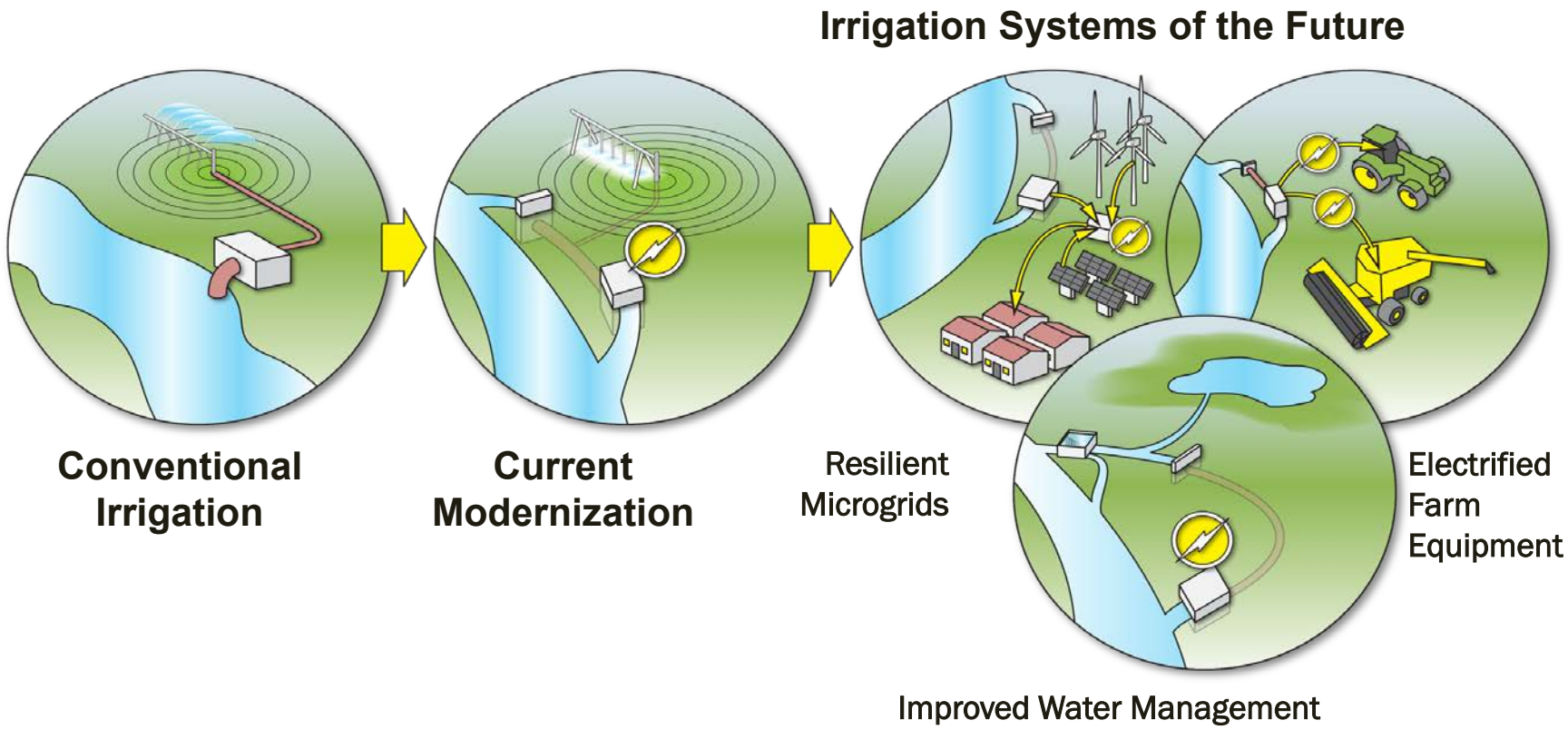
Accelerating Irrigation Modernization

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



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FARMERS CONSERVATION ALLIANCE fca

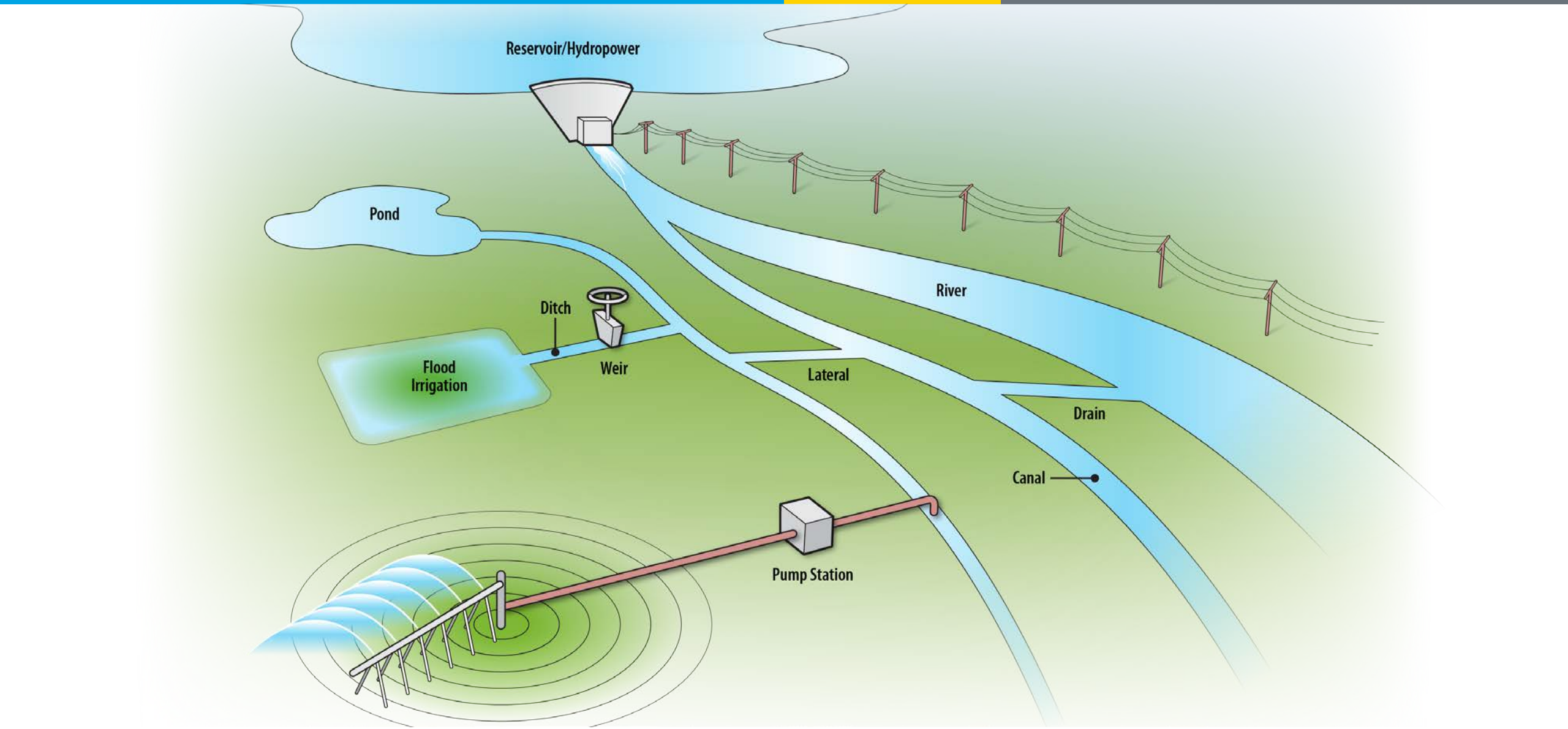
Thomas Mosier, INL
Bo Saulsbury, PNNL
James Kershaw, PNNL

