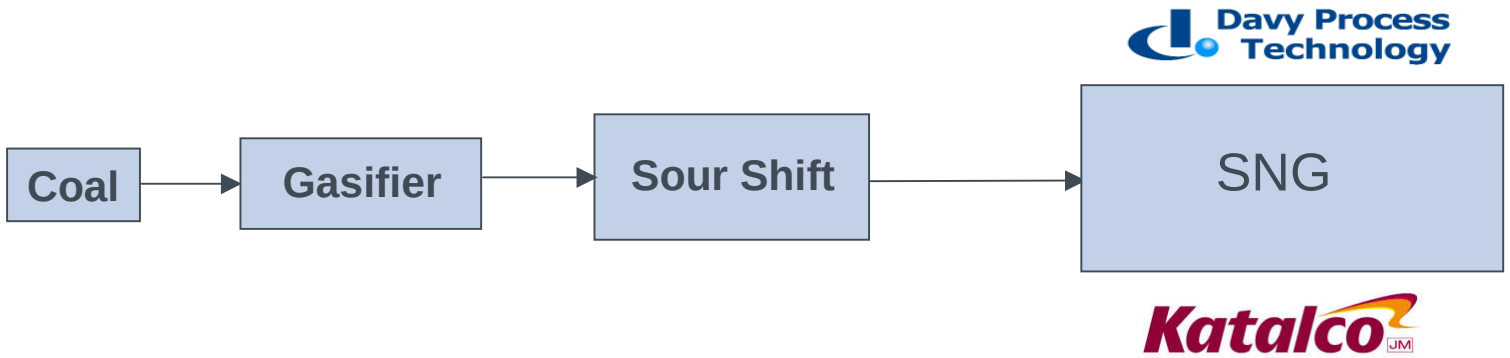
Planned Coal to Chemicals in China



- Current world methanol capacity is 35 mtpa
- JM is a strong catalyst supplier and licensor in this area
- Manufacturing sour shift at JM joint venture in Qingdao

Source: Exposure draft of mid and long term development plans of Coal Chemical Industry, Chinese National Development and Reform Commission 2006
http://www.ndrc.gov.cn/

Coal to Chemicals – Substitute Natural Gas



- JM offers methanation process technology through DPT to produce SNG
- Based on our high activity CRG catalyst
- At Dakota Gasification Company, CO_2 separated and used for enhanced oil recovery (EOR)
- Projects being developed in USA, China, elsewhere

Coal to Chemicals

Coal is a valuable feedstock

Conversion of coal to chemicals is important now and will increase

Compared to power generation CO_2 emissions from coal to chemicals are negligible

New JM opportunities will arise

Johnson Matthey

Coal to Fuels

- If adopted widely would generate huge amounts of CO_2 and require major expansion of coal production
  - Synthetic fuels from coal have a carbon intensity 2.5 - 3.5 times that produced from burning conventional HCs
  - US consumption of liquid fuels is 13 million bpd
    - 10% replacement by coal would require 250 million tonnes coal / yr => 25% increase in US production and corresponding increase in CO_2
- But capturing CO_2 from a fuel plant could be much cheaper than from a power plant
  - 10% incremental cost to put carbon capture on CTL plant

