

SUSTAINABILITY IN ADVANCED MANUFACTURING

Machine Tools and Production Systems

Alessandra Pighi

Area 3: Machine Tools and
Technological Processes Research Area



07/06/2012

Agenda

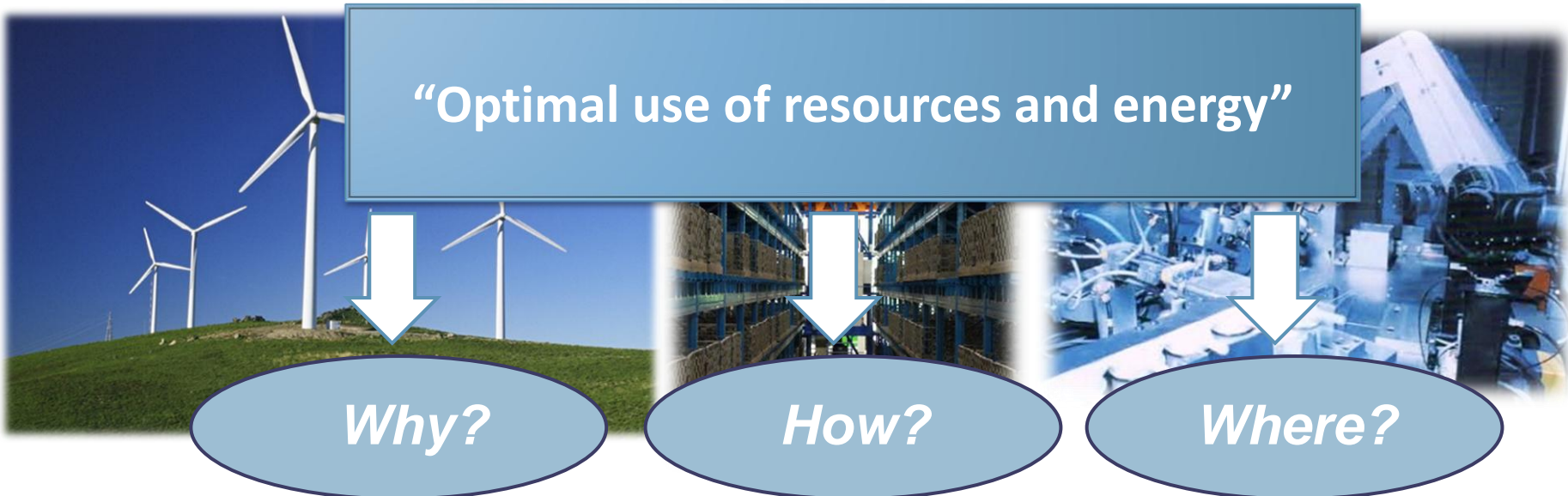
- **Sustainability in advanced manufacturing: *HOW? WHY? WHERE?***
- **The advanced manufacturing in Emilia – Romagna**
- **Energy consumption: Germany, Italy, Emilia – Romagna**
- **Sustainability in advanced manufacturing: *HOW? and WHY?***
- **Sustainability in advanced manufacturing: *WHERE?***
- **Conclusion and Questions**

Sustainability in advanced manufacturing: *HOW? WHY? WHERE?*

“From the maximization of profit with minimal investment”



“Optimal use of resources and energy”



Why?

How?

Where?

The advanced manufacturing in Emilia – Romagna

<u>NUTS2 region</u>	<u>Regional GDP of Industry (excluding construction); million €</u>	<u>Total population</u>	<u>Industry on the regional total GDP (%)</u>
Lombardia	82.869,6	9.642.406	25,25
Stuttgart	49.356,3	4.007.095	34,04
Île de France	48.623,0	11.659.260	8,71
Oberbayern	40.273,1	4.313.446	22,06
Cataluña	38.637,6	7.238.051	19,05
Veneto	37.882,9	4.832.340	25,36
Düsseldorf	37.251,1	5.208.288	20,77
Emilia-Romagna	34.228,4	4.275.802	24,68
Southern and Eastern	33.351,3	3.222.055	22,81
Rhône-Alpes	30.299,0	6.117.229	16,17

