

The GTOG Project synthesis

- The context
- The project
- The actions
- What to bear in mind
- The messages

- **The context**

- A significant reduction of FGD gypsum production in the coming years
- At the same time, opening or extending quarries where natural gypsum is extracted has become more and more difficult

- **Opportunity**

- The eternal recyclability of gypsum products



- **Recycling**

- Explore all alternative sources of gypsum
- Contribute to reduction of environmental impact of our gypsum products
- But the volumes at stake will never compensate the lack of FGD Gypsum availability

Gypsum based wastes in Europe

Three different sources

- **Production waste:** it is already internally recycled by the manufacturers
- **Construction waste:**
- **Demolition waste:** the most complex, because of mixed wastes

Although gypsum products are indefinitely and fully recyclable, only a small percentage of demolition waste is recycled in Europe



The GtoG Life project

- Objectives

- The GtoG project aims at **transforming the European gypsum demolition waste market** to achieve higher recycling rates of gypsum waste
- The Project wish to turn waste **into a resource** for close loop recycling in accordance to the criteria set in Article 6 of the **Waste Framework Directive**.



GtoG: means and methodology



- A consortium of 17 partners led by Eurogypsum with great expertise for a collaborative project between the gypsum industry actors (demolishers, recyclers and manufacturers)
- Budget of 3,5M€ co-financed by the European Commission
- 3 years: 01/2013 → 12/2015

An unique integrated supply chain approach

<http://gypsumtogypsum.org/>

**VALUE CHAIN
ANALYSIS: MARKET
SURVEY**

**DECONSTRUCTION
PILOT PROJECTS**

**GYPSUM WASTE
REPROCESSING
AND
QUALIFICATION OF
RECYCLED GYPSUM**

**REINCORPORATION
OF THE RECYCLED
GYPSUM IN THE
MANUFACTURING
PROCESS**

GtoG: the structure

A. Value chain analysis

- A. Market survey on deconstruction practices and recycling status in 8 EU countries

B. Implementation actions / 5 Pilot projects

- 1. Deconstruction → B1
 - 1. European Handbook of best practices for deconstruction of gypsum system
 - 2. European Manual of best practices for the audit of building
- 2. Recycling → B2
 - 1. European guidelines on qualifications for recycled gypsum
- 3. Reincorporation → B3
 - 1. Optimization of incorporation of recycled gypsum into production process

C. Monitoring the pilot projects

- 1. Definition of best practices indicators
- 2. Assessment of the carbon footprint of gypsum waste recycling
- 3. Roadmap for a sustainable value chain

D. Dissemination and communication



GtoG: the actions

Action A1: Value chain analysis in terms of deconstruction methodologies, economics of logistics and recycling

Partner leader → UPM

- ▶ 2 reports:
 - ▶ Inventory of current practices for light weight construction → DA1 report
 - ▶ Legislative context, procedures and techniques, economical approach
- ▶ For both reports, no specific synthesis: these 2 documents are dedicated to inventory of situations and practices in 8 countries in Europe: Belgium, France, Germany, Greece, Poland, Spain, the Netherlands, the UK

GtoG: the actions

Action B1: Eco efficiency of deconstruction and segregation: technical, economical and market feasibility

Partner leader → Recovering

- ▶ European handbook in audit prior to deconstruction → DB2 report
 - ▶ It is advised to carry out the audit prior to the procurements relative to the works and prior to the acceptance of the preliminary estimations.
 - ▶ This document aims at standardizing waste audits and ensuring that they are comprehensive of all possible elements.
 - ▶ According to the regulation in a given country, it is mandatory to carry out a diagnostic specific to certain hazardous materials. It concerns asbestos in all the countries covered by the GtoG projects. It can also concern lead paint in certain countries.
 - ▶ The reports stemming from the diagnosis on hazardous materials must be given to the person that will carry out the waste audit. Not only the results of these diagnoses can have a huge impact of the waste audit, but they are also essential for health and safety reasons.

Action B1: Eco efficiency of deconstruction and segregation: technical, economical and market feasibility

Partner leader → Recovering

- ▶ European handbook for best practices in deconstruction techniques → DB1 report
 - ▶ The operation costs for both demolition and deconstruction practices are similar. The savings are in fact made on the route: landfilling is much more expensive more especially in the countries with a high landfill tax. Selective demolition facilitates the recycling route and induces savings.
 - ▶ Regarding the practices in terms of deconstruction, it is not relevant to conclude that one practice is better than another. The choice of deconstruction can lead to important cost-savings on big jobsites, especially thanks to the recovering of the gypsum-based wastes that generally cost less than their landfilling
 - ▶ The manufacturers, project owners, architects, and the construction companies must integrate eco-design of the systems of the buildings at each step in order to build buildings and systems that will be easier to deconstruct and recover, preferably recycle at the end of life.

