Water – energy nexus: energy irrigation costs

Juan Valero de Palma Manglano
General Secretary of EIC y FENACORE

Workshop 1:
“Agriculture and water: Protection of resources and the competition for their use”.

“Water – energy nexus: energy irrigation costs”.

Loccum, 18-19 de Septiembre de 2013
I. IRRIGATION ENERGY CONSUMPTION IN SPAIN AND EUROPE

- Historically, irrigation has used surface water for flooding systems: (Romans, Arabs, water-wheels, ...)
• However, in the twentieth century, irrigation using subterranean water resulted in energy consumption.

• Consumption and energy costs are on the rise as a consequence of the efforts of Irrigation Communities to modernize, moving away from gravity systems in favour of pressurised irrigation systems (drip and sprinkler systems).
# Evolution of Irrigation Systems in Spain

<table>
<thead>
<tr>
<th>IRRIGATION SYSTEM</th>
<th>Before 2000</th>
<th></th>
<th>2012 year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hectares</td>
<td>%</td>
<td>Hectares</td>
<td>%</td>
</tr>
<tr>
<td>Flooding (gravity)</td>
<td>1,973,336</td>
<td>59</td>
<td>1,020,406</td>
<td>29</td>
</tr>
<tr>
<td>Sprinkers and others</td>
<td>802,712</td>
<td>24</td>
<td>839,363</td>
<td>24</td>
</tr>
<tr>
<td>Drip</td>
<td>568,588</td>
<td>17</td>
<td>1,662,847</td>
<td>47</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3,344,636</td>
<td>100</td>
<td>3,473,473</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: PNR 2001 y encuesta sobre superficies y rendimientos de Cultivo ESYRCE, 2012, MAGRAMA
Changes in water and energy uses in irrigation

<table>
<thead>
<tr>
<th>Year</th>
<th>Water used (m$^3$/ha)</th>
<th>Energy used (KWh/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>8250</td>
<td>206</td>
</tr>
<tr>
<td>1970</td>
<td>8000</td>
<td>480</td>
</tr>
<tr>
<td>1980</td>
<td>7750</td>
<td>775</td>
</tr>
<tr>
<td>1990</td>
<td>7500</td>
<td>1088</td>
</tr>
<tr>
<td>2000</td>
<td>7000</td>
<td>1435</td>
</tr>
<tr>
<td>2007</td>
<td>6500</td>
<td>1560</td>
</tr>
</tbody>
</table>

Variation rate (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Variation rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-21 %</td>
</tr>
<tr>
<td></td>
<td>657 %</td>
</tr>
</tbody>
</table>

Source: Corominas (2009)
## Evolution of Irrigation Systems

<table>
<thead>
<tr>
<th>Country</th>
<th>Irrigable area</th>
<th>Irrigated Area</th>
<th>Irrigation System (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>3.422.178</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>2.723.700</td>
<td>1.938.730</td>
<td>0%  98%  2%</td>
</tr>
<tr>
<td>Germany</td>
<td>600.000</td>
<td>560.000</td>
<td>0%  98%  2%</td>
</tr>
<tr>
<td>Greece</td>
<td>1.321.340</td>
<td>1.161.000</td>
<td>36%  52%  10%</td>
</tr>
<tr>
<td>Italy</td>
<td>3.892.202</td>
<td>2.471.379</td>
<td>28%  51%  21%</td>
</tr>
<tr>
<td>Maroc</td>
<td>1.484.160</td>
<td></td>
<td>80%  10%  10%</td>
</tr>
<tr>
<td>Portugal</td>
<td>792.000</td>
<td>600.000</td>
<td>30%  38%  32%</td>
</tr>
<tr>
<td>Spain</td>
<td>3.700.000</td>
<td>3.473.473</td>
<td>29%  24%  47%</td>
</tr>
<tr>
<td>Turkey</td>
<td>25.853.674</td>
<td>4.300.000</td>
<td>80%  10%  10%</td>
</tr>
</tbody>
</table>

Source: FAO, German associations, FENAREG, ANBI, CIHEAM & EIC
Modernized irrigation
• Electricity consumption in the Spanish agricultural sector is a major production cost (>30%) and represents almost 2% of the total consumption and power bought in Spain.

– Increased energy costs for double way:
  • excessive cost of electricity prices.
  • greater power consumption

– Since 2006, energy costs have been rising. In July 2008, an EU Directive withdrew special irrigation prices..., power increased by 250% and energy by 15%. Over the following years, power and energy rose.
II. SOLUTIONS.-

• MINIMIZE ENERGY CONSUMPTION IN MODERN IRRIGATION SYSTEMS.

Where geography permits, the water point should be moved to 40 or 50 metres above the irrigation area in order to use the difference in height to provide natural pressure systems without energy costs.

Examples:
Canal of Aragon and Catalonia.
Royal Jucar Ditcht
   Etc…
B.- Use of IT to minimize energy consumption. Aiming for efficient consumption.

