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Energy Efficiency Indicators and Target Setting in South Africa

Pretoria, 28-29 January 2015

Workshop 2 of 3

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Session 1:

Review of Indicators, Data Gaps and Data Collection

Industry

Session 1. Indicators, Data Gaps, Collection

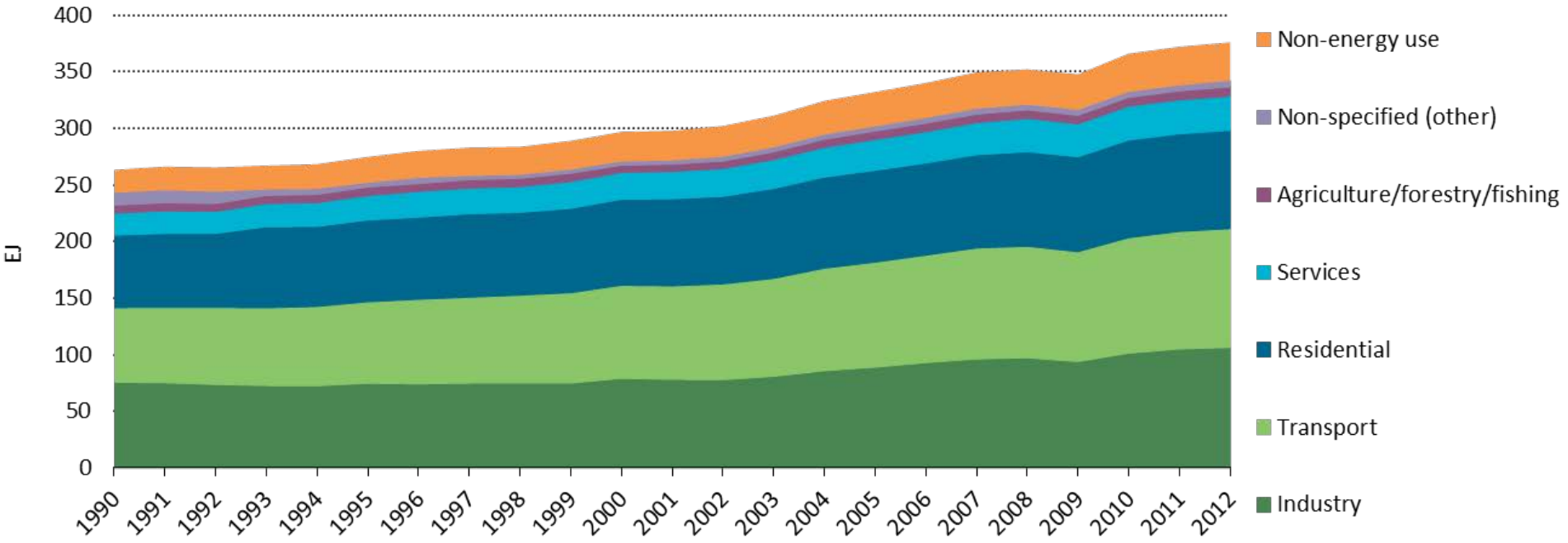
This session will include three sectoral working groups. Within each working group there will be a presentation followed by a high level discussion of indicators, data gaps and data collection.

- Questions to be discussed:
  1. What data or indicators are available?
  2. What data is meaningful for indicators?
  3. What data is or could be collected, and how it should be collected?

Why is industry important?

- Globally, industry accounted for 28% of final energy consumption in 2012

Global final energy consumption by sector

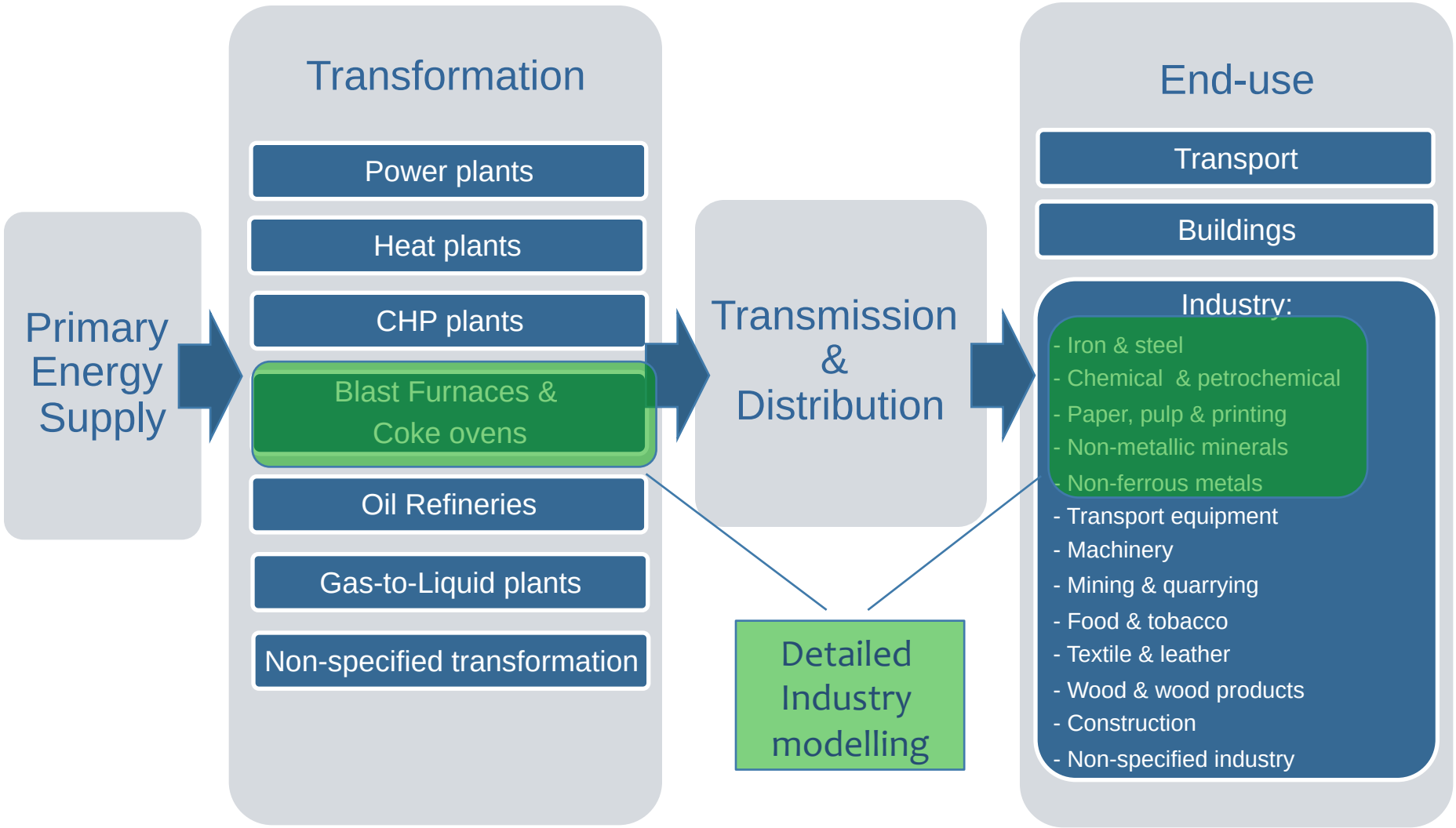


Note: Excludes energy use in blast furnaces and coke ovens and chemical feedstock use.

