global cemfuels
CONFERENCE & EXHIBITION

"Global development AFR use"

Ed Verhamme - Managing Partner

Jacob Zwaal - Business Analist

Alternate Resource Partners (ARP)

alternate resource partners

Topics covered in presentation

- Introduction Alternate Resource Partners
- Introduction and questions global development AFR use
- Cement production & TSR today and future
- Developments:
  - ✓ Traditional fuels/energy
  - ✓ Alternative fuels (TSR)
  - ✓ Alternative fuels (waste sources)
  - ✓ Waste Management
  - ✓ Legislation
  - ✓ CO_2
- Observations and answers questions global development AFR
- Take home messages

Introduction Alternate Resource Partners

- Established 2009
- Group consultants, engineers, trainers, coaches & field operators for resource management & circular economy
- Worldwide experience in mature and emerging countries replacing fossil fuel/primary raw materials by waste transformed to AF and/or AR
- ARP & partners have > 150 years experience in all aspects of resource management and cement manufacturing when it comes to AFR
- Part time consultant UNDP, FAO & World Bank Group on waste market and cement kiln co-processing capability assessments

Introduction Alternate Resource Partners

- Main activities ARP:
  - Resource management business development in cement, lime & electric power industry,
  - Waste – to – AFR market research, feasibility studies, etc.,
  - Pre- & Co-processing Marketing & Sales training & coaching,
  - Consulting, reviews & audits health, safety & environment behavior,
  - Development of specialized recycling machines for waste to AFR activities, example: oil - filter recycling machine emerging countries

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Introduction global development AFR use

- AFR use (co-processing) one of best proven WtE technologies
- Main drivers:
  - Abatement of climate change
    - AFR use: potential CO_2 reduction 0.75 Gt up to 2050
  - Progress towards circular economy
    - Valorization of waste streams – resource recovery
    - Replacement of virgin material
  - Improved waste management
    - Divert energy content from landfill waste efficiently

Source: Status and prospects of coprocessing of waste in EU cement plants

Questions on global development AFR use

- Which areas/countries are coming up?
- Which areas/countries and waste streams have the most potential?
- Which areas are already saturated

- Caveat:
  - Waste business and circular economy are in constant change as well as sustainable development

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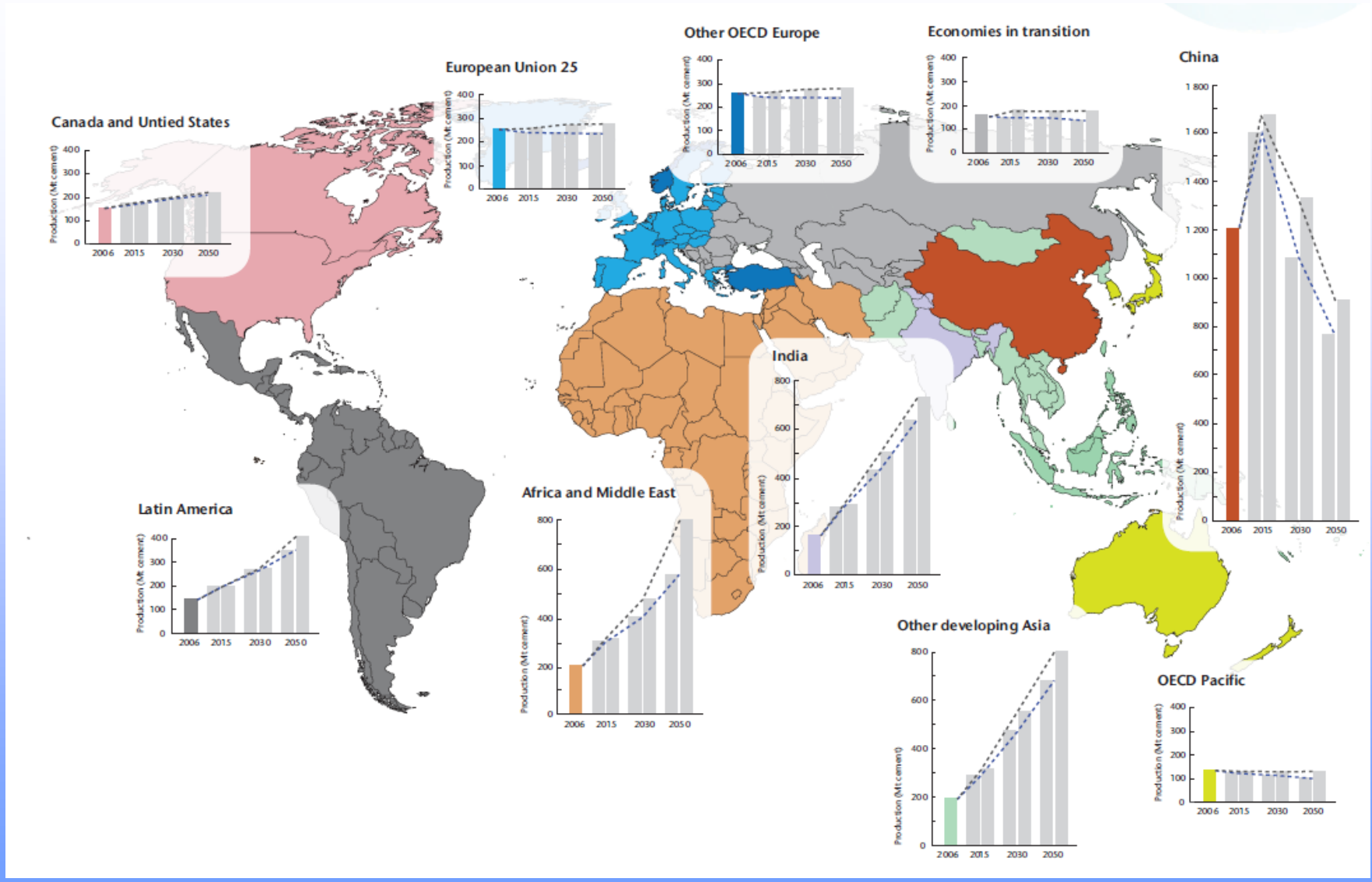
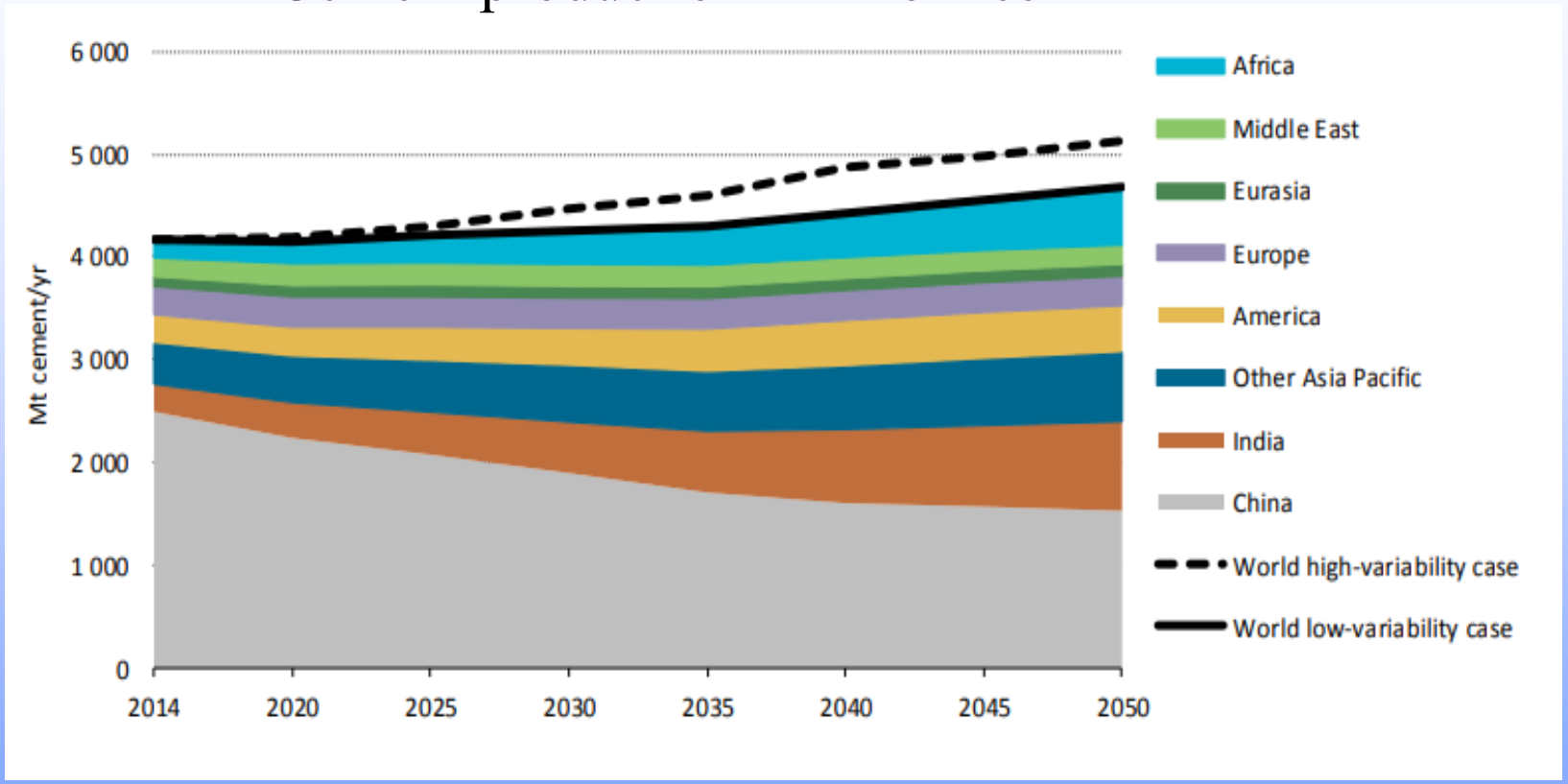
Cement production today & future



