



**Associazione Italiana
TEcnologia Meccanica**
www.aitem.org



Italian Association for Manufacturing



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Italian Association for Manufacturing

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What's:

AITEM is the Italian association of both academy and industry who live manufacturing as their core business. Since 1992, AITEM is the cultural and technological reference for manufacturing and production systems in Italy.





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Italian Association for Manufacturing



Who's:

www.aitem.org

A **motivated** team **242 Italian fellows** coming from academy and industry
 Young generations is one of our focus:
44 junior Italian fellows

Stakeholders:

- ✓ Professors of manufacturing
- ✓ Manufacturing related companies
- ✓ Research institutions



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AITEM vision:

www.aitem.org

A strong scientific base
 A pragmatic «industrial» approach
 Multi-level cooperation
 International Cooperation

Keywords:

Innovation

Integration

Development

Networking

Design

Sustainability



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How's:	
www.aitem.org AITEM promotes studies, knowledge development and applications in the following fields: - manufacturing processes - material characterization - process design methodologies - production planning and control - quality management - manufacturing sustainability	
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How's:	
www.aitem.org How AITEM works: > A conference every two years > Yearly general assembly > Meetings and high education > Information and dissemination >> Labs network >> Performance monitoring >> <u>Technical committee</u> >> <u>Observatories & Interest groups</u>  	
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COLLEGE INTERNATIONAL POUR LA RECHERCHE EN PRODUCTIQUE
THE INTERNATIONAL ACADEMY FOR PRODUCTION ENGINEERING
INTERNATIONALE AKADEMIE FÜR PRODUKTIONSTECHNIK

International Cooperation:

- Organization of CIRP Conferences in Italy
- Grants for young scientist for participating to GA
- CIRP Dictionary
- CIRPedia
- Technical Committee support the CIRP conferences



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Technical committee:

PromoL@ser	
Polymers technologies	
Machining	
Virtual/Digital Manufacturing	



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Observatories:

Tubes and sheet metal forming



Extrusion



Aerospace manufacturing systems





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New initiatives (Interest Groups):

Micromanufacturing



Additive Manufacturing



Sustainable Manufacturing (SOSTENERE)





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SUSTAINABLE MANUFACTURING

«SOSTENERE» network







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SUSTAINABLE MANUFACTURING

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“Lombardy node”

Prof. Tullio Tolio
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Dr. Nicoletta Picone







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<<SOSTENERE>>

"Lombardy node"







Istituto di Tecnologie Industriali e Automazione
Consiglio Nazionale delle Ricerche

from research to market

❖ Highly Evolvable E-waste Recycling Technologies and Systems











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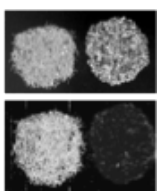


"Intelligent" Recycling Processes






New generation flexible mechanical recycling systems for optimal pre-treatment of complex material mixtures.

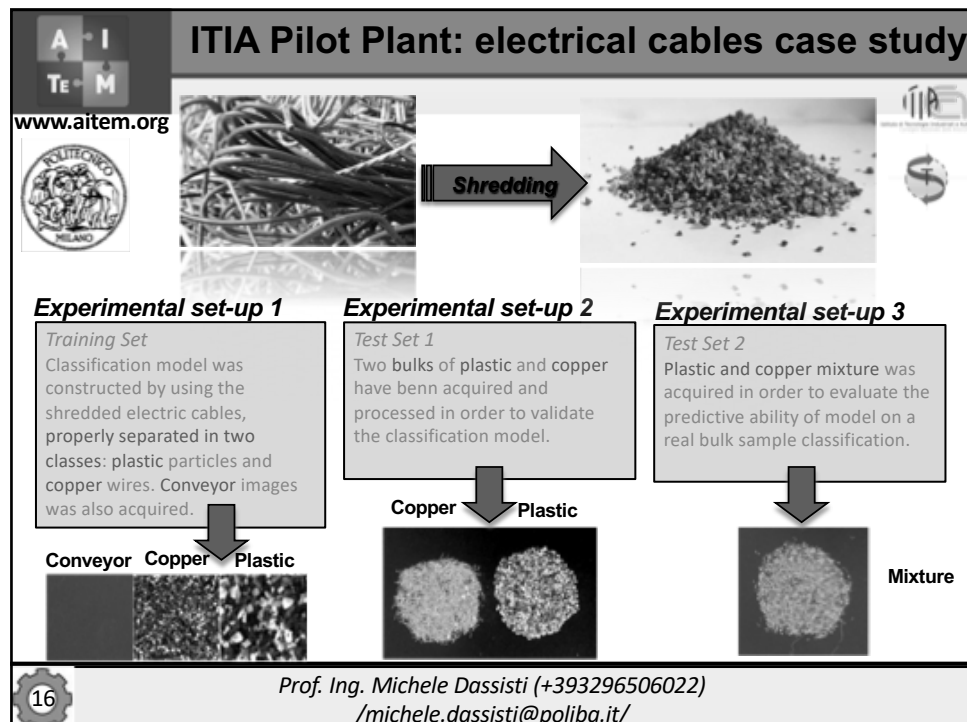
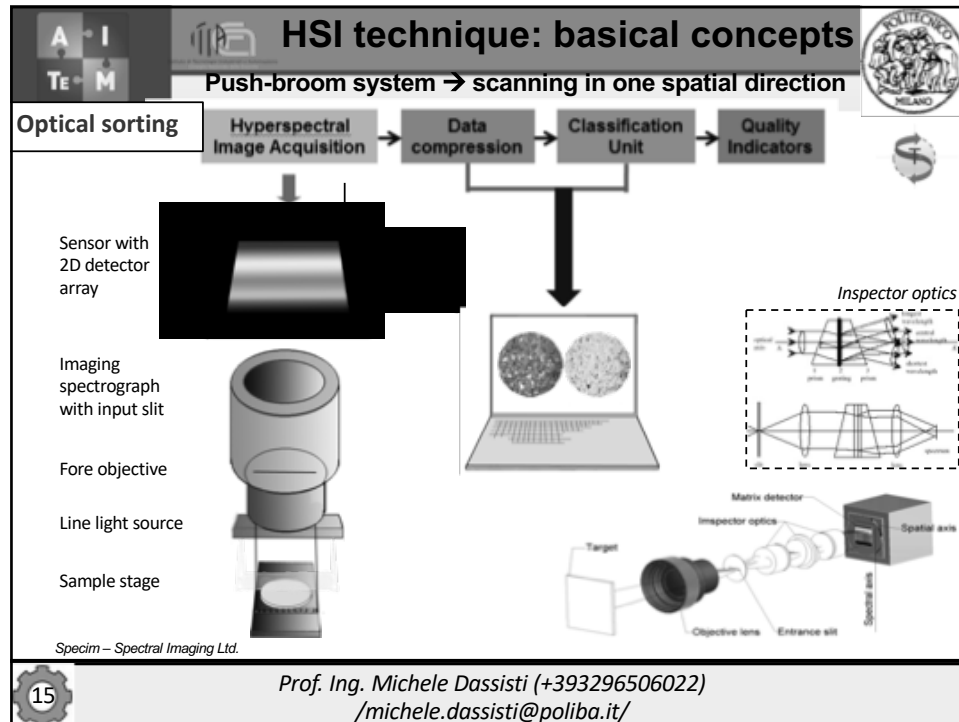