Source: MIT Future of Coal Review 2007

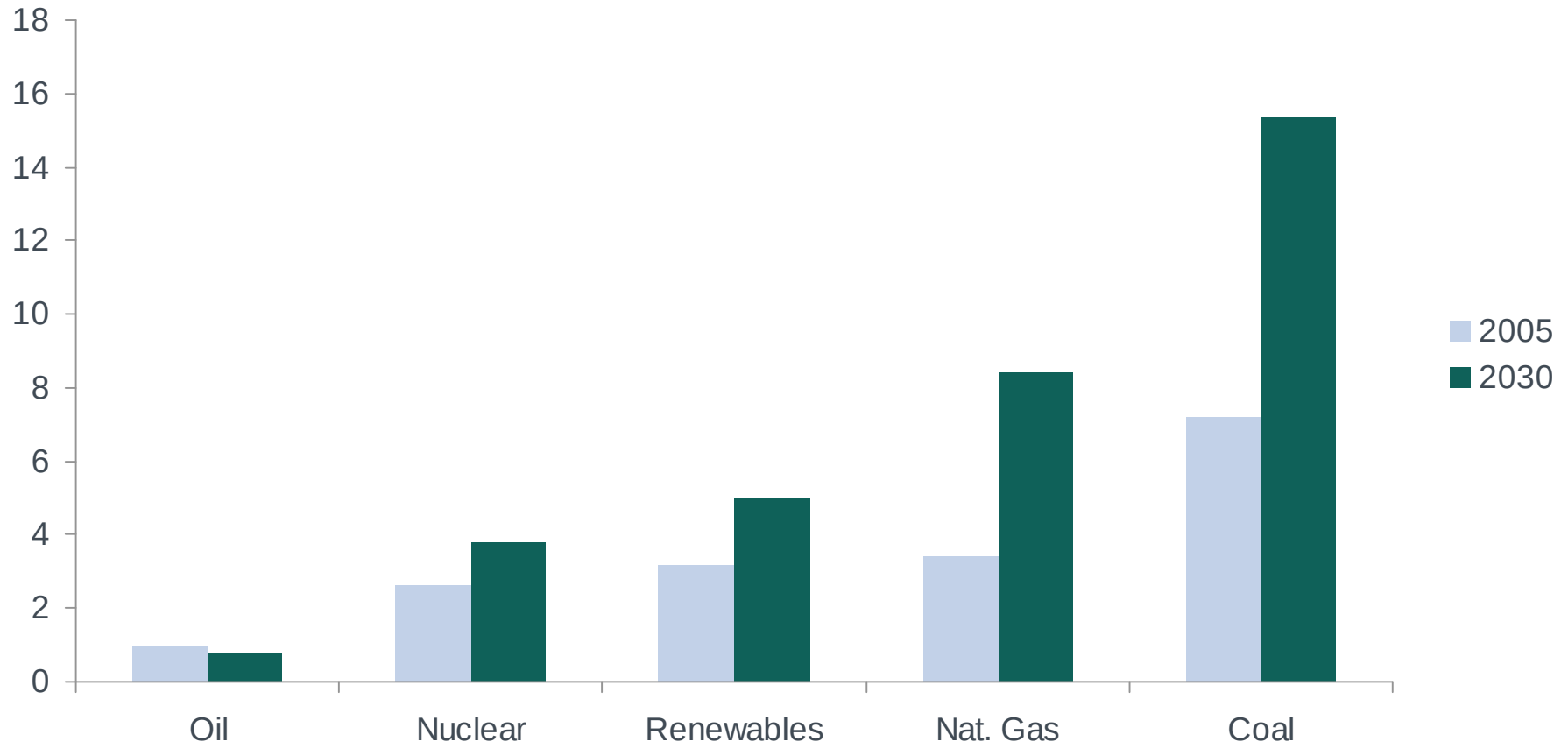
Coal to Electricity

- The largest application of coal
- Will continue to grow

Johnson Matthey

Electricity Generation by Energy Source

Trillion kWh



Source: www.eia.doe.gov Energy information administration international energy outlook 2008

Johnson Matthey

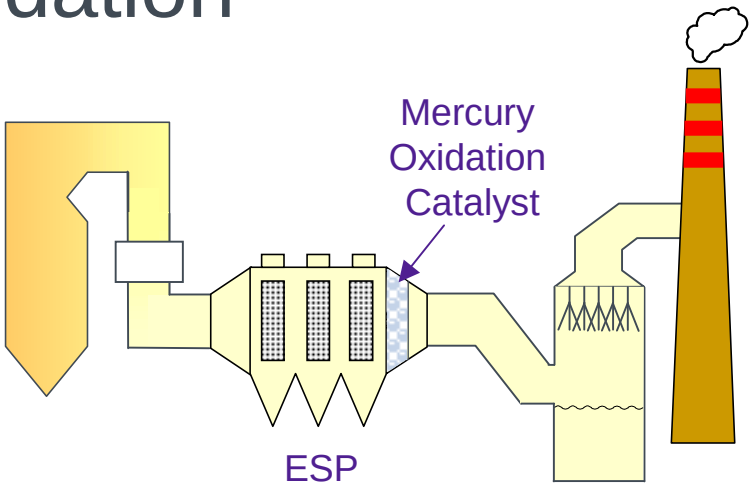
Cleaner Electricity from Coal

- NOx abatement from power plants
  - JM SEC (Argillon)
- Mercury removal from flue gas
- Mercury and other metals in IGCC
- Direct carbon fuel cells

Johnson Matthey

SEC Catalyst for Mercury Oxidation

- Metallic mercury oxidised by gold catalyst
- Oxidised mercury can be scrubbed and removed from flue



Wet FGD System
(SO_2 / Hg Removal)

- Lower Colorado River Authority, Texas
- 200 MW coal fired power station, two year trial
- 1174 ft^3 (8712 blocks) of Au-Al_2O_3
- 36 modules. Hg monitored across catalyst bi-monthly, sonic horns maintain low pressure drop

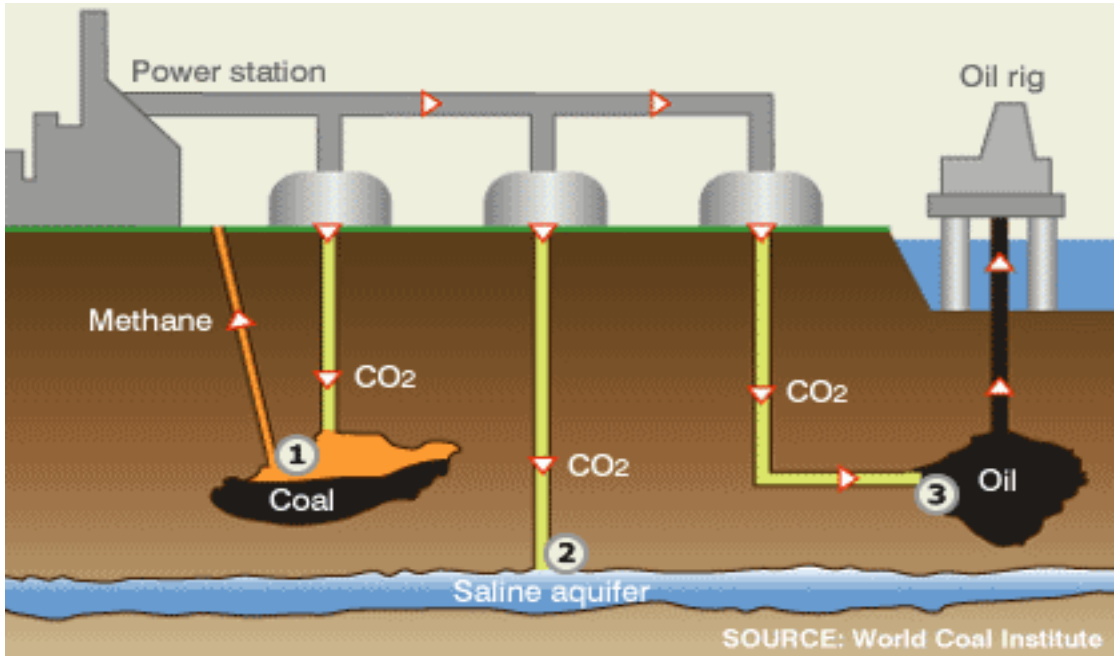
Other JM Hg Related R&D

JM / Anglo / NETL :	Pd based sorbents for removal of Hg, As, Se etc. from syngas at elevated temperatures Trials at two US sites Won US DOE R&D 100 Award in 2008
MERCURYCAP :	EU funded programme – improved Hg oxidation over SCR catalysts Argillon / JM SEC supplying catalysts
PURASPEC :	Niche products for Hg removal from gas and liquid streams

Johnson Matthey

Carbon Capture and Storage

- Necessary for Future Expansion of Coal Use?