Definition of industry

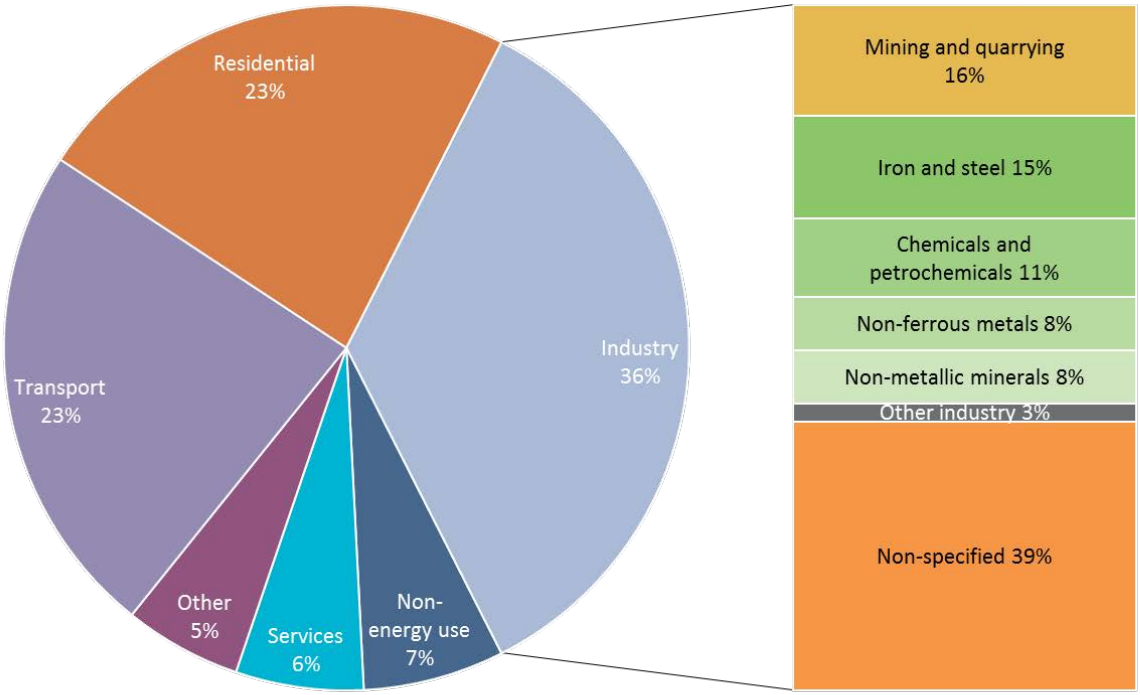
- **IEA Energy Balance:**
  - The manufacture of finished goods and products, mining and quarrying of raw materials, and construction.
- **IEA Indicators Analysis:**
  - Focus on manufacturing sectors, including:
    - blast furnace and coke oven energy use in iron & steel
    - feedstock use in chemicals & petrochemicals

IEA Energy Balance: energy use annually reported by fuel type



South Africa Energy Consumption

Total final energy consumption 2012



- In 2012, industry made up 36% of energy consumption
- More than 1/3 of industrial energy use is reported as non-specified
- The most important industries in South Africa are energy-intensive

Types of data required

Category	Definition
Physical production	• Quantity of physical production at the product, technology, or process-route level
Energy use	• Total energy use, divided by fuel, sub-sector, product, process, etc.
Emissions	• CO2 emissions by fuel, product, technology, process, etc. • Other GHG emissions
Economic output	• Unit of economic value-added by sector, sub-sector or product, and by country or region
Other data relevant to a sub-sector	• Varies depending on sub-sector. • Ex: average clinker ratio, calorific content of alternative fuels/waste materials, recycling rates, waste heat recovered

Types of data required

- **Physical production**
  - Quantities of physical production at the product, technology, or process route level
  - For example:
    - Product: Methanol, ammonia & BTX; Paperboard, coated paper, newsprint, etc. (Mt)
    - Process route: Primary and secondary aluminium; crude steel from EAF, BOF, and OHF routes (Mt)
    - Product/technology: Mechanical wood pulp, chemical wood pulp, other pulp (Mt)

Types of data required

Energy use

- Total energy use by fuel and by sub-sector/product/process
- Greatest possible level of disaggregation to capture differences in carbon content and calorific value – include different types of coal and oil, for example
- Should be expressed in energy terms (J, toe, tce, etc.) rather than in mass (kg, t, etc.) to allow for standardised comparisons

Types of data required

Emissions

- CO_2 emissions by product, technology, or process-route – fuel energy-use emissions and process emissions
- Other GHG emissions data can also be collected, though IEA focuses on carbon dioxide
- Indirect emissions from purchased heat and electricity typically accounted separately using national average emissions factors

Types of data required

- **Economic output**
  - Units of economic value-added by sector, sub-sector, or product for a given country or region
  - Should be expressed in constant units to allow for time series comparisons

Types of data required

Other relevant data

- Depending on the sub-sector and process, other data can also be relevant.
- For example:
  - In the cement industry, average clinker ratios, types and shares of waste co-processed
  - In the iron & steel industry, scrap steel use, recycling rates
  - In many sub-sectors, waste heat recovered, average carbon and calorific content of waste materials/alternative fuels

Data challenges

- **Boundary issues**
  - Definitions and boundaries of products, processes, and sectors should be defined clearly to allow for standardised data and easily comparable indicators
  - IEA approach based on UN Statistics' International Standard Industrial Classification (ISIC) definitions
- **Quality of input resources**
  - Some input materials, such as ores and fuels, can vary significantly in terms of quality and energy content, and can have a large impact on overall indicators. Ensure that factors used accurately reflect the local context, and that data is collected on a standardised basis. Waste fuels, in particular, can have widely varying carbon content, calorific values, and emissions.

Data challenges

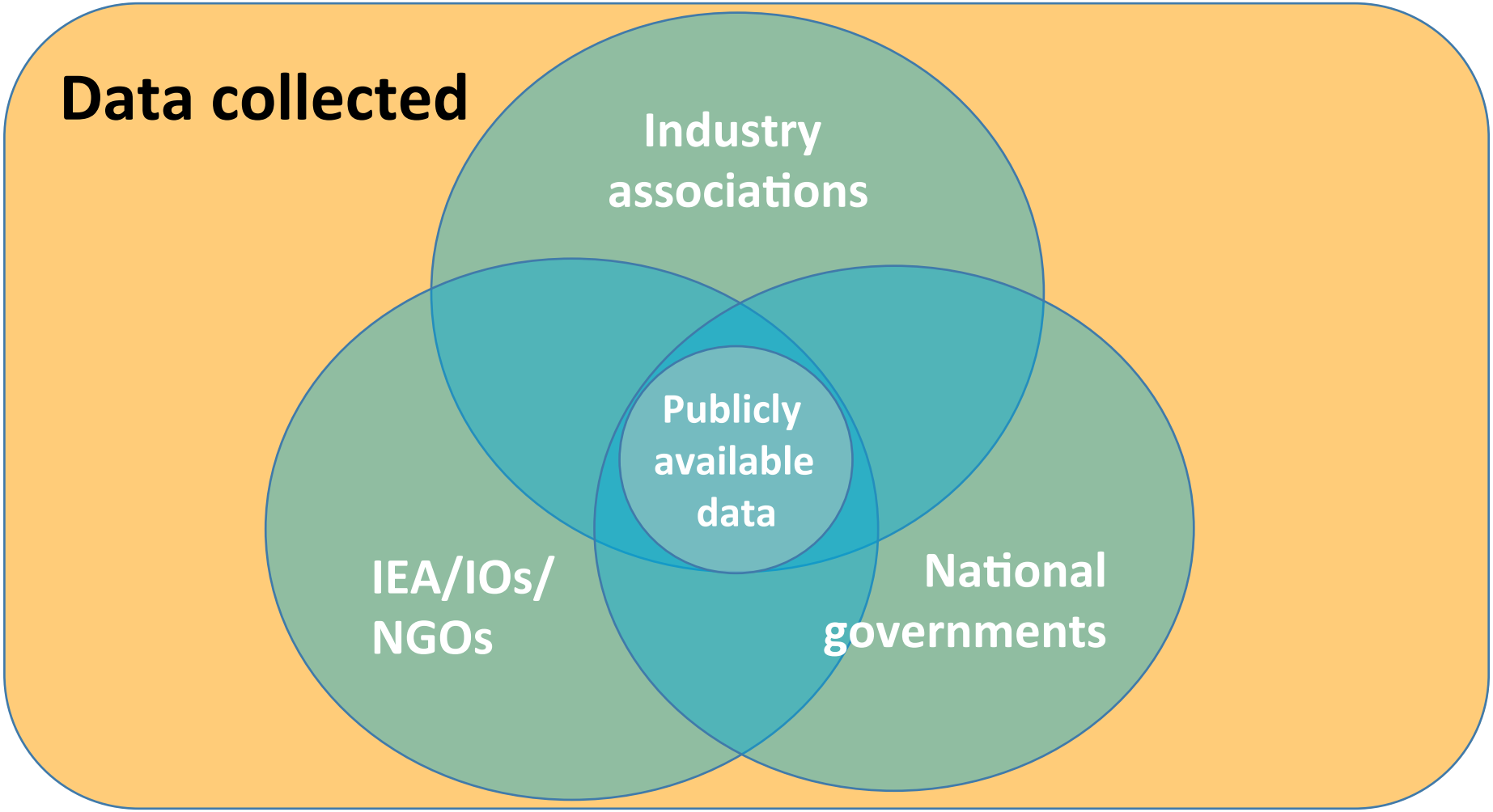
- **Emissions**
  - Ensure that both process and direct emissions are accounted where appropriate, using a standardised system
- **Allocation of co-generation and on-site generation data**
  - These should be accounted for at the site level to ensure accurate accounting of energy efficiency and emissions. However, boundaries (particularly for surplus heat and electricity sold) should be clearly defined.

