EC HORIZON2020
Project Co-Funded by the European Commission
Grant agreement: 768573
Call identifier: H2020 – SPIRE-09-2017
Project Start Date: 1st of September 2017

LIGHT PACKAGE VERSION

Modular, scalable and high-performance
DE-polymerization by MicrowavE TechnolOgy

A new solution to an old problem

Maurizio Crippa
CEO @ gr3n sagl
maurizio.crippa@gr3n-recycling.com

Table of Contents

1. "History" of DEMETO
   - Starting from the plastic trays problem: lab. Activity
   - The patent
   - The proof of concept and the CTI label
   - From Symbioptima to DEMETO
2. The technological approach and its points of innovation
   - The depolymerization reactions
   - The microwave approach: reaction time
   - The purification process
   - Role of the contaminants
3. Comparison with competing solutions: strengths and weaknesses
   - The purification process: advantages of the alkaline approach
   - gr3n: direct reaction
   - Loop industries: chlorinated solvent for swelling
   - Teijyn: methanolysis and so on
   - Jeplan: glycolisis and so on
   - Ioniqa: glycolysis and magnetic flotation
   - Ambercycle: enzymatic process

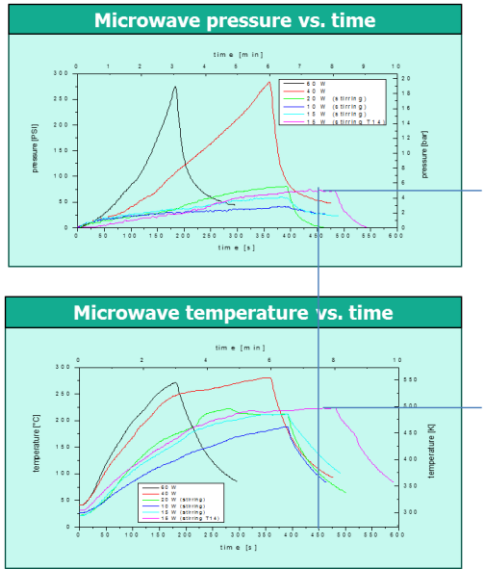
Table of Contents

3. The DEMETO project: what, when, how, who
   - Starting points of DEMETO: the heritance of Symbioptima and the process scale-up
   - The goal of DEMETO: the pilot plant
   - DEMETO timeline
   - Map of the activities: Who does what?
4. The final goal and IAB interactions
   - The final goal: new bottle from scrap-PET
   - Technological role of the IAB: external validation of IN/OUT of the plant

Starting from the plastic trays problem: lab. activity

How can you recycle some multilayered material?

With a selective action on one of those!



2011

The patent

CN103827186 (A)

- **Bibliographic data**
- Description
- Claims
- Mosaics
- Original document
- Cited documents
- Citing documents
- INPADOC legal status
- INPADOC patent family

Quick help

- What is meant by high quality text as facsimile?
- What does A1, A2, A3 and B stand for after a European publication number?
- What happens if I click on "In my patents list"?
- What happens if I click on the "Register" button?
- Why are some sidebar options deactivated for certain documents?
- How can I bookmark this page?
- Why does a list of documents with the heading "Also published as" sometimes appear, and what are these documents?
- Why do I sometimes find the abstract of a corresponding document?
- What happens if I click on the red "patent translate" button?
- What is Global Dossier?

Bibliographic data: CN103827186 (A) — 2014-05-28

In my patents list | Previous 6 / 167 Next | Report data error | Print

Method and apparatus for the recycling of polymeric materials via depolymerization process

Page bookmark	CN103827186 (A) - Method and apparatus for the recycling of polymeric materials via depolymerization process
Inventor(s):	PARRAVICINI MATTEO; CRIPPA MAURIZIO; BERTELE MATTEO VITTORIO ±
Applicant(s):	PARRAVICINI MATTEO; CRIPPA MAURIZIO; BERTELE MATTEO VITTORIO ±
Classification:	- international: ***B01J19/12; C08J11/10; C08L67/00; C08L77/00***
	- cooperative: **B01J19/126**; **B01J19/20**; **C07C51/09**; **C08J11/10**; **C25B1/34**; **C25B15/08**; B01J2219/00006; B01J2219/1227; B01J2219/1272; B01J2219/1281; C08J2367/00; C08J2377/00; Y02W30/702 → more
Application number:	CN2012846867 20120727 Global Dossier
Priority number(s):	WO2012IB53867 20120727 ; IT2011MI01411 20110727
Also published as:	EP2736968 (A1) → ITMI20111411 (A1) WO2013014650 (A1)

Abstract of CN103827186 (A)

Translate this text into

Select language | patenttranslate powered by EPO and Google

In a method and an apparatus for the recycling of polymeric materials, more specifically polyesters and polyamides, via depolymerization process, the depolymerization reaction of the material to be treated is performed with a solvolytic mixture in at least one microwave depolymerization reactor (6) which extends substantially along an axis (A) and is provided with a system (7) for movement of the reactants which allows the reactor (6) to operate continuously; the movement system (7) is an Archimedean screw system which moves the reactants substantially along the axis (A) through the reactor (6).

