SOCIETAL AND ECONOMIC ACCEPTANCE OF NEW TECHNOLOGY, MANAGEMENT PRACTICES AND HIDDEN COST TRANSFERS

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The FEWSTERN Research Challenge Meeting
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FEW – Global Stressors

- Population growth – expected to grow by 70% by 2050
  - Food demand is expected to increase by 60%
  - Global arable land will increase by 4.5%, mostly in developing countries /areas where consistent rain is unreliable.
  - More investments needed for irrigation - 16% of the total cultivated area is expected to be responsible for 44% of total crop production
  - Global energy demand likely to rise by 80%, and demand for bio-fuels expected to grow threefold
  - Increased competition over water with agriculture due to sharp increases in domestic and industrial water use; potentially causing 18% reduction in the global availability of water for agriculture by 2050.

Source: WBCSD – Business Solutions for a Sustainable World, 2014 http://www.eldis.org/document/A68414 or http://wbcsdservers.org/wbcsdpublications/cd_files/datas/business-solutions/water_leadership/pdf/WBCSD_Nexus%20challenges.pdf

FEW – Global Stressors "Wake Up Before It Is Too Late" UN Commission on Trade & Development

➢ Climate Variability / Extreme Weather Events/**Resiliency**:

- Land use, resource "productivity" "ecological intensification" *[Deloitte Review 2016: From Dirt to Data]*
- Increasing temperatures decrease farm productivity
- Energy and the food system represent almost half of global GHG emissions. Overall, emissions will increase by 50% between 2012 and 2050
- International food and agriculture trade needs to be reformed
- Food chain waste production, water and energy usage need to be reduced
- Fertilizer use needs to be optimized
- Shift from conventional mono-culture to mosaics crop diversification systems

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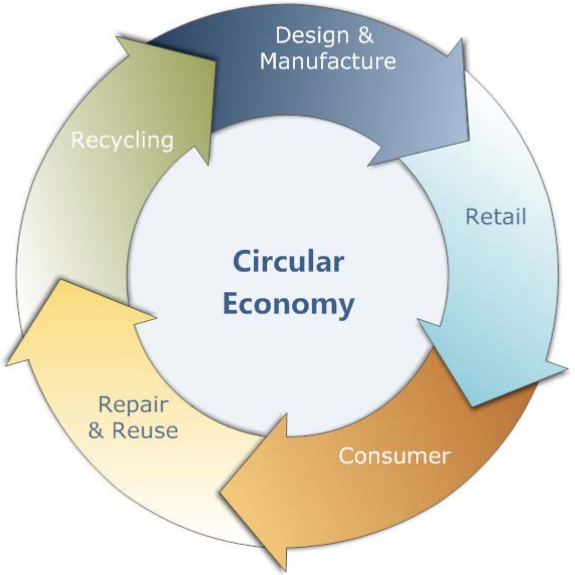
Stress on FEW Resources => Innovation*

- Innovation in the study of “nexus” relationships, systems-integration and interconnectedness with added *contextual* elements and parameters:
  - Education, acceptance, validity of new technologies
  - Behavioral and sociological: stakeholder input and need
  - Local geography, scalability, granularity
  - Policies, regulations, governing bodies



- Promotion of a *circular economy*
  - Uncouple resource use from economic growth
  - Increase productivity while decreasing use of materials
  - Resource recycle, repair and reuse
  - Reduce waste generation and harvest resources from waste streams

William Sarni, *Beyond the Energy–Water–Food Nexus*
New Strategies for 21st-Century Growth” W. Sarni, June 2015, Greenleaf Publishing