Data challenges

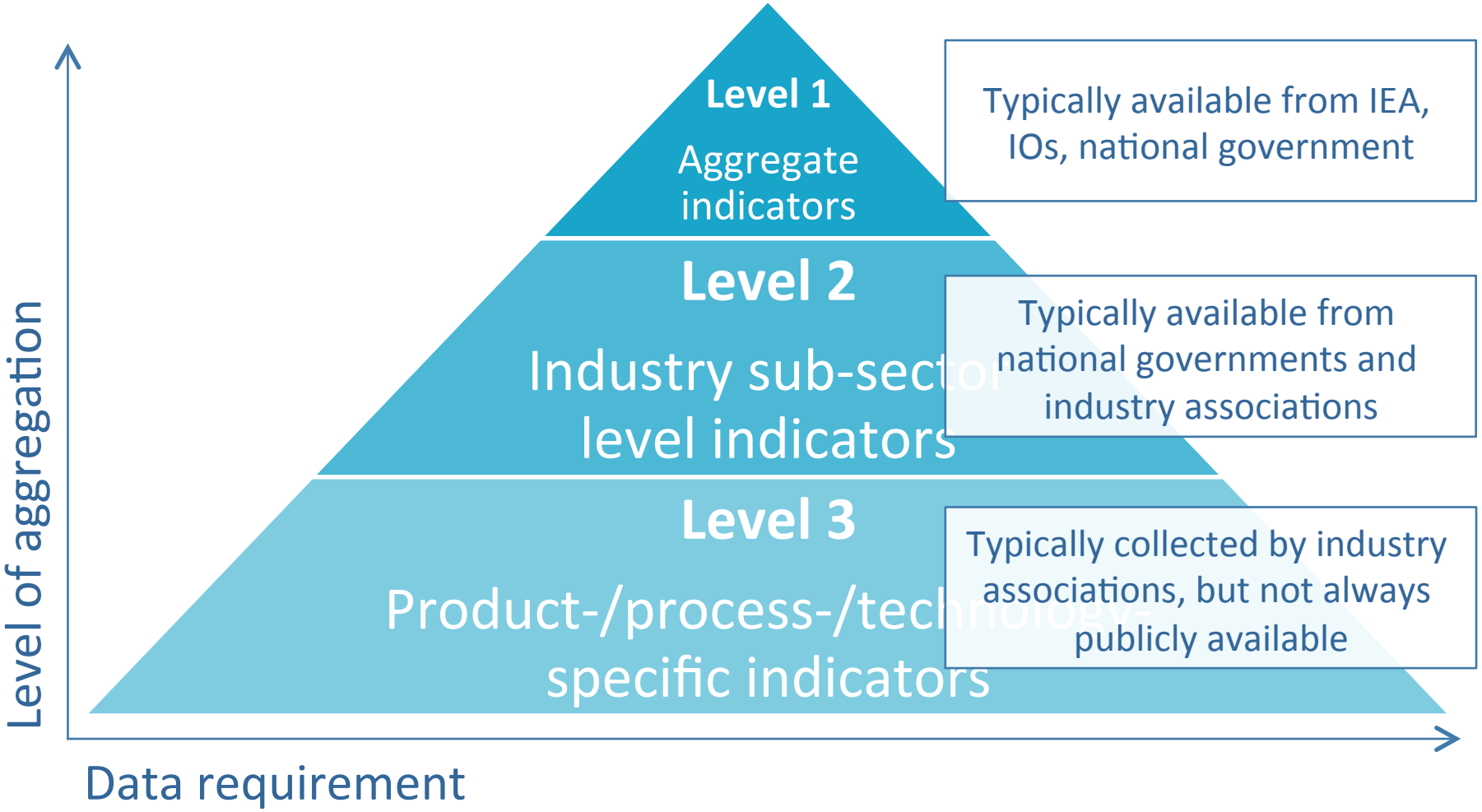
Choosing which data to collect

- Priority should be given to the largest energy-consuming industrial sub-sectors in the country where sufficient data are available.
- If data are not available, the country should prioritise developing the capacity to collect physical production and energy consumption data at the sub-sector level.

Which data are available?



Indicators pyramid



Data collaboration initiatives: Global

- **World Steel energy and CO_2 performance database**
  - Voluntary reporting by members (about 85% of global production)
  - Anonymous site- and process-level data available to World Steel members only for benchmarking purposes
- **Cement Sustainability Initiative (CSI) – Getting the Numbers Right (GNR) Database**
  - Mandatory reporting by 24 members in 100 countries and covering 30% of global capacity
  - Publicly available country-level data for some countries, more detailed data available to members only
- **World Aluminium statistics**
  - Voluntary reporting by member and non-member companies
  - Publicly available data at regional level
  - Estimates used to fill data gaps
  - Data also available from member associations

Data collaboration initiatives: Regional

- **Aluminium Federation of South Africa**
  - Physical production (tonnes) of semi-fabricated products, primary metal, secondary metal and reprocessed metal on website up to 2002
- **Australian Aluminium Council**
  - Aggregated CO_2 emissions (direct & indirect) and emissions intensity of alumina and aluminium manufacturing for its members, 1996-2011 reported on website
- **The Aluminium Association** (North America)
  - Monthly physical production data for 100+ companies surveyed in US and Canada available on website for 1998-2014, more detail for members

Data gaps in South Africa

- Which organisations are collecting data, and what level?
- Which are the most significant data gaps in industry in South Africa?
- How can these gaps be met, while respecting competitiveness and confidentiality concerns?
- Where are there opportunities for collaboration and knowledge sharing?

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Session 2:

Indicators Accounting

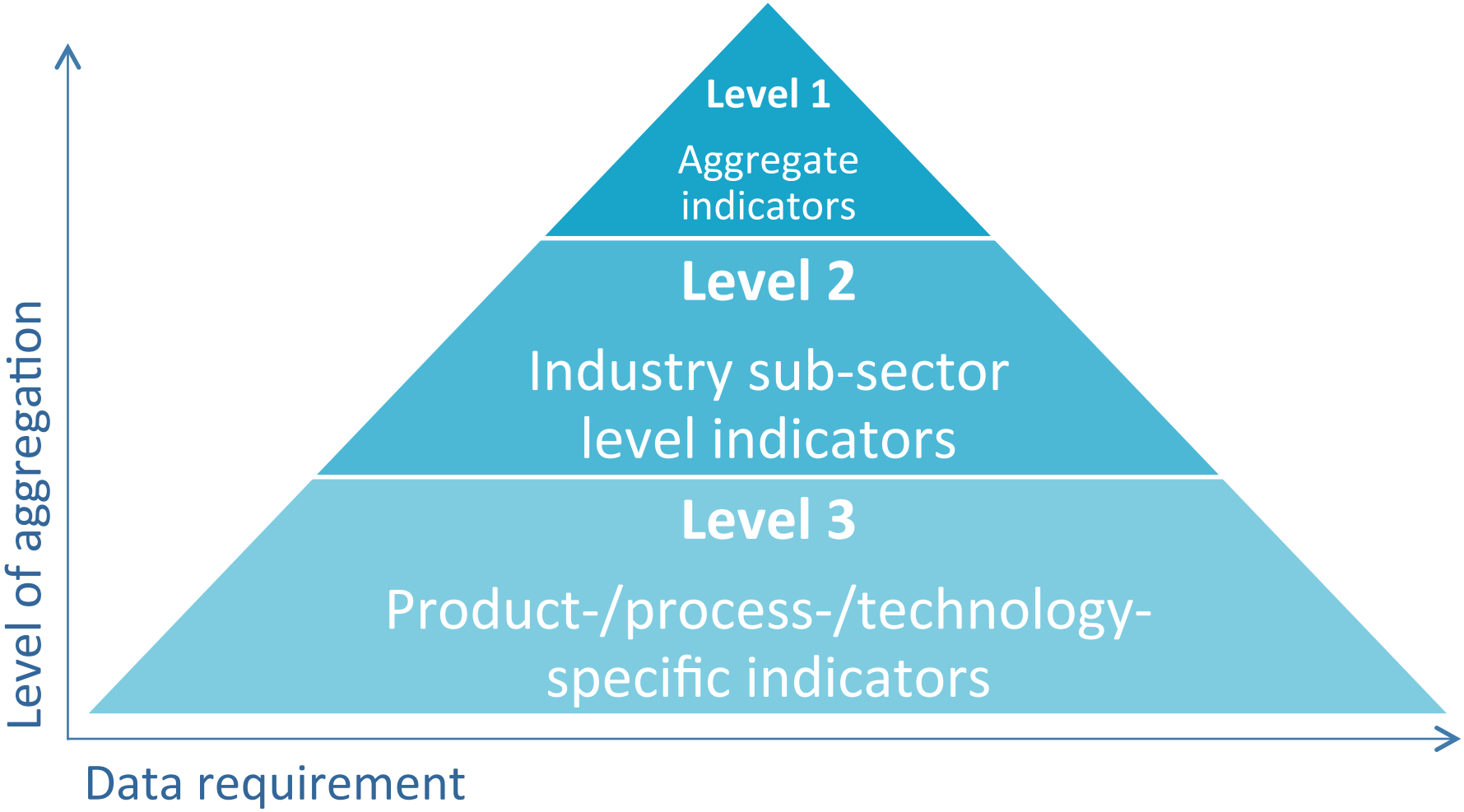
Industry

Session 2. Indicators Accounting

This session will include three sectoral working groups. Within each working group there will be a presentation of the specific sectoral challenges of accounting for energy consumption relevant to the sector and open discussion of how to address the challenges in the sector.

