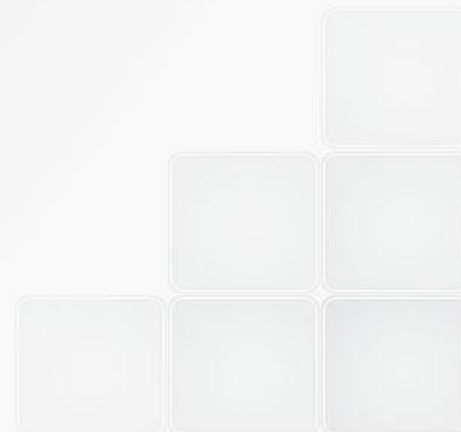


# High added value materials from end-of-life tyres: the TyGRe project

Sergio Galvagno,  
CR. ENEA Portici - UTTP NANO

ECOMONDO 2011- Rimini, 10/11/2011



**The Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) is targeted to “research, innovation technology and advanced services in the fields of sustainable economic development and energy.”**



**The nine ENEA Research Centres and five Research Laboratories – located all over Italy – are endowed with a wide range of expertise, advanced facilities and instruments put at the disposal of both ENEA’s research programmes and the Nation's scientific and productive world.**

In recent years the volumes of Solid Waste has increased significantly in the EU and other industrialized countries.

This fact is a direct consequence of:

- the growth of the consumptions
- the development of new products with high performances, but with shorter lifetime

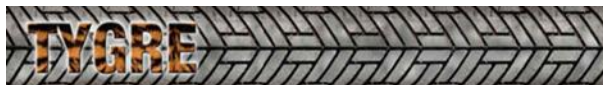


The problem of waste management strongly affects not only the environment protection but also the resource saving.

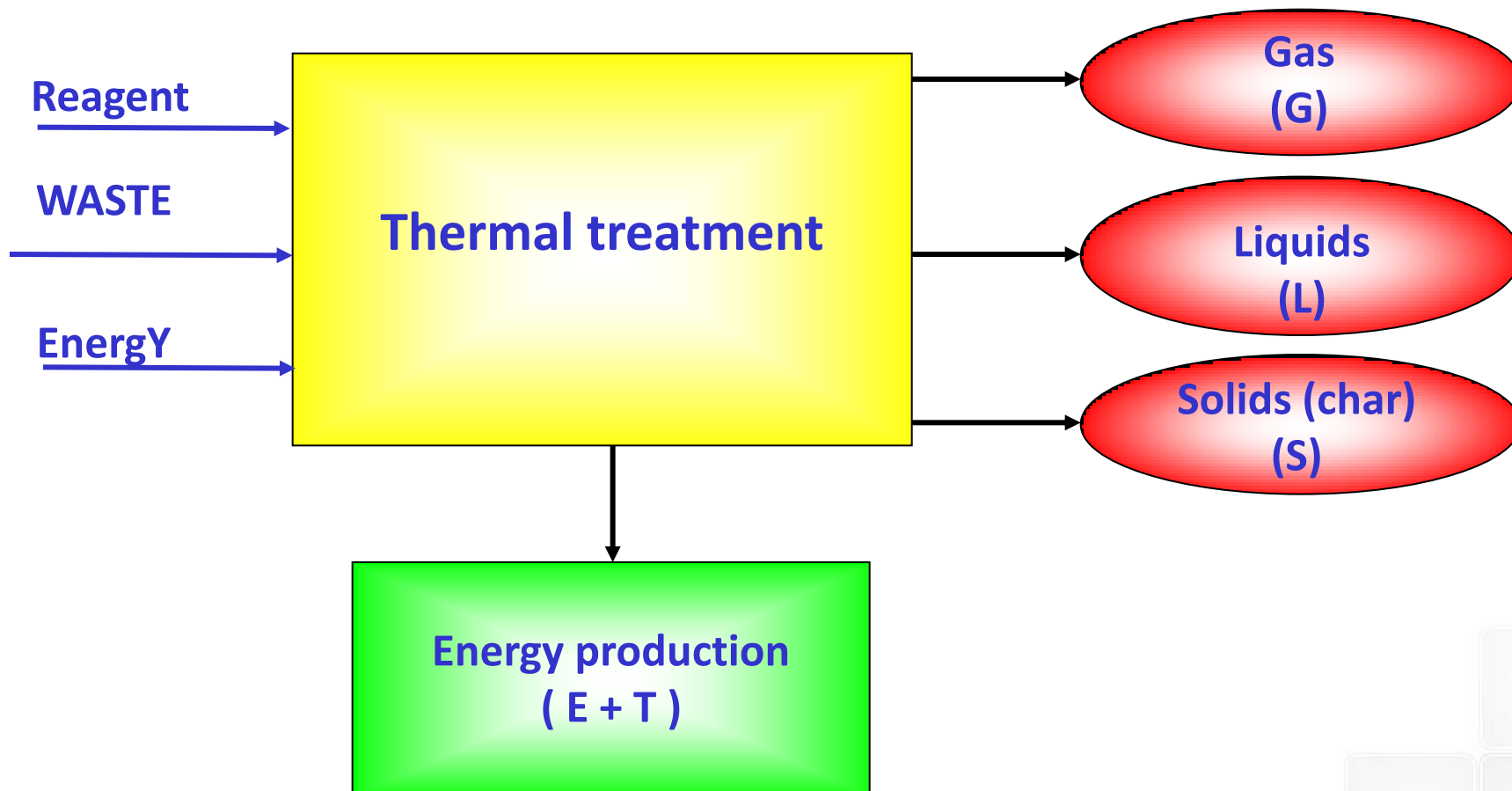
Current EU waste policy is based on a concept known as the waste hierarchy:

- Waste minimization (prevention)
- Re-use
- Recycle (matter and/or energy recovery)
- Final disposal (as last option).

In this frame, thermal processes such as gasification and pyrolysis are in a privileged position among the treatments able to recover resources from end-of-life products.



# THE "THERMAL OPTION"



# The exploitation of waste tyres

The industrial application of thermal technologies dedicated to waste treatment is strongly limited by the final destination of the solid residue.

The char coming from the waste treatment can be used for many different purposes: as adsorbent, as agricultural amendment or as alternative fuel, according to the characteristics (composition, calorific value, ash content, etc.).

Nevertheless it is still unclear how big will be the market for this product

TyGRe approach consisted in looking for another way to achieve the waste tyre exploitation, by producing ceramic materials: the solid residue of the TyGRe process is Silicon Carbide.