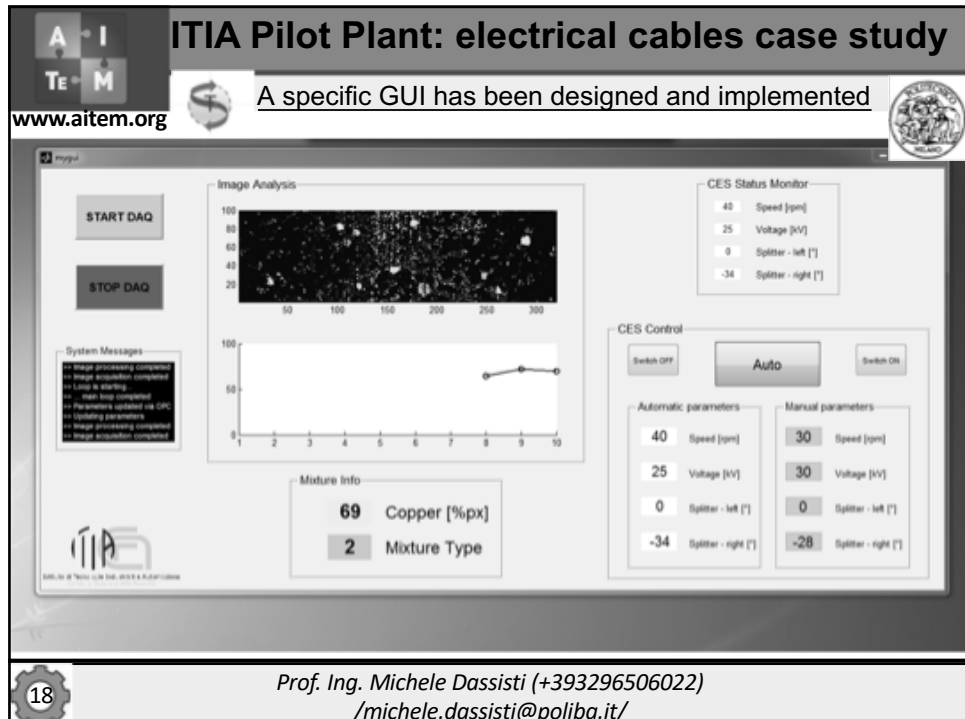
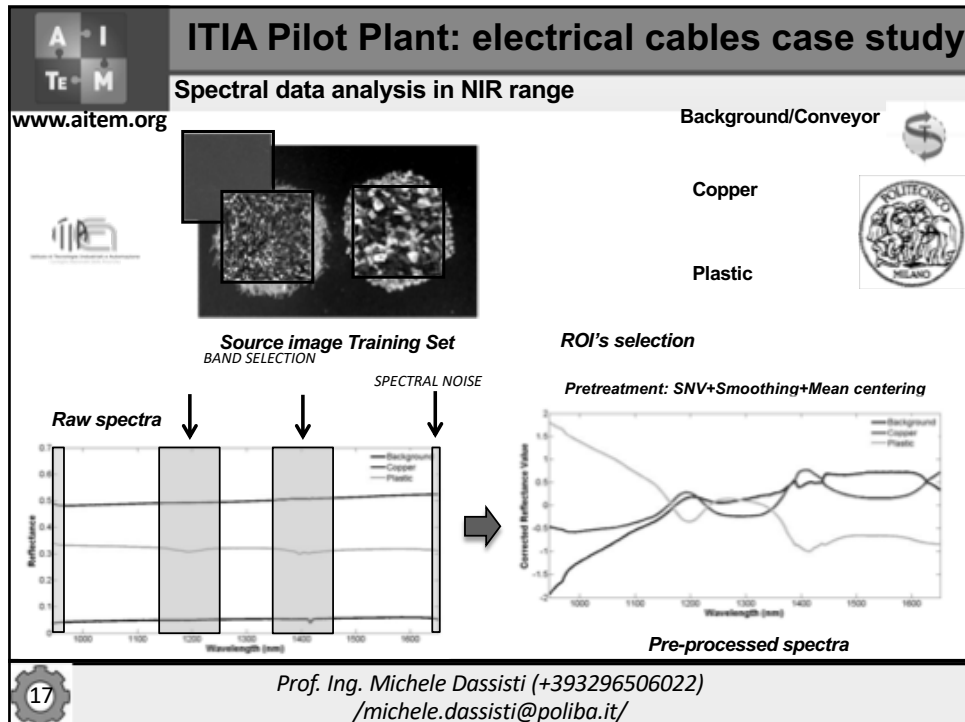
Hyperspectral imaging to perform the on-line classification of product conditions and mixtures.

In-line optimization of the process parameters to adapt to the material characteristics.



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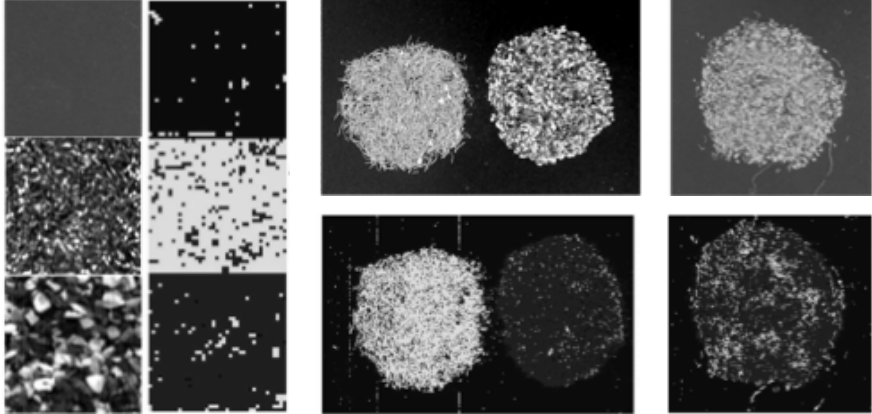
ITIA Pilot Plant: electrical cables case study

Classification results

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Conveyor Copper Plastic

Experimental set-up 1 Experimental set-up 2 Experimental set-up 3



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“Apulia node”

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 Prof. Massimo La Scala
 Prof. Piero Mastrorilli
 Prof.ssa Antonella Dorazio
 Prof. Franco Maddalena
 Dr. Umberto Rizzuti
 Dr. Giuseppe Florio
 Prof. Giuseppe Devillanova



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<<SOSTENERE>>
“Apulia node – sub-net”

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 ❖ WEE Recycling Patent

❖ Sustainable building Patent

LabZERO
Zero Emission Research Option

❖ Advanced energy production systems

H⁺REI
NEW ENERGY GENERATOR

MBL Solutions S.r.l.
Innovazioni per le imprese

OnPEG
Sustainable and Intelligent Energy Policy

HORUS
SOSTENIBILITÀ E SVILUPPO

redGRID

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SUSTAINABLE WEE recycling
Thermo-mechanical processing

LabZERO
Zero Emission Research Option

PATENT PTC/IT2013/000135
**Thermo-mechanical controlled delamination
 process for the full recovery of rigid mono-,
 polycrystalline amorphous materials coated
 with plastic materials**

