

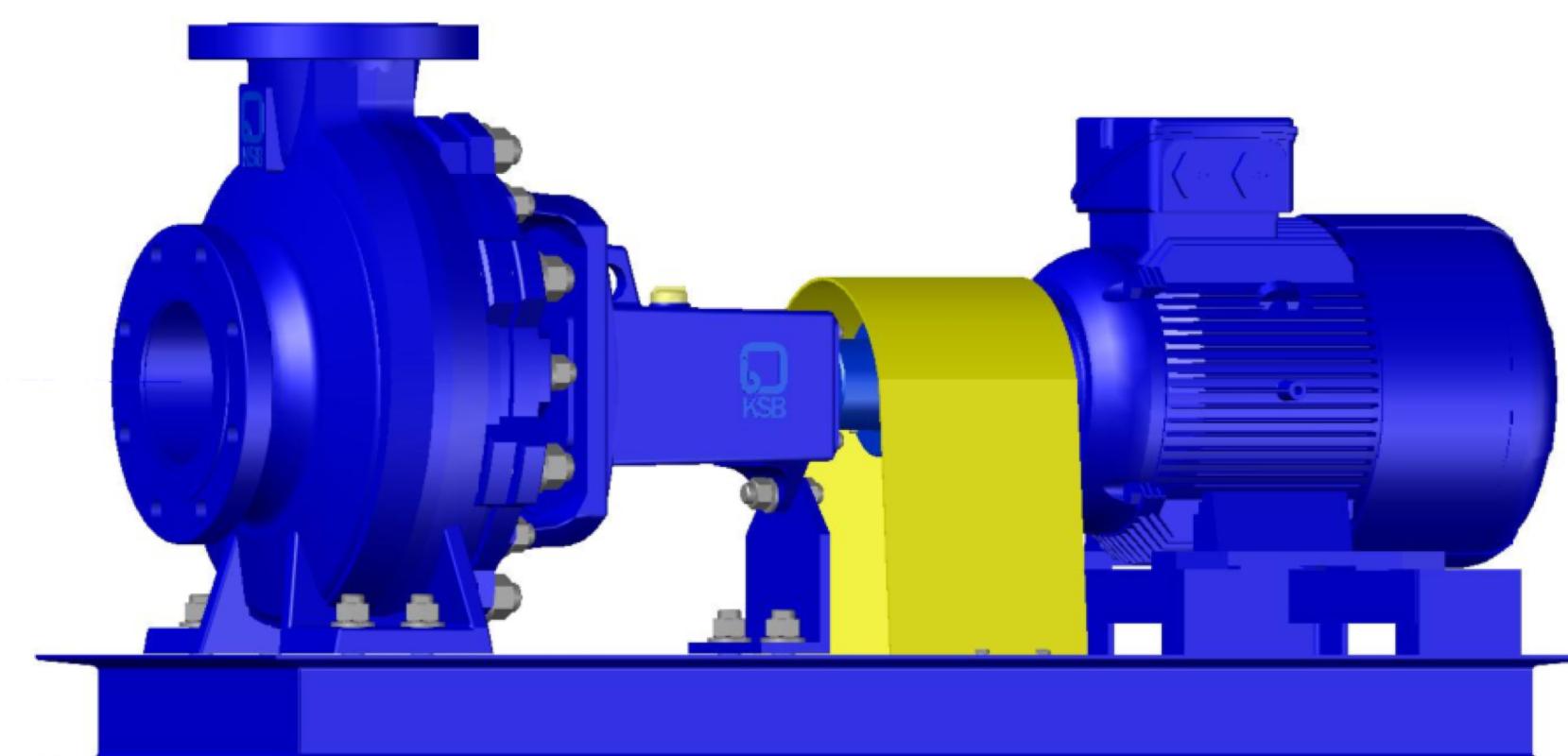


Hydropower energy recovery potential from irrigation networks

INTRODUCTION

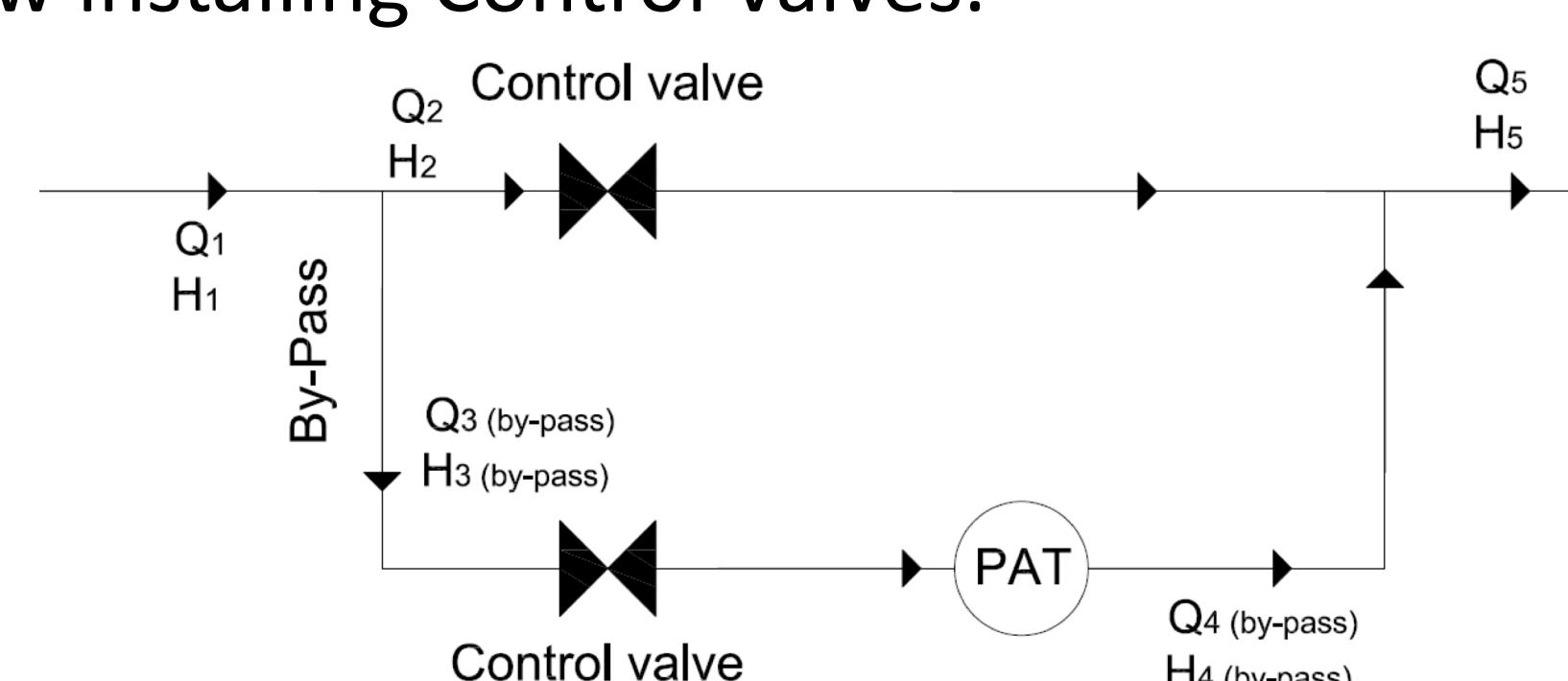
The water industry is the 4th most energy intensive sector in the Atlantic Area, responsible for significant contributions to climate change and reductions in competitiveness due to associated costs. Furthermore, agriculture is the main water consumer, reaching values of around 70% of all water use worldwide. The research aims to improve the energy efficiency of irrigation networks through the installation of micro-hydropower technology, which will recover wasted energy in existing pipe networks.

