



Co-Processing of hazardous waste – challenges and experiences



Serbian cement industry

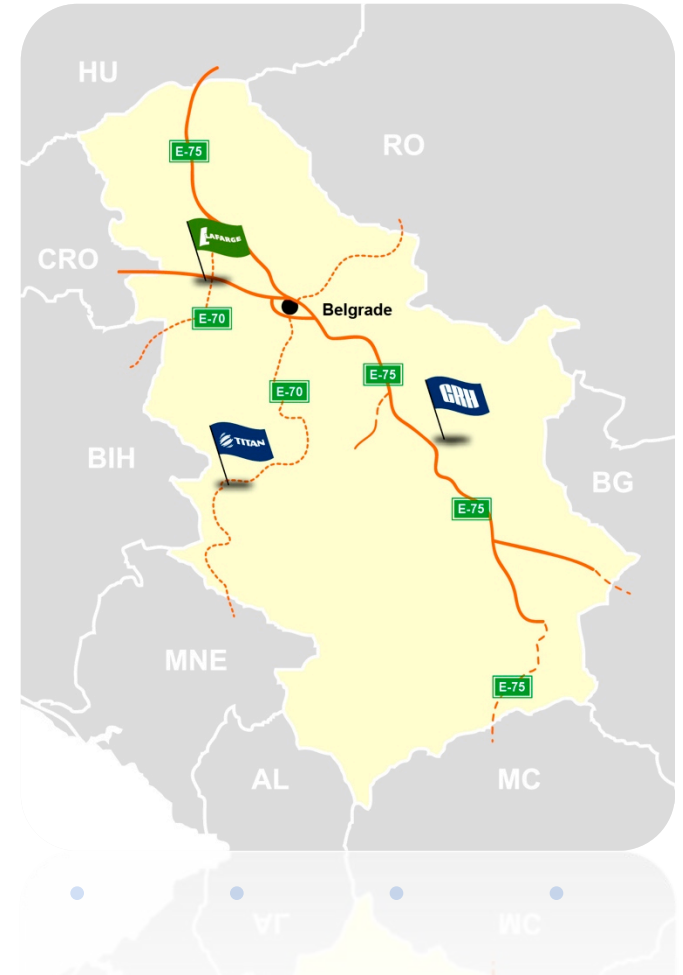
- **Lafarge Serbia** – Beocin, Vojvodina, 100 km northwest of Belgrade
- **CRH Serbia** – central Serbia, 160 km southeast of Belgrade
- **Titan CK** – Kosjeric, 135 km southwest of Belgrade



Serbian cement industry

Road network

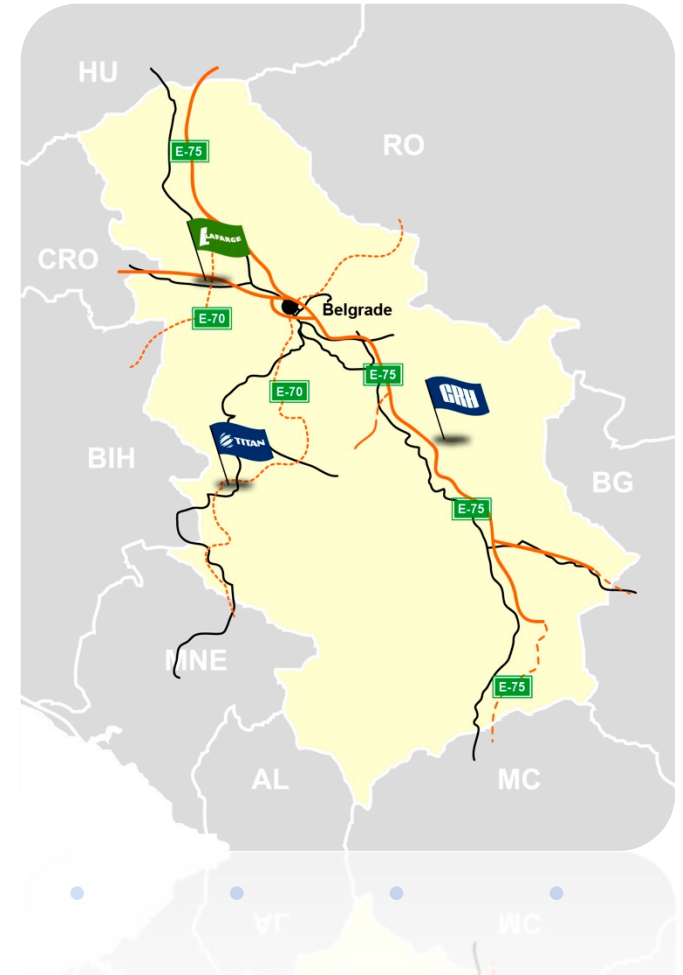
- **Lafarge Serbia** – Beocin, Vojvodina, 100 km northwest of Belgrade
- **CRH Serbia** – central Serbia, 160 km southeast of Belgrade
- **Titan CK** – Kosjeric, 135 km southwest of Belgrade