## FP7 – ENV – 2008 – 1

# TyGRe Project-High added value materials from waste Tyre Gasification Residues



Starting date: 01/09/2009

Duration: 42 months

Total cost: 4,311,857.20 € (ENEA 1,688,289.69 €)

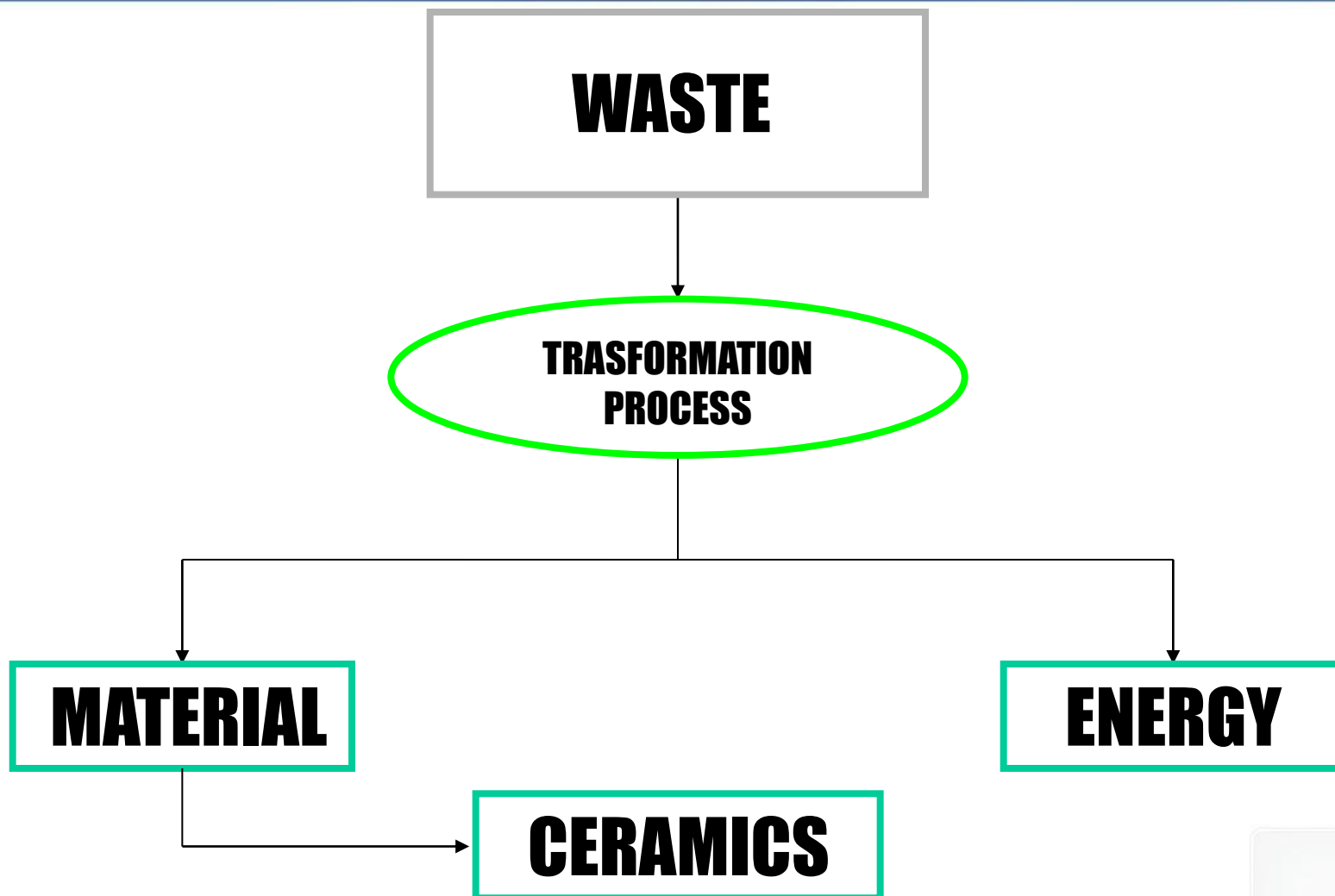
EU contribution: 3,349,992.40 € (ENEA 1,326,789.69 €)



