

EUROPEAN PARLIAMENT

# GYPSUM FORUM

**A CIRCULAR ECONOMY FOR THE CONSTRUCTION SECTOR:  
The Gypsum Example  
Views of Stakeholders**



**TECHNICAL FEASIBILITY OF RECYCLED GYPSUM  
REINCORPORATION IN THE PRODUCTION PROCESS AND  
ENERGY FLOWS**

17 November 2015, Brussels, European Parliament

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# Action B3 – Towards Sustainable Lightweight Systems

- ▶ **Sub-action B3.1: Gypsum waste recycling – Technical feasibility - Process adaptation**
- ▶ **Sub-action B3.2: Economic evaluation – Energy and raw material saving potentials**
- ▶ **Partnership**
  - ▶ **Gypsum producers:** 80% of the gypsum product market is covered by the project partners
    - ▶ Knauf Gips KG (DE)
    - ▶ Saint Gobain Placoplatre (FR)
    - ▶ Saint Gobain Construction Products Belgium NV (BE)
    - ▶ Siniat (FR) & Siniat (UK)- Etex group
  - ▶ **Academic partners**
    - ▶ FGUPM-LOEMCO: Gypsum laboratory (ES)
    - ▶ National Technical University of Athens (GR)



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# Aim & Scope

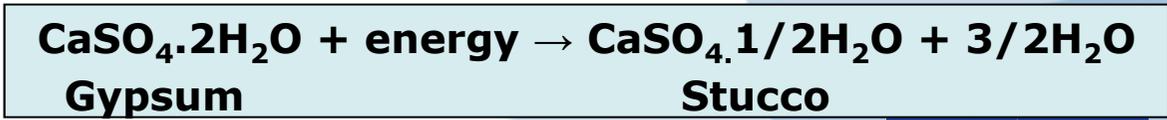
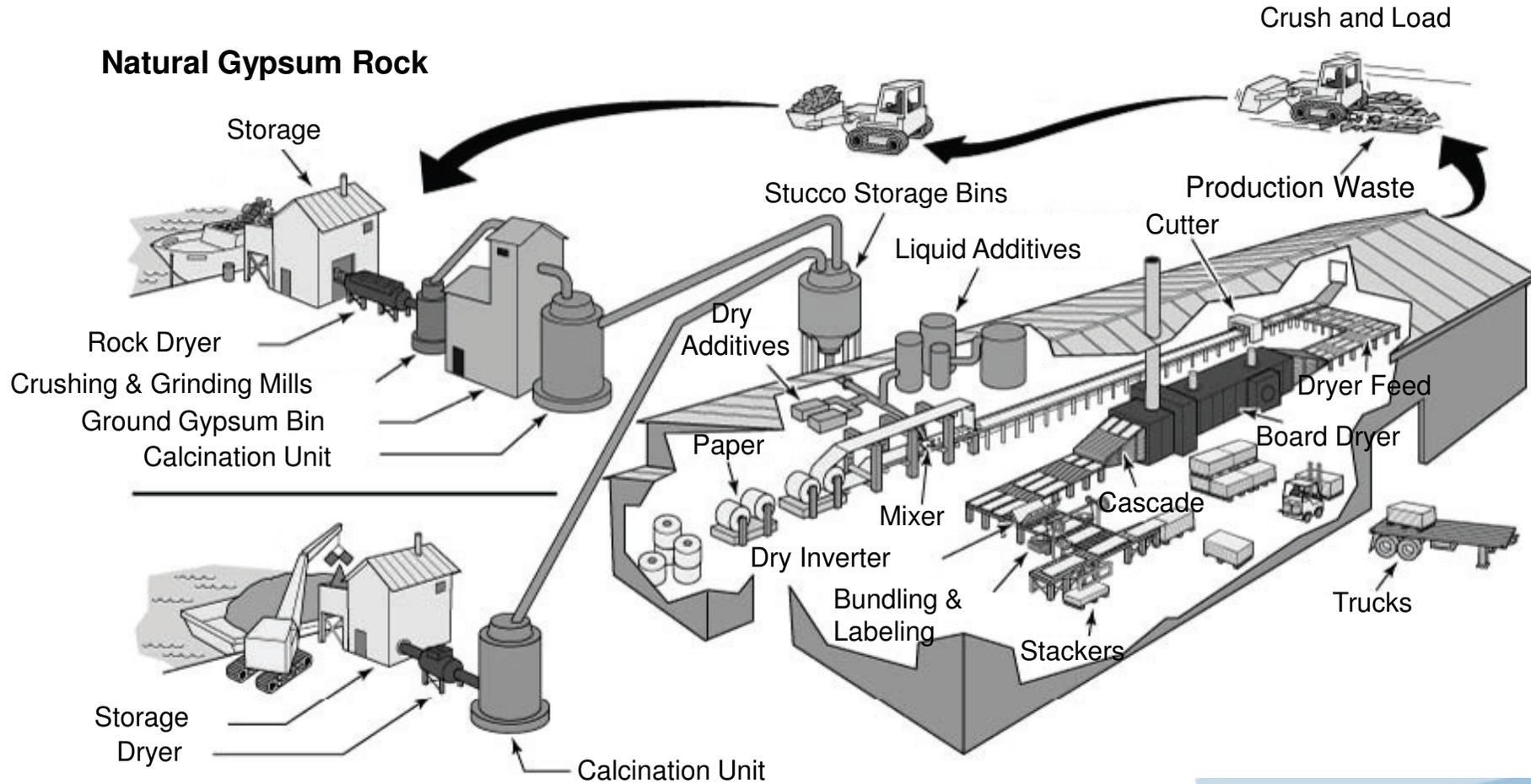
- ▶ Investigation of the technical feasibility of reaching **the set target of 30% recycled gypsum re-incorporation into plasterboard manufacturing** by increasing the amount derived from post-consumer (i.e. C&D) gypsum-based waste
  - ▶ Identification of bottlenecks that hinder the intended increase of recycled gypsum
  - ▶ Investigation of potential solutions to overcome these bottlenecks and to reach the set target of 30%
  - ▶ Determination of the necessary technical changes and modifications in the manufacturing process
  - ▶ Techno-economic assessment of the potential impact on the manufacturing process in terms of product quality, variable costs and energy consumption