RE-CRYO

M. Dassisti

WIPO PATENTSCOPE

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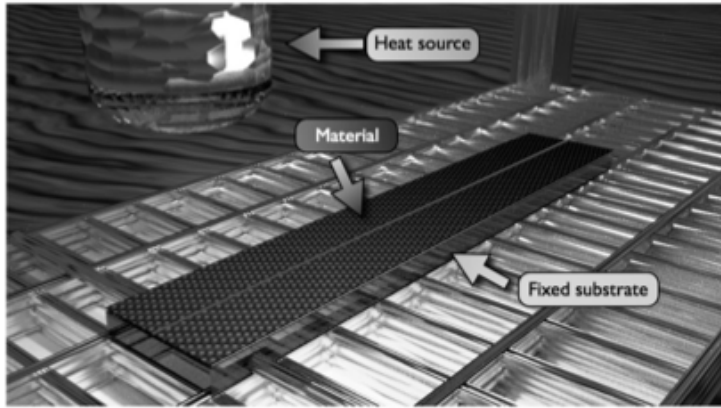
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Implementing the delamination process:
PTC/IT2013/000135 - INITIAL CONDITION

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Material with fixed substrate subject to thermal sources



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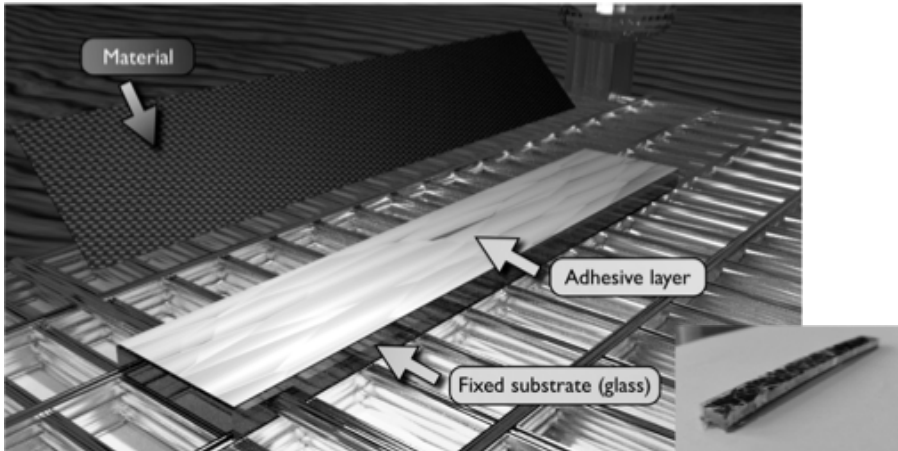
Implementing the delamination process

PTC/IT2013/000135 - FINAL RESULT

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LabZERO
Zero Emission Research Option

Breaking of the plastic layer → delamination!



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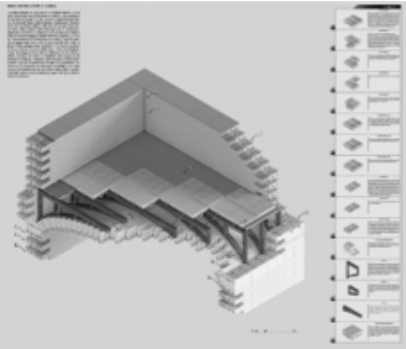


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Sustainable buinding: New stratified modular concept





PAT. PCT/IB2013/000830
Antisismic dry and Self-Sustaining Building-System made by Eco-sustainable stratified and self-blocking elements: Nexus
 Montalbano C., Petruccioli A., Chiarantoni C., Piccinni F., Dassisti M.



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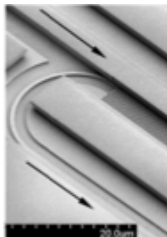


Green photonics for a sustainable economy

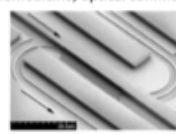


Design, fabrication and characterization of **advanced linear and nonlinear integrated optical devices, photonic crystals, metamaterials and plasmonic structures**, for various applications in sustainability (optical sensing for environment, space or biomedicine; optical communication systems; renewable energy)

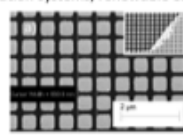
als, applications in e or vable energy)



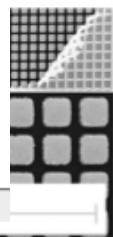
Optical Filter based on 2D Photonic Crystals



Optical chemical plasmonic sensor



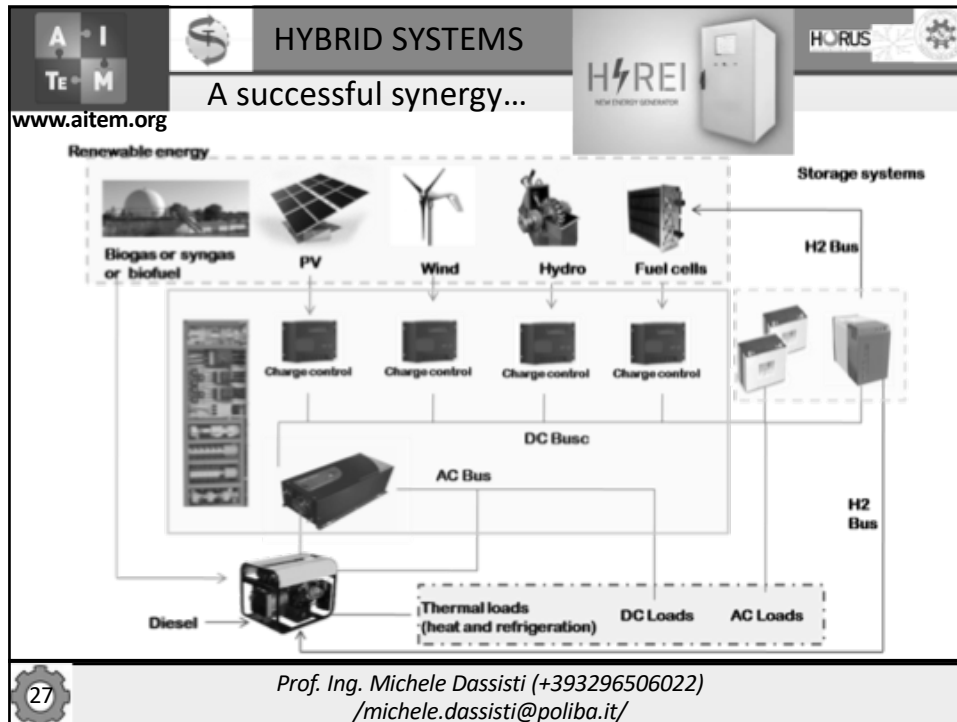
Optical chemical plasmonic sensor



Optical chemical plasmonic sensor



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HY-REI:
Successful applications

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Resellers/Representatives

HyREI - New Energy Generation for House Ilha Do Maio - Cape Verde

Location: Ilha Do Maio - Cape Verde
Kind of System: HyREI_off grid
Power: 3,00 kWp PV + 3 kWp Eolic Generat
Autonomy: 5 h (battery pack: 300Ah@48 V)

Other components:
PV modules: Trina 240 Wp
Eolic Generator: 3 kW (customer-owned)

Configuration 1:
N. 1 HyREI 3 kW_Full renewable mode

HyREI - New Energy Generation for Humanitarian Mission Bozoum - Central African Republic

Location: Bozoum - Central African Republic
Kind of System: HyREI_off grid
Power: 15,00 kWp PV + 20 kWp Generat
Autonomy: 30 h (battery pack: 200Ah@240 V)

