Funded by the EU Life Plus Programme: LIFE11 ENV/DE/343

MARSS

Material Advanced Recovery Sustainable Systems

"Conversion of municipal solid waste into biomass fuel, by means of the MARSS concept. An integrated sustainability assessment"

Kate Hornsby

Department of Processing and Recycling

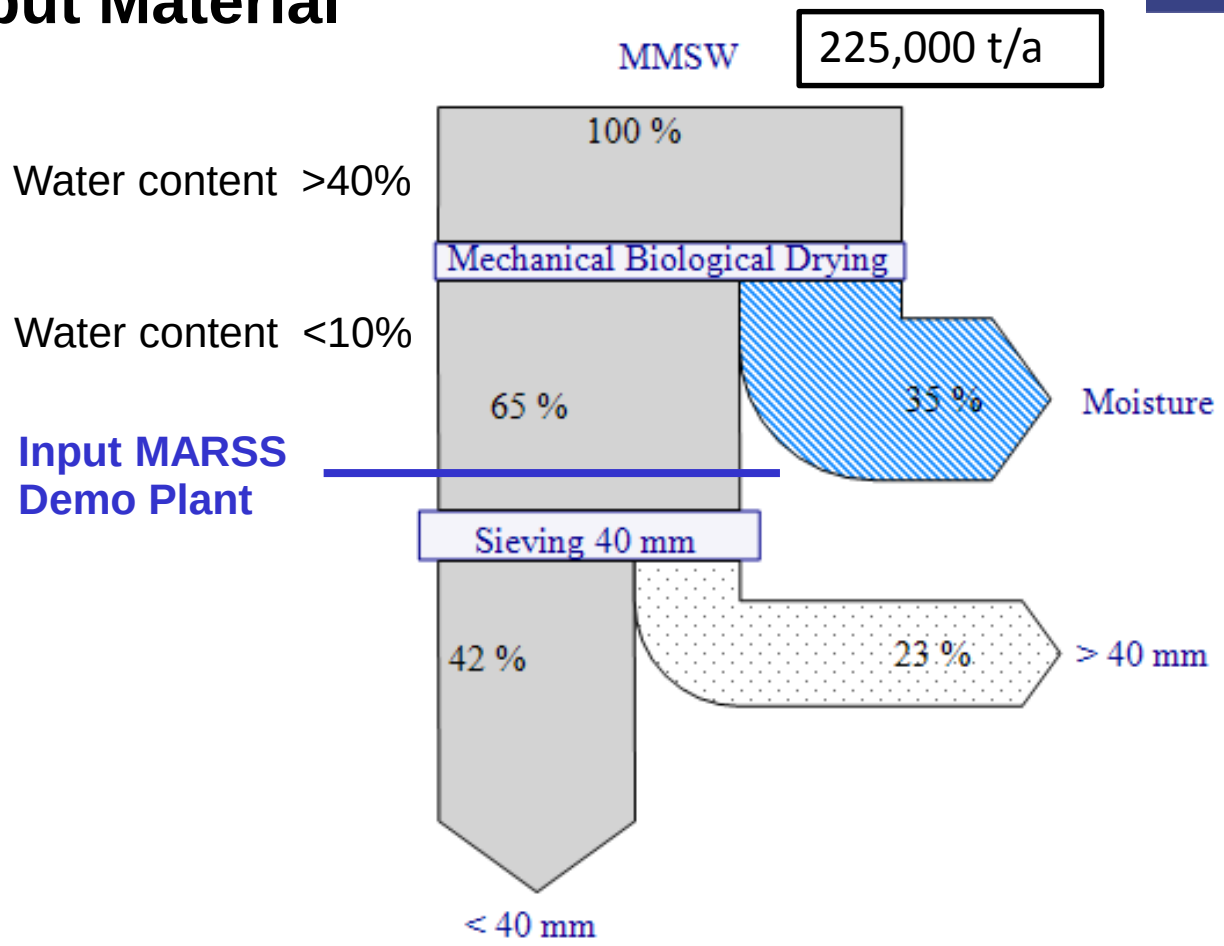
Maddalena Ripa, Chiara Vassillo, Sergio Ulgiati

"Parthenope"University of Naples
Department of Sciences and Technologies

MARSS: Technological steps towards sustainability

MARSS plant in Mertesdorf

Input Material

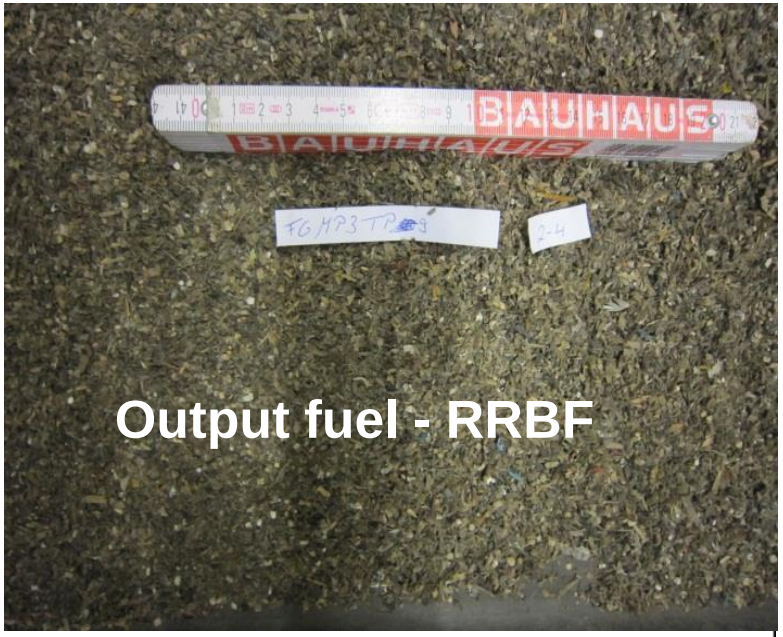


MATERIAL

Output MBT Mertesdorf (Dried MMSW) = Input MARSS Demo Plant

Material Advances Recovery Sustainable Systems – an integrated assessment approach

marss
MATERIAL ADVANCED RECOVERY SUSTAINABLE SYSTEMS



PROJECT PARTNERS

I.A.R. Institut für Aufbereitung und Recycling RWTH AACHEN
RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE (RWTH) AACHEN
WWW.IAR.RWTH-AACHEN.DE

RegEnt Regionale Entsorgungsgesellschaft mbH
REGIONALE ENTSORGUNGSGESELLSCHAFT MBH TRIER
WWW.REGENT-TRIER.DE