Water Power Technologies Office
R&D Deep Dive Webinar Series
June 2, 2021

Webinar agenda

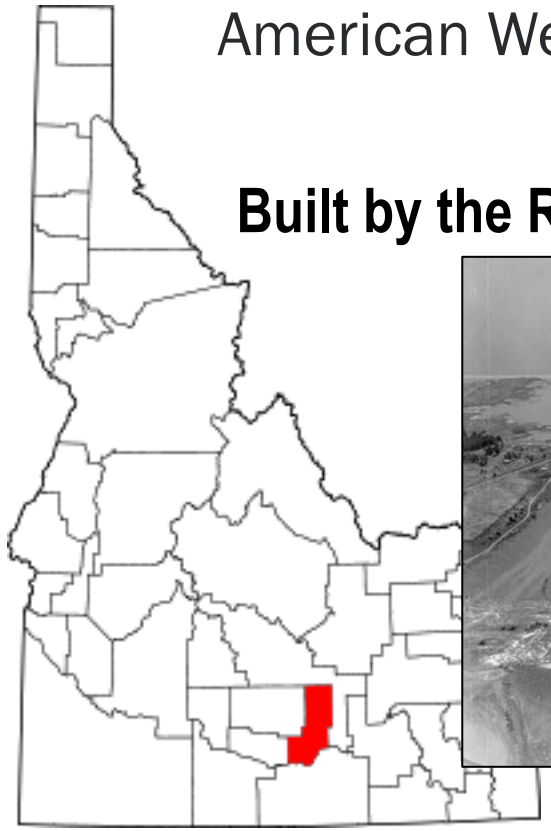
- **WPTO intro:** Maxine (5 min)
- **National context:** Thomas (10 min)
- **Supporting Irrigation Planning:** Bo (10 min)
- **IrrigationViz Demo:** James (15 minutes)
- **Future direction:** Thomas (5 minutes)

What is an irrigation system?



Federal investment in water enabled the West as we know it

- **Example:** Minidoka Dam in SE Idaho enabled agriculture, electricity, commerce, and recreation for the region.
- Reclamation projects provide water to one-third of the population of the American West.