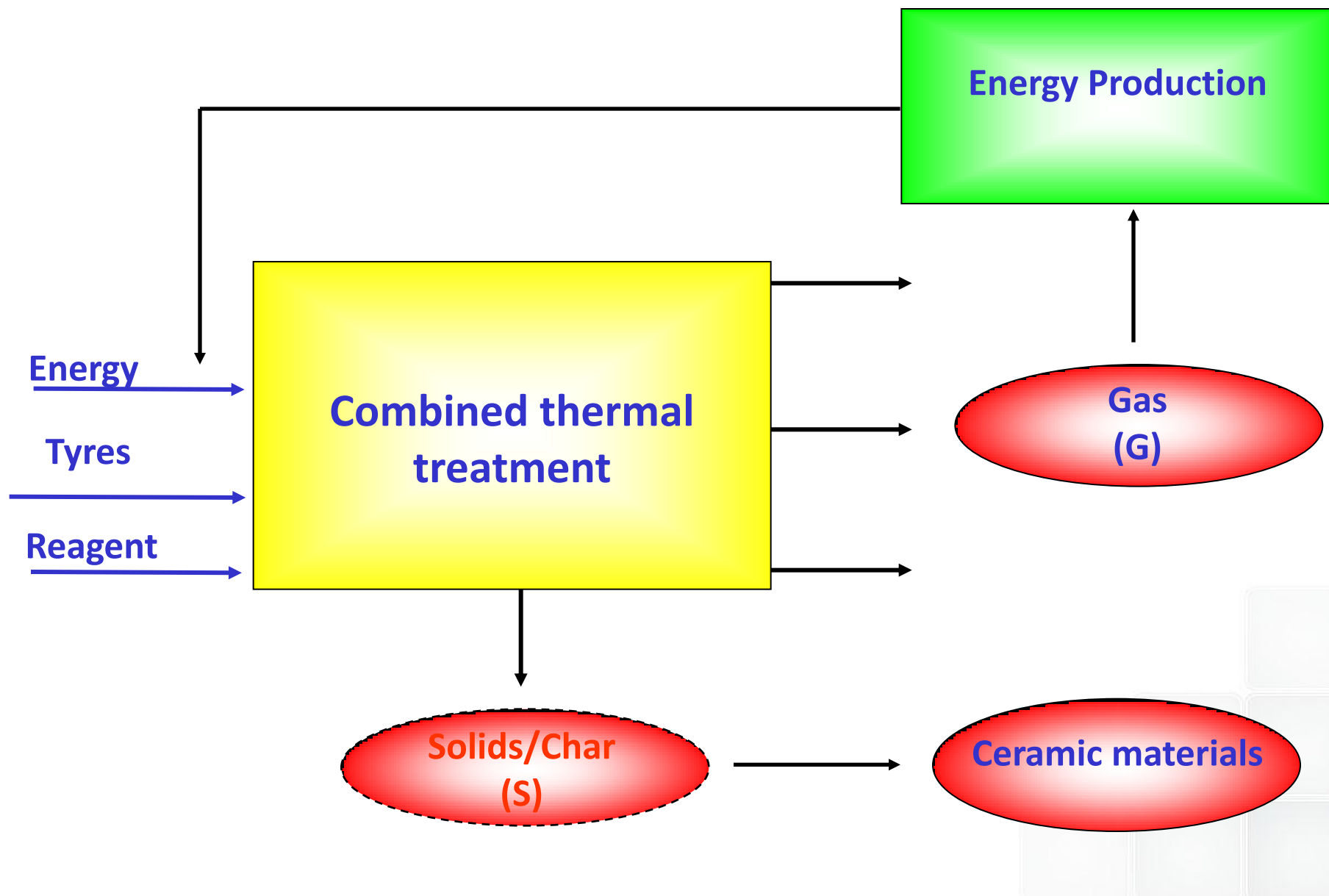
Grant Agreement n° 226549

Beneficiary name	Beneficiary short name	Country
Italian National Agency for New Technologies, Energy and Economical Sustainable Development	ENEA	Italy
European Tyre Recycling Association	ETRA	France
Rheinisch-Westfälische Technische Hochschule Aachen	RWTH	Germany
TUBITAK Marmara Research Center	TUBITAK MAM	Turkey
ELASTRADE S.r.l.	ELASTRADE	Italy
Institute of Materials and Environmental Chemistry	IMEC	Hungary
Febe Ecologic S.r.l.	FEBE	Italy
Copenhagen Membrane Technology A/S	COMETAS	Denmark
SICAV S.r.l.	SICAV	Italy



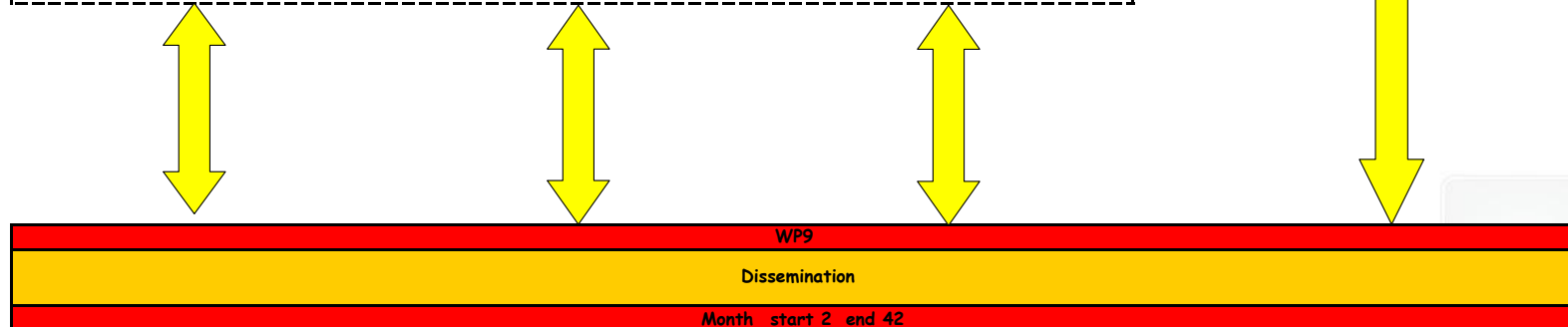
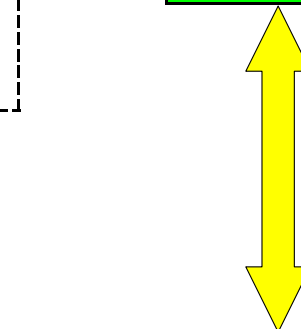
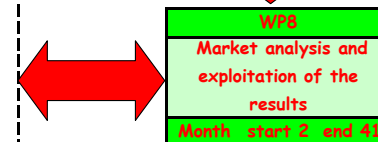
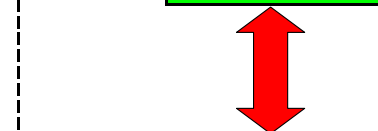
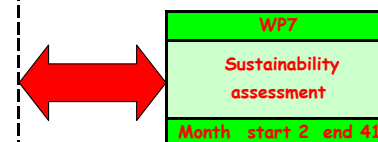
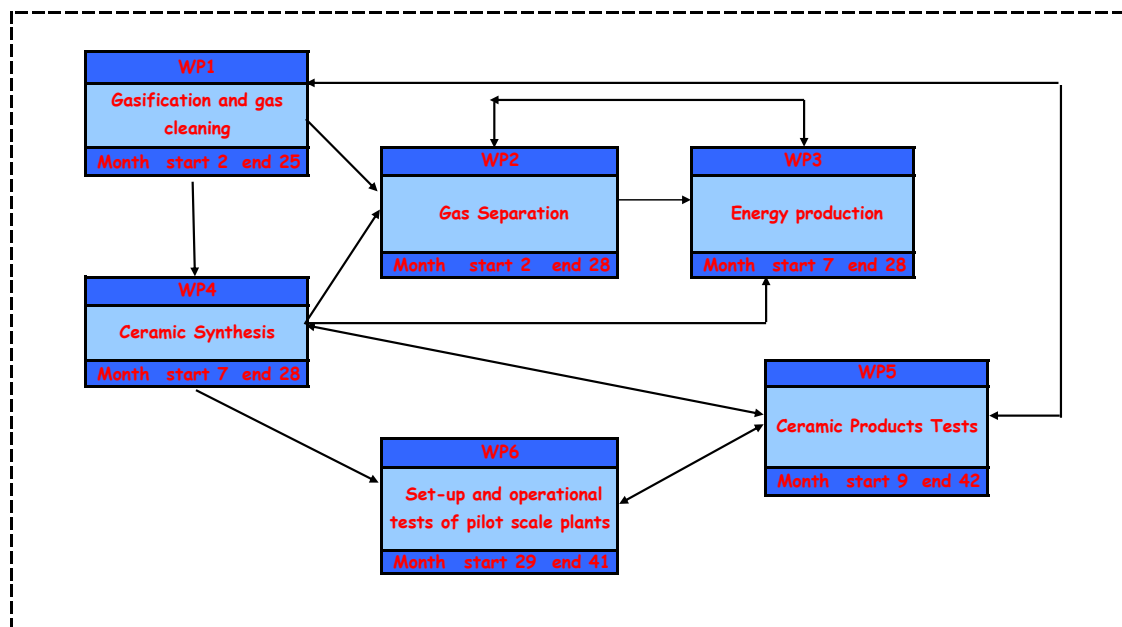


# The “TyGRe option”



The overall strategy of the project mainly consists of three levels:

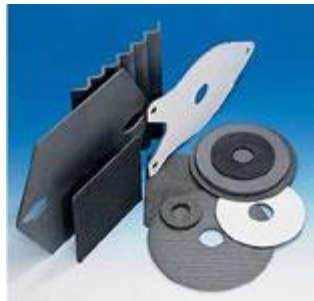
- a. The development of a sustainable recycling process for the waste tyre treatments, with the final construction of a prototype plant
- b. The sustainability assessment, in terms of impact analyses on economical, ecological and social aspects.
- c. The market requirements analysis and the future perspectives in view of the potential stakeholders, and the diffusion of the results



