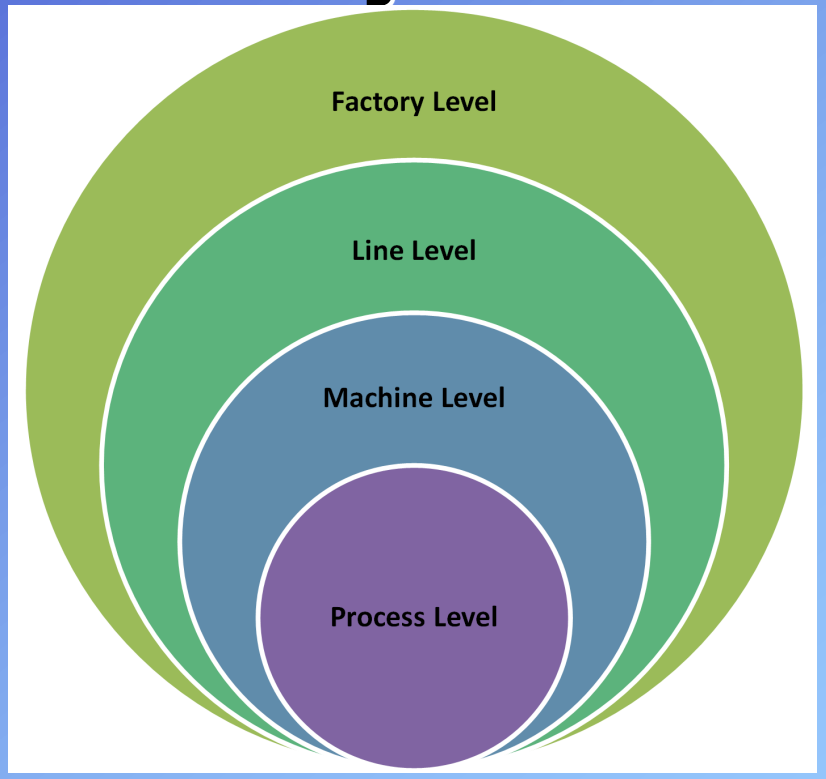
Manufacturing Processes Modelling and Energy Efficiency

Energy Efficiency in Manufacturing

- **Energy consumption is related with a series of mechanisms of completely diverge nature**
- **It is necessary to divide the study of energy efficiency into several different levels**
- **Study the most important factors for each level**



- **The process level concerns the study of energy losses by the physical mechanisms that are relative to the process itself.**
- **At machine level, energy losses are due to the process itself, as well as to a series of peripherals, dedicated to different aspects of the process.**
- **At both the production line level and the entire factory level, the energy efficiency is mainly a function of production planning and the entire scheduling.**

Characteristics:
- Large Working Volumes (up to 2 m^3)
- High laser moving speeds (up to 17 m/s)
- High production rates (typically 60 welds/min)
- Inclined welds are realised

REF: Fysikopoulos A., Papacharalampopoulos A., Pastras G., Stavropoulos P., Chryssolouris G. (2013) "Energy Efficiency Issues of Manufacturing Processes", *(CIRP CMS 46) Procedia CIRP, 46th CIRP Conference on Manufacturing Systems*, Sesimbra, Portugal Volume 7, pp.628-633

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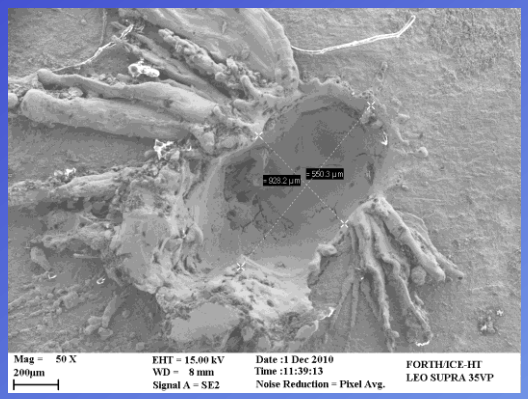
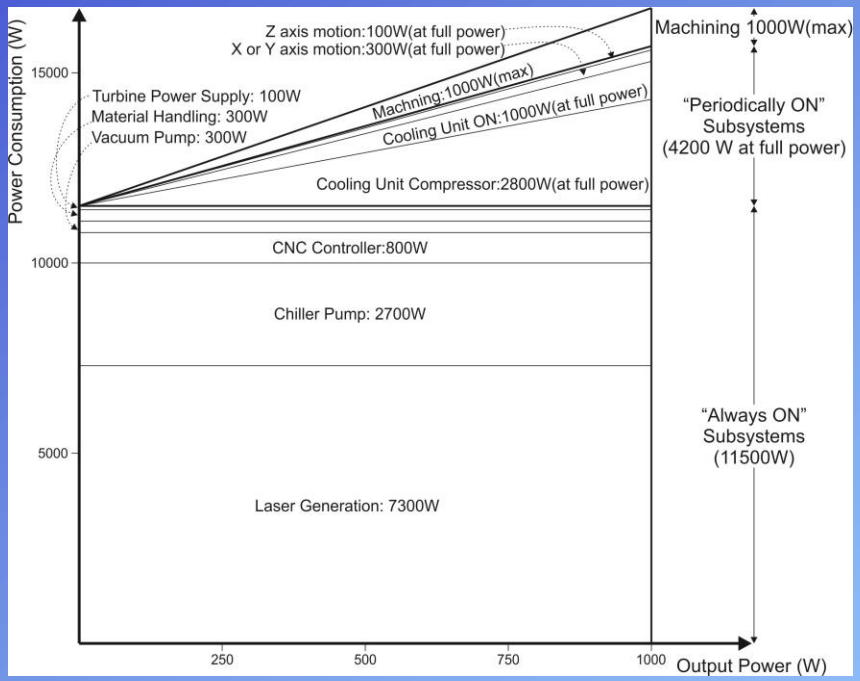
Energy Efficiency at Machine Level: Laser Drilling Case Study





- **Identification of the process parameters window with the most energy efficient performance and the introduction of processing strategies for low laser power (100-1000W) drilling processes**
- **Higher laser power results in improved energy efficiency**
- **The higher pulsing frequency improves the energy efficiency**
- **Laser beam generation demands much higher amounts of energy than the energy of the beam itself.**
- **In order for the machine's overall energy efficiency to be analyzed, indirect effects, such as the beam focusing quality, the positioning system efficiency and the requested time for setting up the laser beam, should also be taken into account.**

REF: Fysikopoulos A., Stavropoulos P., Salonits K., Chryssolouris G (2012) "Energy Efficiency Assessment of Laser Drilling Process", *(LANE 2012) Laser Assisted Net shape Engineering 7*, *Physics Procedia*, Volume 39, pp. 776-783