



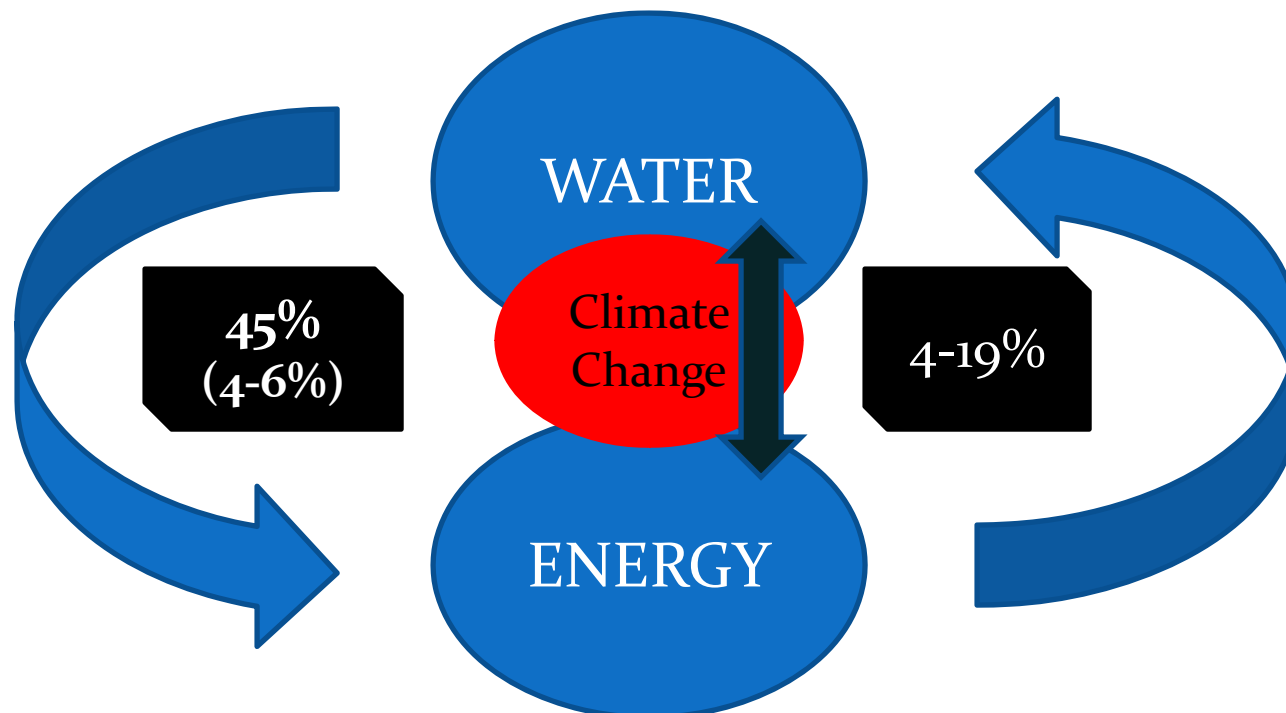
US DOE Efforts to Broaden the Understanding of Energy-Water-Climate Nexus

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Nexus of Energy ,Water & Climate

What do we know that will drive policy?

- Energy Production Requires Water
- Water Production Requires Energy
- Climate is Changing and Impacting Both



CONCERNS

- Population Growth
- Demand for more water from all sectors
- Climate Mitigation Technologies may require more water

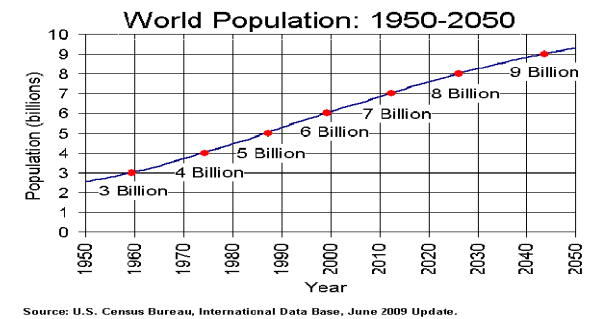


Changing World: Increasing Energy Demand

- **World electricity generation increases by 87 percent from 2007 to 2035. (EIA, 2010)**
- **Electricity demand in the United States increases by 30 percent from 2008 to 2035 . (EIA, 2010).**
- **Most rapid growth projected to occur in developing nations. (Today, over 1.5 billion don't have access to electricity)**
- **Most energy growth occurs in regions that are already water stressed**