Source: WBCSD Cement Roadmap (2009)

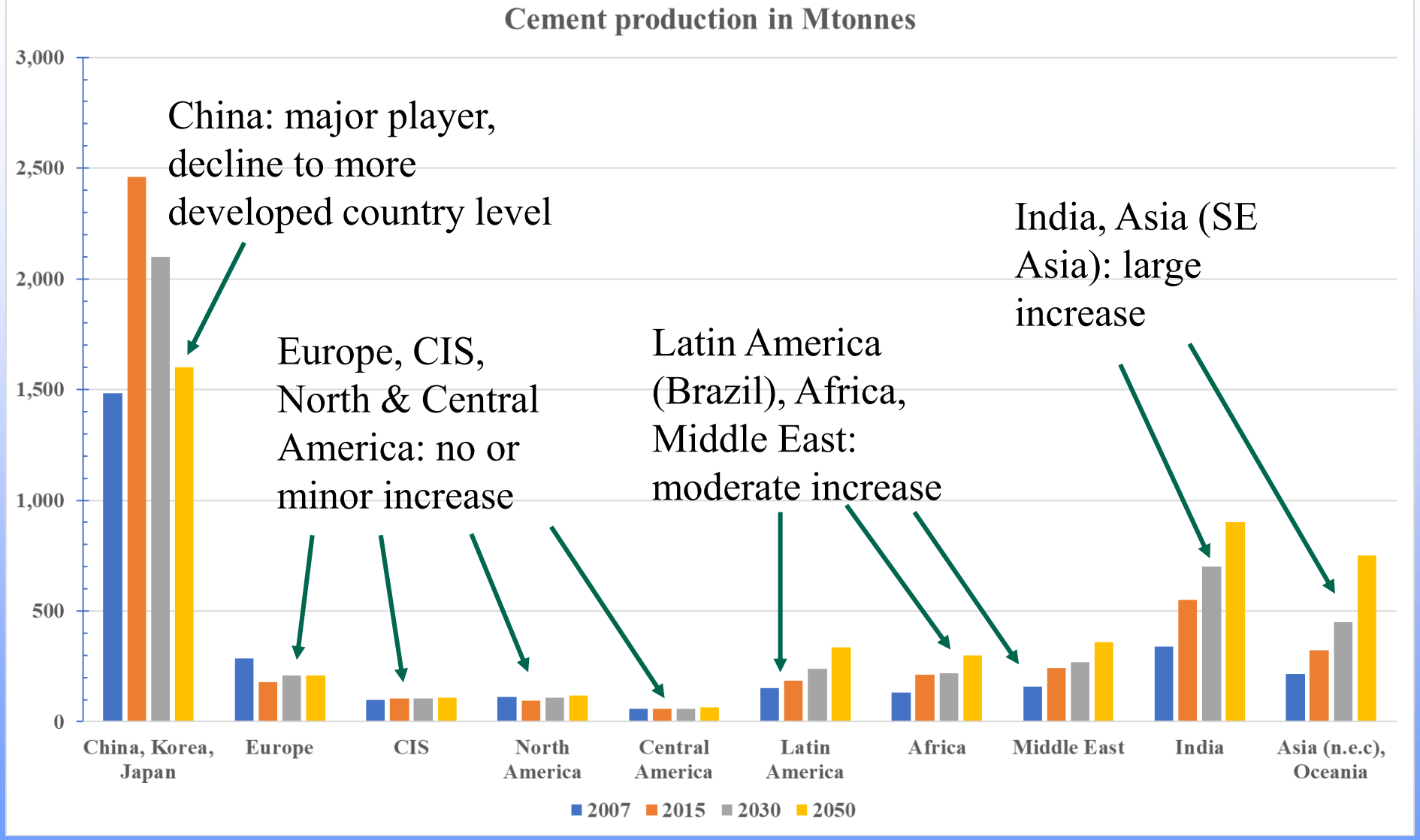
Cement production today & future

Cement production in Mtonnes



Source: IEA: Industry Technology Roadmaps: a focus on Cement (2017)

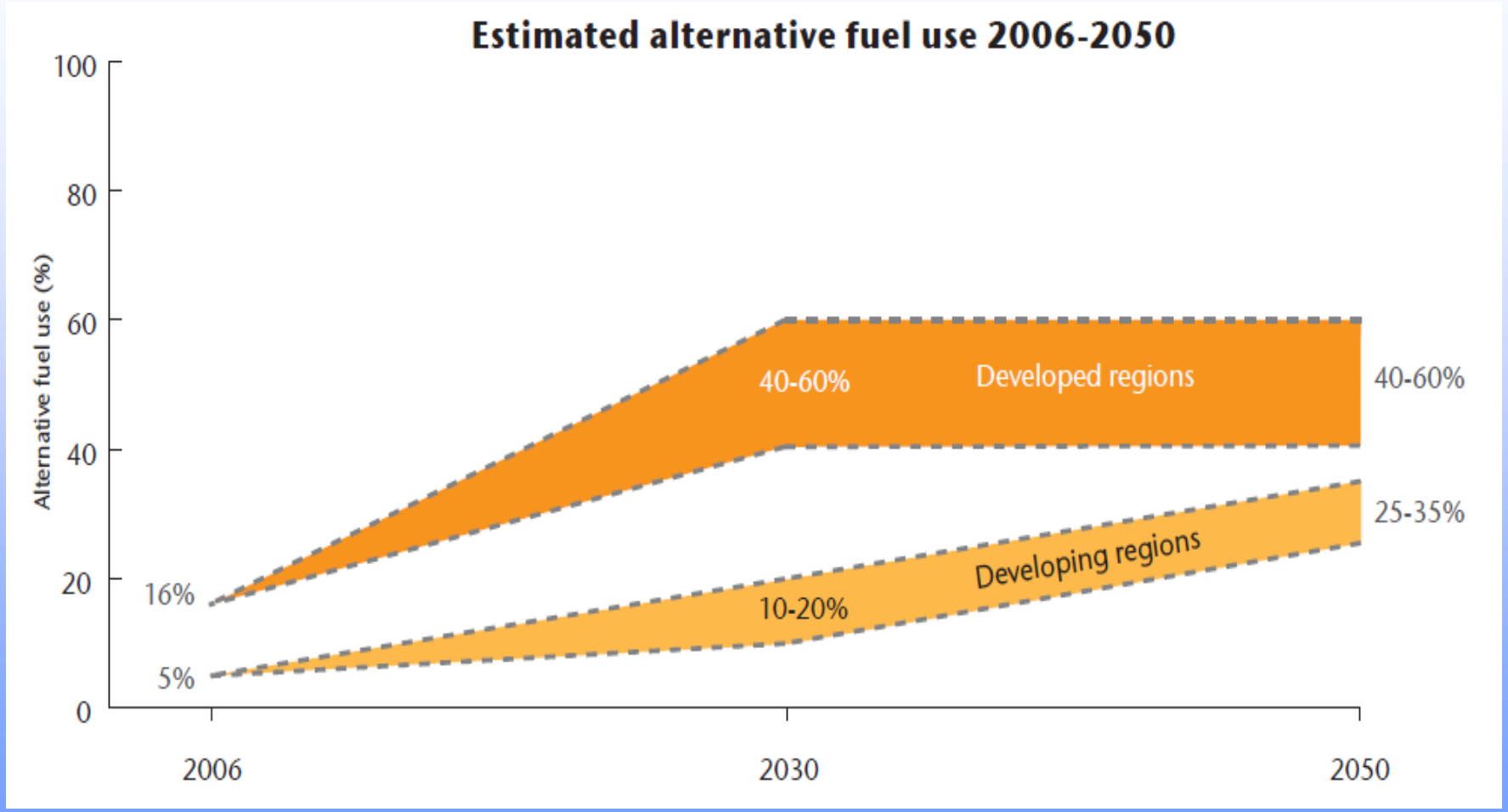
Cement production today & future



Source 2007/2015: WBCSD Cement Sustainability Initiative Getting the Numbers Right Project Emissions Report 2015,
Source 2030/2050: CWBCSD Cement Technology Roadmap 2009