The advanced manufacturing in Emilia – Romagna

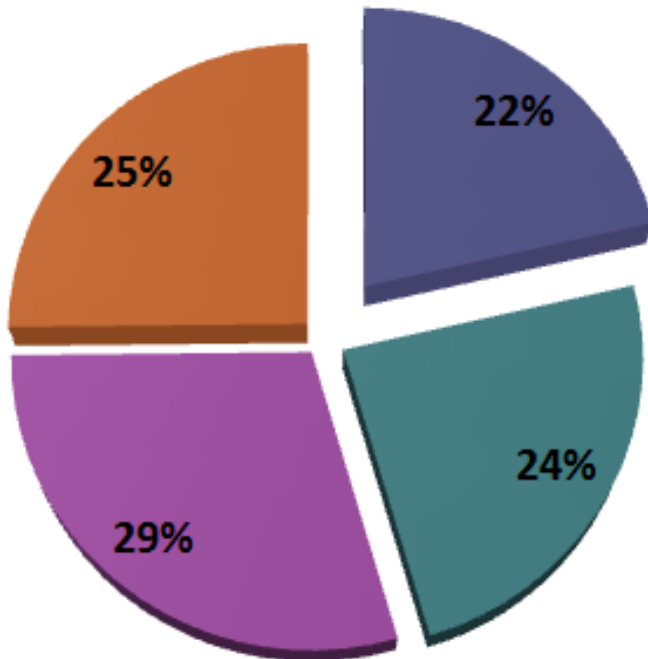
<u>NUTS2 region</u>	<u>Employees in manufacturing</u>	<u>% of total employment in the region</u>
Bayern	1.978.100	31,4
Lombardia	1.509.100	35,1
Cataluña	950.400	29,8
Veneto	810.800	38,4
Île de France	778.600	14,8
Slesia	755.000	40,7
Stuttgart	752.600	37,3
Rhône-Alpes	684.900	26,7
Emilia-Romagna	666.900	34,1
Düsseldorf	631.500	27,2

Energy consumption: Germany – Italy

Total energy consumption

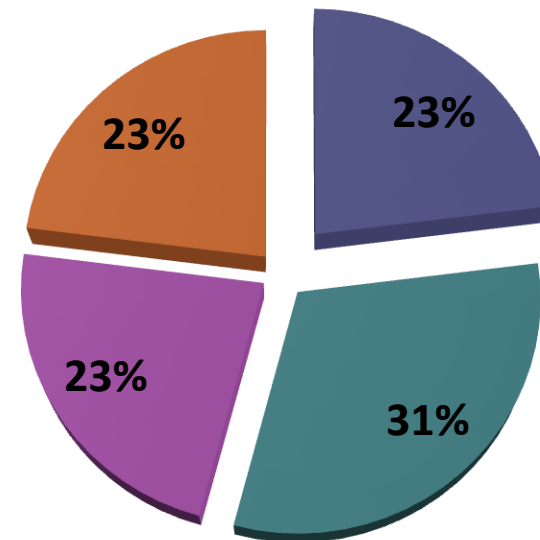
GERMANY

590 000 GWh/year (2009)



