Planet (Environment)-Lean

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Chief Operating Officer

COO activity always involves three elements

Continuous Improvement/Operational Excellence

Sustainability: Profit People Planet

Digitalisation: Technology

A key lever for improving sustainability is to fight waste:

50% of water captured in Italy is wasted while distributing and does not reach the end users

30% of food produced in the world is wasted before reaching the end user, or wasted by the end user

G20- more than 50% of energy in the world is produced using fossile sources. If we reduced energy consumption by 15% we could reduce fossile produced energy by 30%

Environmental Protection Agency

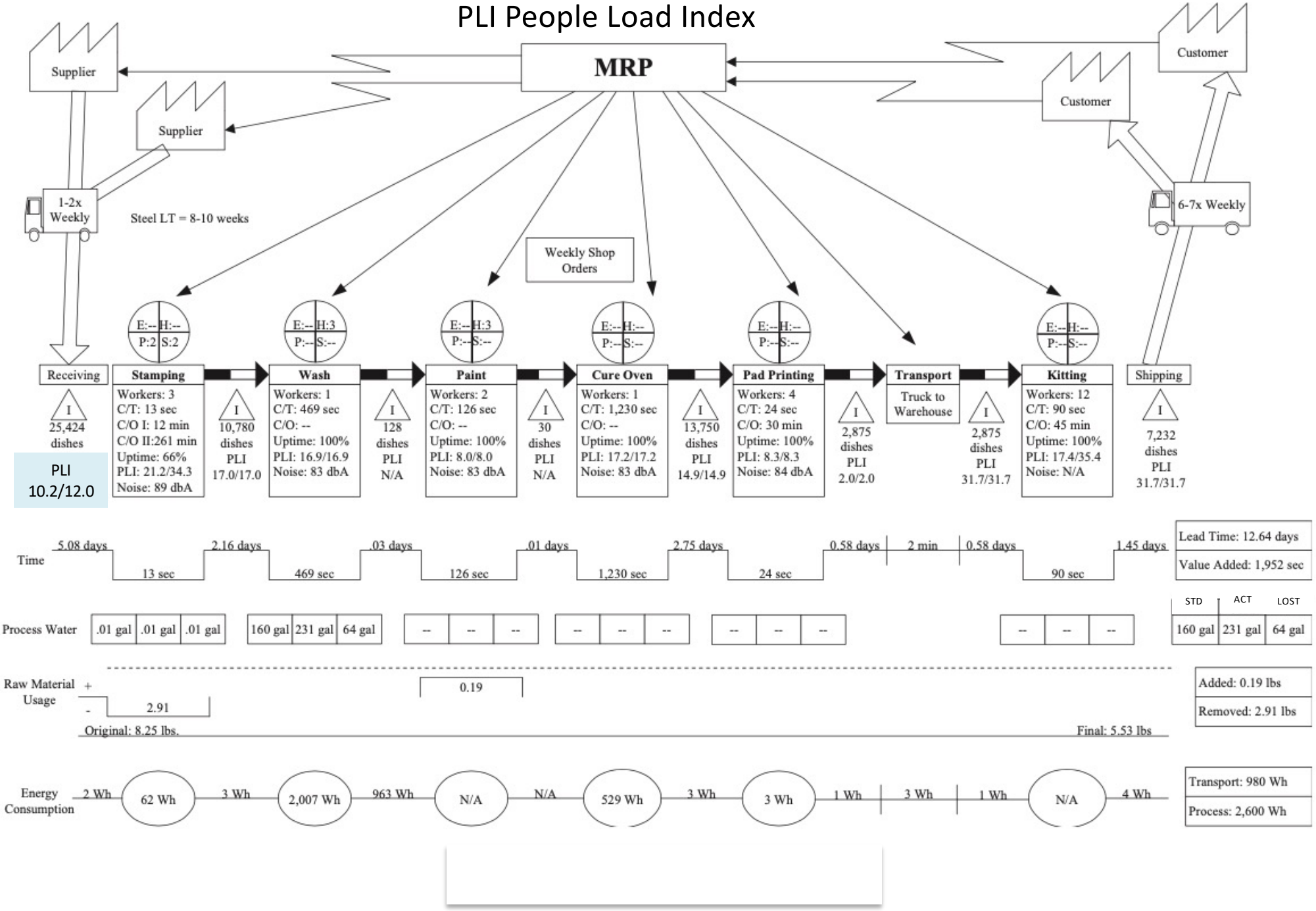
Environmental Protection Agency of USA is promoting Lean as the main approach to support companies in reducing the environmental impact of their activities

https://www.epa.gov/sustainability/lean-environment-toolkit-content-acknowledgments

