

Construction and demolition and mining waste recycling practices in South East Europe - the experiences and outcomes from SARMa and SNAP-SEE projects

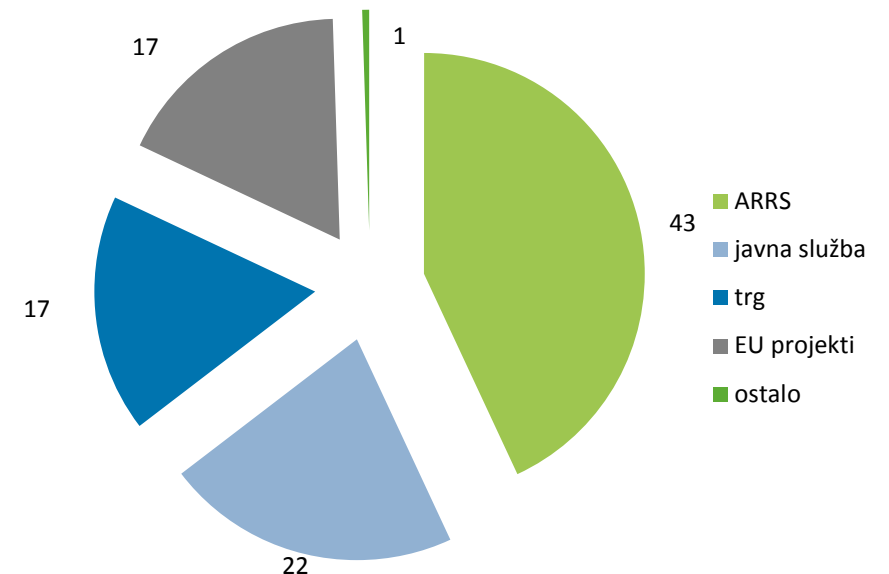
Characterizing the built environment stocks: methods and case studies workshop

Odense, 11-12. 8. 2016

Gorazd Žibret

GeoZS - Geological Survey of Slovenia

- public research institute, holder of public services
- 4 departments: mineral resources, GIC, underground waters, regional geology
- public service: ministries of economy and environment, Slovenian environmental agency
- basic research (3 research groups + infrastrukture group)
- annual turnover:
 approx 4 mio. €
- approx. 80 employees
- GeoZS is an excellent mixture of: basic research, applied research, public service, research for industry & international cooperation



GeoZS past & present international projects

- **COMPLETED:** OneGeology-Europe, TERRAFIRMA, WATMOVE, ClimChAlp, IGPC 467, IGPC 259 & IGCP 360, EWater, TRANSTHERMAL, RESTCa, GEOPORTAL, Via GeoAlpina, AEGOS, AdaptAlp, Alp-Water-Scarce, T - JAM , **SARMa**, I2GPS, Safe Land, INCOME, CO2StoP, GEO.POWER, EuroGeoSource, TransEnergy, EO-MINERS, PanGeo, InGeoCloudS, ASTIS, HYDRO KARST, GeoMol, **SNAP-SEE**, Roof of Rock, LEGEND, eENVplus, Minerals4EU, Minventory, START_it_up, ISTR-HIDRO, ŠKOCJAN-RISNJAK,
- **ACTIVE:** EMODNET, **ProSUM**, iVAMOS!, MINATURA, INTRAW, Geothermal ERA NET, RECALL, UNEXMIN, MICA, **MINEA**, GRETA, EUOGA, MineService, aRAWness, SUB-URBAN, MINLEX, AMIIGA, GEOPLASMA-CE, CapRadNet, AdriaWealth, MEDSALT, PanAfGeo

SUSTAINABLE AGGREGATES RESOURCE MANAGEMENT

- Aggregates (crushed stone, sand and gravel) are crucial for infrastructure and construction. SEE countries are rich in aggregates, but supply is not coordinated within or across the area.
- The main objective of the project is to develop a common approach to (a) sustainable aggregate resource management (SARM) and (b) sustainable supply mix (SSM) planning, at three scales: regional, national and transnational.
- 14 partners, 9 observers
- 2009 - 2011
- <http://www.sarmaproject.eu/>



ustainable approach to aggregates
SARMa



the SARMa project - geographical location



the SARMa project - main outputs

- recommendations on best practices for industry and authorities
- reports and recommendations on illegal quarrying, including social licence to quarrying
- **reports and recommendations on recycling**
- **LCA guidelines and schemes**
- manual on quarry restoration, including special guidelines for near river quarry restoration
- reports and recommendations on regulations and policy
- reports and recommendations on sustainable supply mix
- recommendations on SARM
- manual on resource efficiency in local communities
- **manual on C&D waste**

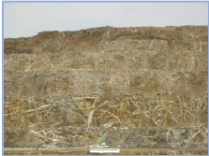


the SARMa project - main outputs

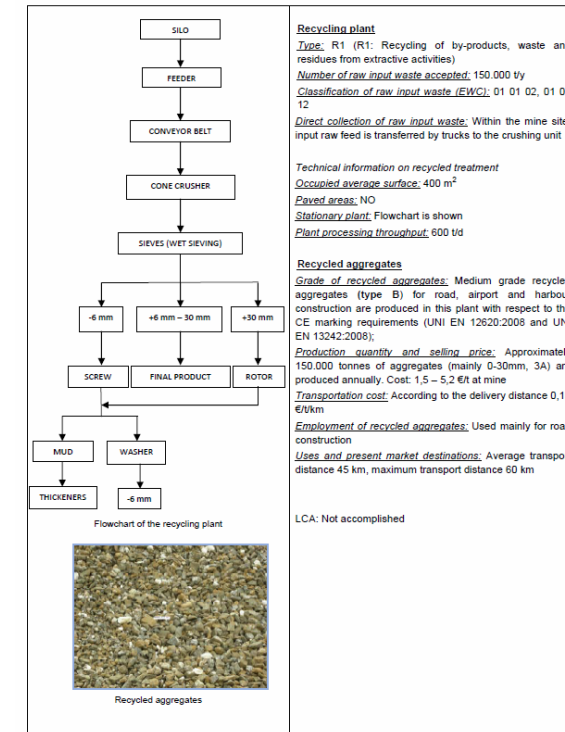
- manual on SARM and SSM
- feasibility study and action plan on regional centre for aggregates
- GIS applications for SARM