ITALY

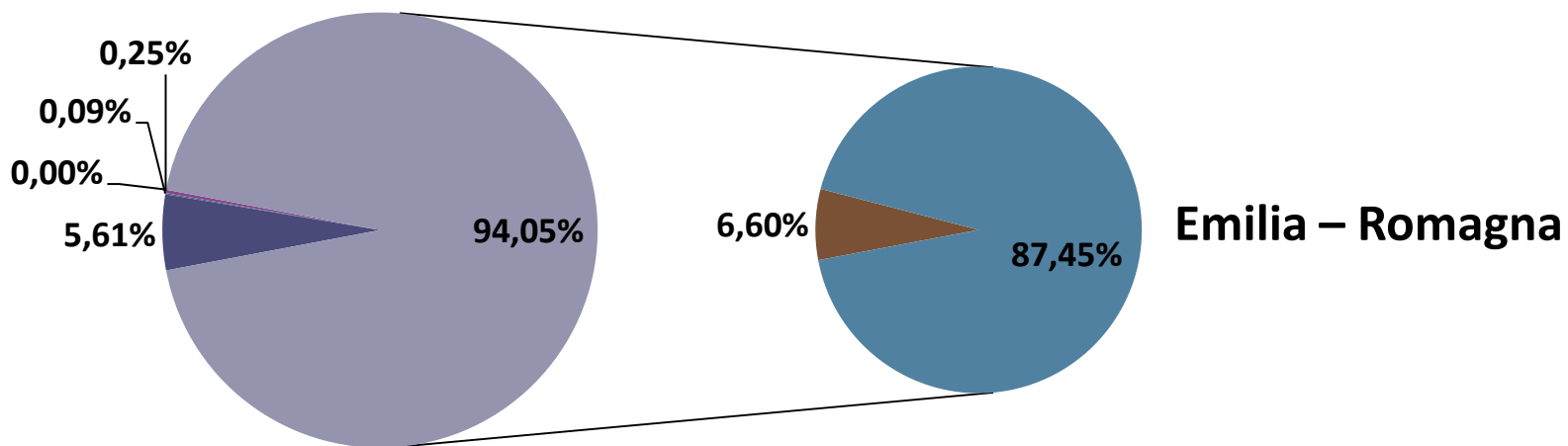
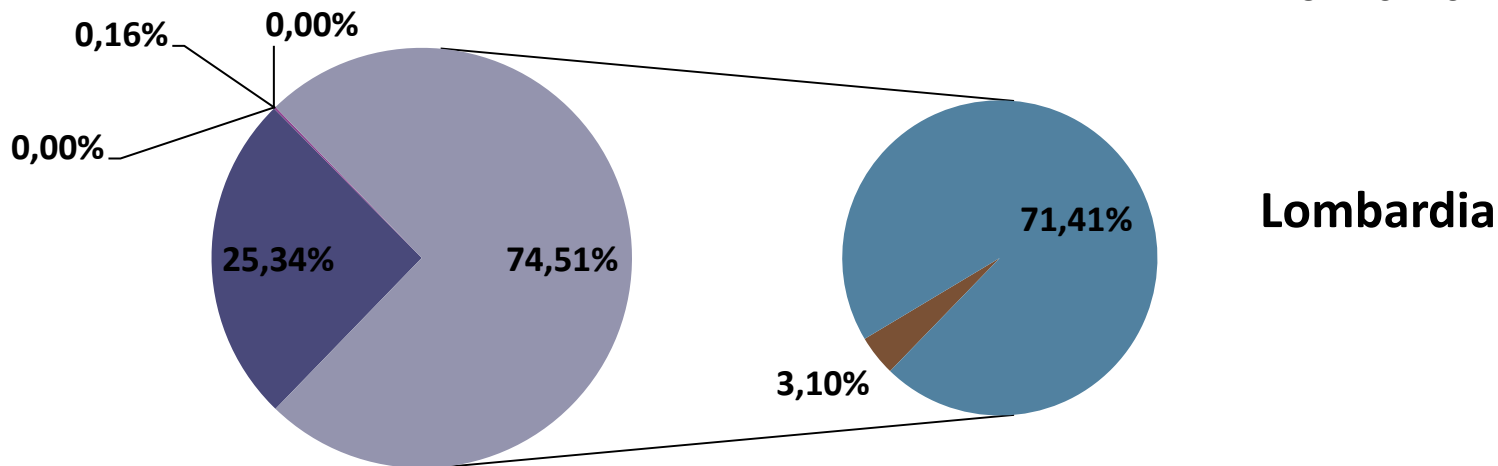
280 000 GWh/year (2009)



■ Industry ■ Transport ■ Home ■ Others (Agriculture, Services, etc.)

