



Assessing resilience, equity, and sustainability of future visions across two urban scales

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Abstract

Cities need to take swift action to deal with the impacts of extreme climate events. The co-production of positive visions offers the potential to not only imagine but also intervene in guiding change toward more desirable urban futures. While participatory visioning continues to be used as a tool for urban planning, there needs to be a way of comparing and evaluating future visions so that they can inform decision-making. Traditional tools for comparison tend to favor quantitative modeling, which is limited in its ability to capture nuances or normative elements of visions. In this paper, we offer a qualitative method to assess the resilience, equity, and sustainability of future urban visions and demonstrate its use by applying it to 11 visions from Phoenix, AZ. The visions were co-produced at two different governance scales: five visions were created at the village (or borough) scale, and six visions were created at the regional (or metropolitan) scale. Our analysis reveals different emphases in the mechanisms present in the visions to advance resilience, sustainability, and equity. In particular, we note that regional future visions align with a green sustainability agenda, whereas village visions focus on social issues and emphasize equity-driven approaches. The visions have implications for future trajectories, and the priorities that manifest at the two scales speak of the political nature of visioning and the need to explore how these processes may interact in complementary, synergistic, or antagonistic ways.

Keywords Urban futures · Assessment · Scenarios · Social–ecological–technological systems · Phoenix (AZ)

Introduction

The latest climate science calls for urgent and ambitious action to stay within a safe operating space for humanity and singles out cities as key arenas of potential transformation to curb greenhouse emissions and reduce the negative impacts of climate change (Steffen et al. 2015; IPCC 2022; Wang-Erlandsson et al. 2022). Cities have been the focus of climate action for some time (Castán Broto and Bulkeley 2013) as many municipal governments are leading efforts to build resilience to climate change in general and to extreme weather events in particular. In the United States, not only will cities deal with increased extreme events, such as hurricanes, flooding, and heatwaves, they will also face increased pressures from rapid urbanization and an aging infrastructure (IPCC 2022; Miller et al. 2018). Impacts from disasters will likely continue to be unevenly distributed (Tschakert et al. 2013; Sharpe and Wolkin 2021), with those who already are economically vulnerable and socially marginalized continuing to face the worst consequences, as

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evidenced in the aftermaths of hurricanes such as Katrina in New Orleans, LA (Wright 2011) and María in San Juan, PR (García-López 2018), wildfires (Davies et al. 2018), or heatwaves (Gronlund 2014). Thus, there is an urgent need to simultaneously address resilience, equity, and sustainability challenges in climate adaptation, and cities are well positioned to be catalytic spaces for this change. We consider resilience to be the ability of a system to absorb disturbance and reorganize while maintaining essentially the same function, structure, identity, and feedbacks (Walker et al. 2004); equity as relating to concerns for fairness and justice, usually conceptualized as having distributional, procedural, and recognitional dimensions (Schlosberg 2013); and sustainability as the ability to meet present needs without compromising the ability of future generations to meet theirs (WCED 1987).

Multiple actors, competing interests, and overlapping governance jurisdictions add complexity and uncertainty to the process of guiding and activating transformative change in cities (Wolfram et al. 2016; Hölscher and Frantzeskaki 2021). In this context, anticipatory and foresight tools can offer a way of dealing with the inherent uncertainty posed by climate and environmental change and the complex ways in which risks interact with infrastructural and societal factors. Popularized as tools for urban planning starting in the 1980s, scenarios and positive visions of the future are increasingly finding broader application in both academic and policy arenas (Wiek and Iwaniec 2014; Abou Jaoude et al. 2022). Scenarios are defined here as plausible narratives about the future of a place or a situation that are internally consistent. Typically, scenarios are used to explore the consequences of following alternative policy pathways, identifying potential barriers to proposed policies, and building robustness to future uncertainty. Moreover, by inviting different knowledge holders to participate in the scenario development, scenarios potentially expand both the problem space and solution space, providing novel opportunities for policy development (Wyborn et al. 2019). In recent years, positive visions of the future, which we consider a subset of scenarios, have become valuable tools for intervention and decision-making (Wiek et al. 2013; Wiek and Iwaniec 2014). Positive visions offer an alternative to dystopian futures by focusing on curating desirable future alternatives that can be used to guide change (Bennett et al. 2016; McPhearson et al. 2016). As well, the process of creating positive visions tends to emphasize participation and co-production.

Climate change compels us to be explicit and ambitious about how we factor in and evaluate the high unpredictability and uncertainty of urban visions, especially when dealing with long-term futures (Muñoz-Erickson et al. 2021). Traditionally, comparison of alternative futures has relied on model simulations, which limits their analysis to the aspects of the future that can be modeled quantitatively. While

simulations are useful, positive future visions present rich and nuanced depictions of desirable futures that may include descriptions of future governance arrangements, or the feel of a place, which are typically poorly captured by quantitative indicators alone. Thus, we developed a complementary analytical tool to compare future visions that focuses on resilience, equity, and sustainability, and that can be used by cities to evaluate future pathways.

In this paper, we start by presenting the resilience, equity, and sustainability qualitative (RESQ) assessment tool (see also Berbés-Blázquez et al. 2021) and demonstrate its use by analyzing two sets of visions that explore the future of Phoenix, AZ, in the U.S. Southwest. The two sets of visions depict futures co-produced at two different scales; one set focuses on regional visions (see also Iwaniec et al. 2020), and the other set depicts village, or borough, visions (see also Berbés-Blázquez et al. 2018). The comparison across scales is critical, since cities constitute nested hierarchies spanning from households to neighborhoods to municipalities and counties, often crisscrossing administrative and ecological boundaries that are relevant when considering the flows of materials and energy into, within, and out of the city, and their differential impacts on communities. While visions that account for multiple scales are becoming more common (for example, Rosa et al. 2017; Frame et al. 2018; Pereira et al. 2020), the majority of cross-scale visioning research tends to focus on downscaling global scenario narratives to a specific region. Moreover, there are few that focus on urban settings. Thus, this paper has the dual purpose of (1) providing proof-of-concept for the use of our RESQ assessment tool; and (2) exploring the insights derived from conducting and comparing positive urban visions across governance scales.

The paper is organized as follows: we first present the RESQ analytical tool, and we describe how the regional and village visions were created. We then explore differences and overlaps in the relative emphasis that visions place on mechanisms for increasing resilience, equity, and sustainability. We conclude by reflecting on the implications for alternative regional and local pathways for radical change that follow from the examination of the future visions. This study was approved by Arizona State University's institutional review board (STUDY# 00004605) and all participants provided informed consent to take part in the co-production of the future visions.

Building a tool for assessing future visions

Future visions are increasingly valuable tools in sustainability science with the potential to influence urban planning for resilient and just futures. For this potential to be realized, decision-makers need to be able to compare

the relative advantages, disadvantages, trade-offs, and synergies of alternative future pathways. Given the diversity of visioning approaches, evaluation and assessment tools need to be tailored to their specific purpose, be it predictive, normative, or transformative (Fauré et al. 2017). Qualitative tools are well suited for the assessment of transformative visions whose purpose is to explore deep changes usually along longer time horizons (Börjesson et al. 2006), where the analysis is meant to unpack the implications of the values and choices contained in each vision, rather than trying to predict likely outcomes (Robinson 1990). Many indicator-based metrics exist for assessing resilience, equity, and sustainability. For example, the City Resilience Index, sponsored by the Rockefeller Foundation, understands urban resilience along four axes—health and well-being, economy and society, infrastructure and environment, and leadership and strategy—resulting in 52 indicators that are combined to form a measure of urban resilience (Rockefeller Foundation 2014). Sharifi and Yamagata (2016) proposed another list of indicators of urban resilience considering five dimensions of cities, namely, materials and resources, society and well-being, the economy, the built environment, and governance. Boyko et al. (2012) developed quantitative and qualitative sustainability indicators for four possible urban futures for the UK. Common to all indicator-based approaches is the synthesis of a multitude of conditions into quantifiable metrics that are easier to convey to policy-makers and that allow for comparison through time and across geographies. However, longer time horizons and more transformative visions can be a challenge to indicator-based approaches due to yet uncertain future states, non-analog conditions, and discontinuities caused by novel solutions and their associated emergent outcomes (Fauré et al. 2017; Iwaniec et al. 2019). Present-day indicators are likely to be less relevant, and in many cases obsolete, to characterize a future reality that is unknown and too specific to assess the rich diversity of urban contexts.