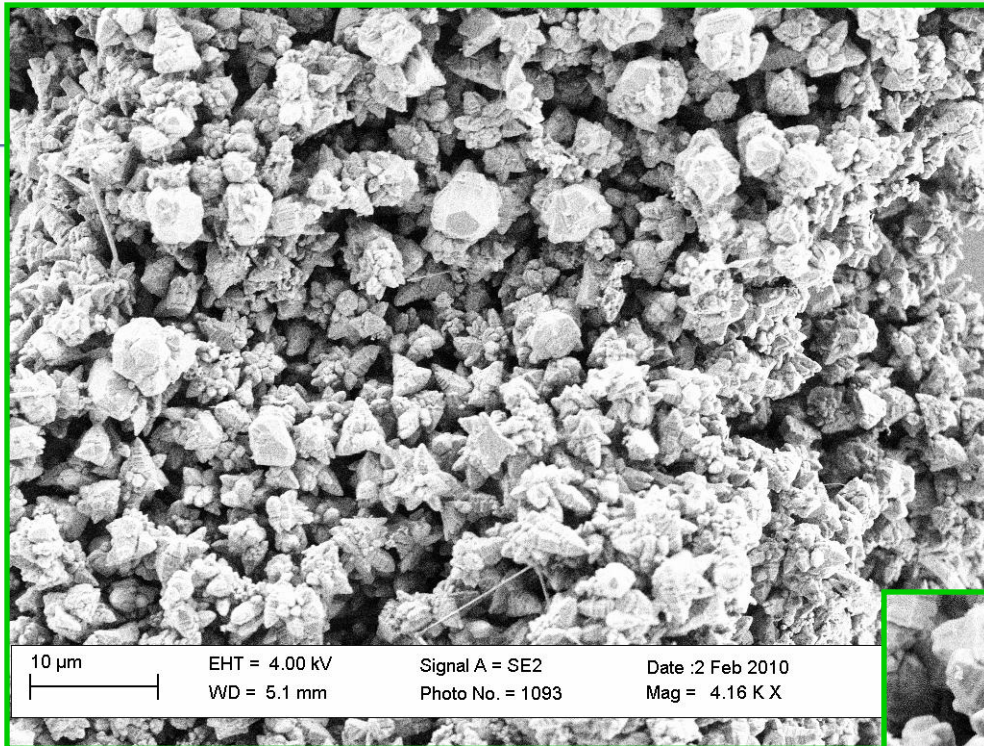
# Why Silicon Carbide?



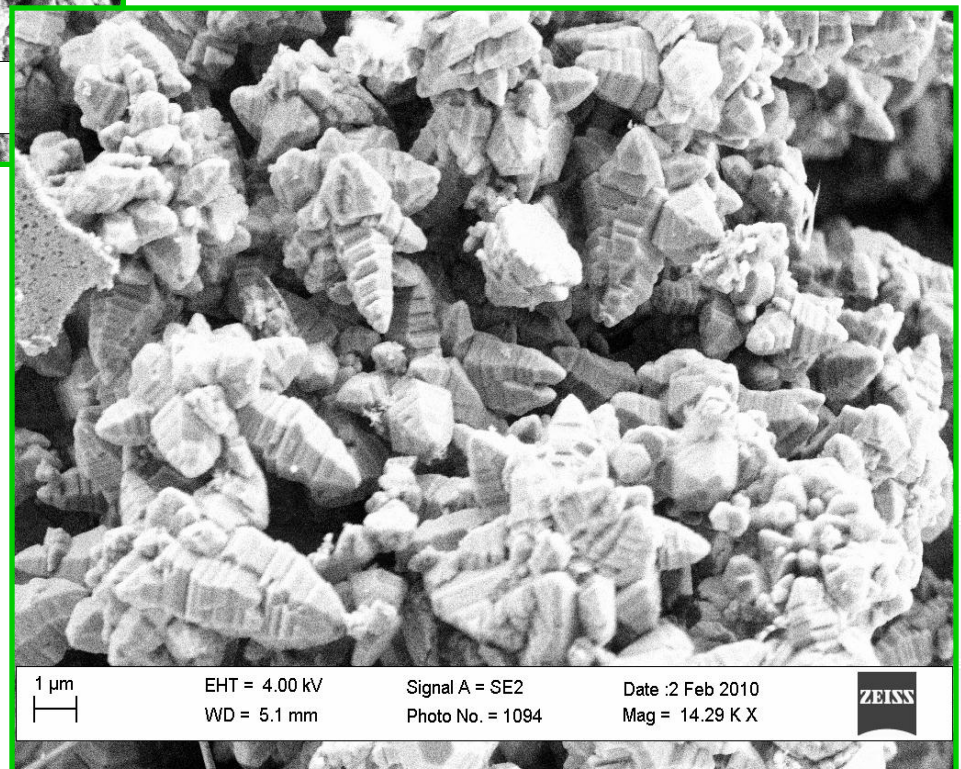
The market of ceramics is in constant growth. Silicon carbide (SiC) is one of the most important non-oxide ceramic materials; it has a wide industrial application due to its excellent mechanical properties, high thermal and electrical conductivity, excellent chemical oxidation resistance and it has potential application as a functional ceramic or for high temperature (over 900 C) uses. In addition because of the high hardness and relatively high elastic modulus, it also find uses in high wear applications.







SiC produced from waste tyre





TyGRe SiC powder



Sintered TyGRe SiC



- The whole process was settled in laboratory by ENEA, RWTH, TUBITAK and IMEC; the construction of prototype plant has already started.
- The SiC powder produced in laboratory by TyGRe process was successfully sintered in test manufacts. The ceramic powder obtained from waste tyre was processed using different sintering methods at COMETAS, ENEA and IMEC.
- ENEA and FEBE performed the sustainability assessment: the screening Life Cycle Assessment (LCA) and Life Cycle Costing studies are almost completed, as well as the first step of the Social LCA study.
- First projections on possible commercial sectors attractive for TyGRe were made by ETRA, in view of the future market application.