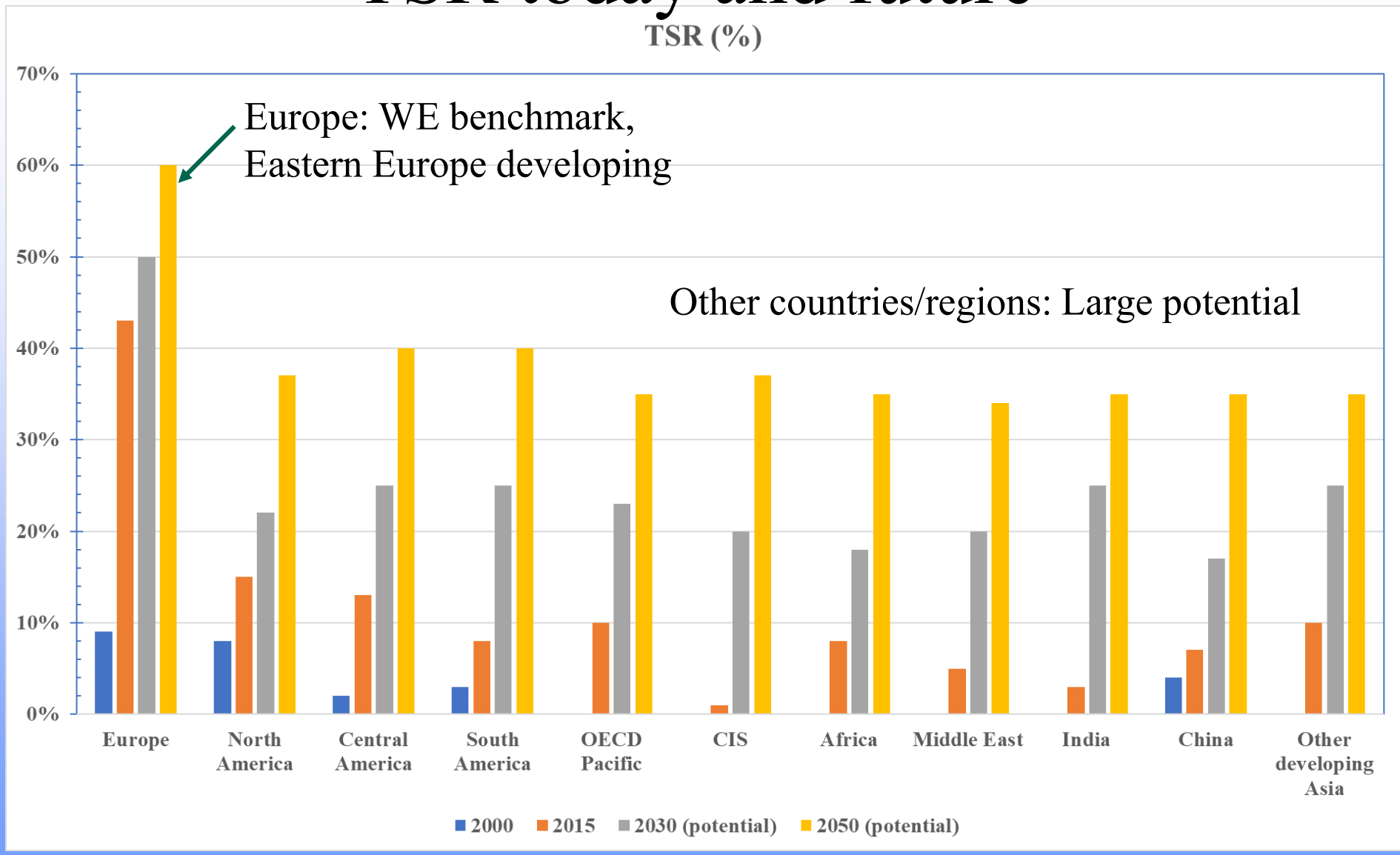
TSR today and future

TSR in %



Source: Cement Technology Roadmap 2009

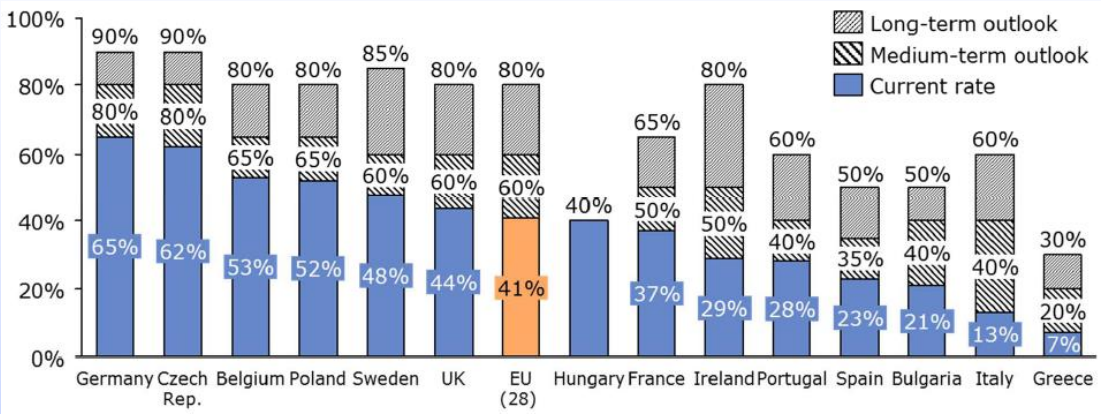
TSR today and future



Source 2007/2015: WBCSD Cement Sustainability Initiative Getting the Numbers Right Project Emissions Report 2015,
Source 2030/2050: CWBCSD Cement Technology Roadmap 2009

TSR benchmark case Europe

- Europe: Average TSR today 41%

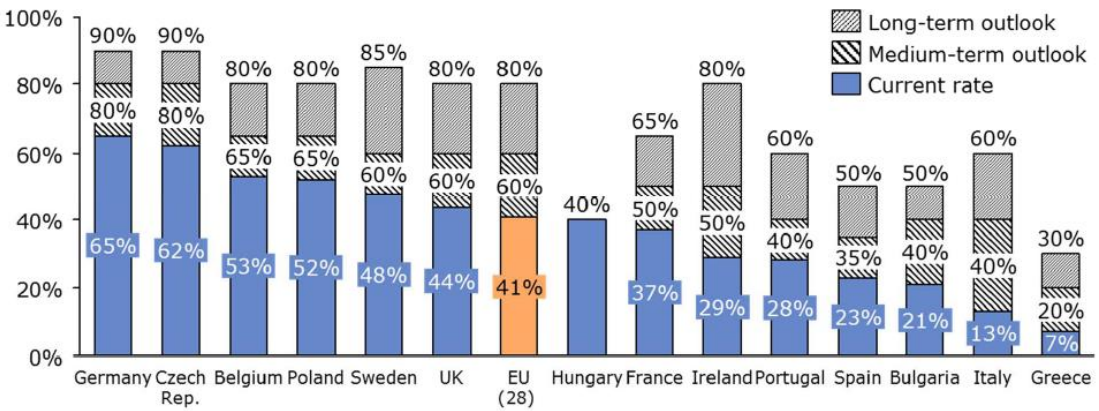


- Number of countries over 60%, some others lagging
- All countries at 60% average rate could:
  - Avoid 26.0 Mtonnes of CO_2 emissions
  - Process 15.7 Mtonnes of waste
  - Save 11.1 Mtonnes of coal equivalent
  - Avoid €12.2 billion investment in dedicated WtE plants

