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# BENEFITS FROM USAGE OF ALTERNATIVE FUELS IN THE CEMENT PRODUCTION

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**Abstract:**
Use of waste for energy recovery as one of the most determinant waste management alternative, is a proven and widely spread practice worldwide. One of the widespread complimentary methods used extensively and internationally to reduce the amount of municipal solid waste (MSW) in a safe and environmentally friendly manner is their conversion to valuable products as alternative fuel. Alternative fuels are safely used in large industrial furnaces such as the cement kilns.
On 24 September 2015, Albania submitted its new climate action plan to the UN Framework Convention on Climate Change (UNFCCC). The INDC (Intended Nationally Determined Contribution ) of Albania is a baseline scenario target: it commits to reduce CO2 emissions compared to the baseline scenario in the period of 2016 and 2030 by 11.5 %. This reduction means 708 kT carbon-dioxide emission reductions in 2030.
Cement plants can help Albania in achieving its 2030 target by substituting fossil based fuels with alternative fuels derived from processing of municipal solid waste producing RDF. This can be done by contributing in two areas:
a. CO2 reduction due to substitution of fossil fuels
b. CO2 reduction from avoidance of waste landfilling
By co-processing RDF in the cement kilns the country avoids emissions of CO2 from waste landfilling and reduces CO2 emissions from substitution of fossil fuels with RDF. Depending on the characteristics of the RDF used, the contribution of cement plants in achieving the 2030 target for Albania can vary from 20 – 42 %.

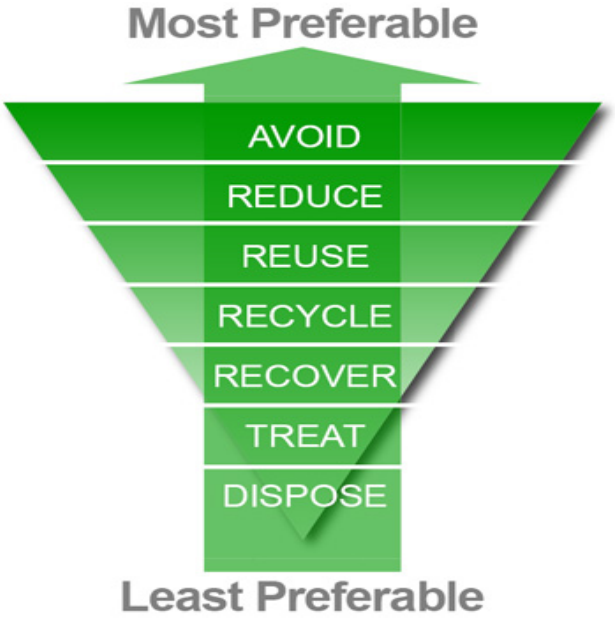
**Keywords:** Alternative fuels, Cement industry, INDC, Co-processing, waste management, CO2

## 1. Introduction

### 1.1. Waste Management in Albania

Although the Albanian waste management legal framework has been prepared according to EU directives and regulation, its full transposition is not yet completed and its implementation/enforcement is lacking behind. Albanian legal provision on waste management imposes a hierarchy for waste management, starting with waste prevention/minimization, preparation for re-use, recycling and recovering and in the end, disposal of wastes. On the other hand, the practices of waste management applied in the country as per waste management hierarchy is too rudimentary and is having serious impediments (i.e. Lack of waste separation at source, lack of infrastructure for easy access at waste sites, lack of appropriate practical arrangements for promoting waste re-use, recycling and energy recovery, lack of clearly stated responsibilities at all levels, etc. Actually the hierarchy of waste management is inverted. Most of waste ends up dumped in illegal dumpsites and landfills.

The recycling and reusing of waste is rudimentary and not fully organized. The recycling industry besides the flourishing of investments done last 5-6 years, is working at its minimum capacity due to the above mentioned and also due to the banning of




imports of green list materials by the approval of the law no. 156/2013 for amendment of law no. 10 463/ 2011 on "Integrated Waste Management" in contradiction to the Regulation No. 1013/2006 of European Parliament and of the Council on "Shipments of Waste" dated 14 June 2006 as amended.

As a result, waste streams in Albania continue to be un-separated (i.e large volumes of waste are collected in a single-bin system, which makes their processing difficult and then deposited in landfill sites or directly deposited on illegal dumpsites), while landfills do not operate according to hygiene and environmental standards as the one predicted by the EU Integrated Waste Management standards and guidelines.