Other components:
PV modules: Vigorelone 220 Wp
Diesel Generator: 20 kW (customer-owned)

Configuration 1:
N. 1 HyREI 20 kW_Hybrid mode

HyREI - New Energy Generation for House - Tanzania

Location: Spicchi - Tanzania
Kind of System: HyREI_off grid
Power: 15,00 kWp PV + 20 kWp Generat
Autonomy: 30 h (battery pack: 200Ah@240 V)

Other components:
PV modules: Vigorelone 220 Wp
Diesel Generator: 20 kW (customer-owned)

Configuration 1:
N. 1 HyREI 20 kW_Hybrid mode

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SUSTAINABLE STORAGE SYSTEM
FOR RESIDENTIAL SECTOR (1-5kW):



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Improved Vanadium Redox Flow Batteries (VRFBs) :

- ☐ High energy density /40-50%> conventional system/
- ☐ Wider operative temperature range /-10°C + 50°C/.
- ☐ Optimisation of cell configuration design for industrial large-scale application







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INNOVATIVE STORAGE SYSTEM
Stack for Lab testing



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Characteristics	Value
Number of stack	1
Nominal Power	150 W
# cells/stack	5
Average voltage at end discharge (SoC=0.2)	6V
Energy density of electrolyte	36,18 Wh/l
electrolyte Volume	6 l
Overall efficiency	0,85
Average Current	25, A
Charge energy	176.47 Wh
Discharge energy	127.5 Wh
Cycle time(Charge and Discharge)	~3 h







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INNOVATIVE STORAGE SYSTEM

In process research on sustainability



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- ☐ New membranes
- ☐ Innovative materials

for bipolar plates

- ☐ Non-aqueous electrolytes

for energy density








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Internet of things platform



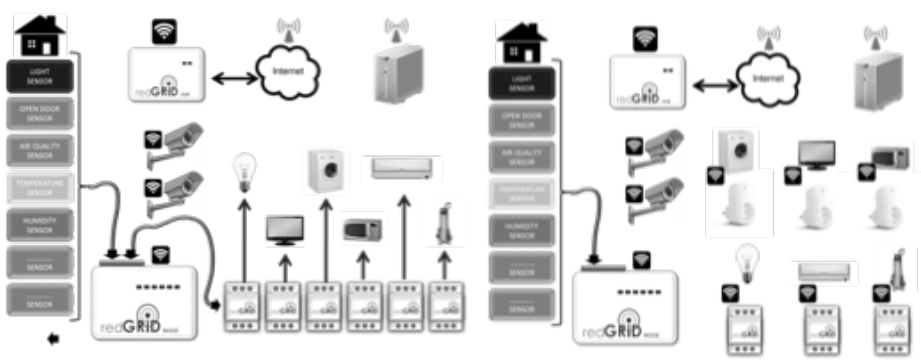
I40.0

WPS



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- Ability to **upload and manage electrical consumption data** via connection to any single-phase line. Add also any sensor and IP cameras as plug&play devices (wired or wireless)





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A - I
Te - M
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SUSTAINABLE MANUFACTURING
«SOSTENERE» NETWORK

“Emilia-Romagna node”
Prof. Luca Tomesani
Prof. Giampaolo Campana
(gianpaolo.campana@unibo.it)

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

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SUSTAINABLE MANUFACTURING
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“Piedmont node”
Prof. Luca Settineri
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POLITECNICO DI TORINO

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<<SOSTENERE>>

"Piedmont node"



POLITECNICO DI TORINO



- ❖ Process design and optimization in view of sustainable development
- ❖ Eco-sustainable lubricoolant strategies
- ❖ Cryogenic-assisted cutting
- ❖ Recycling-related issues



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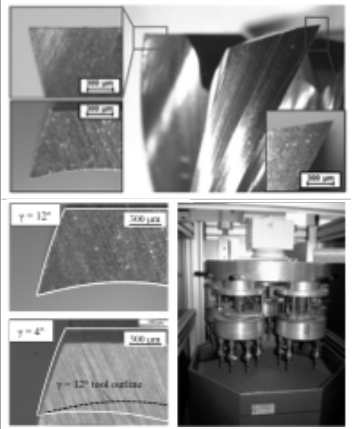
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Advanced Machining

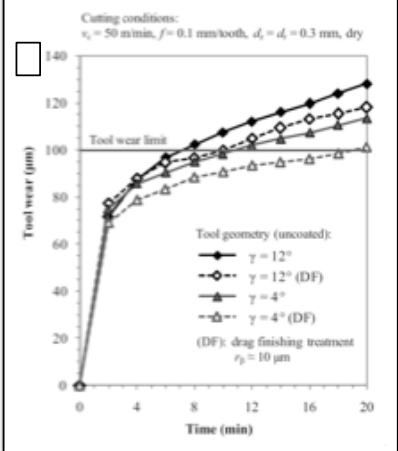


POLITECNICO DI TORINO

❑ Optimization of tool geometries and cutting edge treatments



Cutting conditions:
 $v_c = 50 \text{ m/min}$, $f = 0.1 \text{ mm/tooth}$, $d_f = d_t = 0.3 \text{ mm}$, dry



Tool wear limit

Tool geometry (uncoated):

- $\gamma = 12^\circ$
- $\gamma = 12^\circ$ (DF)
- △- $\gamma = 4^\circ$
- ◇- $\gamma = 4^\circ$ (DF)

(DF): drag finishing treatment
 $r_b = 10 \mu\text{m}$



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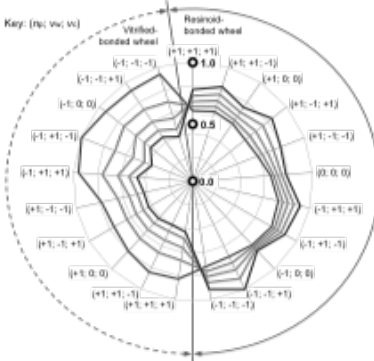
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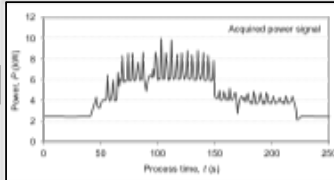
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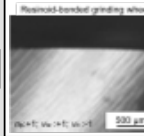
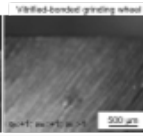
Sustainable Manufacturing

□ Process design and optimization



Quality-oriented optimization of energy consumption in a grinding process





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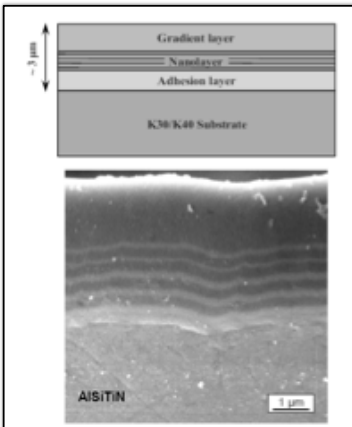
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Advanced Machining