Built by the Reclamation Act of 1902

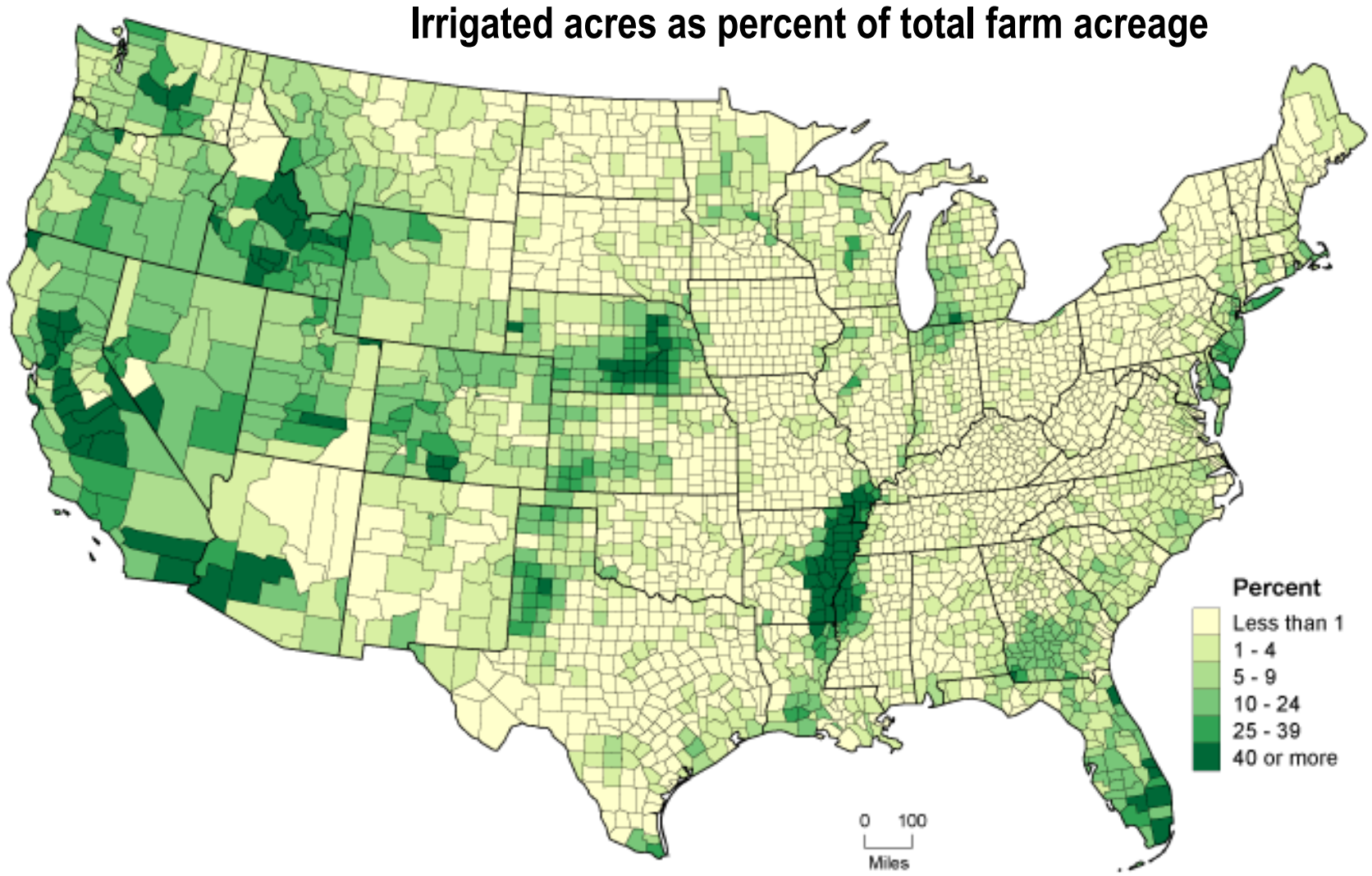
125,000 irrigated acres

16 MW of energy

Regional recreation

Irrigation enables agriculture, particularly the Western U.S.

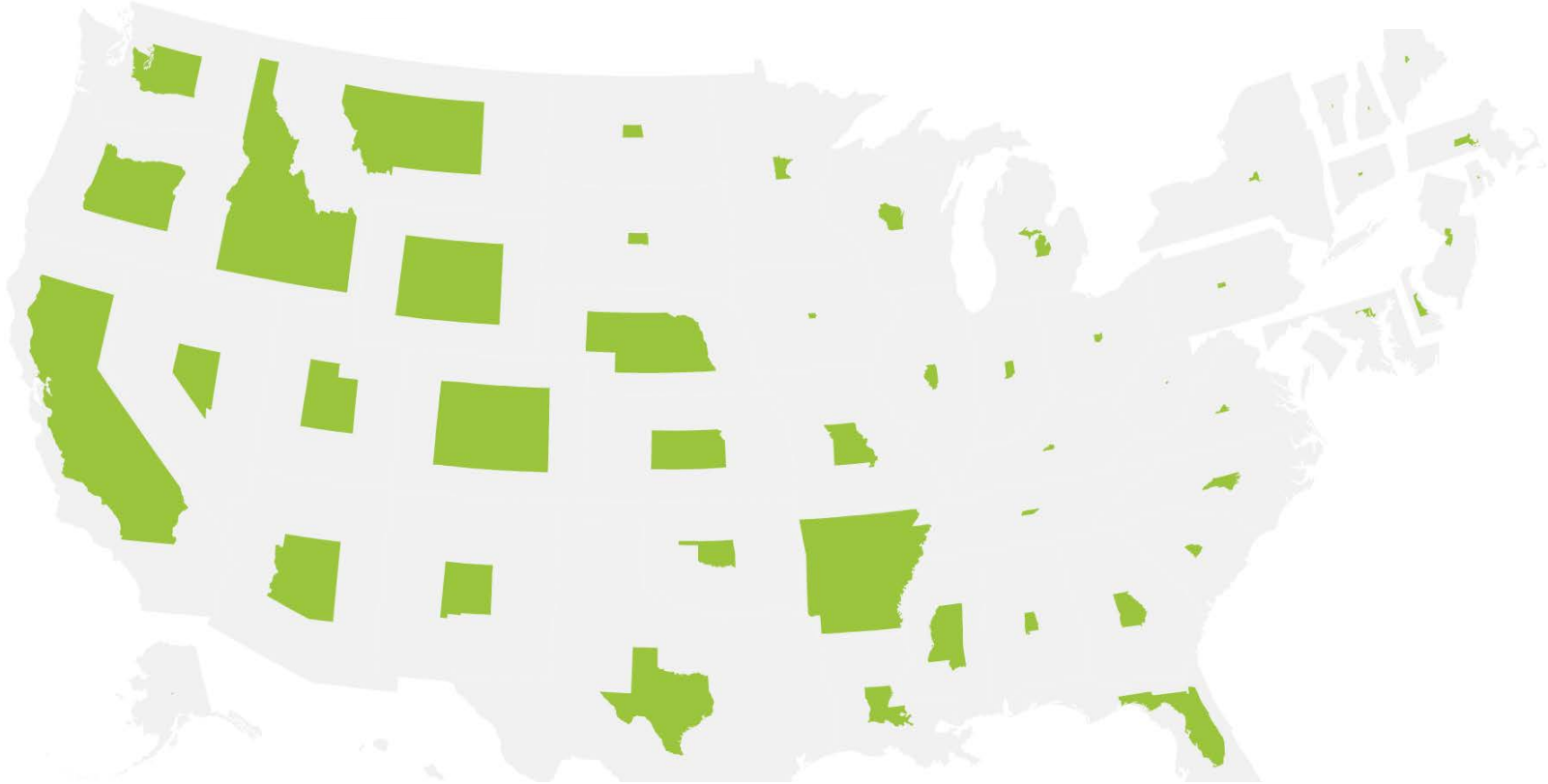
Crops from irrigated land are ~50% of crop market value in U.S. ($106B in 2012)



Irrigation is 37 percent of all water use in the U.S.

- Irrigation uses 846 million gallons per day. [1]
- Outdated irrigation systems can lose up to 30 percent of their water (mostly from seepage into the ground).[3]

Irrigation water use by State (size proportionate to use)



The existing system can be up to 120 years old

- **Operations and maintenance is expensive**
  Modernization reduces these costs
- **Loses 30 to 80 percent of water**
  Modernization enables more water to be left in rivers
- **Requires extensive pumping**
  Modernization reduces costs and diesel consumption
- **And the list of benefits goes on…**

Questions?