- Questions to be discussed:
  1. What type of indicators exist?
  2. What are the uses of indicators?
  3. Are indicators being developed?

Indicators pyramid



Level 1 – Aggregate indicators

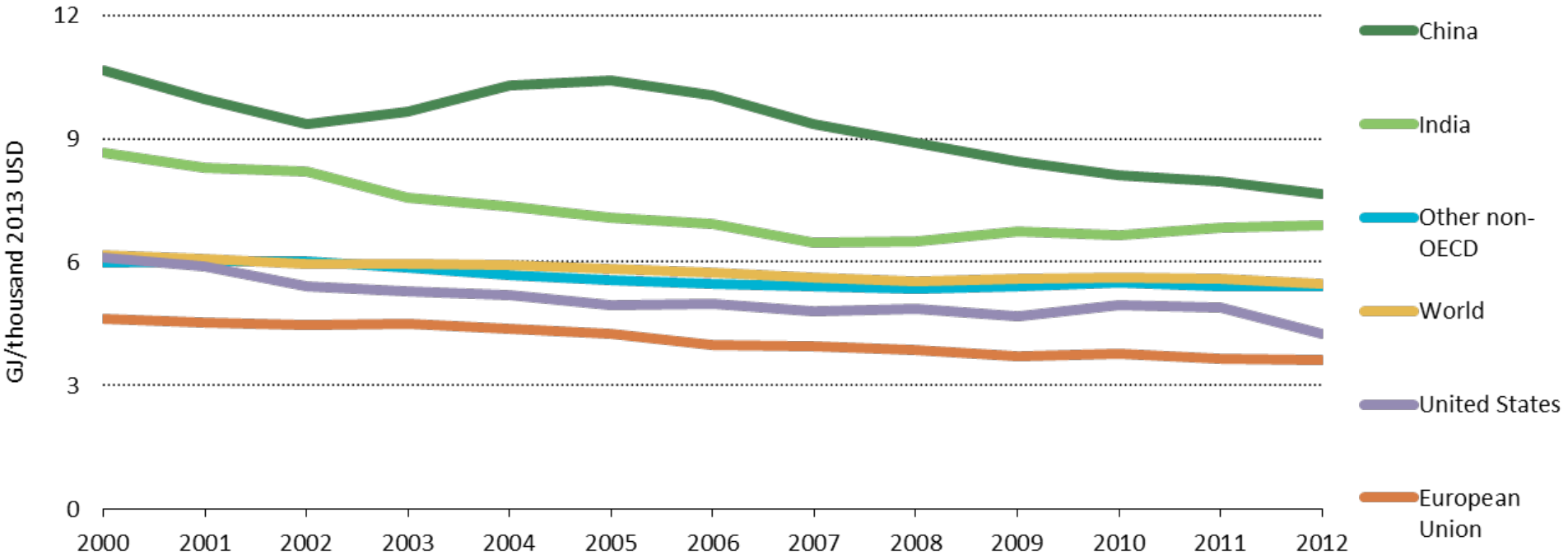
- **Industry sector-level energy intensity**
- **Measures the amount of energy needed to produce one unit of economic output**
- **Energy intensity for industry can provide a general trend of the relationship between energy and economic output**
  - Should not be used for cross-country comparison
  - Affected by other factors, such as structure of the industry sector (i.e. share of production/energy use in energy-intensive sub-sectors), quality of resources, and even weather conditions
  - Could indicate general trend of energy efficiency only if other factors have not significantly changed

Description of Level 1 indicators

Indicator	Data required	Purpose	Limitations
Total energy consumption by unit of industrial value-added	• Total industrial energy consumption • Total industrial value-added (in constant currency)	• Reflects trends in overall energy consumption relative to value-added	• **Does not DIRECTLY measure energy efficiency developments** • Changes over time can be influenced by factors not necessarily related to energy efficiency • Cannot be used for cross-country comparison

Level 1 indicator – example

Energy intensity per unit of value added by region, 2000-2012



- Should not be used for cross-country comparison, though it seems comparable.
- Can provide a picture of the evolution within a country's industry sector

Level 2 – Sub-sector level indicators

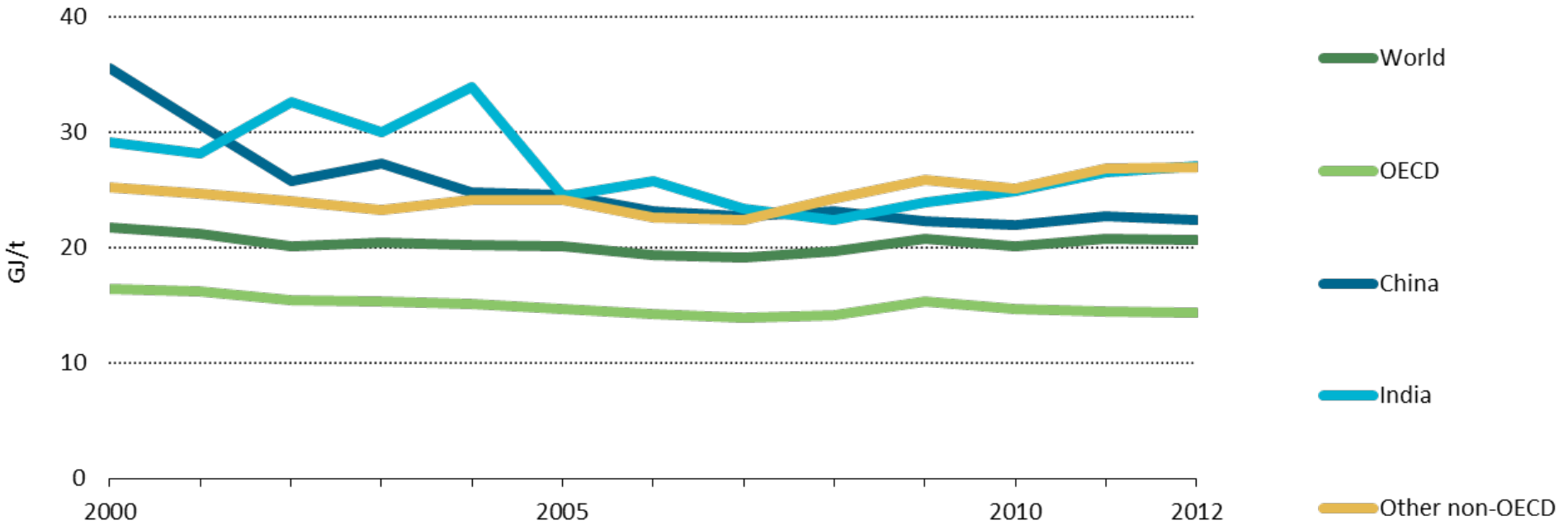
- **Specific indicators depend on data available.** Include indicators at the sub-sector level that measure energy use per unit of production (either in value-added or physical terms)
- **Energy intensity for industry can provide a trend of the relationship between energy and economic output within a sub-sector**
  - Can be influenced by structural shifts within a sub-sector (i.e. changing shares of products/process routes)
  - Can be influenced by pricing effects
  - Cannot be used to compare intensity across sub-sectors

Description of Level 2 indicators

Indicator	Data required	Purpose	Limitations
Sub-sector energy consumption by unit of value-added	• Energy consumption by sub-sector • Corresponding value-added (in constant currency)	• Indicates the relationship of energy consumption to economic output in a particular sub-sector	• May hide important structural shifts in a sub-sector • Value-added is influenced by a range of pricing effects unrelated to physical production or energy efficiency
Sub-sector energy consumption by unit of physical production (specific or unit energy consumption)	• Energy consumption by sub-sector • Corresponding physical production	• Indicates the relationship of energy consumption to physical production	• Not possible to compare across sub-sectors because of differences in process and units • Cannot provide an aggregate picture of efficiency in industry • May hide important structural shifts in a sub-sector • Difficult to apply for industrial sectors where a wide range of products exist and energy consumption cannot be allocated to a specific product

Level 2 indicator – example

Energy intensity per tonne of crude steel, 2000-2012



Source: IEA Energy Balance and IEA analysis.

Note: Energy consumption derived from IEA Energy Balance and therefore may include some energy used for non-core processes, such as some energy for captive heat/CHP.