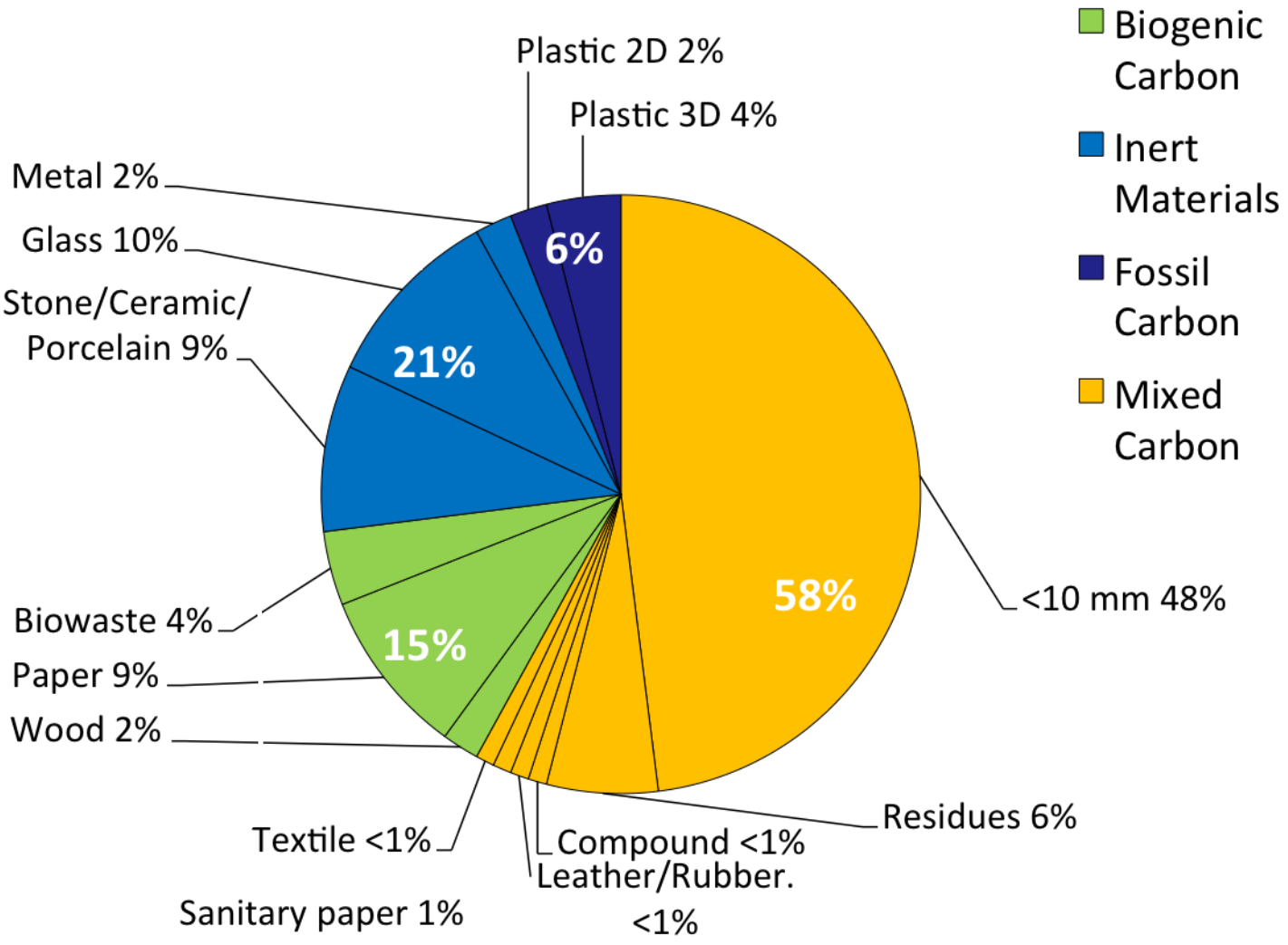
pbo
PBO GMBH AACHEN
WWW.PBO.DE

UNIVERSITÀ DEGLI STUDI DI NAPOLI
WWW.UNIPARTHENOPE.IT

UAB
UNIVERSITAT AUTÒNOMA DE BARCELONA
WWW.UAB.ES

Material Composition (Share of Mass)

RESULTS



Technical Results

- Plant in operation – hot tests being carried out
- Production started of RRBF – material characterisation underway
- Net calorific value for the RRBF fraction > 12.000 kJ/kg
- A high content of inert materials (about 50-60 %) are contained in the particle size group 0-10 mm, heating value up to 13,800 kJ/kg
- Purity of RRBF most likely > 98 Ma.-%

More technical results on MARSS web site plus publications and results

www.marss.rwth-aachen.de

Processing concept for the production of biomass fuel from mixed municipal solid waste. H. Giani, A. Feil, K. Hornsby, A. Clausen, T. Pretz (2014)

Production of biomass fuel from mixed municipal solid waste by MBT. A. Clausen,, H. Giani, T. Pretz (2013)

Away from uni-dimensional assessments!

☐ Performance assessment based on one parameter only is never sufficient for *informed and wise choices*

☐ Trade-offs:

* not everything that is technologically feasible is also environmental friendly, but

* not everything that is environmental friendly is also economically profitable in the short term, but

* not everything that is economical is also acceptable by local populations!