TECHNOLOGY

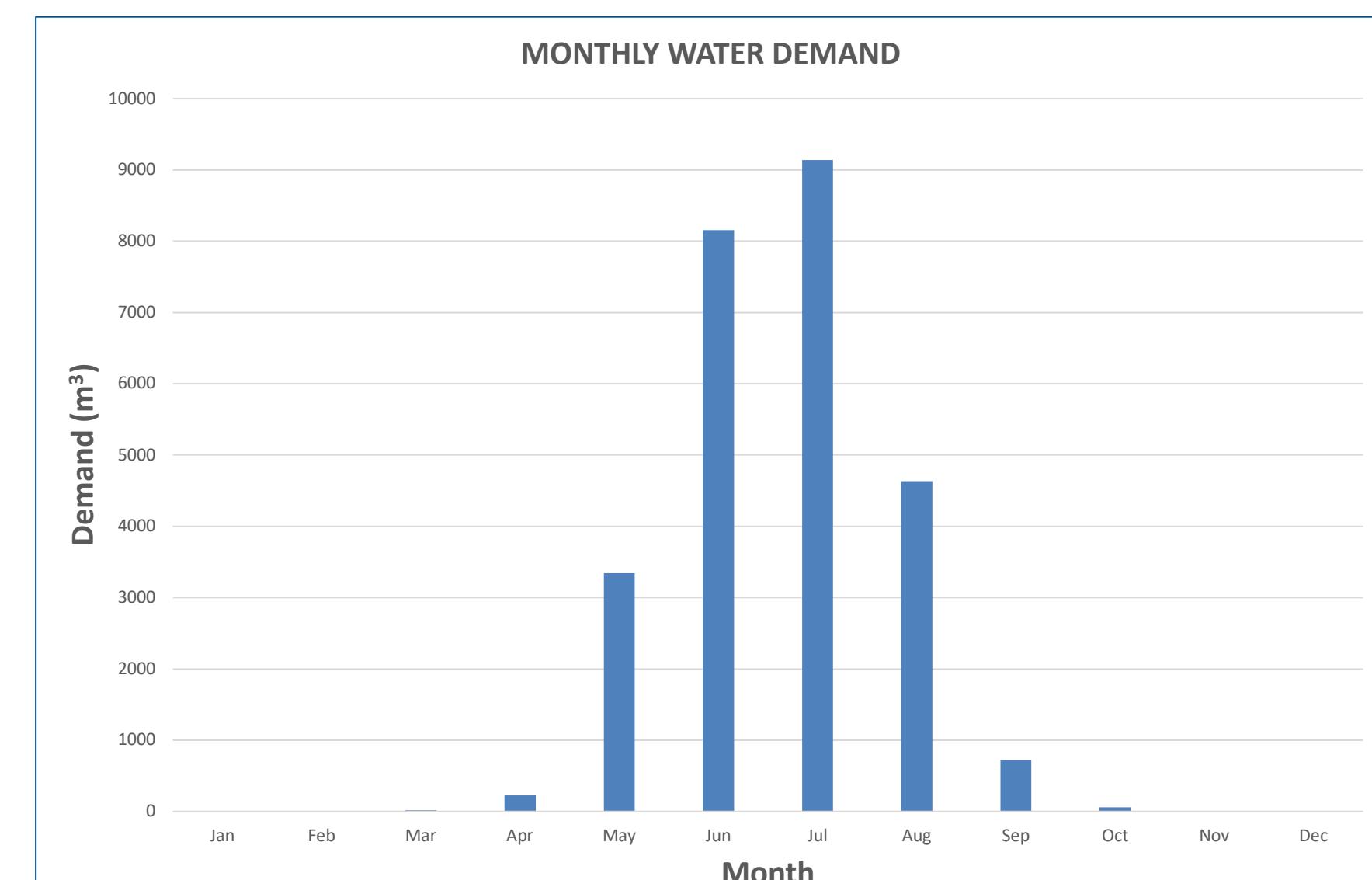


Pump-As-Turbine (PAT)

- Waste energy from the excess pressure in irrigation networks.
- Pumps working in reverse as turbines. Cheap solution.
- Efficiency drops with the flow fluctuation → different requirements along irrigation season.
- Increase the efficiency through maintaining constant flow installing Control Valves.