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# PB Manufacturing Process



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# Means - Methodology

- ▶ Organization of demonstration projects (full-scale industrial trial productions) in the 5 participating manufacturing plants.
- ▶ Trials carried-out in two parts (Jan 2014 - March 2015) in "Standard" (Type A) plasterboard production lines.



**1<sup>st</sup> round: Standard Production**  
**– Current RG incorporation**  
**rates 5-18%**

- *Fine-tuning of data recording*
- *Base Scenario for the assessment*



**2<sup>nd</sup> round: Maximization of**  
**% RG re-incorporation rates**  
**up to 30%**

- ▶ Systematic recording of key technical and economic process parameters (material and energy flows, process conditions data, cost data)
- ▶ Receipt of samples of gypsum raw materials (conventional and recycled) and plasterboards for property analysis
- ▶ Ground observations (problems encountered, process adjustments required/implemented) systematically summarized in questionnaires



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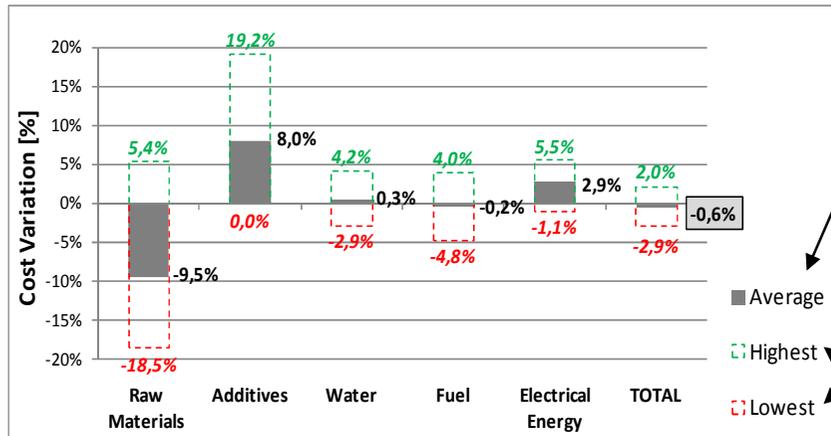


