

STRATEGIC ANALYSIS OF CCS APPLICATIONS IN THE INDUSTRIAL PROCESSES SECTOR

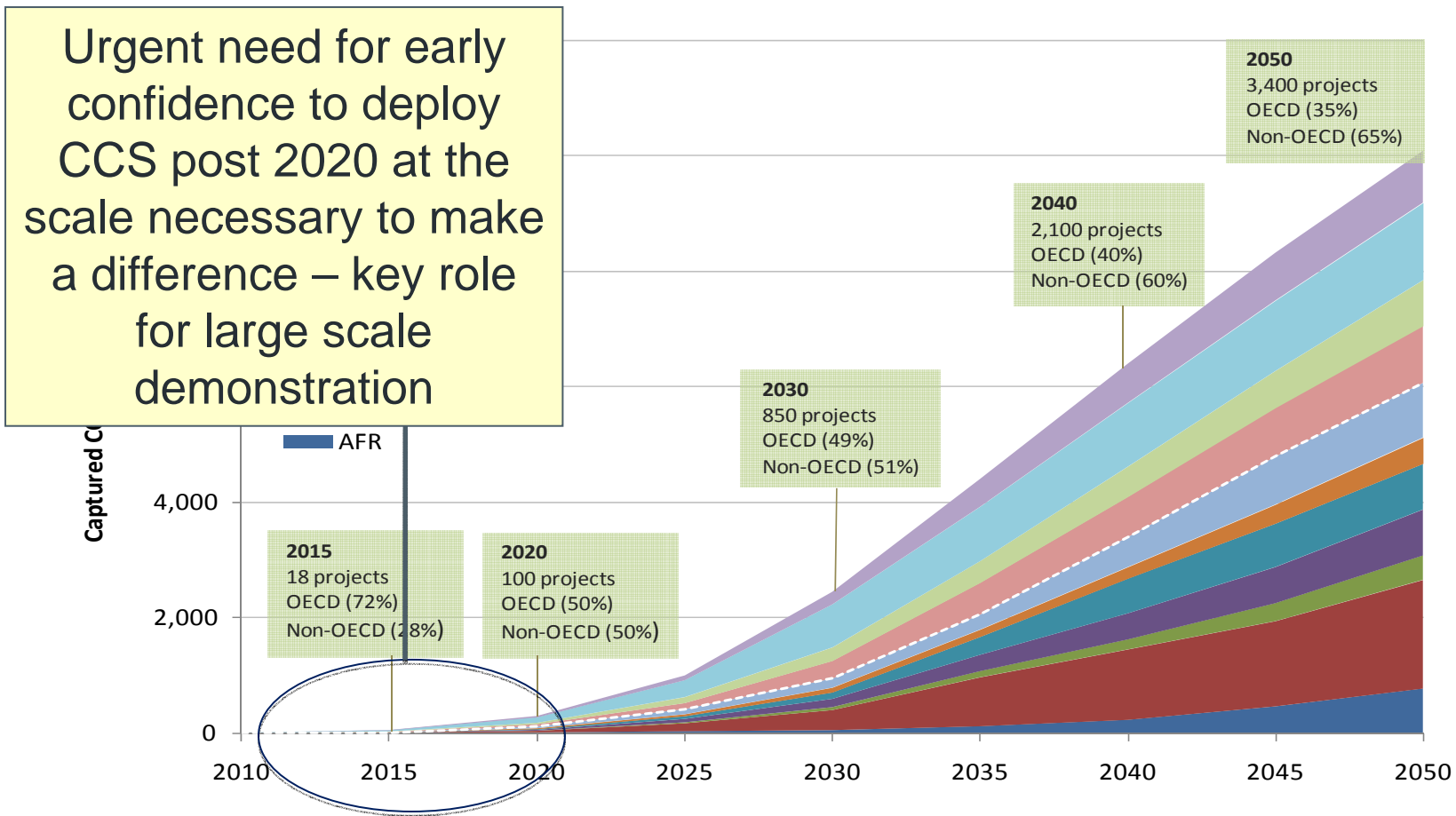
Dale Seymour, Senior Vice President, Strategy

CSLF Financing Task Force Roundtable on the Commercial and Financial Structuring of Commercial Scale Projects with CCS

Washington D.C. 6 April 2010

WWW.GLOBALCCSINSTITUTE.COM

CCS: A ROADMAP TO 2050



Source: IEA, CCS Roadmap .

A 2009 View:IEA

DESIRED PORTFOLIO VS COMMITMENTS

Category	What's required	Status
Funding levels	US\$15-20bn	18-21bn committed
Timing	Demonstration projects operational by 2016-17, design and construction by 2013-15	All projects currently in planning or design phase
Size and number of projects	26 Demonstration projects by 2020 ranging from <ul style="list-style-type: none"> • Powerplants: 0.6-1.6 mt CO₂/pa • Industry: 0.7-3 mt CO₂/pa 	Funds spread over a large number of smaller projects
Geography	Spread over North America, Europe and Asia	Minimal funding in any developing countries
Industry/application	Spread of project technologies in Coal, gas and industry	Large focus on EOR, very few projects in industry (steel and cement)

CCS FUNDING CHALLENGES

Funding Volume

- Level of support
- Portfolio mix

Funding Models

- Limited funding models in use
- Large capital intensive procurement

Finance and risk allocation

- CCS projects are large
- First of a kind risks are always high
- Magnitude and nature of risks limit traditional financing vehicles

Commercial Issues

- Appropriate contract structures across entire CCS chain difficult
- Integrated projects may compound project risk of any individual element