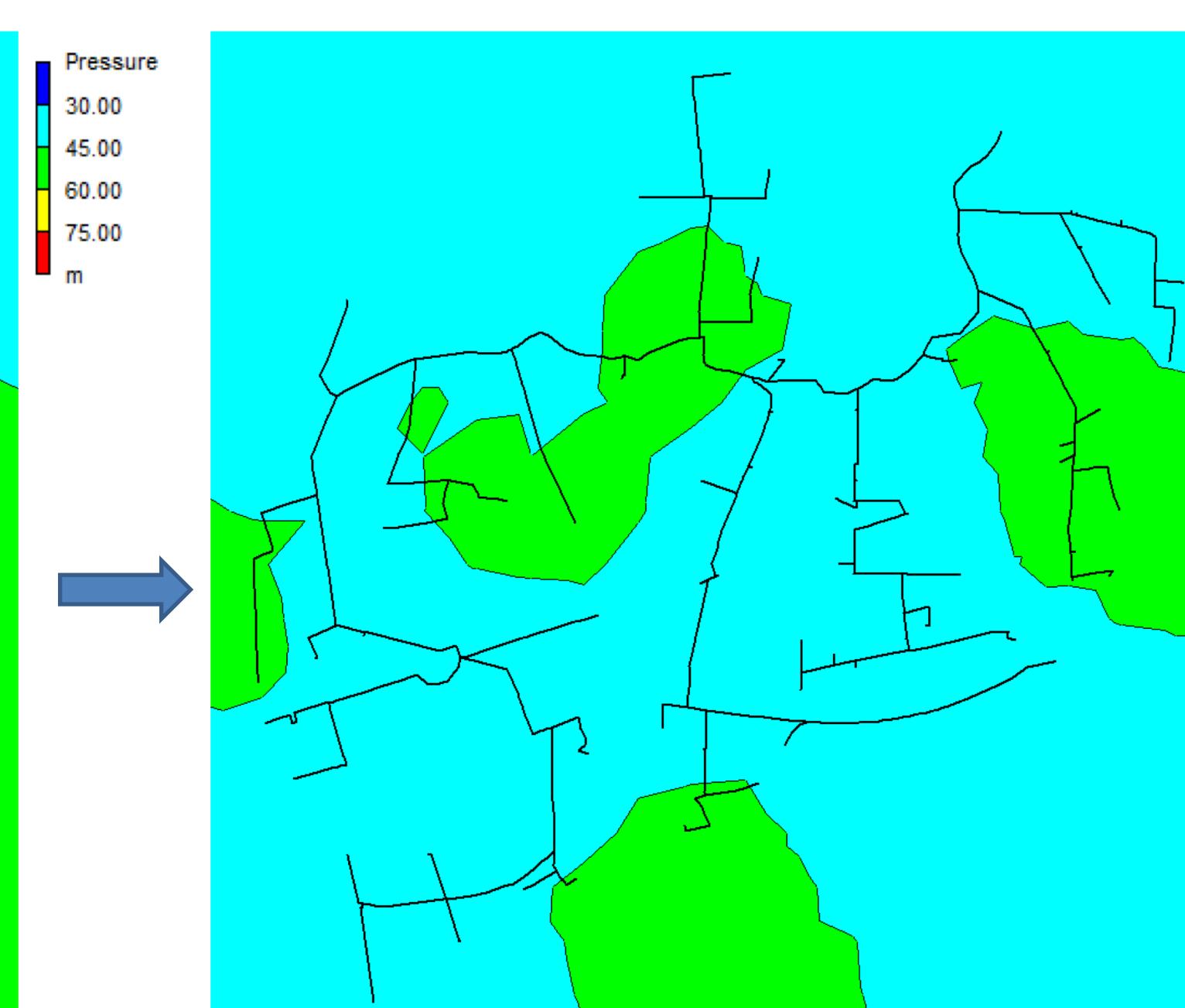