A priority for EUROPE

A) Directive to promote energy efficiency. October 2012


Agriculture

Agriculture has been identified as the major sustainable water management issue in the implementation of the Water Framework Directive (WFD). In particular, abstraction of water for irrigation accounts for 24% of total water abstraction in Europe and can be up to 80% in some southern Member-States (EEA, 2009 water resources in Europe – confronting water scarcity and droughts). Moreover, unlike other sectors like energy production, the majority of the water abstracted is consumed and not returned to the water bodies (c. 70% according to the EEA). Thus, this sector has to be addressed as a priority when considering any action against water scarcity and droughts in Europe.

The Commission will organize with the Belgian Presidency in September a conference on the enforcement of EU water legislation in the agricultural sector with a special focus on illegal abstraction.
The agricultural sector could benefit from the variability of costs in the electricity system, but it is necessary to introduce technology and a regulatory framework that fosters the smart consumption of electricity.
Current context

- As a result primarily of the variability in wind power production, energy market prices are highly variable. Even so they can be scheduled 30 hours in advance of the daily market. Irrigation is the only water use that can adapt its own water demand to the energy market prices.
What are we proposing?

– Digitization of irrigation networks and introduction of information and communication technologies (IT) to:

  • Perform simulations to optimize set point flows and energy consumption.
  • Observe network defects (bottlenecks, leaks, etc.) from measured values and generate alerts.
  • Once irrigation is scheduled, adapt it daily and weekly depending on agricultural or crop restrictions, water consumption and energy costs.

– Use the purchasing and negotiating power of the agricultural irrigation sector through the establishment of an central electricity purchasing.

– Pilot installations in other Irrigation Communities in different EU member states
**Objetives and scope**

– Establish a system that allows farmers and irrigation communities to use water more efficiently and to optimize energy costs.

– For this reason, the system must take into account a number of variables:

  • Water required by crops at any one time.
  • Restrictions on the irrigation infrastructure.
  • Hourly energy rates.
  • Current irrigation scheduling (conditional, by turns, etc ...).
Benefits to the Sector.

✓ Improving water efficiency (less water) both irrigation communities and individual irrigators.
✓ Improving energy efficiency (lower energy and water consumption).
✓ Significant reduction in unit energy costs (€ / kWh) and total.
✓ Joint technological innovation and environmental improvement of irrigation systems.
✓ Use of ICT as a mechanism for improving sustainability and efficiency.
New European Project: WEAM4i ("Water & Energy Advanced Management for Irrigation").

• Agriculture sector is accountable for 30% of the total water consumption in Europe, but reaches up to 70% of total water consumption in several southern European states. In recent years, most of the effort has been focused on water efficiency, without taking care of energy aspects, resulting in some cases in a significant increase in energy consumption, both per irrigated surface and per unit volume of water.

• EIC is actively taking part in the implementation of the European WEAM4i project.

• First meeting with partners was held at EIC offices on March 15th.

• The project is the result of the HISPATEC company’s concept schema based on "smart consumption" and is focused on two priorities within the EIP on Water:
  • Water-energy nexus
  • Decision support systems and monitoring
Thus, the main concept to be developed is the water demand-side management according to available energy offer. In order to develop this concept, the following is required:

- A water demand forecast, and consequently, an associated energy demand forecast
- Instruments for aggregating the energy demand in order to trade in the energy market
- And finally, an ICT platform to support the information.
WEAM4i concept

• Develop an innovative water and smart energy grid for irrigation: tactical energy consumption decisions (days), introducing demand-side management and matching to available energy supply, thanks to the water storage capability (both in reservoirs or on the ground) and the ‘near-almost elastic’ demand from users.

• Demonstrate innovative techniques for resource efficiency at local level:
  • Techniques for minimizing the operational cost of water supply infrastructures, such as strategic management (weekly)
  • Techniques for saving water in the local irrigation systems and, consequently, saving energy
  • Techniques for improving the ratio m3/kW ratio.

• Demonstration in 3 ‘demo’ sites in 2 growing seasons
Demonstration sites
## Demonstration sites

<table>
<thead>
<tr>
<th>Demonstration site</th>
<th>Alqueva area</th>
<th>Bardenas area</th>
<th>Lower Saxony</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
<td>Portugal</td>
<td>Spain</td>
<td>Germany</td>
</tr>
<tr>
<td><strong>Organisation name</strong></td>
<td>Associação de Beneficiarios da Obra de Rega de Odivelas, and AB do Roxo</td>
<td>Comunidad General de Regantes del Canal de Bardenas</td>
<td>Landwirtschaftskammer Niedersachsen (LWK) / Chamber of Agriculture of Lower Saxony</td>
</tr>
<tr>
<td><strong>Total Irrigated surface (ha)</strong></td>
<td>ABoro: 12.000 ABR: 5.000</td>
<td>81.100</td>
<td>300.000</td>
</tr>
<tr>
<td><strong>Water resources</strong></td>
<td>Odivelas and Roxo reservoirs, Alqueva dam</td>
<td>Yesa dam</td>
<td>Groundwater</td>
</tr>
<tr>
<td><strong>Irrigation network</strong></td>
<td>Distribution network of pressurized water</td>
<td>Transport network + distribution network</td>
<td>Direct groundwater pumping to subterranean pipeline network</td>
</tr>
<tr>
<td><strong>Irrigation technologies</strong></td>
<td>Drip, sprinkler and pivot systems</td>
<td>80% flooding system and 20% pressurized system –dripping and sprinkling</td>
<td>High pressure gun spray-jet on reel wagon (95%)</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>Odivelas and Roxo reservoirs</td>
<td>5 regulation reservoirs</td>
<td>None</td>
</tr>
<tr>
<td><strong>Main crops</strong></td>
<td>Olives, maize, rice, pasture, sunflower, almonds</td>
<td>Alfalfa, corn, winter cereal (wheat, barley), sunflower, vegetable and fruit</td>
<td>Potatoes, sugarbeets, grain, corn, onions, vegetables</td>
</tr>
</tbody>
</table>
## WEAM4i consortium