Serbian cement industry

Road/Railway network

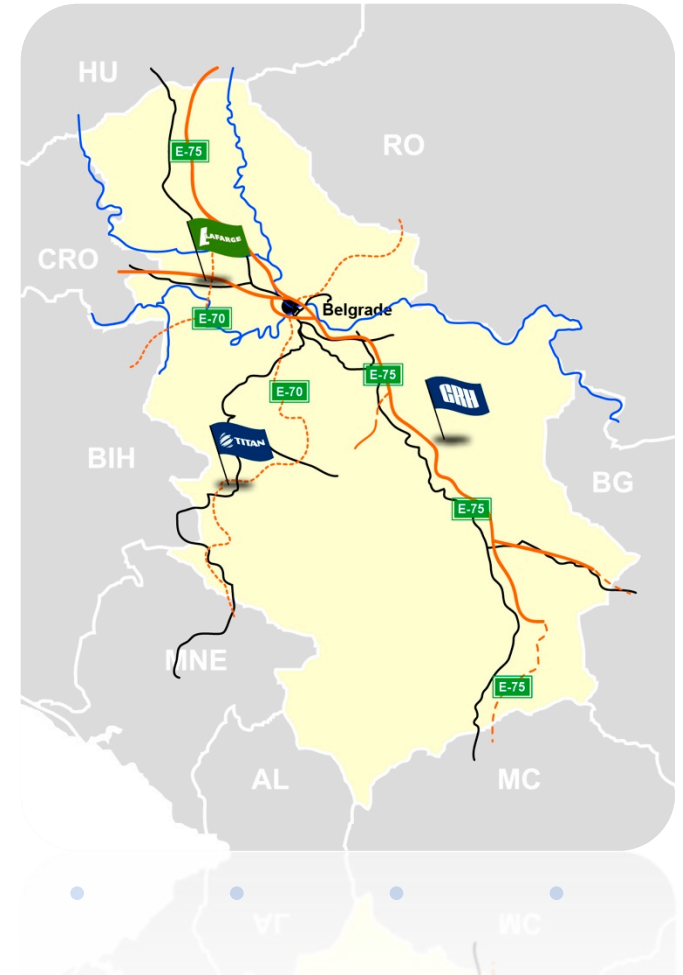
- **Lafarge Serbia** – Beocin, Vojvodina, 100 km northwest of Belgrade
- **CRH Serbia** – central Serbia, 160 km southeast of Belgrade
- **Titan CK** – Kosjeric, 135 km southwest of Belgrade



Serbian cement industry

Road/Railway/Water network

- **Lafarge Serbia** – Beocin, Vojvodina, 100 km northwest of Belgrade
- **CRH Serbia** – central Serbia, 160 km southeast of Belgrade
- **Titan CK** – Kosjeric, 135 km southwest of Belgrade



• • • • •

What is Cement?