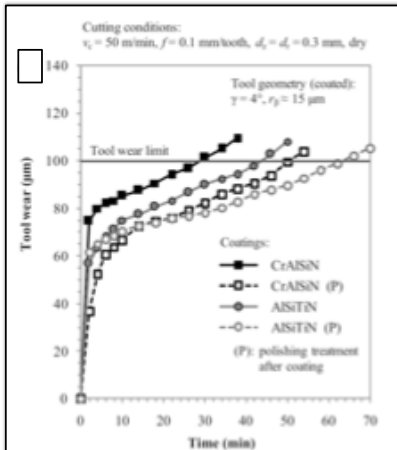
□ Advanced nano-structured tool coatings



POLITECNICO DI TORINO



Cutting conditions:
 $v_c = 50$ m/min, $f = 0.1$ mm/tooth, $d_f = d_c = 0.3$ mm, dry





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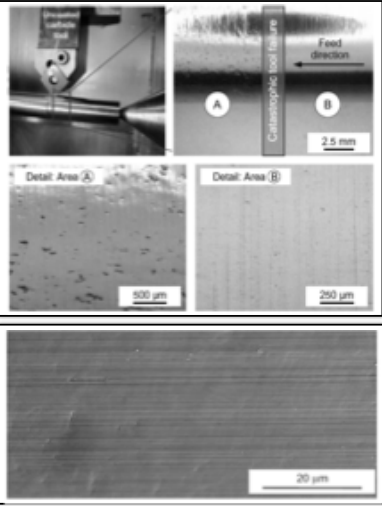


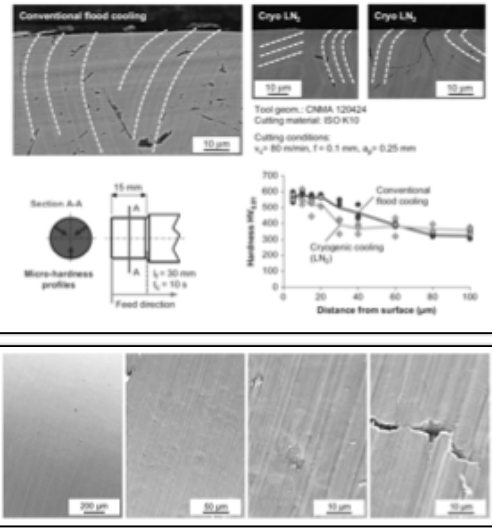
Advanced Machining

□ Surface integrity



POLITECNICO DI TORINO







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In cooperation with:



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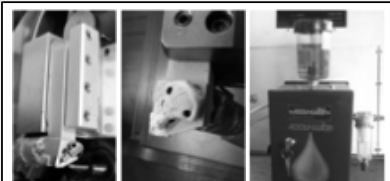


Sustainable Manufact.

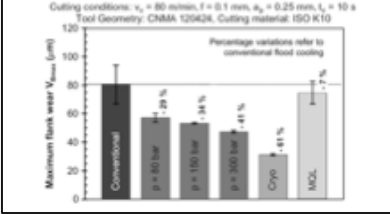
□ Eco-sustainable lubricoolant strategies



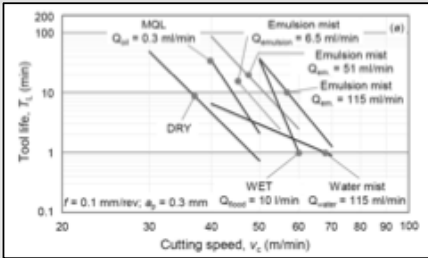
POLITECNICO DI TORINO



Cutting conditions: $v_c = 80$ m/min, $f = 0.1$ mm, $a_p = 0.25$ mm, $t_c = 10$ s
Tool Geometry: CNMA 120424, Cutting material: ISO K10



Comparison among different lubricoolant strategies:
dry cutting, conventional flood cooling, Minimum Quantity Lubrication (MQL), Minimum Quantity Cooling (MQC), cryogenic assisted-machining.





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Sustainable Manufact.

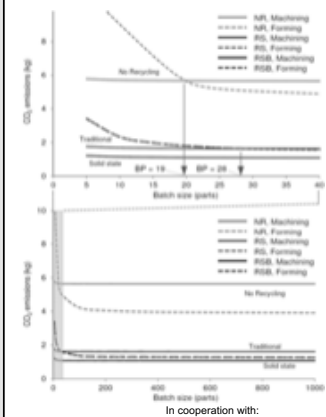


POLITECNICO DI TORINO

□ Recycling-related issues

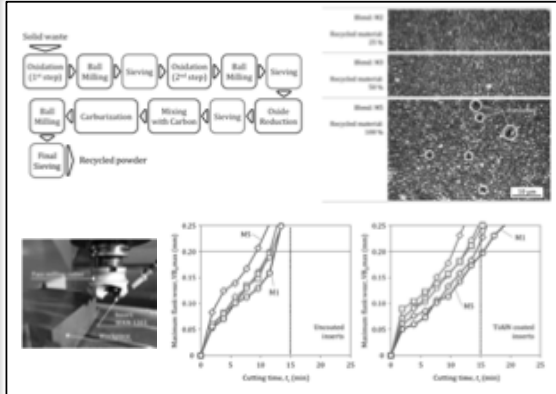
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Analysis of recycling benefits awarding in manufacturing



In cooperation with:

Performance of cutting tools produced from WC-Co scraps





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‘Marche node’

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<<SOSTENERE>>

"Marche node"







- ❖ Design and development of low-environmental impact machine tool
- ❖ New sustainable manufacturing processes



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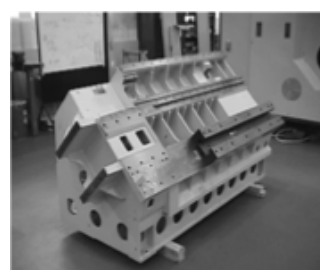
SUSTAINABLE MACHINE TOOL

□ Low environmental impact machine tool



- *Cast iron basament of machine tools replaced by an high-density calcaroeus mineral, bonded with epoxy resin*
- *Machining operations performed under dry cutting conditions*