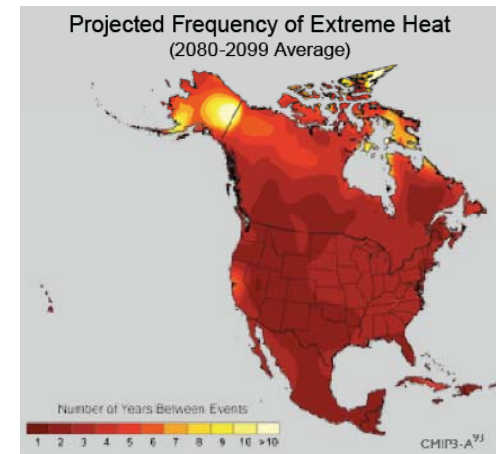
Changing World: Increasing Water Demand

- Globally, freshwater withdrawals tripled over last 50 years. Estimates of 40% gap between supply & demand by 2030.
- Over 1 billion people lack access to clean water
By 2030, population growth will push more than 3.3 billion people into water stress conditions .
- Economic development and changes in lifestyles and eating habits as countries develop are requiring more water consumption per capita.
- Internationally, the risk of violent water-related conflicts appears to be increasing, posing potential national security risk.



Changing Climate: Stress Multiplier for Energy-Water

- Climate change has altered, and will continue to alter, the hydrological cycle.
- Extreme hydrological events (floods and droughts) are likely to become more common and more intense.
- Rising sea levels and impact on coastal infrastructure (groundwater intrusion; nuclear plants, oil and gas refineries, etc.)
- Climate change will place additional burdens on already stressed water systems
“Accelerant of Instability or Conflict”



- “the *future ain't* what it used to be.”
 - Yogi Berra

DOE Strategies: Promote Energy & Water Efficiency



- Promote water friendly energy generation
 - Fuel switching to natural gas (-60%); wind, and PV solar.
 - Improve generation efficiency (PC vs. IGCC; -40%).
 - Develop less water intensive cooling technologies – dry, wet/dry hybrid cooling.
 - Use New Water (Recycle/Reuse) -Use degraded/impaired waters : wastewater treatment discharge, storm water, saline aquifers, mine drainage, produced waters, etc.).