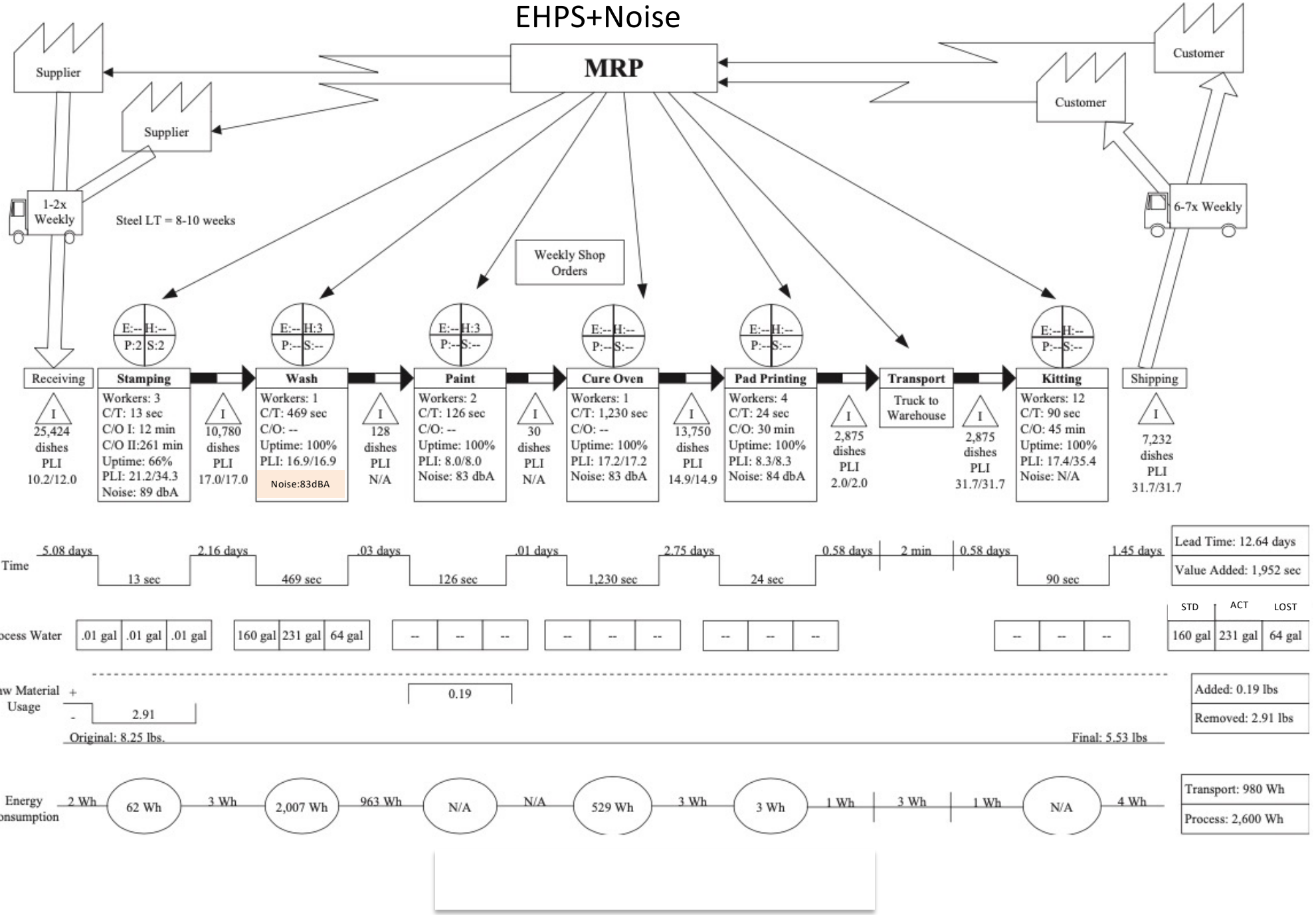
Sustainable Value Stream Mapping

VSM can be effectively adopted to map the main elements related to Sustinability

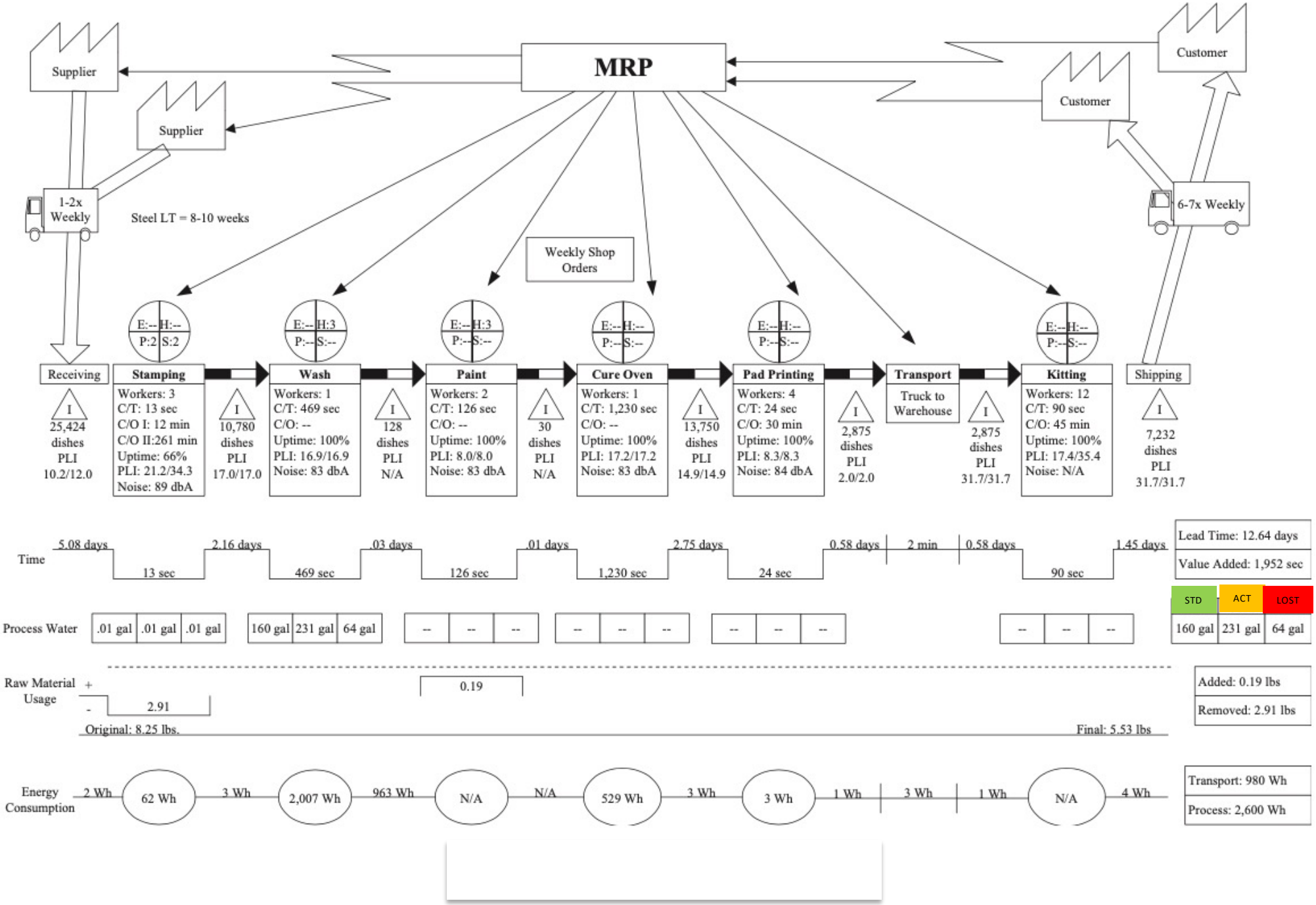
People (ergonomics)
PLI People Load Index