INSTITUTE – DRIVING FORWARD



INSTITUTE RESPONSES

Making available objective data

Providing project qualification advice

Establish project funds with multilateral development banks

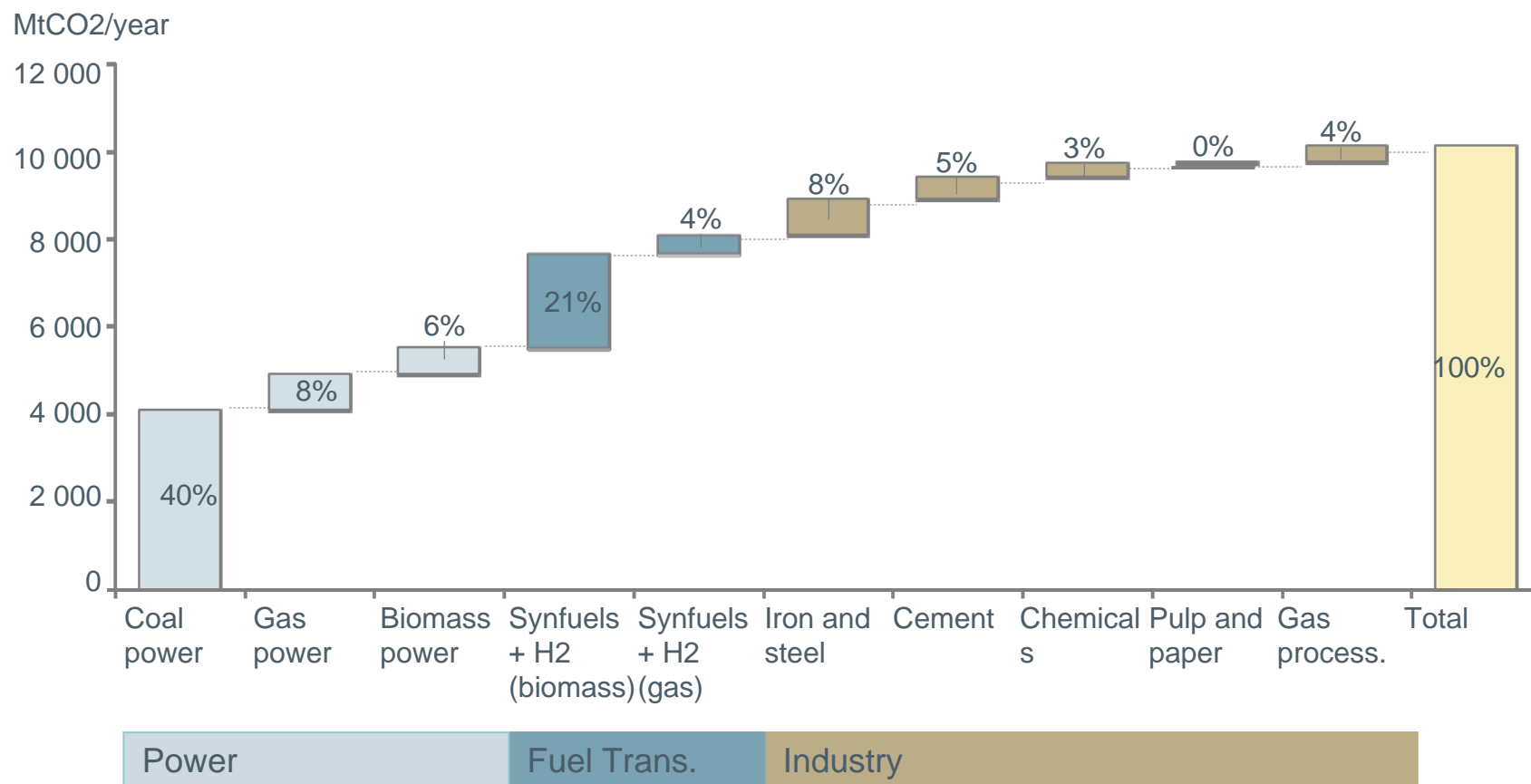
Co-ordinating support and technical advice

Influencing flexible fund approaches such as CCS in CDM

INDUSTRIAL PROCESSES AND THE APPLICATION OF CCS

CCS APPLIED TO INDUSTRIAL PROCESSES REPRESENTS 45% OF CAPTURED CO2 BY 2050

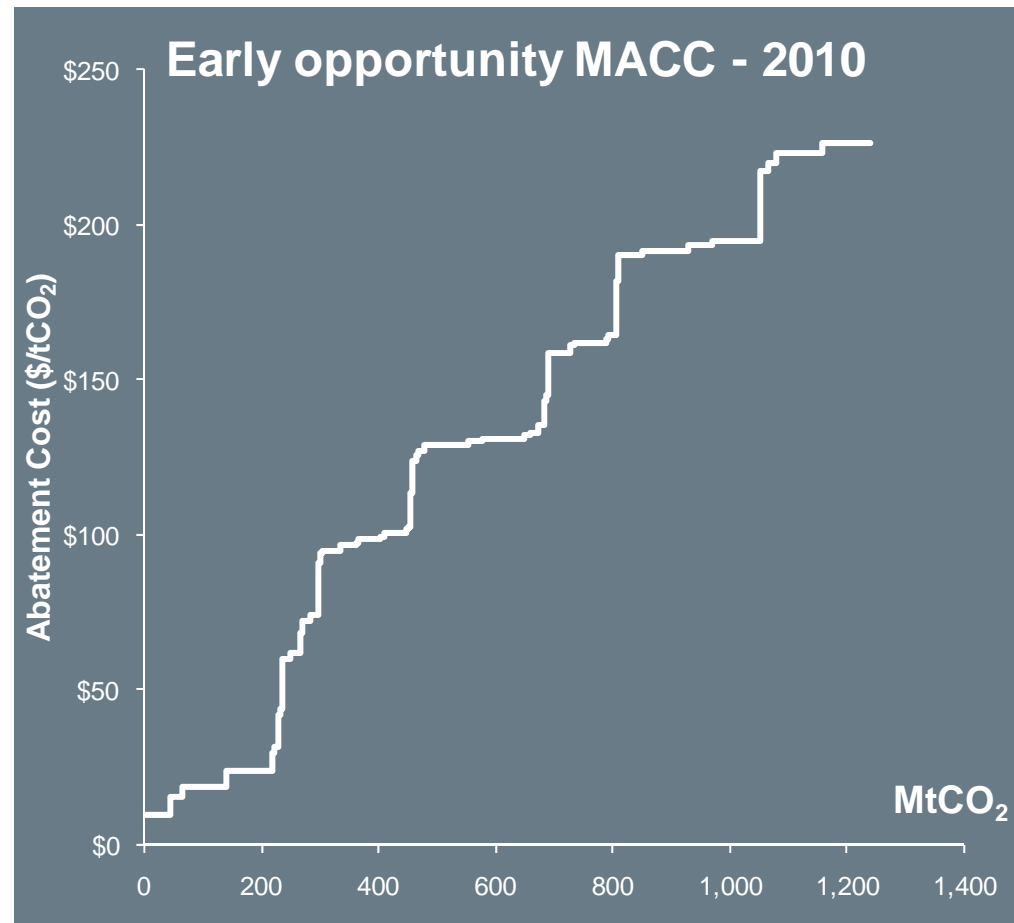
Global installed CCS by sector - 2050



Source: EIA CCS Roadmap 2009, BLUE Map scenario (estimated data)