# Agenda

*Introduction-* Sergio Galvagno - ENEA

*Waste tyre gasification.-* Pierpaolo Iovane - ENEA

*Gas conditioning by Membrane processes* - Thomas Harlacher - RWTH

*Energy production from Syngas* - Alper Sarioglan - TUBITAK

*Synthesis of Silicon Carbide* - János Szépvölgyi - IMEC

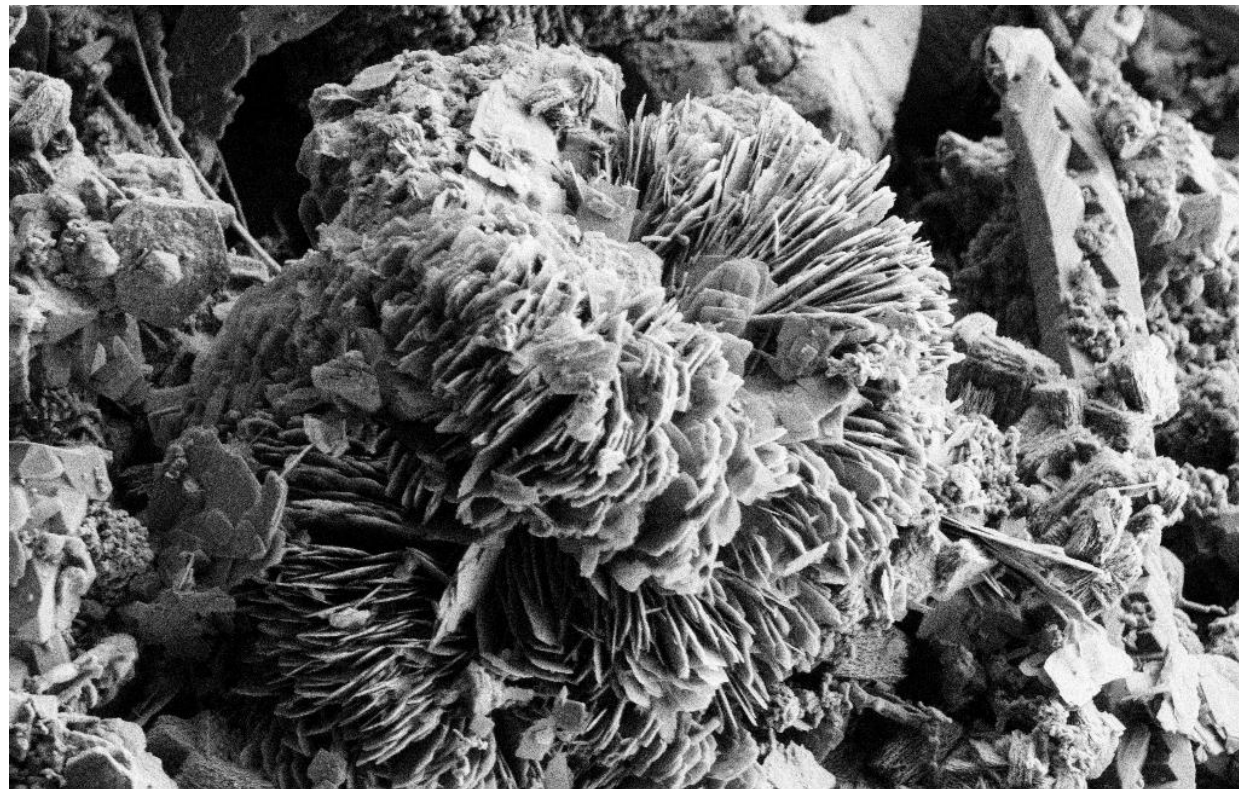
*Sintering of Ceramic powders* - Krista Hald - COMETAS

*Sustain. assess. and analysis of future scenarios for waste tyres* - Patrizia Buttol - ENEA

*Possible route of market exploitation* - Valerie Shulman - ETRA

*Conclusions*





Thank you for your attention!

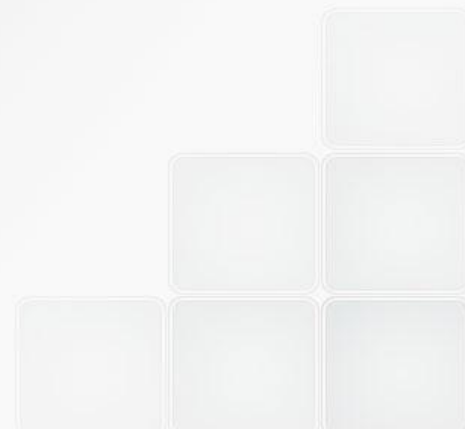
For other information: [www.tygre.eu](http://www.tygre.eu)



## Summary and Remarks

**Sergio Galvagno,  
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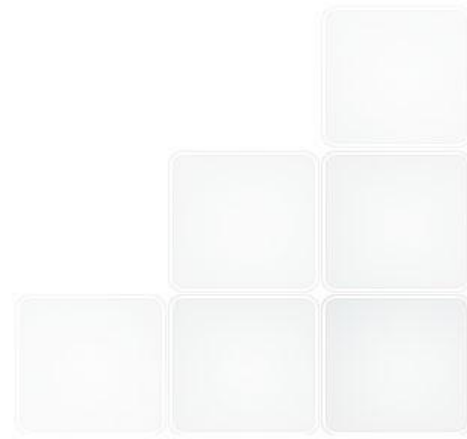
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In recent years the quantity of Solid Waste has increased significantly in the EU and other industrialized countries.

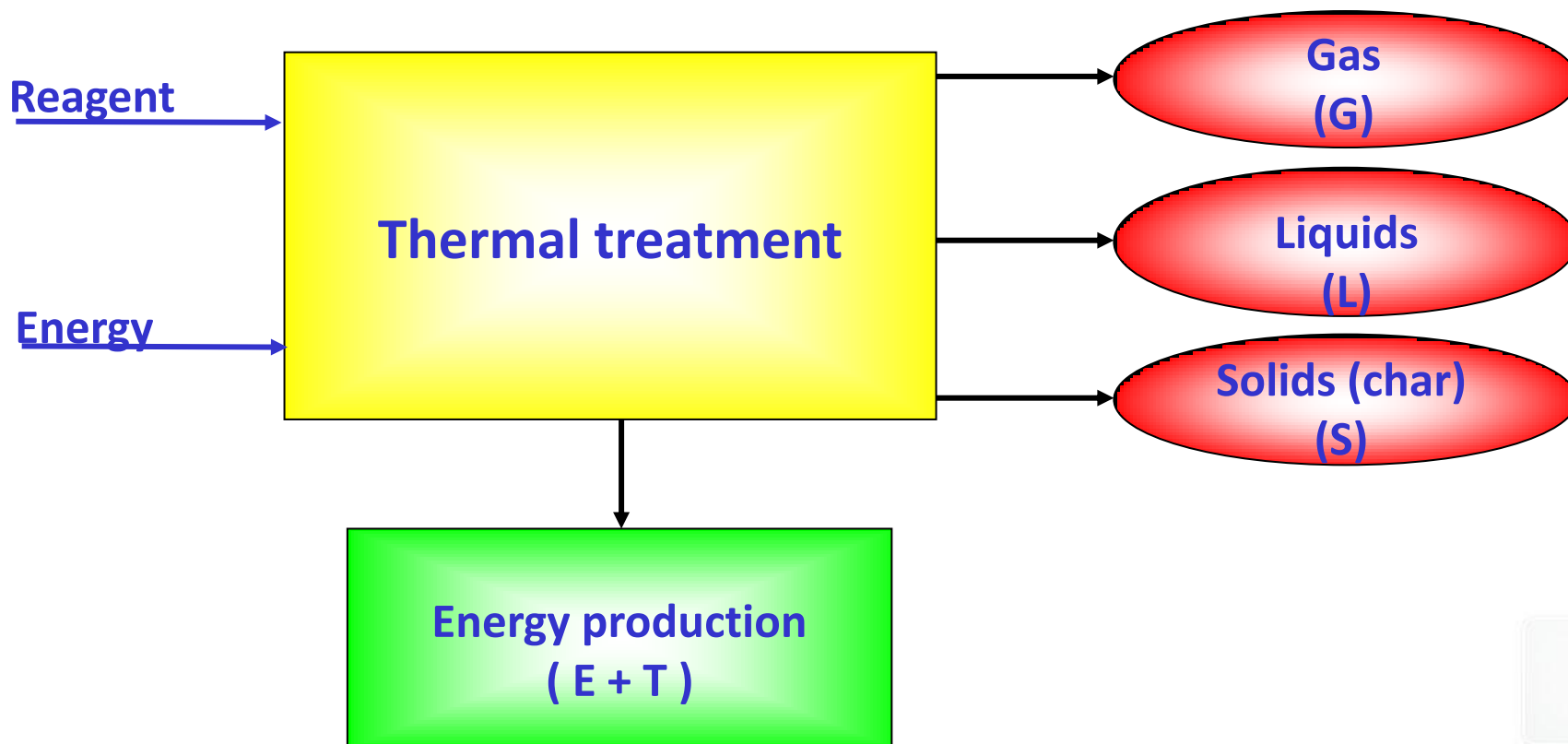


The problem of waste management strongly affects not only the environment protection but also the resource saving.