Level 3 – Product- or process-level

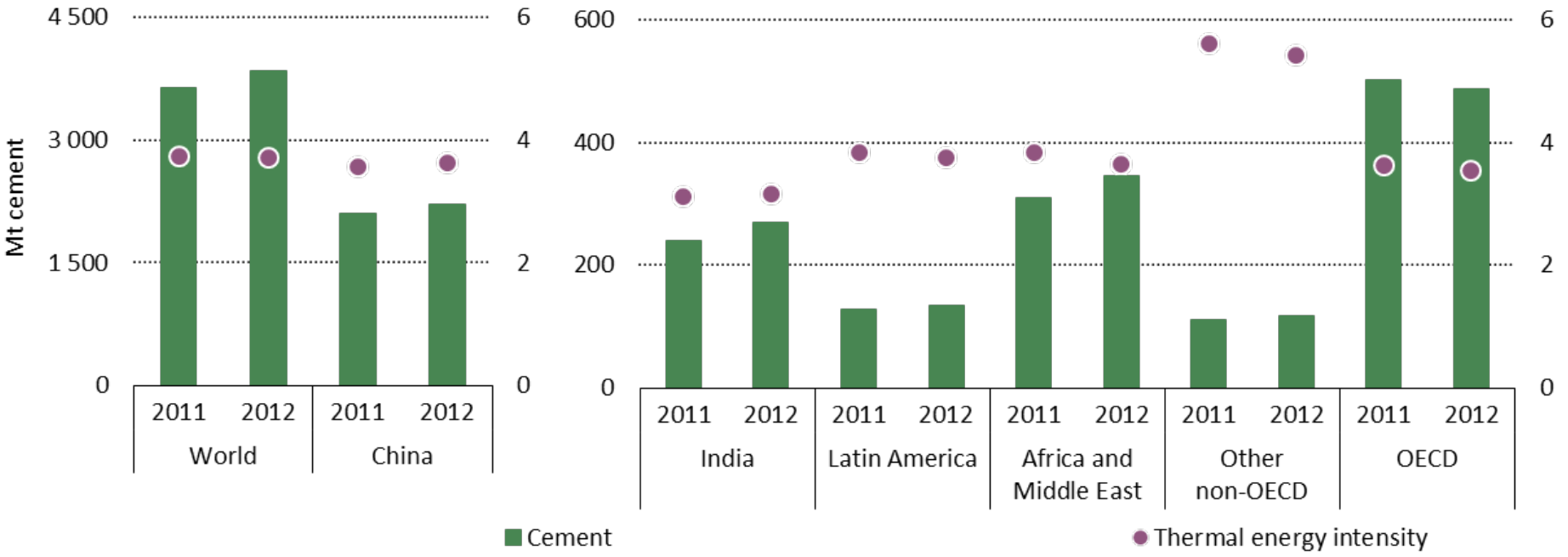
- **Specific indicators depend on data available.**
  - Indicators at the product or process-route level that measure energy use per unit of production for a particular product, technology, or process-route
  - Can also include indicators for a particular fuel or set of fuels
- **Can provide a trend of the relationship between energy and production for a particular process or product**
  - Cannot be used to compare intensity across sub-sectors

Description of Level 3 indicators

Indicator	Data required	Purpose	Limitations
Product or process level energy consumption by unit of physical production (specific or unit energy consumption)	• Energy consumption by product or process • Corresponding physical production	• Indicates the relationship of energy consumption to physical production • Indicates energy efficiency improvements within a process or product	• Not possible to compare across sub-sectors because of differences in process and in units • Cannot provide an aggregate picture of efficiency in industry • Use care when interpreting to ensure consistent boundaries and definitions • Can be influenced by changes in process technology

Level 3 indicator – example

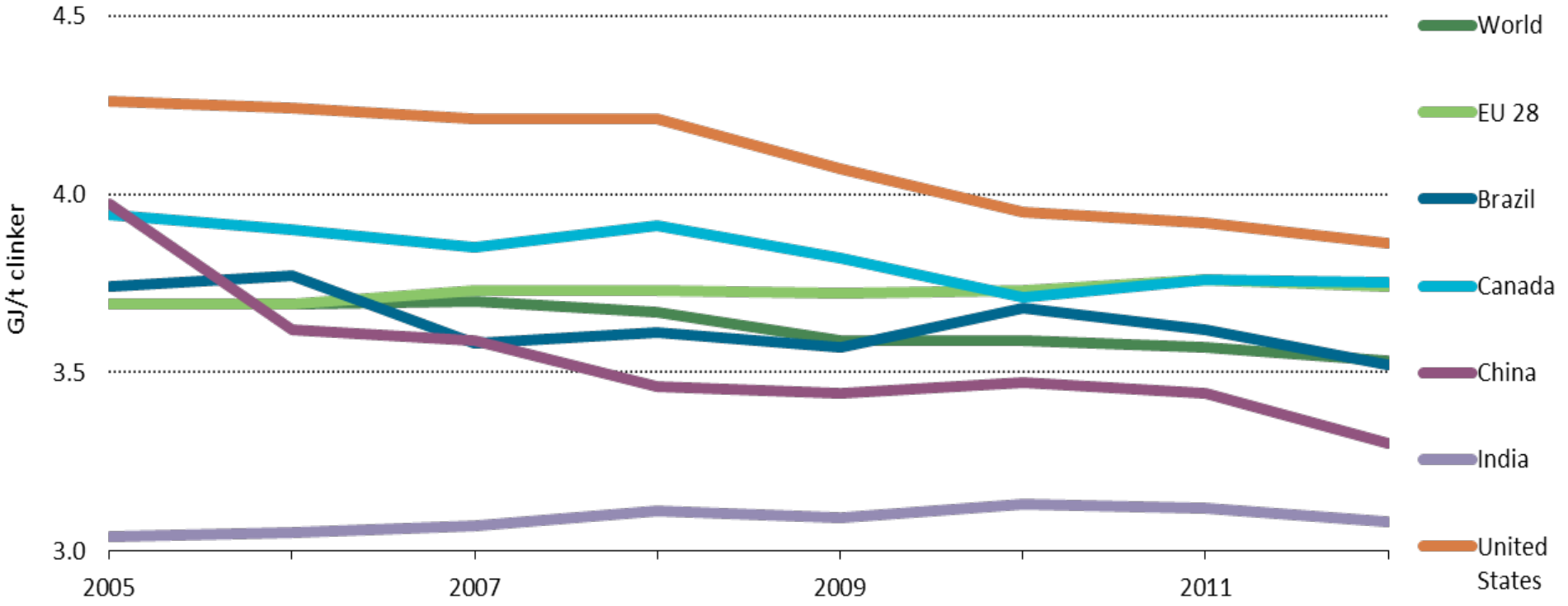
Thermal energy intensity per tonne of clinker



- Decrease largely due to conversion of wet-process kilns to more efficient dry-process kilns with preheaters and precalciners
- Use care when interpreting to ensure consistent boundaries and definitions