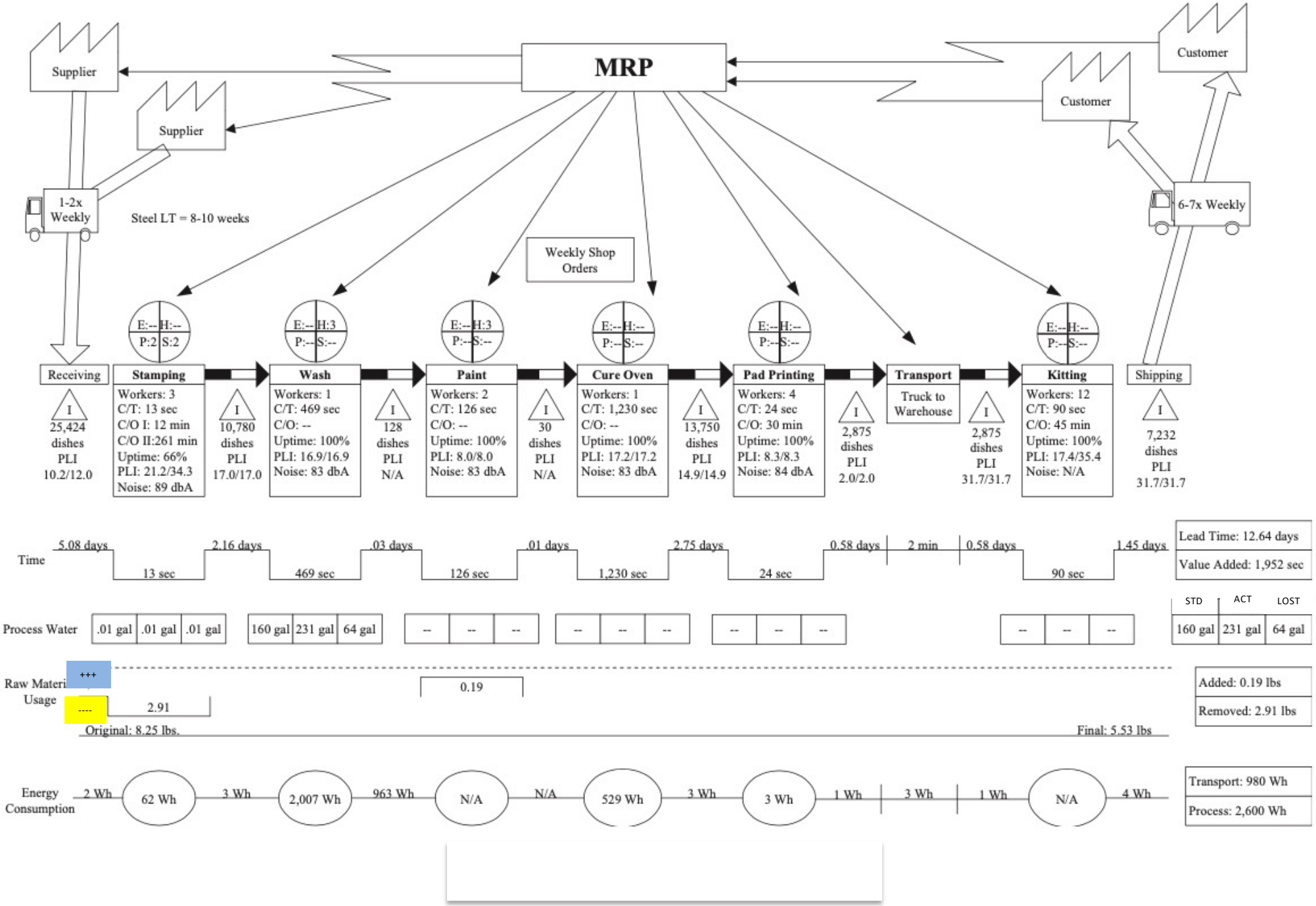
Working Environment
EHPS+Noise



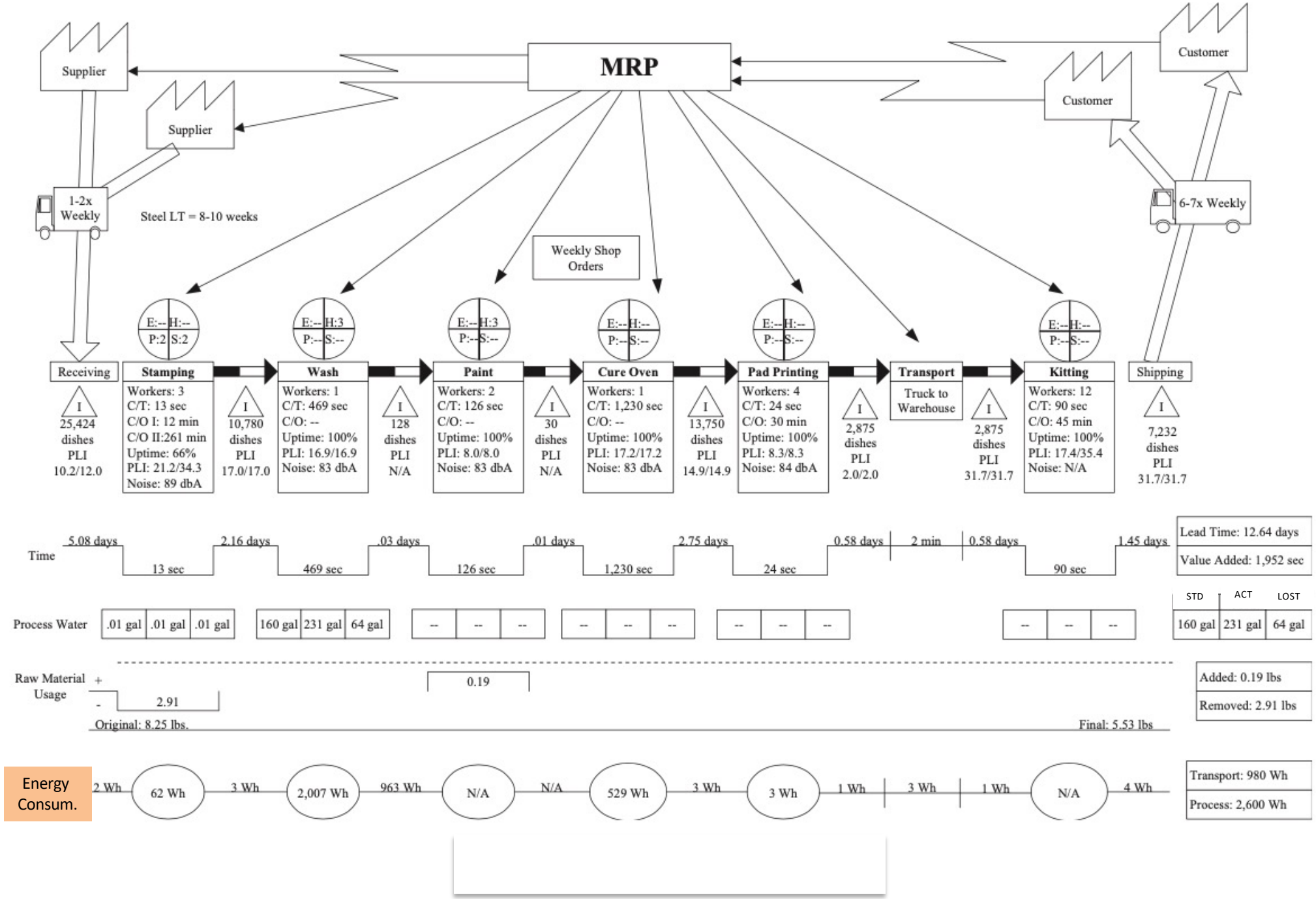
Water consumption



Material consumption



Energy consumption



Example: Baxter International Healthcare Corporation

Baxter Healthcare Corp., a worldwide leader in manufacturing global medical products, adopted a number of Lean techniques to reduce its environmental footprint.

Baxter integrated environmental metrics with traditional Lean manufacturing tools, helping the company double in size and revenue while keeping total waste generation close to the levels of 10 years earlier.

Several company plants completed a value stream map (VSM) to find ways to reduce water and energy consumption.

One plant developed a VSM and implementation plans by walking through the production process and highlighting water usage and major processing steps. In the VSM, 96 opportunities were prioritized with many graphically represented by starbursts; these opportunities were also included in three future state VSMs. Through the VSM event, Baxter developed an action plan that should save $70,000 a year AND 600,000 liters of water per day.