the SARMa project - reports & recommendations on recycling, main messages

- case studies from Albania, Greece, Italy, Romania and Slovenia
- case studies provide information about different recycling plants, like capacity, production, process flows, customers, price, pictures...

2.2 Case study 2 – Greece (IGME): the Magnesite mine of Gerakini

 Magnesite extraction site	<p>Gerakini Mine is located in the Chalkidiki Prefecture of the Region of Central Macedonia in Greece. It belongs to the municipality of Polygyros.</p> <p>Gerakini mine site belongs to the state and is legally operated by the Grecian Magnesite S.A. The mine site is not close to nature protected areas or national heritage sites.</p> <p>The main product of the production unit (kilns) are caustic calcined and dead - burned magnesite. A range of gangue as well as by-products stem out within the framework of the extraction and processing procedures that take place at Gerakini mine for the exploitation of the magnesite deposit.</p>
 Stockpiles of by-products	<p>The mine tailings left over and stockpiled after magnesite extraction and used currently for production of aggregates, is a composite material, comprising dunites and harzburgites of varying grade of alteration, and remaining fragments of magnesite.</p>
 Recycling plant - Aggregates production unit	<p>In order to reduce disposal area needs and exploit part of the aforementioned disposed off materials, the company has established a crushing grinding plant unit for the production of secondary aggregates. This plant unit is located close to the grizzly installation of the production circuit (250-500 m). The feed of this crushing -grinding plant comprises both by-products from the sorter unit plant of the mill and waste material from the quarry as well. The feed mixture to the crushing grinding plant depends on the main production schedule. Feed usually contains magnesite and serpentine in small quantities, but mainly dunite.</p>
 Recycling plant - Aggregates production unit	<p>Thus, the specific input material belongs to the R1 category (R1: Recycling of by-products, waste and residues from extractive activities).</p> <p>Raw input material for the aggregate production unit is transferred by lorries, as all the transportations within the quarry.</p> <p>The average quantity processed yearly is 150,000 tones (1 shift per day).</p> <p>Wastewater of the recycling plant goes to the thickeners which are part of the sorter unit. Clear water produced by the thickeners is useful for other uses in the mine.</p>



the SARMa project - reports & recommendations on recycling, main messages

- aggregates demand per capita: 6-12 t/y
- C&D waste generation per capita 0.8 t/y
- poor statistics
- LCA needed to determine feasibility to recycle C&D waste
- classification of aggregates: natural aggregates, recycled aggregates, secondary aggregates
- classification of recycling activities:
 - R1 - quarrying by-products
 - R2 - C&D waste
 - R3 - extracted soils/rocks from civil works
 - R4 - industrial waste (slags, ash from waste or coal incineration...)

the SARMa project - reports & recommendations on recycling, main messages

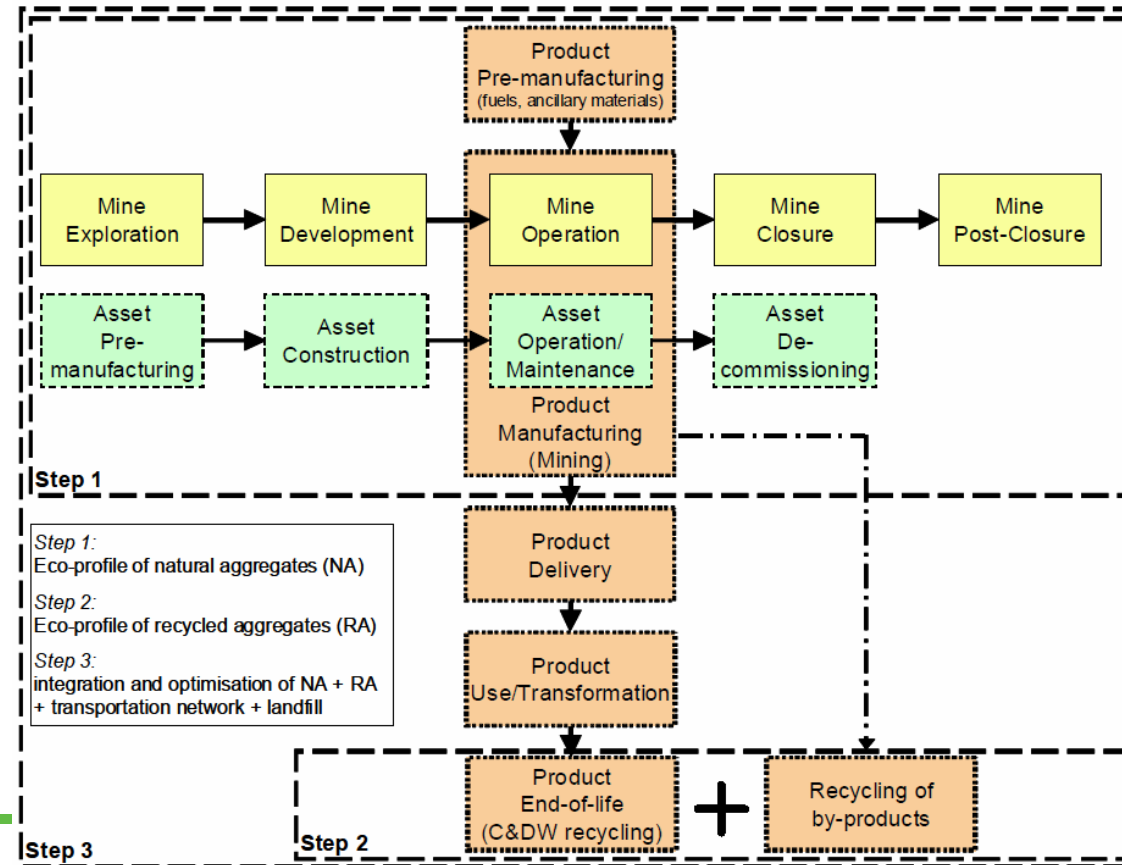
- classification of recycled aggregates
 - type A - high quality RA for concrete and road construction
 - type B - medium quality RA for road, airport or harbour construction
 - type C - low quality RA for environmental filling
- recommendation for parameters to be considered:
 - saturated surface dried specific gravity
 - LA Index
 - Shape index
 - Flakiness index
 - Sand equivalent
 - Fineness modulus
 - Impurity level
 - leaching tests
 - availability of codes and practices on technical excellence
 - availability of CE marking