'Permanent' storage of captured CO_2 in geological formations

Currently used in EOR with economic benefit

Johnson Matthey

Carbon Capture and Storage

"The only hope for mankind…" or "False hope" ?

Prof. David King **Greenpeace**

- Issues
  - Capture technologies too costly and remain to be proven at scale
  - Long term carbon policies are unclear and variable
  - Conventions are needed to cover CO_2 storage and stewardship
  - Public acceptance required

Johnson Matthey

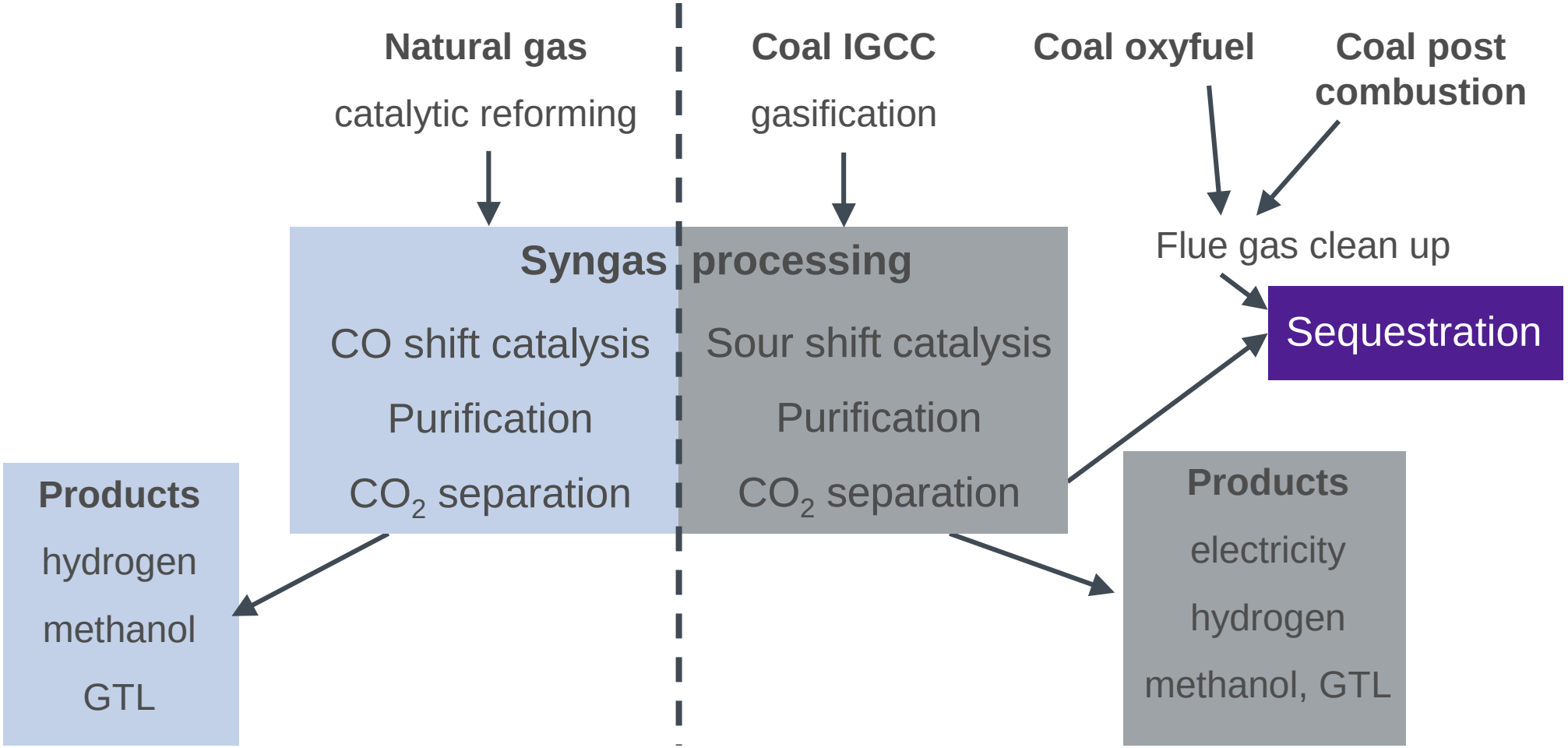
Demonstrated Technologies for CO_2 Capture from Coal Power Stations

- Post combustion – chemical absorption of dilute CO_2 from flue gas
- Oxyfuel – combustion in pure oxygen and direct compression of exhaust
- Pre combustion – physical / chemical separation of high pressure CO_2 from syngas