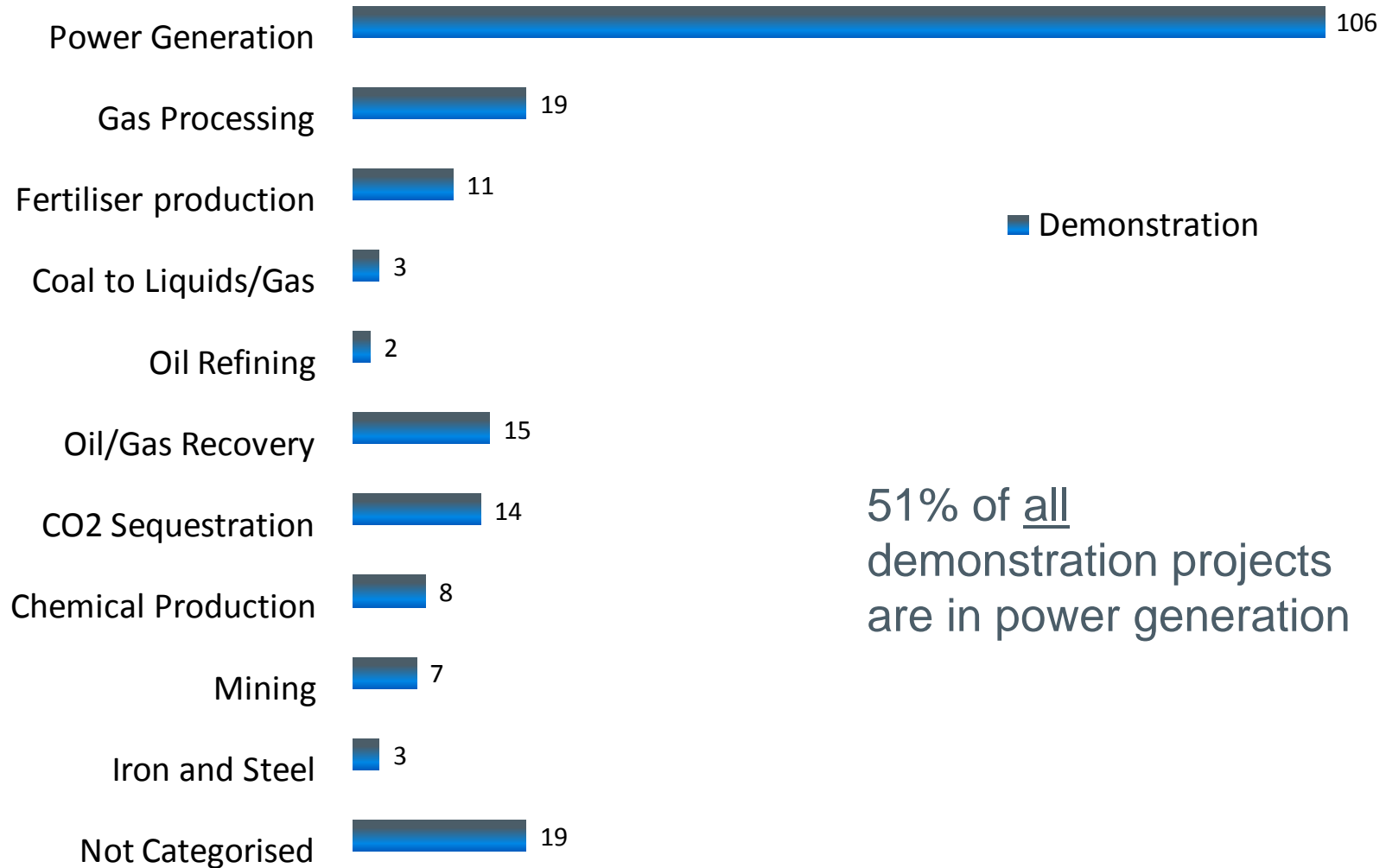
IPCC IDENTIFIED ENHANCED OIL RECOVERY AS EARLY OPPORTUNITY

- IPCC define *early opportunities* as projects that [are likely to] “involve CO₂ of less than 50 km, coupled with CO₂ storage in a value-added application such as EOR.” Early opportunities here includes longer transport distances and lower purity sources (e.g. cement)
- IEA/CSLF mandated to assess CCS ‘early opportunities’ by G8 leaders. Reported in 2007