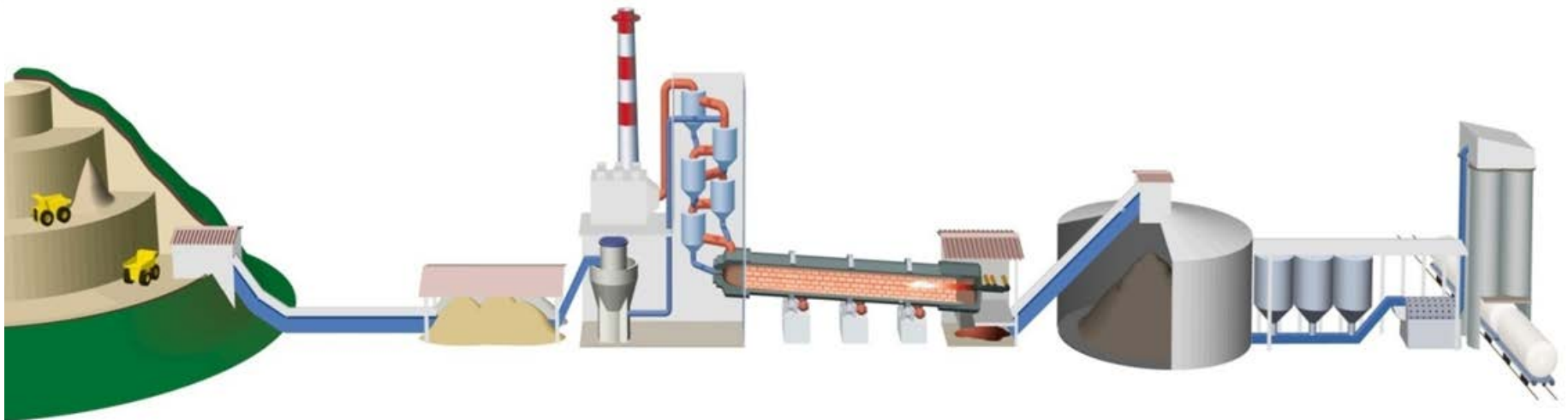
- Cement is an essential and irreplaceable construction material;
- Cement is the most important concrete constituent;
- Cement contributes to safety, durability, efficiency and connecting people.



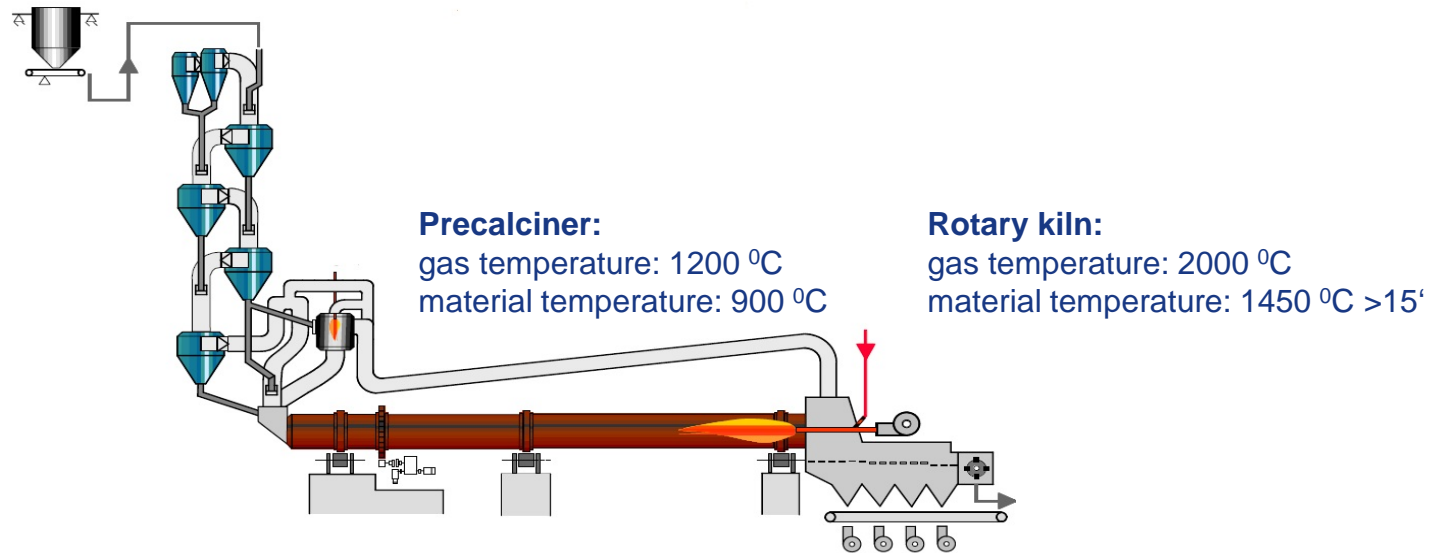
• • • • •

Cement manufacture

- **Preparation of raw materials** into raw meal
- **Clinker production** – calcination of the raw meal into the rotary kiln (energy supplied by burning fuels)
- **Cement production** – grinding of clinker and mineral components to obtain cement

