

# Modelling of aquaculture-hydroponic systems INAPRO

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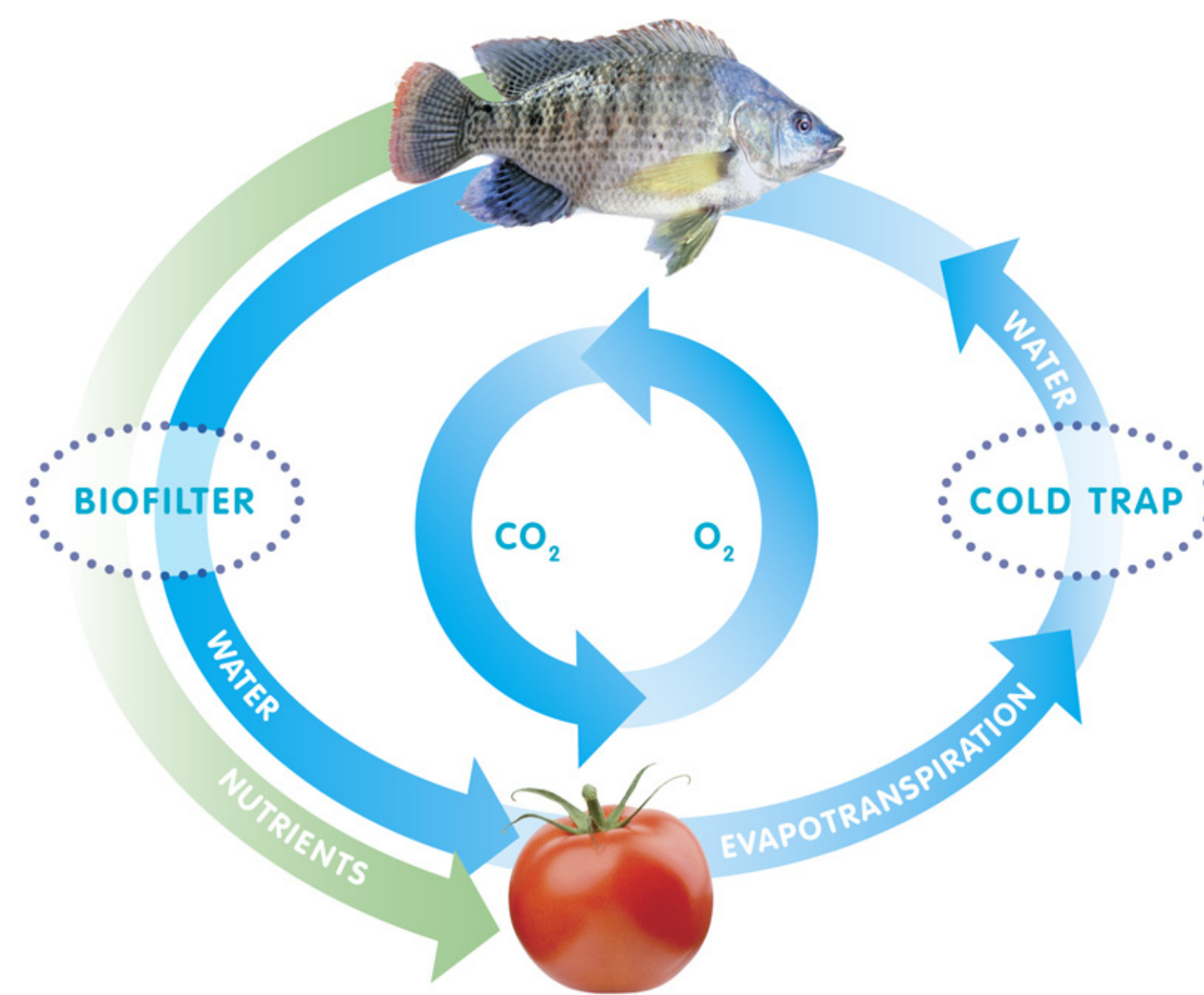
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## Background

**Aquaponics** is a production technique that combines farming aquatic species (**aquaculture**) and soilless plant cultivation (**hydroponics**).

The excretions of the fish are used as nutrients for the plants which, in turn, help cleaning the water that flows back to the fish.



