Drivers for federal investment to integrate IA-IAV-ESM-ABM capabilities

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Important topics for today

- Strategic planning in USGCRP, DOE, and other agencies
- Questions asked by federal agencies
- Limitations of models, data, and computing
- What's on the horizon for systems analysis and computing
- New questions that are being asked
- Federal commitment to funding

Strategic priorities in USGCRP/agencies

Background: IPCC, NCA, and other studies suggest

- *Increasing prevalence of future extremes*
- *Droughts more severe*
- *Greater weight to develop UQ methodologies*
- *Predictions and projections to be more useful for decision-makers*

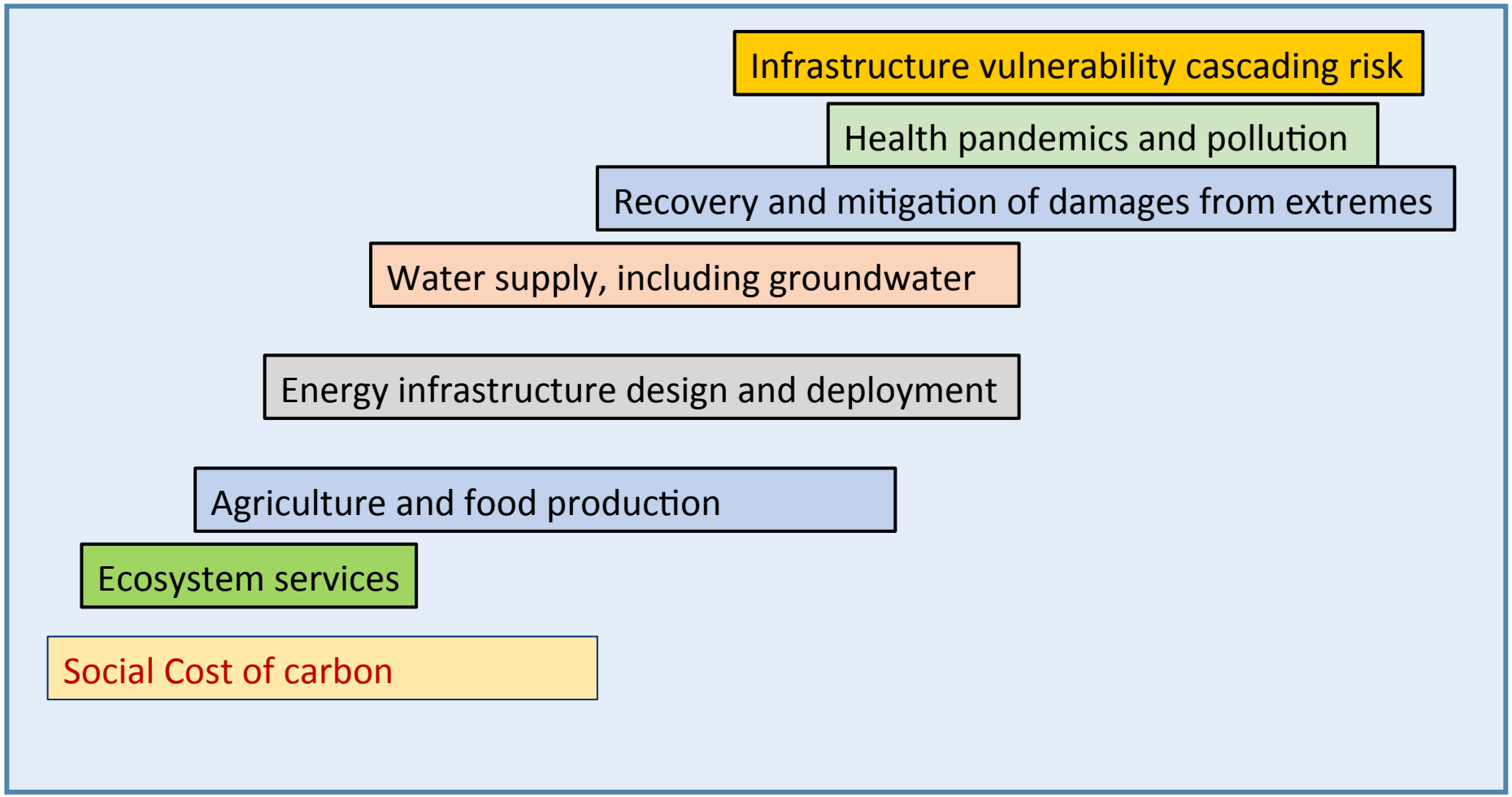
- Strengthen cooperation and collaboration across agencies
  - Compatibility of different modeling types
  - Collective discussions on budget priorities
  - Climate Modeling Forum
    - Started with physical system, increasing interest in human system
    - Software and exascale
  - Energy Modeling Forum
- Exploitation of security/IC capabilities for science
- Recent Town Halls at AGU and AMS
  - Energy Water Nexus commitment to explore IA-IAV-ESM
  - ACME to incorporate IA and IAV
  - NOAA and EPA encouraging UQ in IA and IAV
  - NSF PREEVENTS supports research on extremes, including IAV