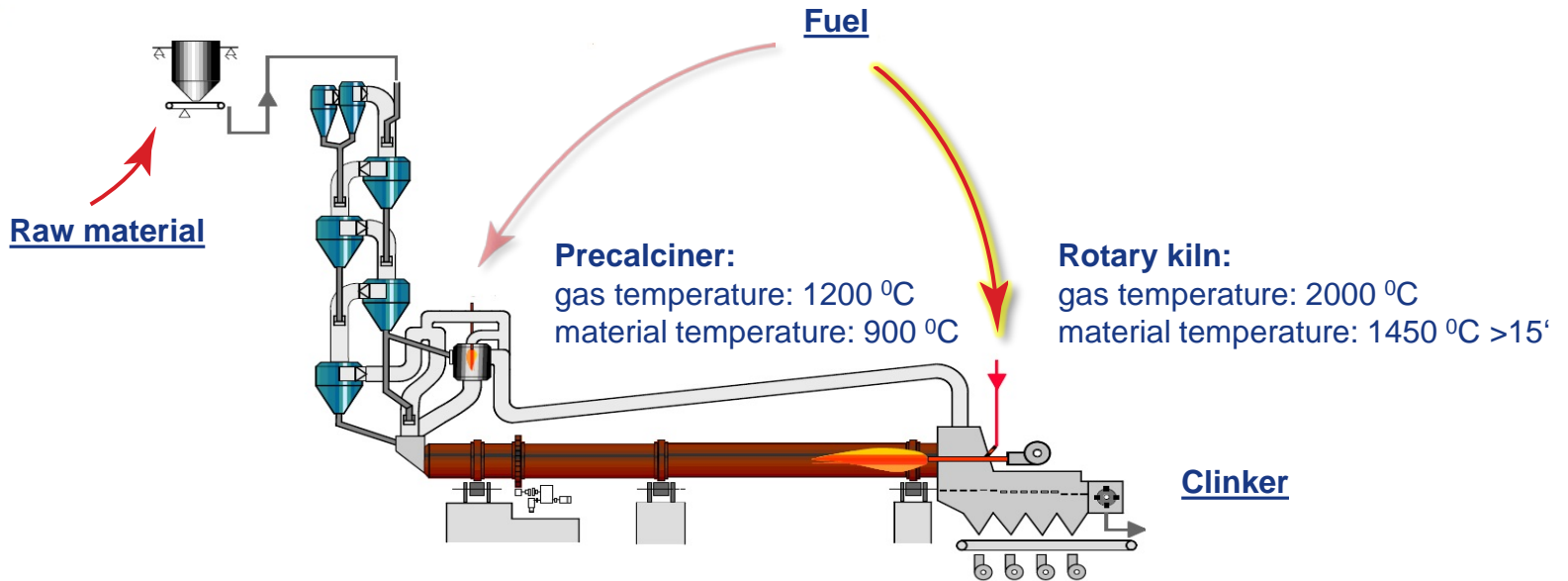


Cement kilns features



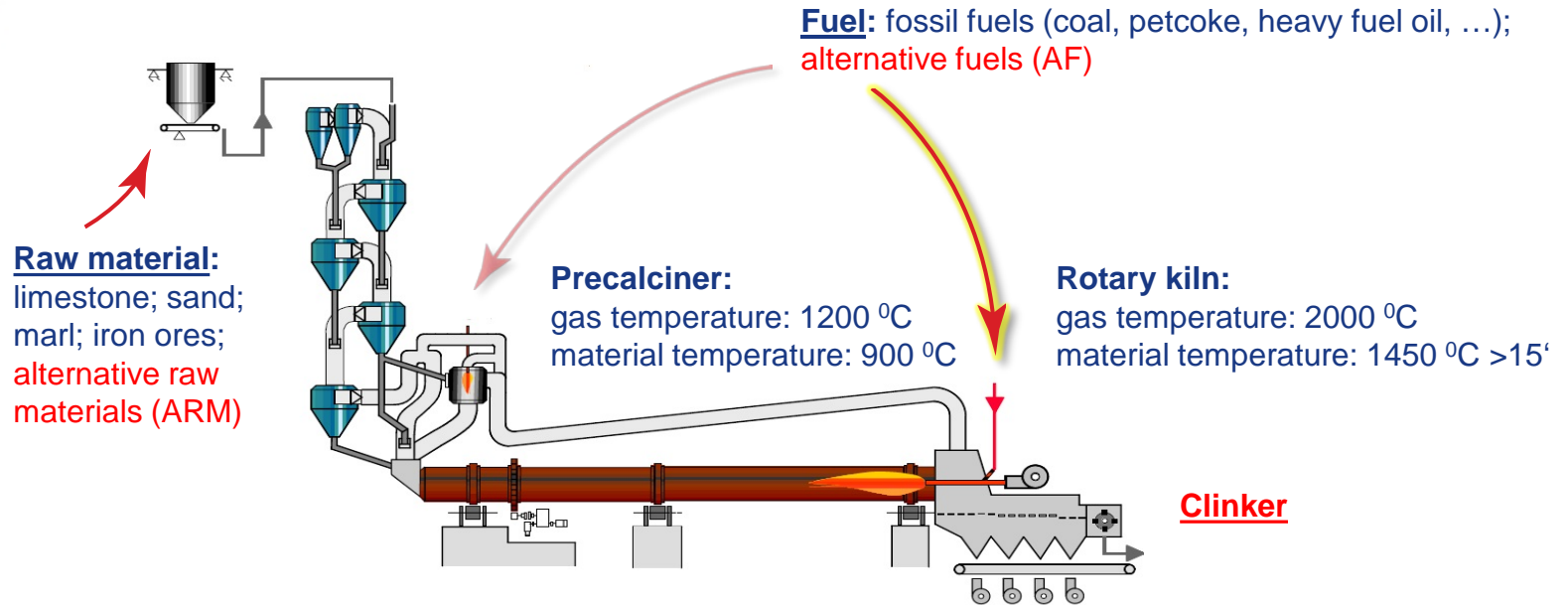
- **Temperature at rotary kiln:** > 1450 °C: material; > 1800 °C: gas
- **Residence time at rotary kiln:** > 12-15 sec > 1200 °C, > 5-6 sec > 1800 °C
- **Temperature at precalciner:** > 850 °C: material; > 1000 °C: gas
- **Residence time at precalciner:** > 2-6 sec > 800 °C