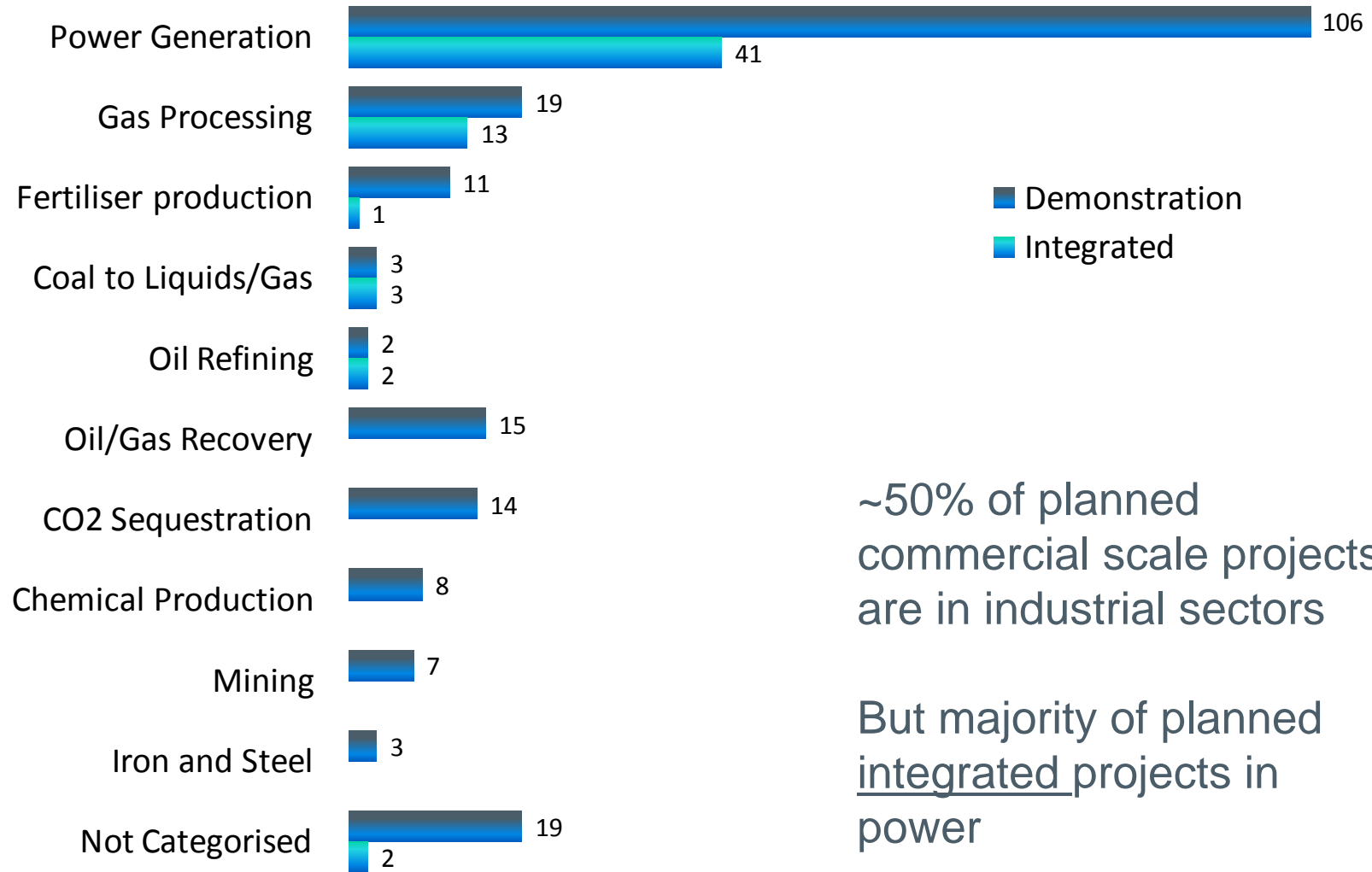


Source: IEA GHG, www.ieagreen.org.uk

INDUSTRIAL PROCESS - STATUS



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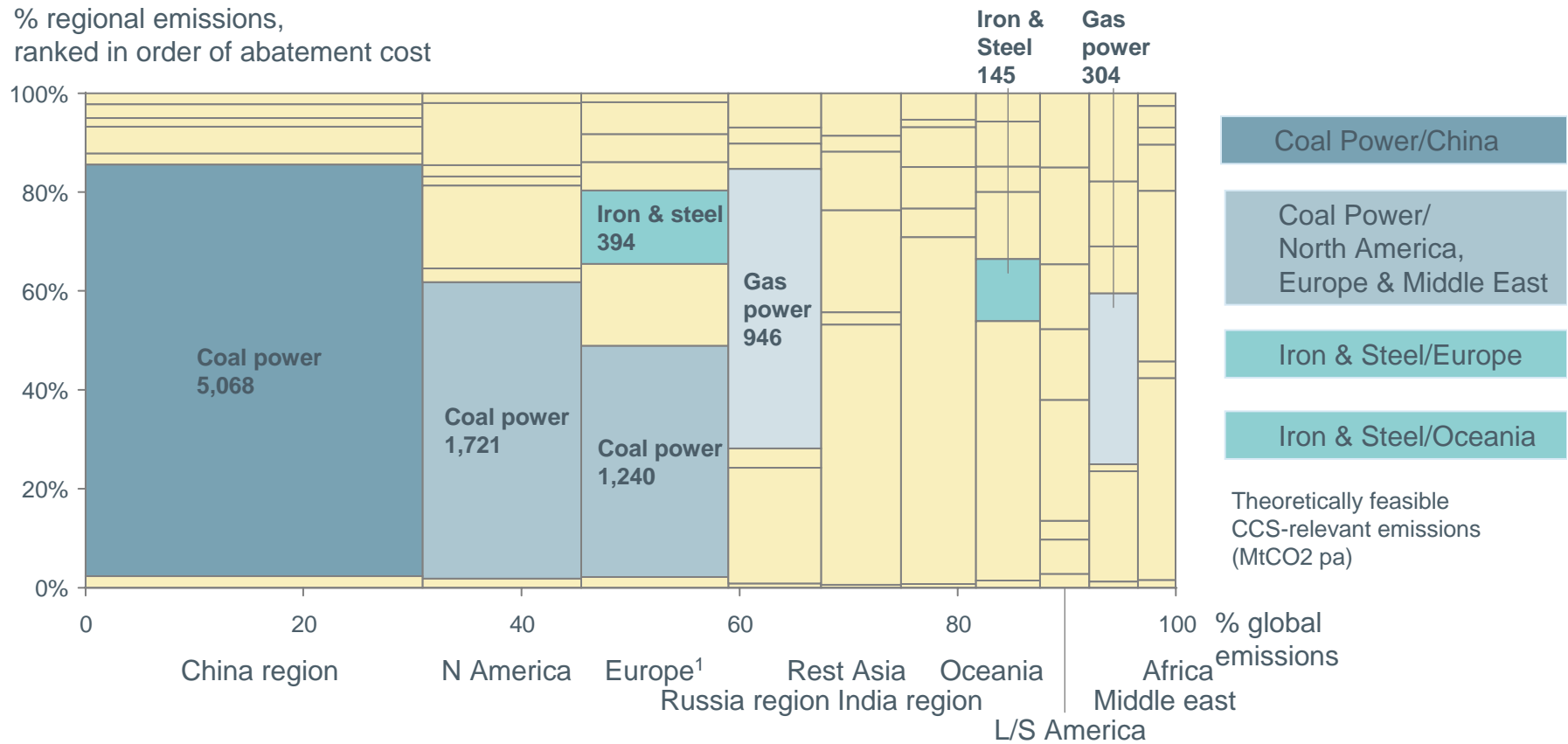
~50% of planned commercial scale projects are in industrial sectors