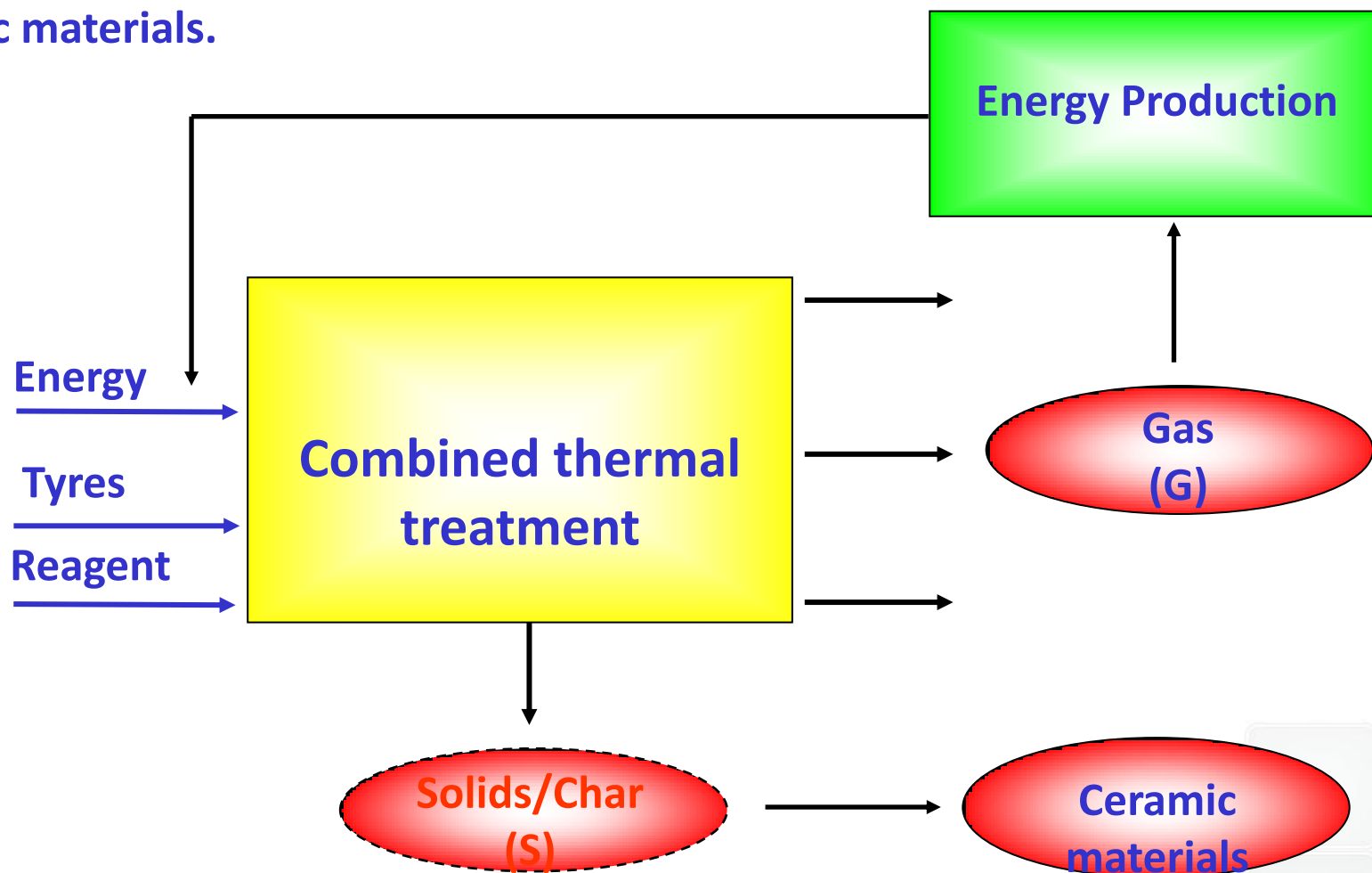


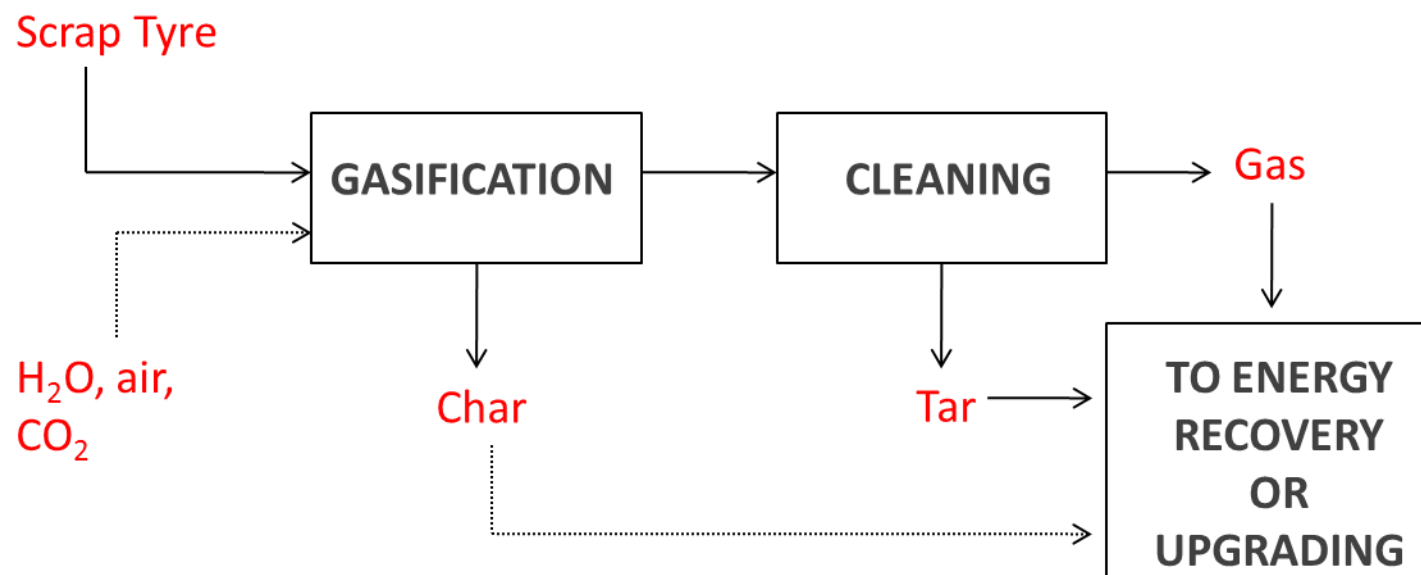
Thermal treatments like pyrolysis and gasification are a promising way for alternative high-efficiency material and energy production.