Johnson Matthey

Carbon Capture and Storage

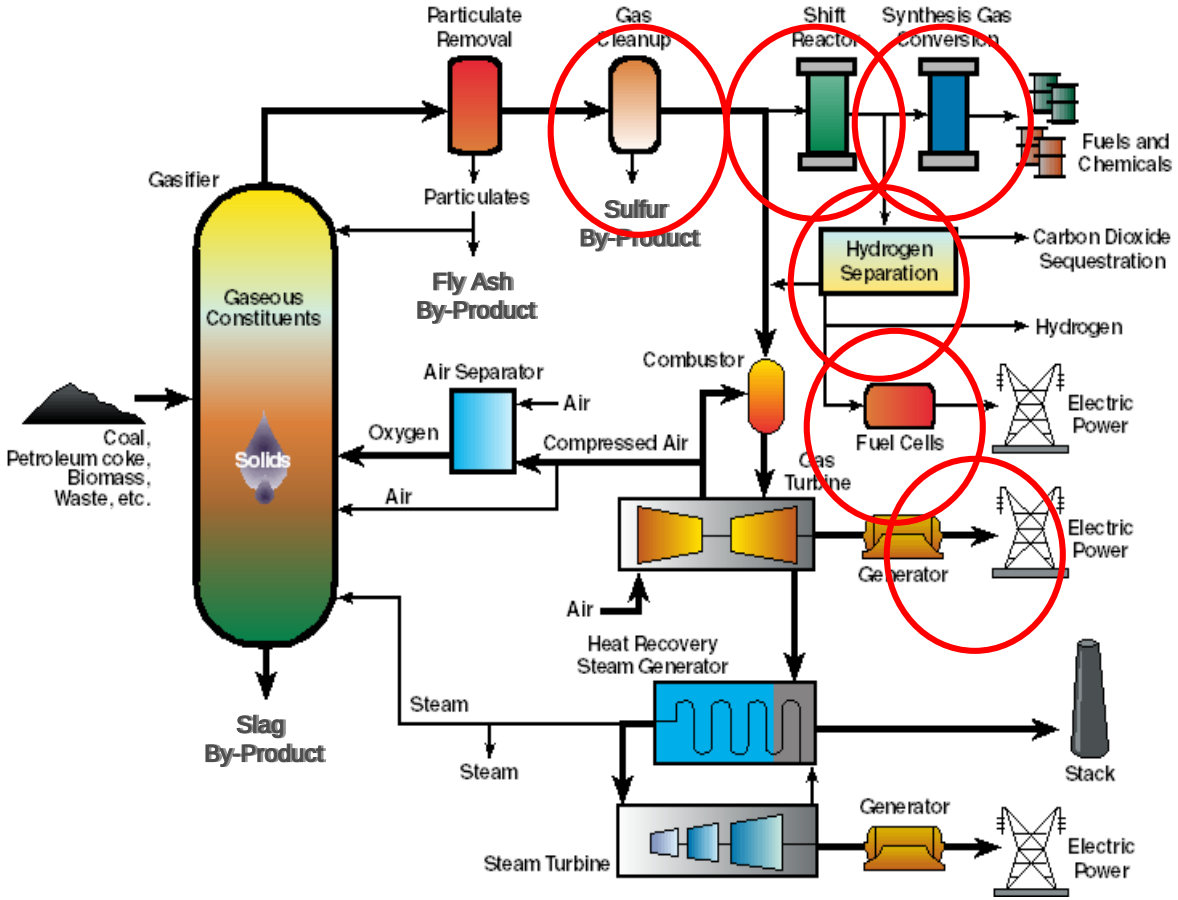
Similarities and Opportunities



Johnson Matthey

IGCC Integrated Gasification Combined Cycle

Gasification Based Energy Production System Concepts

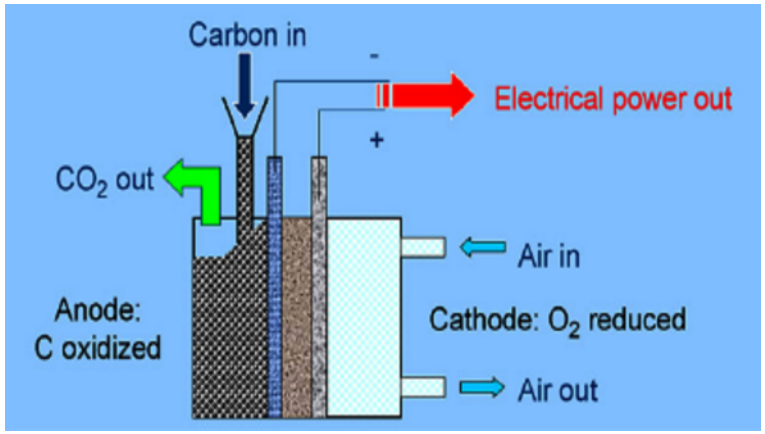


= opportunities for JM catalyst / purification technology

Johnson Matthey

Direct Carbon Fuel Cell

- Electrochemical oxidation of solid carbon
  - E° = 1.02 V, 750 – 850 °C
  - $C + O_2 \rightarrow CO_2$
  - Diverse cell designs



- ✓ Theoretical efficiencies >80%
- ✓ Concentrated CO_2 exhaust suitable for capture
- ✓ Modular power generation concept at tens of MW scale

- x Significant coal processing requirement
- x Complex solids handling
- x Technology in its infancy [W W Jacques, US Pat 555511 (1896)]

Johnson Matthey

Project Portfolio Summary

- There are short and medium term opportunities being worked on by Process Technologies. There is a rigorous project selection and management process in place within Process Technologies
- We have a JMTC / Process Technologies process to identify and prioritise longer term opportunities and have a shortlist
- Longer term opportunities still require JM skills in catalysis, purification and process engineering. We have dedicated research resources on these projects

Low Carbon Technologies – Future Opportunities

Sue Ellis
Manager, Low Carbon Research Group

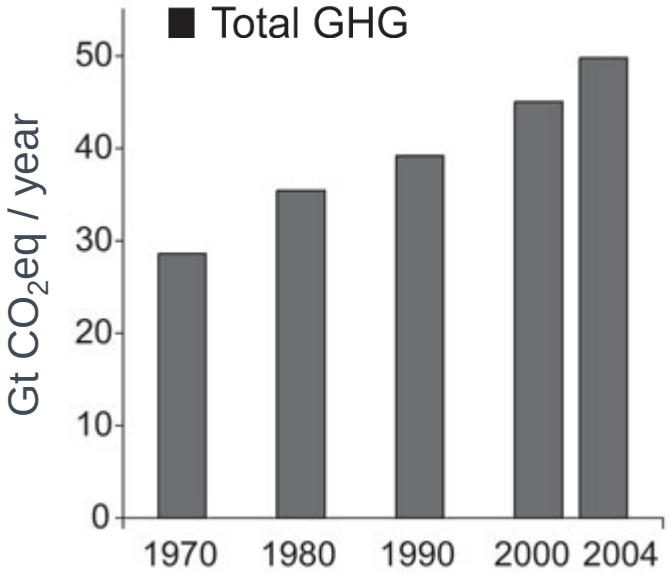
Johnson Matthey

Johnson Matthey

Low Carbon Research Group

- Identify Johnson Matthey's Low Carbon Technology interests
- Understand emerging markets
- Develop early business opportunities
- Implement Low Carbon R&D projects
  - Renewable H_2 generation
  - Distributed H_2 generation
  - Hydrogen storage
  - GHG reduction technologies