Instead, the RESQ gauges the presence of resilience-, equity-, and sustainability-building mechanisms in future visions (see also Berbés-Blázquez et al. 2021). The assessment begins by identifying the defining characteristics that capture the identity of each vision. These essential characteristics constitute what we have termed the vision's *key components* after Holling's rule of hand (2001), which suggests that even very complex systems can be understood by focusing on a few key variables or relations that organize all the rest. In plain language, we would say that the key components embody the gist of the vision. Each key component is then assessed qualitatively for evidence of how it contributes to resilience, equity, and sustainability according to established criteria from the literature (Fig. 1).

Assessing resilience

The concept of resilience as used in this article emerged in the 1970s in the work of ecologist Holling (2001). Since then, the concept has grown in scope and expanded its application from the ecological to the social–ecological domains. Resilience is the ability of a system to absorb disturbance and reorganize while maintaining essentially the same function, structure, identity, and feedbacks (Walker et al. 2004). As well, a defining characteristic of resilient systems is their ability to adapt and recognize when transformation to a new desirable system state is needed (Walker 2020). While there has been a growing interest in developing metrics for measuring resilience for nearly a decade now (Quinlan et al. 2016), indicators of resilience tend to be highly context-specific, quantitative, and often based on past or current characteristics and patterns of the system. Given that our interest was in assessing the resilience of future urban visions, our approach has been to look for evidence of *mechanisms* in the visions, rather than indicators, that build resilience. Following Biggs et al. (2012), the RESQ considers the following mechanisms: (1) fostering diversity; (2) increasing redundancy; (3) managing connectivity between the different parts of the system; (4) paying attention to slow variables; (5) understanding positive and negative feedbacks; (6) adopting a social–ecological–technological systems view; (7) practicing adaptive management; (8) opening opportunities for learning; (9) engaging in participatory decision-making; and (10) favoring polycentric governance structures.

Assessing equity

For the assessment of equity in the future visions, we relied on the tripartite conceptualization of environmental justice that considers distributional, procedural, and recognitional equity components (Schlosberg 2007, 2013). Distributional justice has to do with the way in which environmental benefits and harms are distributed among members of society. For example, the spatial distribution of greenspace in a city indicates which communities have more or less access to this benefit. Distributive aspects of justice were instrumental in the early days of the environmental justice movement in the United States; for instance, demonstrating that the siting of industrial waste facilities overlapped with the places where communities of color lived (Bullard 2000). Beyond distributional patterns, procedural justice is “about the presence of equitable spaces of engagement that determine who is involved with shaping the social, built and ecological conditions of the city and how that involvement takes place” (Langemeyer and Connolly 2020, p. 7). Thus, procedural dimensions of equity consider the degree to which processes of decision-making are inclusive. Finally, recognitional justice is concerned with the acknowledgment and appreciation

Fig. 1 The three dimensions of the RESQ multi-criteria assessment tool and associated principles used to assess resilience, equity, and sustainability



of difference among social groups (Fraser 2000). From this perspective, recognitional aspects of equity have to do with the extent to which the future vision recognizes the distinct histories and perspectives associated with oppressed groups and how it creates the conditions for their expression. In our assessment of future visions, we looked for evidence that the visions contain mechanisms to advance each aspect of justice.

Assessing sustainability

The idea of sustainability was popularized by the Club of Rome in 1972 to signal the need to balance human well-being with the biophysical limits of the planet. It was understood then that sustainability should be a goal for future development and so the World Commission on Environment and Development published *Our Common Future*, which defined sustainable development as “meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p. 43). Under this definition, sustainable development centers intra- and inter-generational equity. Out of the myriad metrics and indicators

assessing sustainability, we used the Sustainable Development Goals (SDGs) adopted at the United Nations Conference on Sustainable Development in Rio de Janeiro in 2012. Out of the seventeen SDGs, SDG 11 specifically addresses “sustainable cities and communities”, and so, we used its subgoals in our assessment of future visions. The subgoals are: (1) providing safe and affordable housing; (2) having access to safe, affordable, and sustainable transportation; (3) participatory governance for urban planning; (4) protecting the world’s cultural and natural heritage; (5) reducing the adverse environmental impact of cities (e.g., cutting atmospheric pollution); (6) providing access to green and public spaces; (7) considering multiscalar relations between urban, peri-urban, and rural areas; and (8) building sustainable and resilient buildings with local materials.

Future visions of Phoenix (AZ) at two different scales

Our case study is based on the assessment of 11 future visions of Phoenix (AZ) co-produced at two different spatial and administrative scales (Fig. 2). The Phoenix Valley is situated in central Arizona at the northern extent of the Sonoran Desert, is home to nearly 5 million residents, and is among the fastest-growing metropolitan areas in the United States. As a desert city, Phoenix's climate is hot and dry, with mean January and June high temperatures of 20 °C and 41 °C, respectively, and an average of ~200 mm of rainfall annually that falls during the winter rainy season and the summer monsoon rains, which can cause flash floods. Six of the visions focused on the regional Phoenix Metropolitan Area (~6000 km²), which includes the city of Phoenix (~1 million residents) and 27 smaller municipalities, including four of the six largest cities in the state (see Iwaniec et al. 2020). The other five visions focused on the village scale within the City of Phoenix (see Berbé-Blázquez et al. 2018). Phoenix has

15 urban villages, similar to boroughs in other cities, that were created to account for the local character and heterogeneous identities within the city, based on historical neighborhoods. The village-scale visions were focused on South Mountain Village, a historically underserved community of Phoenix (Bolin et al. 2005) with approximately 128,000 residents who are predominantly Hispanic (62%). The two sets of visions provide an opportunity to compare how futures differ across scales.

