



The GTOG Project

27 November 2015 Brussels – Belgium



- **Natural gypsum**

- Principal deposits in Europe
- Important production:
 - ~ 20 million tons of gypsum extracted yearly from 160 quarries in Europe

- **Use of alternative resources**

- Flue Gas Desulphurization (FGD) production
 - Eco-industrial collaboration with coal fired power plants
 - 8 million tons, whom 5,2 Mt used for plasterboards and blocks



Managing gypsum resources today

Opportunity: the eternal recyclability of Gypsum products

- Sustain the increasing demand raw material while preserving our natural resources
- Priority: to create a circular economy



The Context

- Gypsum: rock life mineral used in ≠ applications
- Why recycling in the construction sector?
 - ✓ Impact on GDP (10%)
 - ✓ Usage of raw materials
 - ✓ Disposal of raw materials



Gypsum based wastes in Europe

Three different sources

- **Production waste:** the easier, as it is internally recycled by the manufacturers
- **Construction waste:** not ideal, for collection problems
- **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 (What?)

- Achieve higher rates of recycling
- Promote the gypsum circular economy

Levers (How?)

- Application of best practices in
 - Deconstruction
 - Recycling
 - Reincorporating



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)

An unique integrated supply chain approach

**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

1. Market survey on deconstruction practices and recycling status in 8 EU countries (BE, DL, ES, FR, GR, NL, PL, UK)

B) Implementation actions / 5 Pilot projects

1. Deconstruction
 - ✓ European Handbook of best practices for deconstruction of gypsum system
 - ✓ European Manual of best practices for the audit of building
2. Recycling
 - ✓ European guidelines on qualifications for recycled gypsum
3. Reincorporation
 - ✓ 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

GtoG: the overview

Action	Activity	Responsible
A1	Value chain analysis in terms of deconstruction methodologies, economics of logistics and recycling	UPM
B1	Eco efficiency of deconstruction and segregation: technical, economical and market feasibility	Recovering
B2	Valorization of deconstruction waste + fix end of waste criteria – waste processing	GRI
B3	Reincorporation in the production process: technical, economic feasibility - recycling	Knauf / NTUA
C1	Monitoring B1 – B2 – B3	UPM
D1	Dissemination and communication	Eurogypsum
E1	Overall project management and reporting to commission	Eurogypsum

GtoG: the actions

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

Partner leader → UPM

- ▶ DA1 report: inventory of current practices for light weight construction
- ▶ Legislative context, procedures and techniques, economical approach
- ▶ For both reports, no specific synthesis: These 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

- ▶ DB2 report: European handbook in audit prior to deconstruction
 - ▶ 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.

GtoG: the actions

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

Partner leader → Recovering

- ▶ DB1 report: European handbook for best practices in deconstruction techniques
 - ▶ Selective demolition facilitates the recycling route and induces savings. 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.
 - ▶ Regarding the practices in terms of deconstruction, it is not relevant to conclude that one practice is better than another. Demolishers have their habits with high skilled employees mastering a type of practices. 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, project managers including architects, and the construction companies must integrate eco-design of the systems and eco-construction 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.

GtoG: the actions

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

Partner leader → GRI

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

	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

GtoG: the actions

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

Partner leader → GRI

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

Parameter	Powder spec	Test method
Particle size	0 - 15 mm	UNE-EN 933-1
Free moisture	< 10%	VGB serial number 1
Purity ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)	> 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

GtoG: the actions

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

Partner leader → GRI

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

* 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 **

GtoG: the actions

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

Partner leader → Knauf / NTUA

- ▶ DB4 report: report on production process parameters
 - ▶ 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
 - ▶ Process modification investments may become more attractive in the near future, depending on raw material prices and national legislations (e.g. gate fee for land-filling). 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

- ▶ DA2 report: carbon footprint of gypsum: landfilling versus recycling route
 - ▶ Three scenarios are defined (SC0, SC1, SC2) and different assumptions based on LCI references are considered, with the aim of evaluating the impact of different levels of recycled gypsum reincorporated in the manufacturing process (0%, 5%, 18.5%, respectively). The potential contribution of different plasterboard scenarios to global warming, expressed as CO₂ equivalents, results in greater differences: 2.53 kg CO₂ eq/m² in SC0, 2.45 kg CO₂ eq/m² in SC1 and 2.24 kg CO₂ eq/m² in SC2.
 - ▶ 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

GtoG: the actions

Action C1: Monitoring B1 – B2 – B3

Partner leader → UPM

- ▶ DC1 report: best practice indicators for deconstruction, decontamination, characterization and recycling practices
 - ▶ The study therefore 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.

GtoG: the actions

Action C1: Monitoring B1 – B2 – B3

Partner leader → UPM

- ▶ DC3 report: roadmap on a sustainable value chain
 - ▶ 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

GtoG: the actions

Action D1: Dissemination and communication

Partner leader → Eurogypsum

- ▶ DD1: Dedicated website
- ▶ DD2: Leaflet, poster, e-bulletins
- ▶ DD3: seminars
- ▶ DD4 report: networking report based on mind mapping of past and present projects
- ▶ DD5: Layman's report. General presentation of the project

GtoG: the actions

Action E1: Overall project management and reporting to commission

Partner leader → Eurogypsum

- ▶ DE1: Calendar Actions and sub-actions
- ▶ DE2: Web-based tool for finance and communication
- ▶ DE3: Financial guide
- ▶ DE4: Minutes of Steering Committee meetings
- ▶ DE5: Dissemination and communication plan
- ▶ DE6: Report with project corporate image

GtoG: the recommendations

Gypsum is indefinitely recyclable and its recycling leads to benefits for the whole of society

- ▶ Gypsum products like plaster have been used by man in construction or decoration since as early as 9000 B.C
- ▶ Gypsum-based construction products are amongst the very few materials where “**closed-loop**” **recycling** is possible.
- ▶ The physical characteristics of gypsum in the raw material and in plasterboards are the same.

By recycling more, the Gypsum Sector saves natural resources and reduces its environmental impact.

- ▶ The technology to transform the Gypsum Based Waste into recyclable gypsum already exists even though there is scope for further improvements.
 - ▶ But, obtaining high rates of recycled content in gypsum based products will require important investments throughout the value chain
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GtoG: the recommendations

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

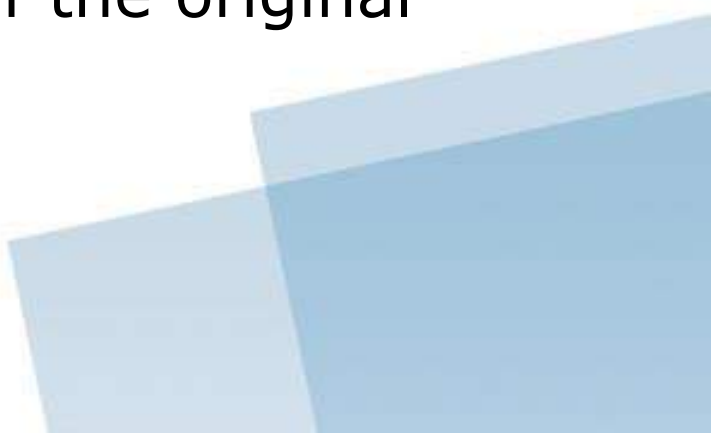
in the majority of Members States, buildings are currently demolished and not deconstructed. Dismantling buildings is the only way to obtain the high quality, well-sorted waste stream meeting the requirements of the industrial processes.



GtoG: the recommendations

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 recommendations

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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