→ **Novel combination of assessment tools and approaches MARSS**

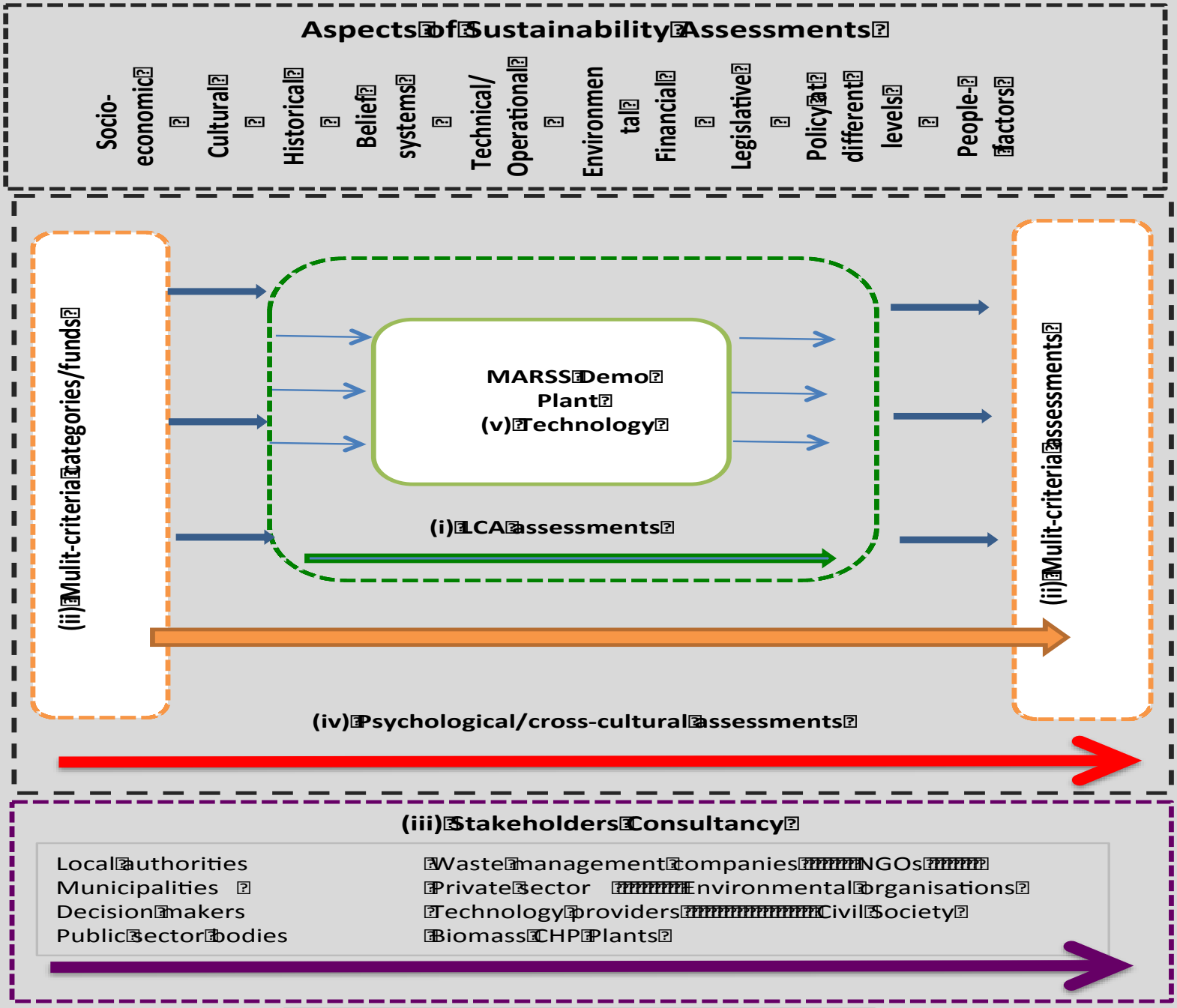
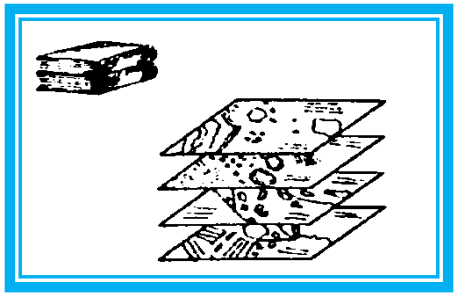


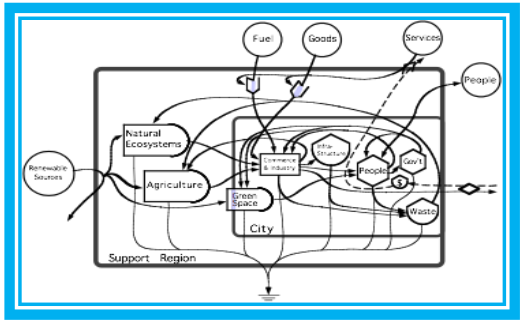
Fig. 1. Integrated approach

Multi-scale integrated analysis approach

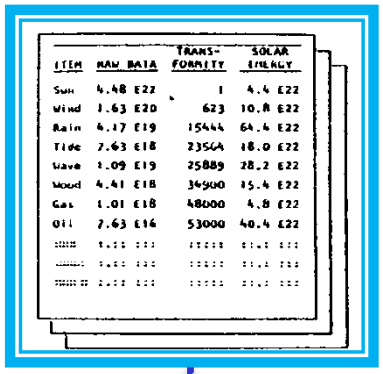
1. Data collection (ENEA)



2. LCA/SUMMA application (UniParth)



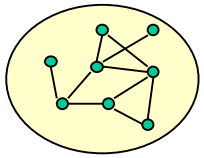
3. Socio-economic evaluation (ICTA) NAIADE/MuSIASEM



ITEM	RAW DATA	TRANS-FORMITY	SOLAR ENERGY
Sun	4.48 E22	1	4.4 E22
Wind	1.63 E20	623	10.8 E22
Rain	4.17 E19	15444	64.4 E22
Tide	7.63 E18	23564	18.0 E22
Wave	1.09 E19	25889	28.2 E22
Wood	4.41 E18	34900	15.4 E22
Gas	1.01 E18	48000	4.8 E22
Oil	7.63 E16	53000	40.4 E22

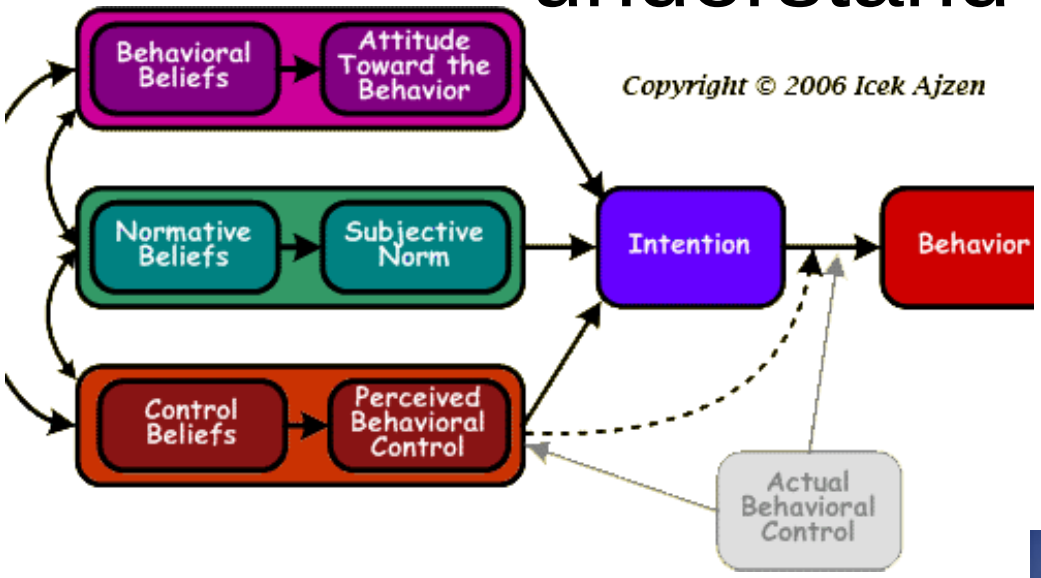
4. LCA results and Indicators
- Energy
- Material Flows
- Emergy
- Emissions