Cement kilns features



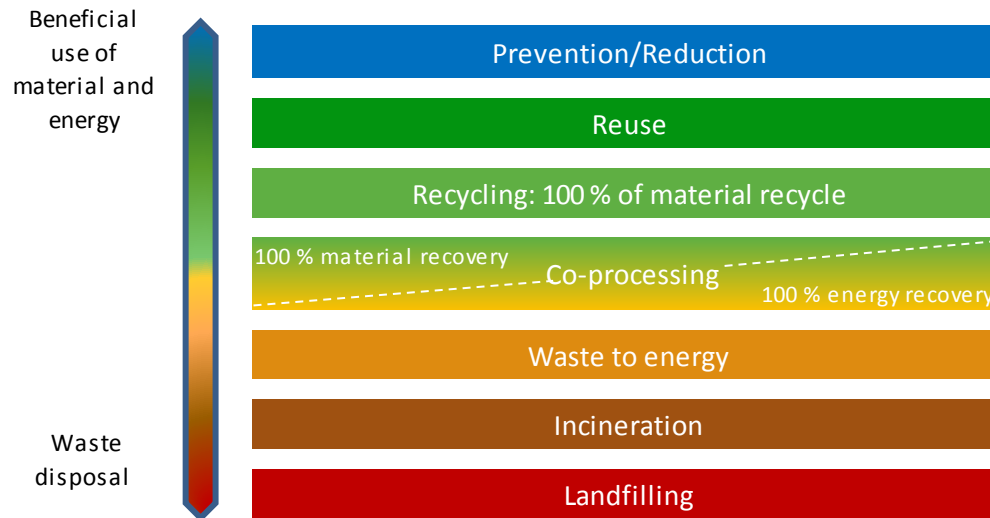
- **Temperature at rotary kiln:** > 1450 °C: material; > 1800 °C: gas
- **Residence time at rotary kiln:** > 12-15 sec > 1200 °C, > 5-6 sec > 1800 °C
- **Temperature at precalciner:** > 850 °C: material; > 1000 °C: gas
- **Residence time at precalciner:** > 2-6 sec > 800 °C