Recap:

- Irrigation systems critical for agriculture across diverse regions of the U.S.
- Much U.S. irrigation infrastructure developed during early 20th century
- Modernization provides the opportunity to provide diverse benefits, helping farmers and rural communities, the environment, and energy system

Our work for WPTO: how can hydropower help enable the many benefits of irrigation modernization?

- Started in FY19: INL and PNNL began working with Farmers Conservation Alliance to answer this question.
- FY19: short-term scoping exercise demonstrated benefits and pathways for irrigation modernization through two case studies in Oregon (Central Oregon ID and East Fork ID).

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CENTRAL OREGON Irrigation DISTRICT Since 1918

EAST FORK IRRIGATION DISTRICT

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Learned that modernization can achieve diverse benefits

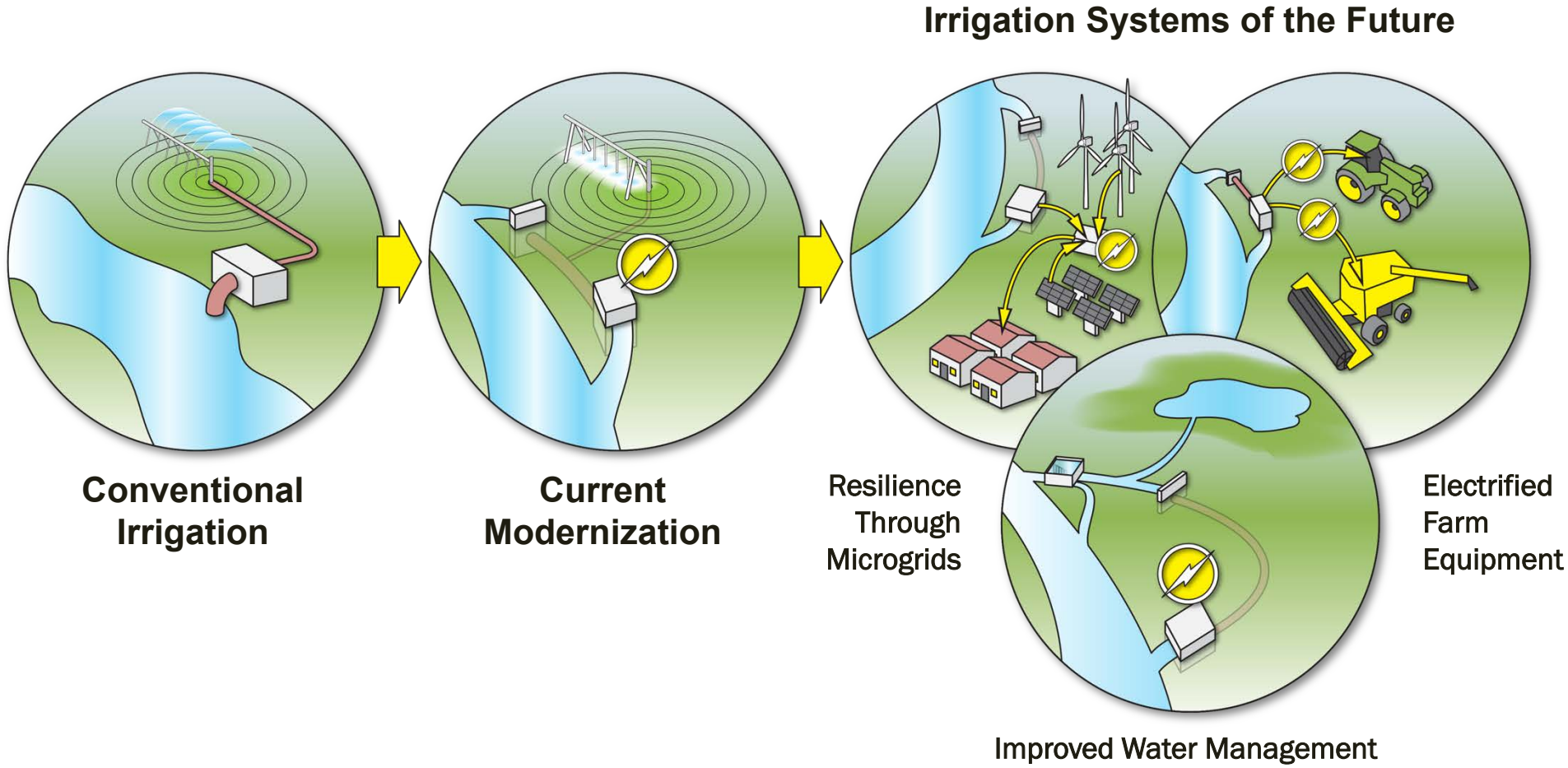
- **Rural economies** – More revenue for farmers; well-paying, multi-year construction jobs; increased recreation opportunities
- **Environment** – Increased water for fish and other species; pollinator corridors; less chemical use
- **Renewable energy** – Increased opportunity for hydropower and solar PV; local energy ownership and benefits
- **Climate** – Lower carbon agriculture; increased water supply reliability

Annualized average value for two case studies

	Central Oregon *includes hydro*	East Fork *no hydro*
Reduced district OMR	$70,000	$248,000
Reduced patron OMR (total)	$810,000	$347,000
Increased agricultural income (total)	N/A	$1,516,000
District energy generation	$2,378,000	N/A
Environmental benefits	$6,097,000	$295,00
Per district subtotal	*$9,600,000*	*$2,445,000*
Per patron subtotal	*$437*	*$1,882*

Learned that hydropower's role in irrigation modernization is changing

What are the value propositions that help us accelerate irrigation modernization and co-development of hydropower into the future?