# Outcome of the Trials

- ▶ Higher level re-incorporation of recycled gypsum into plasterboard manufacturing **has proved feasible in practice;**
  - ▶ Considerable increase achieved in the use of recycled gypsum in all 5 plants; up to 20-30% from originally 5-18% in the 1<sup>st</sup> trials
  - ▶ Average re-incorporation rate in the 5 plants increased from ~11% (Base Scenario) to ~25% (feasible maximum)
  - ▶ The GtoG 30% target was reached in 2 out of the 5 plants
  - ▶ All PB samples from the 2<sup>nd</sup> trials conformed to the EN-520 Standard
- ▶ Problems and difficulties encountered during the 2<sup>nd</sup> trials were overcome by appropriate non-permanent process adjustments (i.e. no investment in equipment). Main adjustments implemented;
  - ▶ Changes in the speed of equipment (feeding conveyors, boardline etc.)
  - ▶ Recipe adjustments concerning the chemical additives used in the stucco slurry
- ▶ Main factors restricting maximization of re-incorporation:
  - ▶ Feeding system capacity limitations
  - ▶ Some recycled gypsum characteristics (mainly residual paper content and to a lesser extent moisture and purity)

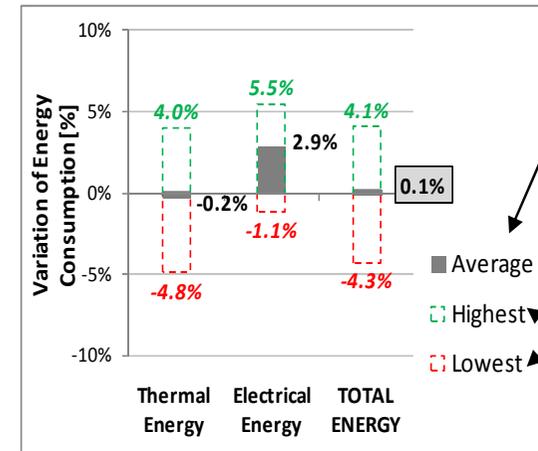


# Techno-economic Assessment



Weighted impact on average variable costs

Range of impact among the 5 plants



Weighted impact on average variable costs

Range of impact among the 5 plants

- ▶ Marginal 0,6% decrease of total weighted average variable cost; the considerable decrease in raw materials cost balances out cost increases noted in other process parameters (*primarily additives*)
- ▶ Practically insignificant impact on total energy consumption / CO<sub>2</sub> emissions and abatement costs. Positive result in terms of environmental impact.
- ▶ Impact on individual cost elements is specific-process dependent (i.e. feedstock mix, feedstock characteristics and pre-processing stages, recipes, industrial equipment, process adaptations implemented etc.); the broad range of impact among the plants indicates high dependence of results on process characteristics. Need for further process specific testing.



# Conclusions

- ▶ GtoG proved that **re-incorporation (up to 30%) of recycled gypsum in Type A plasterboard manufacturing is feasible in practice**, even under the adverse conditions of non-permanent process adjustments
  - ▶ The net weighted impact on total variable manufacturing cost and energy consumption of plasterboard was found to be practically negligible (accounting for the assessment uncertainties, current market prices and quality characteristics of recycled gypsum)
  - ▶ GtoG made possible the collection and analysis of a significant number of recycled material and plasterboard samples, not otherwise feasible.
  - ▶ The individualized procedures of each plant did not allow the establishment of a generalized methodology for optimum/ highest inclusion of recycled gypsum in plasterboard manufacturing. The outcome of the trials allows each manufacturer to plan the necessary industrial adaptations, which require further trials, investment and time.
  - ▶ Stronger economic and environmental benefits can arise in the future, when the modified process will be optimized and the recycled material quality will consistently rely within the specifications set by GtoG
- ▶ GtoG demonstrated in practice the engagement of plasterboard manufacturers to gypsum recycling practices



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# Recommendations & Future Steps

- ▶ The overall findings of GtoG and the collective knowledge-experience acquired are promising and permit planning of future investigations even at higher re-incorporation percentages
- ▶ In order that high level reincorporation becomes standard practice the feasibility of continuous and systematic provision of the required volumes of recycled material to meet production needs must be assessed; mapping of sources with quantitative estimation at national/ EU level
- ▶ Short duration of trials – not categorical conclusions; More tests / production trials required to investigate:
  - ▶ the impact of high re-incorporation rates of recycled gypsum on a constant basis
  - ▶ the optimum solutions for equipment modifications and investments
  - ▶ the impact in relation to basic characteristics of recycled gypsum (i.e. moisture, purity, residual paper etc.)
  - ▶ the expansion of the study's scope to include more technical boards and other gypsum-based products



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