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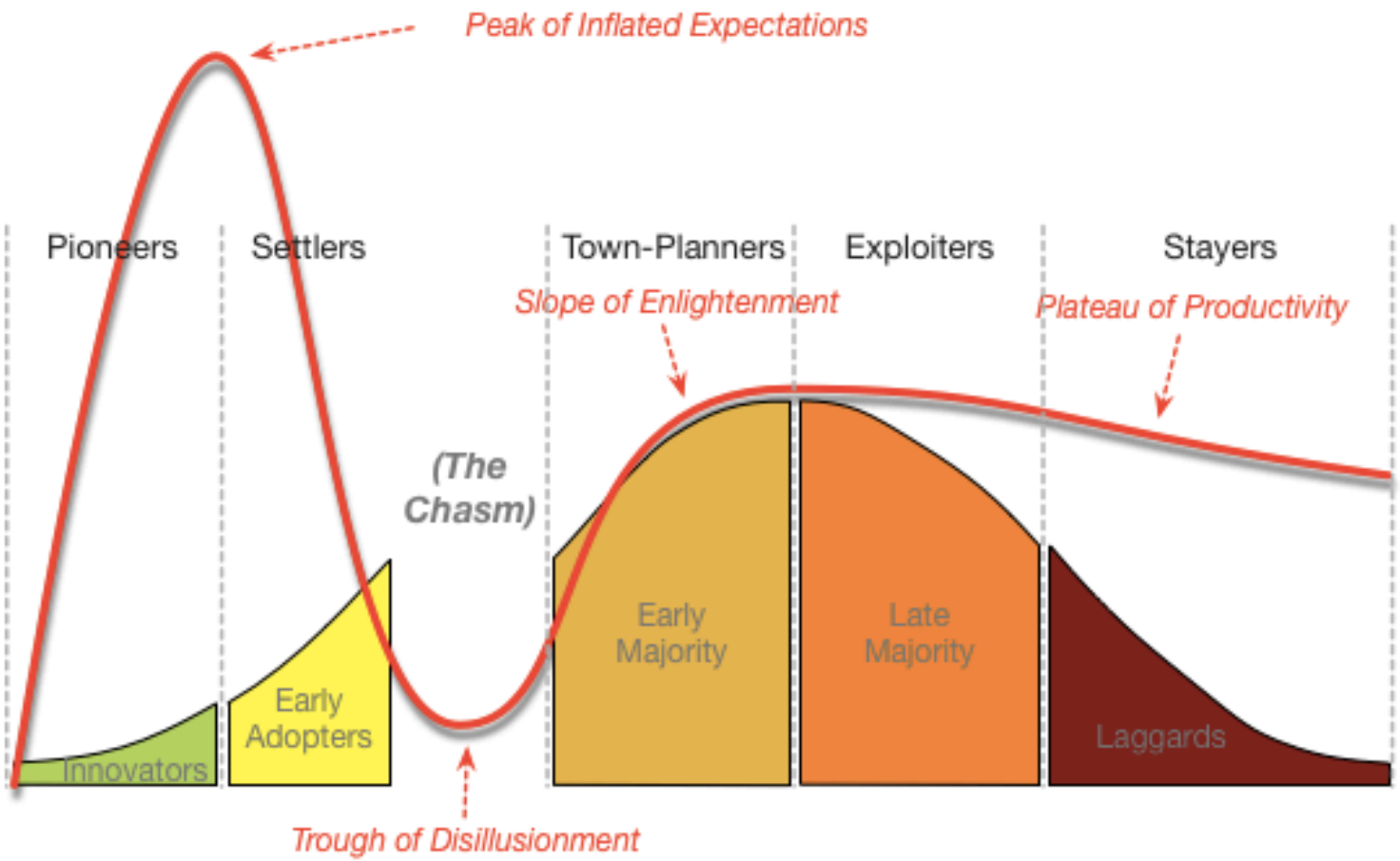
Technology Adoption Model



Joe@foundersresearch.com Joe Betts-Lacroix

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Barriers to Adoption of Technological Innovations

Certain technology (equipment or IT) solutions are not readily adopted by stakeholders: utility and water managers, farmers, urban planners, decision makers, despite great potential impacts due to:

1. Inadequate knowledge about the innovations which limits their broad adoption
2. Technology limitations result in lack of societal acceptance
3. Questions about marketability / practicality
4. Economic profits remain to be demonstrated

Illustrative Case 1: *Zero Mass Water* as a localized-distributed solution

This nano-materials-based technology extracts humidity out of the air, using solar-powered fans to draw ambient air into the device