A framework for modelling energy consumption within manufacturing systems

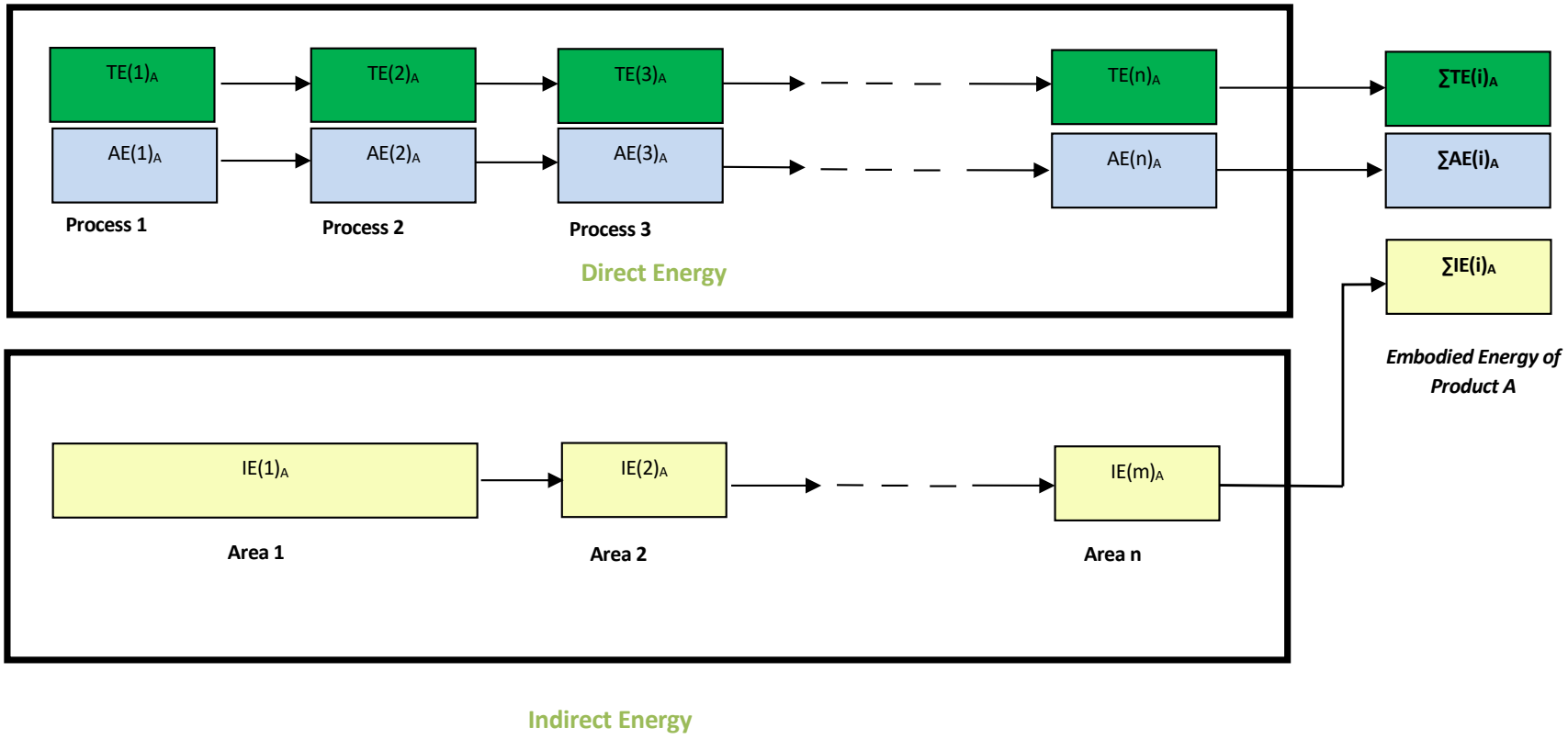
- ***Theoretical Energy (TE)**: refers to the minimum energy required to achieve (physically, or chemically) the final result. For example the energy required to melt a specific amount of metal during casting, or removing a specific amount of material during machining operations, or energy to make a chemical reaction happen;*
- ***Auxiliary Energy (AE)**: energy required by the supporting activities and auxiliary equipment of the process, for example generation of vacuum for sand casting, or pumping of coolant for machining. The AE also includes non-productive energy as for example the heat generated by the electric motors of a machine tool and, in general, all energy that the machine is not converting into the result of the process. And the one used for the machine tool start-up, set-up, stand by and cleaning*
- ***Indirect Energy (IE)**: energy consumed to ensure the correct workplace conditions for the productive processes such as lighting, heating and ventilation.*