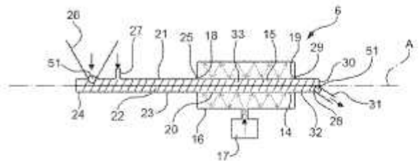


FIG. 2

- The patent covers both the reactor concept and the purification process

2011

The proof of concept and the CTI label

START-UP
Centro Promozione
Swiss Incubator

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Enrolled in KTI program

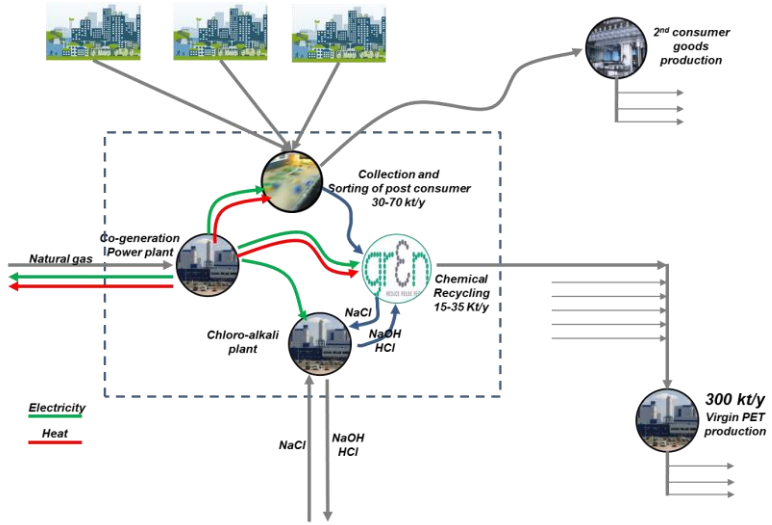
2012-14

CTI CERTIFIED

Awarded KTI label

From Symbioptima to DEMETO

- Synergy and optimization of the flows of a cluster of multiple collaborating Production Units … taking into account disruptive increase of cross-sectorial re-use for particularly impacting waste streams, proposing **advanced WASTE2RESOURCE initiatives for PET**.