Two-panel array produces 5 liters of drinking water per day

Source: Miguel Heff, Forbes, Nov. 15, 2017

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Hydropanels - $24M Invested but Challenges Remain

1. Relatively new technology: Since 2014 - no broad knowledge about it to determine its wide acceptance/implementation
2. Technology limitations: It does not generate enough volume to make it viable for general home use, industrial use, or irrigation
3. Questions about its marketability/practicality: Can it be used in arid regions? (Yes, e.g. Arizona); Can system provide independence from the water utility grid?
4. Economic benefits remain to be demonstrated: Typical setup for a home is $4,500 – only for drinking water; Households still rely on utility for other usages

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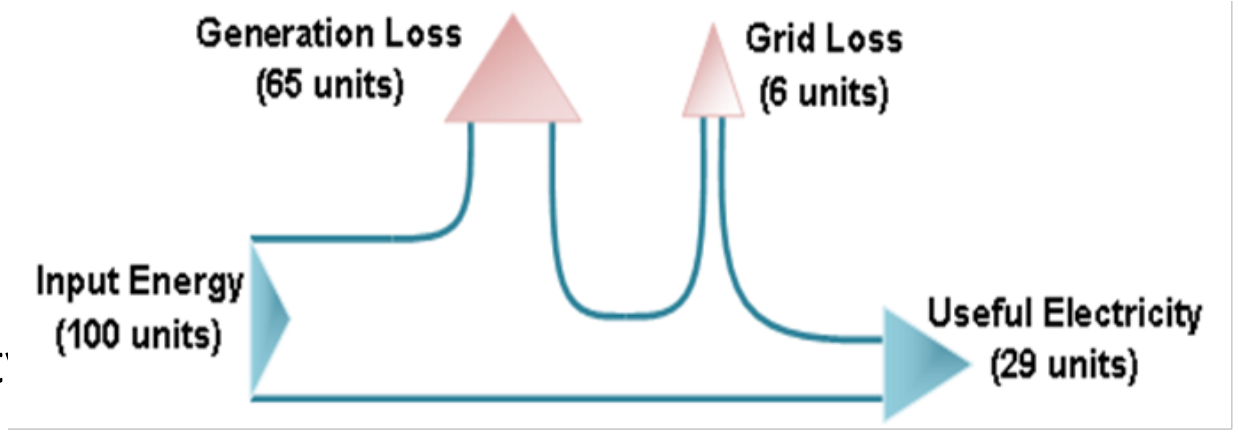
Case 2: Urban Innovation - Infrastructure Ecology

Opportunities for integrated systems at the building or district level:

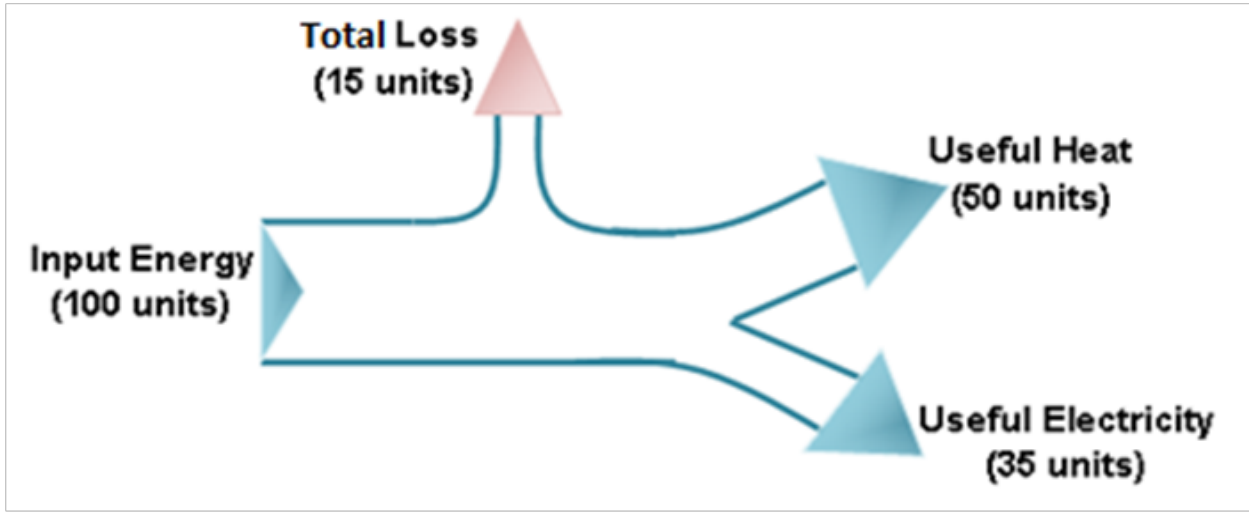
Air-cooled micro-turbine for heating & electricit generation, linked to an absorption chiller for cooling