Value Adding Energy (VAE) = Theoretical Energy

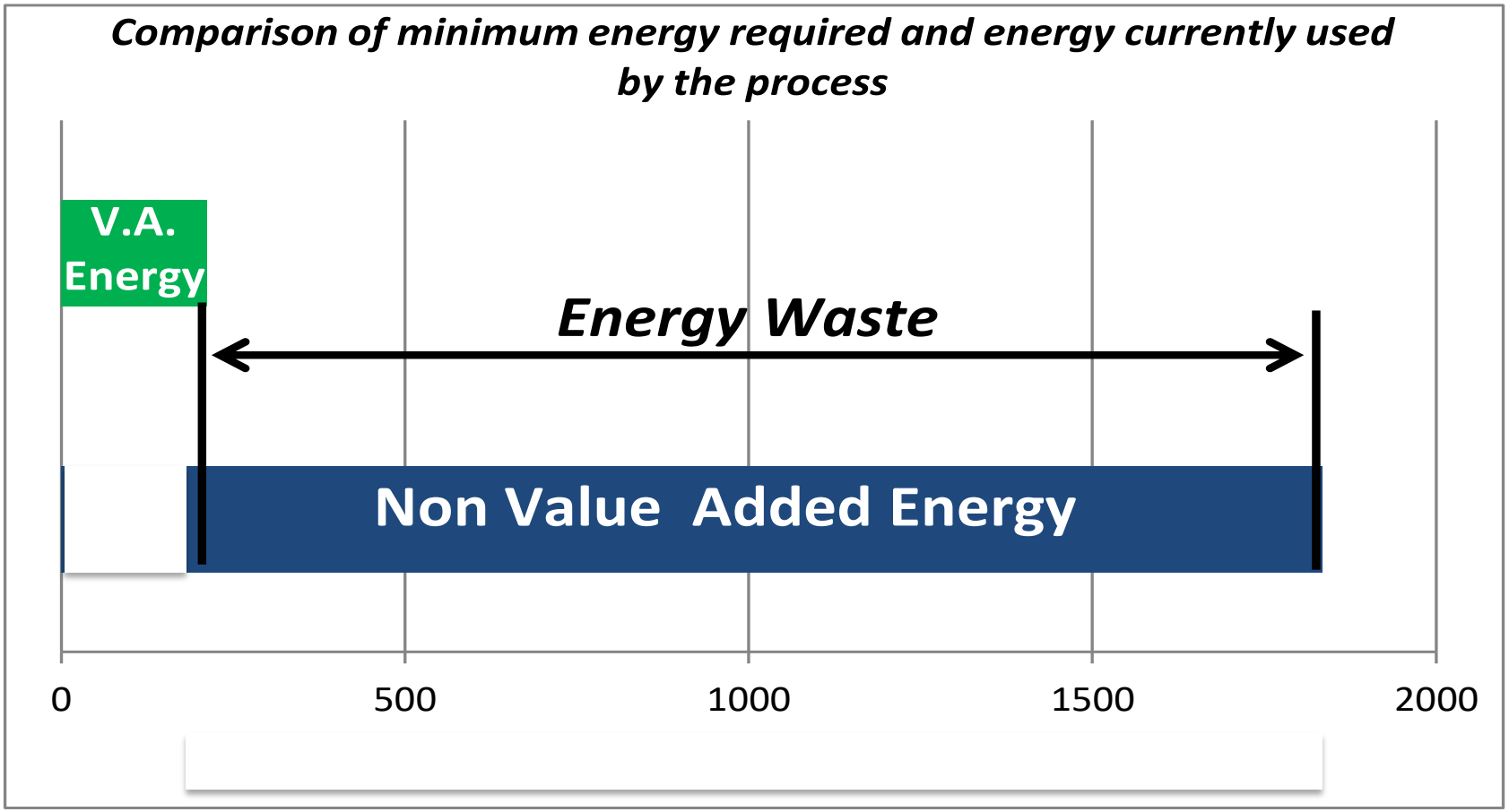
Energy used for doing all the activities that create value for customers

Non Value Adding Energy (NVAE) = Auxiliary Energy + Indirect Energy

Energy consumption related to the Non Value Adding Activities.