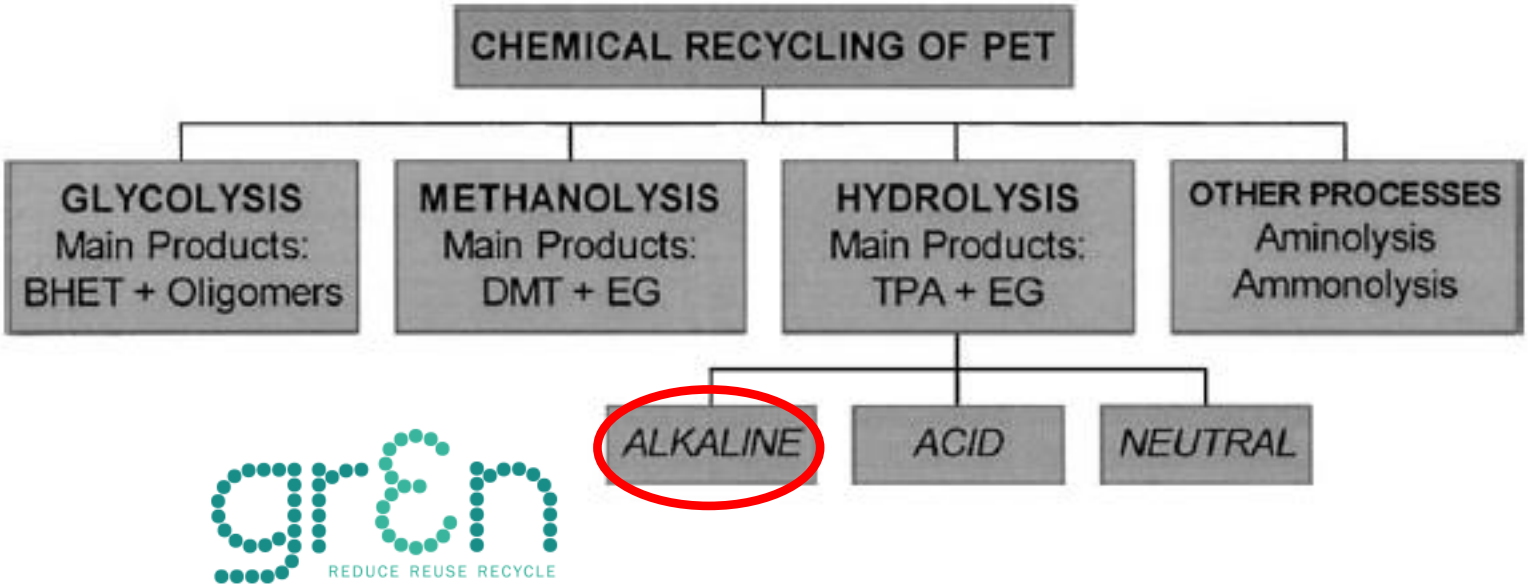
Enabling technology developement

2015-18

http://www.symbioptima.eu

Horizon 2020-SPIRE-2015, No 680426

The depolymerization reactions



- Many depolymerization paths can be chosen.
- The main driving forces of the choice are:

➢The economical benefits in terms of reaction energy/time and product purification efforts

➢The purity of the products according to the feedstock contamination

The Chemical Recycling…, D.S. Achillias adn G.P. Karayannidis, *Water, Air, and Soil Pollution: Focus* **4**: 385-396, 2004.

The microwave approach: reaction time

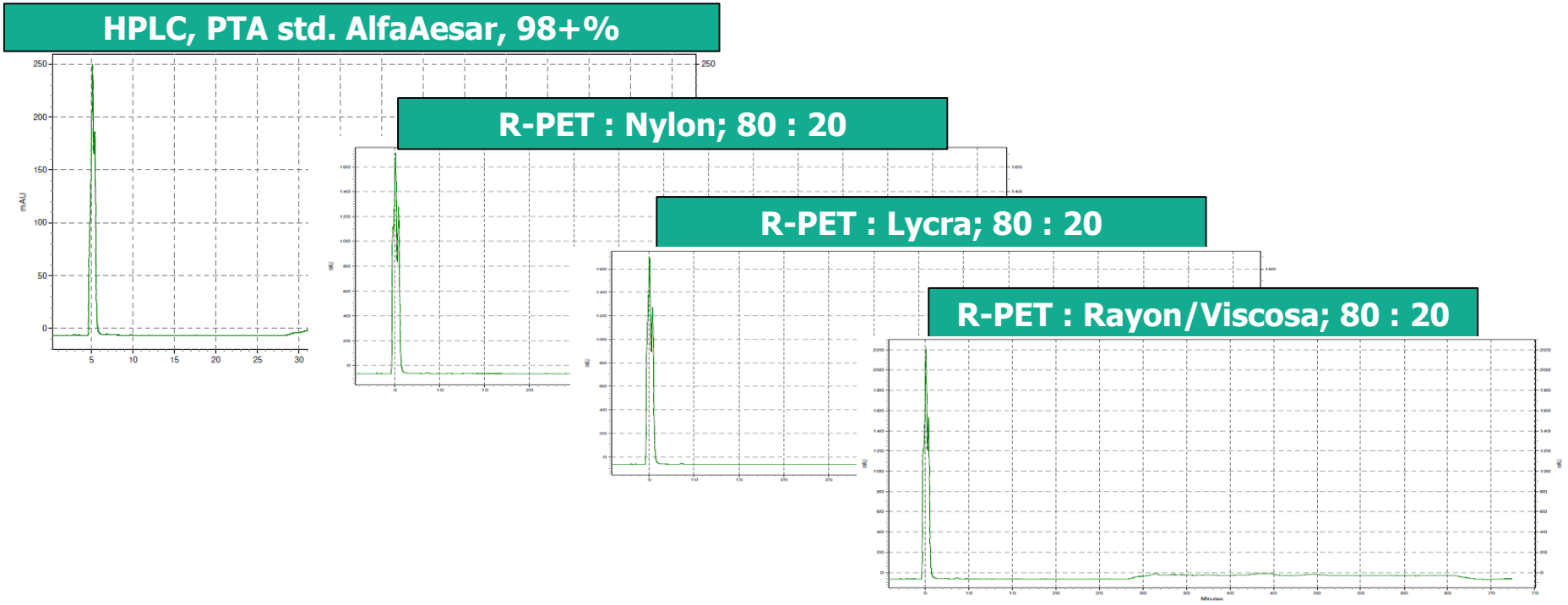
	Temp. (pressure)	Time
Glycolysis*	180-240°C	0.5-8h
Methanolysis	180-300°C (2-15MPa)	1-5h
Acid hydrolysis	70-150°C	5-72h
Neutral hydrolysis	200-300°C (1-4MPa)	1-4h
Alkalyne hydrolysis	210-250°C (1.4-2MPa)	3-5h
Alkalyne+Microwave	**180-200°C (0.6MPa)**	**10min**