Co-processing



The use of suitable waste materials in manufacturing processes for the purpose of energy and/or resource recovery and resultant reduction in the use of conventional fuels and/or raw materials through substitution.

Co-processing in waste hierarchy



“In certain production processes such as co-processing, waste can be used in an operation combining two waste management recovery options at the same time. The energy content of the waste is recovered (R1 operation) as thermal energy, thus substituting fuels, while the mineral fraction of the waste can be integrated (hence recycled) in the matrix of the product or material produced, e.g. cement clinker, steel or aluminium (R4 or R5 operation).”

EC - DG Environment, 2012, Guidelines on the interpretation of key provisions of Directive 2008/98/EC on waste

Co-processing – material and energy recovery

Alternative raw materials – ARM

- Fly ash (**FA**)
- Granulated blast furnace slag (**GBS**)
- Silica fume, contaminated soil, waste glass, foundry sand ...

Alternative fuels – AF

- **Tires** (used waste tyres and rubber waste)
- **Solid Waste** (packaging waste, MSW, plastic waste, various type of industrial waste...)
- **Liquid Waste** (used solvents and used oil)
- **Sludge** (sewage sludge and oil sludge)
- **Biomass** (wood chips, animal and bone meal, sunflower seeds...)

One of the most important goals of industrial ecology is to make one industry's waste another's raw material (OECD, 2000). Within the cement industry the use of wastes as fuel and raw materials is a positive, forward-thinking example..



Co-processing of hazardous waste in cement kilns (1)

Co-processing of hazardous waste in cement production is recognized as an environmentally friendly way of waste management in the context of the Basel Convention.

The suitability of hazardous waste for co-processing in cement kilns and conditions that they have to be met, set out the following documents:

- United Nations Environment Programme (UNEP) – **“Basel Convention Technical guidelines on the environmentally sound co-processing of hazardous waste in cement kilns”**, 2011
(www.basel.int/TheConvention/Publications/TechnicalGuidelines/tabid/2362/Default.aspx)
- The guidelines issued by the Secretariat of the **Stockholm Convention** on Persistent Organic Pollutants – **GUIDELINES ON BEST AVAILABLE TECHNIQUES AND PROVISIONAL GUIDANCE ON BEST ENVIRONMENTAL PRACTICES**, Part II Source category (b): **“Cement kilns firing hazardous waste”**, 2007
(<http://chm.pops.int/Implementation/BATBEP/Guidelines/tabid/187/Default.aspx>)
- **European Commission** IPPC Bureau, **“Best Available Techniques - Reference Document for the Production of Cement, Lime and Magnesium Oxides (BREF)”**, 2013
(http://eippcb.jrc.ec.europa.eu/reference/BREF/CLM_Published_def.pdf)
- Another specific documents / guides on the production of cement, such as: Guideline **Holcim- GTZ, SINTEF - Report**, which provide useful information on the co-processing in the cement industry.