The visions presented in this paper were created to explore social, ecological, and technological challenges and opportunities emerging in the Phoenix Valley and both sets followed the approach detailed in Iwaniec et al. (2020) to articulate positive urban futures. In this approach, visions are co-produced in a participatory setting with policy-makers, urban professionals, members of civil society, and academics. The Phoenix regional visions were co-developed over six half-day workshops between 2015 and 2017, whereas the South Mountain Village visions were created during three full-day workshops in 2018 and 2019. The workshops were attended by 30–40 participants who were subdivided into smaller workgroups to develop a future vision along a

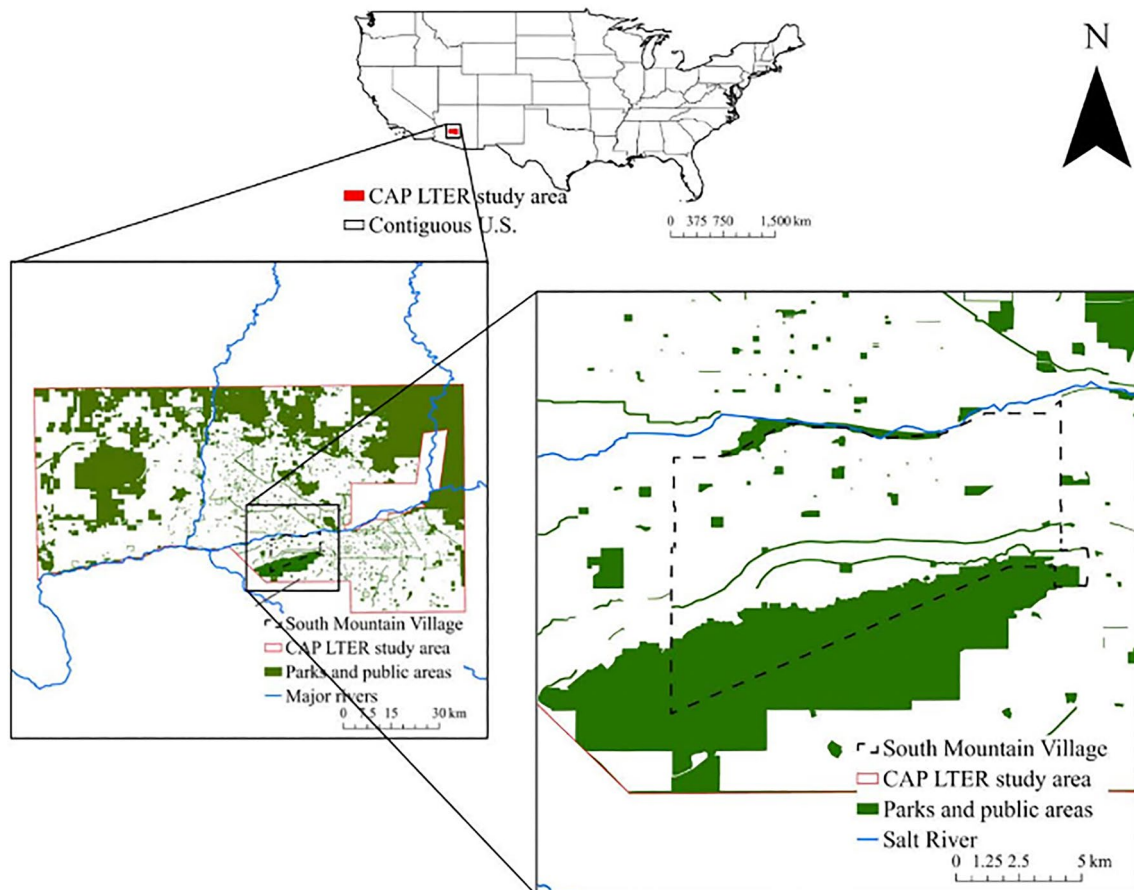


Fig. 2 Map of the Central Arizona Phoenix region and South Mountain Village

particular theme. Here, themes refer to an area of interest that starts the conversation about the future and that corresponds to a concern in the region or village. For example, a theme could be adapting to heat, or improving urban mobility. The themes of the visions were chosen in dialog between city practitioners and researchers prior to the workshops based on their priorities, concerns, and knowledge of the climate and social challenges that communities face. Thus, the Phoenix regional visions focused on six themes, three responded to challenges posed by extreme climate events (drought, extreme heat, and flood), and another three were intended to invite transformative thinking along the lines of densification, greening, and a circular economy (Fig. 3). The South Mountain Village visions also had two visions that focused on climate extremes (heat and flood) and three visions that tackled social issues that were of interest to the community (transportation, equity, and green gentrification) (Fig. 3).

Methods

The RESQ aggregates and synthesizes all data outputs from the visioning workshop activities. Typically these include: (1) overarching goals for each vision theme, e.g., a table working on the future of transportation may come up with the goal of having a car-free city; (2) specific strategies prescribed to achieve the overarching goals, e.g., expansion of public transit; (3) a timeline from the present to 2080 describing the temporal progression of the aforementioned strategies and associated targets, e.g., by 2040, there will be

50% more bicycle paths within city limits; (4) a map representing the physical dimensions of the strategies; and (5) a short narrative where participants describe what the future would look and feel like in the city that they have envisioned (for more details, refer to Mannetti et al. 2021). In addition, we also referred to notes taken during the visioning sessions and to observations from the workshop organizers who were observers as well as facilitators.

A more detailed description of the assessment methodology is found in Berbés-Blázquez et al. (2021); however, there are three steps to the assessment process. The first one determines the archetypal characteristics of the vision, what we have called key components. Reviewers considered the data available for each vision holistically to determine the 2–4 key components that defined it. In the second step, each key component of the vision is assessed against the criteria for enhancing resilience, equity, and sustainability outlined above using a scale from 0 to 4, where 0 was absent and 4 was strongly present. The scores are recorded in a table for each (see figure in the Online Appendix), and finally, we calculate the weighted average based on the scores of the key components and the number of key components. The weighted average facilitated comparison among visions, because the number of key components in each scenario vision differed (visions typically had three but some visions had 2 or 4 key components). We compared the weighted average for each vision in bar graphs and radial plots using a scale of 0–4 (0 = absent, 4 = strongly present). Each assessment was conducted by at least two coders and reviewed by a third one. In case of disagreement between the scores given by the coders, the difference was resolved by negotiated

Phoenix Regional scenarios		South Mountain Village scenarios	
	Cool It or Lose It. This vision explores adapting to increasing extreme temperatures in the Phoenix valley.		Some Like It Hot. This vision explores adapting to increasing extreme heat at the neighborhood level.
	True Cost of Water. This vision explores mechanisms to enhance resilience to ongoing drought conditions in the Southwest.		Equity District. This vision uses an equity lens to explore historical and current environmental and social injustices to create more just futures.
	Desert Wetland. This vision explores how to adapt to short, intense rain events that cause flooding in the valley.		Mountain to River. This vision explore water flows between the South Mountain and the Salt River with a specific focus on avoiding flooding.
	Almost Zero Waste. This vision inspires us to consider ways of reducing our impact through reduced consumption and self-sufficient approaches.		Right Kind of Green. This vision balances how to increase environmental amenities in South Mountain Village while avoiding gentrification and displacement.
	Emerald City. This vision looks at how green infrastructure can deliver multiple benefits for city dwellers.		Connected and Mobile. This vision considered alternatives to improve connectivity in South Mountain Village, focusing on alternative to the use of cars.
	Healthy Harvest. Highly experimental, this vision plays with densification and connectivity in a desert climate.		

Fig. 3 Motivations behind each of the co-created future visions

consensus. All coders had participated in the visioning workshops and were thoroughly familiar with the workshop outputs and materials.

Results

Key components of future visions

We identified two-to-four (most commonly three) key components in each of the 11 future visions (Fig. 4). More detailed descriptions of the Phoenix regional visions can be found in Iwaniec et al. (2020) and in Berbés-Blázquez et al. (2018) for the South Mountain Village visions.

Resilience assessment

The results from the resilience assessment (Fig. 5) show that when participants envisioned a resilient future, they thought primarily about a more connected future. Connectivity was multidimensional, that is, the visions exemplified social, ecological, and technological connectivities. Overwhelmingly, participants wanted to build more connections by implementing urban infrastructure that brought people together through more walkable cities and activated, vibrant, urban spaces. This would be achieved through ecological connectivity that created green

corridors and connected greenspace and patches, and through social connectivity that built up their community networks and neighborhoods. Connectivity scored high (> 10 of 12 points) throughout both the Phoenix regional visions (average of 10.7) and the South Mountain Village visions (average of 11.0) (Fig. 5a).