Energy consumption: Emilia – Romagna

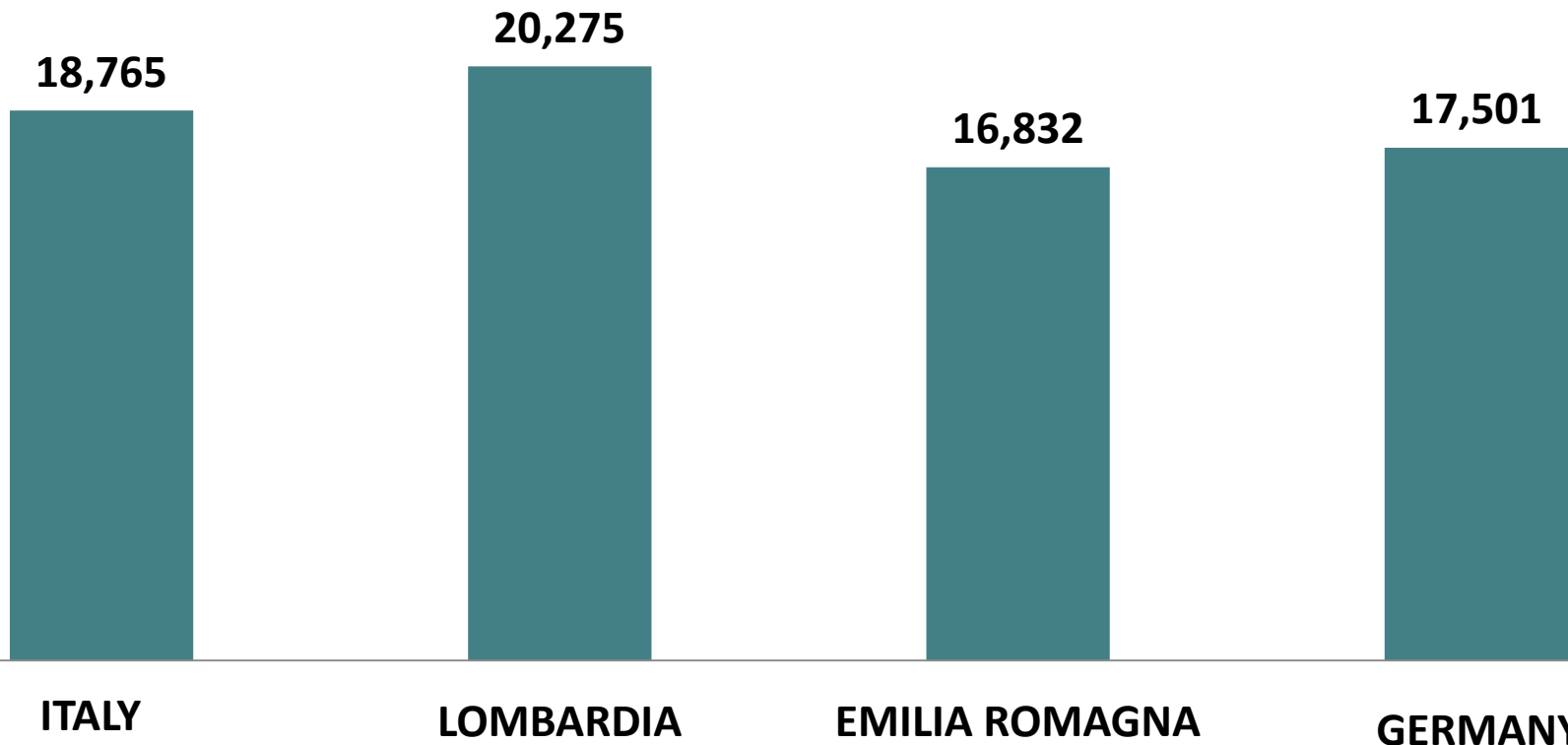
■ IDROELECTRIC
 ■ WIND
 ■ PHOTOVOLTAIC
 ■ GEOTHERMAL
 ■ BIOMASS
 ■ OTHER THERMOELECTRIC