Source: Status and prospects of co-processing of waste in EU cement plants

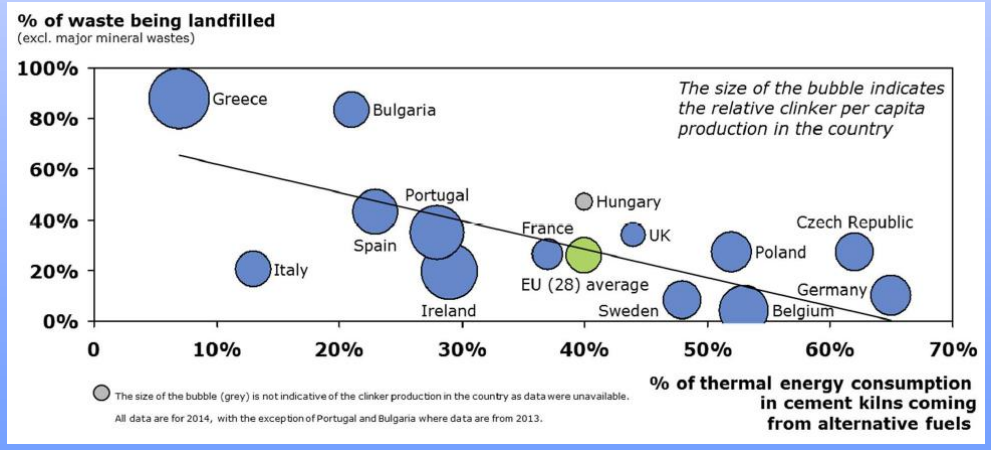
TSR benchmark case Europe

- Europe: Average TSR today 41%

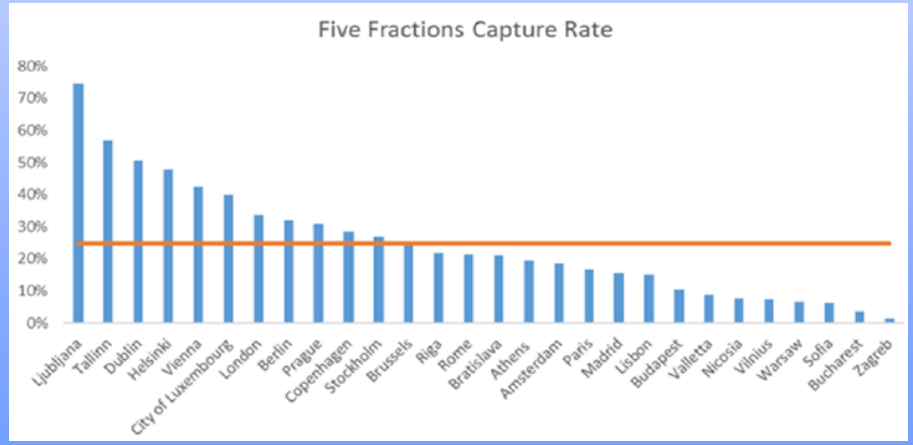


- Correlation with maturity waste management systems

Landfill ban & taxes



Separate collection



Source: Ecofys: Status and prospects of co-processing of waste in EU cement plants (2017), Bipro: Assessment of separate collection schemes in the 28 capitals of the EU (2015)

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  - ✓ Legislation
  - ✓ CO_2
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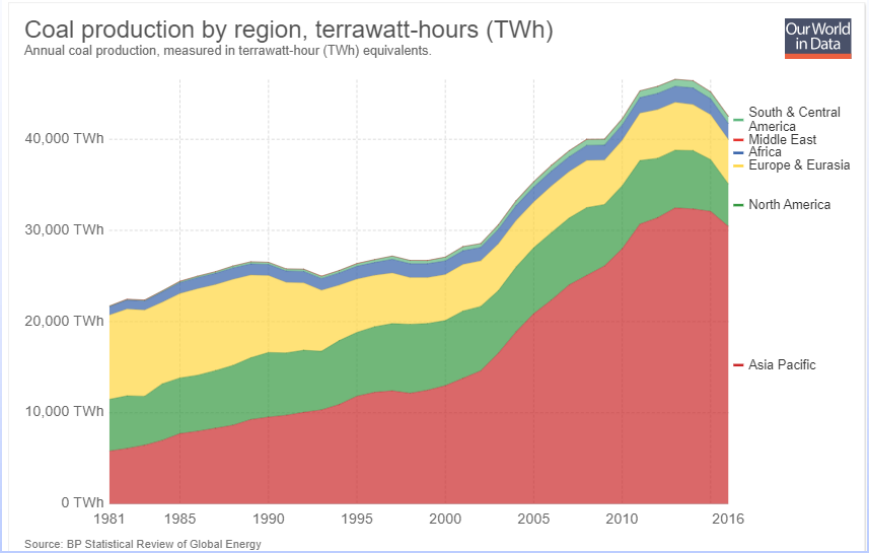
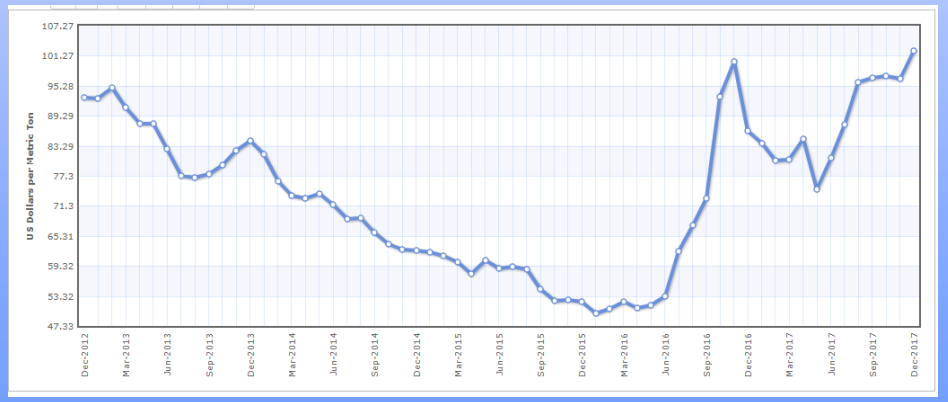
Developments traditional fuel/energy

- Coal production
  - Peak over the years 2013-14, with several years of declining production since
  - Major producer Asia Pacific (70%)
- Coal price:
  - Volatile depending on quality, yet rising



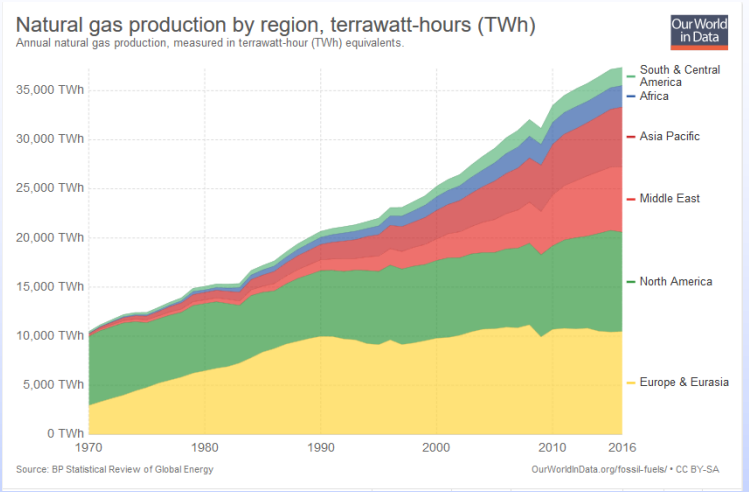


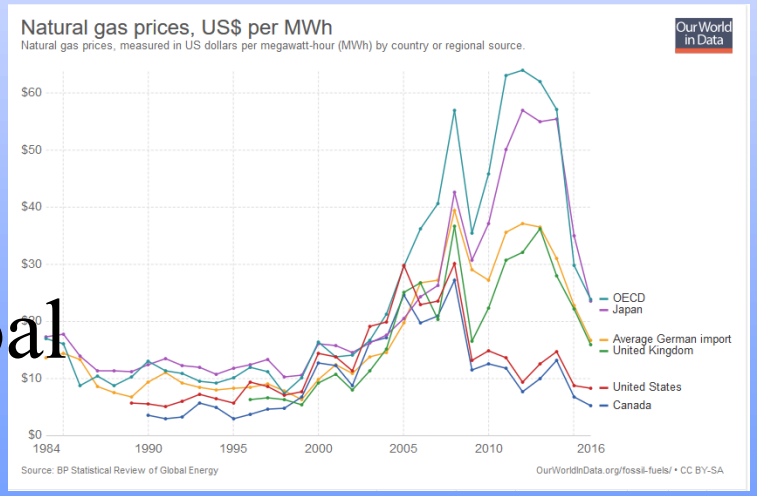
Source: Our world in data: Fossil Fuels

Developments traditional fuel/energy

- Gas production
  - Diversified production
    - North America, Europe, Eurasia 55%,
    - Middle East, Asia Pacific, Latin America, Africa 45%
- Strong competition:

  Fuel substitution for decarbonization
- Gas price less volatile than coal
- Main issue: Reserves





Source: Our world in data: Fossil Fuels

Developments traditional fuels/energy

- Traditional fuels (coal and gas) are main energy source
- But: large source of air pollution and emitter of CO_2 and other greenhouse gases
- Important: balance between social economic development vs transition to low carbon energy sources
- Transition to circular economy will drive search for improved utilization of waste streams
- Non material recyclable waste streams well suited for energy generation
- In cement industry: replacement of traditional fuels