- Every reaction involves different purification steps of the monomers
- The microwave radiation works as a catalyst of the reaction speeding-up the reaction rate
- In some cases the reactions can be combined

*The glycolysis reaction can be accelerated by microwave radiation

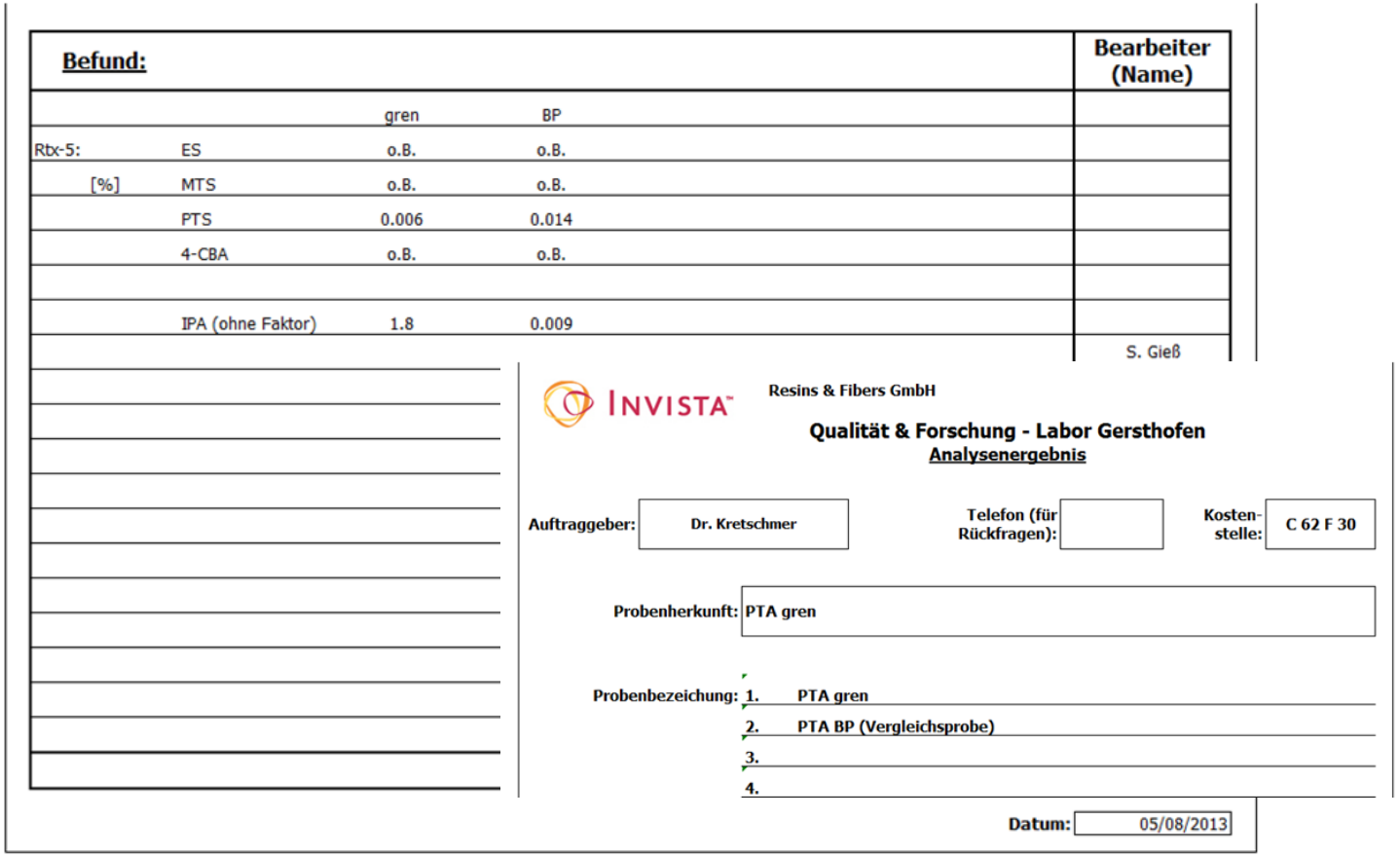
Role of the contaminants-1

- It is evident that the “problematic” contaminants are the “reactive ones”
- Different tests were performed to confirm the “stability” of the purification process according to the variability of the feedstock



Analytical method from: J Chromatogr Sci. Vol 50 (5):410-3 **(2012)**

Role of the contaminants-2



Befund:				Bearbeiter (Name)
		gren	BP	
Rtx-5:	ES	o.B.	o.B.	
[%]	MTS	o.B.	o.B.	
	PTS	0.006	0.014	
	4-CBA	o.B.	o.B.	
	IPA (ohne Faktor)	1.8	0.009	
				S. Gieß

INVISTA Resins & Fibers GmbH

Qualität & Forschung - Labor Gersthofen

Analysenergebnis

Auftraggeber: Dr. Kretschmer

Telefon (für Rückfragen):

Kosten-stelle: C 62 F 30

Probenherkunft: PTA gren

Probenbezeichung:
1. PTA gren
2. PTA BP (Vergleichsprobe)
3.
4.