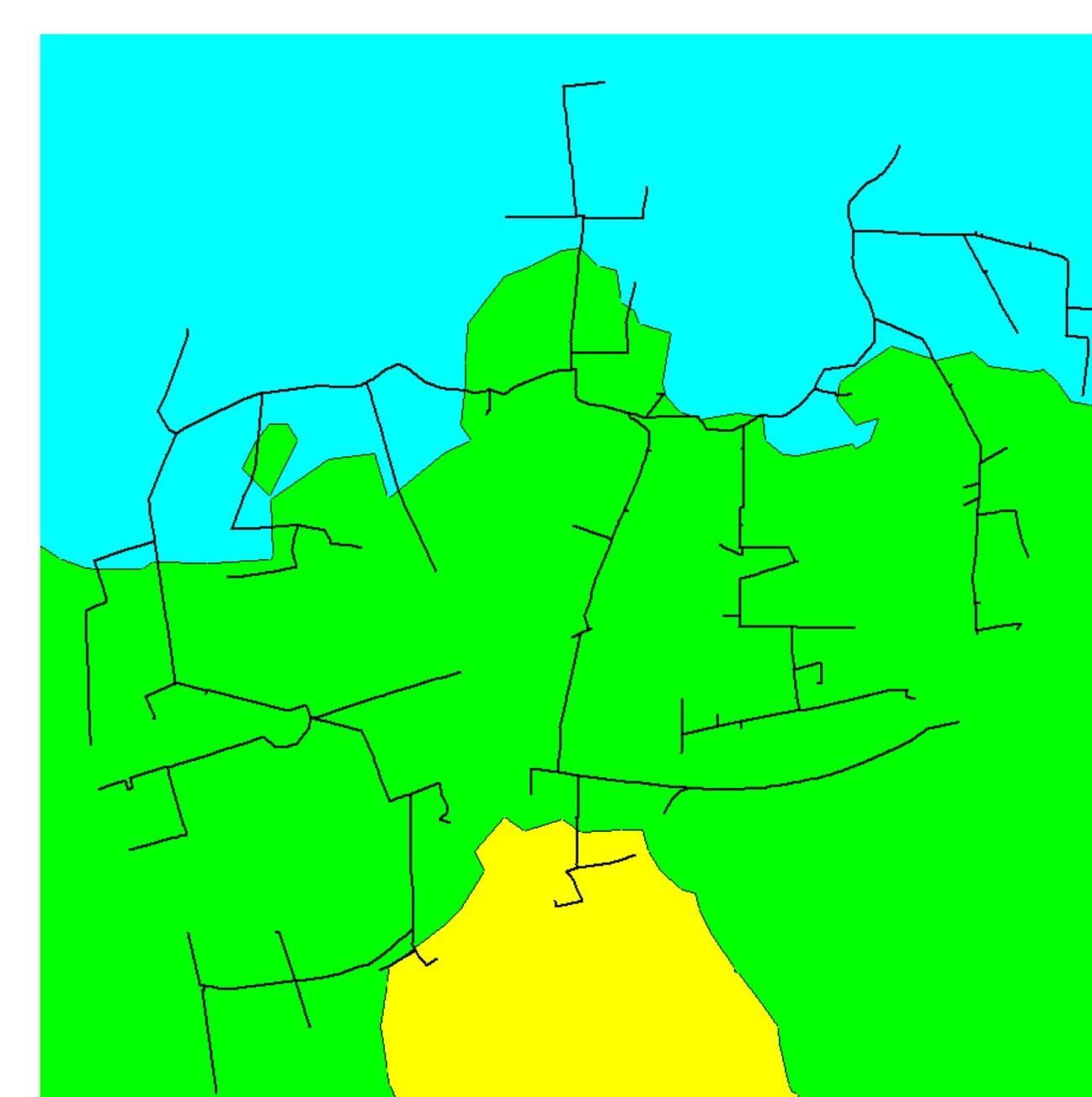
RESOURCE