Source: Our world in data: Fossil Fuels

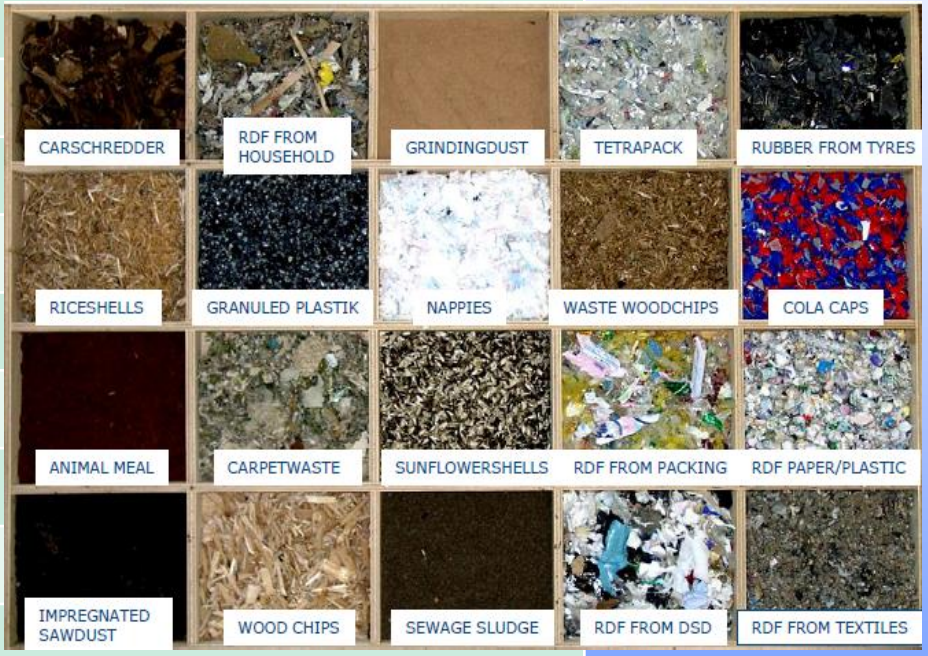
Developments alternative fuels

- Physical and chemical properties require increased HS&E management
- Where to enter value chain in waste management to secure continues supply of source material/AFR
- Presence of (integrated) waste management systems (collection, separation, “treatment”) needed to ensure sufficient source material for supply to kilns
- Pre-treatment increasingly needed to ensure uniform composition and optimum combustion in case of higher TSR
- Present technical limitations on usage of AF
- Future technical developments to increase TSR needed

Source: Cement Technology Roadmap 2009

Developments alternative fuels; sources

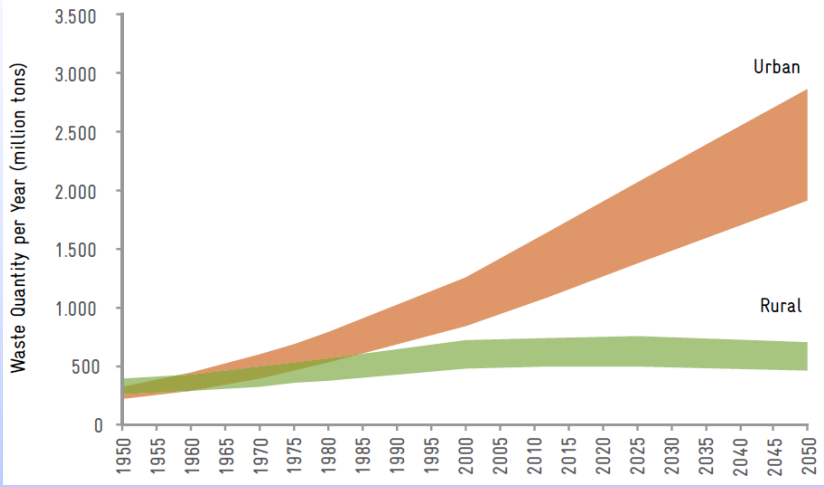
Waste source
Pretreated solid municipal, industrial & commercial waste - RDF/SRF
Plastics, textiles and paper residues (not for material recycling)
Biomass
✓ Sewage sludge
✓ Agricultural crop waste
✓ Wood chip and other biomass
✓ Meat and bone meal
✓ (Impregnated) sawdust
Construction & demolition waste
Used tires
Waste oil, used solvents and liquid waste
Other industrial waste and fossil based fuel



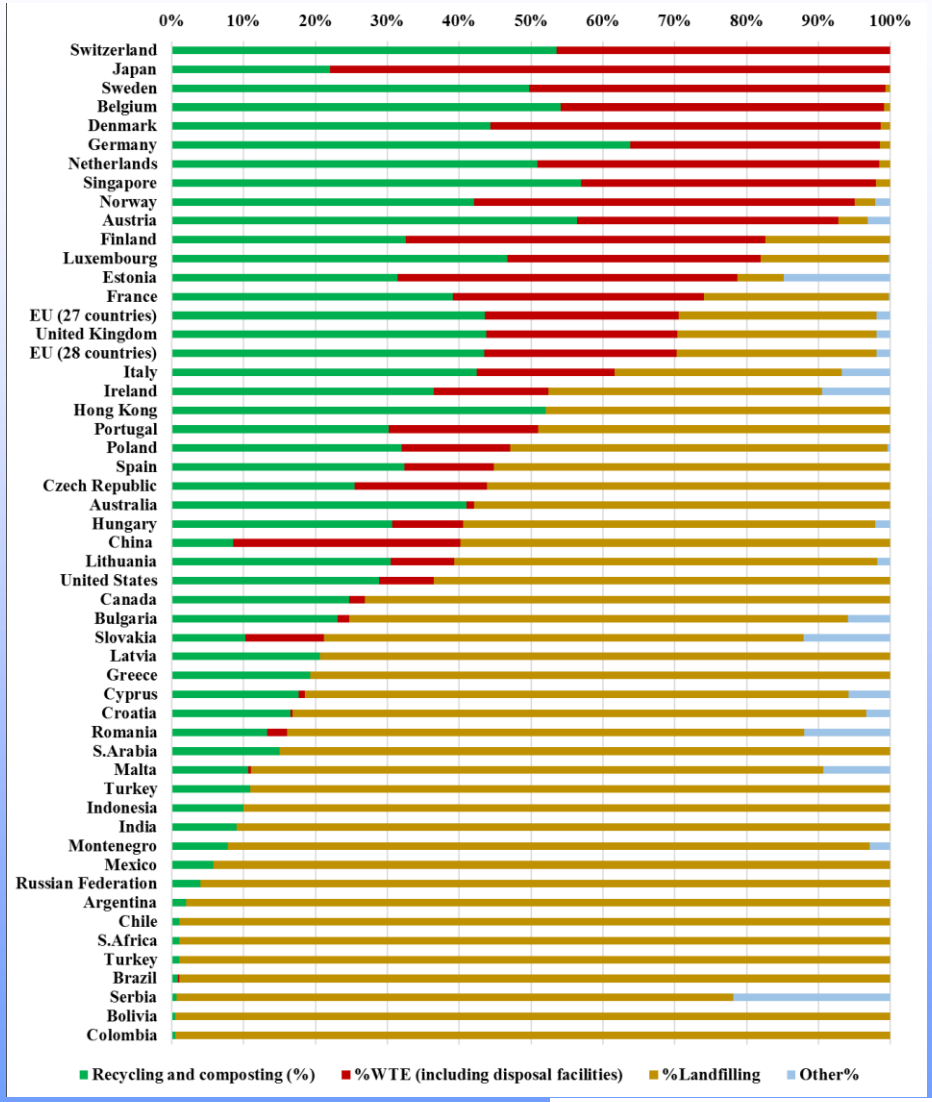
Source: GIZ: Waste-to-Energy Options in Municipal Solid Waste Management

Developments waste management; MSW

- Current 2 billion tons MSW is generated, growth mainly in urban areas



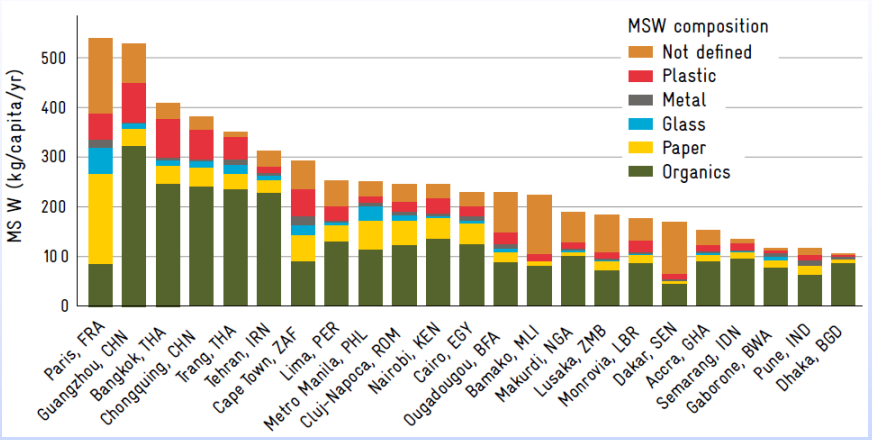
- 70% of MSW today to landfills and/or uncontrolled dump sites
- Current material recycling levels insufficient
- Waste can be used for energy recovery by co-processing in cement kilns as the most efficient WtE technology