Learned that design stage planning is critical, but also a challenge

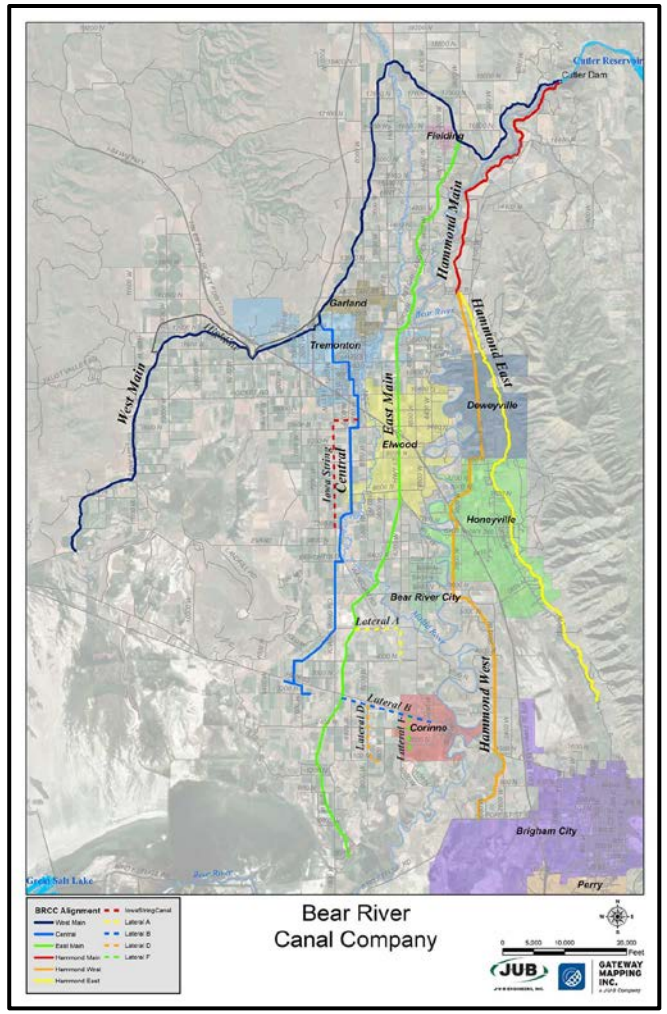
- **Expensive**
  $100Ks just to do initial design
- **Requires specialized knowledge**
  Irrigation district managers know their systems best, but may want help analyzing modernization options
- **Many, diverse stakeholders**
  No simple, user-friendly tool to communicate across perspectives

How do we address these challenges?

- FY20: developed *prototype* visualization tool (IrrigationViz) to assess modernization options (more details on the tool later).

- Implemented functional version based on one case study (Bear River Canal Company, Utah) supporting multiple uses cases.

- BRCC's highest priority modules for tool
  - Piping and lining: how much would it cost to convert?
  - Water conservation: how much water is saved from lining or pipes?
  - Hydropower: how much generation potential is there?
  - Agriculture: How could conserved water be used for planting additional acres?
  - Aquatic weed control: How much money is saved on chemicals and labor by piping?



How do we address these challenges?

- FY21: developing additional IrrigationViz functionality to support development of *pilot* version, including: (1) important modules not core to FY20 BRCC case study (e.g., groundwater recharge, recreational flows) and (2) enhanced dashboard features.

- FY21 development based on two case studies: East Columbia ID, Washington, and Minidoka ID, Idaho.

- Work with IDs to identify their high priority use cases for module development and incorporate ID-specific data (infrastructure, flows, etc.).

- Also, with FCA conduct stakeholder engagement beyond these two IDs to identify stakeholder values, perspectives, and jurisdictional considerations.

IrrigationViz is composed of rigorous decision support model and web-based user interface

Decision Support Model

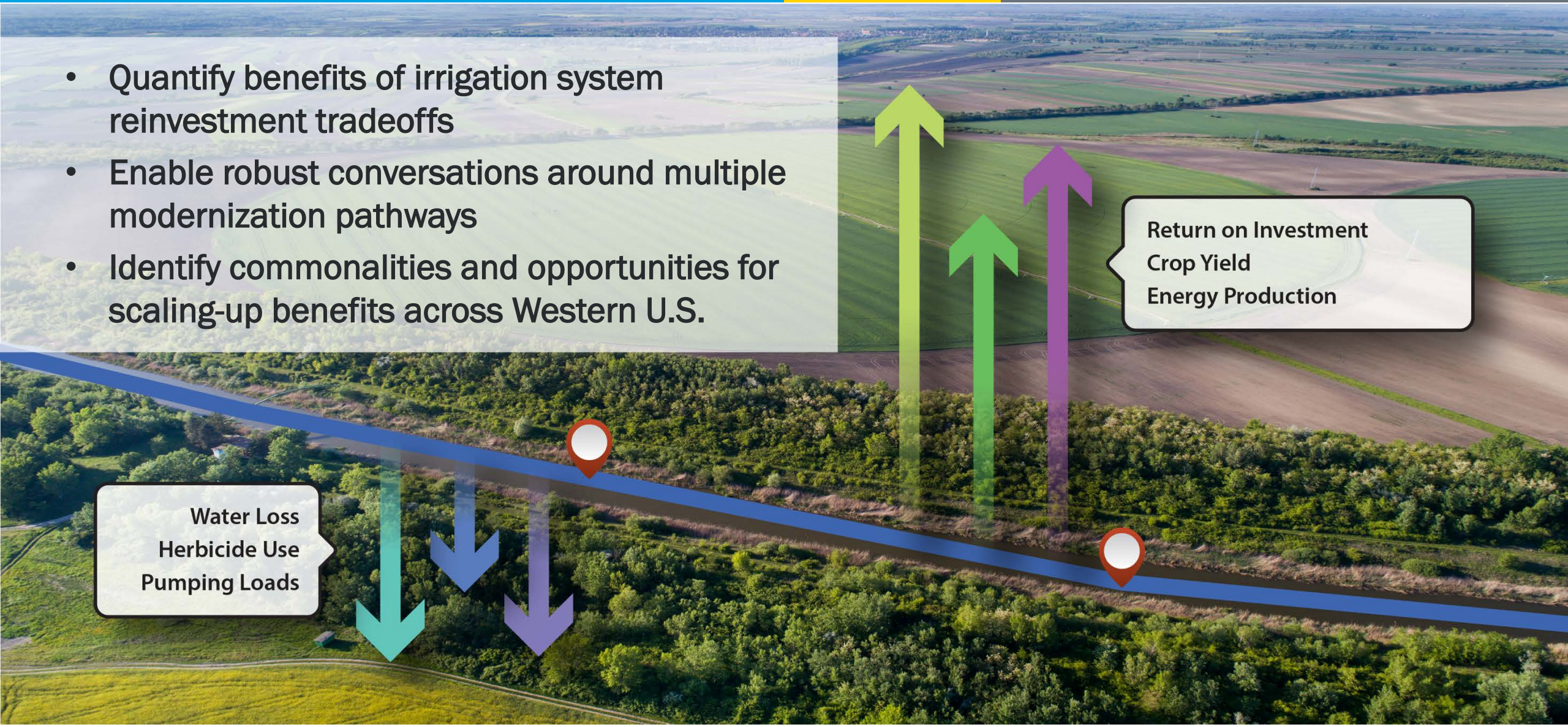
- Composed of multiple process modules (e.g., hydropower, water loss, ag potential, water purification, etc.)
- Assesses modernization benefits and costs based on design choices