Questions asked by agencies -starting with largest scales

- Social cost of carbon – better estimates with reduced UQ
- Ecosystem services – incorporate thresholds and mitigation
- Agriculture and food production – incorporate severe future droughts
- Water supply – add groundwater and risks of lost supply
- Energy infrastructure design/deployment – incorporate future extremes
- Health pandemics – combine extremes with species migration
- Infrastructure vulnerability – address risks of cascading failures
- Recovery and mitigation of damages from future extreme events

Complexity and scale resolution requirements

ESM fully integrated
Nested weather fx
Non-hydrostatic
Dynamic damages
Dynamic demography



Simple climate
Hydrostatic
Country scale
Damage functions
Constant demography

Coarse/multi-year time steps

Highest resolution/hourly

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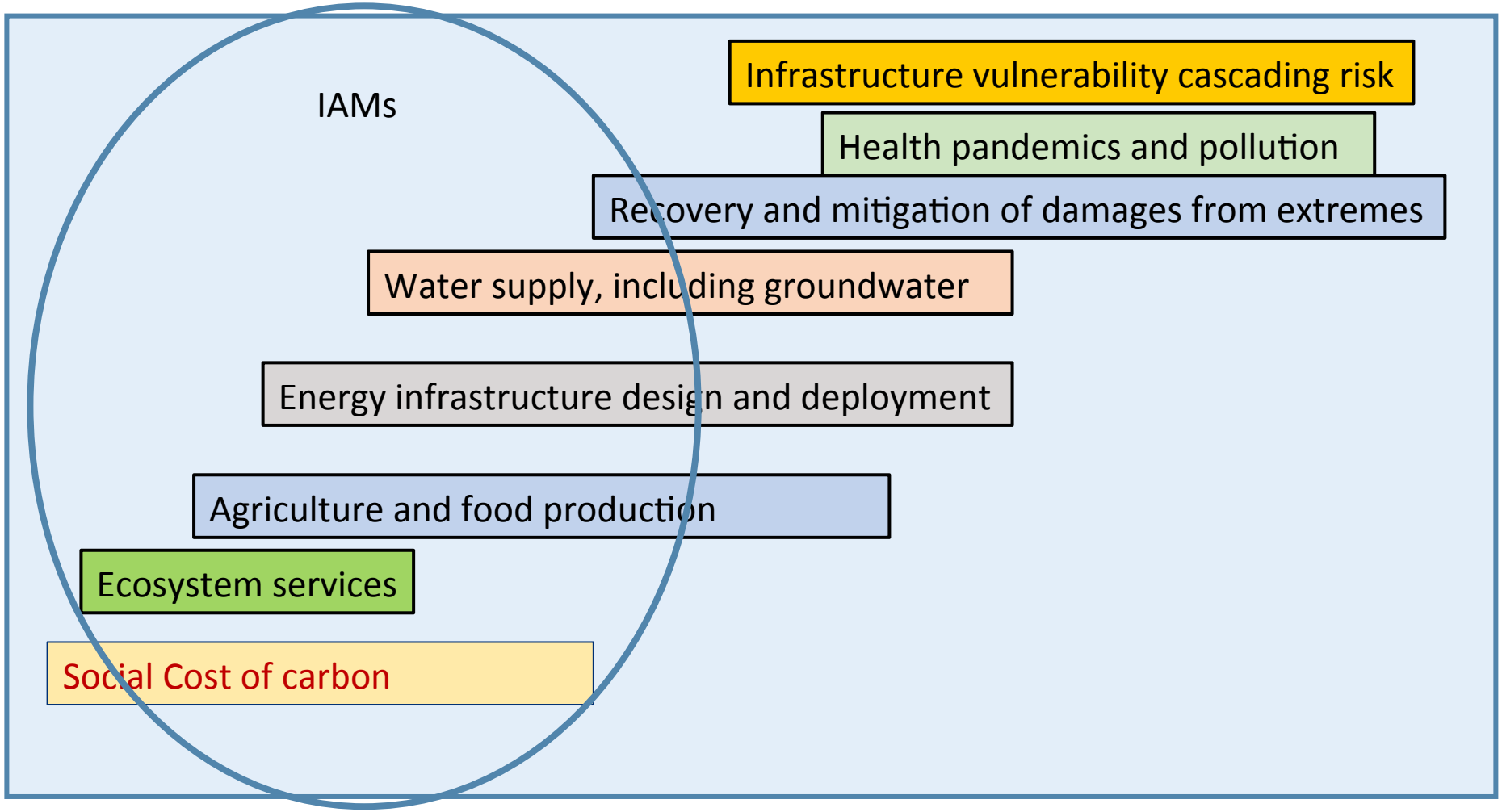