Based on design plans, surface irrigated, dotation, crops distribution and working conditions:

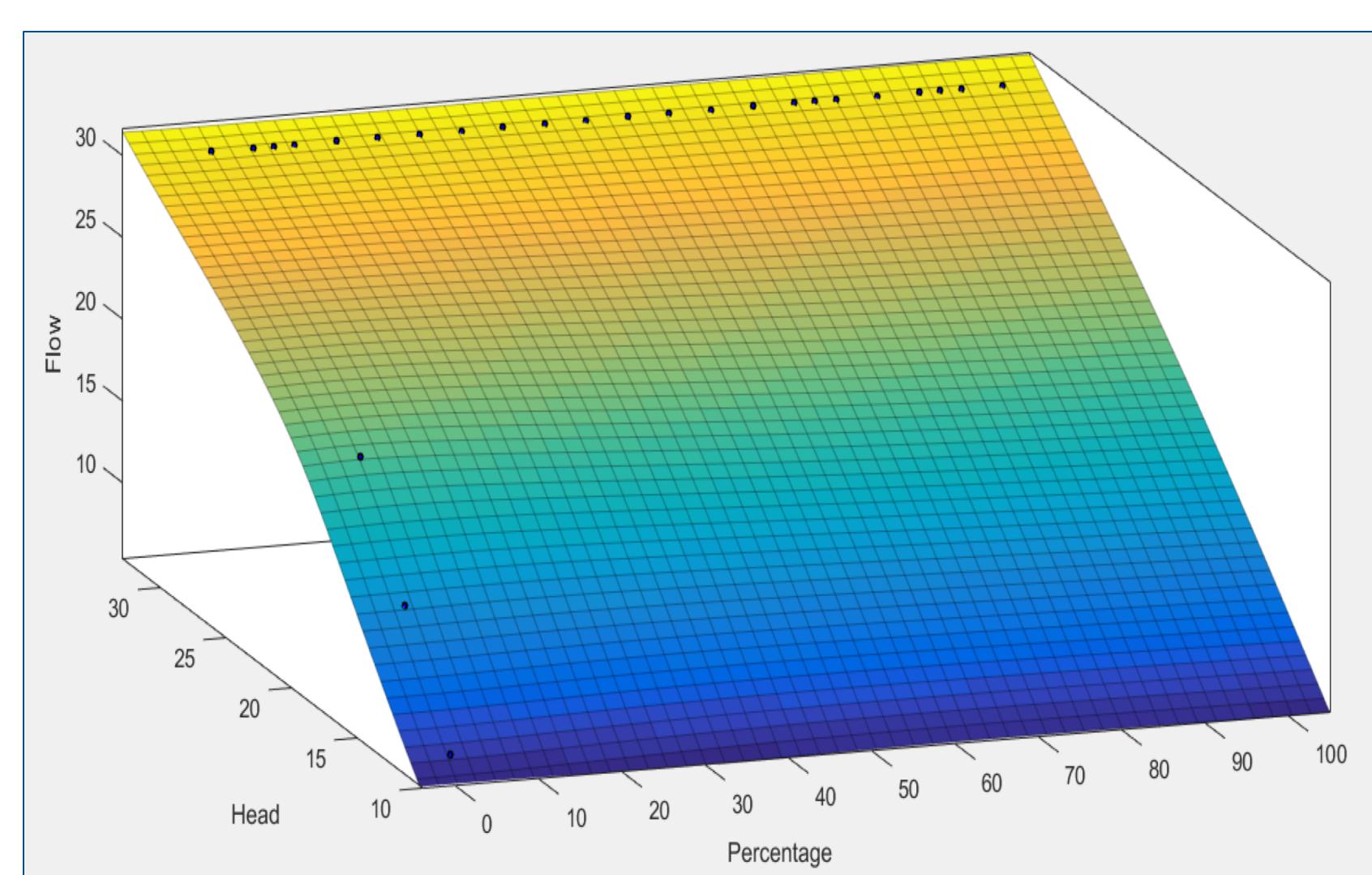
- Surface irrigated → 16,000 hectares
- Dotation ($1.2 \text{ l s}^{-1} \text{ha}^{-1}$) * Farms surface → Base demands
- Crop distribution → Monthly water requirements
- Working conditions → 30-35 meters pressure required in hydrants

RESULTS



- Reducing existing excess of pressure
- Potential sites found in 12 irrigation networks: 43
- Range of power: 5-112 kW
- Potential energy: > 1GWh

CHALLENGES



- Pressure management in irrigation networks.
- Constant inlet flow maximize the performance of the PAT.
- Increase the economical viability requires permanent working parameters → Initial investment in control devices

- 92 % of the networks studied presents two or more potential points to recover energy.
- A rate of $0.07 \text{ MWh yr}^{-1} \text{ha}^{-1}$ was estimated.
- Generate a potential energy recovery cartography from the theoretical results.
- Prove the effectiveness of this technology constructing a pilot plant.

CONCLUSION

The modernization of irrigation networks in the agricultural sector has led to an increase in energy consumption. Several determinants can explain the presence of this excess pressure such as the difference of hydrants elevation or the long distances that water needs to travel to reach the issuing hydrant. Although the irrigation season is concentrated in a few months during the year, depending on the crops in the area studied, most of the potential energy recovery is focused in the summer months.

This research highlights the potential for MHP generation in the pressurized irrigation networks. It has also assessed the possibility of using MHP turbines or PATs for energy recovery. Over one GWh has been estimated that could be recovered in 12 irrigation networks.