Co-processing of hazardous waste in cement kilns (2)

Hazardous waste suitable for the co-processing in cement kilns include:

• *tank bottom sludges • acid alkyl sludges • oil spills and acid tars from petroleum refining • natural gas purification and pyrolytic treatment of coal • waste machining oils • waste hydraulic oils and brake fluids • bilge oils • oil/water separator sludges • solids or emulsions • washing liquids and mother liquors • still bottoms and reaction residues from the manufacture • supply and use of basic organic chemicals • plastics • synthetic rubber • man-made fibres • organic dyes • pigments • organic pesticides and pharmaceuticals • waste ink • wastes from the photographic industry • tars and other carbon-containing wastes from anode manufacture (aluminium thermal metallurgy) • wastes from metal degreasing and machinery maintenance • wastes from textile cleaning and degreasing of natural products • process wastes from the electronic industry •*

(GTZ/Holcim, 2006)



Co-processing in cement kilns in Serbia - achievements

- Starting from 2006 with co-incineration of waste tires
- Waste used by cement plants as AF from 2006 – 2014 amounted near 210,000 t (of which 11,500 t of hazardous waste)
- 320,000 t of ARM (mainly FA and GBS), cement plants in Serbia are used on annual basis
- CO₂ emissions were reduced by about 215,500 t/year



Co-processing of hazardous waste in EU - achievements

eurostat

Treatment of waste by waste category, hazardousness and waste op
Last update: 15-03-2017

Table Customization [hide](#)

Labeling: ☐ Codes ☐ Labels ☐ Both ☒ Dimension specific

Cell Formatting: ☐ 1.234,56 ☒ 1.234,56 ☐ 1 234,56

☐ Hide empty lines ☐ Hide flags/footnotes

WST_OPER

Hazard class

Hazardous

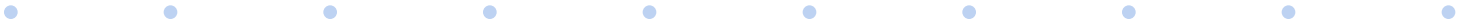
	Total waste treatment	Incineration / energy recovery (R1)
European Union (28 countries)	75,570,000	5,700,000
Belgium	1,926,143	392,926
Bulgaria	12,176,438	333
Czech Republic	597,309	51,433
Denmark	1,819,120	210,161
Germany (until 1990 former territory of th	20,521,107	2,788,642
Estonia	10,315,094	15,279
Ireland	86,518	32,436
Greece	115,015	3,211
Spain	2,321,536	137,387
France	7,605,065	1,046,249
Croatia	66,055	11,371
Italy	3,574,305	76,739
Cyprus	161,446	1,394
Latvia	43,375	12,119
Lithuania	55,457	0
Luxembourg	37,843	35,199
Hungary	372,580	21,541
Malta	439	0
Netherlands	4,483,340	270,694
Austria	439,247	143,749
Poland	1,876,577	2,492
Portugal	414,768	16,806
Romania	500,394	124,293
Slovenia	91,696	1,443
Slovakia	202,713	4,590
Finland	1,915,719	45,705
Sweden	1,092,814	153,013
United Kingdom	2,762,524	102,777
Iceland	38,960	1,303
Norway	1,566,241	289,034
Former Yugoslav Republic of Macedonia, t	3,763	0
Serbia	13,493,547	2,286
Turkey		

Source: <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do> (2014)



Experience ...

- Cement factories in Serbia, which performs thermal treatment of hazardous waste have the necessary permits for waste management defined by the Law on Waste Management ("Off. Gazette of RS", No. 36/2009, 88/2010 and 14/2016)
- Cement factories in Serbia have IPPC permits under the Law on Integrated Prevention and Control of Environmental Pollution ("Off. Gazette of RS", No. 135/2004 and 25/2015)
- Cement industry has many years of experience in the treatment of hazardous and non-hazardous waste
- Available capacities for treatment of hazardous waste in cement factories exceed the current requirements of the waste market
- Unequal position of players in the waste market in Serbia





Challenges ...

- Introduction of fees for the landfilling of municipal and industrial waste
- Adoption of the local and regional waste management plans
- Developing of model for collecting of reliable data in the fields of waste generation/composition
- Developing of cooperation between the public and private sectors (PPP).
- Providing mechanisms for the establishment of equal conditions for the participation in the waste market
- Providing mechanisms to enforce surveillance over the operation of facilities that carry out pre-treatment and quality control of pre-treated waste