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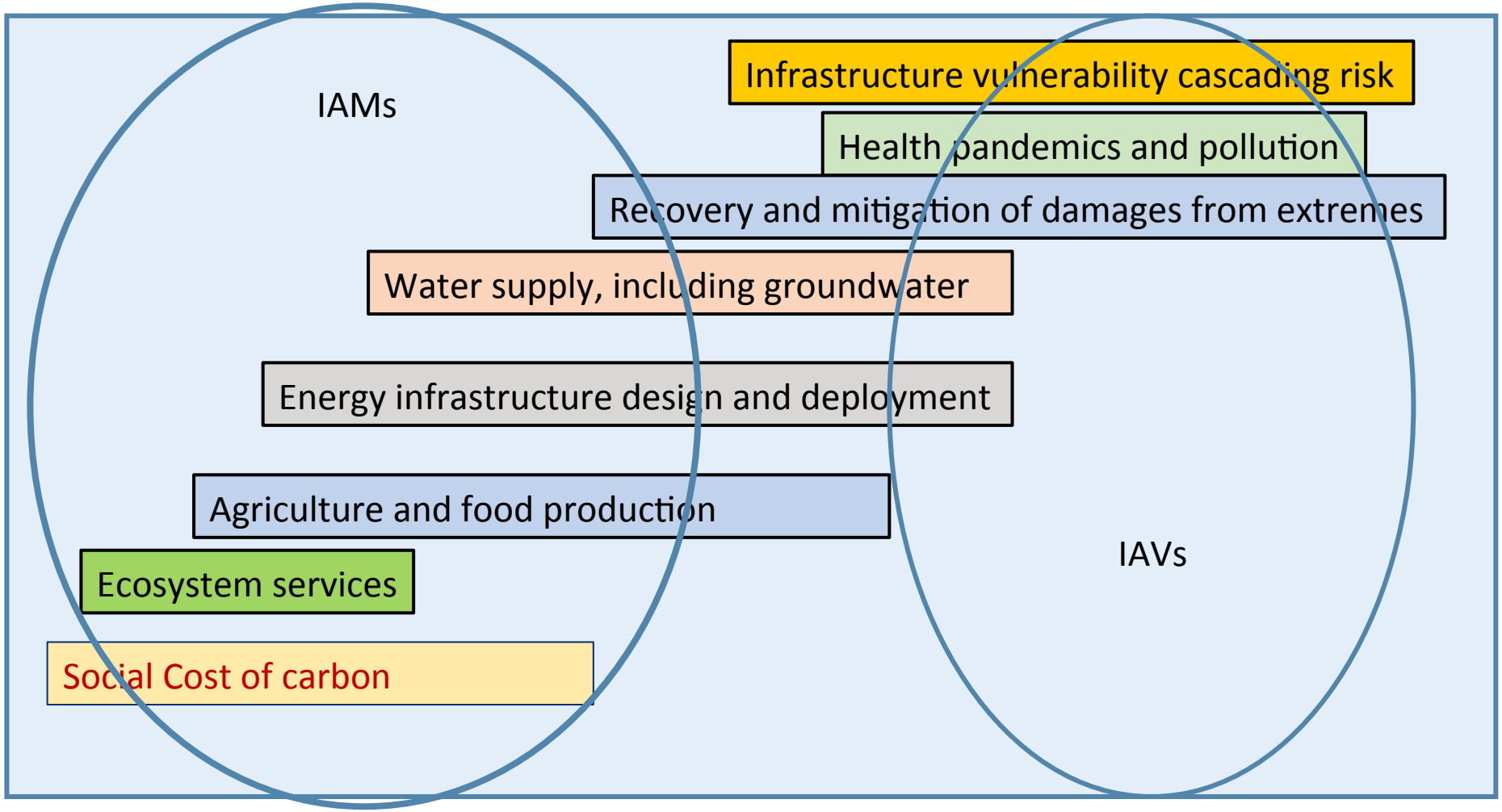