Cast iron bed

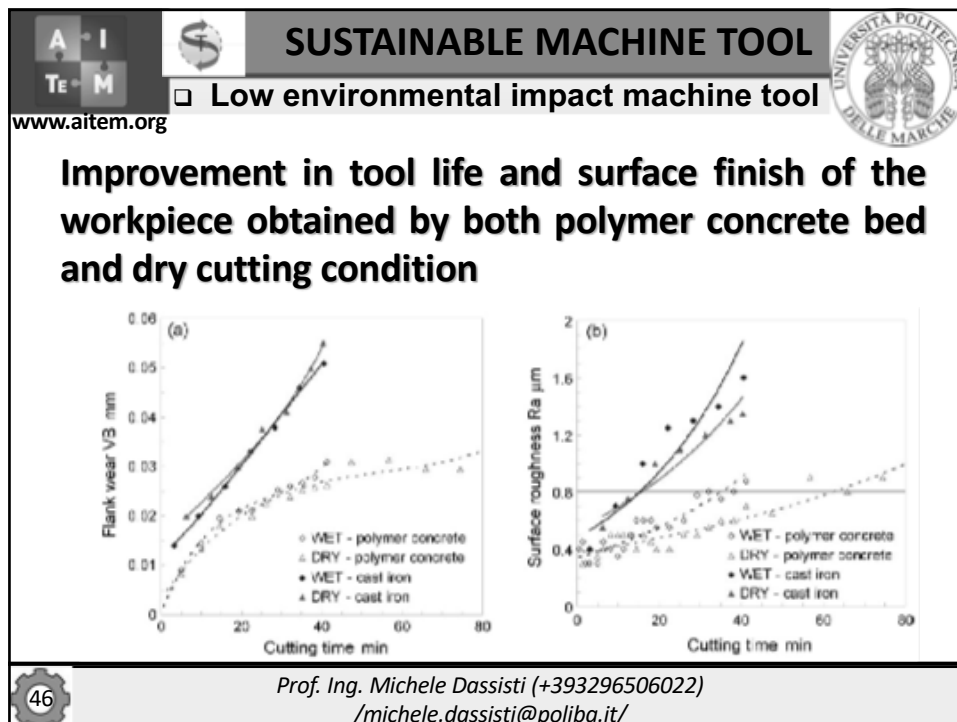
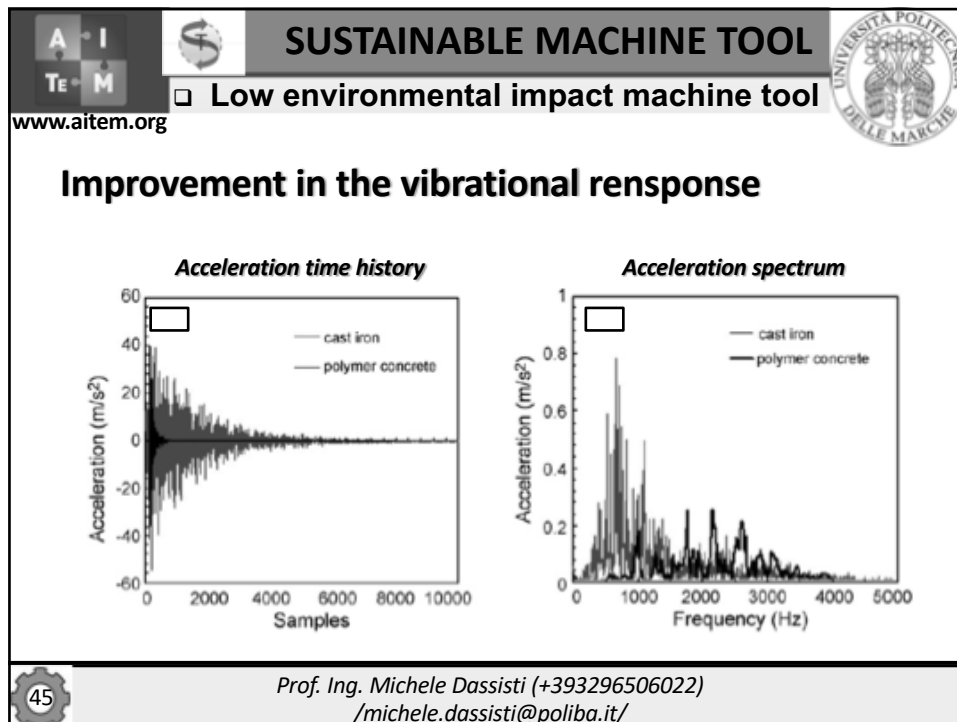


Epoxy concrete bed





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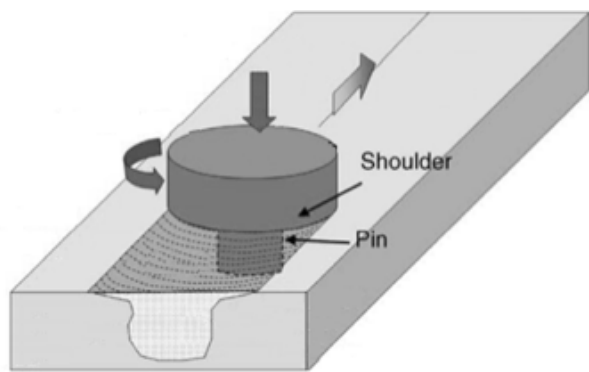


NEW SUSTAINABLE PROCESS

Friction Stir Welding



Friction Stir Welding considered as a "green technology"





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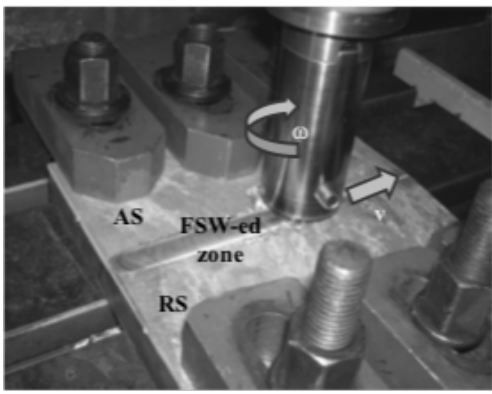


NEW SUSTAINABLE PROCESS

Friction Stir Welding



FSW performed using different tool set-up







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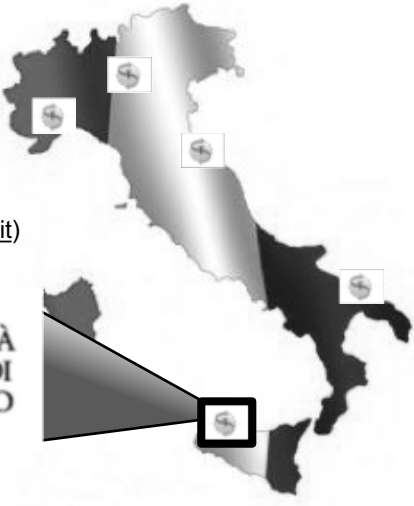
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“Sicily node”

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Giuseppe Ingarao
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UNIVERSITÀ
DEGLI STUDI
DI PALERMO
L'Università



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<<SOSTENERE>>

“Sicily node”







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- ❖ Environmental impact analysis of manufacturing processes
- ❖ Material related environmental impact reduction
- ❖ Environmental impact reduction at production system level



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Guidance for new ISO standard 14955
(Environmental evaluation of machine tools)



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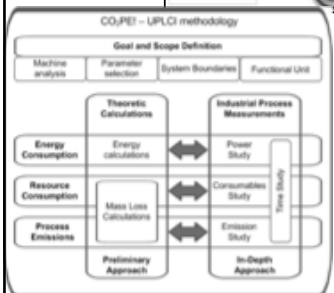
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Methodology for Systematic Analysis and Improvement of Manufacturing Unit Process Life Cycle Inventory





Manufacturing processes, as used for discrete part manufacturing, are poorly documented in terms of environmental footprint

the CO2PEI-Initiative has the objective to coordinate international efforts aiming to document and analyze the overall environmental impact for a wide range of available and emerging manufacturing processes and to provide guidelines to improve these.