Source: GIZ: Waste-to-Energy Options in Municipal Solid Waste Management

Development waste management; MSW

- MSW 100 – 400 kg/capita/a
  in developing countries

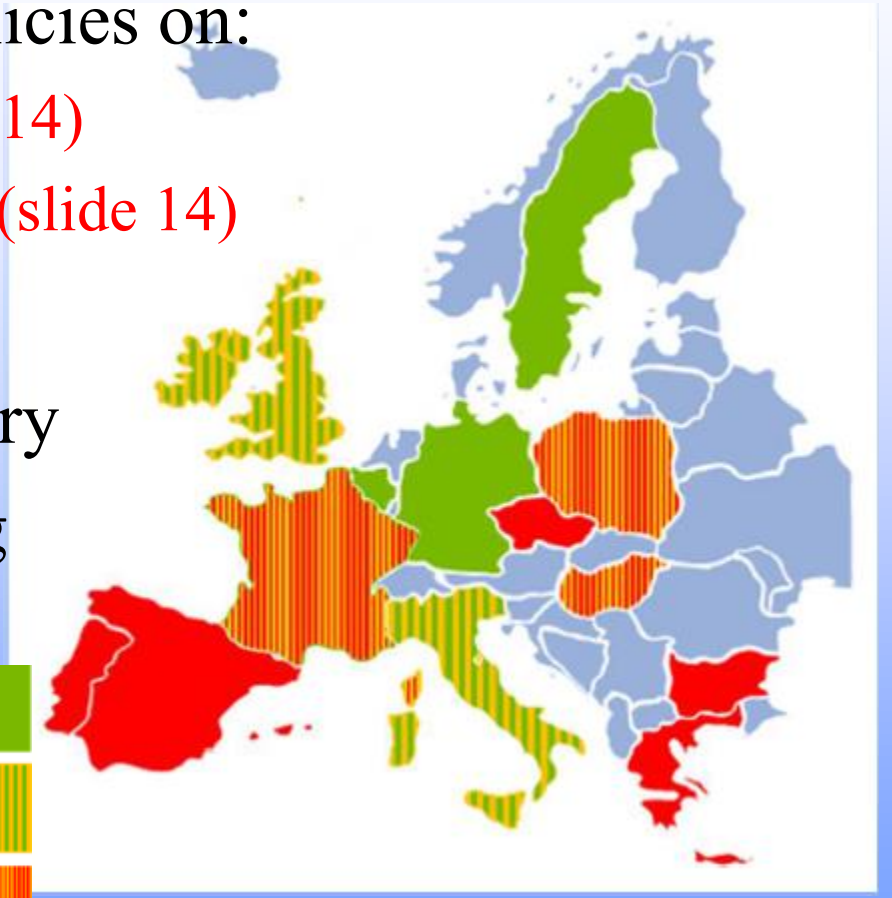


- Issues to keep in mind:
  - After material recycling remaining fraction is heterogeneous, highly organic with low calorific value.
  - Continuous assessment of waste material required prior to co-processing
  - Transport to kiln
  - Social impact on informal market
- Legal framework requires:
  - Legal certainty, roles and obligations clear, protection
  - Legitimacy of administrative actions
  - Emission standards/environmental prescriptions require legal anchorage and regular control by qualified and well-equipped public authorities

Source: GIZ: Waste-to-Energy Options in Municipal Solid Waste Management

Developments waste management; EU

- Main drivers:
  - EU waste management policies on:
    - Landfill ban & taxes (slide 14)
    - Separated waste collection (slide 14)
  - Low levels of bureaucracy
  - Modernized cement industry
  - Fossil fuel price (including volatility)



Source: Status and prospects of coprocessing of waste in EU cement plants

Developments waste management; Plastic

- Growing awareness plastic waste problem,

  Co-processing contributes to:

  - Reduction of plastic leakage, environmental contamination by treating non-recyclable plastic waste.

  - Mitigation CO_2 emissions from cement production and reduction virgin fossil feedstock in cement manufacturing.
  - Reduction of new public expenditure as waste is co-processed in existing cement capacity network.

- Required: Plastics strategy policymakers to focus on:
  - Need for landfill ban recoverable and recyclable waste streams.
  - Recognition co-processing activity reduces cement industry's need for primary fuel and raw materials and lowers CO_2 footprint.

Source: Position paper on plastics strategy (CEMBUREAU, 2018)

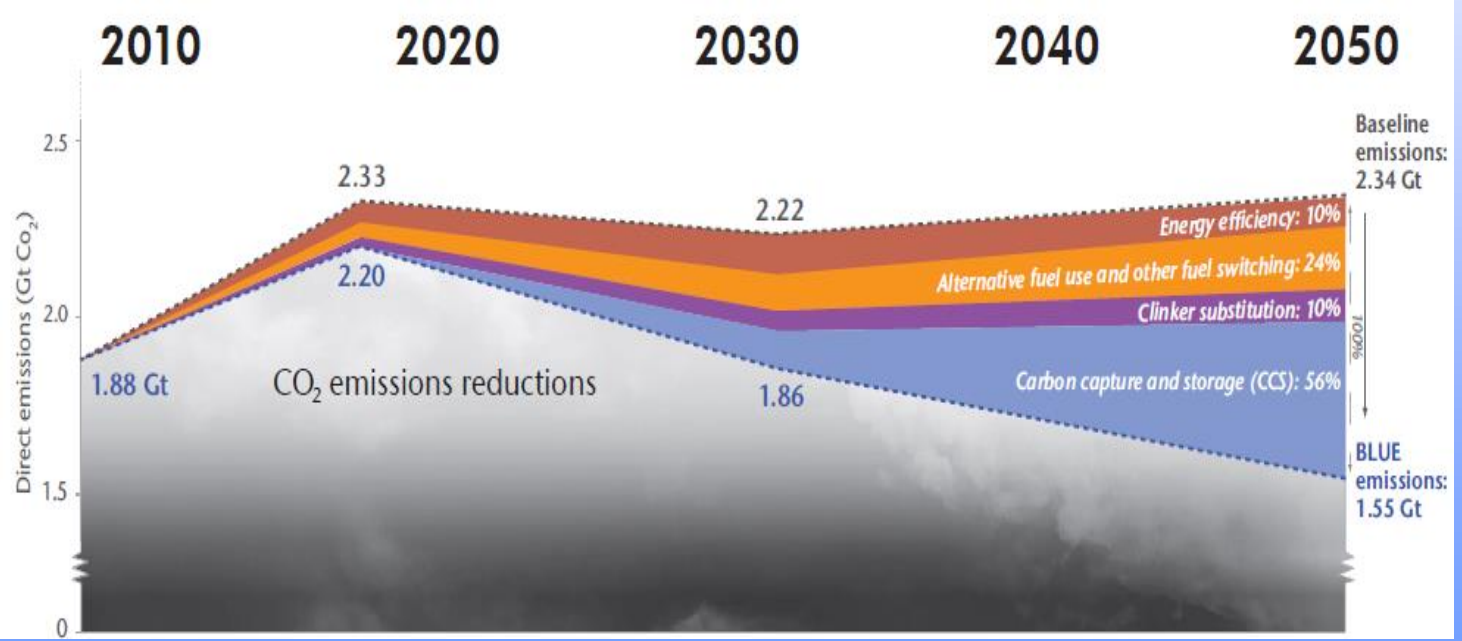
Developments legislation

- Political & legal requirements to increase/allow use AF:
  - Waste management legislation must:
    - Restrict landfill (ban)
    - Introduce specific landfill taxes
    - Allow controlled waste separation, collection and treatment and AF production
  - CO_2 regulation must be present
    - Increases availability of waste and biomass fuels
  - Reduced subsidy policy on production biogenic materials
    - Fiercer competition with other industrial sectors
- Level of social acceptance of co-processing

Note: continuous communication/lobby needed to get/maintain required position

Developments CO_2

- CO_2 emission reduction cement industry through:
  - Thermal en electric efficiency
  - Alternative fuels
  - Clinker substitution
  - Carbon Capture and Storage (CCS)
- Targets:

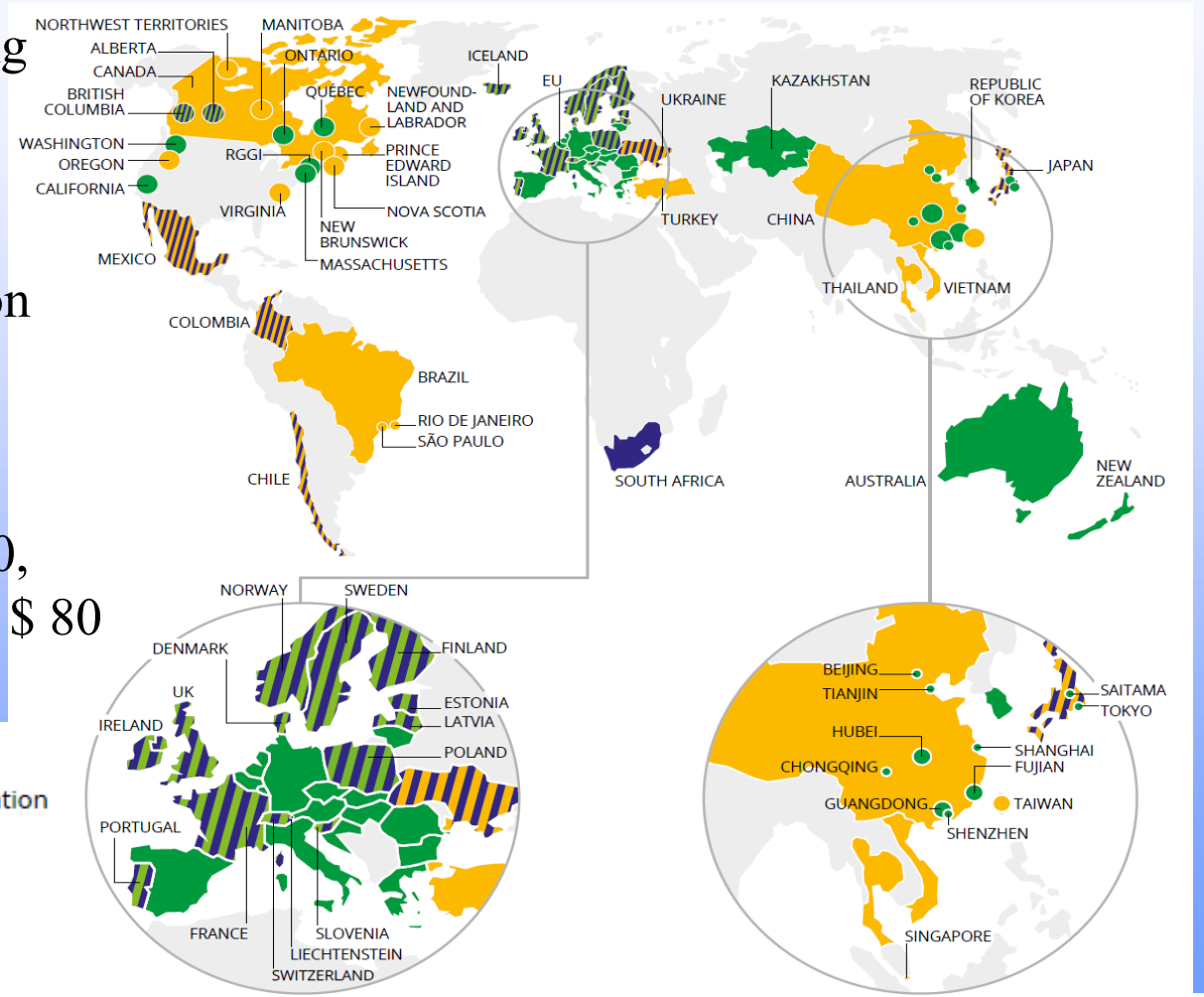


Source: WBCSD Cement Technology Roadmap 2009

Developments CO_2

- Carbon pricing in view Paris Agreement:

- Links domestic carbon pricing initiatives to international market mechanisms (ETS)
- Half of global economy (67 jurisdictions) use a carbon pricing mechanism
- This is covering > 25% of global GHG emissions
- Carbon price level $1 - $ 140, 75% under $10, target $ 40 - $ 80



Source: World Bank - State and Trends of Carbon Pricing 2017

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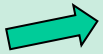
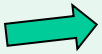
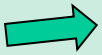
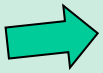
Observations

	Cement production	TSR potential	State of legislation	Waste Management System	CO_2
Europe			****	****	****
North America			****	****	****
Central America			****	****	****
Latin America			****	****	****
China			****	****	****
CIS			****	****	****
India			****	****	****
SE Asia			****	****	****
Africa			****	****	****

Observations

Waste source	Potential
Solid municipal, industrial & commercial waste – SRF/RDF	
Sewage sludge	
Agricultural crop waste	
Wood chip and other biomass	
Plastics, textile and paper residues (not for material recycling)	
Construction & demolition waste	
Used tires	
Waste oil	
Solvent and liquid waste	
(Impregnated) sawdust	
Meat and bone meal	
Other industrial waste and fossil based fuel	

Answers questions global development AFR use

- ***Which areas/countries are coming up?***
  - ✓ ***Based on Cement production & TSR development:***
    - ***China (major player)***
    - ***SE Asia, India, Eastern Europe***
  - ✓ ***Depending on waste management legislation:***
    - ***SE Asia, Latin America***
    - ***Longer term: Africa***
  - ✓ ***Depending on new technical developments:***
    - ***Europe***
  - ✓ ***Based on CO_2 developments***
    - ***All but North America***

Answers questions global development AFR use

- ***Which areas have the most potential?***
  - ✓ ***Based on Cement production & TSR development:***
    - ***China, India, Eastern Europe***
  - ✓ ***Depending on waste management legislation:***
    - ***SE Asia, Africa, Latin America***
    - ***China when adopting separate waste collection systems***
  - ✓ ***Depending on new technical developments:***
    - ***Europe, improved pre-treatment to increase present TSR,***
    - ***Other regions will benefit later on***
  - ✓ ***Based on CO_2 developments***
    - ***Depending on carbon pricing developments, all areas have potential***

Answers questions global development AFR use

- ***Which waste streams have the most potential?***
  - ✓ ***Based on availability:***
    - ***Pretreated solid municipal, industrial & commercial waste – SRF/RDF***
  - ***Based on social impact:***
    - ***Pretreated plastics, textile and paper residues (which are not suited for material recycling)***
  - ✓ ***Based on CO_2 abatement:***
    - ***Biomass like sewage sludge, agricultural crop waste, etc.***

Answers questions global development AFR use

- ***Which areas are already saturated with regards to use of AF?***
  - ✓ ***None of the areas are saturated although some technical developments need to be researched for improved quality of AF and increase of TSR***

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Take home messages

- Key success factors AFR program:
  - Use of AFR = service to private and public waste generators
  - Competence and capability to use AFR in cement kilns
  - Good knowledge of waste markets
    - ✓ Other actors,
    - ✓ Available waste sources (quality/quantity/price)
  - How to go to market assessment
    (Develop in-house or in partnership)
  - Control waste collection/separation and pre-treatment activities
  - Flexible permits to use waste as alternative fuel
  - Management commitment
  - Stakeholder involvement

Source: Increasing the Use of Alternative Fuels at Cement Plants: International Best Practice

List of sources used for presentation

- *ARP experience and library*
- *Status and prospects of coprocessing of waste in EU cement plants (Ecofys, 2017)*
- *Cement Technology Roadmap 2009 (WBCSD, IEA, 2013)*
- *Industry Technology Roadmaps: a focus on Cement (IEA, 2017)*
- *Cement Sustainability Initiative Getting the Numbers Right Project Emissions Report (WBCSD, 2015)*
- *Assessment separate collection schemes in the 28 capitals of EU (BiPRO/CRI, 2015)*
- *Our world in data: Fossil Fuels (University of Oxford, website)*
- *Waste-to-Energy Options in Municipal Solid Waste Management (GiZ, 2017)*
- *Progress Report on Application of Waste to Energy Technology (Columbia University, 2017)*
- *Position paper on plastics strategy (CEMBUREAU, 2018)*
- *State and Trends of Carbon Pricing (World Bank, 2017)*
- *What a waste: A Global Review of Solid Waste Management (World Bank, 2012)*
- *Increasing the use of alternative fuels at cement plants: International best practice (IFC, 2017)*

Danke

Thank you

“Global development AFR use”

Danke für Ihre Aufmerksamkeit

Thank You for Your attention

Dank U voor Uw aandacht

Dank U

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global fuels
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Ed Verhamme

