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Green lean approach for improving sustainability and economic performance of vegetable supply-chain: the ZEROEMISSION case

Efficient and safe production processes in sustainable agriculture and forestry

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Definition

Lean management is the sum of thought, methods and procedures to manage without wasting the entire value chain in order to meet the expectations of current and prospective customers



the primary objective is the maximization of customer value and reducing resources to build it.



Lean & green

The lean & green concept is related to the use of lean methodologies in order to improve the environmental sustainability of a process or product

The five basic principles

To achieve the primary objective is required the reorganization of process according to five basic principles:

- Value
- Value Stream
- Continuous flow
- Pull
- Perfection

Value

- What counts is to identify what is useless, what is produced, stored and transported (value).
- The consumption of resources is justified only to produce value, otherwise it is waste (muda).
- The value can be defined solely by the final customer.
- The value is meaningful only when it is expressed in terms of a specific product to meet customer needs at a given price and at given time.

Value stream

- The set of actions required to lead to a given product (a product, a service, or a combination of both) through the three critical management tasks of any business:
 - **problem-solving** from concept to production launch,
 - **the management of information** from order receipt to delivery,
 - **the physical transformation** of raw materials into a finished product

Continuous flow

- Is to ensure that all the steps that create value make up a stream can flow in order add value to a stream without interruption.
- This can be achieved thru organizing the interfaces between different phases of production and logistic.



Pull

- It means to make in order to meet the actual production demand (pull).
- The question today is increasingly unstable not only in quantity but also in terms of volatility of preferences.

Perfection

- It is a provocation: if you really want to apply the lean thinking in no uncertain terms it must point directly to perfection.
- The aim is to maintain a systematic process of improvement in a corporate culture based on continuous improvement, problem solving, eliminating waste and common growth.
- Just in time principles were aiming at the same

Types of waste

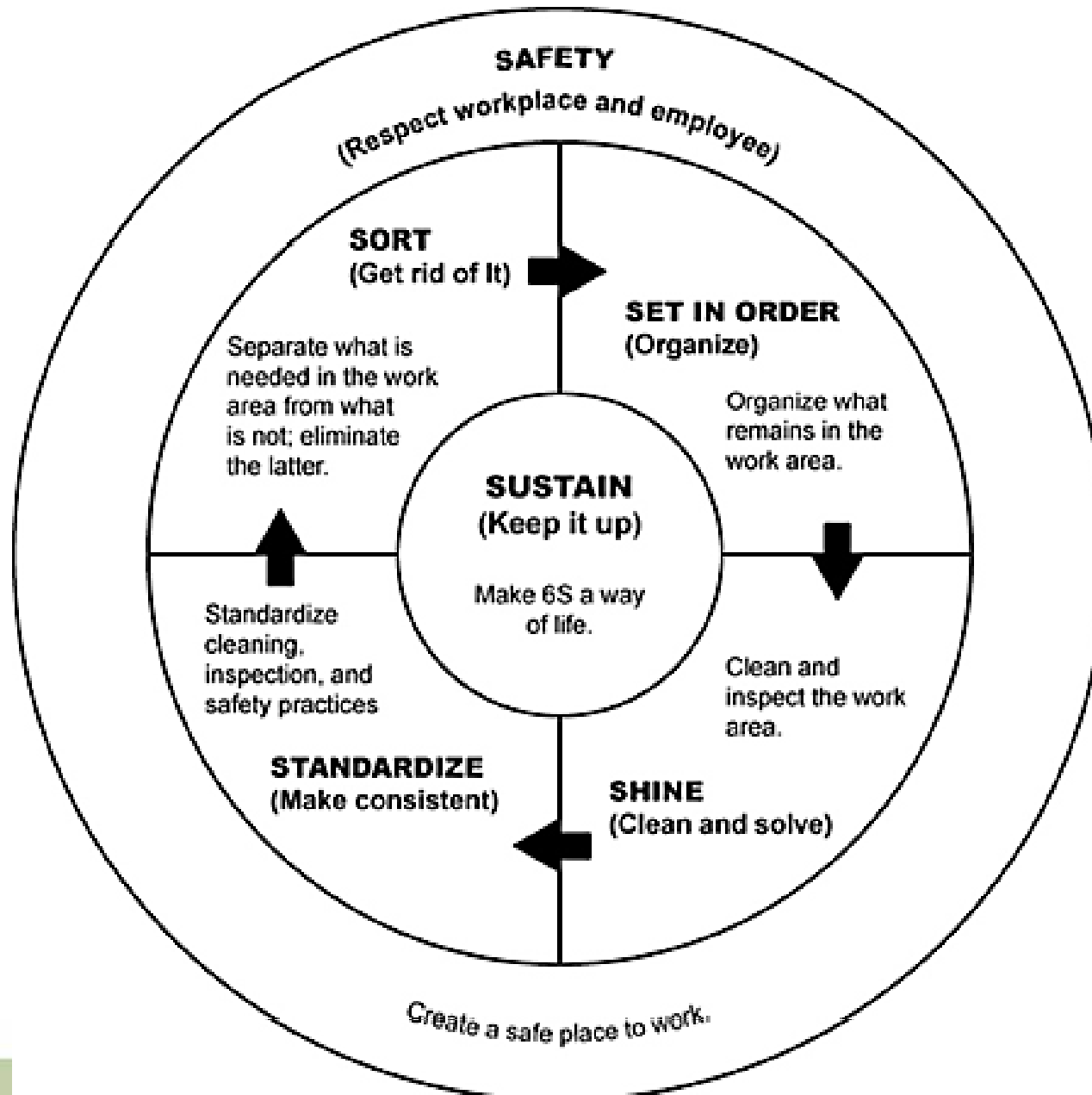
| Waste (muda) | Lean Management | | |
|------------------------|--|--|---|
| | General (Hines, Found et al. 2008) | | Environmental (EPA 2007) |
| | Effect | Cause | Environmental Impact |
| Over production | Manufacturing of item for which there are no orders | Wrong information flow, wrong production schedule | More energy, water and material used in making the unnecessary product Extra produce may spoil or become obsolete Extra emissions |
| Inventory | Excess in raw materials, WIP or finished goods | Product or process inefficiency, long set-up times, push production approach, low customer service | More packaging to store (WIP); waste from deterioration or damage of stored WIP; more energy to heat, cool, and light inventory space |
| Defects | Product with defects that require rework or disposal | Design error, machine setup, wrong process production and quality protocol assessment | More energy, water and material used in making the defective product Defective product require recycling or disposal, more space for rework and repair, increased energy use for heating, cooling and lighting |