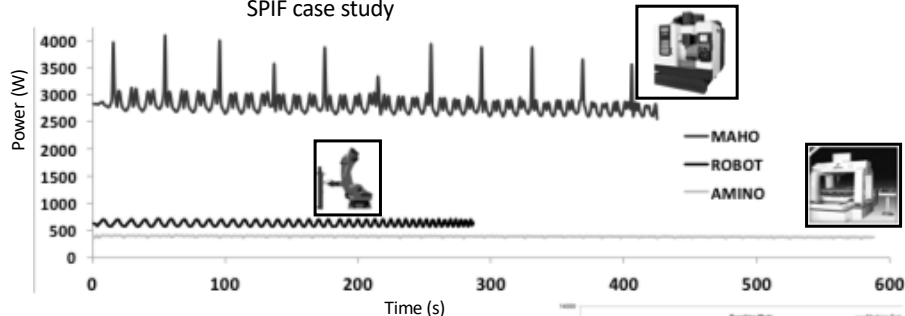
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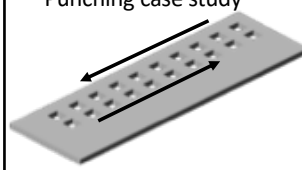


Environmental impact analysis at unit process level
Electrical energy demand analysis

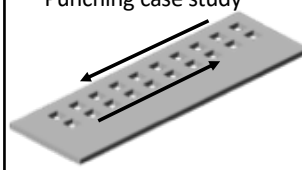
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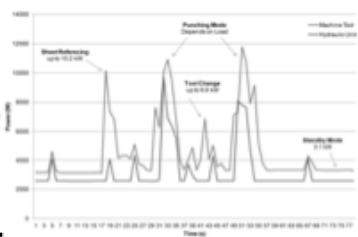
SPIF case study





Punching case study







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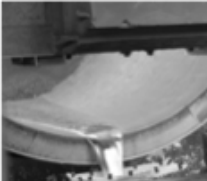


Innovative solid state recycling

The case of aluminum alloys



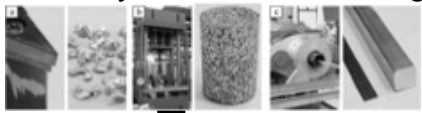
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Traditional remelting

vs

Secondary solid state remelting



Modelling effort

Process	Energy [MJ/kg]	CO ₂ Emissions [kg/kg]
Cold compacting	0.26	0.01
Heating	2.32	0.13
Extrusion	2.89	0.51
Extrusion Material Efficiency	75%	



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Innovative solid state recycling

□ Ecological recycling of AA-7075



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Process	Embodied Energy (MJ/Kg)	Recycling Rate (r)
Primary	202	-
Secondary Remelting	34.3	95%
Secondary Solid State	7.3	100%



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Innovative solid state recycling



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☐ Material related Environmental impact reduction

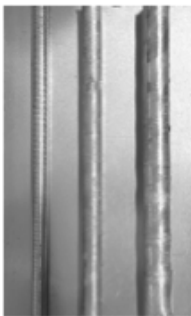
Solid state recycling approach: friction stir extrusion process for recycling magnesium as well as aluminum alloys chips



Temperature (C)



22.7 Min
347 Max



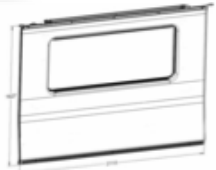
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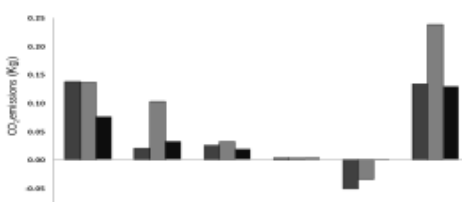


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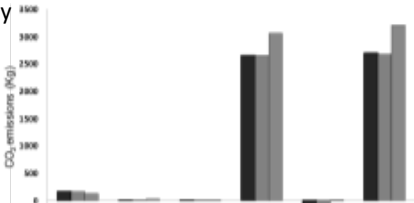
LCA based analyses for green material selection

☐ Train window panel case study



Material	Manufacturing	Transport	Use	Credit End	Total
PS	0.137	0.005	0.005	0.002	0.150
SL	0.135	0.005	0.002	0.008	0.150
PP	0.076	0.002	0.008	0.008	0.100



Material	Manufacturing	Transport	Use	End of life	Total
PS	208.80	3.80	0.30	2651.30	3064.20
SL	108.80	3.80	0.30	2651.30	2866.20
PP	108.80	21.40	0.30	8086.90	8217.40

Food packaging case study





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Environmental impact comparison of manufacturing approaches

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LCA based analyses

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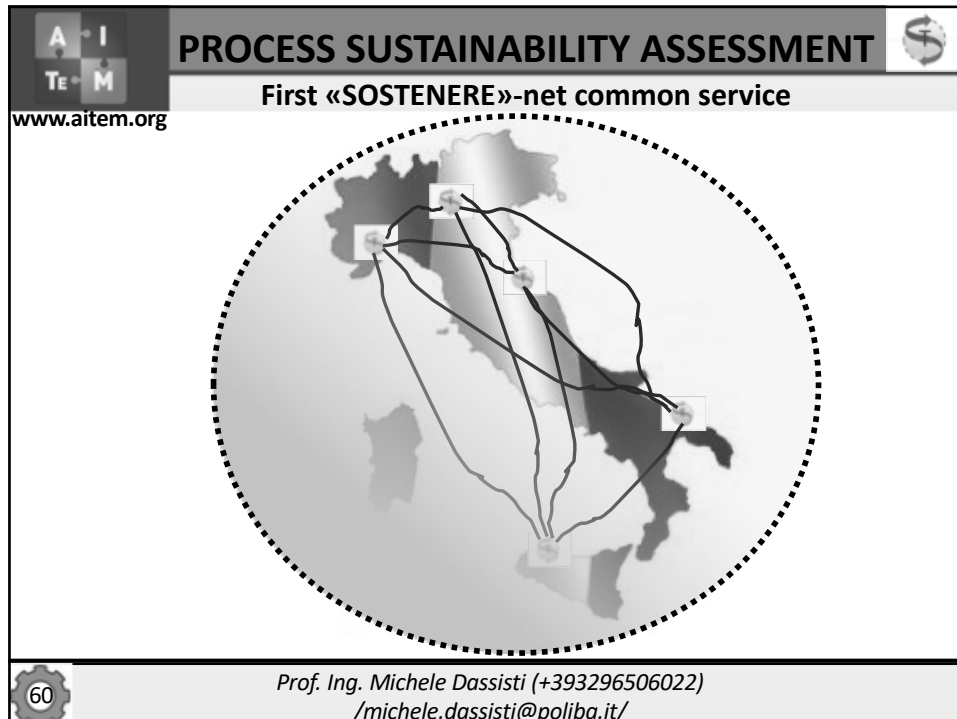
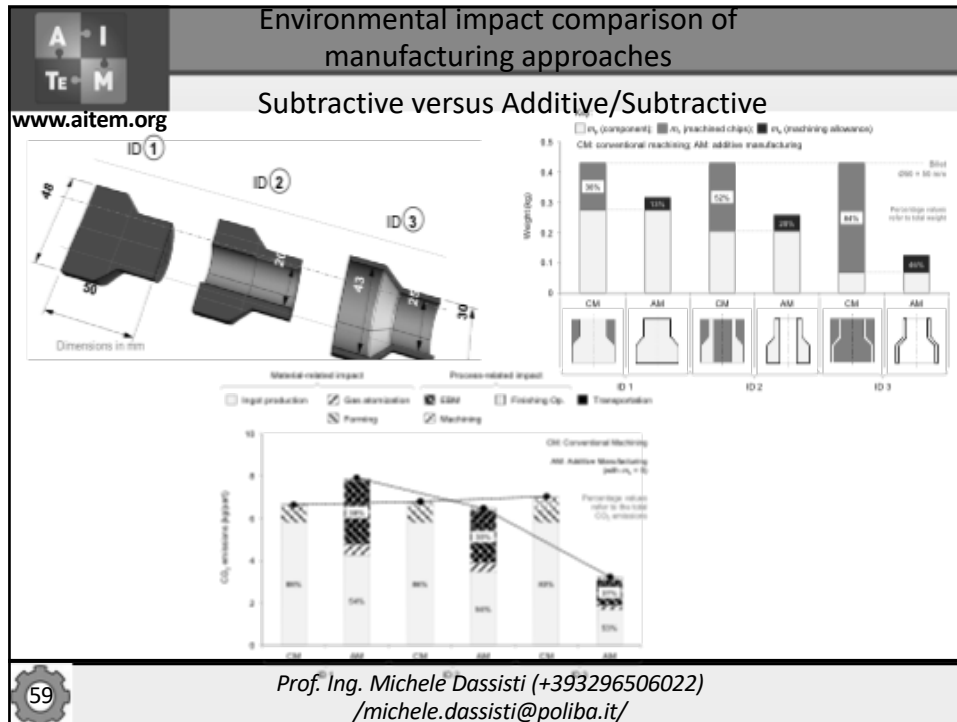
Environmental impact comparison of manufacturing approaches