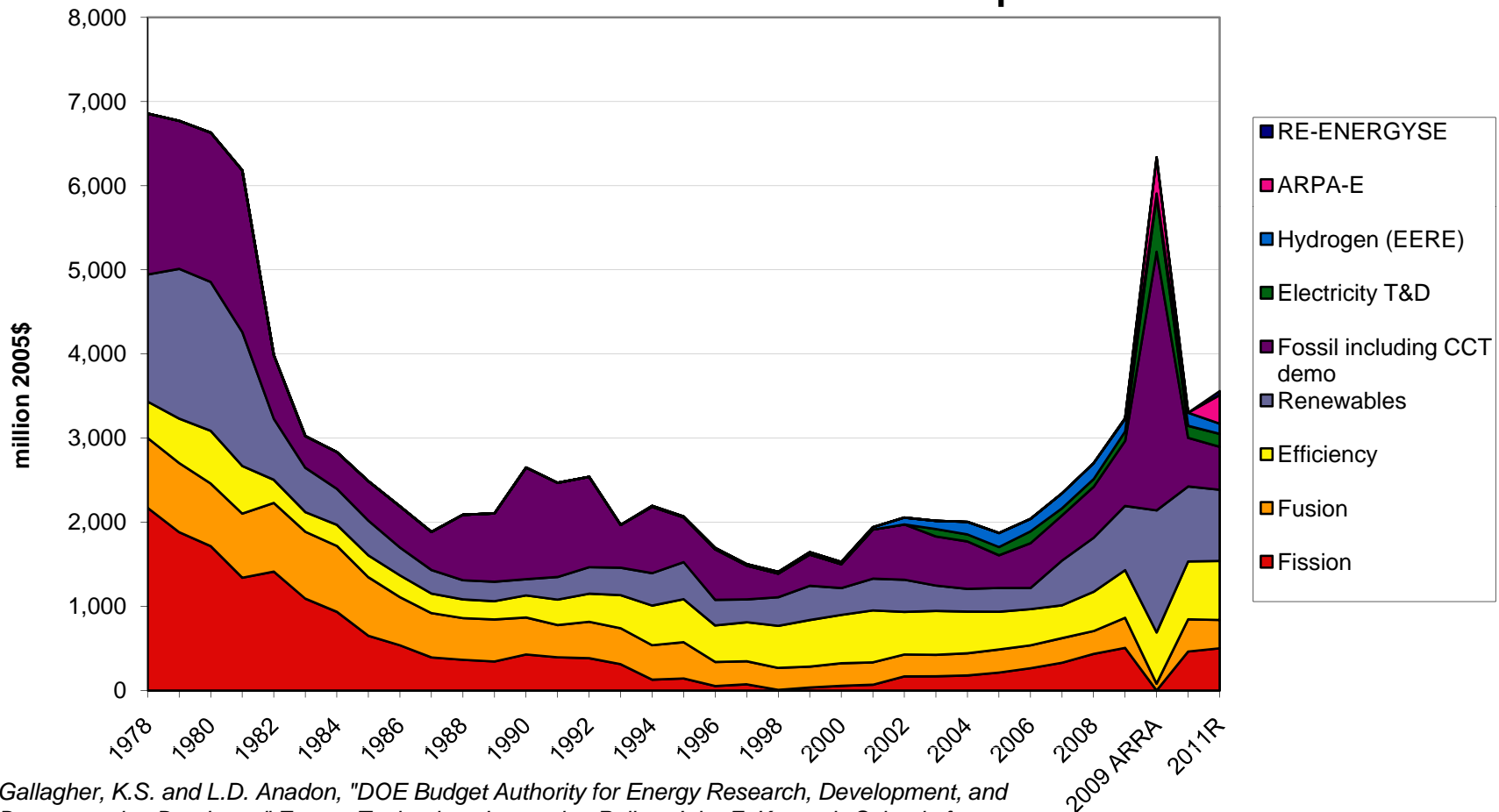


DOE Strategies: Promote Energy & Water Efficiency

- Improve energy/water/climate modeling to predict impacts on regional/local scale (scope, scale and timing).
- Promote water conservation and increased efficiency of energy use (appliances, homes, buildings). Domestic/International

Historical Perspective on DOE Spending

U.S. DOE Energy RD&D 1978-FY2011 Administration Request



Gallagher, K.S. and L.D. Anadon, "DOE Budget Authority for Energy Research, Development, and Demonstration Database," *Energy Technology Innovation Policy*, John F. Kennedy School of Government, Harvard University, March 22, 2010.

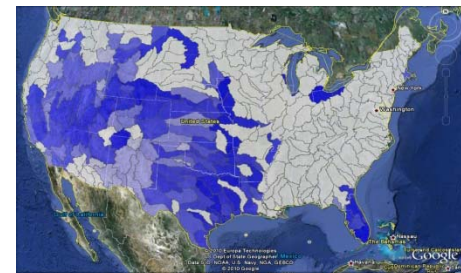


Co-benefits of DOE Funding from America Recovery and Reinvestment Act (ARRA)

- **Recovery Act represents an \$80 billion down payment on clean energy economy. Focus on energy, but co-benefits for water. Examples:**
 - **Renewable Energy** - \$1.64 billion, including biomass, geothermal, solar, wind, hydropower.
 - **Energy Efficiency** - \$12 billion, including weatherization, buildings, and appliance rebates/ENERGY STAR.
 - **Modernize Electric Grid** - \$4.5 billion, including Smart Grid, Energy Storage, and Interconnection Transmission
 - **Carbon Capture and Storage** - \$3.4 billion, including power plant and industrial CCS RD&D and geological sequestration site characterization.

DOE's Office of Policy and International Affairs: Energy-Water Initiatives

- **SHALE GAS:** Assessing water implications of large development, and options for cost effective water management activities. (ANL)
- **POWER OUTAGES:** Assessing vulnerabilities to the economy and human health of power plant outages associated with climate change and water shortages. (LBNL)
- **CARBON CAPTURE & STORAGE:** Future water demands and constraints associated with full deployment of CCS. Identify vulnerable areas limiting full deployment (SNL/ANL)

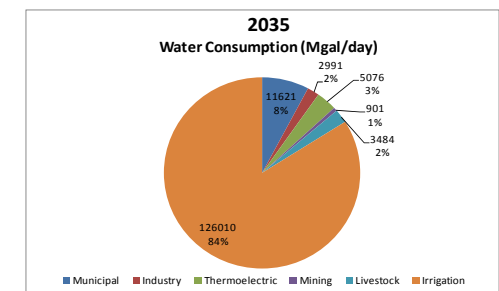
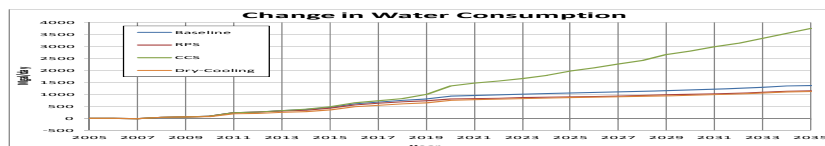