Global Anthropogenic Greenhouse Gas Emissions

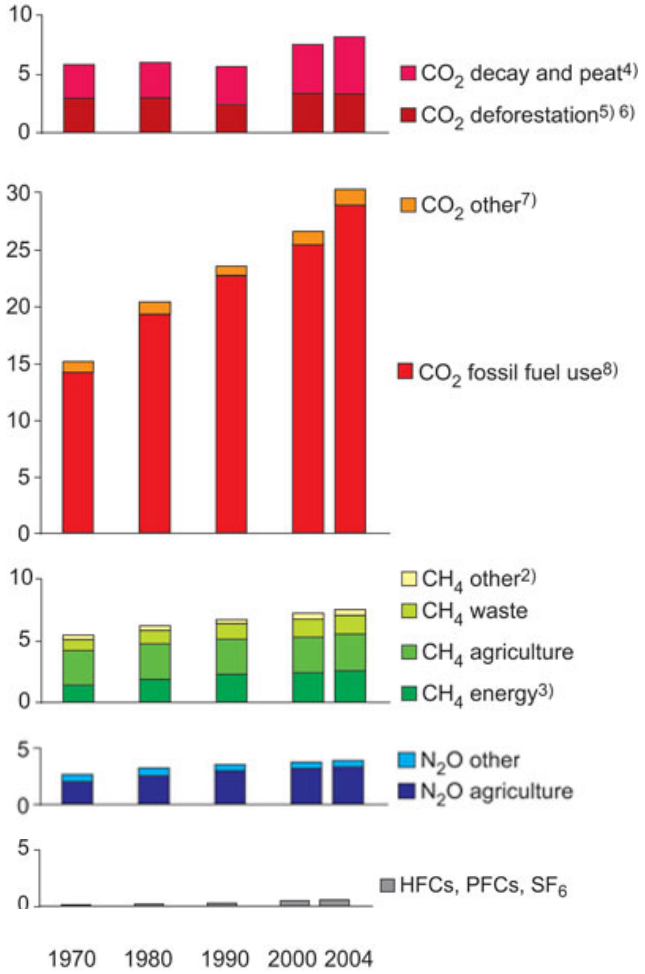


CO_2 77% total GWP = 1

CH_4 14% total GWP = 21

N_2O 8% total GWP = 310

Others 1% total



2005 Data
Source: IPCC 4th Assessment Report 2007

Johnson Matthey

N_2O Abatement

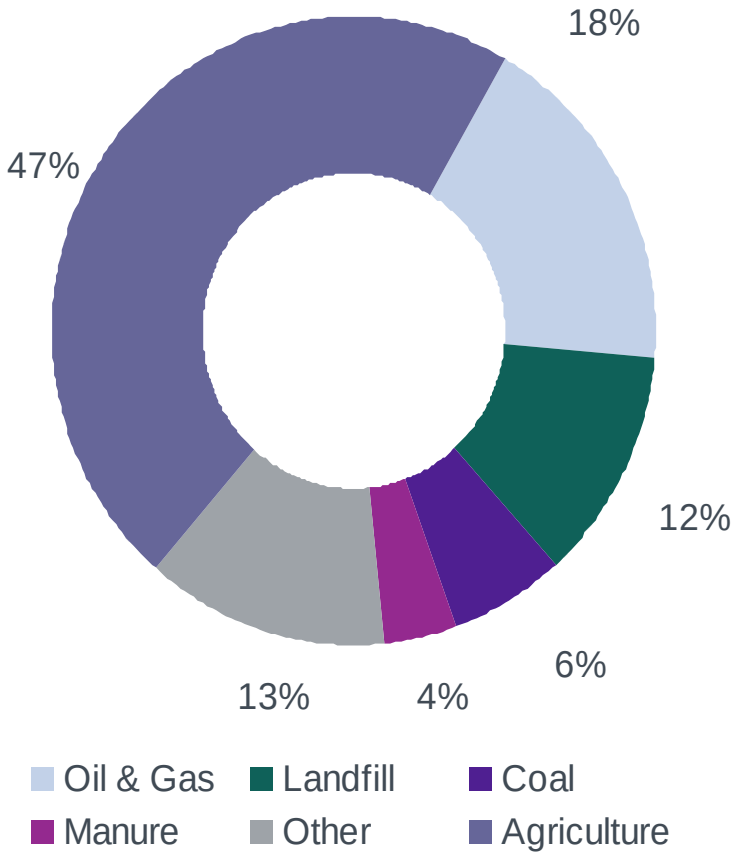
A Growing Opportunity

- N_2O is formed as a side reaction in nitric acid manufacture
  - 5% of anthropogenic N_2O emissions
  - Global emissions: 400,000 t/yr = 125 million tonnes CO_2 equivalent
- Catalytic technology developed by JM / Yara reduces >90% emissions
  - 70% market share with installation into 50 plants by mid 2009
  - Emission reductions of 16.3 million tonnes CO_2 equivalent
- Revenue is through catalyst effect, rather than catalyst sales
  - JM co-authored UN CDM Methodology AM0034
- Regulation will expand market further

Johnson Matthey

Anthropogenic Methane Emissions

- Agriculture accounts for almost half
- Other significant sources
  - Oil & gas operations
  - Landfill gas
  - Coal mining
  - Manure



2005 Data
Source: Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases 1990 - 2020 (EPA Report 430-R-06-003)

Mine Related Methane

Coal Bed Methane	Coal Mine Methane	Ventilation Air Methane
Gas drained from coal seam pre-mining / unmineable coal seam	Gas drained from worked areas of mine	Extracted from mine to allow safe working
60 - 94% CH_4	30 - 95% CH_4	0.1 - 0.8% CH_4 in air
Few m^3/sec	Few m^3/sec	100s m^3/sec

