Central Arizona–Phoenix LTER and Society: Co-developing Sustainable Future Scenarios

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Why Develop Sustainability Scenarios?

- The future development of cities requires collaborative approaches addressing planning and management needs

- Combining knowledge networks through collaboration of researchers and practitioners enhances research and decision-making capacity for long-range sustainability and resilience planning.

- Scenarios provide use-inspired knowledge to explore complex and changing interactions between people, infrastructure, land, water, energy, and climate.

Key Features of the Scenario Workshop Series:

- **Co-development**: Moving beyond just allowing relevant stakeholders to provide input → stakeholders collaborate as full partners
- **Multiple Futures Approaches**: Coupled forecasting and backcasting allows us to explore a variety of pathways to a sustainable and resilient future
- **Capacity Building**: Starting with simple tasks (e.g., qualitative systems maps) and iteratively build capacity for more complex tasks (e.g., participatory modeling)
- **Knowledge Integration**: Synthesize different sources and types of knowledge

Phases of the Workshop Series

Scoping the Process
Initial scoping meetings were conducted with stakeholders and researchers to identify (a.) project objectives, (b.) partners who should be at the table, and (c.) the temporal and spatial scale.
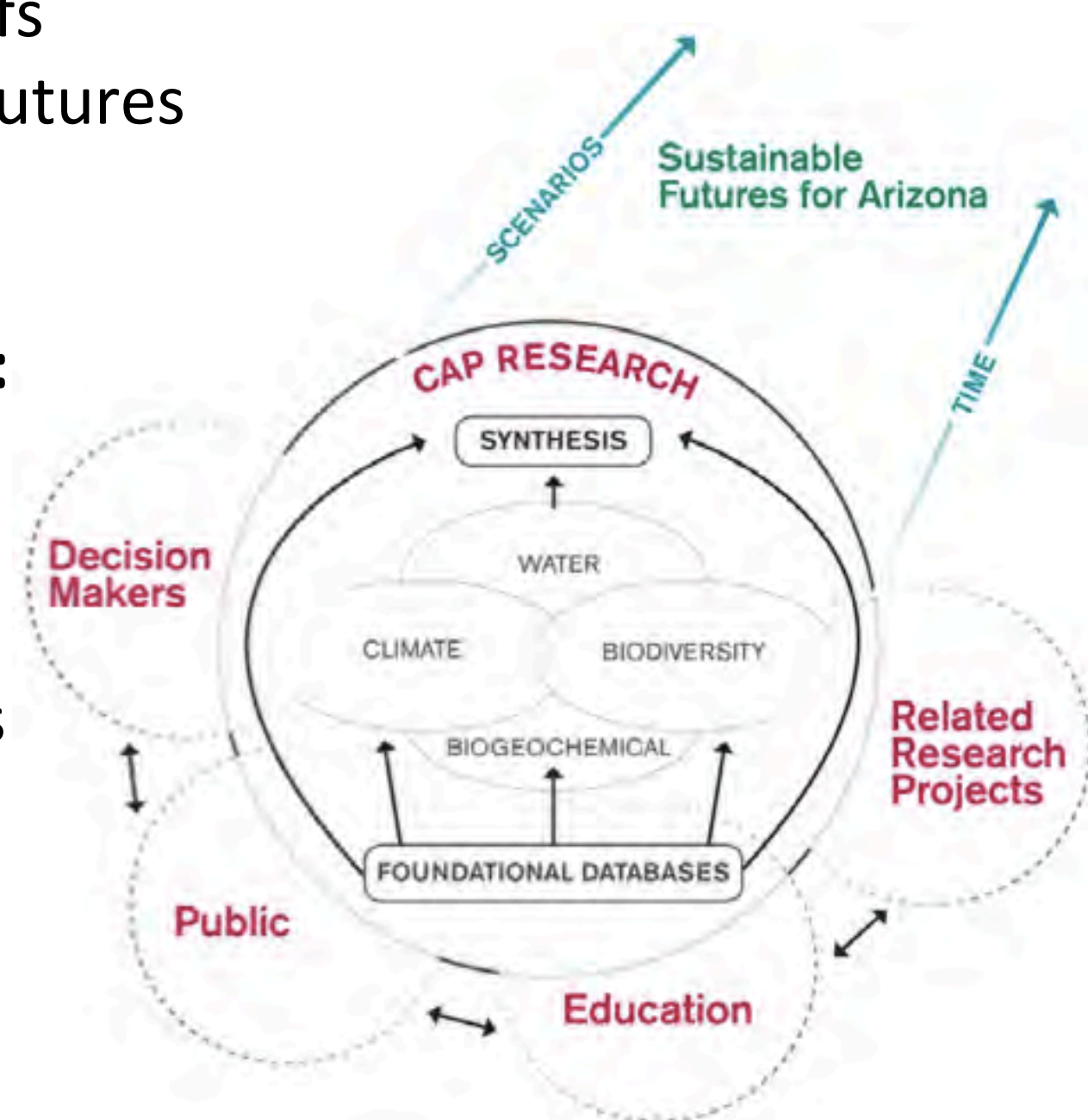
a. Co-developed project objectives:
- Synthesis and future research
- Understand conflicts and trade-offs
- Explore sustainable and resilient futures
- Guide decision-making