DOE's Office of Policy and International Affairs: Energy-Water Initiatives

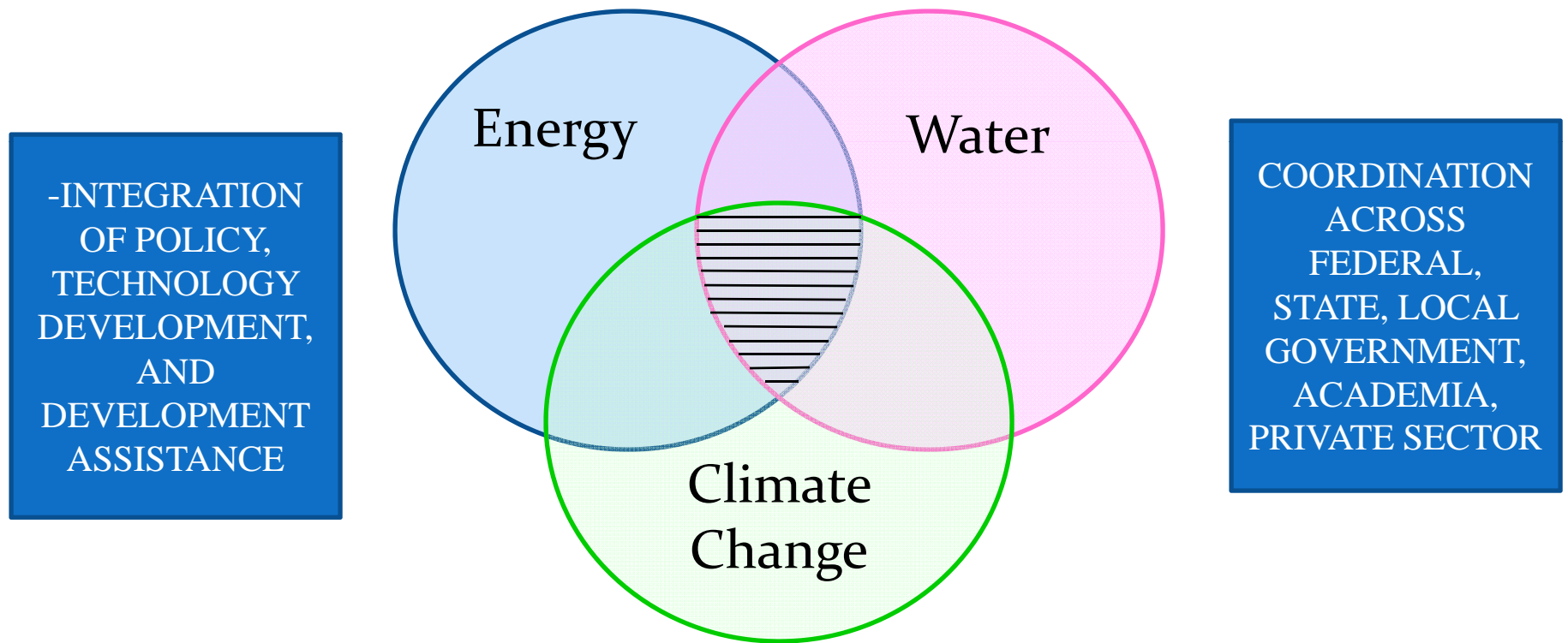
- **CONCENTRATED SOLAR POWER:** Assess deployment in arid regions subject to decreased water availability and warmer temperatures with climate change, and options to reduce water-intensity of CSP. (NREL)



- **IMPROVED MODELING CAPABILITY:**
 - **EPWSim:** Projections of future water supplies and impacts for existing and alternative energy technologies from a national and regional perspective. (SNL, INL)
 - **MARKAL Model:** Energy – Water Enhancement project (BNL, NREL).




The Need for an Integrated Approach with Sustainable Solutions.





SUMMARY

- All indicators suggest the need for effective climate resilient technologies and practices:
 - **Improved Models:** Need for better climate science and predictive models to project impacts.
 - **Better Technology:** Need to develop and deploy cost effective climate resilient energy- and water efficient technologies.
 - **Incentivize Early Action:** Need to remove the barriers.
 - **Effective Integration:** Need to integrate considerations of water use into existing programs and planning processes.
 - **Build Public Awareness:** Educate the public on more efficient energy and water use practices .
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For Additional Information

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