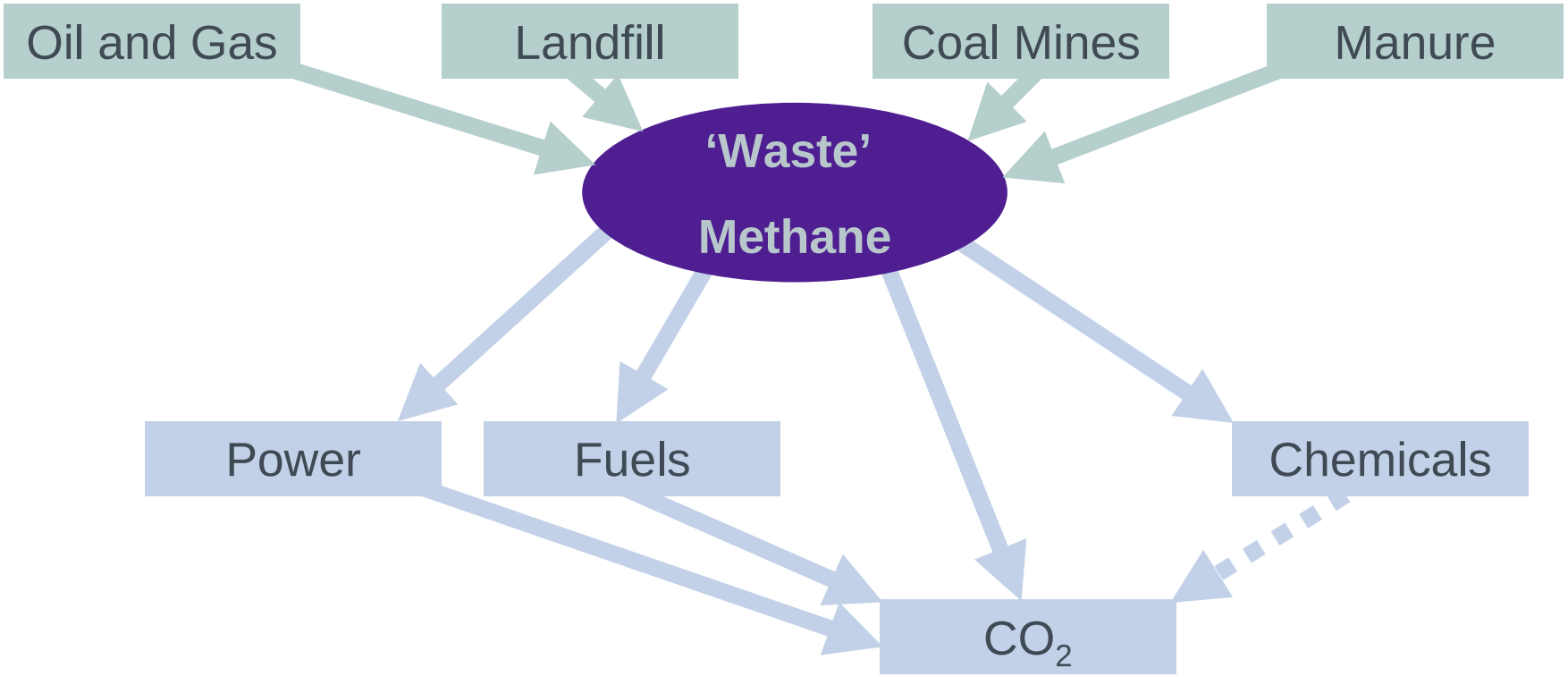
Easiest to capture / use → **Highest GHG impact**