Energy consumption: Germany, Italy, Emilia – Romagna

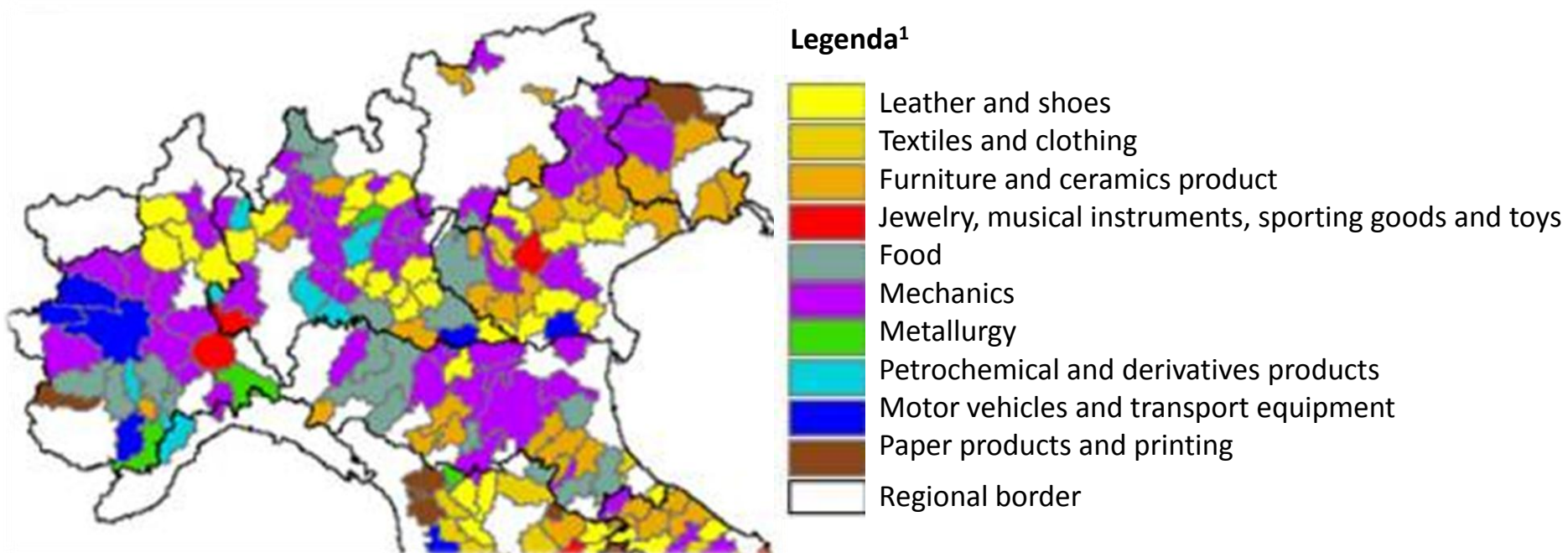
Electrical energy consumption in industry

■ MWh/employee/year



Summary:

- **Manufacturing sector is a significant part in the regional national and European economy and it is currently not replaceable.**
- **Except for limited exceptions, Emilia – Romagna region is not characterized by production significantly "energy intensive" (steelworks etc.).**



¹ Russo M., Pirani E., Paterlini s., The mechanic industry in Italy: a cluster analysis of regional differences, 2006

Summary:

Actions:

- ✓ ***HOW AND WHY? Technological interventions on the production process: saving energy and material resources***
- ✓ ***HOW AND WHY? Ecodesign Directive 2005/32/EC is a framework provided by the European Union, which is also relevant for production engineering***
- ✓ ***WHERE? Reshoring initiatives VS Offshoring initiatives***