Datum: 05/08/2013

- Origin of the material: opaque bottle:deep blue bottle, 50:50
- The difference is the IPA (isophtalic acid) content

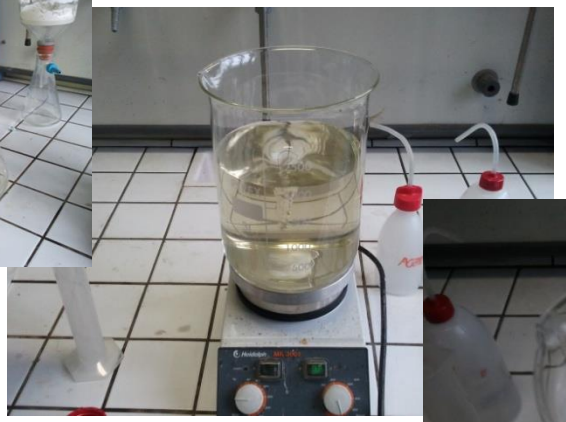
The purification process: advantages of the alkaline approach

After reaction

After distillation

Na_2-PTA+contaminants 2

Elimination of contaminants 2

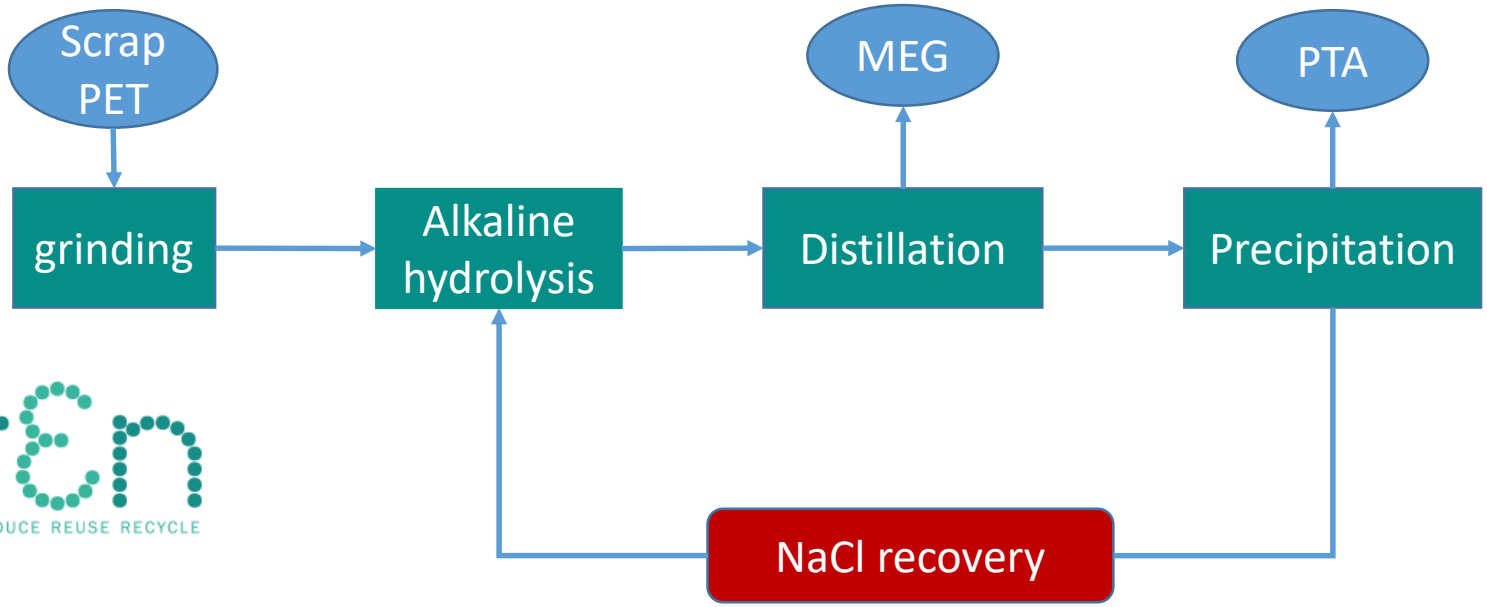


Na_2-PTA

Pure PTA

gr3n: direct reaction

- gr3n depolymerization method is based on a the direct alkaline hydrolysis in a microwave reactor
- Microwave radiation works as catalyst. The reaction does not need energy to take place: it is exothermic
- The material is grinded in order to flow in the flowing trough reactor
- The process tolerates high level of contaminants
- Reaction time: 10 min, Reaction temperature: 180-200°C