- Markets developing through regulatory and carbon trading mechanisms

Johnson Matthey

Methane Abatement

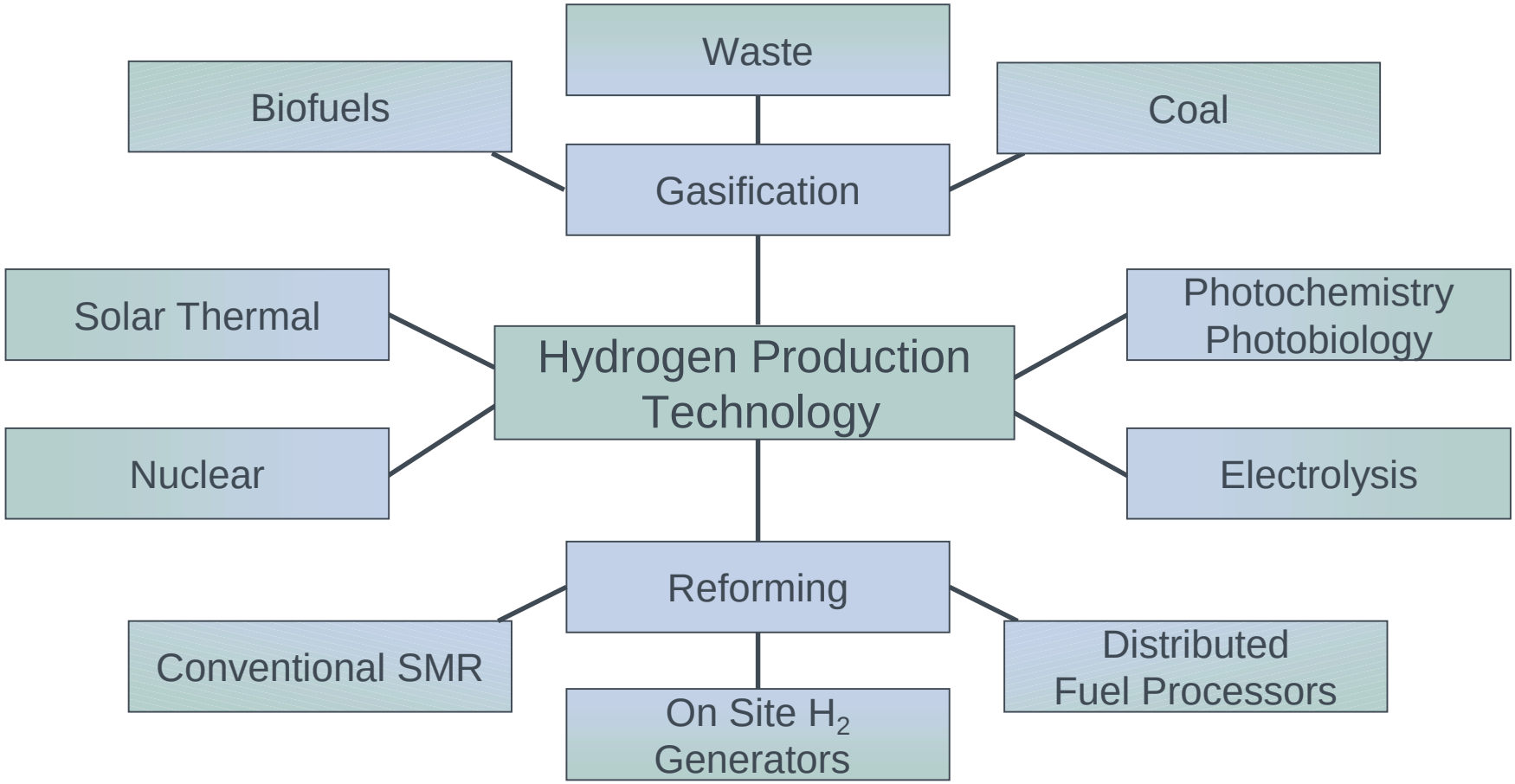
New JM Opportunities



- Issues with variable methane concentrations, gas flow and contaminants

Johnson Matthey

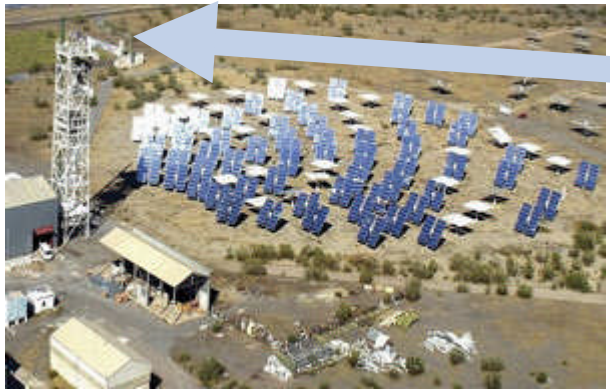
Hydrogen Generation Pathways

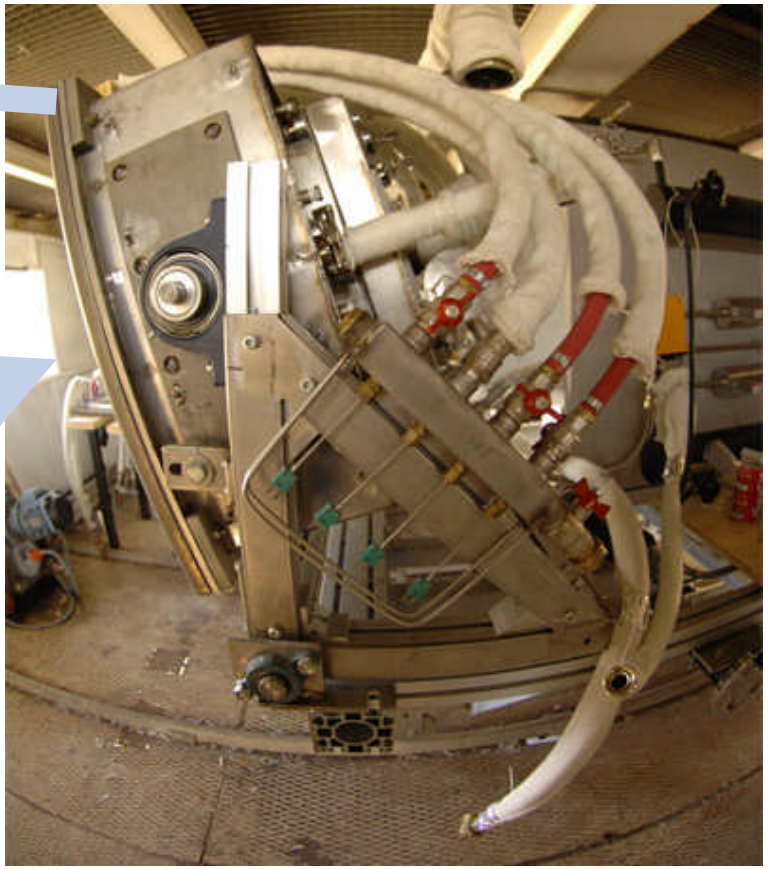


Johnson Matthey

Hydrosol

Splitting Water with Sunlight





Johnson Matthey

Hydrogen Storage

A Problem Waiting for a Solution

- Fuel cell vehicles are being designed with >300 mile range using high pressure tanks to store the hydrogen

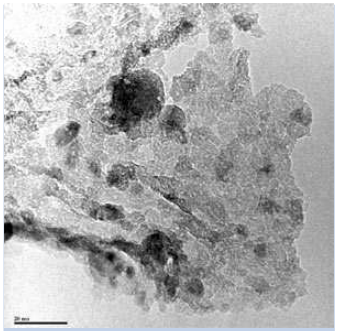
- A low pressure alternative could offer benefits of
  - Space
  - Cost
  - Performance

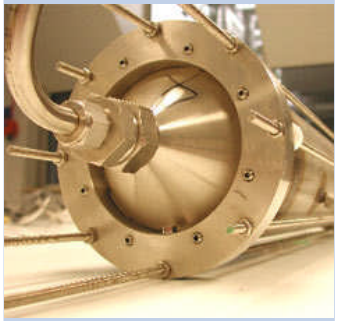
- The international R&D effort continues…