But majority of planned integrated projects in power

SELECTED MARGINAL ABATEMENT COSTS BY VOLUME ACCORDING TO PROJECT TYPE

CCS-relevant emissions by 2030

% regional emissions, ranked in order of abatement cost



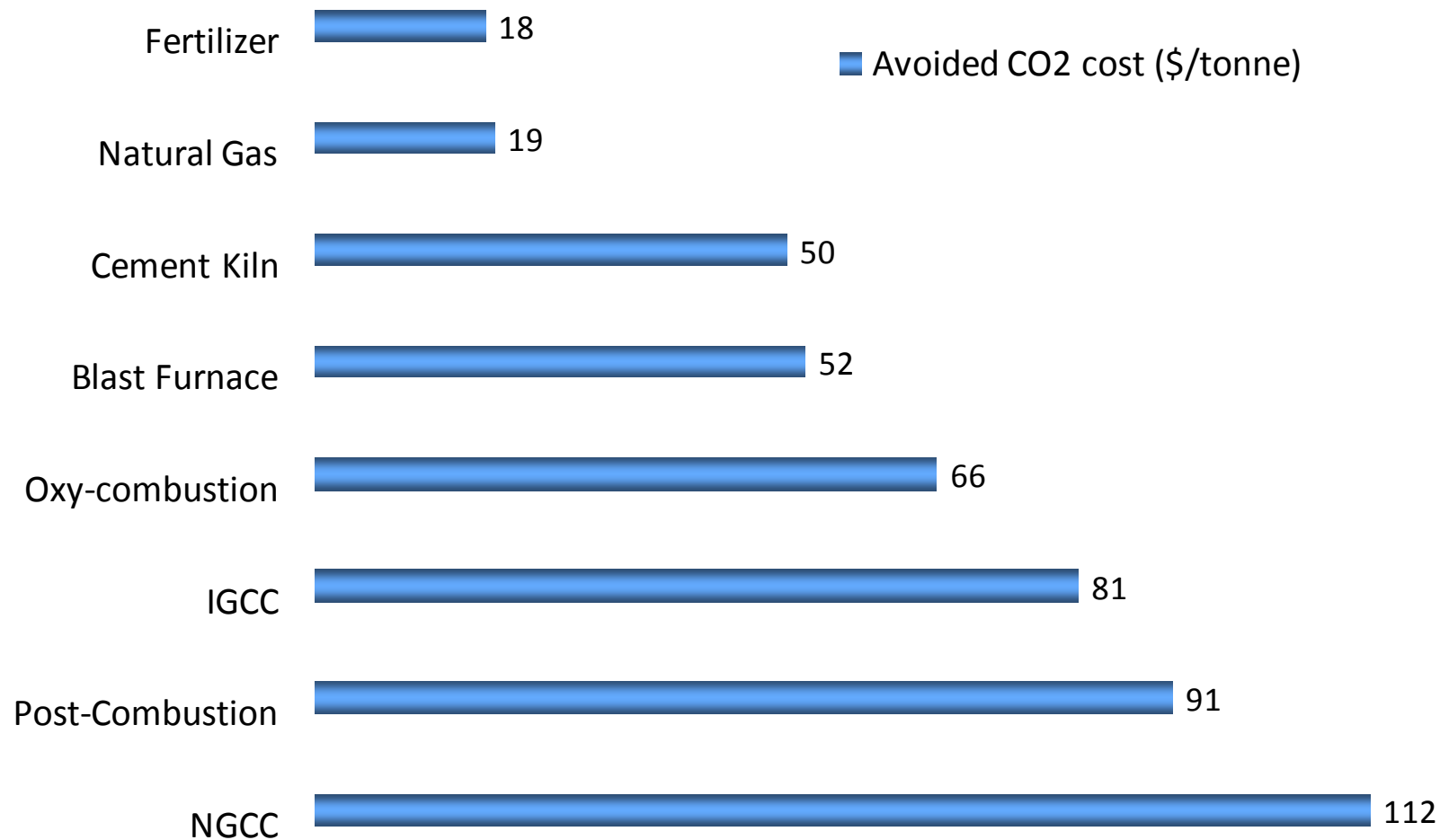
1. Includes ammonia, ethanol, ethylene oxide, gas processing, hydrogen
Source: BCG