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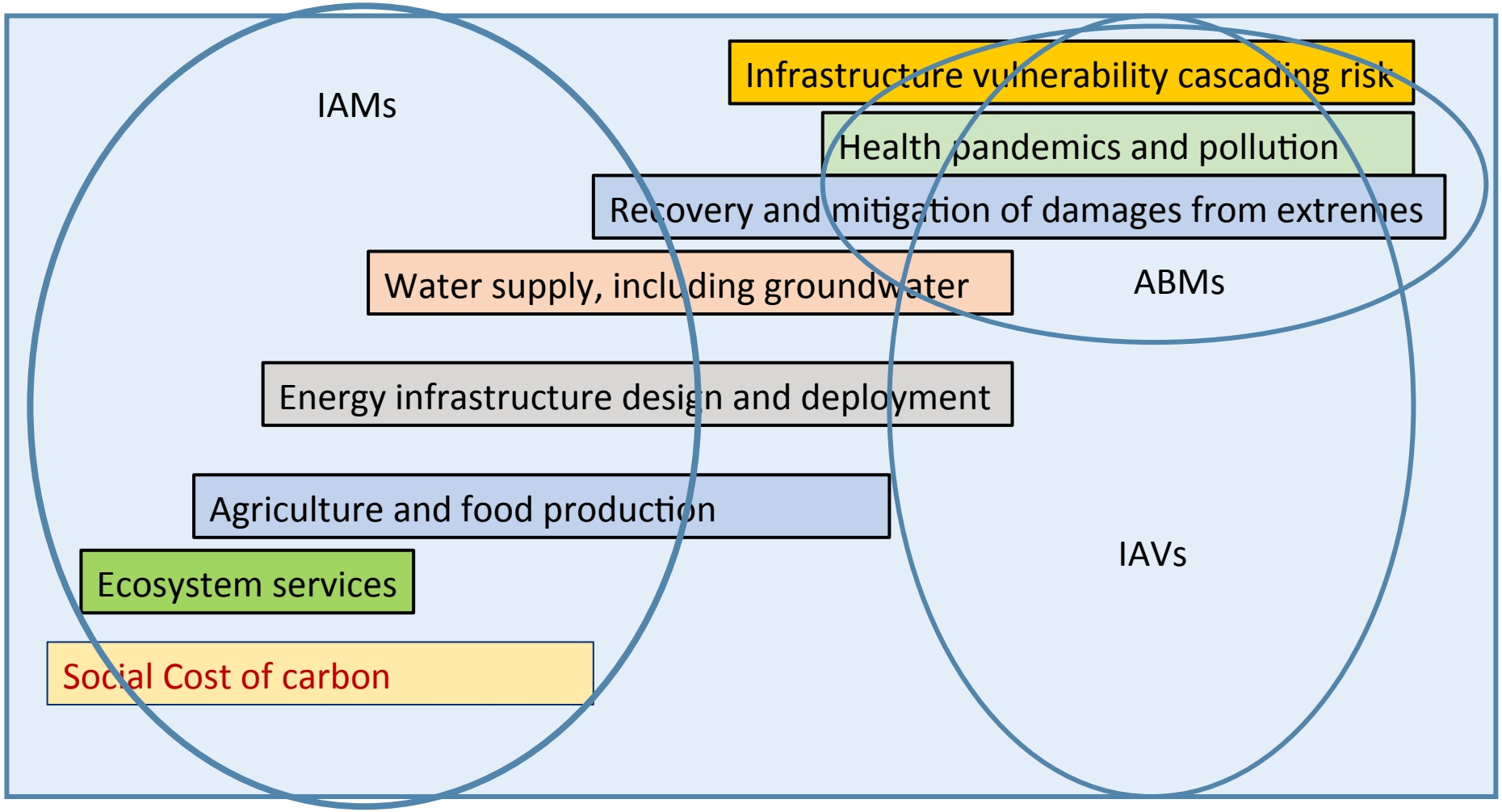