Types of waste (2)

| Waste (muda) | Lean Management | | |
|------------------|--|---|--|
| | General (Hines, Found et al. 2008) | | Environmental (EPA 2007) |
| | Effect | Cause | Environmental Impact |
| Motion | Human movement not necessary, non-ergonomic work position, loss of tools | Wrong layout of the facility and/or of the workplace | More space for WIP movement, increase of lighting, heating, cooling demand, waste of time |
| Transport | Increase of leading time, cost | Excess transport of WIP or products | More packaging and waste produced, damage and spills during transport |
| Process | Process steps not required to produce the item | Procedures and methods not designed to meet production requirements, machine set-up too long | More parts and raw material used per unit of production, increase of waste, energy use, emissions |
| Waiting | Delays with stock-outs, equipment downtime, capacity bottlenecks, information transfer | Inefficient information flow, work organization not efficient, maintenance program not adequate | Potential material spoilage, wasted energy from heating, cooling and lighting during production downtime |

Order, cleanliness and safety in the workplace (6 S)

1. **Sort** (get rid of it): Separate what is needed in the work area from what is not; eliminate the latter.
2. **Set in order** (organize): organize what remains in the work area.
3. **Shine** (clean and solve): Clean and inspect the work area.
4. **Safety** (respect work place and employee): create a safe place to work.
5. **Standardize** (make consistent): standardize cleaning, inspection and safety practices.
6. **Sustain** (keep it up): make 6 S a way of life.



Value Stream Mapping

- This tool was developed at Toyota, also known by the name “Material and Information Flow Mapping”, whose purpose lies in the analysis of the flow of current value and to provide concrete actions to increase value and reduce waste.
- This technique, is particularly suitable for the production area in order to describe the current status, future or "ideal" in the process of developing implementation plans leading to the adoption of lean systems.