Our visions also show that participants desired diverse futures. In general, the Phoenix regional visions diversified in terms of means rather than ends; that is, rather than focusing on one type of solution, participants identified a variety of strategies to fulfill a given goal. For example, visions often depicted varied energy portfolios and multi-modal transit systems, as opposed to a single energy source or a dominant transport type. Because the visions identified these diverse ways of achieving objectives, redundancy was also high in the regional visions. Redundancy refers to having elements in the visions that have functional overlap. For example, the Phoenix regional visions combined mechanical and natural shade options to reduce heat exposure. On the other hand, the South Mountain village visions tended to interpret diversity as an end in itself. This was especially evident in the visions that had a strong equity component, such as *Some Like it Hot* (Fig. 5c). In these visions, diversity meant increasing representation by adding more voices to decision-making processes. Consequently, in the South Mountain Village visions, redundancy scores tended to be lower.

Key components of future visions

a. Phoenix regional visions



True cost of water

- Promote water security via aggressive water conservation measures including water recycling
- Impose growth boundaries to reduce sprawl and agriculture and promote densification
- Promote decentralized and local food production



Almost zero waste

- Small-scale, life-cycle approach to energy, water, food nexus + self-sufficiency
- Novel green economy innovations supporting reused materials diverted from the waste stream
- Connectivity



Healthy harvest

- Expanded multi-modal transit system, no cars
- Land use change to concentrate land uses, restore desert ecosystem
- Solar farms, wind farms, agriculture hubs, hydroponics

Cool it or lose it

- Amplify the implementation of heat-reducing green and gray infrastructure throughout the city
- Enhance the community's adaptive capacity to heat through changes in norms, e.g. change work hours
- Spatial decentralization of urban form and services



Desert wetland

- Implement green infrastructure to reduce or manage flooding at all levels, from households to city to region
- Develop a network of greenspace to enhance ecological connectivity and public transportation



Emerald city

- Nature-based solutions for an eco-city
- Sustainable energy, water, and food flows that balance tradeoffs
- Livable, accessible hubs/neighborhood



b. South Mountain Village visions

Equity district

- Self-sustaining economies, self-determining governance
- Progress but preserve, identity, history
- Megablock city placemaking



Some like it hot

- Heat mitigation and health promotion through land use change and urban design
- Pursuit of social equity through mechanisms that increase representation + inclusion
- Environmental & sustainability awareness in community



The right kind of green

- Strong emphasis on social cohesion
- Cool and efficient design
- Local agriculture and health-centered green infrastructure



Mountain to river

- Holistic, systems-based water management planning.
- Socio-eco-hydrological corridors
- Strong emphasis on community building processes



Connected and mobile

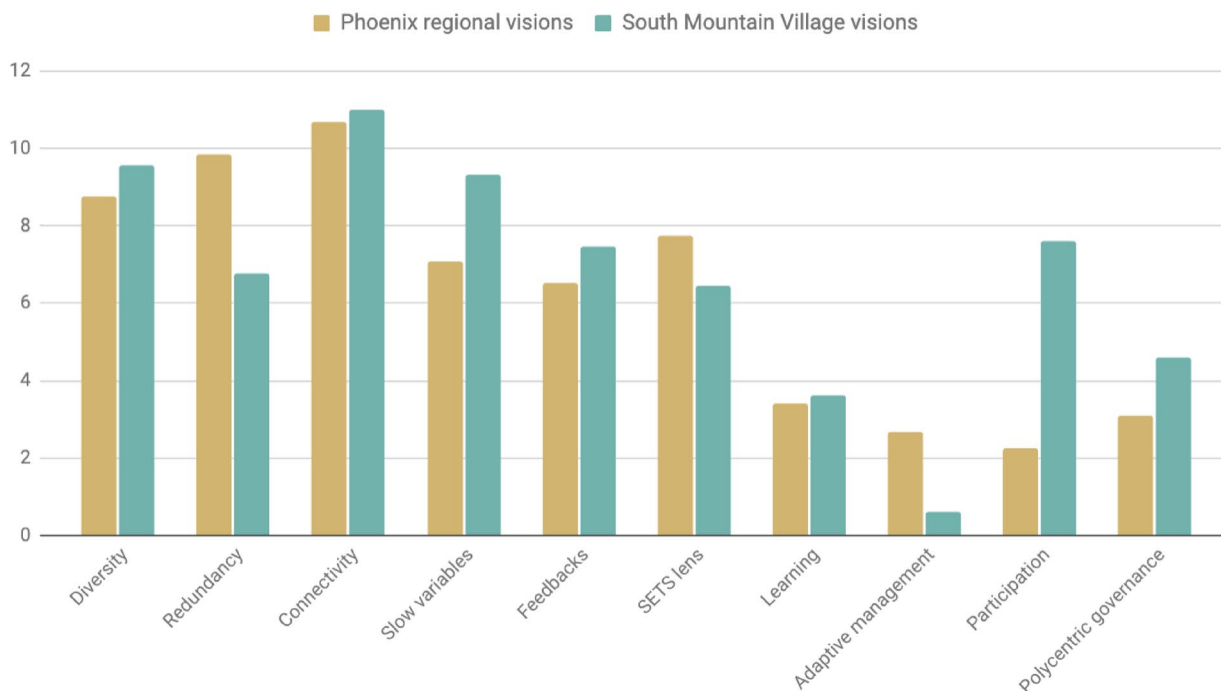
- Live, work, and play within a short, walkable distance
- Multifunctional revitalization of the Salt River
- Activated public space, from car-centric to car-free



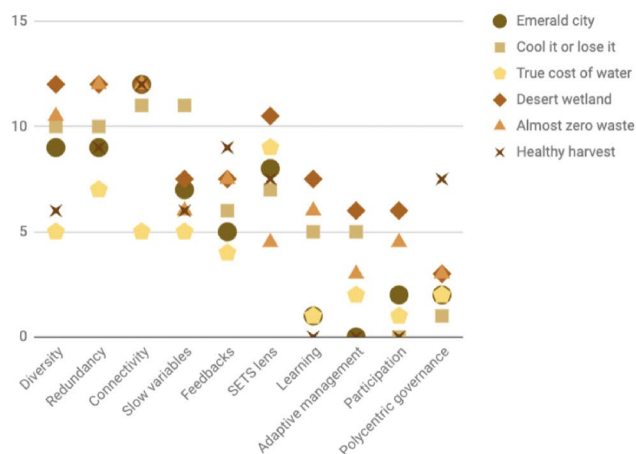
Renderings by: Brandon Ramirez, Arizona State University ViciLab's Jacob Sahertian and Selina Martinez, as well as students from Paul Cosco and Alyce Hargrove's Landscape Design studio in Arizona State University.