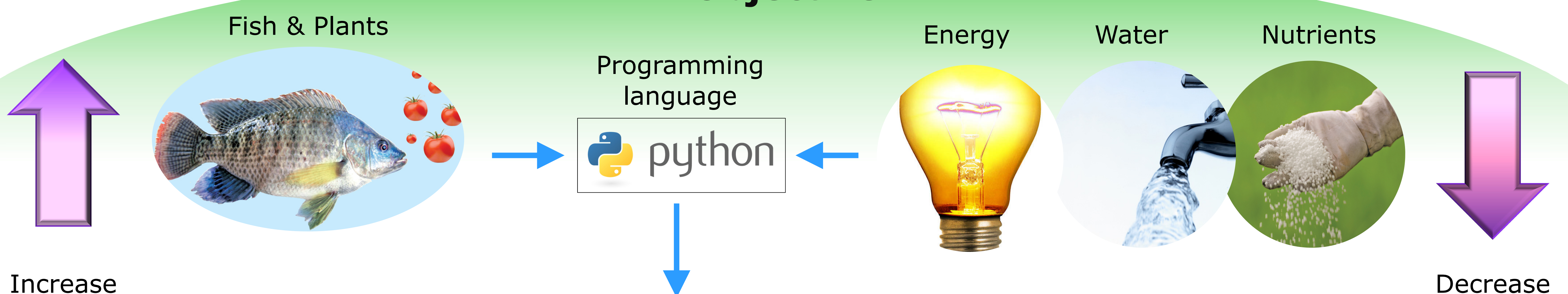
The **mathematical model** is an essential component of the EU-FP7 **INAPRO** project, which aims at developing aquaponics towards its commercialization.

Initially, INAPRO focuses on **tilapia** and **tomato**.

**Table 1.** Current commercial energy costs.

Production	Energy [kWh/kg]	New water [L/kg]
Finfish fisheries in Europe with bottom trawl	7.6	
Tilapia aquaculture	5.2	500
Tomato in greenhouses	8.1-10.0	

## Objective



The model will provide:

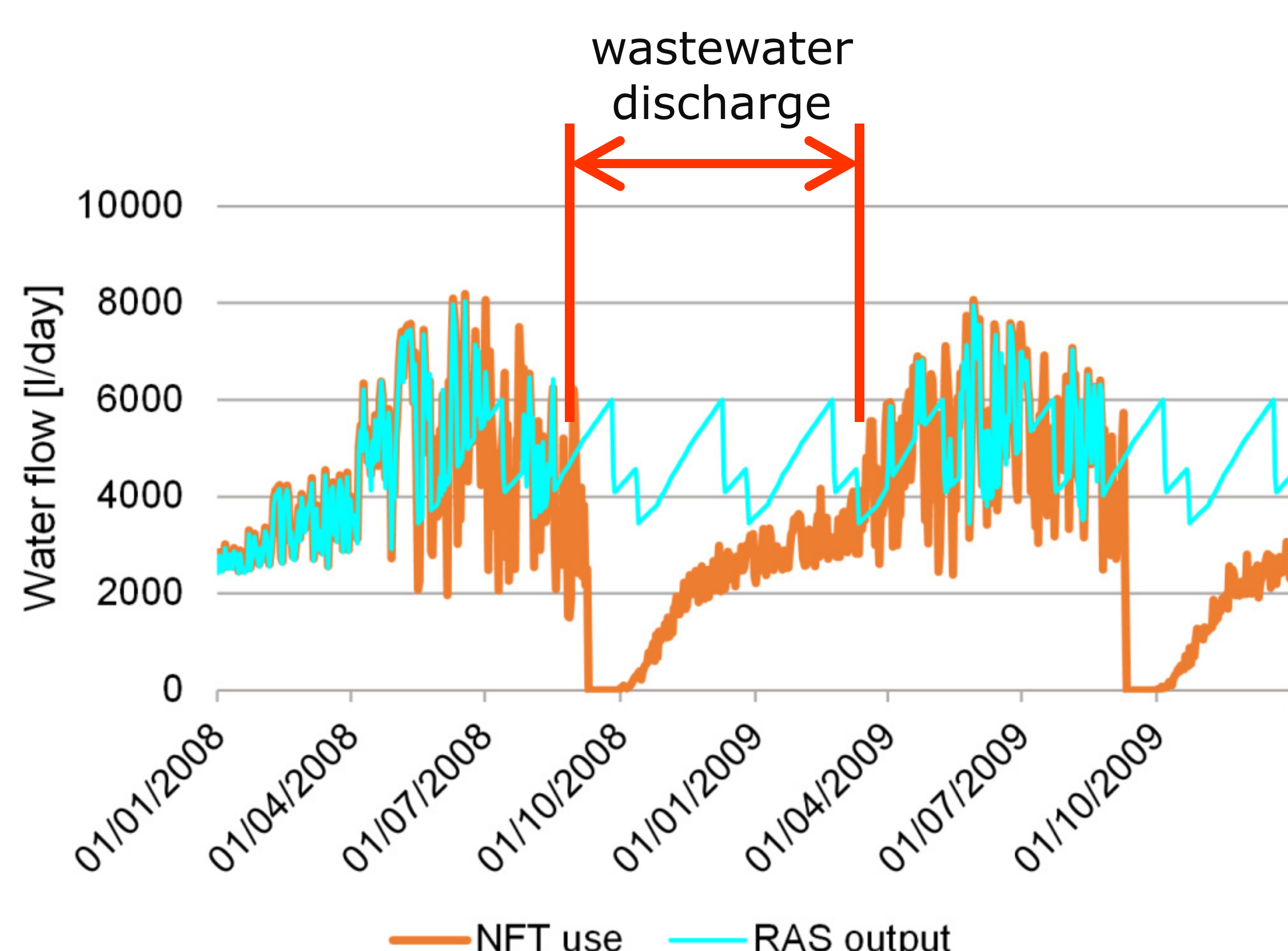
- Understanding of the dynamic behaviour, transport phenomena and interactions in aquaponics.
- Aid in the design and operation of the system.