b. Partners co-developing scenarios:
Over 50 leaders and decision-makers from federal, state, county, tribal, and municipal departments, academic representatives, and NGOs representing different communities and interests.

c. Temporal and spatial scales:
- Current state – 2060
- Phoenix metropolitan region
- Multi-level interventions (household to regional scale)

Household ◄──────► Regional

Scoping & Framing
- Identify: objectives, partners, process
- Analyze long-range governance documents

Initial Pool of Scenarios
- Systems & future-oriented capacity
- Co-produce: system maps, interventions narratives, appraisals

Defining Core Scenarios
- Develop core scenario storylines & structures
- Identify temporal sequence of targets & interventions

Filling in the Details
- Develop land use / land change maps
- Craft design vignettes
- Add / revise targets & interventions

Modeling & Indicators
- Scenario validation
- Exploration of modeled projections
- Selection of scenario indicators

Assessments
- Sustainability & resilience multi-criteria assessments
- Evaluate impacts & trade-offs
- Refine scenarios

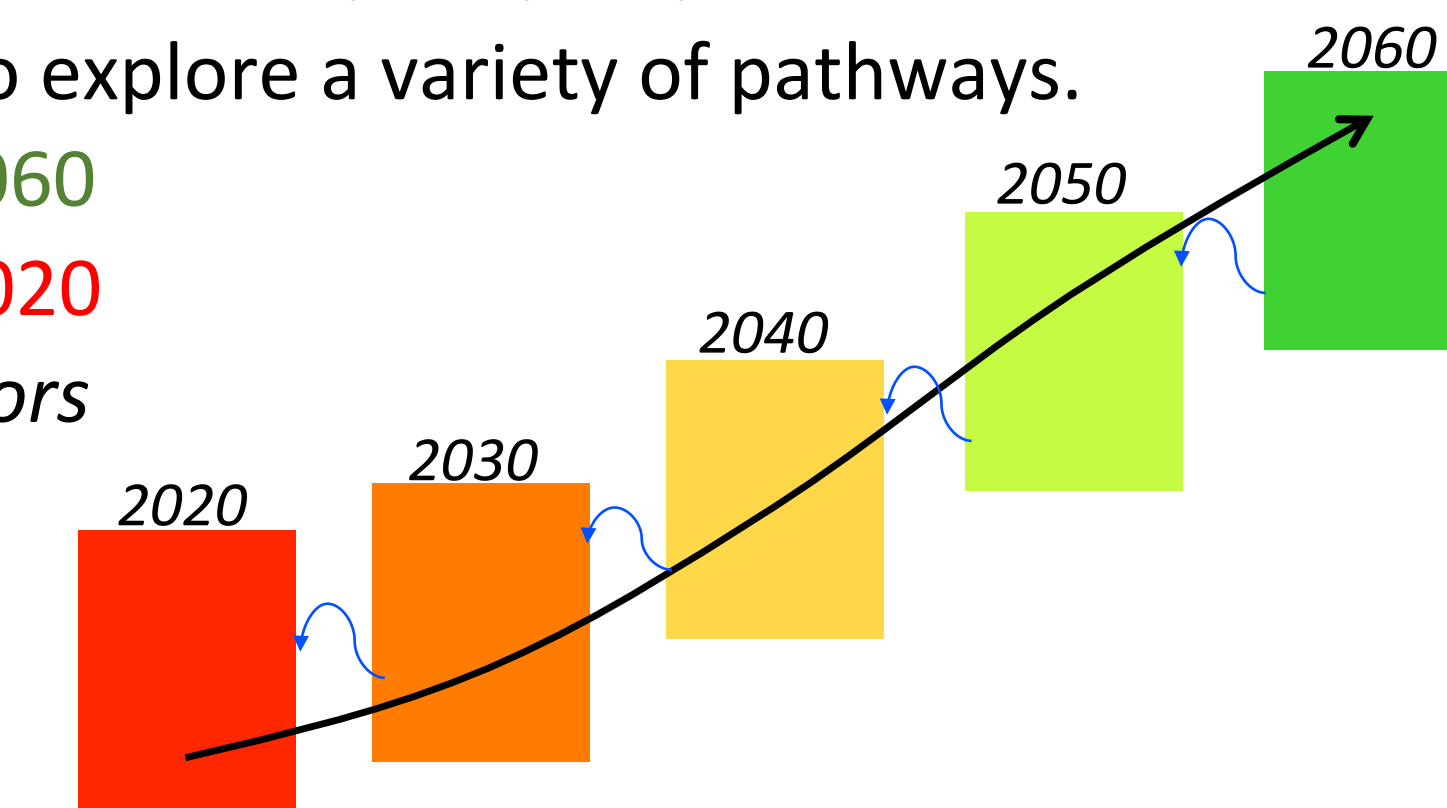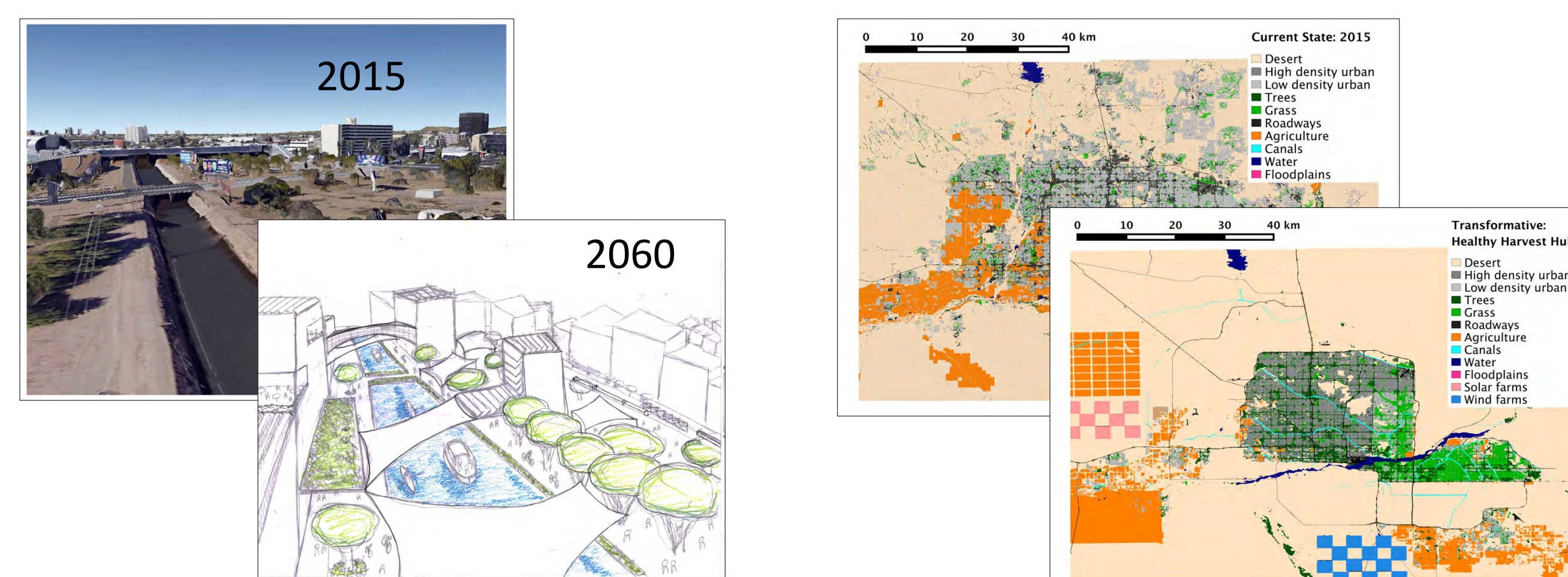**Framing the Futures:** 9 distinct scenarios: 3 adaptive, 3 strategic, and 3 transformative scenarios
- *Adaptive scenarios* of resilient futures in response to extreme events (heat, drought, flood)
- *Strategic scenarios* of plausible futures from existing governance documents
- *Transformative scenarios* of radically transformed sustainable futures