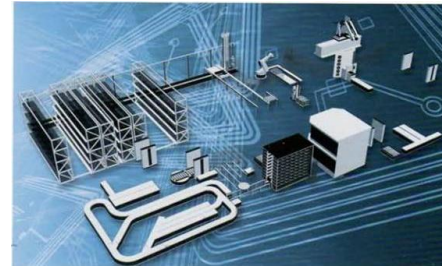


HOW and WHY Sustainability in Manufacturing

✓ *Energy efficiency in production*



Processes



Machines



Materials



HOW and WHY Sustainability in Manufacturing

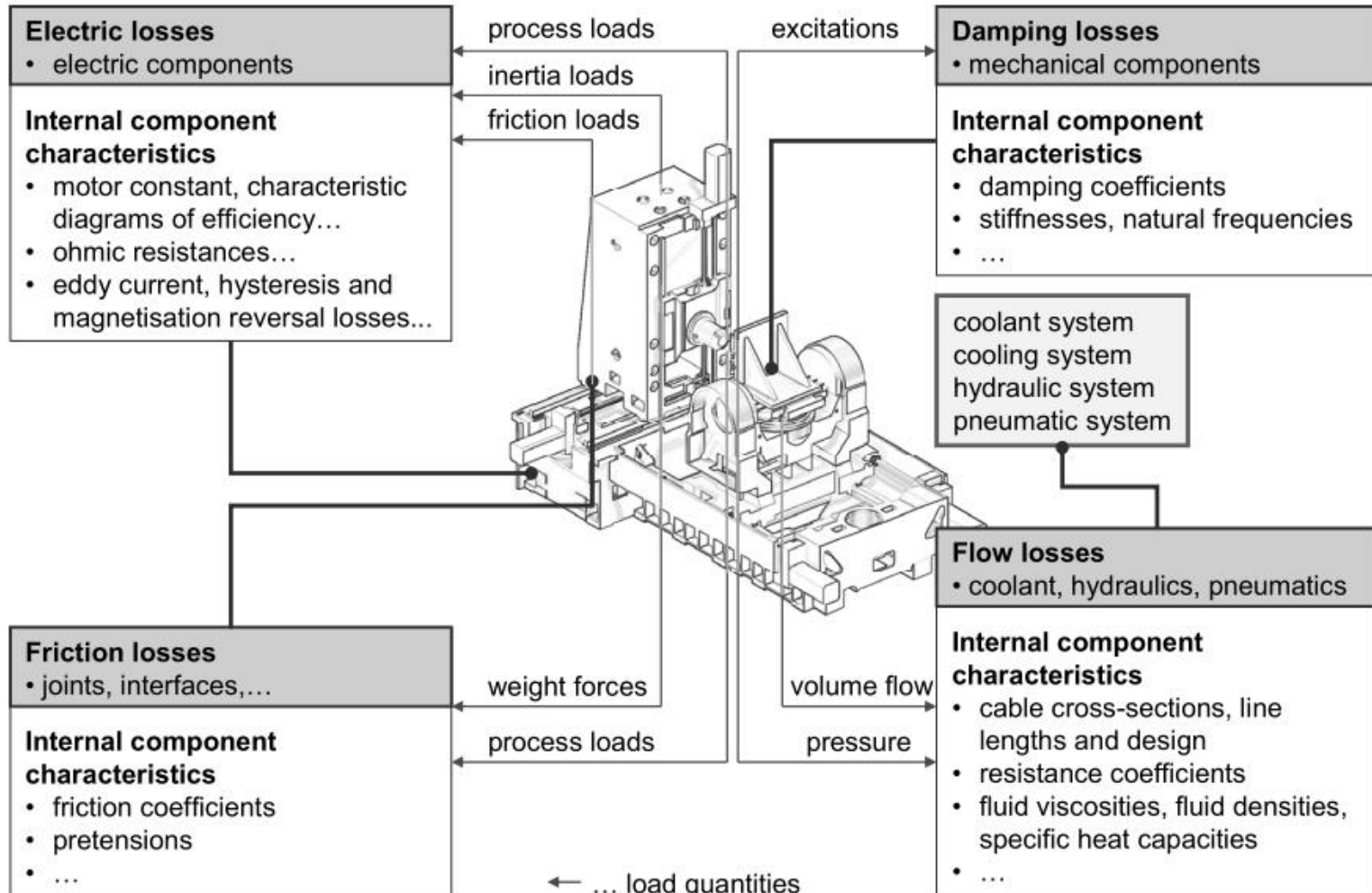
- ✓ **Energy efficiency in production: optimization of energy consumption of the PROCESS**

Only 4% of energy used is due to mechanical processes, and more than 55% of energy is spent in stand-by phases.



HOW and WHY Sustainability in Manufacturing

✓ *Energy efficiency in production: optimization of energy consumption of the MACHINE¹*



¹ Neugebauer R., Wabner M., Ihlenfeld S., Frieß U., Schneider F., Schubert F., Design Principles Inspired by Bionics for Energy Efficient Machine Tools, ICMC 2012

HOW and WHY Sustainability in Manufacturing

✓ *Energy efficiency in production: optimization of MATERIALS*



How and Why optimization?

If there are rejects at the end of a machining process chain, one kilogram of component mass correspond to an energy loss of 60 to 80 MJ

Every kilogram of steel saved in production corresponds to 6 to 21 MJ of energy saved