## 2. Methods

### 2.1. Co-processing AF in Cement Plants –an efficient way of waste management

Use of waste for energy recovery as one of the most determinant waste management alternative, is a proven and widely spread practice worldwide. One of the widespread complimentary methods used extensively and internationally to reduce the amount of municipal solid waste (MSW) in a safe and environmentally friendly manner has been the selection of "light fractions"[1] fractions of MSW and not only (other industrial wastes can be used as well), and processing towards conversion to valuable products as alternative fuel. Alternative fuels are safely used in large industrial furnaces such as the cement kilns. These materials are generally known as Refuse Derived Fuels ("RDF"). RDF can be produced from a wide range of waste materials, which have also been pre-processed (at landfill sorting facility), to produce an alternative fuel that fulfills all regulatory and industry specifications.

The use of RDF as alternative fuels in the cement production process, in particular, has unique operational benefits, because it allows the safe replacement of a portion of the traditional fossil fuels used. RDF and other alternative raw materials can substitute up to 80% of fossil fuel.

The hierarchy for waste management practices, starting with waste prevention/minimization, preparation for re-uses, recycling, energy recovery, and in the end disposal of wastes have been defined in the legal provision on waste management.

Implementation of the 98/2008 EC Directive with target: "To minimize Landfill space through material and energy recovery".

The target of this waste management hierarchy is to reduce the amount of the waste ending in landfills. In order to achieve this, since not all the waste can be reused or recycled, it is necessary that certain amounts be processed to valuable materials for usage in co-processing and energy recovery. This process can reduce the waste ending in landfills from 20 -35 %.

Co-processing of alternative fuels derived from waste in cement kiln has significant advantages

[1] Light fraction is composed of sorted landfill waste containing waste paper, plastics, textiles, etc. and other non-recyclable materials that have calorific value

compared to classic waste incinerators which do require additional treatment of the remaining ashes after the process of incineration has taken place. Co-processing of AF in cement kilns, through utilization of existing infrastructure, allows the reduction of energy demand from fossil fuels, and thereby prevents unnecessary natural resource exploitation. Furthermore, AF co-processing is directly linked to reduction of economic cost and environmental footprint in regard to GHG. Two modern cement kilns, which can offer the aforementioned benefits, are already operating in Albania.

The European Integrated Pollution Prevention and Control Bureau (EIPPCB) (2010) acknowledgesthe cement production process as the most suitable process for the co-processing of waste materials. Co-processing MSW in cement kilns has multiple benefits in addition to offering a waste management solution:

i. Avoiding negative impacts of waste incineration and landfilling:
ii. Reduction of greenhouse emissions
iii. Conserving non-renewable fossil fuels and protecting the environment:
iv. Avoiding new investment in incinerators or landfill facilities:
v. Reducing dependency on non-renewable sources of fossil fuels:

## 3. Results

### 3.1. Benefits in terms of CO2 2030 target achievement for Albania.

On 24 September 2015, Albania submitted its new climate action plan to the UN Framework Convention on Climate Change (UNFCCC). This so-called Intended Nationally Determined Contribution (INDC) comes well in advance of a new universal climate change agreement which will be reached at the UN climate Conference in Paris (COP21), in December this year. The INDC of Albania is a baseline scenario target: it commits to reduce CO2 emissions compared to the baseline scenario in the period of 2016 and 2030 by 11.5 %. This reduction means 708 kT carbon-dioxide emission reductions in 2030.

Cement plants can help Albania in achieving its 2030 target by substituting fossil based fuels with alternative fuels derived from processing of municipal solid waste producing RDF. This can be done by contributing in two areas:

a. CO2 reduction due to substitution of fossil fuels
b. CO2 reduction from avoidance of waste landfilling

By co-processing RDF in the cement kilns the country avoids emissions of CO2 from waste landfilling and reduces CO2 emissions from substitution of fossil fuels with RDF. Depending on the characteristics of the RDF used, the contribution of cement plants in achieving the 2030 target for Albania can vary from 20 – 42 %.