Combined cooling, heating and power

Recovery & reuse of grey water



Separate Electric Power



Combined Heat and Power

Urban Innovation: Infrastructure Ecology Challenges

1. Infrastructure Ecology is a relatively new field - need to build a database of demonstration projects

1. Factors hindering its broad acceptance:

- Synergies may be easier to find in new developments as opposed to already built assets
- Decentralized services versus centralized utilities (does duplicating services make sense?)

3. Remaining questions: reliability issues of decentralized services;
At what level do synergies for decentralized services work? District? Building?

4. What happens to the economic bottom line of current utilities?

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Case 2: IoT, AI, Big Data, and Connectivity Technology Solutions

FACT: By 2020 – 20 billion connected IoT devices and 5,000 gigabytes of data on each person on earth

- Low-energy desalination; **smart** precision agriculture; urban agriculture etc
- Remote global water resources data collection via NASA GRACE satellites or drones
- Data display on mobile apps

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Accelerating Change and Finding Solutions

By engaging stakeholders

- Via education and outreach to co-create aligned action initiatives that address challenging FEW issues affecting a community, industry, or territory
- Via advocacy with local and state and federal government

Fostering broad partnerships and networks

- "Integrated" resource management can benefit collaborative frameworks, integrating diverse perspectives and disciplines
- Favor diversity of partners – multi-sector, including NGOs, industry, private and public sector, researchers, innovators, investors

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Accelerating Change and Finding Solutions-cont.

Public policy and "collaborative regulation":

- Regulatory bodies and utilities can't continue to operate in silos
- They need to recognize "nexus effects" and favor "joint" efficiency programs among utilities
- They need to identify synergies and integrated solutions among FEW systems
- They need to recognize current regimes' limitations and question current practices that need to change (e.g., water allocations and/or subsidies to grow crops in arid regions)

Proposed initiatives to accelerate innovation

- Prizes (X-Prize in NY State)
- Crowdsourcing
- Other financing strategies, subsidies, tax abatements

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Accelerating Change and Finding Solutions-cont.

Hidden cost transfers: externalities and ecosystem damage

- The external costs for FEW resources/ecosystem services are not reflected in commodity prices and there are no incentives for producers to conserve resources (e.g., water used for energy generation or food production)

- When natural resources are scarce, and clearly limit production, there is an opportunity for policymakers or the market to force producers to pay for, or "internalize," the cost of of natural resources

ACS Sustainable Chem. Eng., **2017**, *5* (3), pp 2119–2128; e360.yale.edu; resources for the future Maureen Cropper

Industry/Private sector:

- Industry is likely to adopt innovative management practices faster once bottom line is affected by resource constraints
- NGOs and professional societies need to highlight the need to stop transferring external costs of private operations (pollution) to society