Level 3 indicator – example

Thermal energy intensity per tonne of clinker

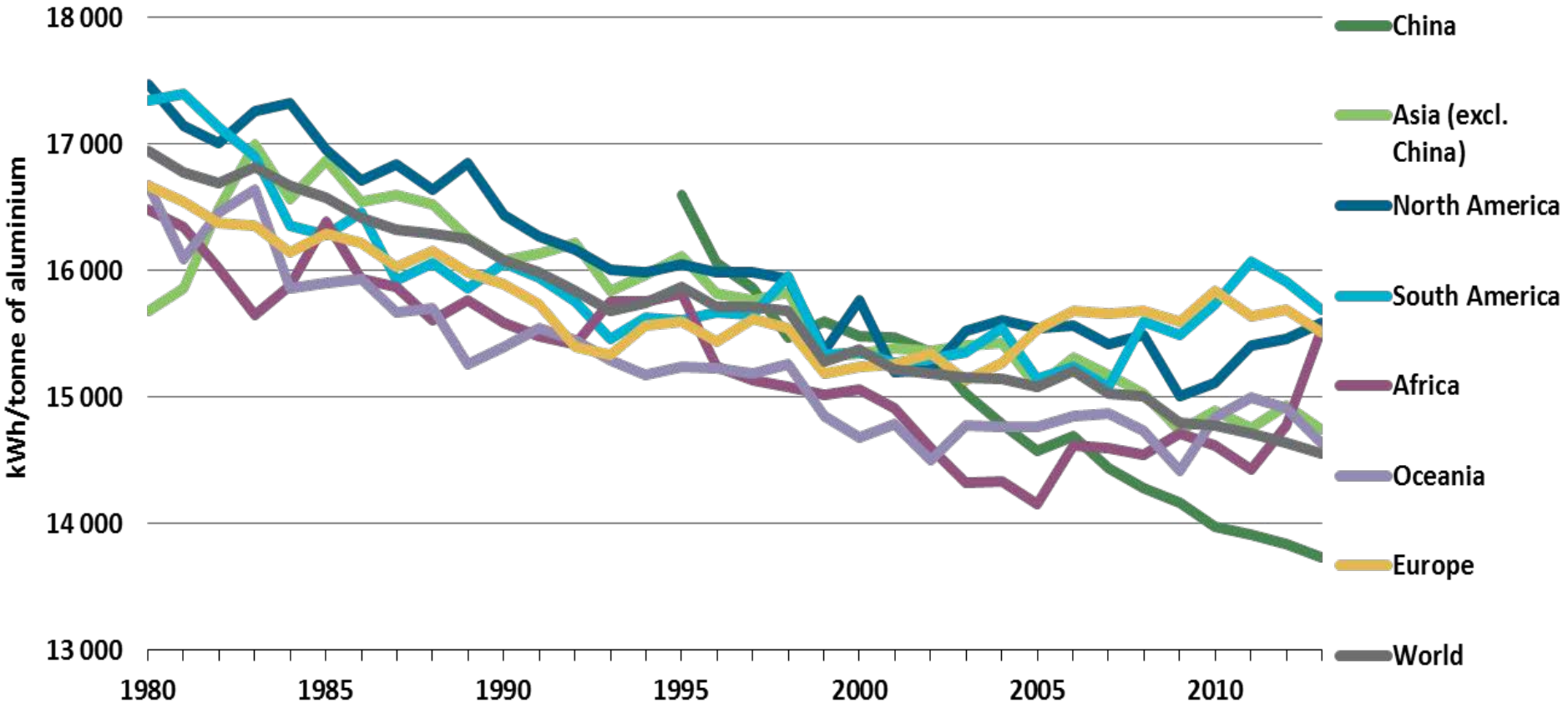


Source: Cement Sustainability Initiative (CSI), Getting the Numbers Right Database (GNR), 2015, www.wbcsdcement.org/GNR-2012/index.html.

Note: Covers 30% of global capacity, and may not have equal coverage in each region.

Level 3 indicator – example

Specific electricity consumption in aluminium smelting

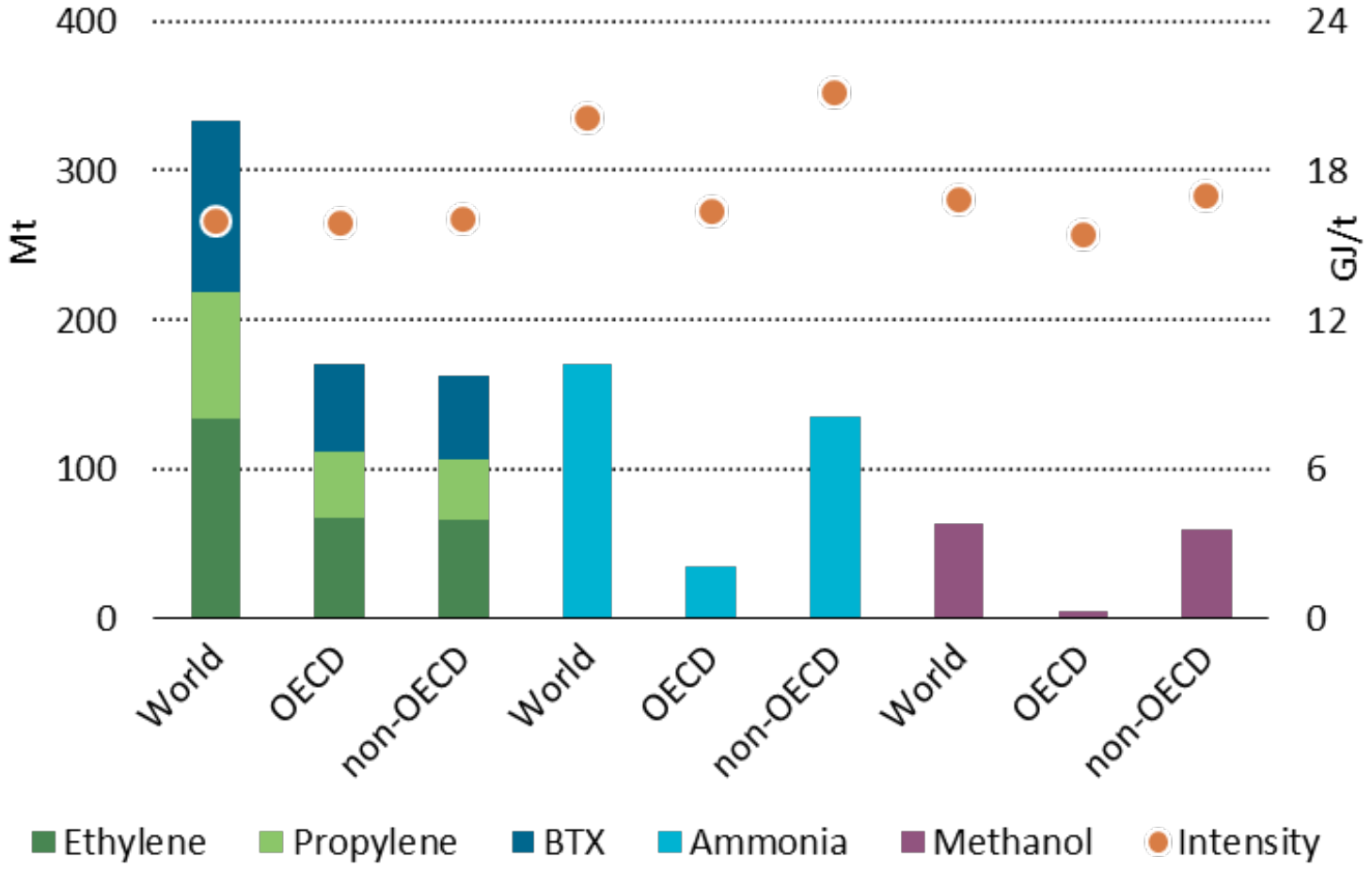


Source: International Aluminium Institute (IAI) Statistics, 2014, www.world-aluminium.org/statistics/.

Note: Estimates used for some regions, and may not have equal coverage in each region.

Level 3 indicator – example

Energy intensity by product and region, 2012



Source: IEA analysis and modelling.

IEA Indicators analysis – examples

Energy intensity by product	Current BAT	2012		
		World	OECD	Non-OECD
Paper and paperboard (GJ/t)	n.a.	7.6	7.5	7.7
Clinker (GJ/t)	3.0	3.7	3.5	3.7
Primary aluminium (kWh/t)	13 611	15 256	15 136	15 296
Aggregated – crude steel (GJ/t)	n.a.	20.7	14.3	23.8

Note: For crude steel energy intensity, fuel used in captive utilities to generate heat used on site is included, fuel used to generate heat for sale is excluded.

Source: Tracking Clean Energy Progress, IEA, 2015; IEA analysis.

Indicators analysis in South Africa

- Which organisations are developing industrial EE indicators, and at what level?
- Which are the most significant gaps in industry EE indicators analysis in South Africa?
- How can indicators that exist contribute to a better understanding of energy efficiency in the South African industrial sector?
- Which indicators should have priority for future development?

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Session 3:

Energy Efficiency Target Setting

Industry

Session 3. Energy Efficiency Target Setting

This session will include a panel discussion of energy efficiency target setting and indicators. The panel session will then follow with three sectoral working groups. Within each working group there will be a presentation and open discussion of energy efficiency target setting and indicators.

Questions to be discussed:

1. What energy efficiency targets are useful?
2. How can indicators be used to set targets?
3. Are indicator-based targets being set?

Session 3. Group B: Industrial

- **Session 3.** Target-setting
  - Developing targets
  - Role of roadmaps and indicators in target-setting
  - Case studies

How are targets developed?