Action B2: Valorization of deconstruction waste + fix end of waste criteria – waste processing

Partner leader → GRI

- ▶ Guidance document with criteria for acceptance of recycled gypsum for recycling → DB3 report

	Accepted by GRI, NWGR, SINIAT SA	After approval by specific recycler	Not accepted GRI, NWGR, SINIAT SA
Gypsum Blocks	x		
Gypsum ceilings, floors, walls, stucco..	x		
Gypsum waste with nails and screws, wallpaper, glass tissue and other wall coverings	x		
Plaster in bags	x		
Cove	x		
Glass reinforced gypsum products (GRG)	x		
Boards with tinfoil and polystyrene		X	
Gypsum Fibre boards		X	
Moulds		X	
Plasterboard with glass fiber netting		X	
Gypsum based ceiling tiles		X	
Plasterboard with insulations (EPS-PS)		X	
Hazardous materials, e.g. asbestos			X
Autoclaved aerated concrete (AAC)			X
Cement bound boards			X

Action B2: Valorization of deconstruction waste + fix end of waste criteria – waste processing

Partner leader → GRI

- ▶ Valorization and qualification of gypsum waste quality criteria of the recycled gypsum – technical parameters → DC2 report

Parameter	Powder spec	Test method
Particle size	0 - 15 mm	UNE-EN 933-1
Free moisture	< 10%	VGB serial number 1
Purity (CaSO ₄ 2H ₂ O)	> 80%	VGB serial number 2.3
TOC	< 1.5%	Gigt 3.1.3.2 DepV DIN EN 13137
Magnesium salts, water sol.	< 0.1%	VGB serial number 8.1.2
Sodium salts, water sol.	< 0.06%	VGB serial number 8.2.2
Potassium salts, water sol.	< 0.05%	VGB serial number 8.3.2
Sol. Chloride	< 0.02%	VGB serial number 8.8.3
pH	6-9	VGB serial number 4

Action B2: Valorization of deconstruction waste + fix end of waste criteria – waste processing

Partner leader → GRI

- ▶ Valorization and qualification of gypsum waste quality criteria of the recycled gypsum – technical parameters → DC2 report

* Ni (Nickel):

For Nickel, the maximum concentration in the Beckert dataset was 13 mg/kg. The values from the Beckert-study are widely recognized as reference values for heavy metal concentrations in FGD and natural gypsum. However, these values do not represent the concentrations above which a human health risk occurs. These “risk-based threshold values” have not been defined. Further study in relation to the toxicological parameter of FGD Gypsum is currently being carried out by the Gypsum Industry. After the Life-project, the results of the study can be analyzed for the recycled gypsum. The quality criteria would then be revised in 2017.

Element [mg/kg]	Powder spec	Test method
As	< 4	DIN EN ISO 11885 Determination of selected elements ICP-OES (acc to DepV)
Be	< 0,7	
Pb	< 22	
Cd	< 0,5	
Cr	< 25	
Co	< 4	
Cu	< 14	
Mn	< 200	
Ni	-*	
Se	< 16	
Te	< 0,3	
Tl	< 0,4	
V	< 26	
Zn	< 50	
Hg	< 1,3	DINEN 1483 AAS-DINEN 12338-Mercury process after enrichment by amalgamation. DIN ISO 1785 atomic fluorescence spectrometry (acc to MatelVO)
Radioactivity Index	< 0,5	RP 112 Document (EC)
Asbestos	none	atomic absorbance-method and PLM **

Action B3: Reincorporation in the production process: technical, economic feasibility - recycling

Partner leader → Knauf / NTUA

- ▶ Report on production process parameters → DB4 report
 - ▶ It is proved that re-incorporation (up to 30%) of recycled gypsum in plasterboard manufacturing is feasible in practice, even under the adverse conditions of non-permanent process adjustments.
 - ▶ For the examined cases, the net average impact on the total variable manufacturing cost and energy consumption per m² of plasterboard was found to be practically negligible
 - ▶ Stronger economic and environmental benefits can arise in the future, when the necessary process modifications will be optimized and the recycled material quality will consistently rely with the quality specifications set by the GtoG project.
 - ▶ Potential production bottlenecks have been highlighted in terms of recipe modifications (e.g. in additives) and production process equipment (e.g. storage, feeding conveyors, recycled gypsum pre-processing etc) that may arise when the increased percentage becomes standard practice in the plasterboard manufacturing.