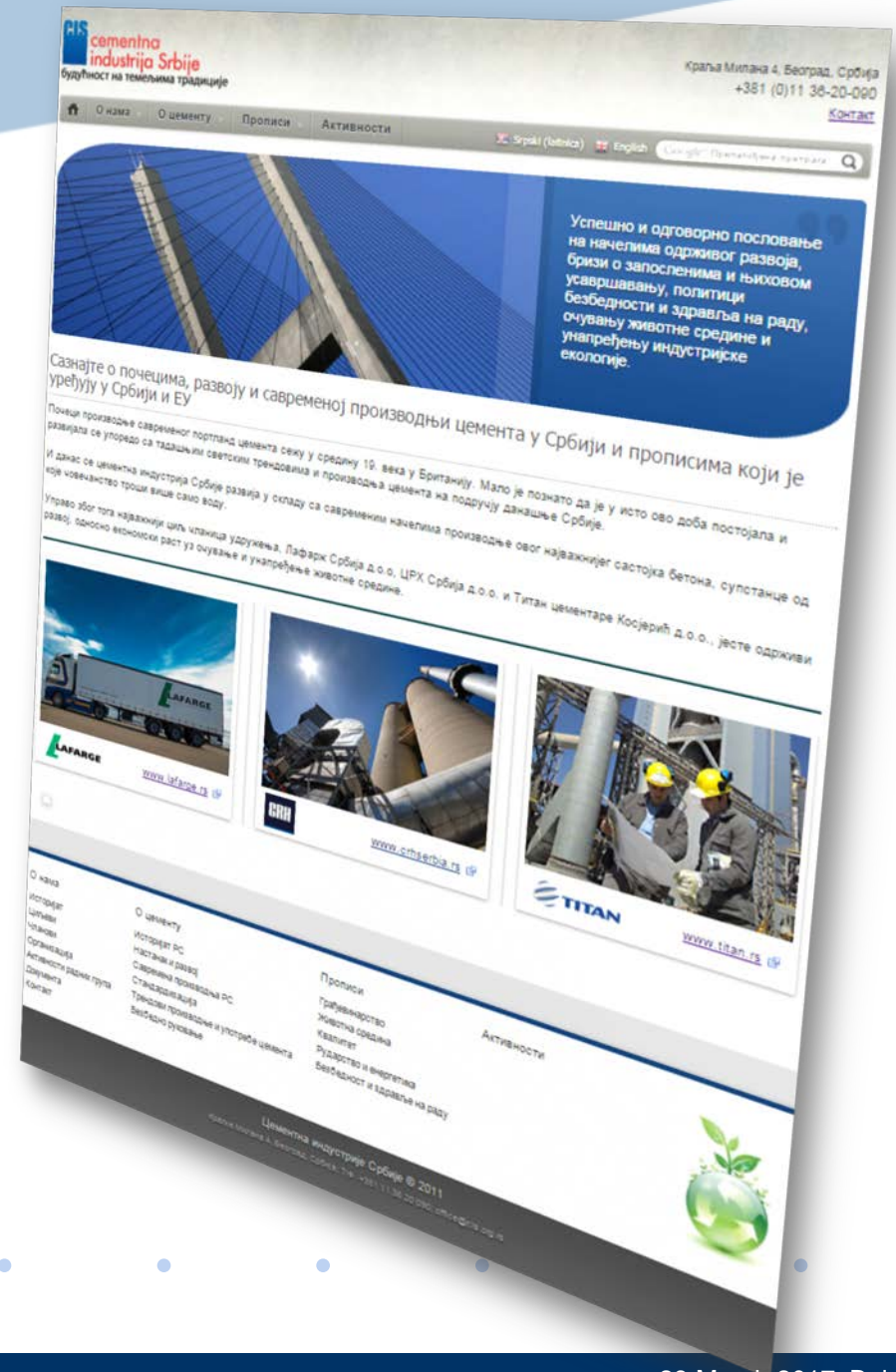
Plans and perspectives...

- Capacity expansion for thermal treatment of hazardous waste – in the measure which would allow that total generated quantities in Serbia could be treated in this way
- The implementation of permitting process for thermal treatment of different types of hazardous waste
- Support the establishment of an integrated management system for hazardous waste
- Recognized as a safe and reliable partner in the treatment of significant quantities of different types of waste





www.cis.org.rs





Thanks for your attention!

Serbian cement industry
Dejana Milinkovic, Director
dejana.milinkovic@cis.org.rs