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Coord.)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Adasa Sistemas S.A.U.</td>
<td>ADASA</td>
</tr>
<tr>
<td>3</td>
<td>Grupo Hispatec Informatica Empresarial S.A.</td>
<td>HISPATEC</td>
</tr>
<tr>
<td>4</td>
<td>Aquagri - Assistencia Tecnica e Consultoria ACE</td>
<td>AQUAGRI</td>
</tr>
<tr>
<td>5</td>
<td>Federacion Nacional de Comunidades Regantes de España (Fenacore)</td>
<td>FENACORE</td>
</tr>
<tr>
<td>6</td>
<td>Federação Nacional de Regantes de Portugal (Fenareg)</td>
<td>FENAREG</td>
</tr>
<tr>
<td>7</td>
<td>Instituto Valenciano de Investigaciones Agrarias (IVIA)</td>
<td>IVIA</td>
</tr>
<tr>
<td>8</td>
<td>Meteosim S.L.</td>
<td>MET</td>
</tr>
<tr>
<td>9</td>
<td>eLeaf (WaterWatch BV)</td>
<td>ELEAF</td>
</tr>
<tr>
<td>10</td>
<td>Landwirtschaftskammer Niedersachsen (LWK)</td>
<td>LWK</td>
</tr>
<tr>
<td>11</td>
<td>LGRain GmbH</td>
<td>LGRAIN</td>
</tr>
<tr>
<td>12</td>
<td>Système Euro-Méditerranéen d'Information sur les savoir-faire dans le Domaine de l'Eau (SEMIDE/EMWIS)</td>
<td>EMWIS</td>
</tr>
<tr>
<td>13</td>
<td>Inergia Grupo Engineering &amp; Architecture S.L.</td>
<td>INERGIA</td>
</tr>
<tr>
<td>14</td>
<td>Eclareon GmbH</td>
<td>ECLAREON</td>
</tr>
<tr>
<td>15</td>
<td>Comunidad General de Regantes del Canal de Bardenas</td>
<td>CGB</td>
</tr>
<tr>
<td>16</td>
<td>Hydrologic BV</td>
<td>HR</td>
</tr>
<tr>
<td>17</td>
<td>Schulz+von der Ohe GmbH</td>
<td>DEROHE</td>
</tr>
<tr>
<td>18</td>
<td>ZIM Plant technology GmbH</td>
<td>ZIM</td>
</tr>
</tbody>
</table>
# Advisory board

<table>
<thead>
<tr>
<th>Scope</th>
<th>Member</th>
<th>Sector</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain/portugal</td>
<td>OMIE</td>
<td>Energy</td>
<td>Rafael Gómez-Elvira González</td>
</tr>
<tr>
<td>European union</td>
<td>EUWMA</td>
<td>Water management</td>
<td>Jörg Janning</td>
</tr>
<tr>
<td>European Union</td>
<td>WssTP</td>
<td>Technological association</td>
<td>Durk Krol</td>
</tr>
<tr>
<td>Spain</td>
<td>CHG</td>
<td>Water authority</td>
<td>Manuel Omedas</td>
</tr>
<tr>
<td>European Union</td>
<td>COPA COGECA</td>
<td>Farmers association</td>
<td>Tania Runge</td>
</tr>
<tr>
<td>Belgium</td>
<td>EnergyVille</td>
<td>Smart cities</td>
<td>Peter Verboven</td>
</tr>
<tr>
<td>Germany</td>
<td>Ministry of Food, Agriculture and Consumers Protection Lower-Saxony</td>
<td>Public institution</td>
<td>Dr. Volker Garbe</td>
</tr>
</tbody>
</table>
Steps

- Project total budget: 8,055,000 €
- EU contribution: 5,132,500 €
- 13\textsuperscript{th} September, 3\textsuperscript{rd} deadline: End of negotiation with EC.
- October: Grant Agreement signature
- All partners must sign GPFs (Grant Agreements preparation Forms).
- Consortium Agreement in parallel
- Project duration: 42 months.
DANKE FÜR IHRE AUFMERKSAMKEIT

THANK YOU FOR YOUR ATTENTION

EURO-MEDITERRANEAN IRRIGATORS COMMUNITY (EIC)

E-mail: eic@fenacore.org
Tel: +34 91.563.63.18 / Fax: +34 91.563.62.53

www.e-mic.org