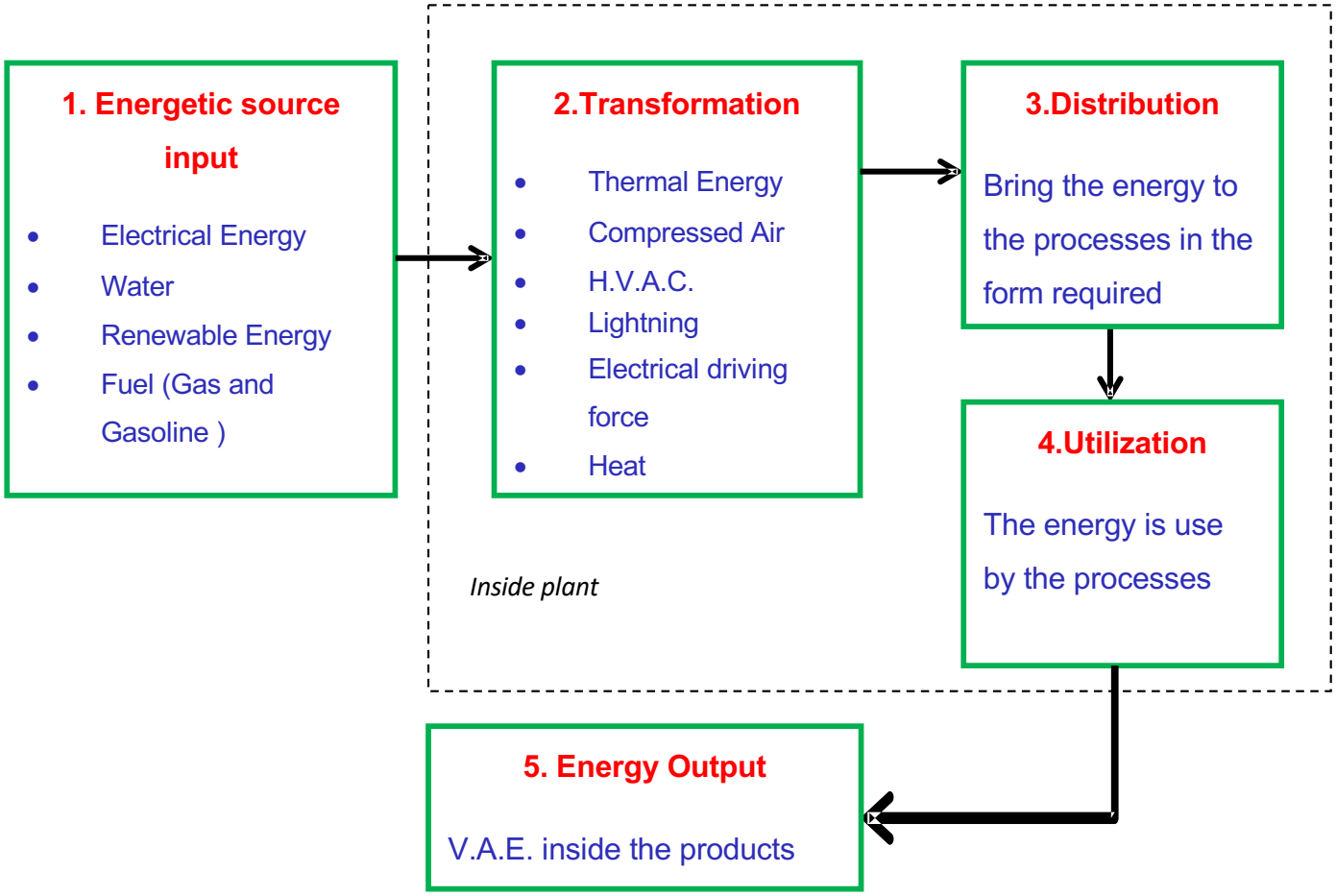


Energy Value Ratio = Value Adding Energy [TE] / Total Energy Used [TE+AE+IE]


Comparison of minimum energy required and energy currently used by the process
V.A. Energy
Energy Waste
Non Value Added Energy
0
500
1000
1500
2000

TDU Framework

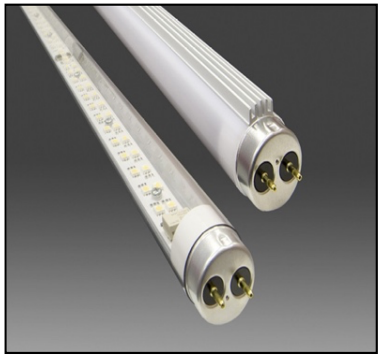
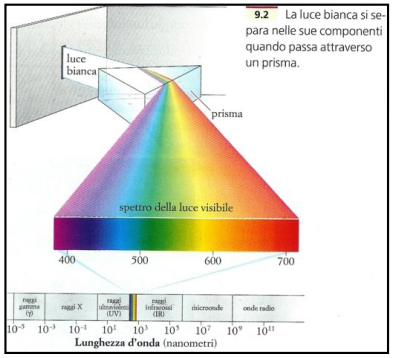
The ***T.D.U.*** framework is based on an important assumption: the utilities used inside a manufacturing plant pass through three phases *Transformation, Distribution and Utilization.*


1. Energetic source input
Electrical Energy
Water
Renewable Energy
Fuel (Gas and Gasoline)
2.Transformation
Thermal Energy
Compressed Air
H.V.A.C.
Lightning
Electrical driving force
Heat
3.Distribution
Bring the energy to the processes in the form required
4.Utilization
The energy is use by the processes
Inside plant
5. Energy Output
V.A.E. inside the products

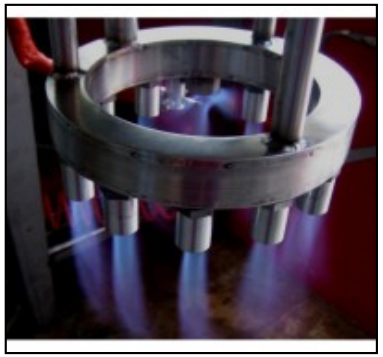
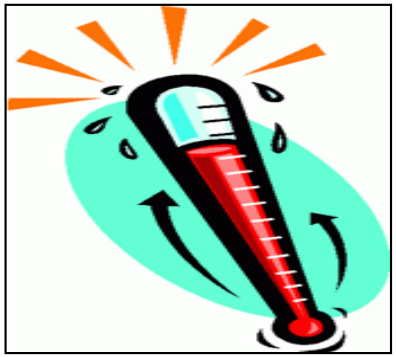
Compressed Air

Transformation	Distribution	Utilization
		

Lighting

Transformation	Distribution	Utilization
		
The bulb transforms the electric energy into light	The lamp, spreads the light on the work space	The result is an adequate illumination of the work space

Thermal Energy

Transformation	Distribution	Utilization
		
The burner transforms the fuel (gas or electricity)into heat	The heat is distributed inside the plant by an appropriate suitable mean (e.g. steam)	Heat can be used for treatment process

