Renewable energy in the water-energy-food nexus
The water, energy and food *nexus*

A transformation in one sector has ripple effects on others
What does the energy transition mean for the nexus?
Assessing impacts of the transition across sectors crucial to tap into synergies, address trade-offs and maximise benefits.
Renewable energy in the food supply chain

Energy inputs (traction, electricity, mechanical, heat/cooling)

<table>
<thead>
<tr>
<th>Primary Production</th>
<th>Post-Harvest and Storage</th>
<th>Transport and Distribution</th>
<th>Processing</th>
<th>Retail, Preparation and Cooking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar, wind-based water pumping</td>
<td>Solar, geothermal food drying</td>
<td>Biofuel use for transportation and distribution</td>
<td>Solar, wind, hydro-based milling, threshing</td>
<td>Renewable energy-based water purification</td>
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<td>Biofuels for tractors and on-farm machinery</td>
<td>Solar cooling and refrigeration</td>
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<td>Renewable energy-based electricity and heat applications</td>
<td>Modern biomass use for cooking applications</td>
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<td>Solar-based desalination, heating and cooling for protected cropping</td>
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<td>Biomass residues use for on-site energy generation</td>
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<td>Indirect renewable energy inputs for fertilisers</td>
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Source: Based on FAO, 2011b; Practical Action, 2012

Assessing socio-economic benefits of renewables in agri-food chain

Off-grid renewable energy applications in the agriculture sector offer substantial opportunities for stimulating socio-economic development.
Solar-powered irrigation increasingly adopted in many contexts, with multiple benefits: resilience, cost-savings, productivity, lower pollution.

Source: IRENA
In 2014, energy sector accounted for ~10% of total worldwide water withdrawals and ~3% of water consumption.

- Rapid growths in water withdrawal in developing Asia as power generation capacity grows to keep pace with demand.
- Competition for limited water resources compelling governments to adopt measures that reduce the water intensity of power generation.

Source: IEA, 2016
Some renewable energy technologies (e.g. solar PV, wind) are significantly less water intensive than conventional

**Operational water withdrawals**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Water Withdrawals</th>
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<tbody>
<tr>
<td>Wind</td>
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<tr>
<td>Solar PV</td>
<td></td>
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<tr>
<td>Geothermal</td>
<td><img src="image" alt="Geothermal" /></td>
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<tr>
<td>Natural Gas</td>
<td><img src="image" alt="Natural Gas" /></td>
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<tr>
<td>CSP</td>
<td><img src="image" alt="CSP" /></td>
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<tr>
<td>Coal</td>
<td><img src="image" alt="Coal" /></td>
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<tr>
<td>Nuclear</td>
<td><img src="image" alt="Nuclear" /></td>
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</tbody>
</table>

Operational water withdrawal, median values.
1 drop = ~100 gal/MWh. Source: based on NREL data

- In producing electricity:
  - Wind consumes the least amount of water during operation compared to conventional technologies
  - Solar PV consumes up to 25 times less water than nuclear, gas and coal
  - Water impacts of more water-intensive technologies need to be accounted for and managed
  - Trade-offs between cooling technologies and carbon
An increase in RE deployment in line with NDC objectives and IRENA's REmap 2030 options, coupled with improvements in cooling technologies, could reduce the water- and emissions-intensity of power generation by up to 42% and 37% respectively by 2030.
Renewable energy integration in the water supply chain can improve accessibility, affordability and safety.
Steps towards integrated planning

• Identifying entry-points for water into energy planning and programme design:
  • Introducing water constraints in centralised energy sector planning tools (e.g., in South Africa with WB/Thirsty Energy)

• Building a data and information base that can inform decision making:
  • Reporting water use of power infrastructure (renewable and non-renewable) and cooling tech adopted
  • Establishing common statistical frameworks for gathering country-level data related to ‘water in energy’ and ‘energy in water’

• Adopting an end-use application oriented approach to renewable energy deployment could unlock new applications and innovations – from kWhs to services

• Agricultural and water energy demands can serve as effective anchor loads for rural electrification initiatives
Achieving the Sustainable Development Goal on energy will transform the energy system while helping meet other SDGs

Source: IRENA
Thank you!
IRENA’s work on the nexus

- IRENA’s nexus work stream launched in 2013 to address the knowledge gap on interactions of renewables in the nexus.

- Highlights:
  - First major publication focusing on the RE dimension of the nexus in January 2015
  - Case study on impact of renewables on water intensity of power in China
  - Renewables-based desalination: GCC Market Analysis
  - RE Benefits: Decentralised Solutions in Agri-Food Chain
  - Policy brief on Solar Pumping for Irrigation
Key Policy Messages

- Foster innovation and flexibility in the delivery of solar pumping solutions
- Focus on after-sales support and capacity building
- Assess the direct and indirect impacts on water resources
- Consider the influence of availability and cost of energy on the choice of crops grown
- Account for target groups and market sustainability when designing financial instruments
- Package energy and water-efficient solutions
- Monitor performance and gather data
- Adopt an integrated approach to programme design