Case study

ZEROEMISSION project: to produce onions and potatoes at zero CO₂ emissions from fossil fuels

- Adoption of best available techniques for production and product processing, storage
- Use of renewable sources (photovoltaic, rapeseed oil)
- First stage of the work are presented
- Results are related to a production of 2050 t of potatoes and 700 t of onions

Value Stream Map water

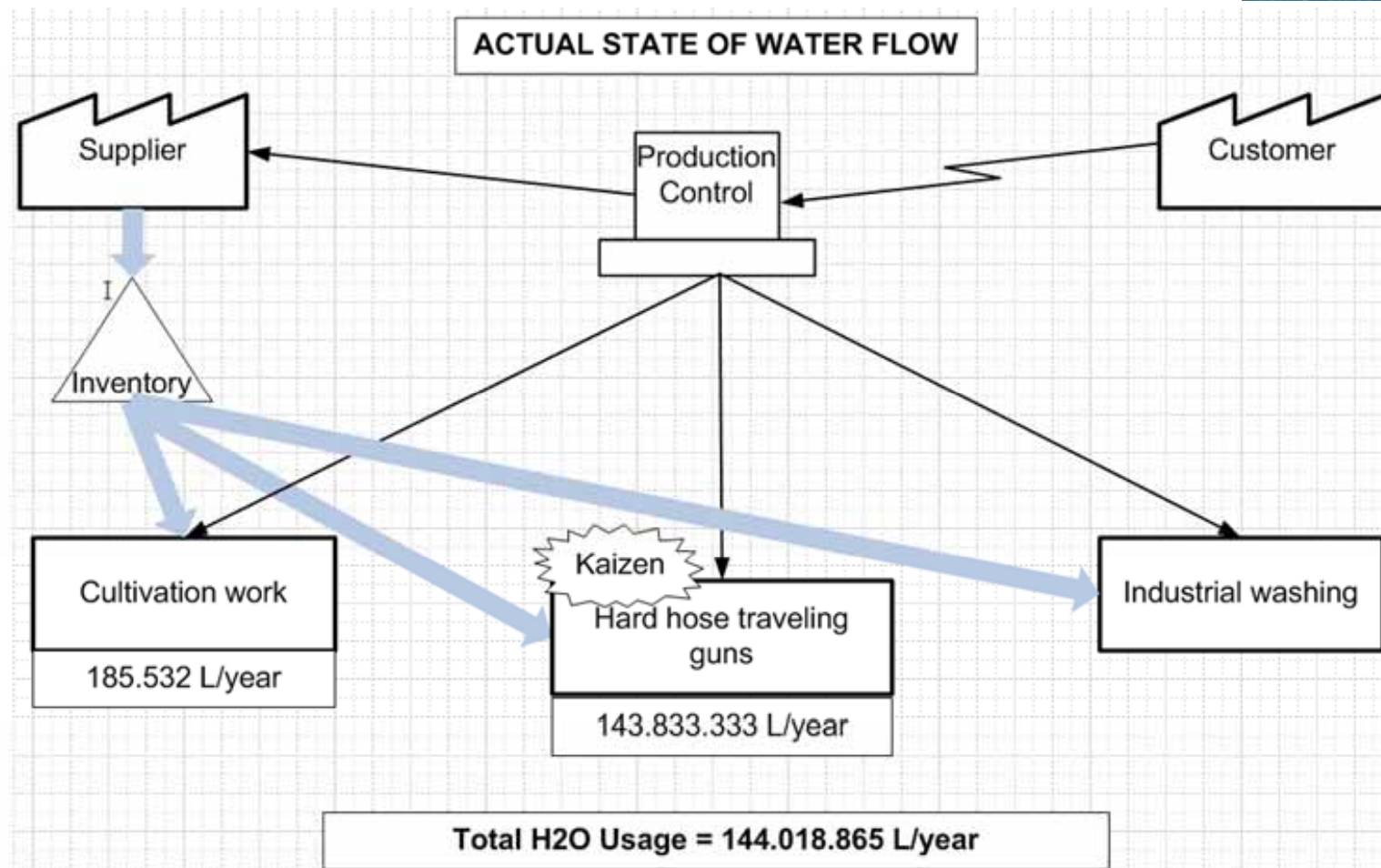


Figure 2. Map of water consumption. Actual state.