MARGINAL ABATEMENT COST CURVE

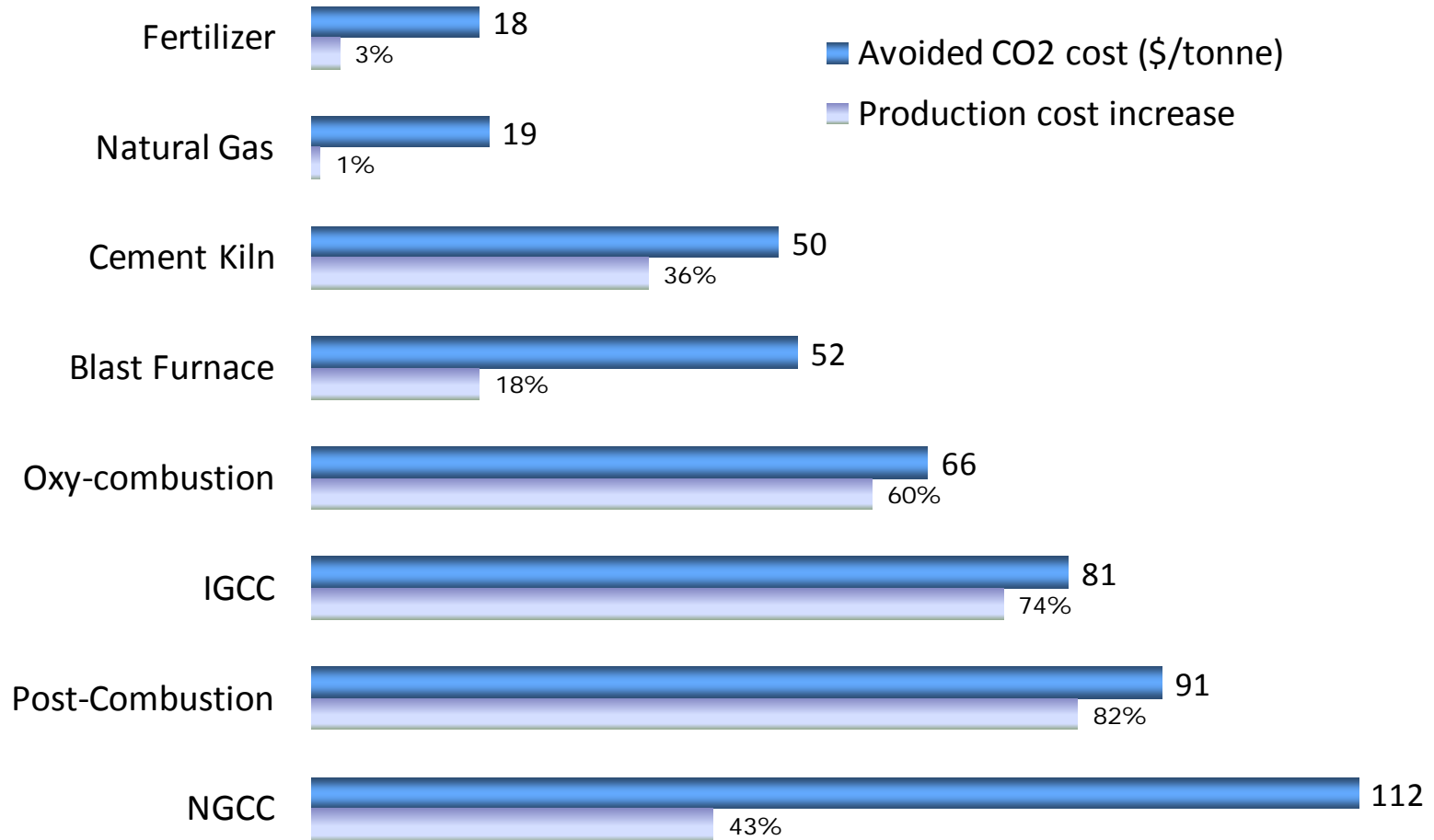
KEY MESSAGES

- CCS deployment should be pursued across a variety of geographies and project types
 - Coal fired power in China, Europe and North America
 - Gas processing in Asia and the Middle East
 - Iron and steel in Europe and Oceania
 - However options for India and other regions still need to be pursued on an emissions basis

COSTS BY INDUSTRY



Production cost increases for industrial processes are significantly less than for power generation.



INDUSTRIAL PROCESSES...

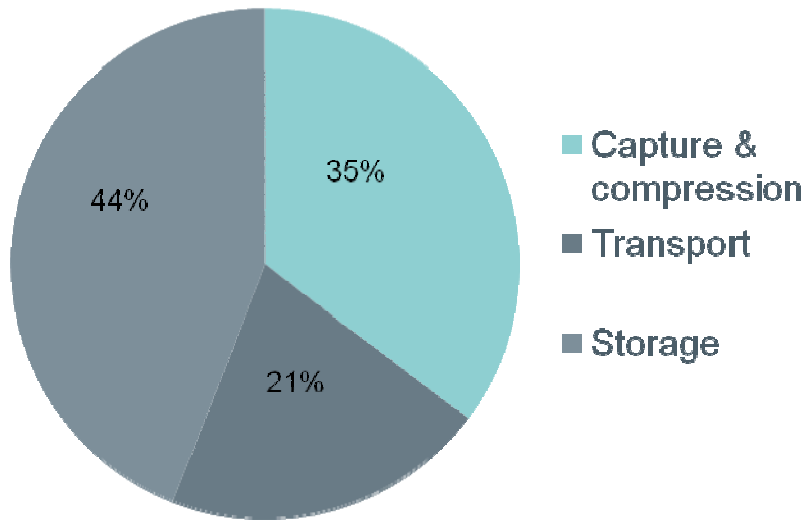
LOW HANGING FRUIT

- Cheaper to finance
- Lower increases in production costs for industrial processes compared to power generation
- Lower cost option than power generation to increase learning from projects
- Alternative to way to address barriers to:
 - Storage
 - Regulatory issues
 - Managing risks

CAPITAL COSTS FOR INDUSTRIAL PROCESSES

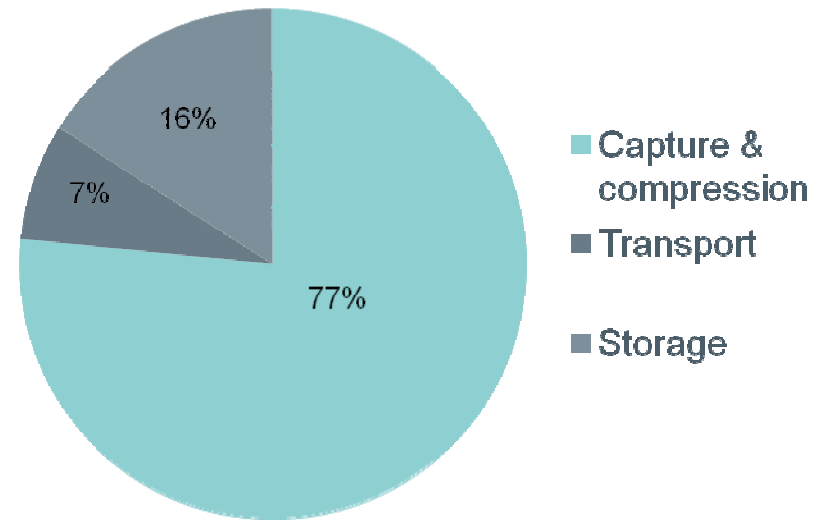
LOWER OVERALL PROJECT COSTS FOR CCS

Gas Processing- \$18tonne/CO2*



* Cost of CO2 avoided, based on NOAK project

Cement & Steel \$47tonne/CO2*



*Cost of CO2 avoided, based on NOAK project

For power generation:

Total costs for CCS significantly more expensive.
Capture & compression represents 82% of capital costs
Storage represents 11% of capital costs

CHALLENGES AND THE WAY FORWARD

- Level of uncertainty for project costs
 - Design analyses not formulated so costs will vary significantly
 - At the study level estimates can vary by 30%
- Cost estimates increase in accuracy as project moves through development phases
 - FEED stage estimates within 15% accuracy
 - Define stage within 15% accuracy
- Challenges still remain from financing perspective
 - Managing the various risks such as construction, operation, storage
 - What is the quantum of risk? Who is best placed to manage the risks?
- Additional policy challenge for industrial processes where products are export orientated
- Issues around a CO₂ price signal, liability and transboundary transport

The top half of the image features a dark blue background with four horizontal, wavy white lines that create a sense of movement and depth.

www.globalccsinstitute.com

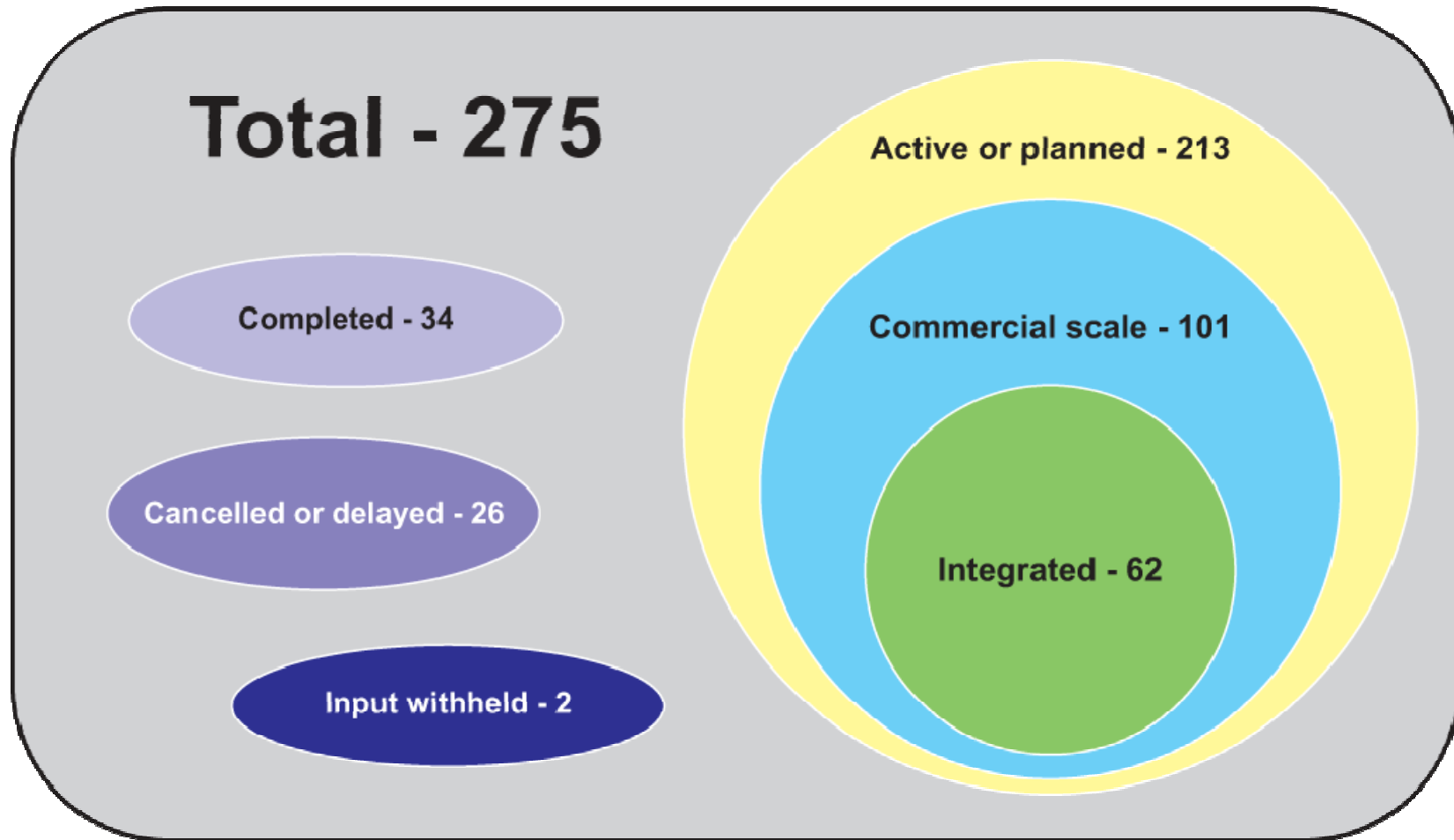
STRATEGIC FRAMEWORK

MOVING THE CCS AGENDA FORWARD

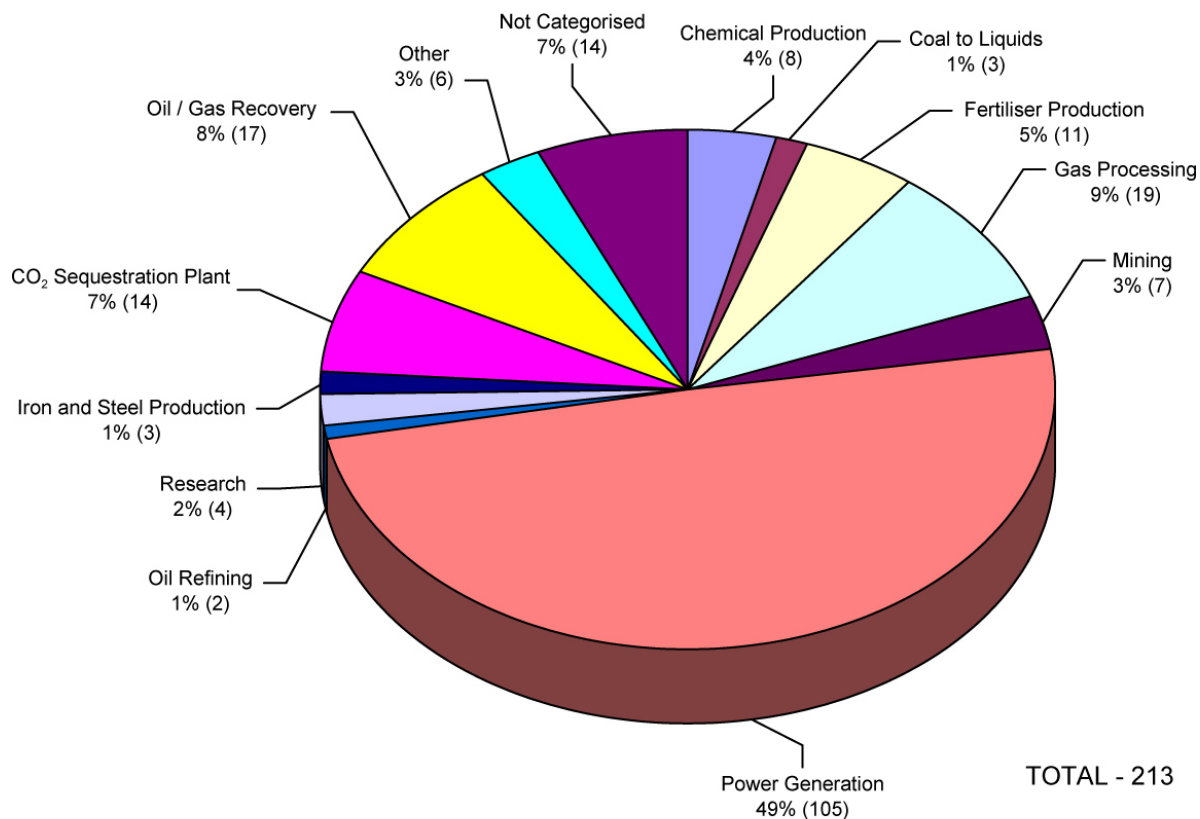


- **2015 outcomes**
- Relevant CCS demonstration projects underway
- **2020 outcomes**
- Directly contribute to development of 20 demonstration projects
- IEA proposed 100 projects globally
- **2050 outcomes**
- A significant contribution to reducing greenhouse gas emissions