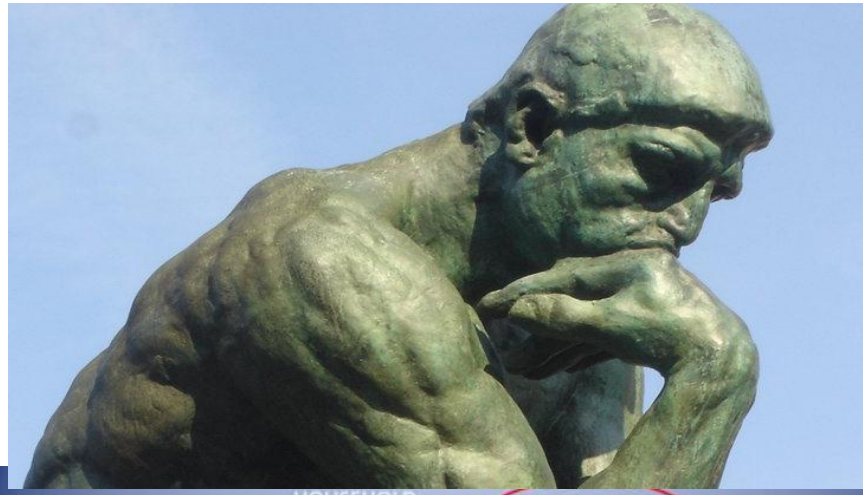
5. Assessing complexity and sustainability of the system.

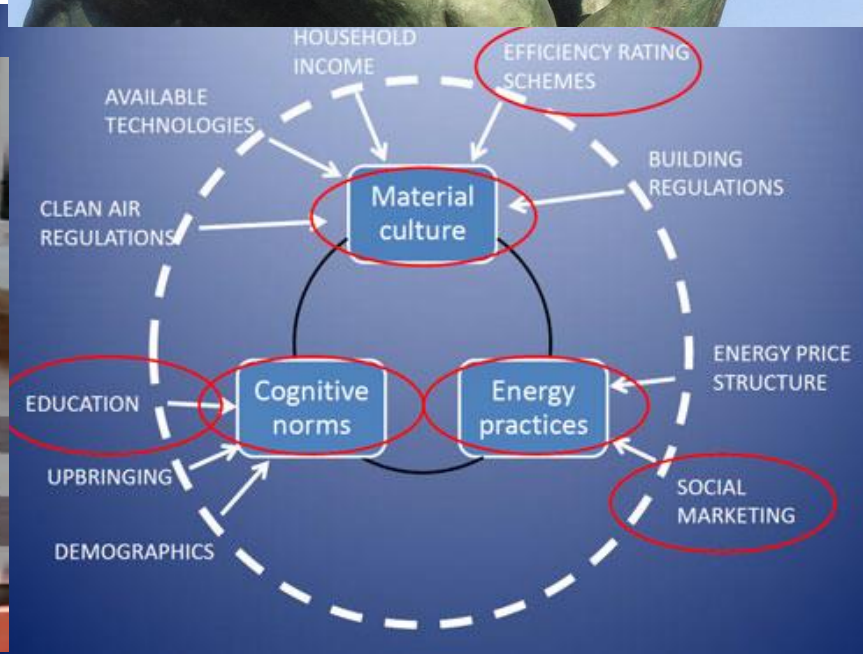


Multi-cultural consultancy

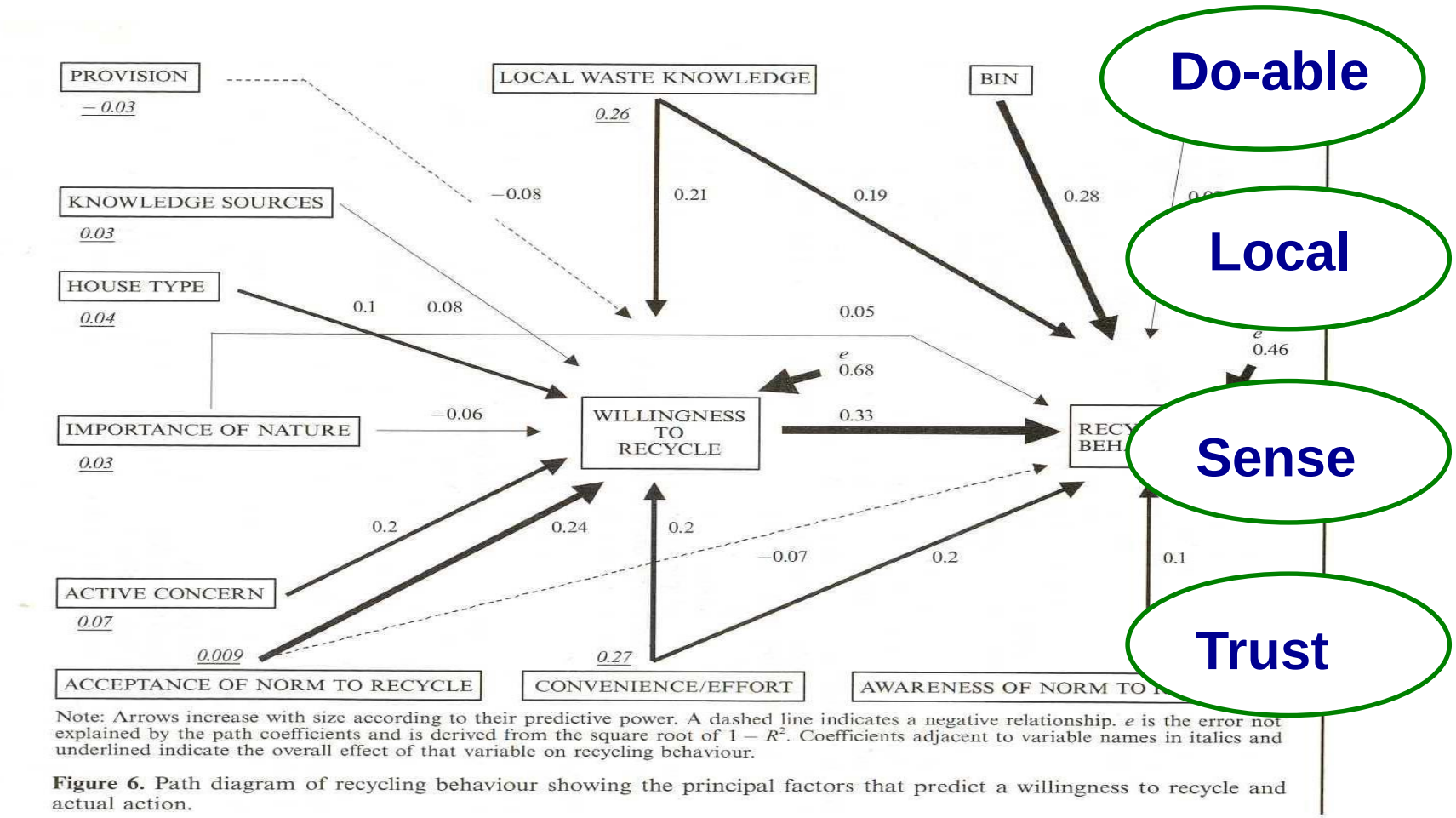
What can we learn from psychology to understand waste behaviour?