Value Stream Map water

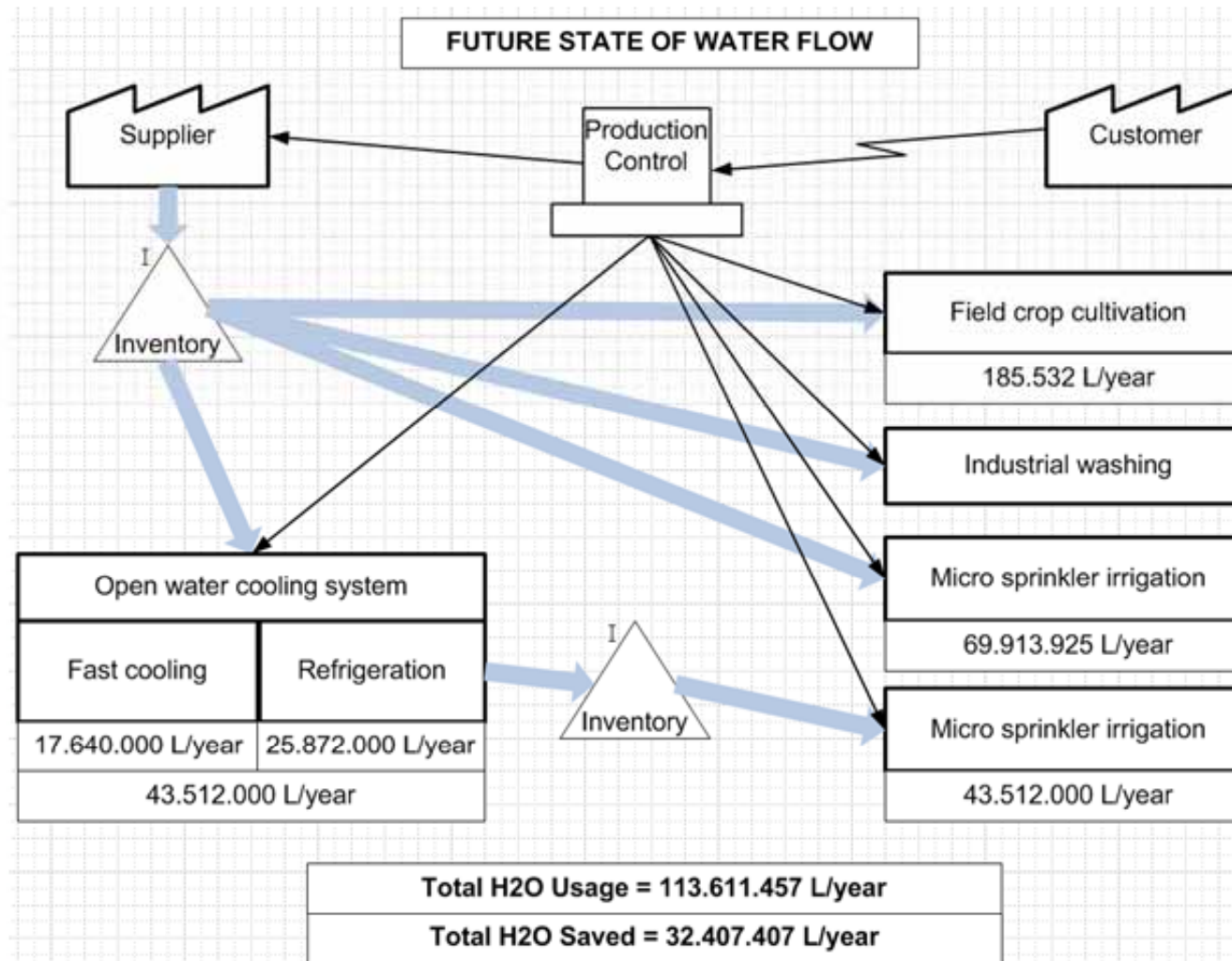


Figure 3. Map of water consumption. Future state.