Web-based Dashboard

- User loads current infrastructure and inputs "what-if" upgrade scenarios
- Sees tradeoffs of choices in near real-time
- Can generate output statistics and reports to support next steps

IrrigationViz helps solve challenges

- Quantify benefits of irrigation system reinvestment tradeoffs
- Enable robust conversations around multiple modernization pathways
- Identify commonalities and opportunities for scaling-up benefits across Western U.S.

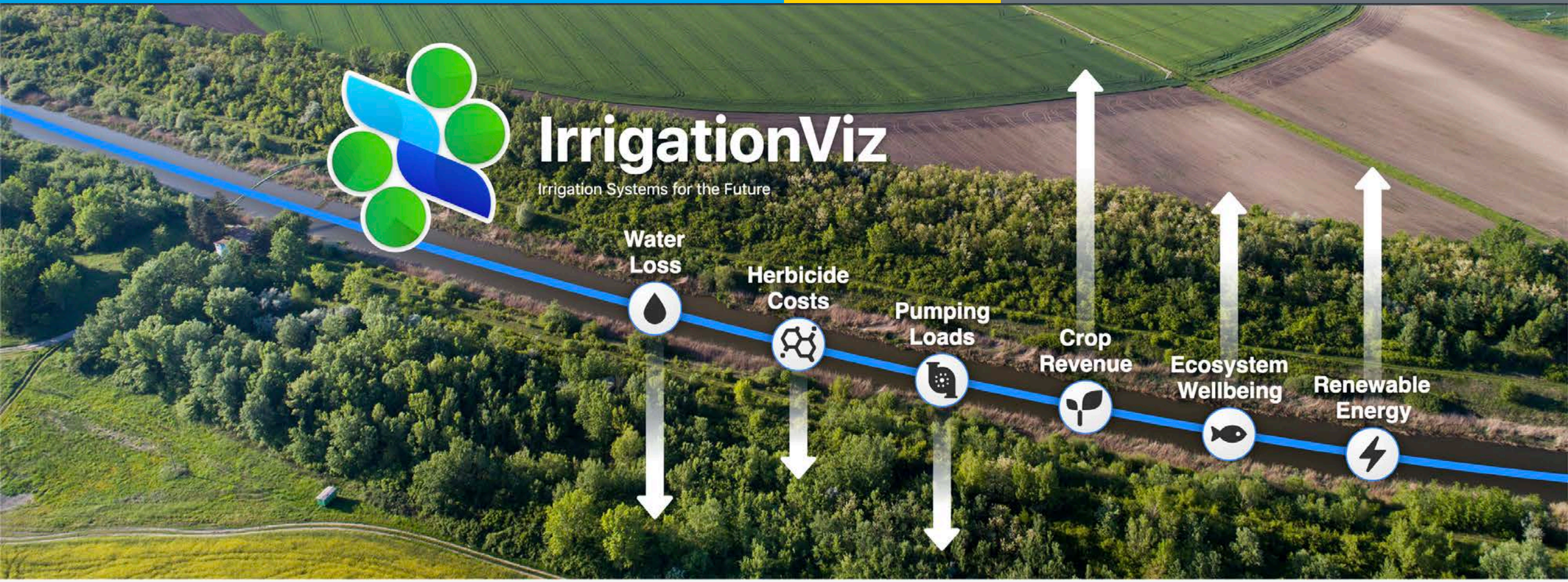


Questions?

Recap:

- Innovation in energy systems is enabling diverse opportunities for using clean energy in irrigation contexts
- Master planning reinvestment is expensive and requires specialized knowledge, creating inequities between communities
- IrrigationViz is a planning tool to help irrigation districts design projects and prioritize investments