1 example of Psychological approach to understanding waste behaviour



Note: Arrows increase with size according to their predictive power. A dashed line indicates a negative relationship. e is the error not explained by the path coefficients and is derived from the square root of $1 - R^2$. Coefficients adjacent to variable names in italics and underlined indicate the overall effect of that variable on recycling behaviour.

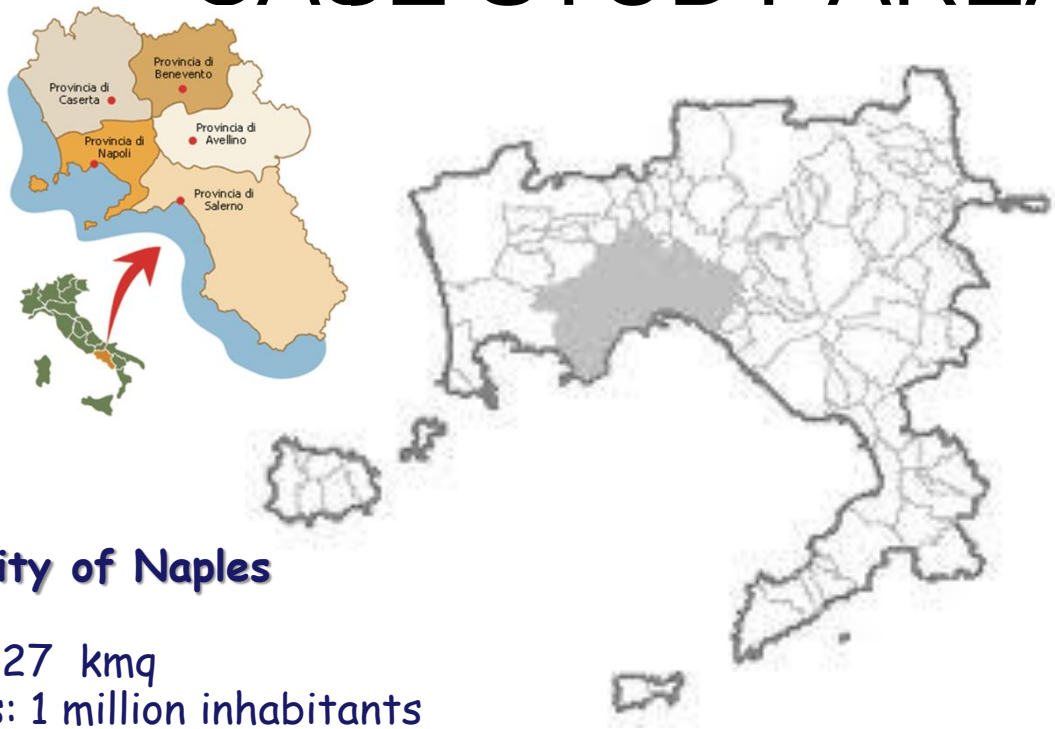
Figure 6. Path diagram of recycling behaviour showing the principal factors that predict a willingness to recycle and actual action.

Source: Prof P. Philips – STaR City Programme

Cross cultural aspects in Waste management – lack of equivalence

- How strong is the influence of culture on behaviour and attitudes?
- Can we identify these cultural specific variables?
- Can we measure this in any way?
- Can this lead to a deeper understanding of differences and uniformities?
- How should this knowledge impact on the methodology and approach used in the stakeholder consultancy programme?
- Can we predict behavior of different stakeholder groups who speak different languages, and are governed by different social and political systems?