the SARMa project - reports & recommendations on recycling, main messages

- recommendations
 - strong synergies between mining, processing and recycling
 - aggregates producers has all know-how
 - conventional and recycled aggregates are not competitors
 - recycling is an extension and adaptation of existing tech.
 - promote cooperation of recycling & mining sectors
 - recycling should be an evolution from mining (for ex. - recycling plant in abandoned quarry)
 - recycled aggregates can replace natural ones with respect to quality
 - shift the focus from origin to technical quality
 - mandatory CE marking
 - use of best techniques to produce recycled aggregates
 - LCA assessment to prove net environmental gains

the SARMa project - recommendations on LCA - main messages

- 3 cycles in mining/quarrying/recycling industry (mine development, asset development and products)
- 3 steps in LCA (LCA of natural agg., LCA of recycled agg., integration + transport + landfill)



the SARMa project - recommendations on LCA, main messages

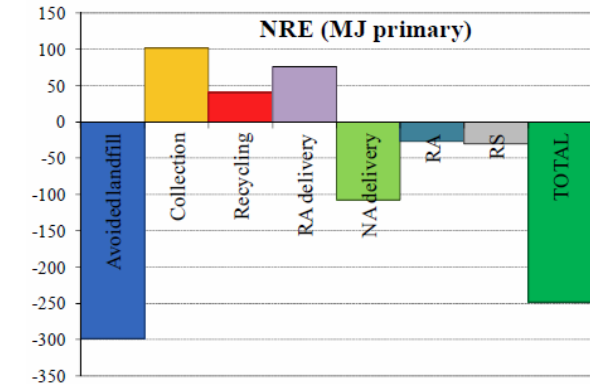
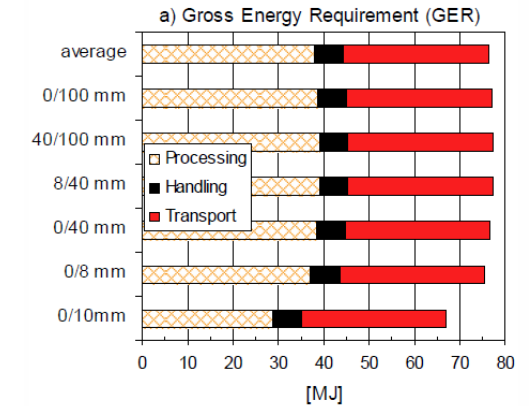
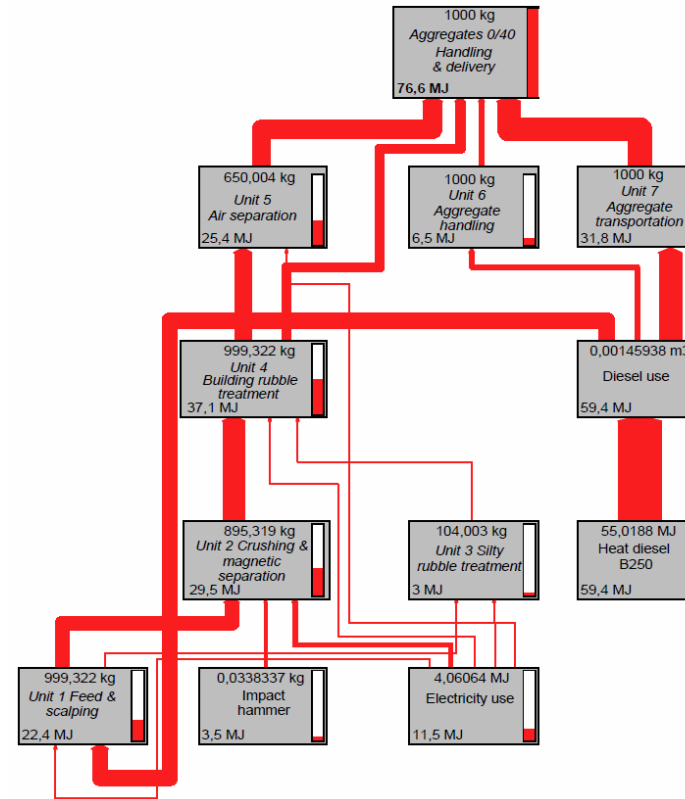
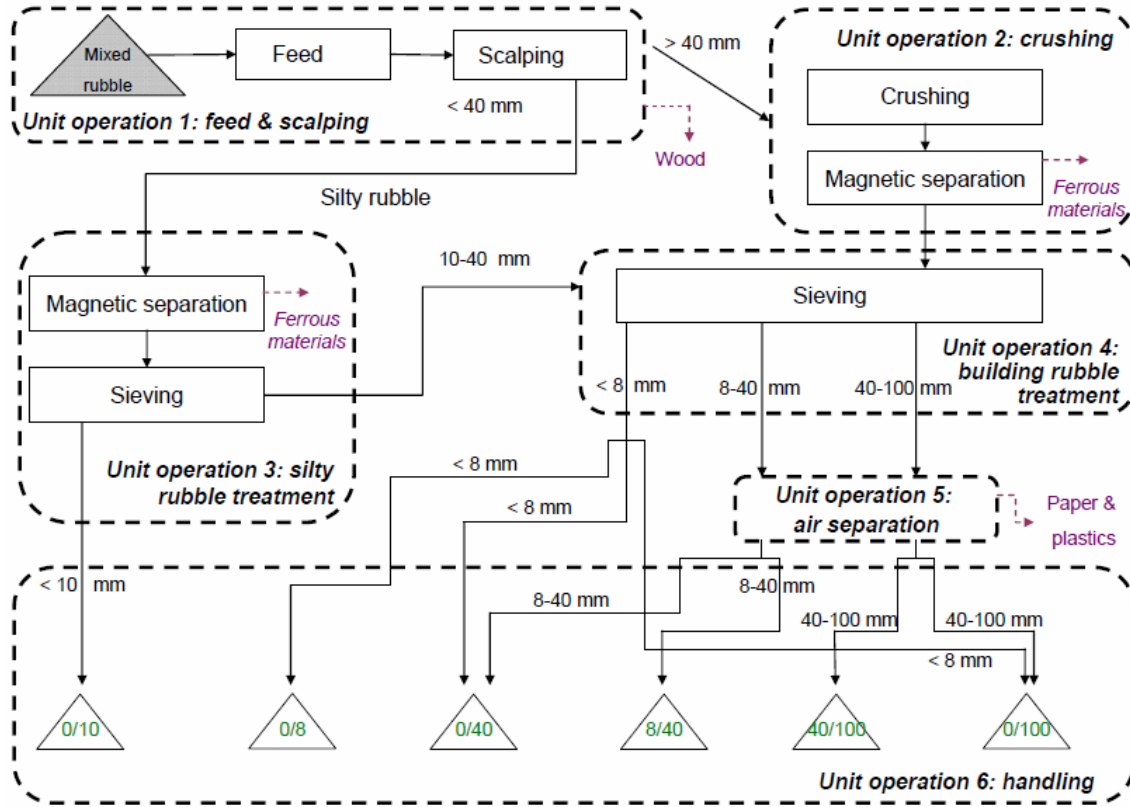
- additional burdens from site preparation and rehabilitation are usually negligible
- concept from-grave-to-cradle should be applied
- scraps or waste do not hold any past energetic-environmental burdens (zero burdens assumptions) - the system that receives the waste is credited to avoid need of "virgin" raw materials

the system boundaries should therefore include:

- the collection of input materials (transportation)
- recycling (processing)
- avoidance of quarrying

the SARMa project - recommendations on LCA, main messages

stationary recycling plant CAVIT near Turin (Italy), dry treatment



Induced and avoided impacts in the life cycle of 1 t of C&DW

the SARMa project - recycling status within SEE area

In **Albania**, part of the tailings from the chromites processing industry is treated for the production of aggregates for the constructive industry.