IrrigationViz



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IrrigationViz Demo

DEMO

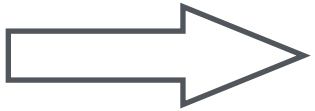
Energy I-Corps

ENERGY I-CORPS
U.S. Department Of Energy

Workshops

+

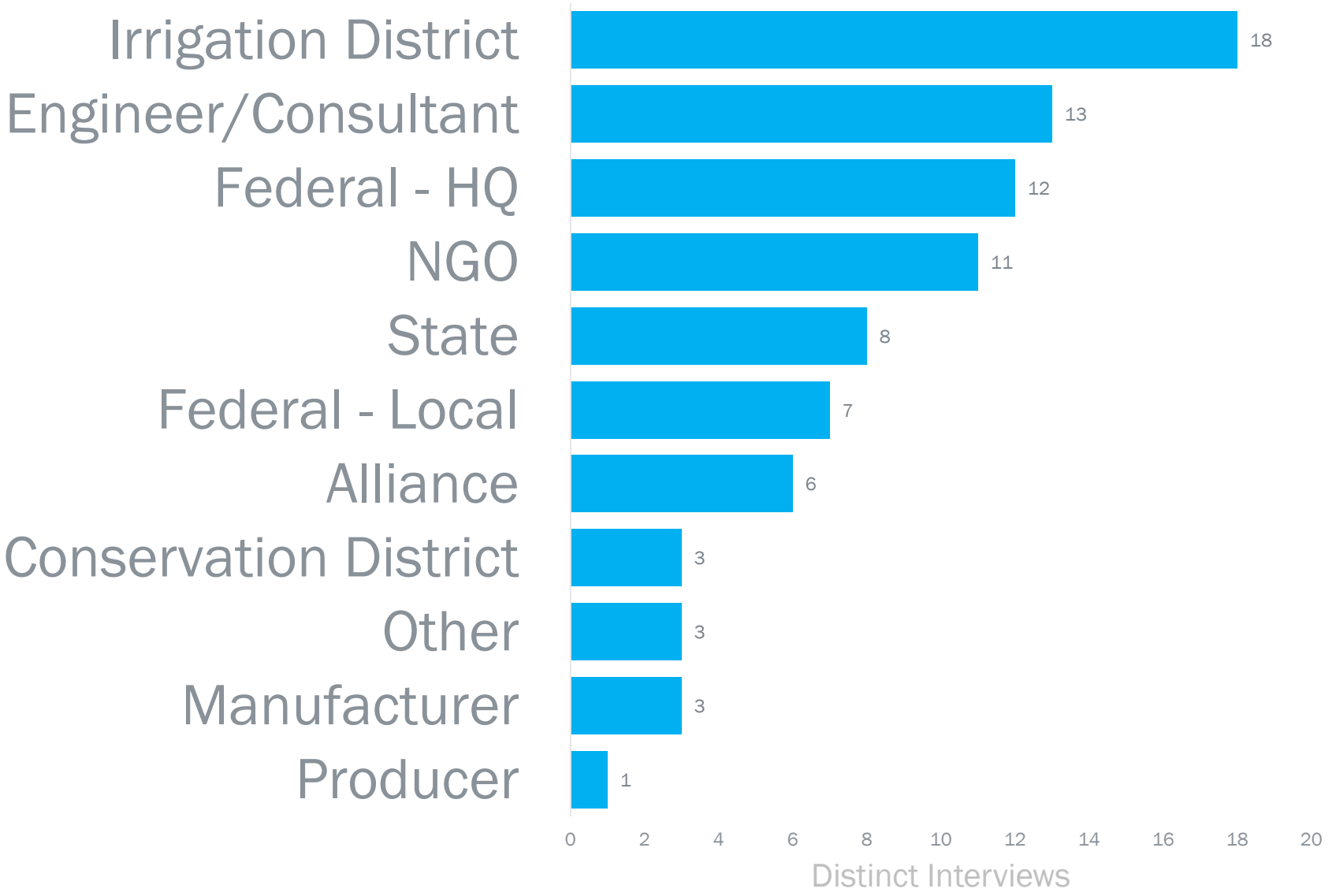
Customer Interviews



Viable Market Pathway

https://energyicorps.energy.gov/

Energy I-Corps

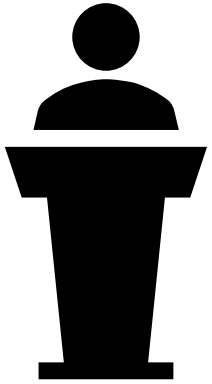


96 Interviews

Value Proposition

Irrigation District Manager

Instant pre-engineering estimates to understand and plan the needs of the district



State Program Managers

Improved visibility into area needs in order to invest capital more strategically

IrrigationViz - Future

Continued module development

e.g. Groundwater recharge, recreational benefits

Further customization

e.g. additional user inputs and overrides

Comprehensive Planning

e.g. Master planning, full district analysis

Questions?

Recap:

- IrrigationViz leverages **user-inputs** and known **datasets** to produce estimates based on researched-based **data models and formulas**.
- The IrrigationViz team participated in a DOE program called Energy I-Corps to explore market viability.

Demonstration and Deployment
The next step in irrigation modernization

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Status quo

Existing irrigation systems

- Infrastructure is over 100 years old
- Loses 30% of water to seepage
- Has high O&M costs

Solution

Pre-engineering design

IrrigationViz

- Bring together diverse stakeholders
- Design infrastructure packages based on cost and benefits
- Connect investments to funding opportunities

Demonstration

Physical test sites

Digital platform

- Verification of benefits
- Reduce the cost and time of construction
- Apply lessons to new sites

Opportunity

Irrigation system of the future

- Infrastructure to meet 21st century needs
- Provides diverse benefits to communities, food supply, renewable energy, and environment

Digital integration amplifies reach of physical demonstration

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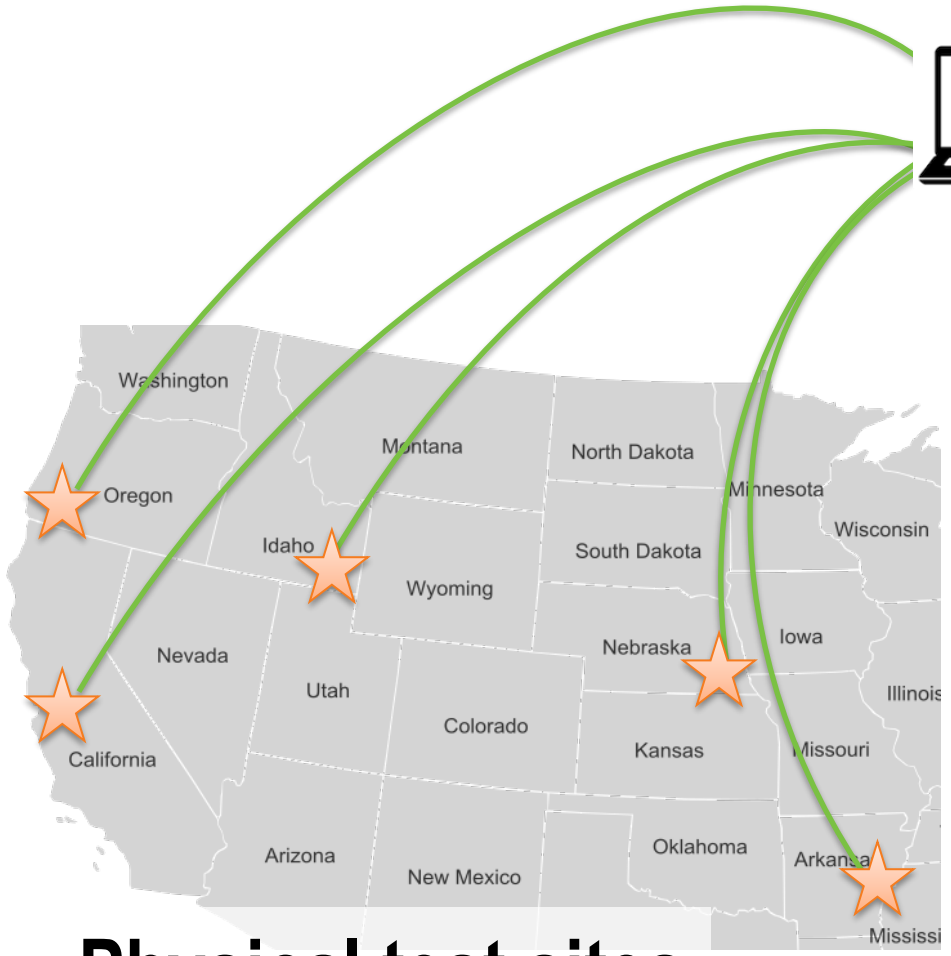