- CCS an integral part of the suite of options to limit global temperature increases to 2 degrees
- 3000 projects globally (IEA)

275 PROJECTS IDENTIFIED WORLDWIDE



32% OF ALL ACTIVE OR PLANNED PROJECTS ARE IN THE INDUSTRIAL SECTOR



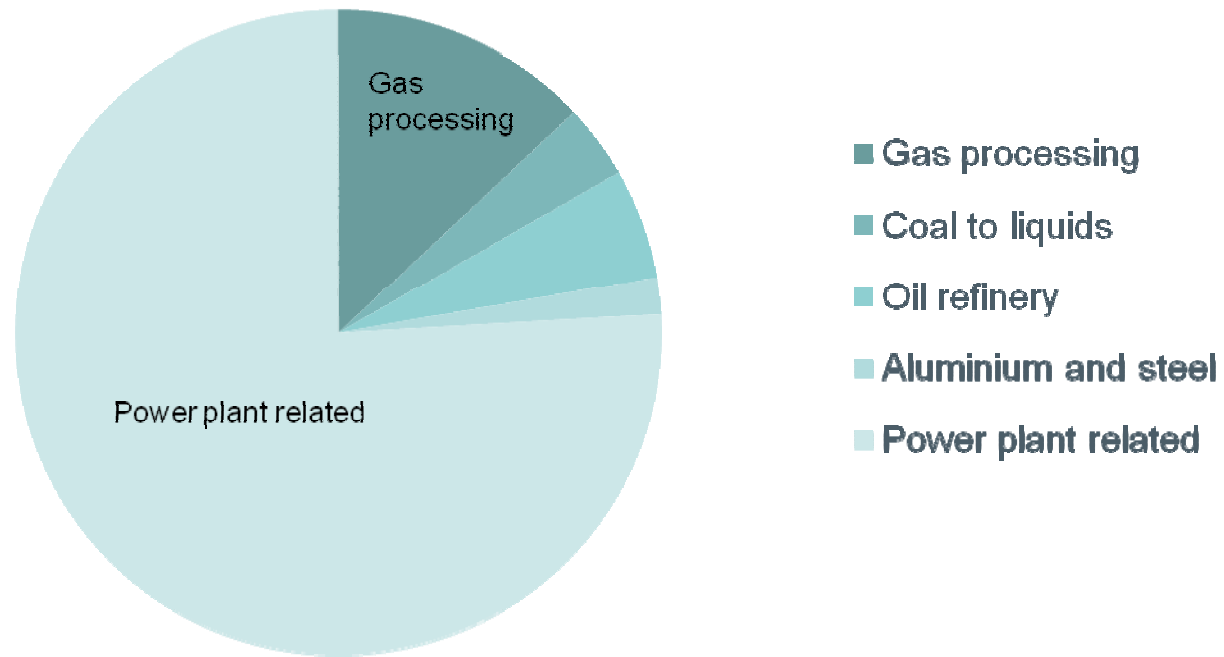
Prepared for the Global CCS Institute by WorleyParsons, 2009

Power sector is very active, however there are no commercial scale integrated operational plants in this sector. Gas and Oil Processing utilise CO₂ separation for the normal process and there are a number of operational CCS projects utilising these facilities as capture plants.

Very minimal activity in other large emitting industries such as Iron, Steel, Cement and Aluminium production.

62 COMMERCIAL SCALE INTEGRATED PLANTS- ACTIVE OR PLANNED STAGE IDENTIFIED

Project type



Industrial processes:

- 7 gas processing projects
- 2 coal to liquids projects
- 3 oil refinery projects
- 1 includes steel and aluminium smelter

VARIANCE OF STORAGE

- Capture costs for some industrial processes are not a key capital cost, will focus costs on storage
 - CO₂ separation included in design of gas processing, ammonia production
- Variance in storage costs will be key issue for industrial processes
 - Represent a larger portion of costs
- Financial risks and liabilities for storage need to be better understood if industrial projects are to move forward