Starting points of DEMETO: the heritance of Symbioptima and the process scale-up

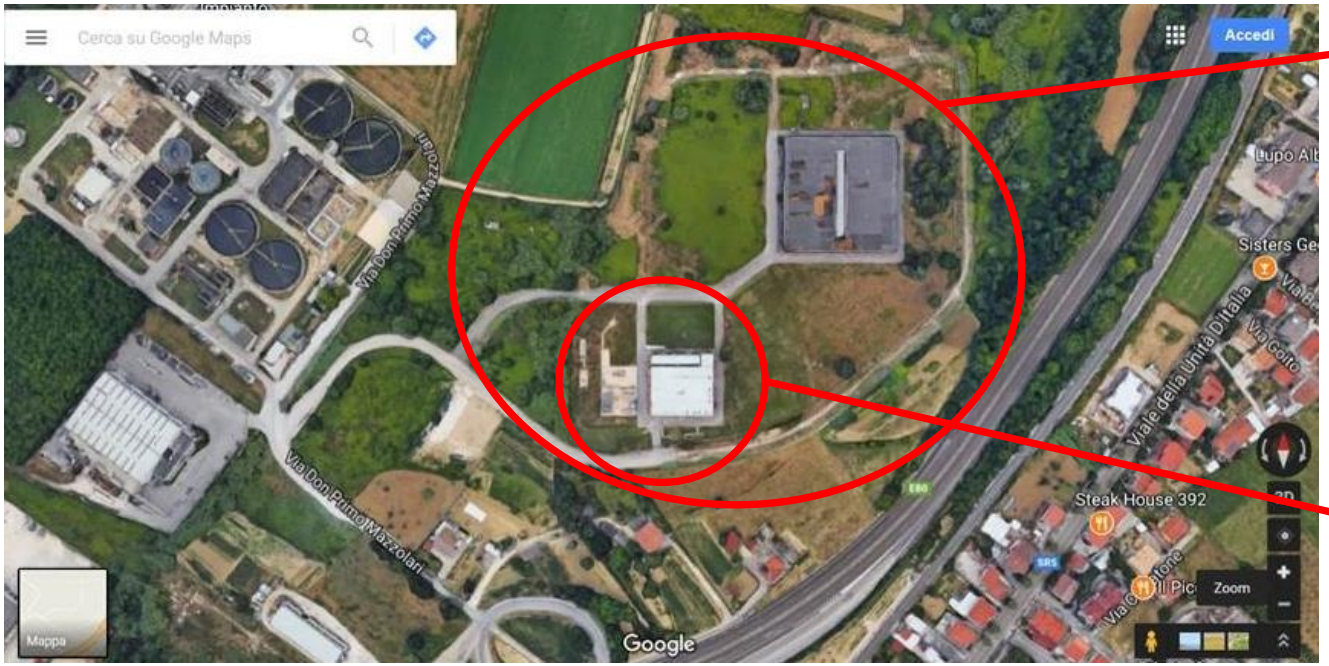
- The depolymerization machines scales and….the purification process scales up

~1 kg/h

~10 kg/h

~100 kg/h

The goal of DEMETO: the pilot plant



Processi Innovativi

- The goal of DEMETO is to realize the pilot plant of the technology
- Validate all the technological aspects such as:

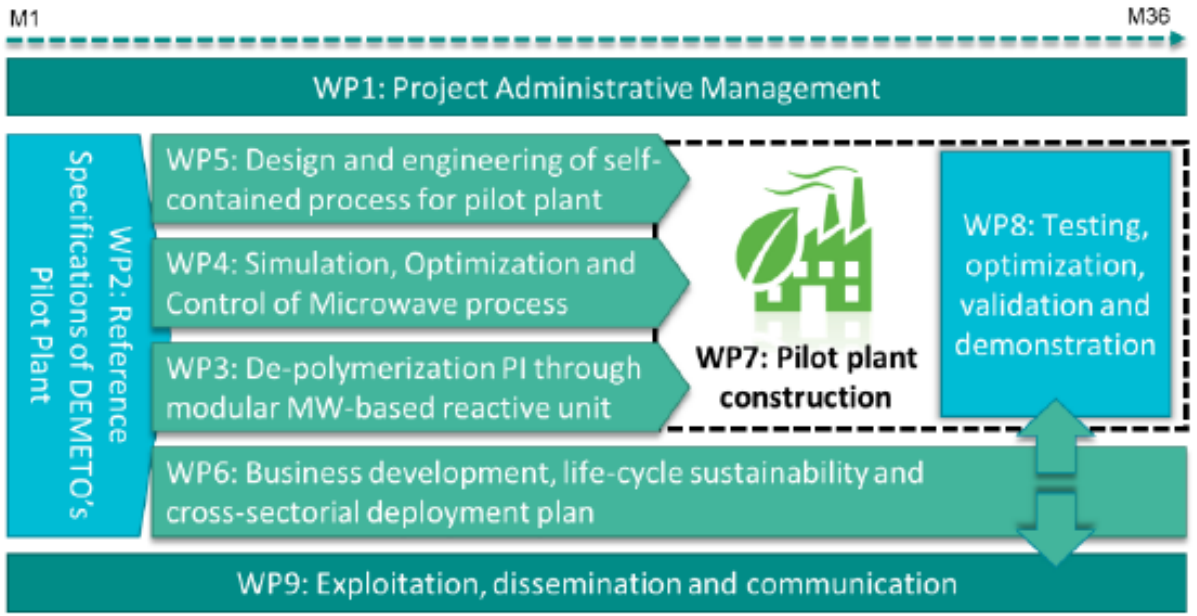
➢ Energies management

➢ Waste managements: can some wastes such as cotton, PE, PP reintroduced into their recycled market?

➢ How the process affect their properties?

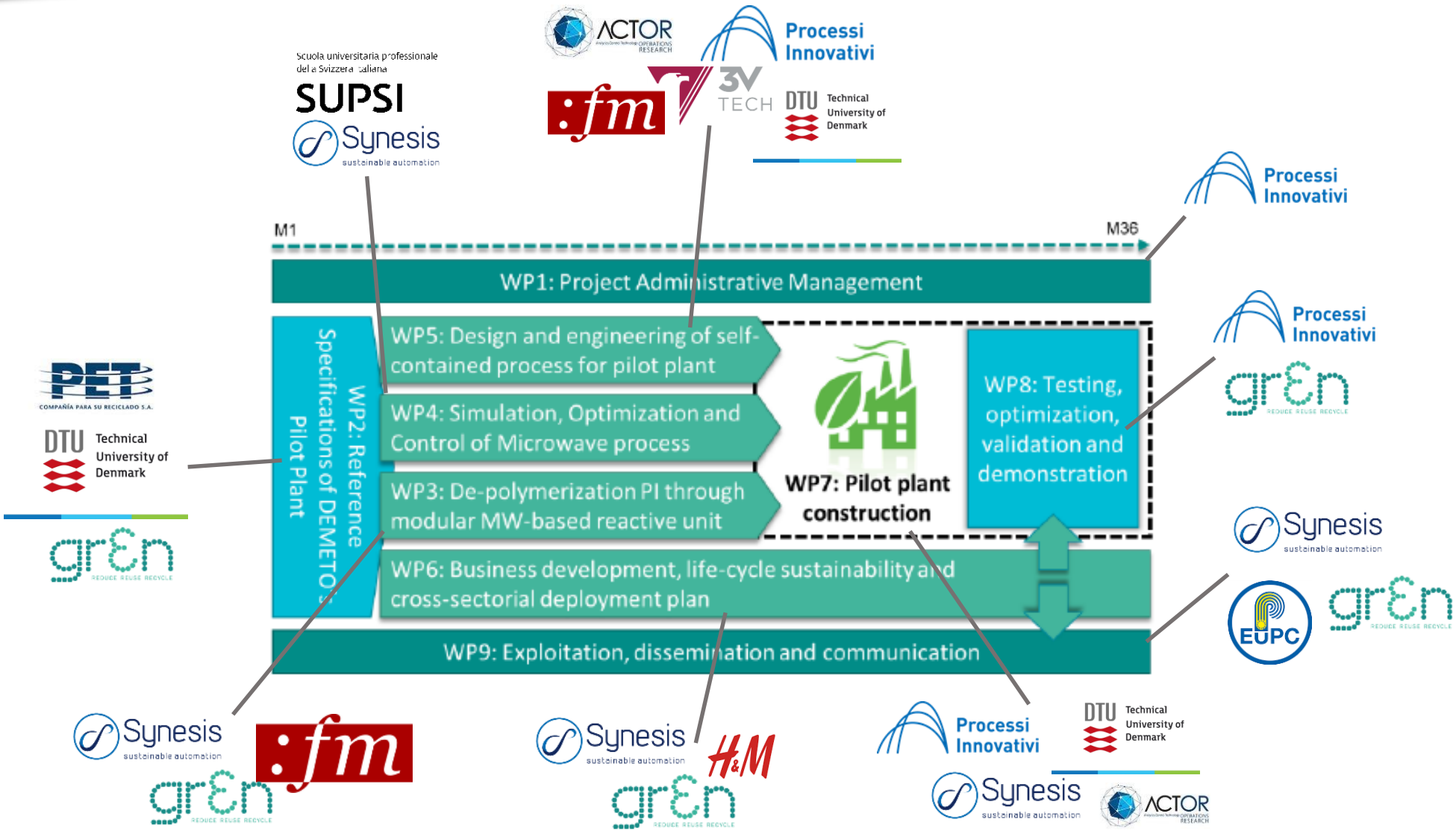
- Evaluate the management of some contaminants normally contained at the ppm level