Initial Pool of Scenarios:
- Elicitation of key variables from scenarios (adaptive, strategic, and transformative)
- Develop systems maps to identify relationships among variables
- Conduct rapid sustainability and resilience appraisals
- Craft actor-oriented narratives for each scenarios
- ✓ *Outcomes*: Partner report of potential strategies and solutions that served as the building blocks for our core scenarios

Defining Core Scenarios: Co-develop scenarios on timelines to specify sequence of events
- Different approaches to scenario development allow us to explore a variety of pathways.
- Forecasted pathways are developed from year 2020 to 2060
- Backcasted pathways are developed from year 2060 to 2020
- ✓ *Outcomes: Identify scenario goals, pathways, and indicators*

2020 2030 2040 2050 2060

Filling in the Details:
- Establish consensus on the distinct features of each scenario to better understand what we are comparing and contrasting
- Initiate design-based and land use / land change activities
- Adding specificity for quantitative modeling and assessments
- ✓ *Outputs: Refined scenarios, design-based illustrated vignettes, and land use / land cover maps*

Modeling, Validation, & Assessments:
- Adaptive and Transformative scenarios are evaluated by CAP LTER modeling teams: water use, water availability, heat, energy, carbon storage
- ✓ *Outputs: Model simulations and multi-criteria assessments are used to further explore, compare, and revise each scenario*
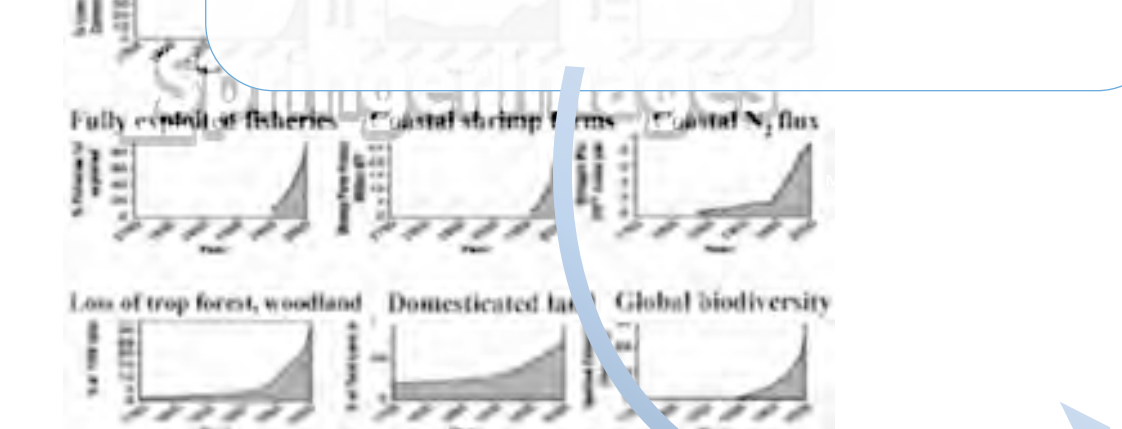

Below is a piece of the Sustainable Future Scenarios workflow demonstrating how different types of knowledge are integrated. Targets & interventions are developed using a variety of generative activities during early phases workshop series. These are used to craft vignettes and LU/LC maps for each scenario. Vignettes are used as inputs to Micro-Climate modeling. LU/LC maps are used as inputs to WRF modeling. Multi-scale temperature projects are used to evaluate impacts and trade-offs.

Targets & Interventions

2015 2060

Products for broader engagement

CAP IV & UREx SRN Scenarios

Statistical Micro-Climate Model: Human-scale heat projections

Weather Research and Forecasting (WRF) Model: Regional scale heat and precipitation projections

Multi-criteria Assessments

CAP RESEARCH — SYNTHESIS — Decision Makers — WATER — CLIMATE — BIODIVERSITY — BIOGEOCHEMICAL — Related Research Projects — FOUNDATIONAL DATABASES — Public — Education — SCENARIOS — Sustainable Futures for Arizona — TIME