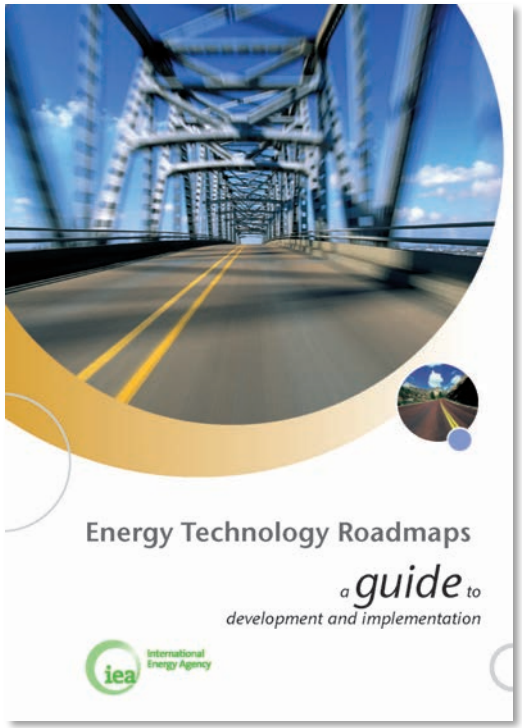
- Outline goals of policy
- Consult with relevant industry stakeholders to understand challenges and opportunities for each sub-sector
- Define indicators and metrics that will be used to set goal and track progress
- Ensure goals are realistic, achievable, and aligned with other policy packages
- Describe steps toward reaching target
- Create monitoring and verification mechanisms

Roadmapping process

- **Roadmaps are closely related to target-setting**
  - Can help identify broad goals, realistic targets, and metrics and indicators for tracking progress
  - Engage public and private stakeholders throughout a sector or sub-sector
  - Outlines first steps toward goals
  - Creates a framework for ongoing collaboration in support of work towards targets

Overview of IEA roadmap process

- **Engage cross-section of stakeholders**
- **Identify a baseline:**
  - Where is technology today?
- **Establish a vision:**
  - What is the deployment path needed to achieve 2050 goals?
- **Identify barriers:**
  - Technical, regulatory, policy, financial and public acceptance barriers
  - What are the near term action items?
- **Develop implementation action items for stakeholders**



Roadmapping process

- **Low-Carbon Technology for the Indian Cement Industry – 2011**
  - IEA and WBCSD
- **Carbon Capture and Storage in Industrial Applications – 2011**
  - IEA and UNIDO
- **Energy and GHG Reductions in the Chemical Industry via Catalytic Processes – 2013**
  - IEA, ICCA, and DECHEMA
- **Roadmaps by major European industry associations**
  - CEFIC (Chemicals)
  - Eurofer (Iron & steel)
  - CEMBUREAU (Cement)

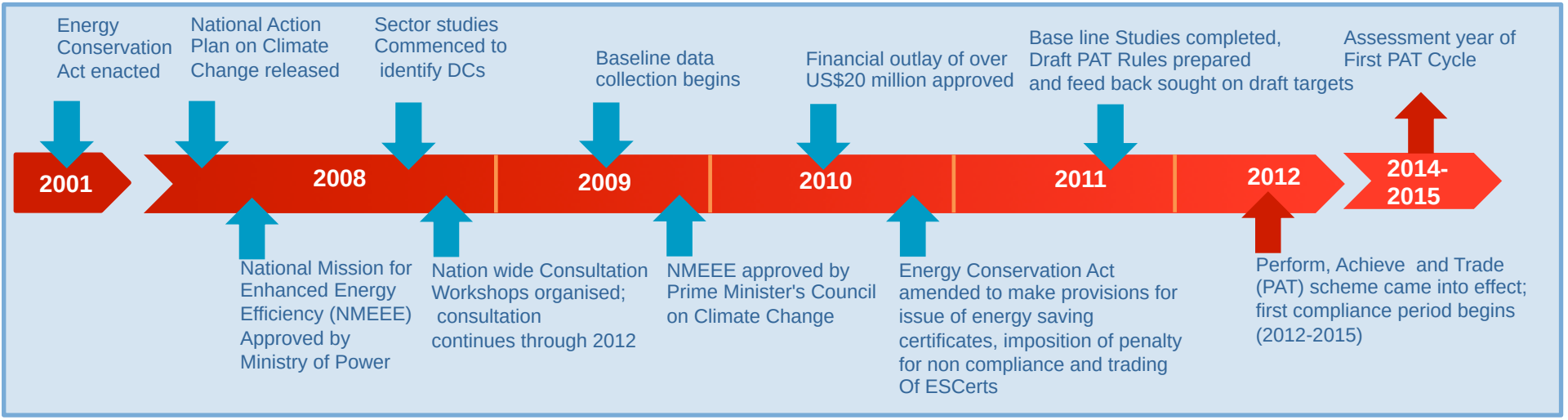
Target-based policy case study: PAT

- **Perform Achieve and Trade (PAT) – India**
- **Covers 478 plants in 8 energy-intensive sub-sectors**
  - Aluminium, cement, chlor-alkali, fertilizer, iron & steel, pulp & paper, textiles, thermal power stations
  - Others could be added in future phases
  - Accounts for 1/3 of final energy consumption in baseline year
  - Large variations in energy intensity in different units in these sectors
- **Target: mandated improvement in specific energy consumption at the unit level**
- **Multi-cycle process** – first enforcement cycle from 2012-2015
- **Policy design and targets based on extensive consultations**

Source: Jyoti Arora, Joint Secretary, Ministry of Power and K. K. Chakarvarti, Energy Economist, Bureau of Energy Efficiency. IPEEC/IEA Joint Session, 12 March 2014.

Perform Achieve &Trade (PAT) timeline

PAT Overview and Elements



Source: Jyoti Arora, Joint Secretary, Ministry of Power and K. K. Chakarvarti, Energy Economist, Bureau of Energy Efficiency. IPEEC/IEA Joint Session, 12 March 2014.

PAT: Establishing a clear baseline

- **Methodology outlined for baseline specific energy consumption at plant level**
  - Typical values defined in PAT consultation document, as well as methodology for calculation and boundary definitions
  - Industry stakeholders extensively consulted in order to define boundaries and indicators, and provide relevant data

PAT: Setting a target

- **Target-setting methodology clearly defined**
  - Percentage reduction of specific energy consumption defined in PAT consultation document
  - Transparent and simple methodology
  - Extensive consultation with industry stakeholders to ensure reasonable goals
- PAT target: **4.2% reduction in SEC** of industry sector over first commitment period (3 years)
  - SEC=**Total energy input to plant boundary (*Mtoe*)/Physical quantity of production (*units of product*)**
  - Baseline SEC: average SEC of past three years

PAT: Setting a target

- Energy savings target is distributed proportionally among sub-sectors according to energy consumption

SN	Sector	Energy Consumption	Share of Consumption	Apportioned Energy reduction	No. of identified DCs
		(mMTOE)	(%)	(mMTOE)	
1	Power (Thermal)	160.30	66.64%	6.66	154
2	Iron & Steel	36.08	15.00%	1.50	110
3	Cement	14.47	6.02%	0.60	92
4	Fertilizers	11.95	4.97%	0.50	22
5	Railways (Approximated)	9.00	3.74%	0.37	8
6	Textile (Approximated)	4.50	1.87%	0.19	197
7	Aluminium	2.42	1.01%	0.10	11
8	Paper & pulp	1.38	0.57%	0.06	70
9	Chlor-Alkali	0.43	0.18%	0.02	23
Total		**240.53**	**100.00%**	**10.00**	**687**

Source: SP Garnaik, Energy Economist, Bureau of Energy Efficiency. Pre-Bid Conference on Baseline Energy Audit under PAT, http://beeindia.in/content.php?page=schemes/schemes.php?id=9.

PAT: Setting a target

- Distributed proportionally among plants within those sub-sectors according to SEC performance relative to similar plants

Plant Name	Production (in Tonnes)				Estimated SEC (in MTOE/ ton)				Relative SEC	Total Energy consumption (in MTOE)	% Target	To be Energy Saving
	2005-06	2006-07	2007-08	Average production (MT)	2005-06	2006-07	2007-08	Average SEC				
Plant1	3,62,793	3,68,867	3,78,157	3,69,939	1.275	1.272	1.277	1.274	1.000	4,71,455	X	4714.55x
Plant2	3,58,954	3,58,734	3,59,213	3,58,967	1.364	1.365	1.362	1.364	1.070	4,89,546	1.07X	5238.14x
Plant3	76,867	2,07,741	2,50,981	1,78,530	1.569	1.355	1.276	1.400	1.098	2,49,920	1.10X	2749.12x
Plant4	66,347	73,008	99,406	79,587	1.425	1.452	1.408	1.428	1.121	1,13,679	1.12X	1273.2x
Plant5	NA	NA	37,635	37,635	NA	NA	1.780	1.780	1.397	66,995	1.40X	937.93x
Total										13,91,594		14912.9X

Source: SP Garnaik, Energy Economist, Bureau of Energy Efficiency. Pre-Bid Conference on Baseline Energy Audit under PAT, http://beeindia.in/content.php?page=schemes/schemes.php?id=9.

PAT: Sub-sectoral divisions

Sector	Basis for division	Categories
Thermal power plants	Fuel input	Coal, gas, oil
Cement	Process route	Dry-process, wet-process
Iron & steel	Operation	Integrated, sponge iron
Fertilizer	Feedstock	Natural gas, naphtha
Aluminium	Operation	Refinery, smelter
Pulp & paper	Raw material	Wood, agro, RCF
Textile	Operation	Spinning, processing, composite, fiber, yarn
Chlor-alkali	Technology	Membrane cell, mercury

Source: Bureau of Energy Efficiency (2011). *PAT Consultation Document, 2010-11*, http://beeindia.in/NMEEE/PAT%20Consultation%20Document_10Jan2011.pdf.