Fig. 4 Key components of each scenario vision based on Iwaniec et al. (2020) and Berbés-Blázquez et al. (2018)

a) Average resilience scores for regional and village visions



b) Resilience scores for Phoenix regional visions



c) Resilience scores for South Mountain Village visions

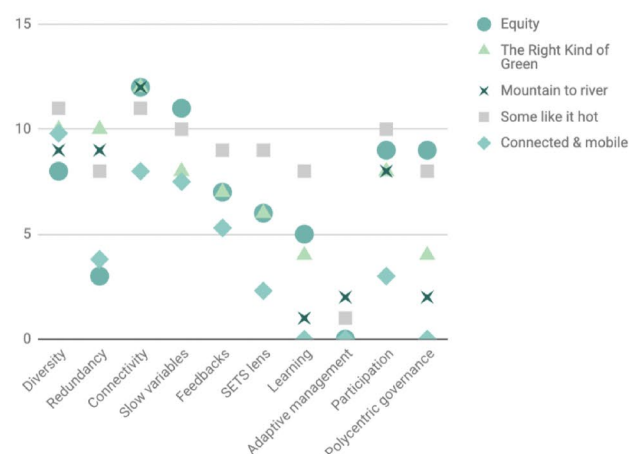


Fig. 5 Resilience assessment for Phoenix regional visions and South Mountain Village visions. Average scores are shown in the top graph (a), disaggregated scores for Phoenix regional visions (b), and South Mountain Village visions (c) are shown below

Oftentimes, moving toward more desirable futures requires long processes of incremental change that tackle the underlying variables controlling the system, known as slow variables. Both sets of visions identified slow variables (Walker et al. 2012), although they were more prominent in the South Mountain Village visions. Typical slow variables included strategies aimed at changing people's values and perception, such as imparting cultural sensitivity training for city staff or environmental awareness campaigns, as part of

achieving broader system changes. Another example of strategies that tackled slow variables were the zoning changes that were proposed throughout to accomplish greening, housing, and transportation objectives.

For the most part, resilience principles scored similarly in the two sets of visions except on their approach to broadening participation in decision-making. The Phoenix regional visions contained a few mechanisms for increasing participation, whereas more participatory

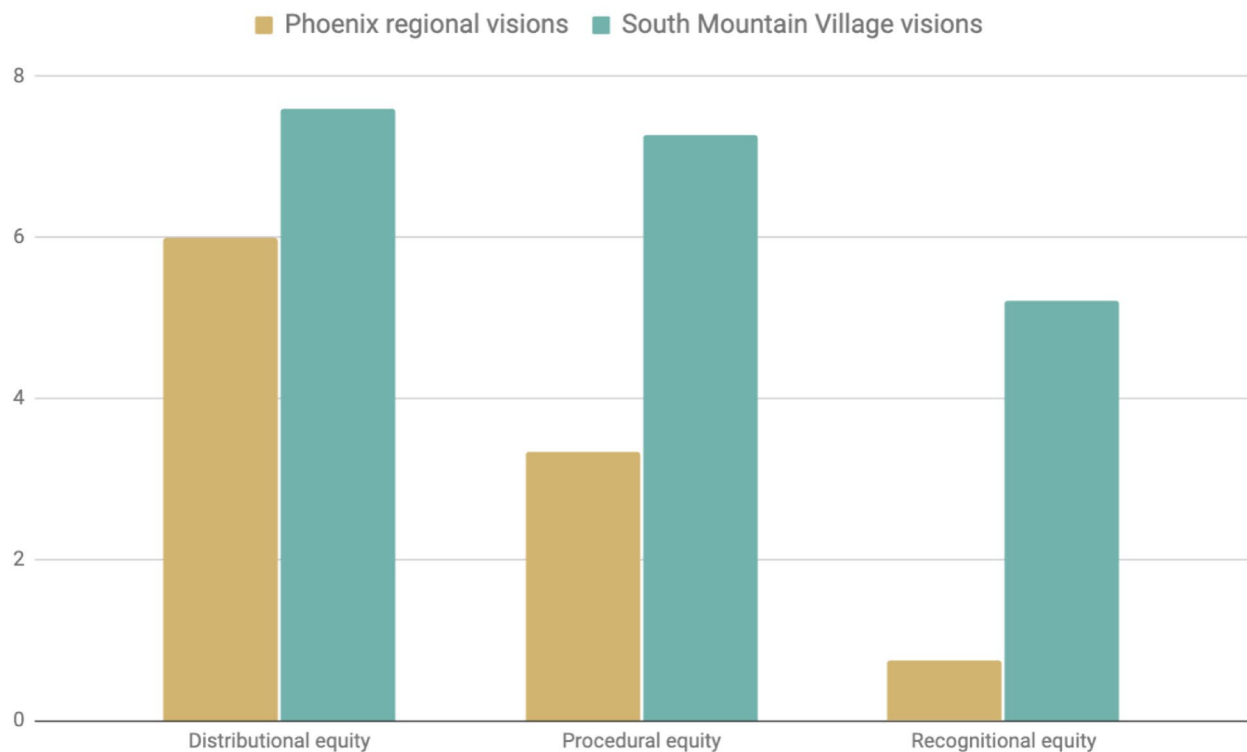
decision-making was central to the South Mountain Village visions. For example, the South Mountain Village visions contained schemes for community ownership and management of greenspaces, mechanisms for increasing social cohesion, and ideas about identifying block representatives for policy-making. Finally, in both sets of visions, there was relatively less attention paid to

governance variables, such as strategies that would foster adaptive management and polycentric governance.

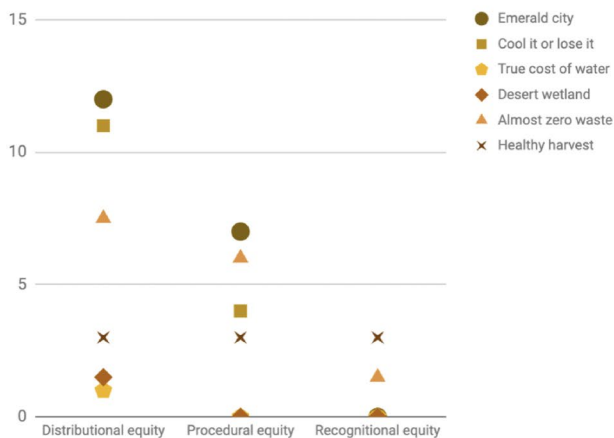
Equity assessment

The results from the equity assessment revealed differences between the regional and village scales, as well as

a) Average equity scores for regional and village visions



b) Equity scores for Phoenix regional visions



c) Equity scores for South Mountain Village visions

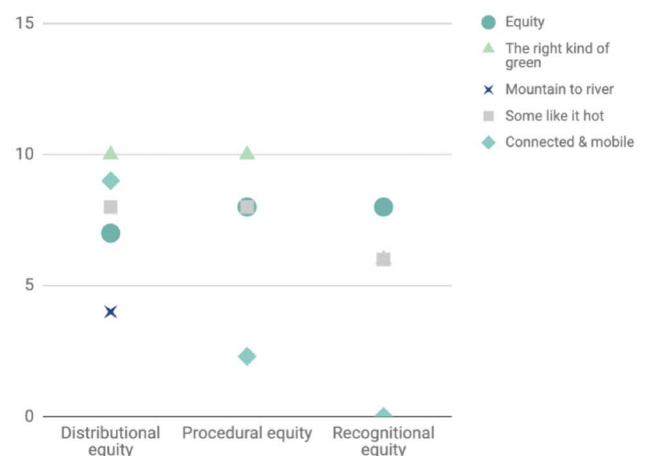


Fig. 6 Equity assessment for Phoenix regional visions and South Mountain Village visions. Average scores are shown in the top graph (a), disaggregated scores for Phoenix regional visions (b), and South Mountain Village visions (c) are shown below

significant variations between the aspects of equity emphasized in each vision (Fig. 6). In general, the South Mountain Village visions contained more mechanisms for increasing equity across all aspects, i.e., distributional, procedural, and recognitional, than the Phoenix regional visions (Fig. 6a). Indeed, two of the village-level visions, *Equity District* and *The Right Kind of Green*, had an explicit equity focus, which was decided during a community engagement (a world café exercise) prior to the workshop (Fig. 6b).