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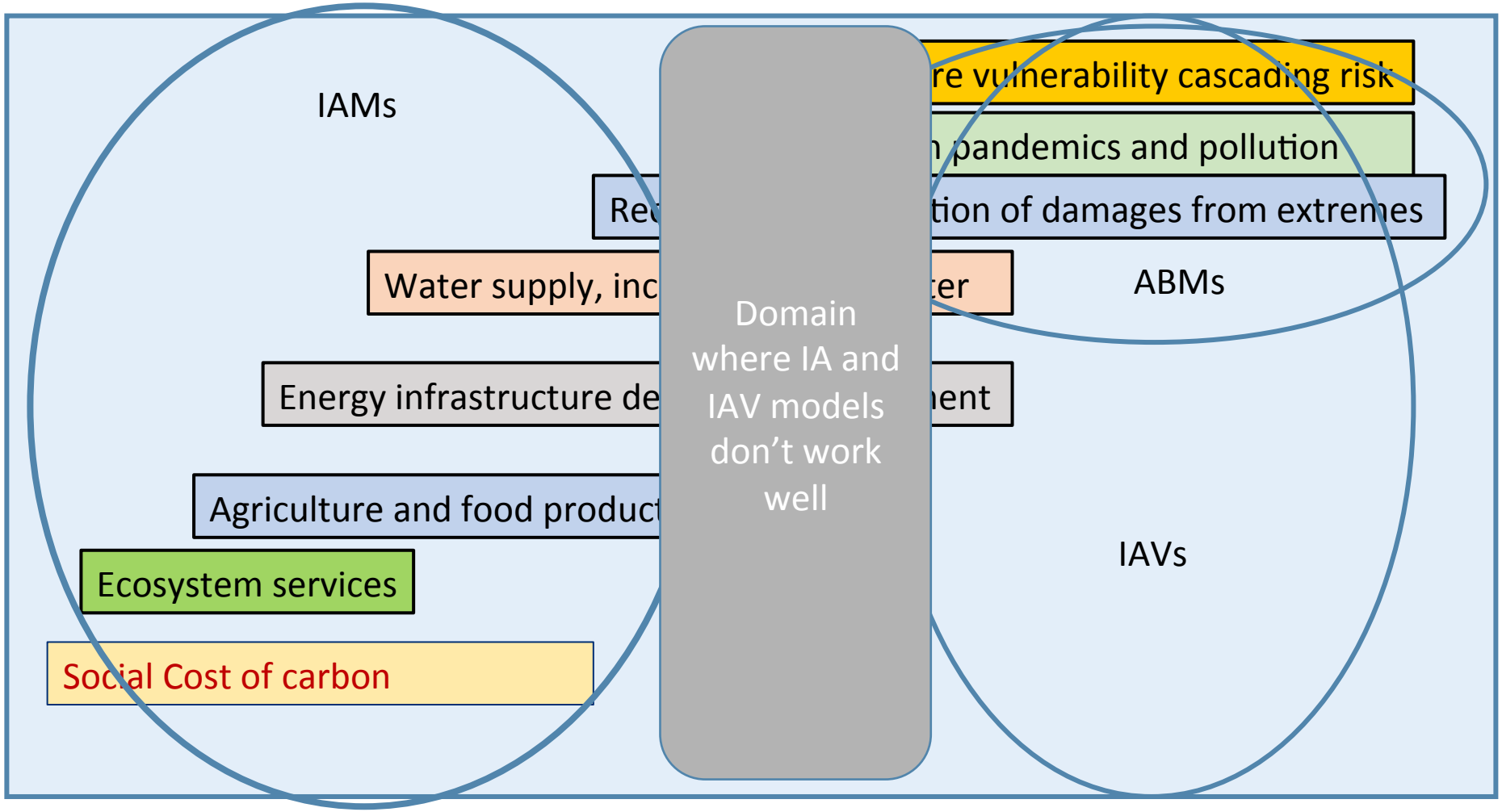