Electric Driving Force

Transformation

The transformer switch the electric energy in input from high voltage to middle

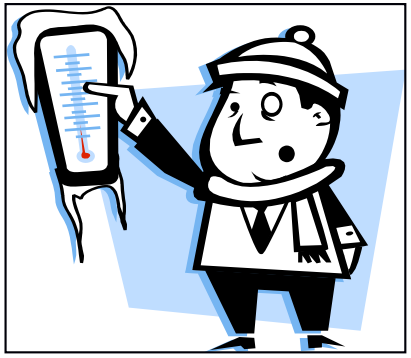
Distribution

The electric bar bring the electrical driving force to the equipment

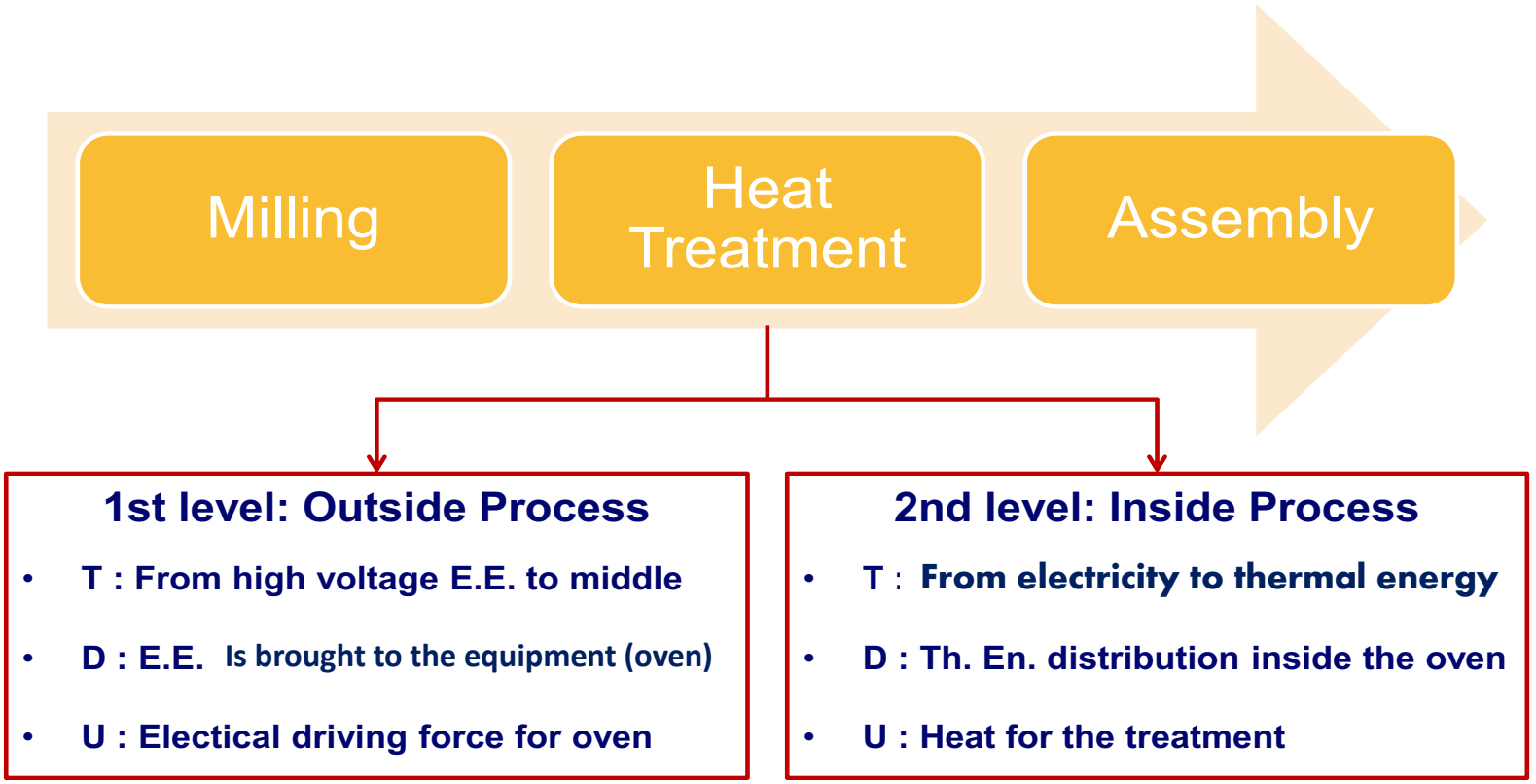
Utilization

Electrical driving force it's used by the equipment

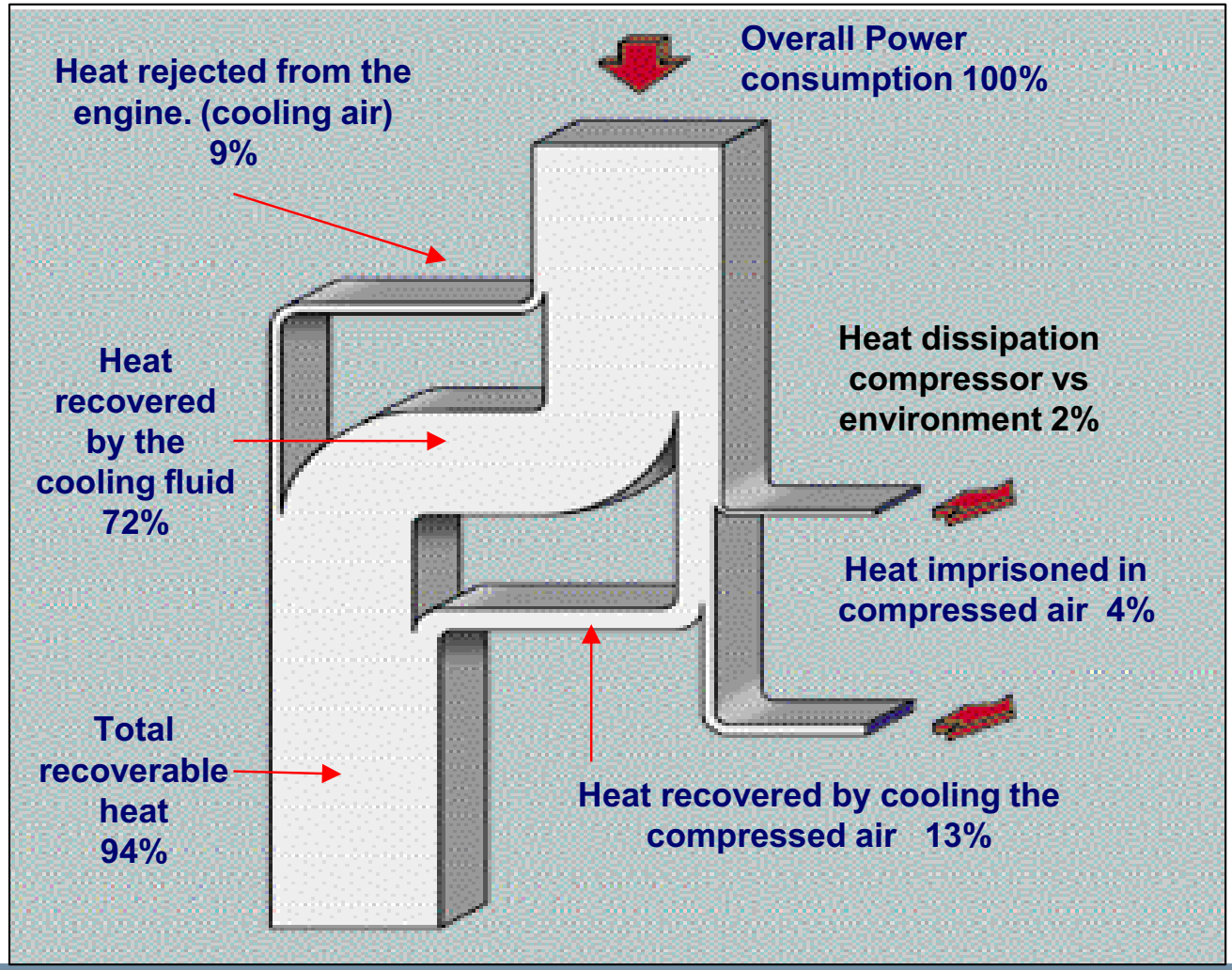
Heating Ventilation Air Conditioning

Transformation	Distribution	Utilization
		
The boiler or the blue box use electricity to obtained hot / cold water	Different type of split spread hot / cold air	An increase / decrease of the workplace temperature is obtained

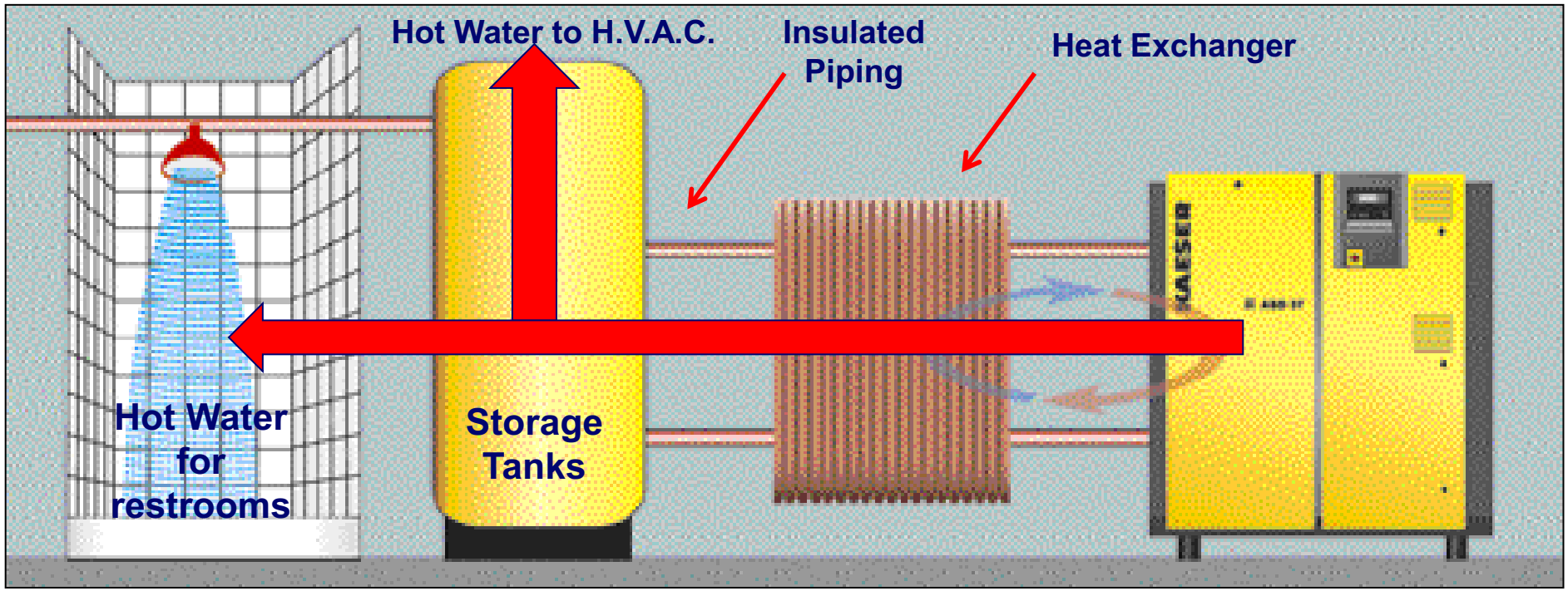
Heat treatment



Compressed Air



Transformation



Distribution (leakages)

Diameter of hole	Air leak at 6 Bar [l/s]	Air leaks at 12 Bar [l/s]	Loss of energy in kWh at 6 Bar	Loss of energy in kWh at 12 Bar	Leak costs at 6 Bar [EUR]	Leak costs at 12 Bar [EUR]
1	1,2	1,8	0,3	1,0	104	345
3	11,1	20,8	3,1	12,7	1072	4390
5	30,9	58,5	8,3	33,7	2868	11646
10	123,8	235,2	33,0	132,0	11405	45620

Costs are extimated as follows:***kWh x 0,06 [€/kWh] x 5760[h]*** (24/7 240 days/year)

Utilisation

Are there concentrated air leak on your equipment?

- *Improve a monthly self - inspection for mapping air leaks in the different departments of the plant.*
- *Develop a procedure for closing the air valves by the operators at the end of the shift.*

These activities help the company to improve its energy culture, monitoring the status of the machines and solve the problem in the starting point.

Is the Venturi effect used inside the processes ?

- *Replace the Venturi effect with a vacuum pumping system where is possible.*

*T*he Venturi's effect is one of the most energy expensive operation from the compressor point of view. A Vacuum pumping system ensure the same results with a lower energy consumption.

Reduce the pressure available on the blow gun.

Blow gun are often directly connected to the general distribution system when the pressure needed for their task is much lower

Use Energy Star Blow Gun and equipment

Results: an example

An implementation in a manufacturing plant in Europe lead to savings of € 50k/y with zero investment cost

And an additional € 200k/y with a payback time of 6 months

The company was also evaluating the possibility to pave the roof with solar panels

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