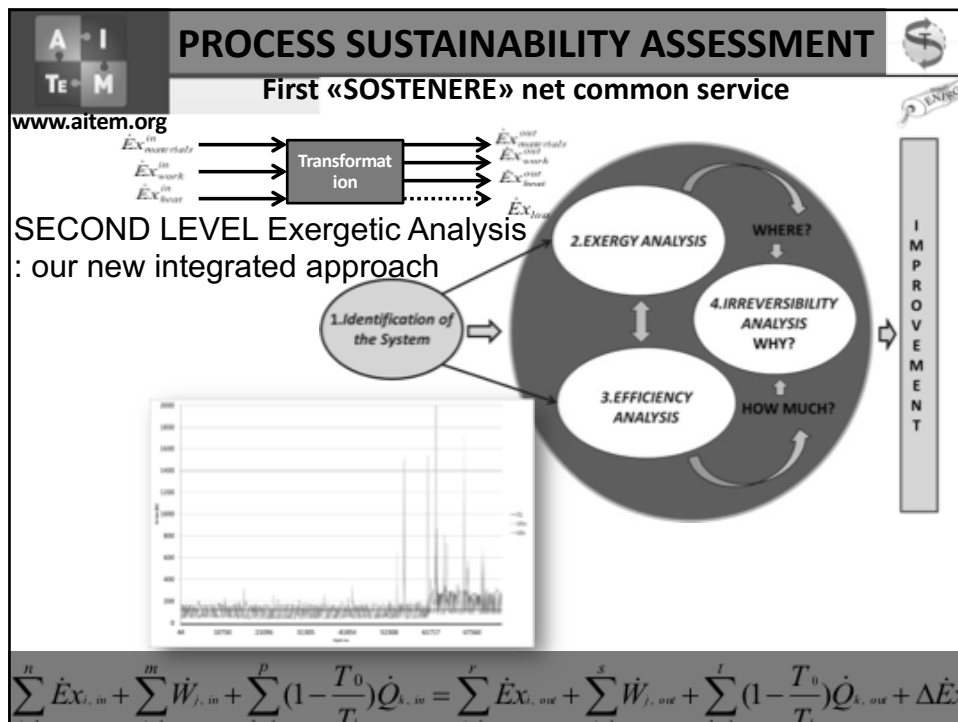
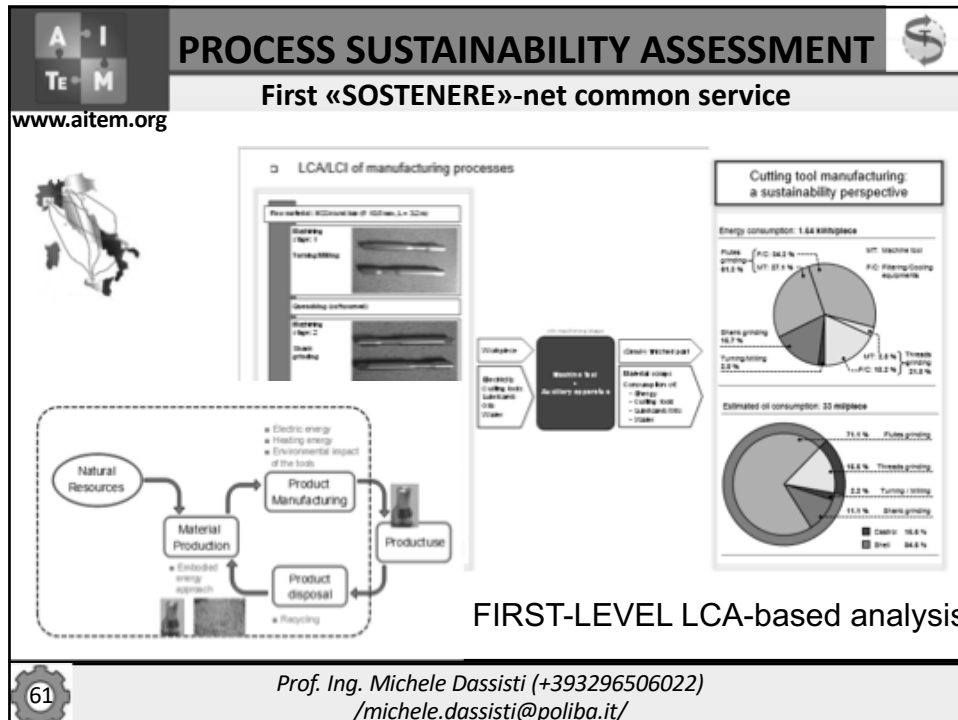
Subtractive versus mass conserving

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Cooperations



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- ITIA CNR Cluster Fabbrica Intelligente
- Shanghai Jiao Tong University – Shanghai (Supervision of PhD thesis (Frigerio Nicola), Energy Saving Control Policies in Automated Transfer Lines, thesis under development (fourth year), Politecnico di Milano, Department of Mechanical Engineering.”
- CTI, Center for Information Technology Renato Archer (CTI) di Campinas (BR), parte del Brazilian Ministry of Science, Technology and Innovation e ITIA-CNR hanno posto le basi per un accordo di cooperazione internazionale sul tema del riciclo di materiali ad alto valore da rifiuti elettronici.







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SUSTAINABLE MANUFACTURING



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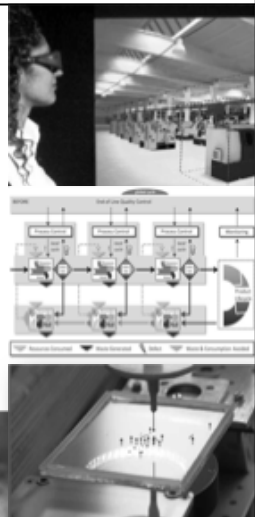


Future is not a measure of time,
it actually concerns imagination
and dreams!

(Beppe Cartella)



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Research Lines (RL)	
RL1: Solutions for personalized production RL2: Models and tools for sustainable production RL3: Valorization of workers in the factory RL4: Systems for high efficiency in production RL5: Innovative production systems RL6: Adaptable and reconfigurable systems RL7: Strategies and management for the next generation production systems	
	

	Research line & SOSTENERE	
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 		Strategies, methods and tools for industrial sustainability
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