There are no recycling plants in **Herzegovina**, while very few plants exist in Bosnia.

In **Greece**, national legislation on recycling of C&DW was enforced very recently. R1 waste (extractive waste) and R4 waste (slag) are used for the production of aggregates for road construction. R1 waste and R3 waste (excavated soils/rock from civil works) are often used for backfilling works, but there are no available data on tonnages.

In **Serbia**, the quantities of C&DW that are recycled for production of aggregates are very low presently. Industrial waste, such as slag and ashes from coal combustion, are used as sources for aggregates production, but only occasionally.

the SARMa project - recycling status within SEE area

Slovenia has recycling plants that treat mostly R2 waste (C&DW), R1 waste (mining waste) and R4 waste (industrial waste). Aggregates produced from these plants are used for backfilling purposes, concrete production and other construction purposes.

In **Austria**, R1 waste (mining waste) is used mostly as backfilling material within the quarries. However, high percentages of other types of wastes are treated: 83% (5 million tonnes out of 6 million tonnes) of R2 waste (C&DW), 72 % (15.9 million tonnes out of 22 million tonnes) of R3 waste (excavated soils/rock) and 69 % (1.1 million tonnes out of 1.57 million tonnes) of R4 waste (industrial waste). Nearly 100% of asphalt (R2 waste) is recycled, while 90-95% from used concrete (R2 waste) is also recycled.

the SARMa project - policy recommendation on recycling

EU level

- Include financial regulatory instruments for certain non-hazardous wastes within framework directive, to prevent distorted competition among aggregate suppliers across borders.
- An up-to-date legal terminology is needed for aggregates.
- It is recommended that product-specific eco-label and eco-award legislation should be extended to both primary and secondary aggregates production schemes.

