

"Global development AFR use"

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- 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
 - \checkmark CO₂
- 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









Topics



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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









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





Cement production in Mtonnes





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







Source: Cement Technology Roadmap 2009

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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:

- \blacktriangleright Avoid 26.0 Mtonnes of CO₂ emissions
- Process 15.7 Mtonnes of waste
- Save 11.1 Mtonnes of coal equivalent
- ➤ Avoid €12.2 billion investment in dedicated WtE plants





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TSR benchmark case Europe



Europe: Average TSR today 41%



Correlation with maturity waste management systems Landfill ban & taxes Separate collection

Landfill ban & taxes







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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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













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













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







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









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
- $\checkmark\,$ Wood chip and other biomass
- $\checkmark\,$ 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







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



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Development waste management; MSW

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



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- 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



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)

Landfill ban and high landfill taxes for remaining waste

Partial landfill ban and high landfill taxes

Partial landfill ban and low landfill taxes

No landfill ban and low landfill taxes







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 CO₂ 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 CO₂ 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
 - \succ CO₂ 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



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- \succ CO₂ emission reduction cement industry through:
 - > Thermal en electric efficiency
 - Alternative fuels
 - Clinker substitution
 - ➤ Carbon Capture and Storage (CCS)









Developments CO₂ 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

ETS implemented or scheduled for implementation Carbon tax implemented or scheduled for implementation ETS or carbon tax under consideration

ETS and carbon tax implemented or scheduled Carbon tax implemented or scheduled, ETS under consideration



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Observations



	Cement production	TSR potential	State of legislation	Waste Management System	CO ₂
Europe	\longrightarrow		* * * *	* * * *	* * * <mark>*</mark>
North America			****	****	****
Central America			****	****	****
Latin America			****	****	****
China	\checkmark		****	****	****
CIS			* * * *	****	****
India			****	****	****
SE Asia			****	****	****
Africa			****	****	****











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	\checkmark
Meat and bone meal	
Other industrial waste and fossil based fuel	









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:
 - o Europe
- ✓ Based on CO_2 developments
 - All but North America









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> 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
- \checkmark Based on CO₂ developments
 - Depending on carbon pricing developments, all areas have potential









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> 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.









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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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- ➢ 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
 - $\checkmark \quad \text{Other actors,}$
 - ✓ 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



Contraction 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)









Global development AFR use" Danke für Ihre Aufmerksamkeit Thank You for Your attention Dank U Dank U voor Uw aandacht

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"Global development AFR use"

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Backup slides



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Cement production	Curi	rent	Forecast *		
(Mtonnes)	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





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





- 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

CONFERENCE & EXHIBITION Source: WBCSD cement roadmap







Use alternative fuels today

Thermal energy consumption	Alternative fossil/mixed waste		Biomass		Total	
(% of total energy)	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%	220/	220/	250/	250/
Middle East	0%	5%	2270	3370	2370	33%0
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









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	
		202	25 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	









Development waste management; MSW MSW waste composition:

Туре	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

AI	R	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