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Exploiting computational opportunities

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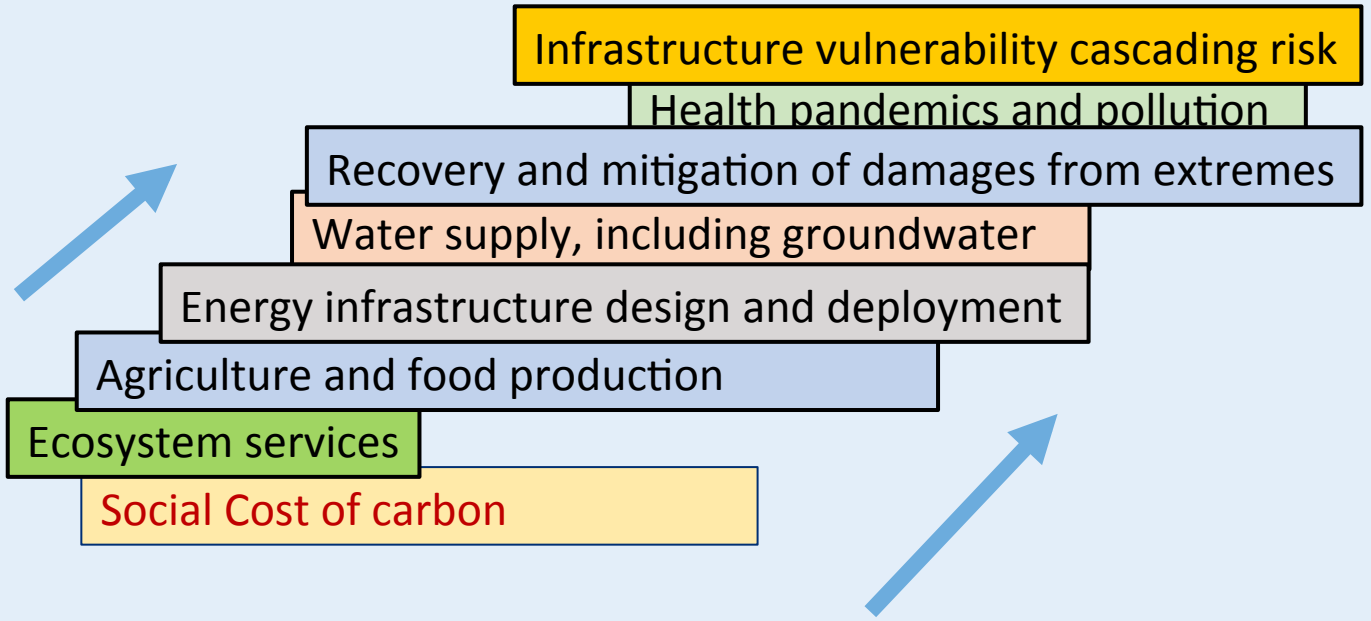

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New questions involving interdependencies across these various challenges can be asked, given advances in computing and data analytics