DEMETO timeline



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1																																				
WP2																																				
WP3																																				
WP4																																				
WP5																																				
WP6																																				
WP7																																				
WP8																																				
WP9																																				

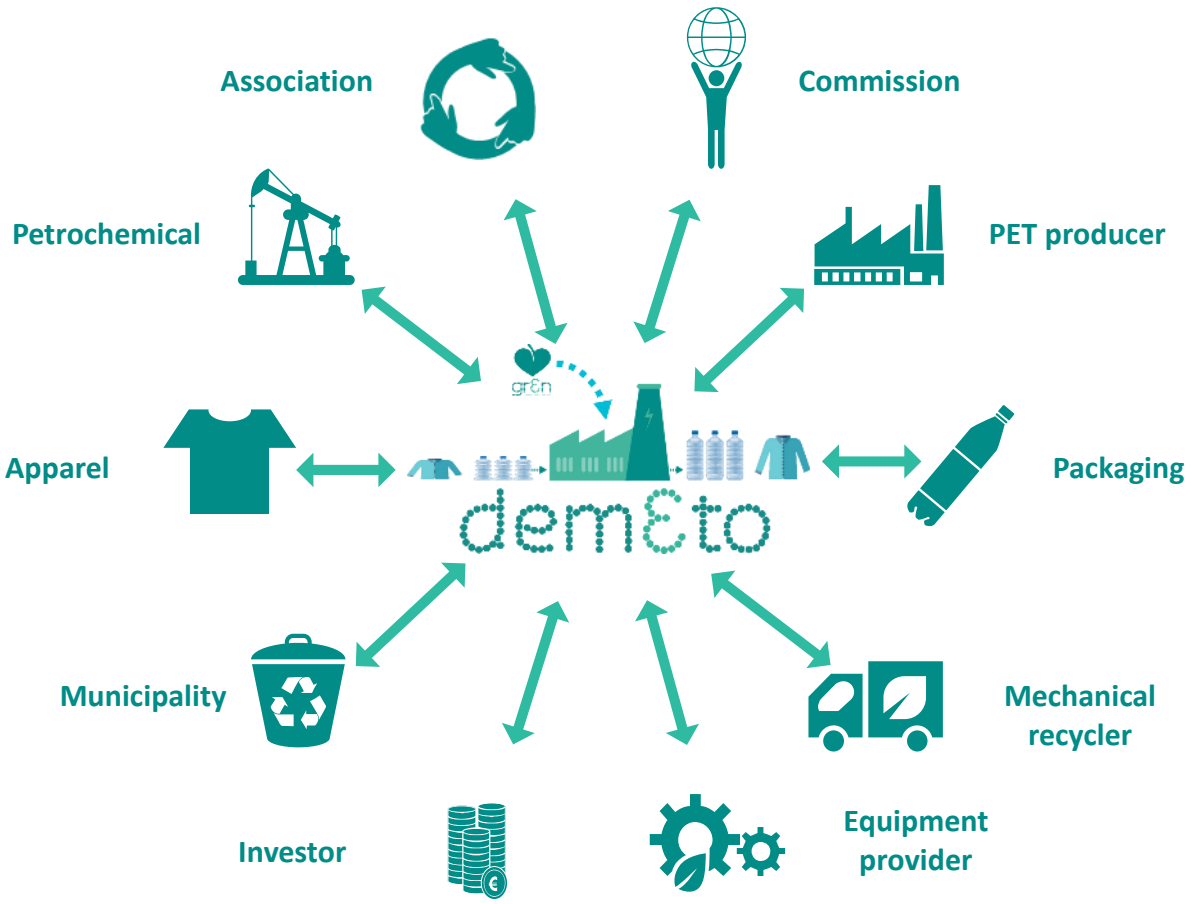
Map of the activities: Who does what?



The final goal: new bottle from Scrap-PET

- From cradle-to-cradle!

Open Points and IAB role
validation of IN/OUT of the plant



- Technical validation of the whole process means:
  - ➢ Please give to us some materials to process; let work together on the contaminants identification
  - ➢ Please take the monomers and analyze it
  - ➢ Or take the monomers and produce virgin PET
  - ➢ Help us identifying new PET sources and characterize it

Q&A session

THANK YOU!

Maurizio Crippa
CEO @ gr3n sagl
maurizio.crippa@gr3n-recycling.com