Most future visions included a variety of mechanisms for enhancing distributional equity. These mechanisms were about the conscious sharing of benefits and services, with a focus on traditionally underserved communities, although who constituted an underserved community was not always defined during the conversations held during the workshops. Examples of increasing distributional equity focused on access to the benefits derived from urban green infrastructure, such as planting trees for shade, establishing parks for recreation, or community gardens for food, as well as increasing access to urban services such as public transportation or reliable energy sources. Many of the future visions were explicit in demanding that all residents have access to these types of benefits within walking distance, e.g., the concept of a 20-min city.

In terms of procedural equity, or mechanisms to ensure fairness in the processes that decide the distribution of urban benefits, there were noticeable differences between the regional and the village visions. South Mountain Village visions emphasized the need for more representation in decision-making. These visions identified several mechanisms aimed at devolving power to the community, often imagining new governance arrangements to do so. For example, in the village visions, participants envisioned creating a neighborhood committee to advance specific agendas (e.g., an anti-gentrification committee) or schemas for neighborhoods to become collective owners and stewards of the greenspace near the Salt River that constitutes the North boundary of the village. In the Phoenix regional visions, procedural equity showed up in more implicit forms, for example, through the decentralization of services such as energy production, which would give people more control in how they organize to meet their energy needs.

Finally, mechanisms for advancing recognitional equity were less prevalent in both sets of visions and nearly absent from the Phoenix regional visions (Fig. 6). Recognitional equity has to do with the ways in which difference is honored, with a specific emphasis on the ways and cultures of traditionally disenfranchised populations. The set of South Mountain Village visions was generally inward-looking, often highlighting how future developments should take inspiration from their history, how leaders should come from the community, and how public and greenspaces should celebrate the mix of cultures that have shaped the community.

Examples of this include activating the space surrounding the canals that were originally dug by the Huhugam of the Sonoran Desert, paying homage to the South Mountain and its views, which is a landmark of the area, or including citrus trees to remember the orchards that once dominated South Mountain Village and to honor agricultural workers. Examples of recognitional justice in the Phoenix regional visions were once again more implicit; for instance, they often highlighted the use of native desert species, but it was less clear if this was to honor their cultural heritage or for ecological reasons. Only the *Healthy Harvest Hubs* regional vision had an element of creating three separate urban hubs with distinct characters that reflected their prior histories.

Sustainability assessment

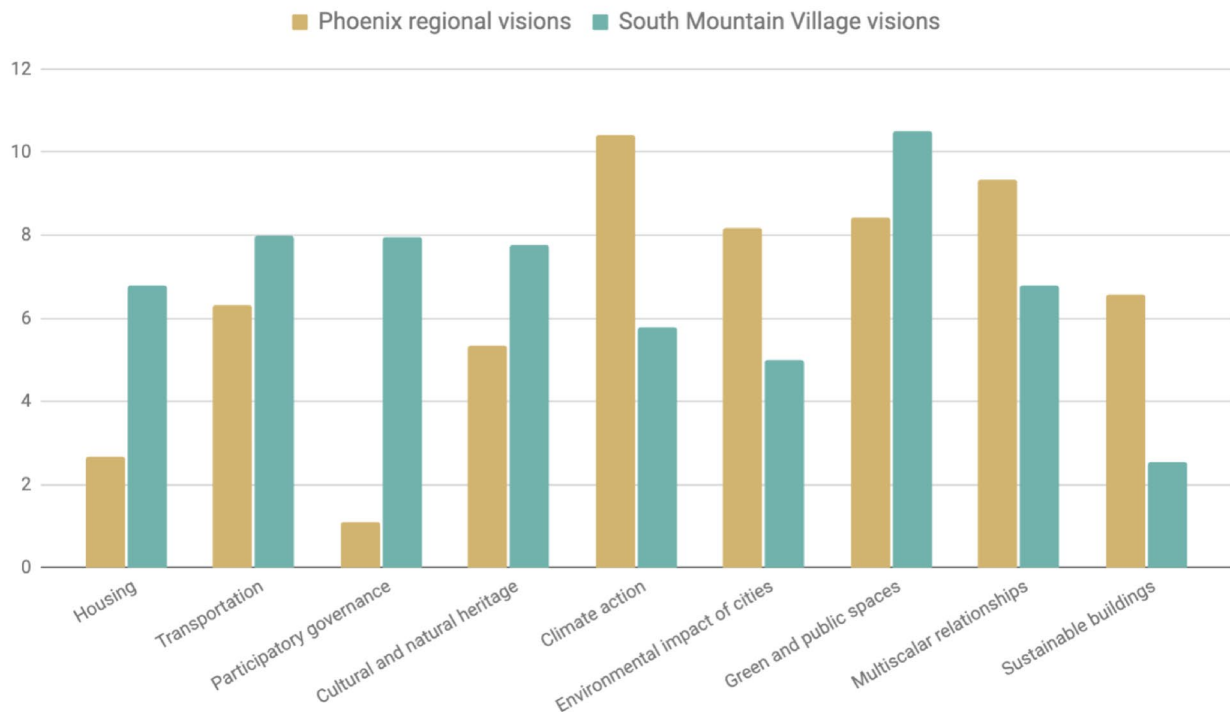
While all visions focused on more greening, the assessment of SDG 11 goals also showed differences in other sustainability objectives (Fig. 7). In both sets of visions, the availability of green and public spaces scored high. There was a broad variety of ways in which these spaces were conceptualized, from building pocket parks and vibrant spaces surrounding the network of canals, to abandoned highways that are turned into green lanes. However, the two sets of visions demonstrated a difference in orientation for the remaining SDG 11 targets. The Phoenix regional visions performed better on SDG11 goals having to do with environmental and translocal dynamics and relationships, that is, on goals related to increasing climate resilience, reducing the environmental impact of cities, and building multiscale relationships. The emphasis on addressing urban climate and pollution is evident even in the more transformative visions, such as *Emerald City* or *Almost Zero Waste*, which remained linked to solving environmental challenges (Fig. 7b).

On the other hand, the South Mountain Village visions revealed an approach to sustainability that prioritized social dimensions and meeting human needs. The village visions scored higher on providing essential services, such as housing and transportation, preserving the character and heritage of the area, and ensuring political representativeness (Fig. 7a). The social dimensions of sustainability are evident for *Equity District* and *The Right Kind of Green* but even for visions focused on climate stressors, such as in *Some Like it Hot*, which was a heat resilience scenario, participants quickly reframed the scenario as a heat equity vision during the workshop (Fig. 7b).