The experiences on both pilot and industrial scale have shown that several problems must be solved before their valuable exploitation on the market.

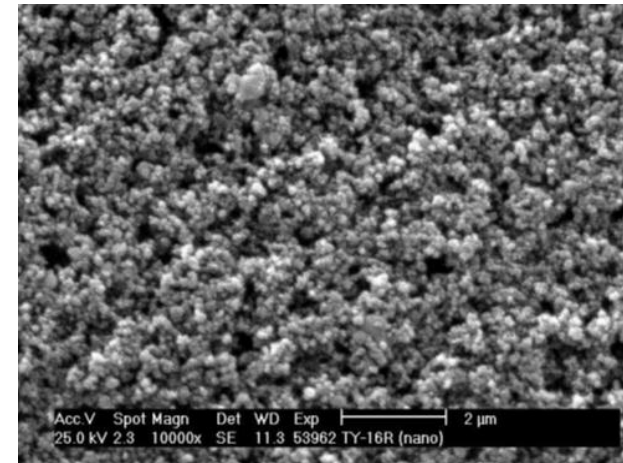
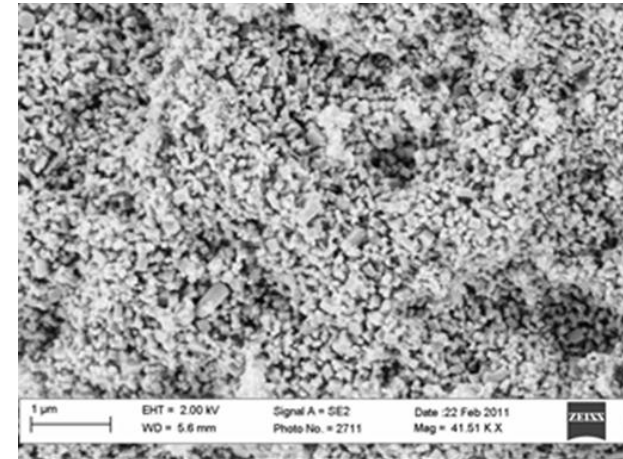
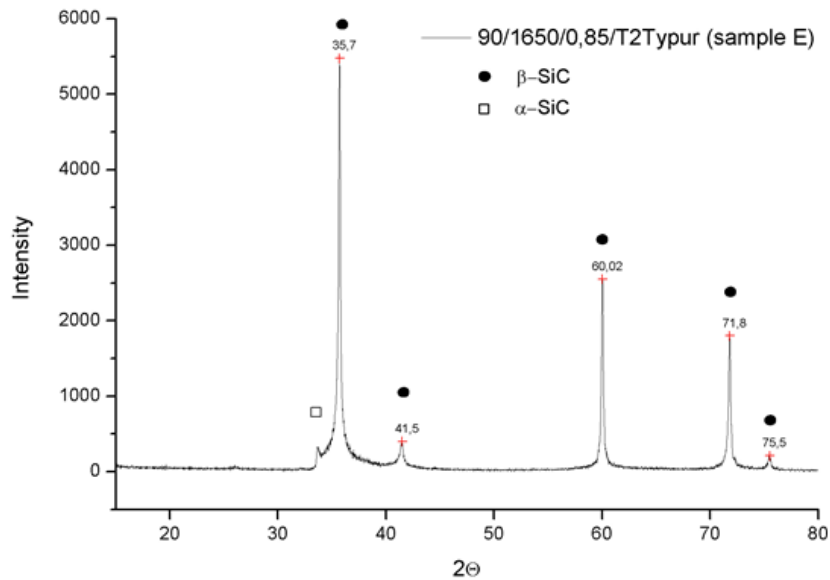
In this frame, TyGRe project focus the attention on **waste tyres** (a priority waste stream) by promoting a **thermal process** mainly devoted to the **production of ceramic materials**.



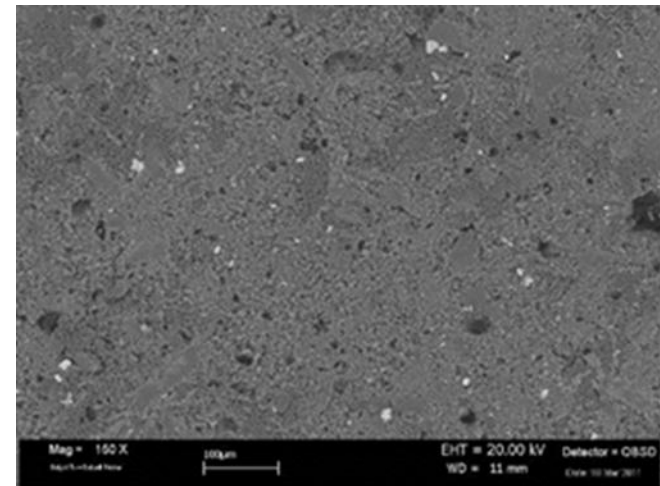


TyGRe developed a combined process with the aim to overcome the problems related to the industrial exploitation of conventional thermal treatments on waste tyres.

Valuable Silicon Carbide powder was produced



# The TyGRe process



The powders were successfully sintered in simple shapes, testing different sintering methods.

The results demonstrated that TyGRe SiC can be used for industrial purposes.

The main impact of the process will be analysed (sustainability assessment).

In **TyGre** the use of the following tools is tested:

**LCA**, which offers a well-defined basis for the environmental assessment **LCC**, which allows assessing the costs of a technology

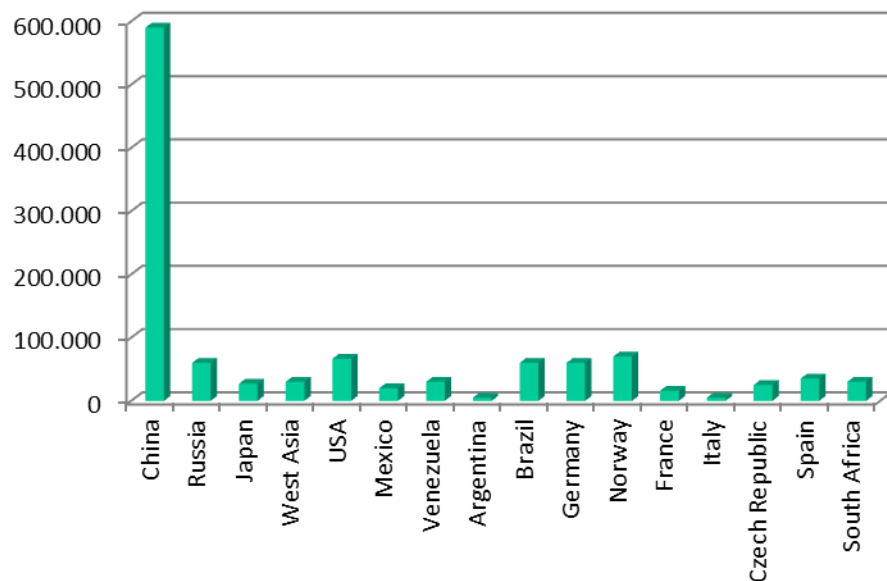
**S-LCA**: the methodology is still in its infancy and quantitative information is seldom available