Below table shows rough calculations based on two types of RDF. The two scenarios vary because RDF characteristics can vary significantly. Type 1 is from TITAN experience and type 2 RDF is from Lichtenberg & Partner, who is one of the world's leading consulting firms for the implementation of alternative fuels from biomass and useable wastes in the cement industry

I. CO2 savings due to substitution of Fossil fuels with RDF type 1

| **Type I RDF scenario** | Baseline | Fossil fuels Substitution Rate heat basis | | | |
|---|---|---|---|---|---|
| | 100 % fossil fuel | 35 % | 40 % | 50 % | 60 % |
| CO2 savings ton/ year 1 cement plant | 0 | 33,630 | 41,960 | 58,620 | 75,280 |
| **% contribution in target achieve** | **0** | **4.8** | **5.9** | **8.3** | **10.7** |

| **ment** | | | | | |
|---|---|---|---|---|---|
| CO2 savings ton/ year both cement plant | 0 | 67,260 | 83,920 | 117,240 | 150,560 |
| **% contribution in target achievement** | 0 | **9.5** | **11.9** | **16.6** | **21.3** |

II. CO2 savings due to substitution of Fossil fuels with RDF type 2

| **Type II[2] RDF scenario** | Baseline | Fossil fuels Substitution Rate heat basis | | | |
|---|---|---|---|---|---|
| | 100 % fossil fuel | 35 % | 40 % | 50 % | 60 % |
| CO2 savings ton/ year 1 cement plant | 0 | 66,117 | 77,502 | 100,271 | 123,040 |
| **%contribution in target achievement** | **0** | **4.5** | **9.3** | **10.9** | **14.2** |
| CO2 savings ton/ year both cement plant | 0 | 132,234 | 155 004 | 200,542 | 246,080 |
| **%contribution in target achievement** | 0 | **9.5** | **18.7** | **21.9** | **28.3** |

III. CO2 emissions avoidance from landfilling

| **RDF usage in cement plant** | 35 % | 40 % | 50 % | 60 % |
|---|---|---|---|---|
| Total CO2 savings from landfilling avoidance One cement plant | 28,851 | 31,663 | 39,579 | 47,494 |
| **% contribution in target achievement** | **3.9** | **4.5** | **5.6** | **6.7** |
| Total CO2 savings from landfilling avoidance Two cement plant | 55,410 | 63,326 | 79,157 | 94,988 |
| **% contribution in target achievement** | **7.8** | **8.9** | **11.2** | **13.4** |

## 4. Discussions and Conclusions

As it can be seen from the above tables, to what extent cement plants can contribute to CO2 target in both directions are respectively:

a. CO2 reduction due to substitution of fossil fuels **can vary from 4.5 – 28.3 % of the CO2 target of 2030**
b. CO2 reduction from avoidance of waste landfilling **can vary from 8 – 13.4 % of the CO2 target of 2030**

As stated in the European Integrated Pollution Prevention and Control Bureau (EIPPCB) (2010) and confirmed from the experience in the Titan plants, we may list below the following characteristics of cement production that allow for the proper co-processing of waste materials:

- Maximum temperatures of approximately 2,000°C (main firing system, flame temperature) in rotary kilns
- Gas retention times of about 8 seconds at temperatures greater than 1,200°C in rotary kilns
- Material temperatures of about 1,450°C in the sintering zone of the rotary kiln
- Oxidizing gas atmosphere in the rotary kiln
- Gas retention time in the secondary firing system of more than 2 seconds at temperatures greater than 850°C; in the

[2] Differs from type one RDF from the specific calorific value and composition

pre-calciner, correspondingly longer retention times and higher temperatures

- Solids temperatures of 850°C in the secondary firing system and/or the calciner
- Uniform burnout conditions for load fluctuations because of high temperatures and sufficiently long retention times
- Destruction of organic pollutants because of high temperatures and sufficiently long retention times
- Sorption of gaseous components like hydrogen fluoride (HF), hydrogen chloride (HCl), and sulfur dioxide (SO2) on alkaline reactants
- High retention capacity for particle-bound heavy metals
- Short exhaust-gas retention times in the temperature range known to lead to de-novo synthesis of dioxins and furans
- Complete utilization of burnt waste ashes as clinker components
- No product-specific wastes because materials are completely incorporated into the clinker matrix (some European cement plants dispose of bypass dust)
- Chemical-mineralogical incorporation of nonvolatile heavy metals into the clinker matrix

As explained above, the use of RDF as alternative fuels in the cement production process, in particular, has unique advantageous operating conditions, because it allows the safe replacement of a portion of the traditional fossil fuels used. RDF and other alternative raw materials can substitute up to 80% of fossil fuel.

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