Managing Partner Alternate Resource Partners

ed.verhamme@alternateresourcepartners.nl

www.alternateresourcepartners.nl

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Backup slides

Cement production today & future

Cement production (Mtonnes)	Current		Forecast *	
	2007	2015	2030	2050
World	2,808	4,078	4,200-4,500	4,300-5,200
Europe	287	179	210	210
North America	111	96	110	120
Central America	58	58	60	65
Latin America	151	184	240	335
CIS	98	104	104	110
Africa	133	212	220	300
Middle East	159	244	270	360
India	340	549	700	900
China, Korea, Japan	1,485	2,459	2,100	1,600
Asia (n.e.c), Oceania	215	324	450	750

* Indication only

Source 2007/2015: WBCSD Cement Sustainability Initiative Getting the Numbers Right Project Emissions Report 2015

Cement production today & future

- Cement production recovering from last crisis
- Europe, CIS and Australia no or small increase
- North America moderate growth
- China cement production post 2015 declines to more developed country level, still a major player
- Demand growth post 2030 in:
  - Latin America,
  - India,
  - SE Asian countries,
  - Africa
  - Middle East

Source: WBCSD cement roadmap

Use alternative fuels today

Thermal energy consumption (% of total energy)	Alternative fossil/mixed waste		Biomass		Total	
	2000	2015	2000	2015	2000	2015
World	4%	10%	1%	5%	5%	15%
Europe	8%	28%	1%	15%	9%	43%
North America	7%	12%	1%	3%	8%	15%
Central America	2%	11%	0%	2%	2%	13%
South America excl. Brazil	2%	6%	1%	2%	3%	8%
Brazil	3%	9%	6%	10%	9%	19%
CIS	0%	0%	0%	1%	0%	1%
Africa	0%	3%	0%	5%	0%	8%
India	0%	2%	0%	1%	0%	3%
China, Korea, Japan	4%	6%	0%	1%	4%	7%
Asia (n.e.c), Oceania	0%	5%	0%	5%	0%	10%
Middle East	0%	4%	0%	1%	0%	5%

Source: WBCSD Cement Sustainability Initiative Getting the Numbers Right Project Emissions Report 2015

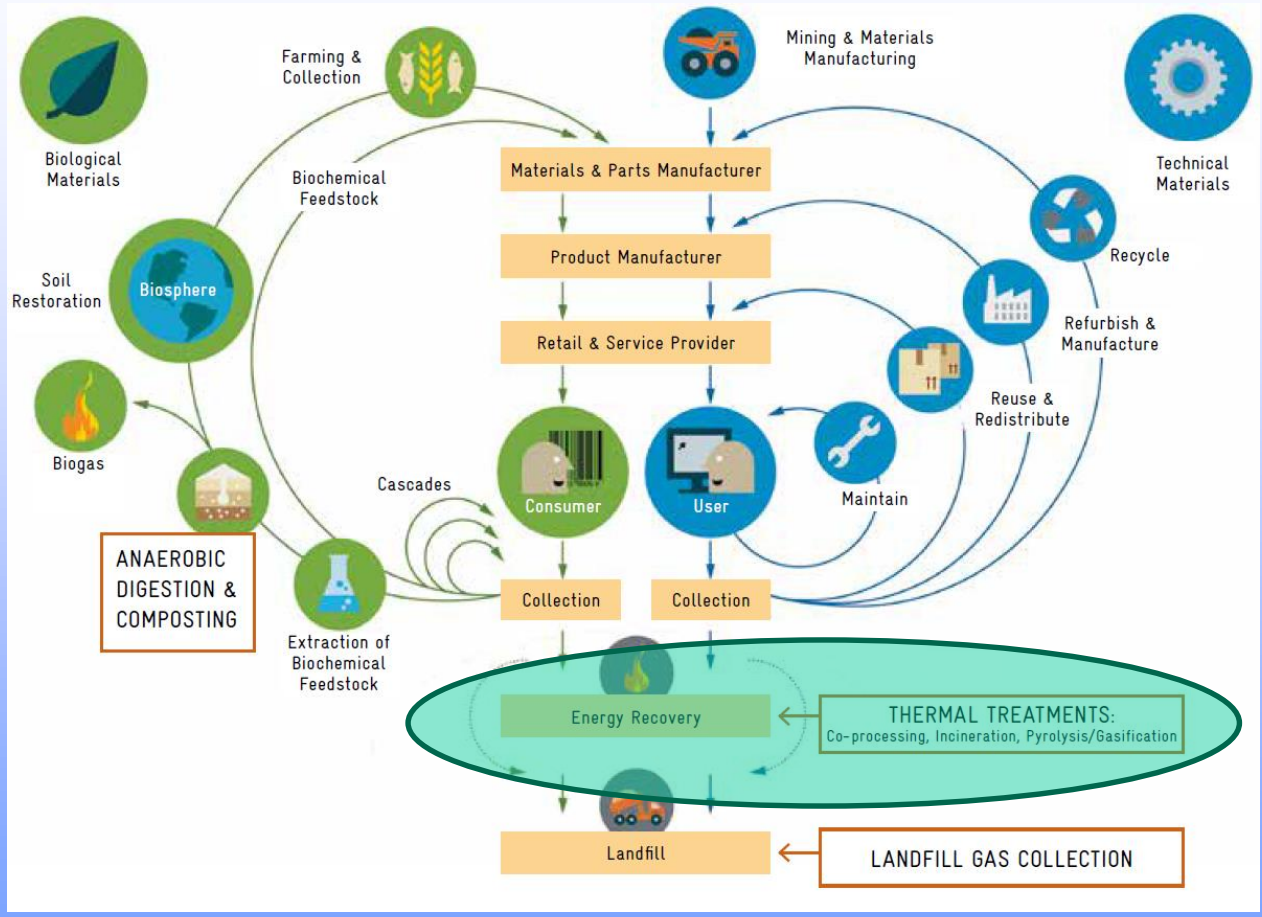
TSR today and future

	Current		Low demand		High demand	
	2000	2015	2030	2050	2030	2050
Europe	9%	43%	28%	39%	30%	40%
North America	8%	15%	21%	37%	22%	38%
Central America	2%	13%	25%	39%	25%	40%
South America excluding Brazil	3%	8%	25%	39%	25%	40%
Brazil	9%	19%	25%	39%	25%	40%
OECD Pacific	0%	10%	23%	35%	24%	35%
CIS	0%	1%	22%	35%	16%	37%
Africa	0%	8%	22%	33%	25%	35%
Middle East	0%	5%				
India	0%	3%	23%	35%	27%	35%
China	4%	7%	20%	36%	14%	34%
Other developing Asia	0%	10%	21%	34%	28%	35%

Source 2007/2015: WBCSD Cement Sustainability Initiative Getting the Numbers Right Project Emissions Report 2015,
Source 2030/2050: CWBCSD Cement Technology Roadmap 2009

Development waste management; position WtE in Circular Economy

- WtE = Energy recovery from non-recyclable MSW fractions
- WtE preferable to disposal
- WtE must fulfil high emission standards
- WtE requires knowledge on available waste on longer term (waste management plans/)
- WtE builds on efficient MSWM system



Source: GIZ: Waste-to-Energy Options in Municipal Solid Waste Management

Waste market (including waste infrastructure)

- MSW waste composition by country income level:

CURRENT ESTIMATES*						
Income Level	Organic (%)	Paper (%)	Plastic (%)	Glass (%)	Metal (%)	Other (%)
Low Income	64	5	8	3	3	17
Lower Middle Income	59	9	12	3	2	15
Upper Middle Income	54	14	11	5	3	13
High Income	28	31	11	7	6	17
2025 ESTIMATES**						
Income Level	Organic (%)	Paper (%)	Plastic (%)	Glass (%)	Metal (%)	Other (%)
Low Income	62	6	9	3	3	17
Lower Middle Income	55	10	13	4	3	15
Upper Middle Income	50	15	12	4	4	15
High Income	28	30	11	7	6	18

Source: WHAT A WASTE A Global Review of Solid Waste Management

Development waste management; MSW

- MSW waste composition:

Type	Sources
Organic	Food scraps, yard (leaves, grass, brush) waste, wood, process residues
Paper	Paper scraps, cardboard, newspapers, magazines, bags, boxes, wrapping paper, telephone books, shredded paper, paper beverage cups. Strictly speaking paper is organic but unless it is contaminated by food residue, paper is not classified as organic.
Plastic	Bottles, packaging, containers, bags, lids, cups
Glass	Bottles, broken glassware, light bulbs, colored glass
Metal	Cans, foil, tins, non-hazardous aerosol cans, appliances (white goods), railings, bicycles
Other	Textiles, leather, rubber, multi-laminates, e-waste, appliances, ash, other inert materials

- Waste disposal in million tonnes

AFR		OECD	
Dumps	2.3	Dumps	–
Landfills	2.6	Landfills	242
Compost	0.05	Compost	66
Recycled	0.14	Recycled	125
Incineration	0.05	Incineration	120
Other	0.11	Other	20

Source: WHAT A WASTE A Global Review of Solid Waste Management