VSM energy

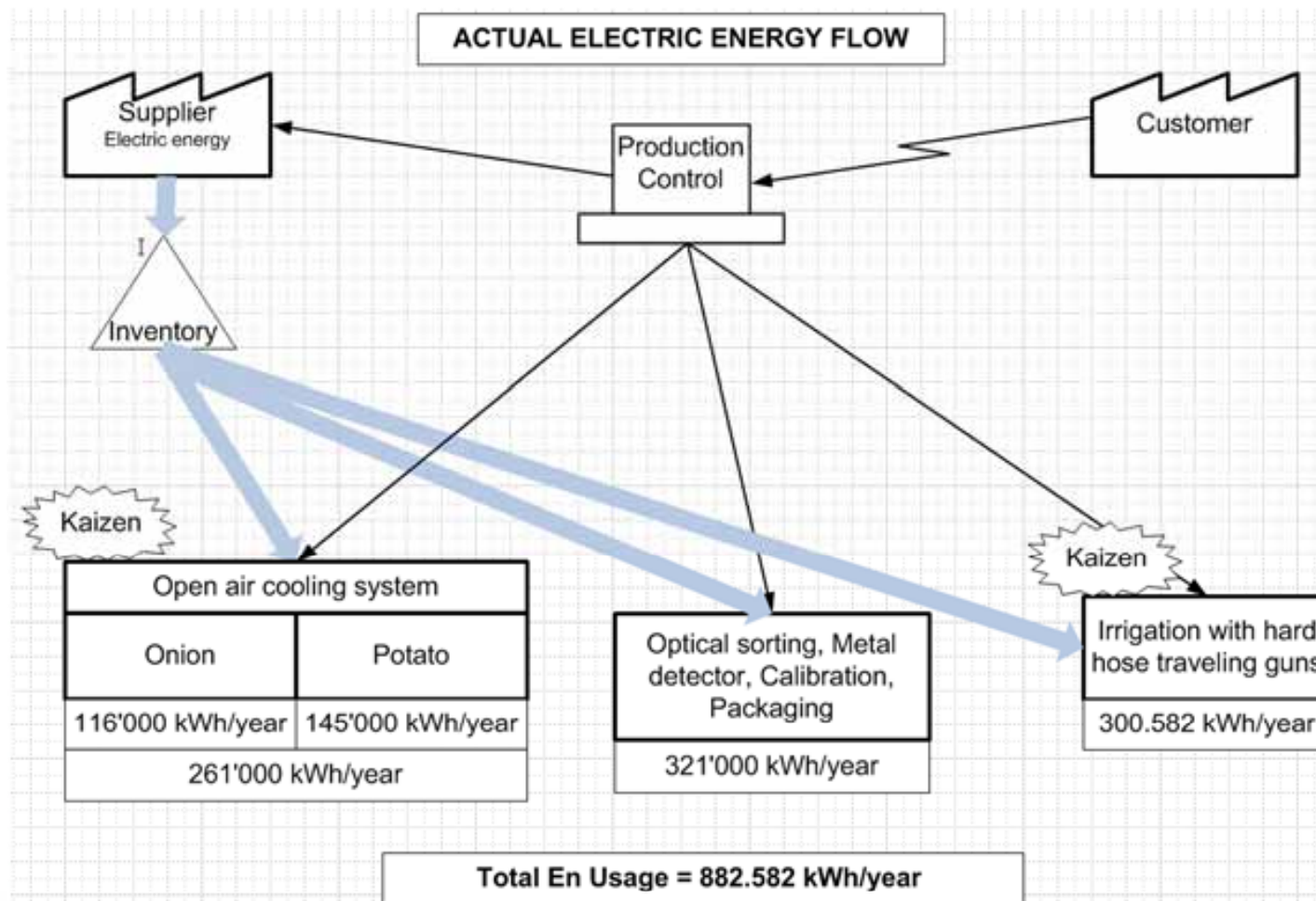


Figure 4. Map of energy consumption. Actual state.