## Results

Preliminary system design and model.

### Water and fertiliser

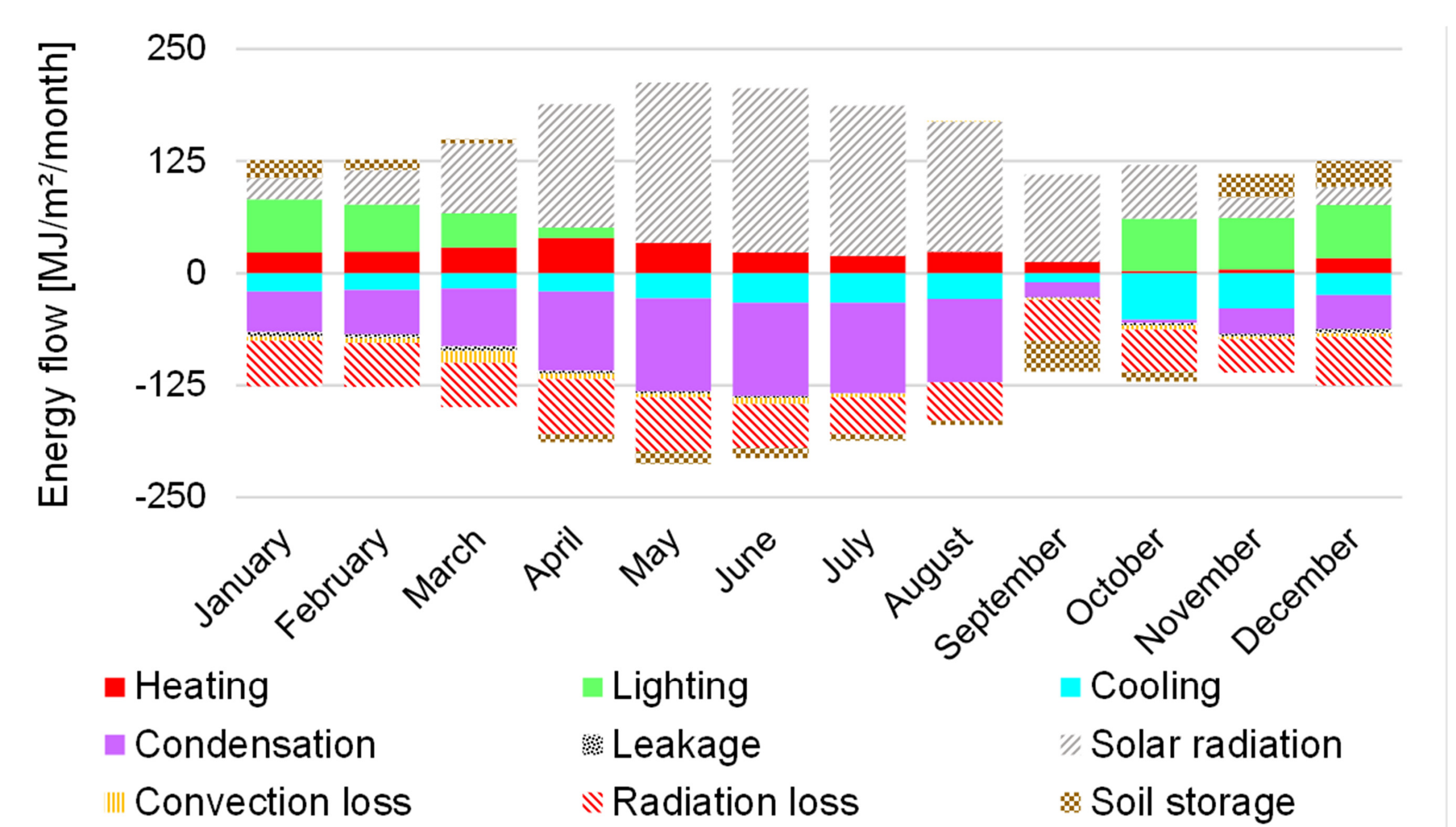
Water and nutrients are transported from the recirculating aquaculture system (RAS) to the nutrient film technique greenhouse (NFT).



**Figure 1.** Water flow from the fish system to the tomato system for 2 years.

### Energy

Large energy inputs are required by INAPRO system.



**Figure 2.** Average monthly energy balance in the greenhouse.

## Conclusions

Current production in INAPRO model

- Tilapia: **125 kg/m<sup>3</sup> yr** vs. 100 kg/m<sup>3</sup> yr commercially
- Tomato: **75 kg/m<sup>2</sup> yr** vs. 60 kg/m<sup>2</sup> yr commercially

With new water use: **123 L/kg tilapia**

But energy in greenhouse alone: **17.7 kW/kg tomato**  
Not better than existing commercial systems.

New design needed based on local conditions e.g. rainwater.