GtoG: the actions

Action C1: Monitoring B1 – B2 – B3

Partner leader → UPM

- ▶ Carbon footprint of gypsum: landfilling versus recycling route → DA2 report
 - ▶ Three scenarios are defined based on LCI references with different levels of recycled gypsum reincorporated in the manufacturing process (0%, 5%, 18.5%) . The contribution of different plasterboard scenarios to global warming, expressed as CO2 equivalents, results in greater differences: 2.53 kg CO2 eq/m2 (0%), 2.45 kg CO2 eq/m2 (5%) and 2.24 kg CO2 eq/m2 (18%).
 - ▶ That is due to
 - ▶ biogenic emissions from paper degradation in the End-of-Life stage, which are dependent on landfill type and infrastructure, They are primary drivers of the difference between total GHG emissions in the different scenarios.
 - ▶ greater impacts occur in the processes of transport of recycled gypsum, pre-processing stage, transport of plasterboard waste to recycling and waste processing, while lower impacts are observed in gypsum mining, transport of natural gypsum and final disposal.

GtoG: the actions

Action C1: Monitoring B1 – B2 – B3

Partner leader → UPM

- ▶ Best practice indicators for deconstruction, decontamination, characterization and recycling practices → DC1 report
 - ▶ The study is based on three pillars: the crucial factors for the effectiveness of the recycling route, relevant results from the monitoring of a set of European pilot projects, and conclusions regarding the close loop recycling effects.
 - ▶ These indicators enable not only to monitor and compare progress, but also to set the basis for future formulation of mitigation measures to avoid and minimize the negative effects derived from potential weakness detected.

Action C1: Monitoring B1 – B2 – B3

Partner leader → UPM

- ▶ Roadmap on a sustainable value chain → DC3 report
 - ▶ The target group is stakeholders in the value chain, local, regional and international industry associations, relevant institutions and public administration bodies.
 - ▶ The road map includes strategic assessment criteria, such as Level of innovation, Transferability and potential for commercialization, Relevance for environmentally significant issues or policy actions, Relevance for other significant issues or policy areas.
 - ▶ Parts of this document already exist in previous documents

Action D1: Dissemination and communication **Partner leader → Eurogypsum**

- ▶ Dedicated website:
<http://gypsumtogypsum.org/>
 - ▶ Leaflet, poster, e-bulletins
 - ▶ Seminars
 - ▶ Networking report based on mind mapping of past and present projects
 - ▶ Layman's report. General presentation of the project
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GtoG: what to bear in mind

- ▶ Demolition costs and reincorporation costs are not discriminant.
- ▶ Logistic costs from jobsites to plasterboard plants are key compared to landfilling costs
- ▶ Recyclable gypsum and recycled gypsum have to be clearly distinguished. The first one is before treatment, the second one reaches general specifications for reincorporation
- ▶ Specification of recycled gypsum are close to VGB/Ecoba/Eurogypsum quality criteria except Ni (because of crushing wastes)
- ▶ the re-incorporation of recycled gypsum has been increased considerably to 20-30% from the first trial to the second trial.
- ▶ Needed to meet regularly deconstruction sector and recycling sector

GtoG: the messages

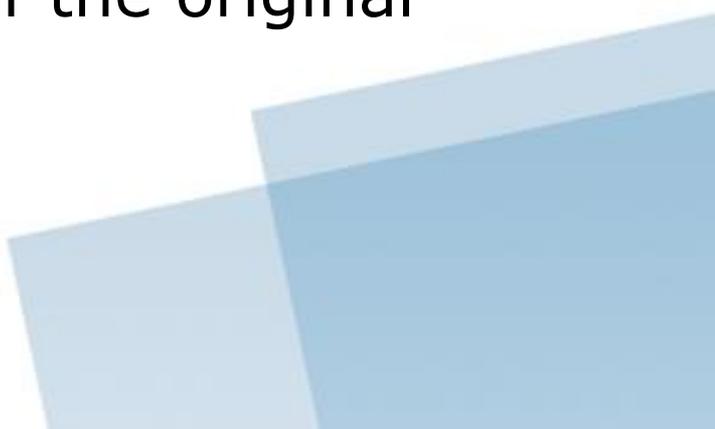
European Commission and Members States can support gypsum recycling by favoring deconstruction versus demolition

in the majority of Members States, buildings are currently demolished and not deconstructed. Dismantling buildings is the only way to obtain the high quality, well-sorted waste stream meeting the requirements of the industrial processes.



Pushing the correct implementation of the current EU waste legislation in a harmonized way across Europe.

This issue is crucial to drive **recycling and dismantling** forward. The European Commission should undertake actions to close the gap between the ambition of the original legislation and the end-result.



GtoG: the messages

Fostering the economic competitiveness of the recycling route compared to other currently permitted routes.

- ▶ The landfill route often remains the most profitable and thus most attractive waste treatment route, even for recyclable materials.
- ▶ In this respect the European Commission should reinforce the legal framework in order to discourage the disposal of recyclable gypsum based waste in landfills.

Turning waste into a resource

- ▶ Diverting the waste stream from landfill route allows recyclers and gypsum industry to invest with confidence.
 - ▶ Recycled gypsum shall become a trusted resource once having legally obtained the **end-of waste status** at European or national level in accordance to article 6 of the Waste Framework Directive.
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