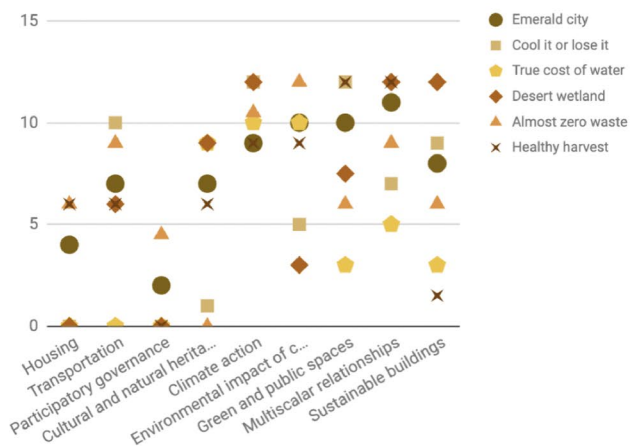
Comparison of heat visions

Given that extreme heat is a central part of life in the Phoenix valley, both sets of future visions had one vision that explored heat resilience. The regional vision was entitled *Cool It or Lose It* and focused on drastically increasing the

a) Average sustainability scores for regional and village visions



b) Sustainability scores for Phoenix regional visions



c) Sustainability scores for South Mountain Village visions

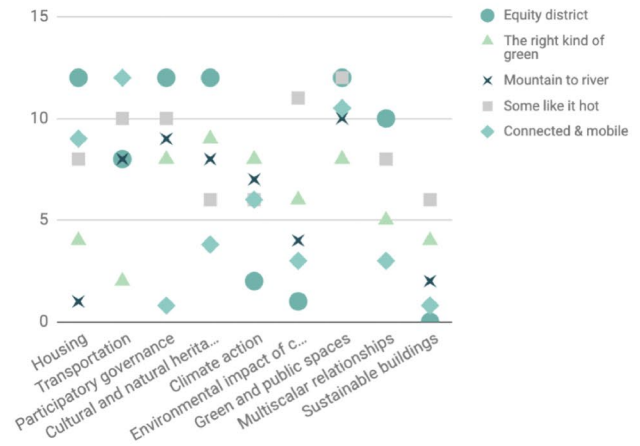


Fig. 7 Sustainability assessment for Phoenix regional visions and South Mountain Village visions. Average scores are shown in the top graph (a), disaggregated scores for Phoenix regional visions (b), and South Mountain Village visions (c) are shown below

amount of shade through the implementation of green and gray infrastructure and cooling technologies, such as cool pavements. Consequently, in this vision, patterns of population density change and people and housing concentrate in areas that are experiencing local cooling, such as around the canals. In turn, this limits sprawl and improves walkability. There are also efforts to increase heat awareness of residents through educational activities and data gathering. The village-level vision, *Some Like It Hot*, presented a future for

South Mountain Village that centered the health of residents. A variety of green heat-mitigating strategies are deployed in combination with strategies to increase engagement, representation, and the education of residents around heat. In this section, we focus our analysis on the resilience, equity, and sustainability of these two visions that are addressing the same challenge at different scales (Fig. 8).

In terms of resilience mechanisms (Fig. 8a), both visions scored similarly high on metrics of diversifying, building

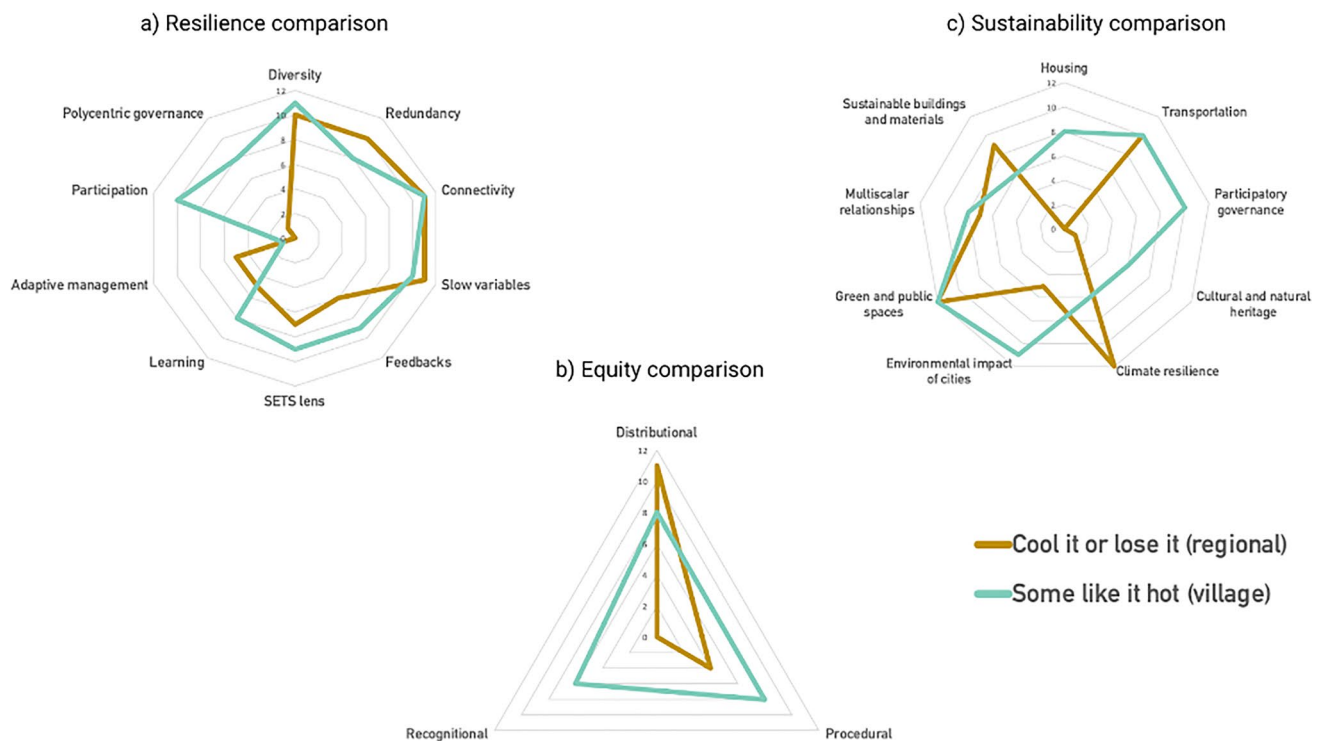


Fig. 8 Assessment of resilience (a), equity (b), and sustainability (c) for the two heat visions. In brown *Cool It or Lose It* (regional), in aqua *Some Like It Hot* (village)

redundancy, and connectivity. Both visions also scored high in terms of mechanisms that considered slow variables. However, in the regional scenario, *Cool It or Lose It* slow variables are represented by changes to the built environment that will influence subsequent changes in population density. By contrast, in the *Some Like It Hot* village vision, slow variables appear in the form of increasing community capacity, by enhancing leadership and education among residents of South Mountain Village. As noted for all visions, there was a greater focus on participation and polycentric governance in the village-scale heat vision than in the regional heat vision.

In terms of equity (Fig. 8b), we observe that both visions considered distributional aspects of justice, but only the village visions contained additional mechanisms for ensuring procedural and recognitional justice. The *Cool It or Lose It* regional vision reflected a strong sense of decentralization and spoke to the need to increase access to benefits starting with those who have been traditionally disadvantaged. For example, in the *Cool It or Lose It* vision everyone had access to greenspace within a 5-min walk, a network of cooling stations, more transit options, and decentralized energy options. The *Some Like It Hot* village vision contained some of these strategies as well but to a lesser extent. Instead, the village vision emphasized increasing recognition and representation in decision-making, which was largely absent from the regional scenario. For example, in the South Mountain

Village heat vision, they wanted to ensure that they had local leaders, and they indicated the need for culturally sensitive processes to deal with heat extremes.

In terms of sustainability (Fig. 8c), both visions emphasized providing access to adequate transportation, green and public spaces, and considered multiscalar relationships. Multiscalar relationships manifested in both sets of visions in how they considered strategies at different levels. For example, both visions offered layered arrangements of green infrastructure that included street trees, pocket parks, and larger naturalized areas. As well, the visions contained mechanisms to ensure that heat readiness considered individual, household, and community needs. With regard to transportation and green public spaces, the *Cool It or Lose It* regional vision presented an increase in vegetated spaces as an integral part of the cooling efforts, and the vision contained “shade corridors” or green, connected areas for people to move around the city. In this vision, active modes of transportation, such as walking and biking, had become popular forms of transit for residents. In the *Some Like It Hot* village vision, greenspaces were equally important, but they typically came in the form of smaller green areas, such as pocket parks, or places to take respite from the heat. At the village scale, there was explicit discussion about making those greenspaces safe for people of color. Active transportation

was also important in the village visions, along with more public transit options, such as rail and buses. Once again, a concern with making public transit safe for the community living in South Mountain Village was key.