SEE level

- On-line, easily accessible (or even publicly available) service providing aggregates information for both primary and secondary aggregates supply (and demand) sources is needed in all countries. National ministries should recognize the importance of possessing more reliable and complete statistics on aggregates.
- Secondary aggregates should be considered and incorporated into national, regional and local minerals plans, land use plans, environmental programs, waste management plans, and development plans by the enforcement of law to protect the primary aggregate resources, and to move towards a recycling society.
- Secondary aggregates should be considered and incorporated into national, regional and local minerals plans, land use plans, environmental programs, waste management plans, and development plans by enforcing laws for the protection of primary aggregates resources, and by moving towards a recycling society.

the SARMa project - policy recommendation on recycling

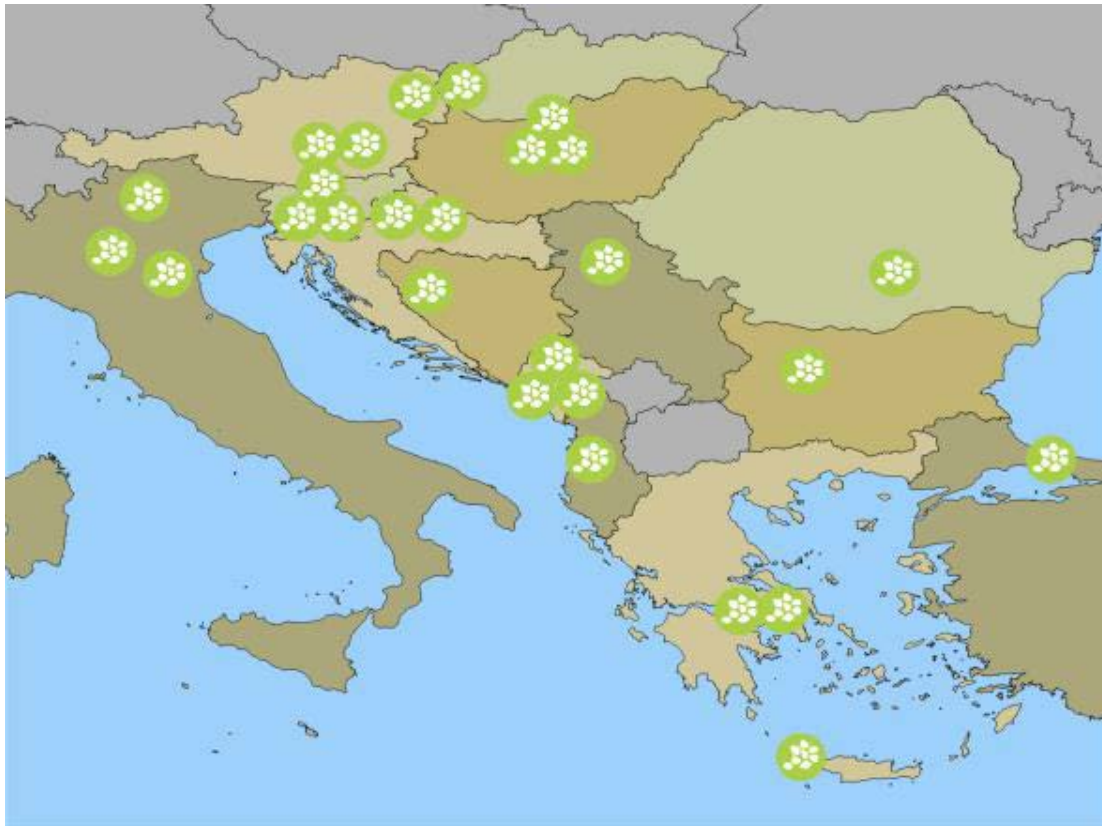
local level

- To improve the market of recycled aggregates, their price must be kept at least 20% lower compared to the price of natural aggregates in order to overcome “cultural resistances” of the market, which at the moment downgrade aggregates produced from waste.
- The methodology applied for demolition affects significantly the performance of the recycling process and the technical features of the recycled products. Pre-sorting of C&DW at source into homogeneous segments reduces recycling costs and ensures better quality for the recycled products.

the SNAP-SEE project - overview

SNAP-SEE: SUSTAINABLE AGGREGATES PLANNING IN SEE

27 partners from 14 SEE countries; 2012 - 2014



the SNAP-SEE project - overview

The working hypothesis of the project was, that countries in the SEE area have one or more of the following drawbacks at aggregates supply planning practices:

- The lack of coordinated/regional planning for aggregates' supply that addresses cross-sectoral interactions and ensures that documents are consistent;
- The lack of integrated planning for primary and secondary aggregates that addresses resource efficiency;
- The lack of capacity and competence to address the preceding two problems;
- Very low level of stakeholder engagement in the aggregates planning process to ensure that planning addresses the concerns and needs of all target groups.

the SNAP-SEE project - overview

Main goals:

- prepare "aggregates planning toolbox", covering
the SNAPSEE *vision*
handbook on *capacity building*
handbook on *data* analysis methodologies
aggregate *planning* scheme

other objectives

- to engage stakeholders in capacity building process
- to conduct national/regional consultations on aggregates planning
- to establish consultation process beyond snapsee project

Glossary:

Manufactured aggregates: Aggregates produced from industrial activities as processing or re-processing of waste, by-products and residues.

Recycled aggregates: Aggregates obtained from recycling of construction and demolition waste. The “Percentage Recycled” is calculated as the percentage of available Construction and Demolition materials that are suitable for recycling.