PAT: Measurement and Verification

- **Mandatory reporting by plants included in the PAT scheme**
  - Baseline
  - Annual reports
  - At the end of the commitment period
- **Audits by designated independent auditors**
- **Provisions for both transparency as well as safeguarding of confidential information**

PAT: Market-based mechanism

- **Energy savings certificates trading**
  - Certificates (ESCerts) will be issued to plants who exceed targets
  - ESCerts can be traded to plants who have been unable to meet their targets, either bilaterally or on specially created exchanges
  - Penalty for non-compliance based on fixed fine + additional fine linked to fuel prices

PAT: Lessons learned

- Early industry and stakeholder **consultation** is key
- **Accurate data** for baseline, target-setting, and monitoring is needed
  - Clear definitions of boundaries needed
  - Confidentiality issues to overcome
- Success requires **significant time and institutional support**
- **Some industries fit framework better than others**
  - i.e. complexity of chemicals/fertilizers industry makes SEC calculation difficult

Source: Neelam Singh (2013). World Resources Institute, "Inside Stories on climate compatible development", http://r4d.dfid.gov.uk/PDF/Outputs/CDKN/India-PAT_InsideStory.pdf

Policy case study: EEO

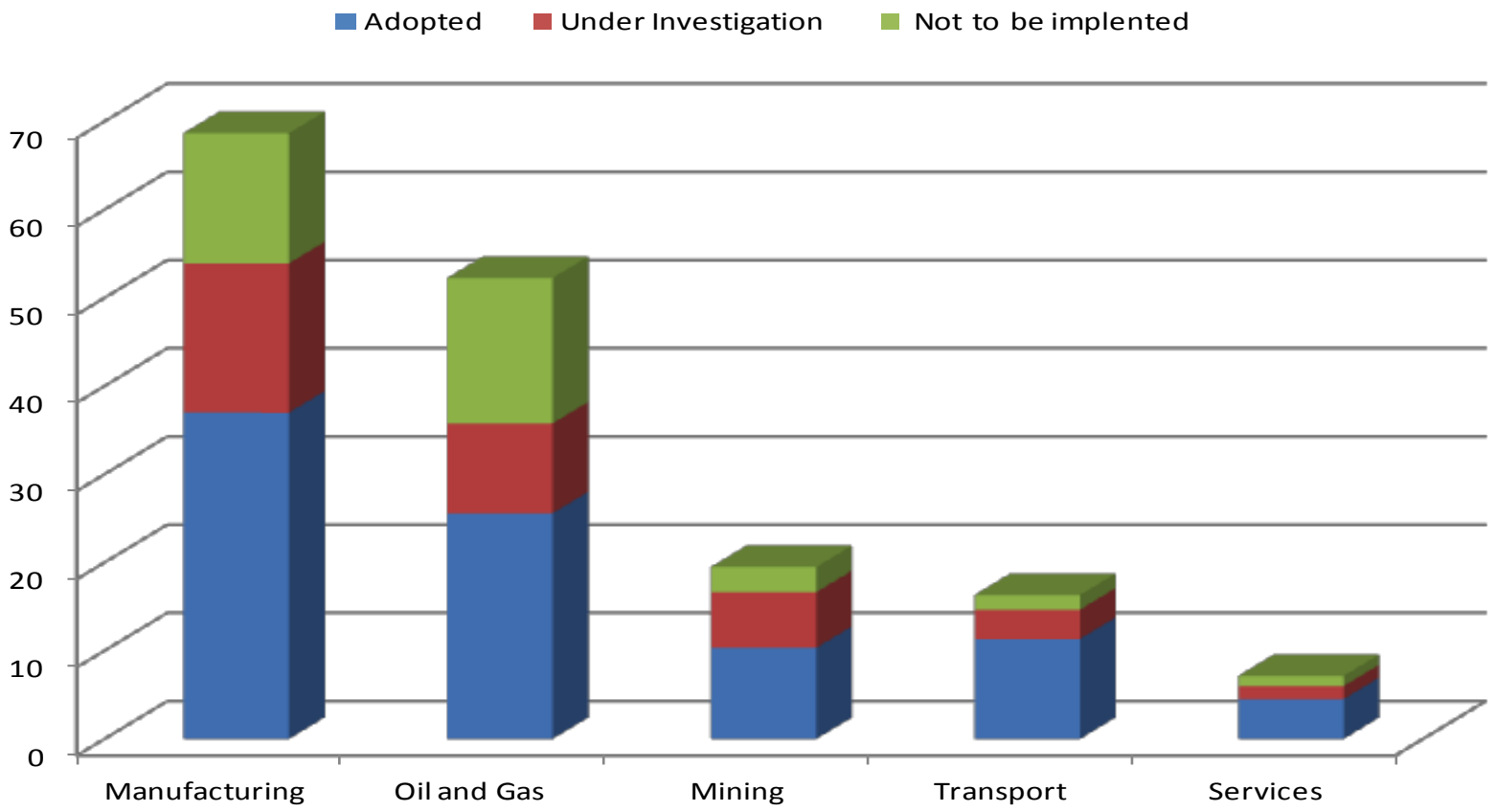
- **Energy Efficiency Opportunities (EEO) programme – Australia**
- In place from **2006 to mid-2014**
- Mandatory participation for energy users over **threshold of 0.5 PJ/year**, voluntary for other users
- Covered over **300 companies** representing over **65% of total energy consumption**
- **Required assessment of energy use** and reporting on results and response
- **No required EE implementation actions**

EEO: Assessment Framework

- **6 requirements:**
  - Support and commitment from **leadership**
  - Skilled and knowledgeable **people**
  - Sufficient **information, data and analysis** to track outcomes
  - Effective process for **opportunity identification and evaluation**
  - Clear mechanisms for informed **decision making**
  - **Communicating outcomes** throughout corporation and senior management
- Participating companies must provide **evidence of specific actions** in each of the 6 categories
  - Results reported to government and to public
- Verification by Dept. of Industry

EEO: Results

- 164 PJ of energy savings opportunities identified, 89 PJ implemented



Source: Dominic Zaal, Department of Resources, Energy and Tourism (2013). "EEO Program Update", http://energyefficiencyopportunities.gov.au/templates-and-tools/eeo-workshops-2013/.

EEO: Results

- First 5 year cycle completed in June 2011
- **89 PJ of energy savings implemented** (voluntary basis)
  - $800 million financial benefit per year
  - 1.5% of annual GHG emissions
  - Estimated 40% average energy savings for participating firms
- Reports containing **significant opportunities identified** in each sector
- Case studies available on website:
  - http://eex.gov.au/energy-management/energy-efficiency-opportunities/

EEO: Case study – Thiess Mining

- **Thiess Australian Mining business unit**
- 206 ideas, 46 potential projects investigated, 4 selected to proceed immediately
  - Payload management
  - Automated mobile lighting equipment
  - Plant idle-time management
  - Turbo idle-down time
- Estimated **150 800 GJ/year savings** (1.7% of total energy use)
  - 10.6 ktCO2-equivalent
  - $3.7 million
  - Simple payback period of less than two years

Source: Australian Government, Department of Resources, Energy and Tourism (2009). "Case Study: Thiess' Australian Mining Business Unit", http://energyefficiencyopportunities.gov.au/files/2012/11/Thiess-Australian-Mining-Business-Unit.pdf.

EEO: Lessons learned

- **Accurate data** for baseline, target-setting, and monitoring is needed
  - Data must be shared with appropriate stakeholders in order to get results
- Some **duplication of efforts** as a result of overlapping reporting requirements from various policies
- **Alternative compliance mechanisms should be provided** for those already addressing EE
- **Clarity** is needed in policy requirements

Source: ACIL Tasman(2013). "Executive summary of Energy Efficiency Opportunities Program Review", http://eeo.govspace.gov.au/files/2013/05/EEO-Program-Review-Executive-summary.pdf.

Key questions to consider

- **Data Availability:** Is the data that is needed for relevant indicators currently available? If not, how will it be collected?
- **Target Requirements:** Will targets be mandatory or voluntary? If mandatory, how will the targets be enforced?
- **Target Basis:** Will the targets be based on absolute improvements of indicators, or percentage?
- **Applicability:** To which sub-sectors will the targets apply? How will boundaries be defined for the policy? Will there be thresholds in terms of energy consumption?
- **Target Application:** At which level will the target be applied? Sector-wide, sub-sector, company-level, plant-level, product-level?
- **Policy Interaction:** How does this target interact with other policies that affect industry?

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