Real case feasibility study – Naples
CASE STUDY AREA



Municipality of Naples

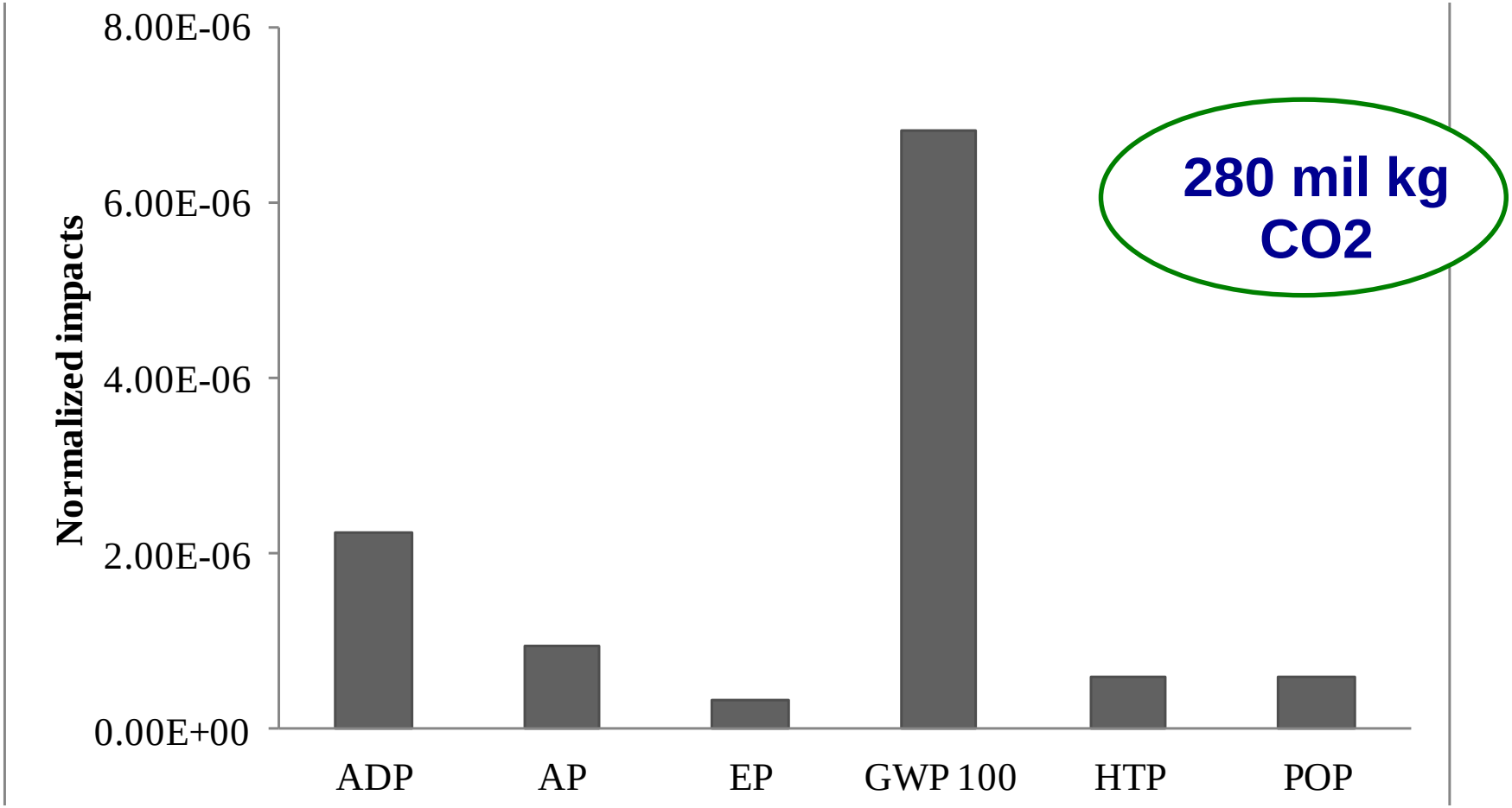
Area: 111.27 kmq
Residents: 1 million inhabitants
Population Density: 8180 inhs/kmq
Municipal Solid Waste Production: 517000 tons/yr* (2011)

More than 60% of MSW is sent to landfill

Naples waste "emergency" situation still not resolved

*all data are provided by regional authority

Waste disposal in Naples LCA results– Impact categories: Business as usual (BAU)



How do we get to the truth and which truth is the right one?

Making a list of possible stakeholders is easy but identifying each person`s "story" is much more complicated!

Simply asking the question influences the answer!

- What is the background to the opinion given, social position, personal history, affiliations!
- Local power struggles!
- Local fears! Conflicts!

Compromises!!

Stakeholder Questionnaire Survey

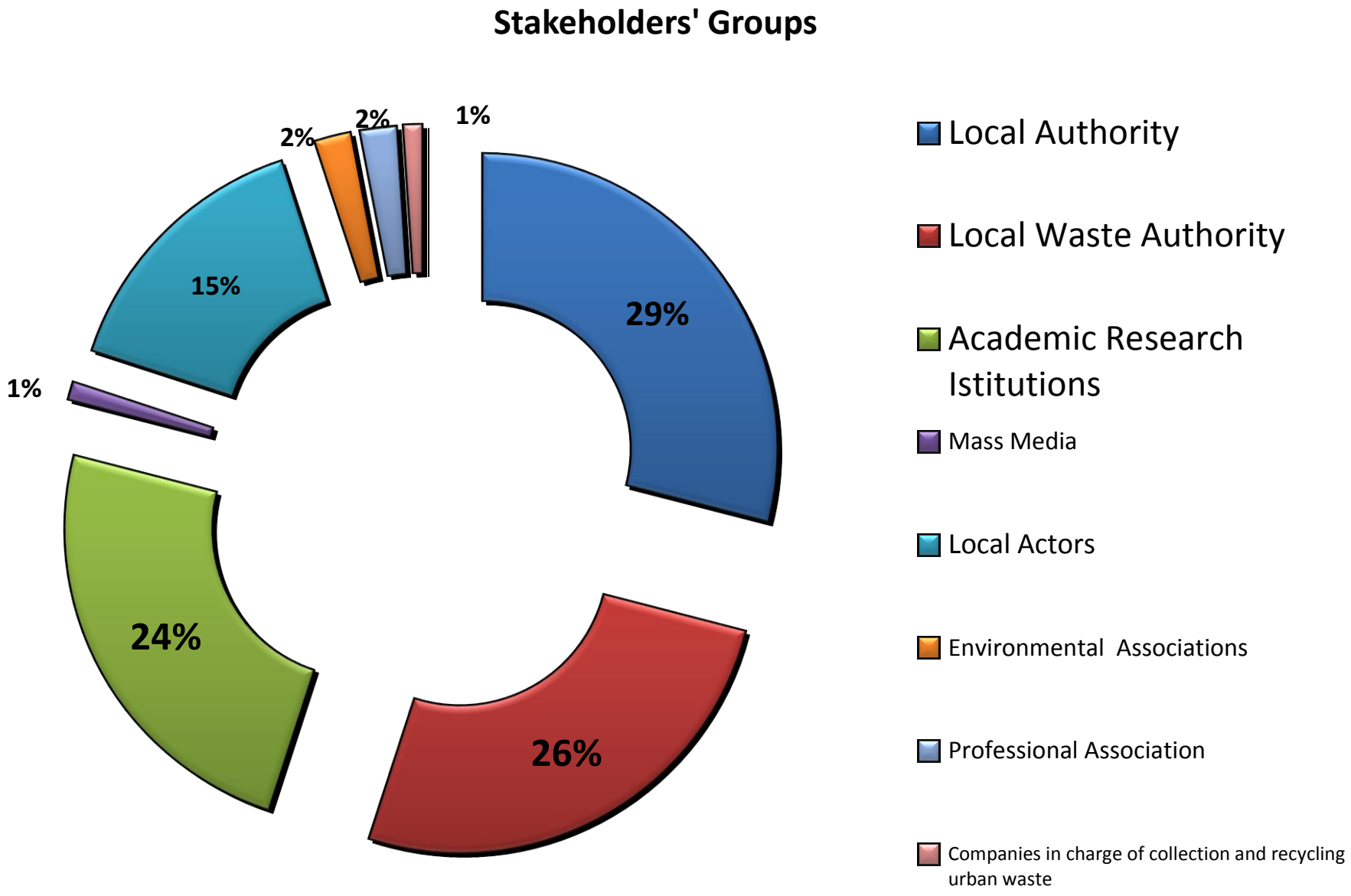
Stakeholders identified - 300 persons involved