1. Aggregates derived from both construction waste, for example damaged bricks, and demolition waste, such as broken concrete, brickwork and masonry.
2. Aggregates resulting from the processing of inorganic material previously used in construction.

Sustainable Aggregate Resource Management (SARM): is efficient and low socio-environmental impact quarrying and waste management throughout the quarry life-cycle. SARM is directly related to quarrying. In this sense potential secondary aggregate resources are not included.

Sustainable Supply Mix (SSM): means that the demand for aggregates should be fulfilled with a mix of primary and secondary aggregates that together maximize net benefits of aggregates supply across generations.

Secondary aggregates: aggregates which originate as a waste of [other quarrying and] mining operations, or from industrial processes (e.g., colliery waste or mine stone, blast furnace slag, power station ash, china clay sand, slate waste, demolition/construction waste including road planning), but excluding chalk and clay/shale worked primarily for aggregate purposes.

the SNAP-SEE project - data manual

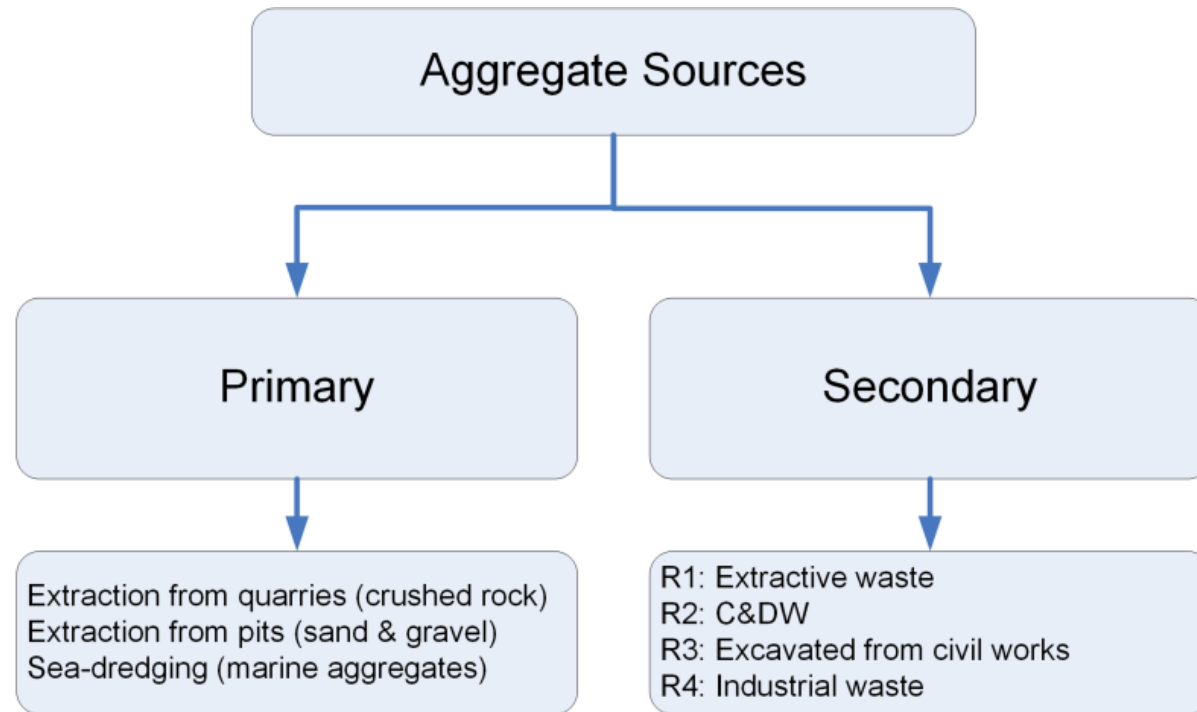


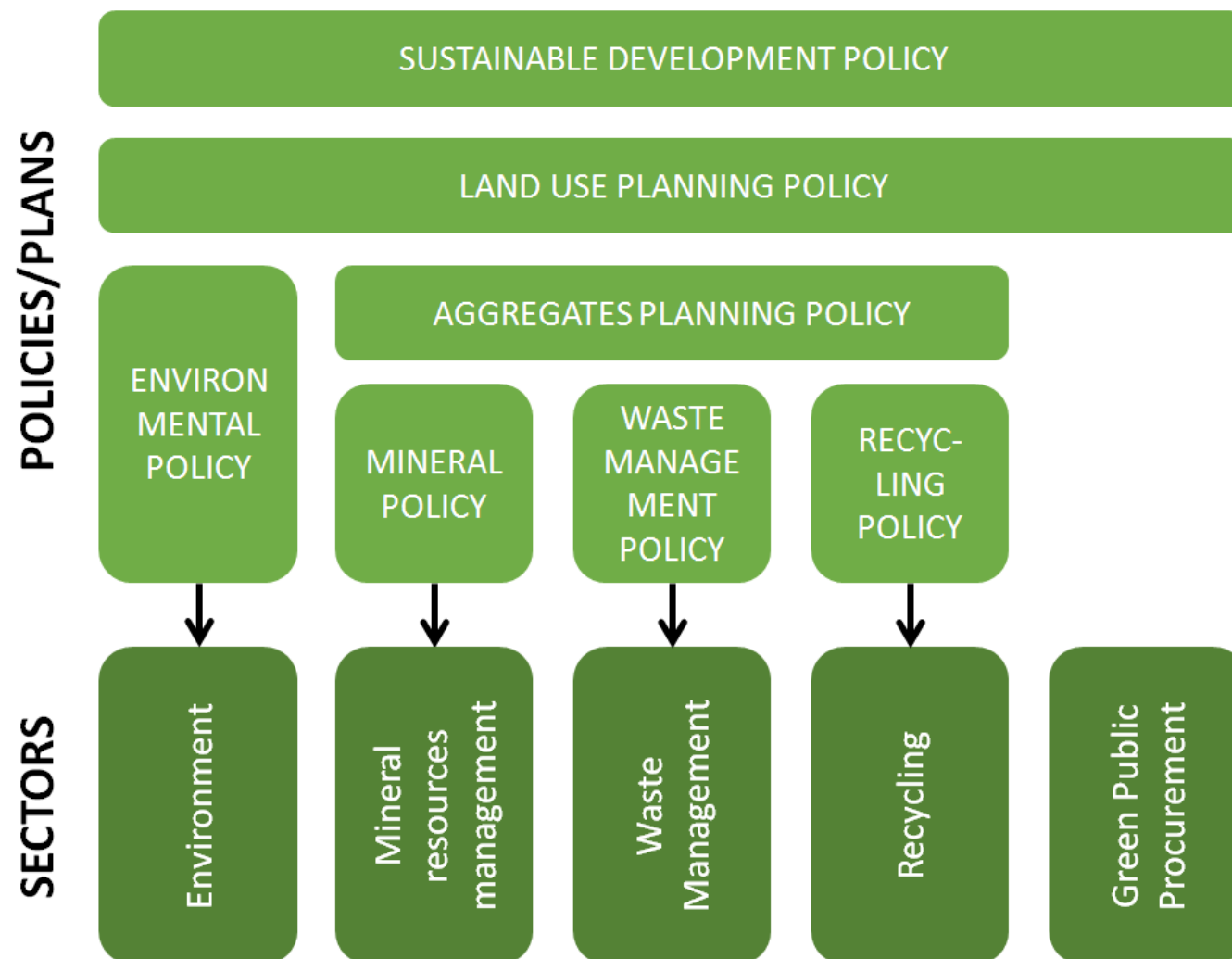
Table 2.1: Availability of data on secondary aggregate resources in the SEE countries (Hatzilazaridou, 2014)