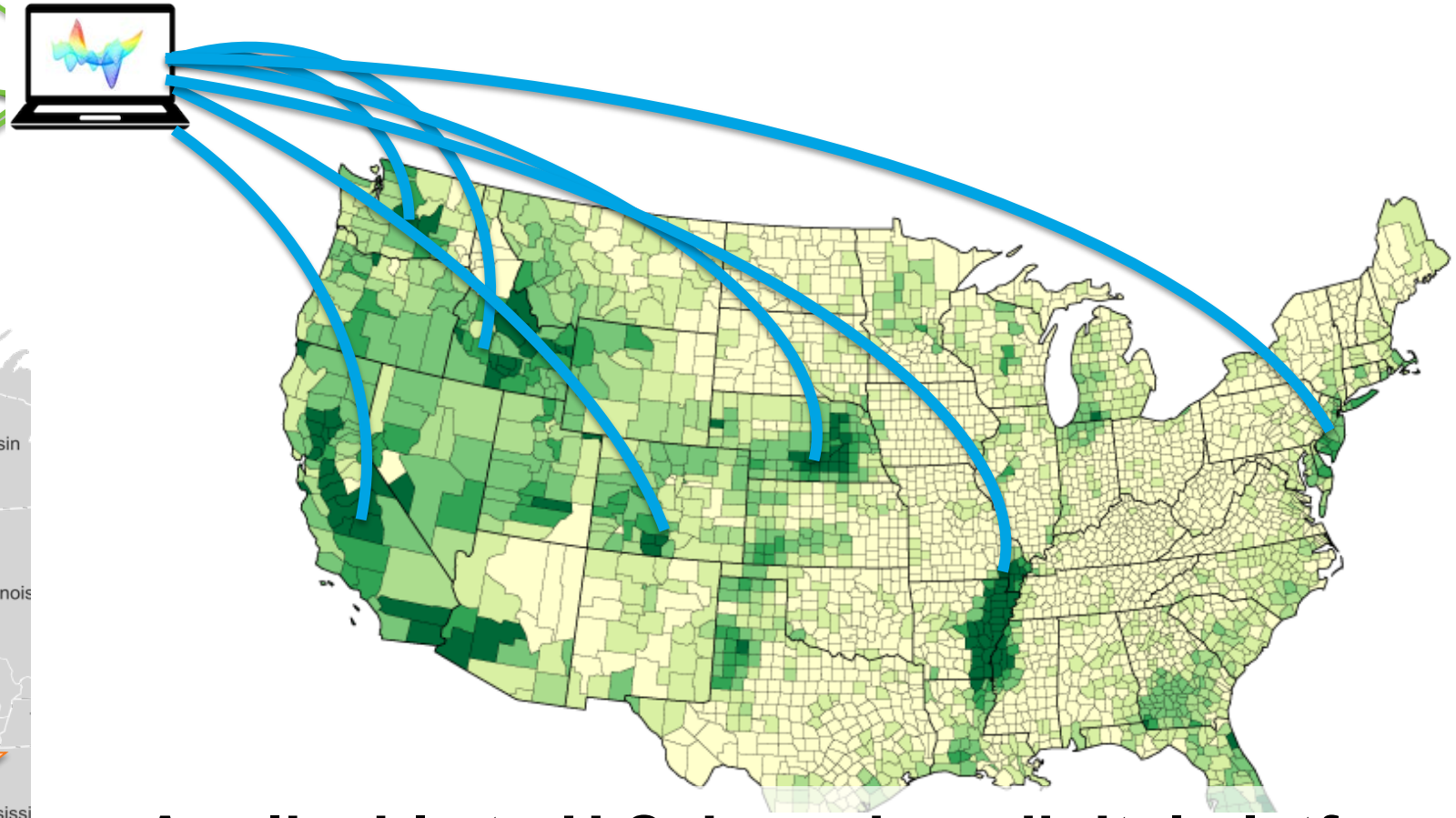

Physical test sites

Applicable to U.S. based on digital platform

Modernizing irrigation infrastructure achieves diverse benefits

Recap:

- Federal investment in water and irrigation during the early 20th century enabled agriculture and rural communities across much of the U.S.
- Demonstration and deployment programs can help achieve diverse 21st century objectives:

Sustainable water resources

- Secure water resources for agriculture and enhance community and environmental benefit
- Adapt to unavoidable impacts of climate change

Community wellbeing

- Increase agricultural revenue
- Create multi-year well-paying jobs
- Reinvest in rural communities
- Promote environmental justice and sustainability

Decarbonization

- Generate community-owned renewable energy
- Enable precision and low-carbon agricultural practices
- Reduce fuel consumption
- Increase energy efficiency for farmers and ranchers

Send us a note if you have questions!

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Thomas Mosier
Thomas.Mosier@inl.gov

Bo Saulsbury
James.Saulsbury@pnnl.gov

James Kershaw
James.Kershaw@pnnl.gov

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