VSM Graphs energy

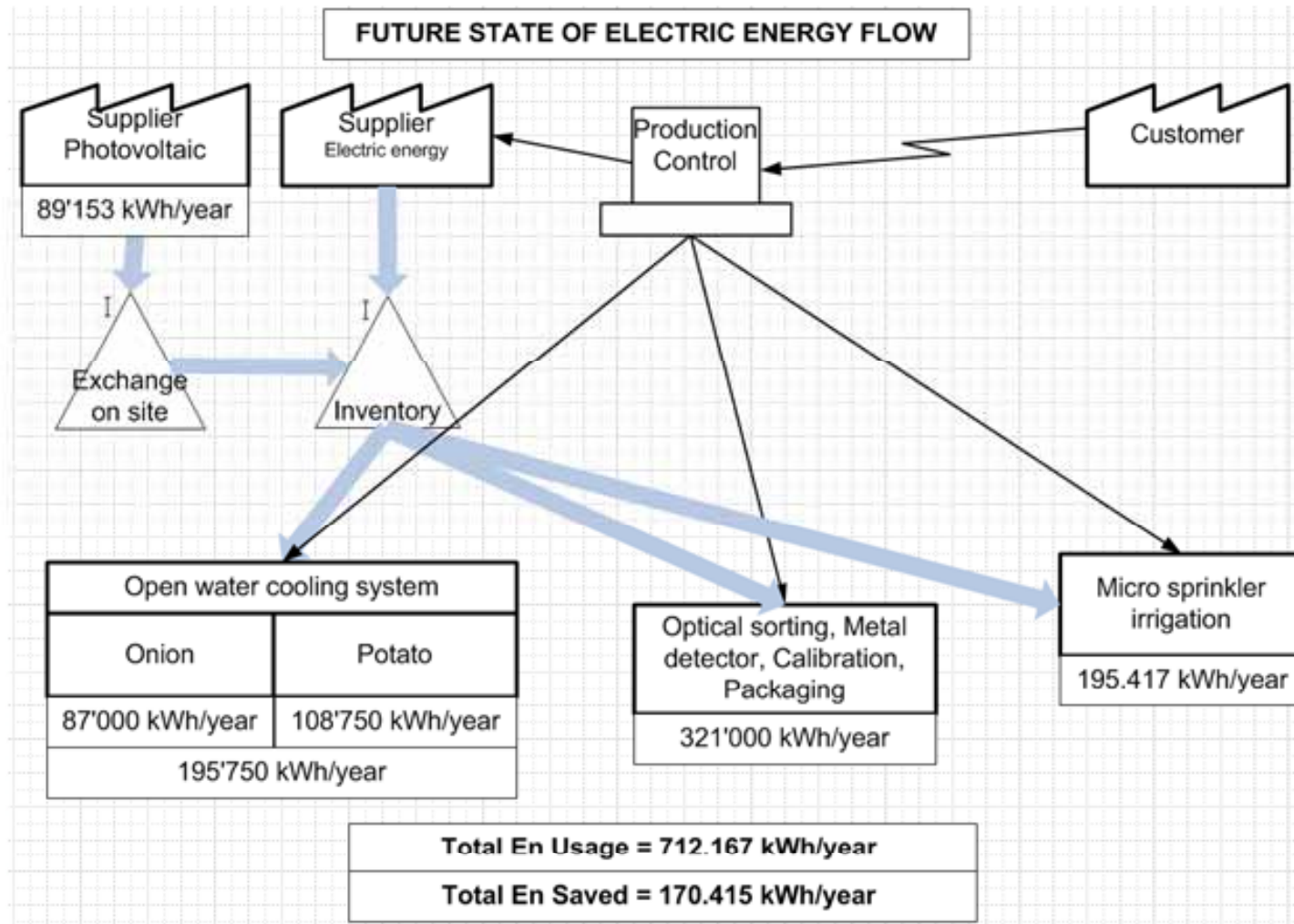


Figure 5. Map of energy consumption. Future state.

Conclusions

- For the optimization of energy utilization and the increase of efficiency in water use, the lean&green methodology results was very promising
- The results, considering a production of 2050 t of potatoes and 700 t of onions, allowed savings of 130 t y⁻¹ of CO₂ and 32407 m³ y⁻¹ of water, with a positive effect of cost reduction and sustainability of the supply chain
- The value stream map with the annex kaizen (possible improvement point in the process) analysis proven to be effective in showing the possible improvements



Future activities



- Standardize processes in order to reduce set up times of machines;
- Logistic activities:
 - Standardize the varieties of onions to get less waste (and related CO₂ emissions) and less set-up time;
 - Decrease the number of bins for transport by taking advantage of greater standardization of onions;
 - Decrease the number of vehicles and trips due to better filling of the bins and better location of storages

Thanks for your attention!

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