Country / Region	Data on production volumes per type of recycled waste (tonnes)				Data on % of secondary materials recycled	
	R1 (*)	R2 (*)	R3 (*)	R4 (*)	Data on % of secondary materials recycled	Data on % of recycled used as aggregates
Albania	Estimated	NO	NO	Estimated	NO	NO
Austria	Estimated	YES	NO	YES	YES (R2) YES (R4)	NO
Croatia	Estimated	Estimated	Estimated	Estimated	NO	NO
Emilia Romagna	YES	YES	NO	YES	YES	NO
Greece	NO	Estimated	NO	Estimated	NO	NO
Herzegovinian Canton	NO	NO	NO	NO	NO	NO
Hungary	Estimated	Estimated	NO	Estimated	YES	NO
Montenegro	Estimated	NO	NO	Estimated	NO	NO
Romania	Estimated	NO	NO	Estimated	NO	NO
Serbia	Estimated	NO	NO	Estimated	YES (R1) NO (R4)	YES (R1) NO (R4)
Slovakia	Estimated	Estimated	NO	Estimated	NO (R1) YES (R2) YES (R4)	NO
Slovenia	Estimated	YES	NO	Estimated	YES (R1) YES (R2) NO (R4)	NO
Trento	Estimated	YES	Estimated	YES	NO (R1) YES (R2) NO (R3) YES (R4)	YES (R2)

Each efficient planning process requires reliable and relevant data. Data on secondary aggregates, required for efficient planning:

- technical specifications
 - environmental impacts of recycling
 - data on volumes of secondary resources (R1, R2, R3 and R4)
- + other data, connected to primary aggregates (safeguarding areas, geological distribution, permitted reserves, sales/production and capacities, active and inactive quarries, borrow pits, transport routes, technical specifications, demand forecasts)