Johnson Matthey

JM and Hydrogen Storage

- H_2 storage cited as a barrier to fuel cell commercialisation
  - Strategic driver from fuel cell business
- Current JM materials have technical benefits but not suitable for automotive systems
  - Historical IP position on Mg and La Ni_5 (AB_5) materials
- Excellent technology fit with JM core competencies
  - Catalysis
  - Materials scale up
  - Heat and fluid management

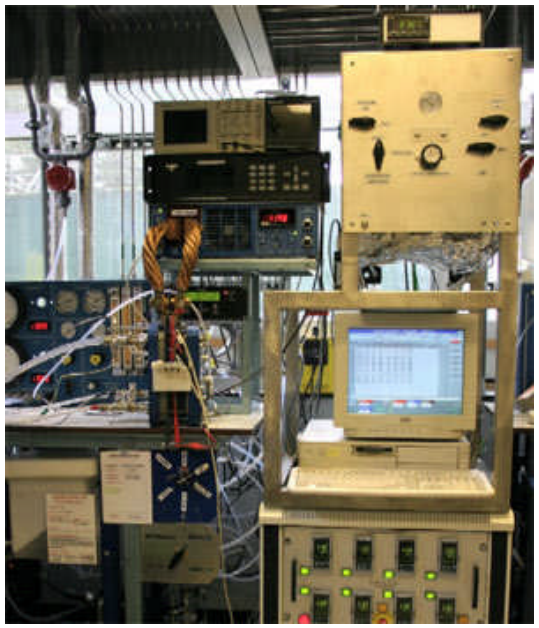


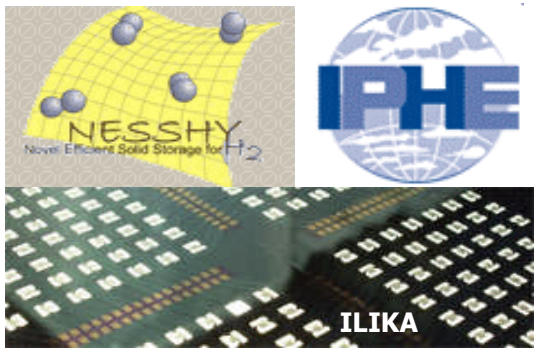


Johnson Matthey

JM Hydrogen Storage Activities

- Research and Development
  - Full range of metal and complex hydrides
  - Translating powder and thin film results into reality
  - Microscale → gram scale → kg scale
  - Testing and characterisation
- Networked with 25 Universities
  - EU FP7 project
  - Two Technology Strategy Board projects
- Evaluating other H_2 storage options
  - e.g. Organic carriers
  - e.g. Ammonia





Low Carbon Technologies - Summary

- Greenhouse gas regulation will open up opportunities for JM
  - New markets for existing products
  - New process and licensing opportunities
  - New technology offerings
- JM has a breadth of core technologies that can be used to tackle the emerging challenges
- N_2O abatement experience illustrates a different way of doing business
- Opportunities are many, but often speculative and evolving, and need careful assessment
- ….more on the tour

Tour of Johnson Matthey Technology Centre

Johnson Matthey

Wrap Up and Q&A

Neil Carson
Chief Executive

Johnson Matthey

Johnson Matthey

Glossary

AFC	Alkaline fuel cell
APU	Auxiliary power unit
As	Arsenic
ASC	Ammonia slip catalyst
BRIC	Brazil, Russia, India, China
CARB	California Air Resources Board
CCRT®	Coated continuously regenerating trap
CDM	Clean Development Mechanism
CH_4	Methane
CHP	Combined heat and power
CO	Carbon monoxide
CO_2	Carbon dioxide
CRT®	Continuously regenerating trap
CTL	Coal to liquids
DME	Dimethyl ether
DMFC	Direct methanol fuel cell
DOC	Diesel oxidation catalyst
DPF	Diesel particulate filter
DPT	Davy Process Technology
ECA	Emission control area
ECT	Emission Control Technologies
EGR	Exhaust gas recirculation
EOR	Enhanced oil recovery
EPA	Environmental Protection Agency (USA)
ESP	Electrostatic precipitator
FGD	Flue gas desulphurisation
FLT	Fork-lift truck
FT	Fischer-Tropsch
GHG	Greenhouse gas
GTL	Gas to liquids
GW	GigaWatt
GWP	Global warming potential
H_2	Hydrogen
HC	Hydrocarbons
HDD	Heavy duty diesel
HFCs	Hydrofluorocarbons
Hg	Mercury
IC	Internal combustion
IGCC	Integrated gasification combined cycle
IMO	International Maritime Organization

Glossary

JMFC	Johnson Matthey Fuel Cells
JMTC	Johnson Matthey Technology Centre
LDD	Light duty diesel
LNT	Lean NOx Trap
MCFC	Molten carbonate fuel cell
MEA	Membrane electrode assembly
MTBE	Methyl tert-butyl ether
MTO	Methanol to olefins
MY	Model year
N_2	Nitrogen
N_2O	Nitrous oxide
NAC	NOx adsorber catalyst
NETL	National Energy Technology Laboratory (USA)
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
O_2	Oxygen
OE	Original equipment
OEM	Original equipment manufacturer
PAFC	Phosphoric acid fuel cell
PEM	Polymer electrolyte membrane
PFCs	Perfluorocarbons
Pgm	Platinum group metal
PM	Particulate matter
S	Sulphur
SCR	Selective catalytic reduction
SCRT®	Selective catalytic reduction + CRT®
Se	Selenium
SEC	Stationary emission control
SF_6	Sulphur hexafluoride
SMR	Steam methane reforming
SNG	Substitute natural gas
SO_2	Sulphur dioxide
SOFC	Solid oxide fuel cell
Syngas	A mixture of hydrogen and carbon oxides
tgvw	Tonnes gross vehicle weight
UPS	Uninterruptible power supply


JM
Johnson Matthey