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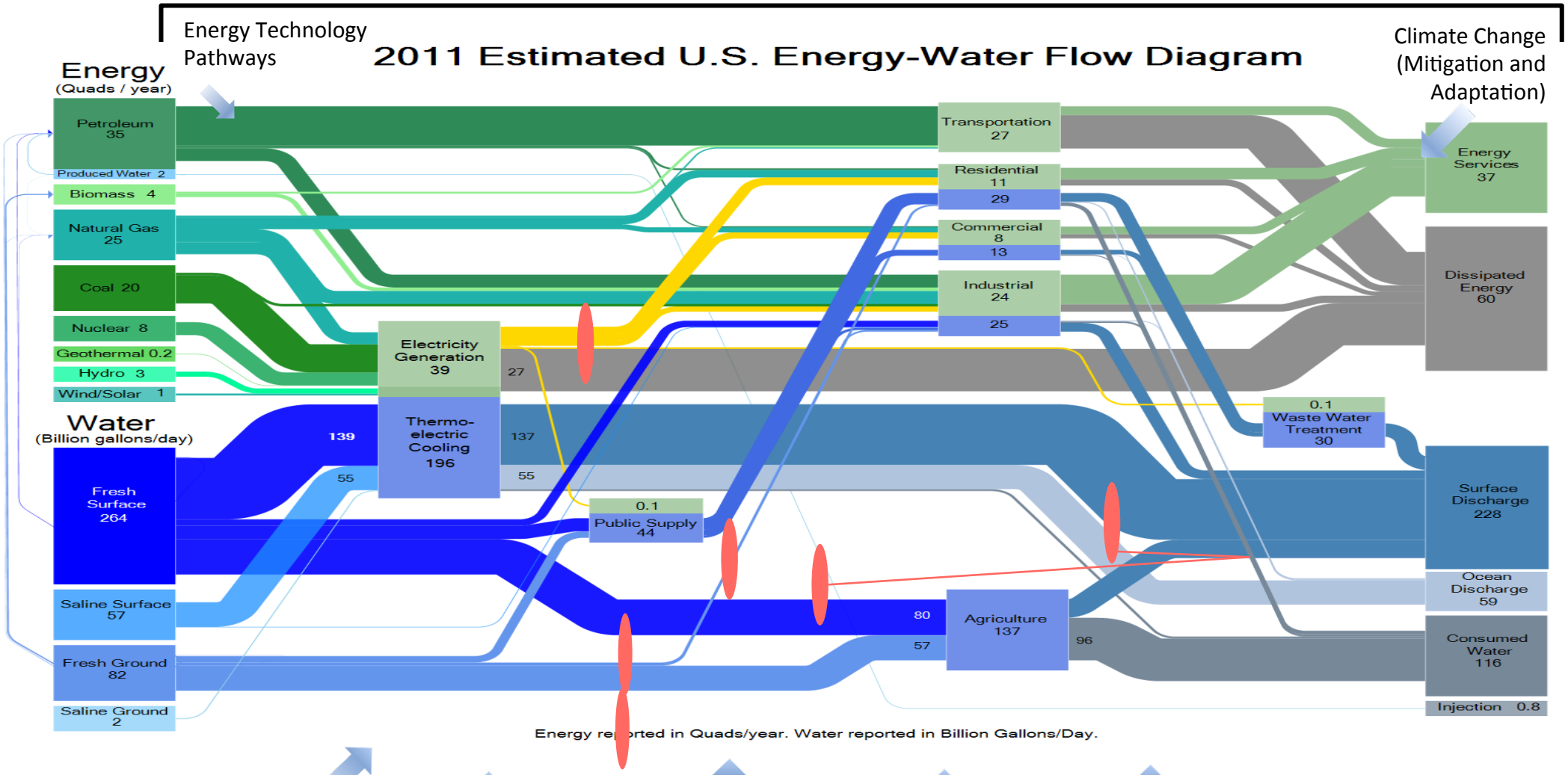
Filling the uncertainty gap and developing a next generation capability

- Integrative framework that combines IA-IAV-ESM-ABM communities
  - IA community historically DOE, USDA, EPA, NOAA, etc.
  - IAV community historically DHS, DOE, EPA, DOD, NGA, etc.
  - Develop interagency approach to new architecture, with help from EMF
- New questions that must be asked at the nexus of these scales
  - Drought prone regions
  - Cascading failures of interdependent infrastructures, from precursors and triggers
  - Uncertainty quantification, and biases from missing processes
  - Upscaling results to influence regional planning
  - Evaluation of feedbacks on regional climate prediction
- Town Halls and other briefings to advertise value added of successes

Responding to Challenges in the Energy-Water System



Policy and Institutional Changes

Land Use & Land Cover Change

Stakeholder and Consumer Preferences

Population/ Migration

Urbanization & Infrastructure Dynamics

Regional Economic Development