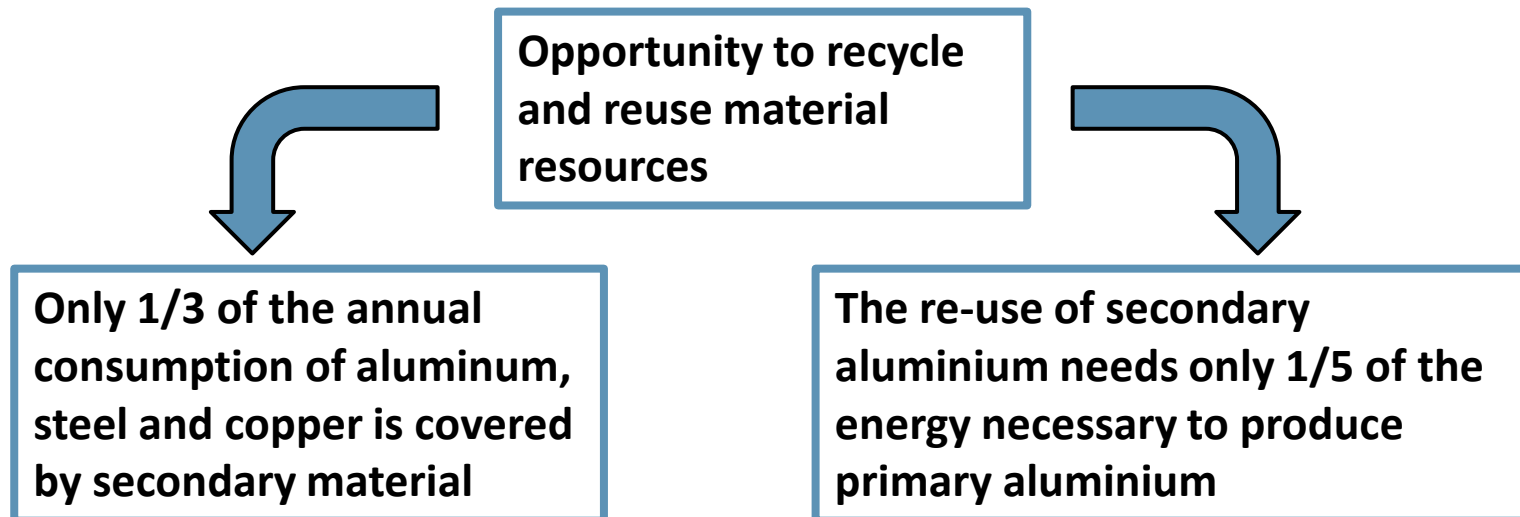
80 MJ allow to feed 100 light bulbs of 60 W for about 4 h

HOW and WHY Sustainability in Manufacturing

✓ **Energy efficiency in production: optimization of MATERIALS**



How and Why optimization?



WHERE Sustainability in Manufacturing

✓ *Reshoring initiatives in the U.S.A.*



Reshoring Initiative

Bringing Manufacturing Back Home

Main sponsors:



WHERE Sustainability in Manufacturing

Top reasons for companies to reshore:

- Reduces Total Cost of Ownership
- Improves quality and consistency of inputs
- Reduces pipeline and surge inventory impact on just-in-time operations
- Clusters manufacturing near R&D facilities, enhancing innovation
- Reduces intellectual property and regulatory compliance risk
- Eliminates the waste and instability caused by offshoring
- Strengthens companies' ability to respond quickly to customers' demands

Top reasons for the nation to reshore:

- Brings jobs back to the U.S.
- Helps balance U.S., state and local budget
- Motivates recruits to enter the skilled manufacturing workforce
- Strengthens the defense industrial base

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 **Conclusion and Questions**

Conclusion and Questions

Sustainability in advanced manufacturing: *HOW and WHY?*

How and Why?

- *Do you think that the design of the production process on the basis of energy efficiency is a real opportunity for the growth and the competitiveness of the final product?*
- *Has your company ever considered the possibility to adopt energy efficiency policies in production processes? What kind of actions have been done?*

Conclusion and Questions

Sustainability in advanced manufacturing: *WHERE?*

Where?

- *How is the production of your company organised ? Are you used to bring the production offshore or do you prefer reshoring initiatives?*
- *Do you think that the reshoring initiatives, recently promoted by some companies in the U.S.A., are valid solutions for the development of companies and countries? What are the aspects that might encourage/discourage the phenomenon?*

LABORATORIO MUSP

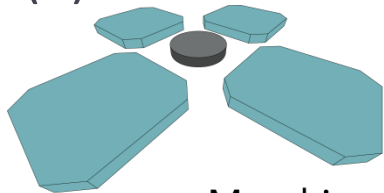
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Thank you!

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