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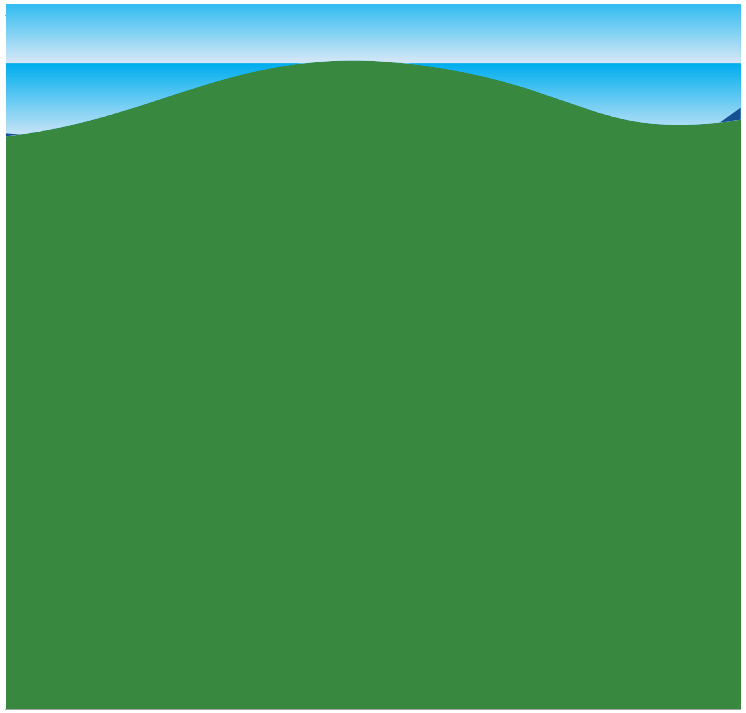
AIChE The Global Home of Chemical Engineers

Knowledge Dissemination



- Special peer reviewed journal issues
- Public policy statements
- White papers for presentation to gov officials
- Reports
- Opinion articles in major news outlets
- Media appearances
- Stakeholder social media campaigns/surveys
- Engagement meetings with key players/groups
- Data access and sharing
- New knowledge creation/education

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Conclusions

1. Networks and partnerships on FEW systems-interdependency, integration, constraints, and tradeoffs are paramount for the creation, testing and adoption of novel frameworks

2. Transformative technologies should be embraced

3. Multiple stakeholder perspectives and sectors (private & public) should be engaged to bring about economically acceptable and sustainable societal gains

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QUESTIONS?

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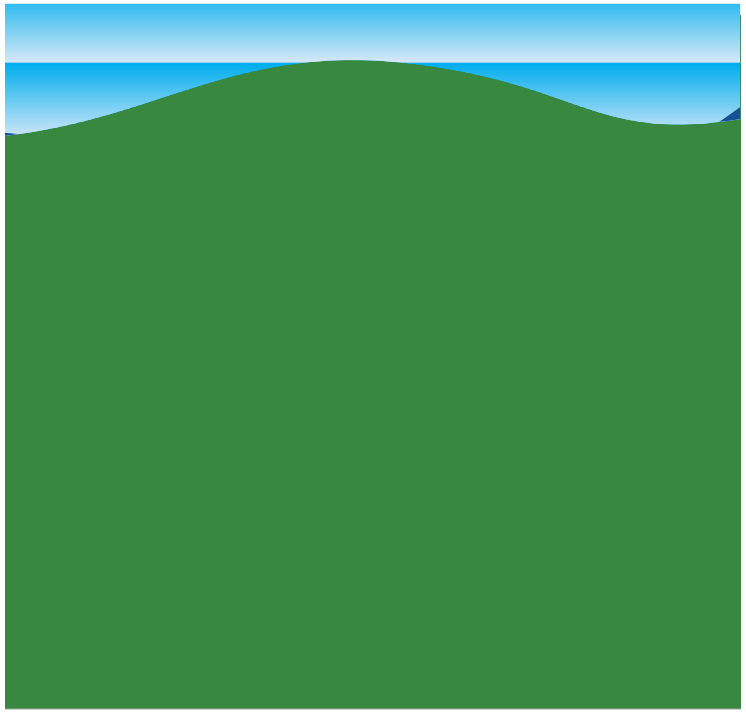
Knowledge Dissemination – Special January Issue!



- FEW Nexus: sustainability challenges
- Anthropogenic disruptions to vital FEW resources
- Research advances on systems-based analysis of complex FEW systems
- Public policies and allocation approaches for a more efficient and equitable management of FEW resources
- Sensors and information systems for real-time monitoring and analyses of FEW

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