the SNAP-SEE project - vision manual



the SNAP-SEE project - vision manual

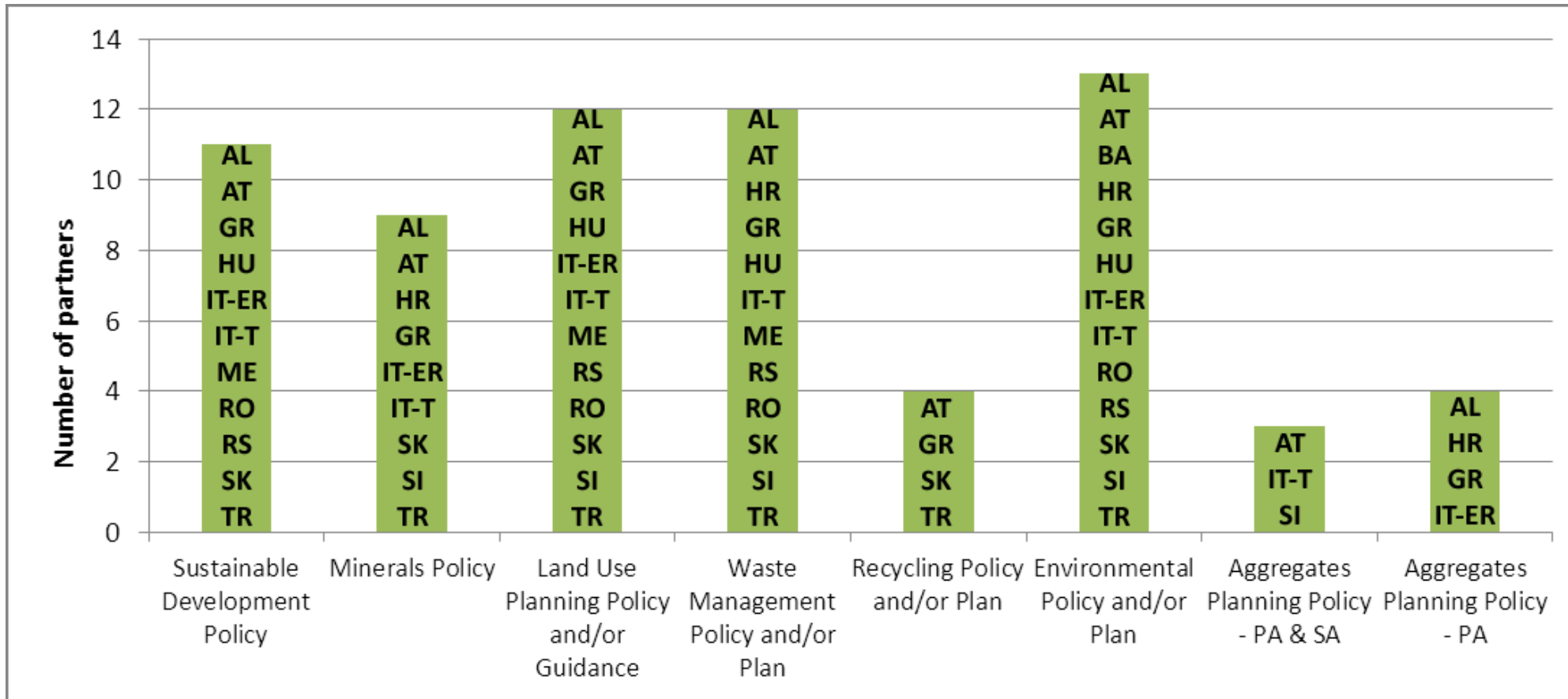


Illustration of Sustainable Development Policy, Minerals Policy, Land Use Planning Policy, Waste Management Policy, Recycling Policy, Environmental Policy and Aggregates Planning Policy in SEE countries. PA: primary aggregates; SA: secondary aggregates

The SNAP-SEE vision emphasis:

Waste Management Policies support the recycling of mining waste, construction & demolition waste, excavated soils and rock from civil works and industrial waste as aggregates. There is no bureaucratic obstacle of recycling. The transition from waste to secondary raw materials is encouraged.

Tax on C&DW disposal promotes the shifting of consumption from primary to secondary aggregates. **Financial measures** are instituted in order to support construction and demolition waste recycling. **Landfill taxation** promotes the waste minimization and recycling. The purpose of the tax is to encourage business and consumers to produce less waste, to discourage landfill and to encourage waste minimization and investment in other forms of material recycling and/or resource recovery.

Comprehensive inventories of primary and secondary aggregates are developed in SEE countries including inert mining and construction and demolition wastes or having access between them.

Secondary raw materials, such as mining waste, construction & demolition waste, excavated soils and rock from civil works and industrial waste, are used as aggregates. **Construction & Demolition Waste (C&DW) is recycled at least in 70%** as it is prescribed by the 2008/98/EC Directive. C&DW recycling offers important opportunities: reduce land disposal requirements for landfilling (i); avoid overconsumption of natural non-renewable aggregate resources, by introducing alternative and supplementary materials onto the aggregate market (ii); create new business opportunities from waste recycling (iii).

C&DW is pre-sorted at source into homogeneous segments. This **selective demolition** reduces recycling or disposal (where applied) costs and ensures better quality for the recycled products. ... The choice of aggregates for a specific application **depends only on the material's characteristics** and not on its origin. The European technical norms of use do not distinguish aggregates according to their origin but according to their **characteristics**. So recycled aggregate products that meet the prevailing European norms and specifications and are CE marked can compete with conventional aggregates. The integrated use of natural and recycled aggregates, besides an appreciable saving of natural resources, enables a better exploitation of the available resources according to the different uses.

the SNAP-SEE project - vision manual

Cultural resistance to the use of recycled aggregates, due to their waste origin, is one of the main obstacles for the development of the aggregates recycling industry. In order to definitely eliminate all user prejudice it is necessary, pursuant to the 2008/98/EC Directive, to define as soon as possible the criteria by which waste changes into useful material (Bressi et al., 2011).

After the secondary aggregates resources lose their “waste” status they can be considered as an alternative source of materials for specific uses. Due to this “change of state”, as of today in many SEE countries primary and secondary aggregates policies and plans do not reside within a **single document**; they are distributed among many different legal documents, making coordination and a comprehensive understanding difficult. Also, there is a widespread **lack of coordination on planning** supply from primary and secondary aggregates.

Since the secondary aggregates are the key to replace the use of non-renewable aggregates and reduce the impacts on environment, **planning authorities should identify the volume of secondary resources that could be used as aggregates**. In particular, the use of recycled aggregates has been increasing as a number of countries have been adjusting their objectives and policies in aggregate planning (Agioutantis et al., 2014).

Disclaimer

The figures, data and text is taken from the SARMa and SNAP-SEE projects outcomes, available at:

<http://www.sarmaproject.eu/>

<http://www.snap-see.eu/>

Presented texts are synthesis, made according to the results from numerous workshops, stakeholders consultations, questionnaires, case studies, policy analysis and expert visits. All project participants contributed at such tasks.

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Horvath Zoltan et al., who coordinated tasks relates to SNAP-SEE vision

Agioutantis Zach et al., who coordinated tasks relates to data handbook

Conclusion

- - joint projects
- - joint publications
- ...and is ready to invest some work for such goal.

THANK YOU for your attention