Email sent with questionnaire and MARSS technical details

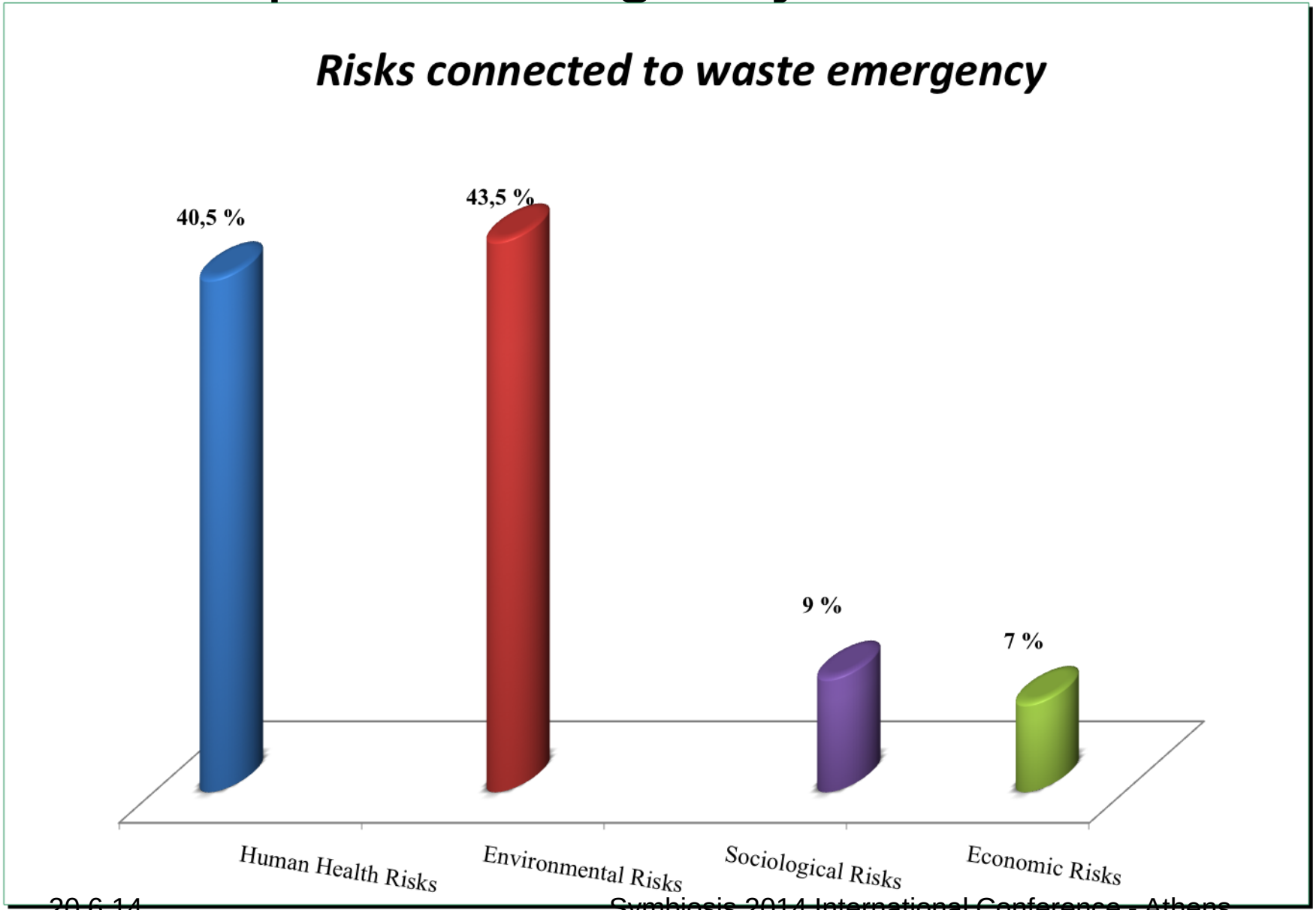
69 questions

86 questionnaires filled out and returned so far

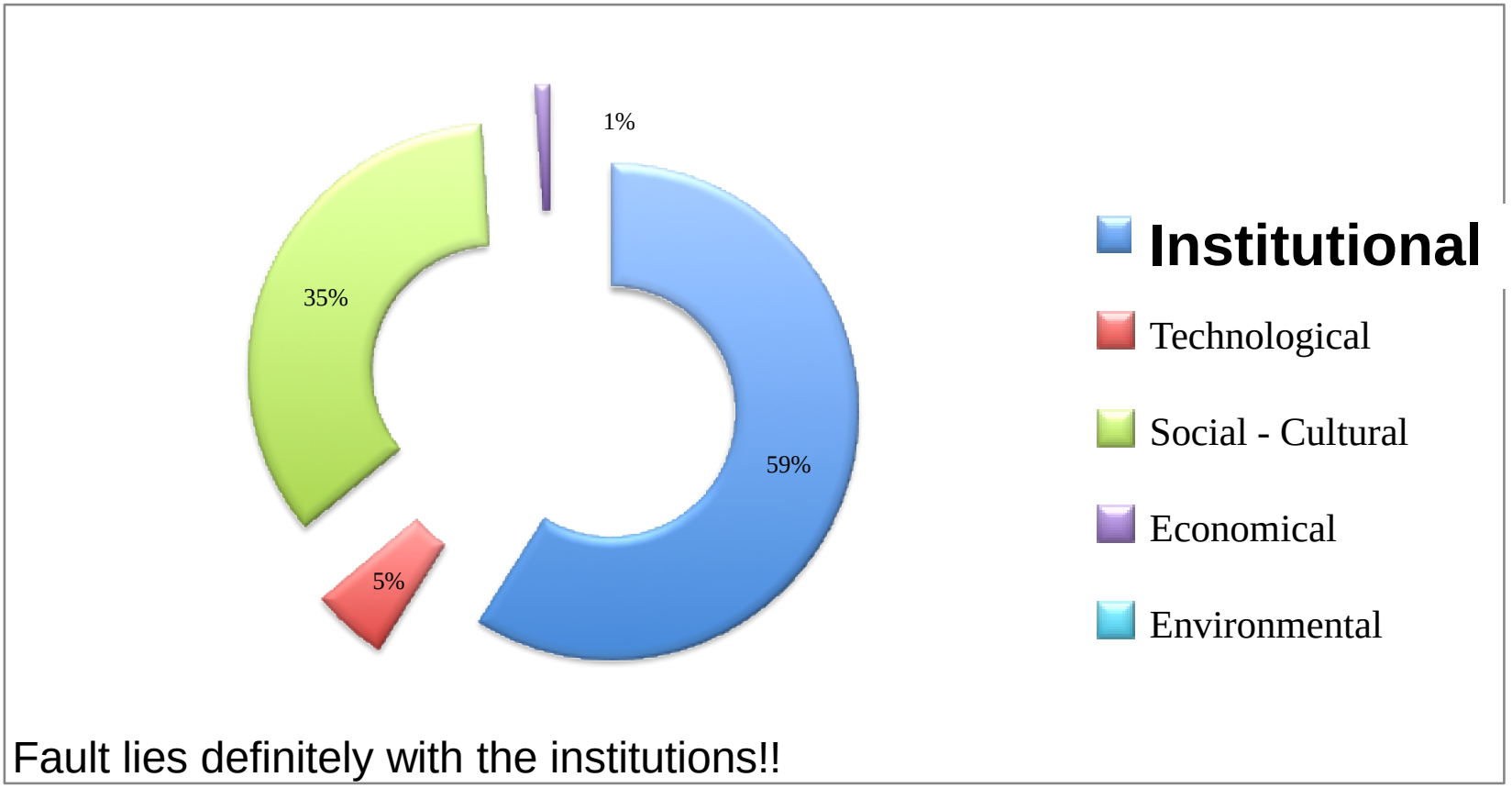
Groups of respondents



Naples “Emergency” situation

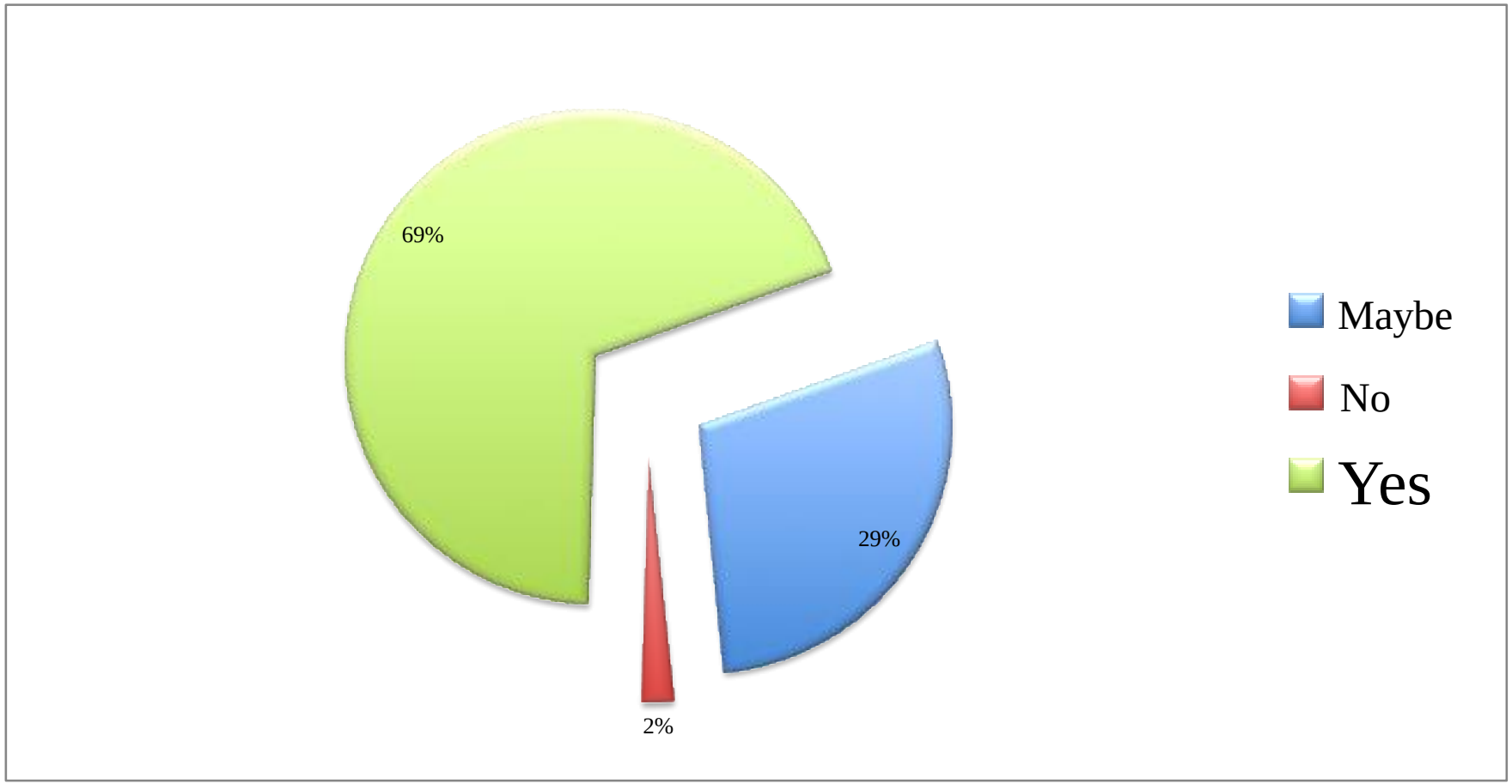


What do you believe is the main reason for the current emergency in Naples and Campania Region?



Fault lies definitely with the institutions!!

How likely is MARSS able to solve the problem of waste management and emergency in Naples?



1st conclusions – Naples Study

The launch of new technologies is a major challenge

Significant psychological elements in stakeholder responses

Civil society has clear concerns

New technology alone cannot solve the “emergency”

People believe that the fault lies with the institutions

Confirmation that we are dealing with a complex situation

Away from uni-dimensional indicators: Wise and informed choices

- Sustainability performance assessment based on one tool only is not enough
- Trade-offs are unavoidable:

* not everything that is technologically feasible is also environmental friendly, but

* not everything that is environmental friendly is also economically profitable in the short term, but

* not everything that is economical is also acceptable by local populations.

Life is complex…

…and sustainability does not make it simpler!

MARSS Public workshop
with plant visit
October 2014
Everyone invited!

In Trier, Germany

Organiser: Kate Hornsby

Thank you!

For contacts

hornsby@ifa.rwth-aachen.de

maddalena.ripa@uniparthenope.it

chiara.vassillo@uniparthenope.it

www.marss.rwth-aachen.de