The Main result will be the **comparative assessment** of new and current scenarios of scrap tyres treatment

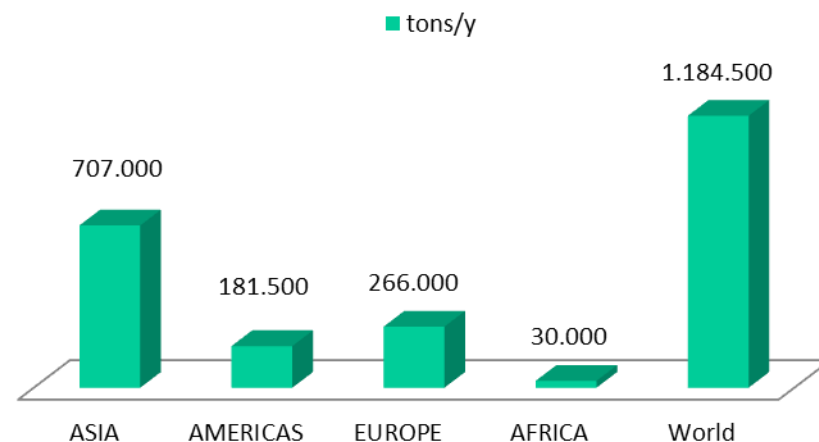




The market of ceramics is in constant growth. Silicon carbide (SiC) is one of the most important non-oxide ceramic with a well defined and experimented market.



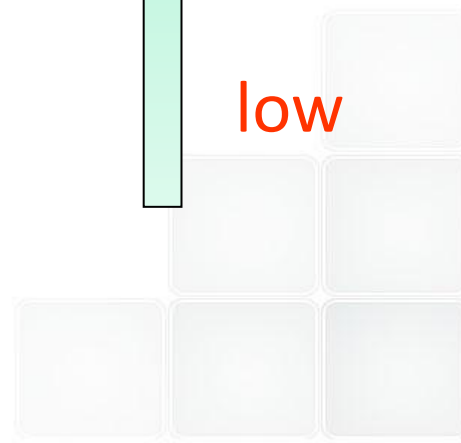
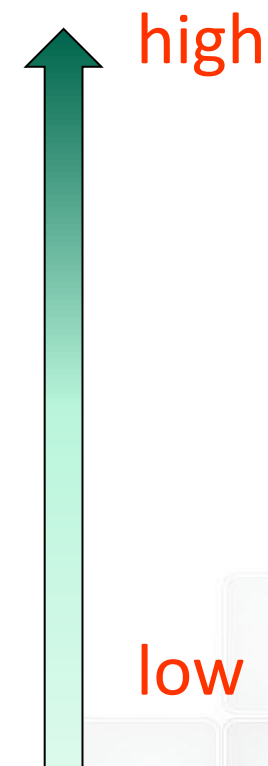
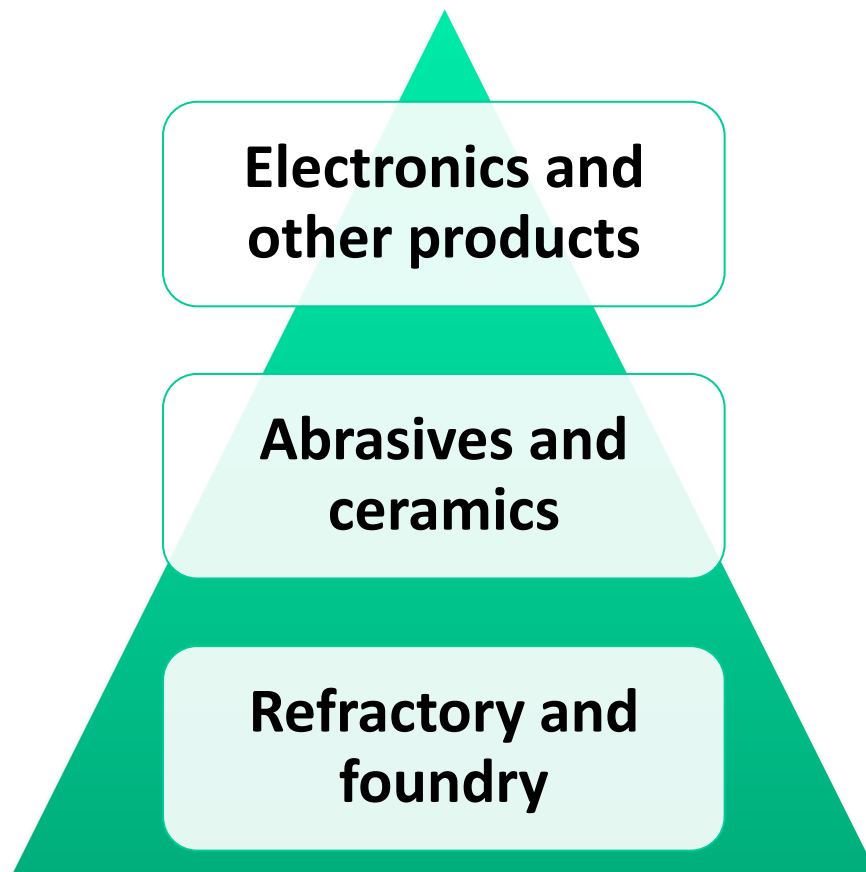
## SiC world production (2009)



■ tons/y

## Production

## Purity (and Price)



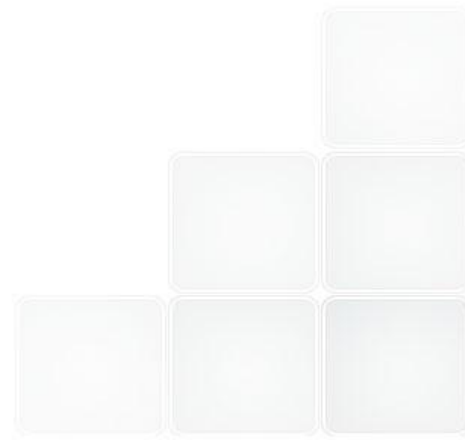
**The future.....**



**.....is under construction!**

Thank you  
for  
your attention!

For other information: [www.tygre.eu](http://www.tygre.eu)



# TyGRe Project-High added value materials from waste Tyre Gasification Residues



The research leading to these results was funded from the European Community's Seventh Framework Programme G.A. n° 226549 call FP7-ENV-2008-1