For the rest of the SDG11 goals, the two future visions scored very differently. The *Some Like It Hot* village vision showed concern for increasing access to housing and political participation. As well, the village vision depicted a desire to recognize and celebrate their historical heritage and distinctiveness as a community. Both dimensions were missing from the regional vision. The two visions were concerned with pollution, but addressing poor air quality was a clear priority in the village scenario, as the incidence of asthma is an ongoing concern in South Mountain Village. The reverse is true when it comes to climate change. Concerns for the impacts of climate change were present in both visions, but they were more central in the regional vision. Finally, the regional scenario emphasized a sustainable and resilient built environment as it sought to integrate heat-reducing infrastructure throughout (e.g., mechanical shade, cool pavement). The focus on sustainable materials was lesser in the South Mountain Village scenario, although it mentioned using waste materials as a future source of revenue for the community.

Comparison of resilient flood visions

Finally, we compared the two visions that explored building resilience to flooding at the regional and village scales (Fig. 9). As mentioned earlier, Phoenix receives a small amount of annual precipitation, but the precipitation is concentrated in two rainy seasons that regularly cause flash floods, so flooding is a broadly shared concern. The regional vision is the *Desert Wetland*, a vision inspired by the sponge city imaginary (Chan et al. 2018) adapted to desert conditions. The vision imagined a network of green and blue infrastructure features and increased hydrological connectivity joining neighborhoods throughout the region to manage stormwater. To mitigate regional flooding, the transportation network, including highways, was designed to become part of the interconnected drainage system during extreme precipitation events to reduce flooding and support infiltration. The village-level scenario was titled *Mountain to River*, and it explored hydrosocial connections from the South Mountain to the Salt River, the two natural features that form the southern and northern boundaries of South Mountain Village. The vision emphasized connectivity of people, water, and non-human organisms and featured a strong sense of place based on the two iconic natural features that dominate the landscape.

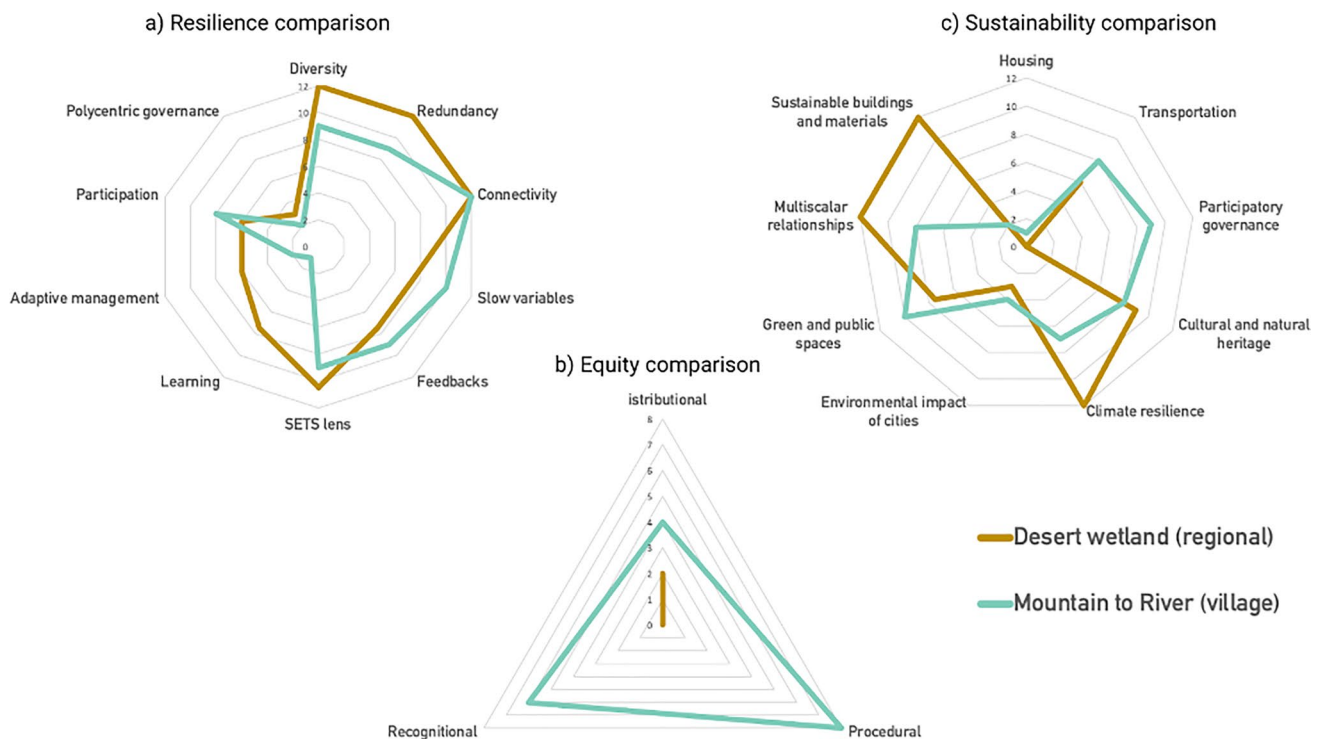


Fig. 9 Assessment of resilience (a), equity (b), and sustainability (c) for the two flood resilience visions. In brown *Desert wetland* (regional), in aqua *Mountain to river* (village)

The two visions scored similarly high in terms of mechanisms to build resilience (Fig. 9a), although the regional vision had slightly more developed mechanisms in almost all dimensions of resilience. Both visions prioritized building and managing connectivity the most, although it manifested in different ways. The *Desert Wetland* regional vision expressed connectivity in the ways that it linked all forms of green infrastructure to move water during flood events utilizing a network of urban ecological infrastructure spanning different scales. In addition, this vision created a multimodal transportation network integrated with the ecological infrastructure. In the *Mountain to River* vision, connectivity came from creating socio-hydrological corridors connecting the South Mountain to the Salt River that would partially restore historical water flows and activate community life around them. The largest difference in resilience scores between the two visions was the lack of adaptive management and learning in the village scenario, whereas the *Desert Wetland* regional vision contained green infrastructure pilot projects to learn and inform larger multiscale green infrastructure transformations. The resilience mechanisms in which the *Mountain to River* village vision scored slightly higher than the regional counterpart were participation and the managing of feedbacks and slow variables. Although both sets of visions alluded to bottom-up participation, only the village vision contained explicit details. For example, the *Mountain to River* vision proposed a scheme for community representatives to be part of the water governance body.

The equity assessment revealed the most difference between the regional and the village visions (Fig. 9b). There were almost no mechanisms promoting equity in the regional visions, whereas the village-level visions developed sophisticated ideas around distributional, procedural, and recognition justice. Distributional justice is the only mechanism that was somewhat addressed in the *Desert Wetland* vision, as it promoted green infrastructure features throughout. In contrast, the *Mountain to River* addressed distributional justice through the promotion of green infrastructure, but also through educating the population on rainwater harvesting, and by creating green jobs in the community. In this vision, there were also several mechanisms to increase community representation in decision-making by creating a watershed stewardship program with representatives from different neighborhoods as well as village-wide coalitions. Finally, the *Mountain to River* vision used the historical legacy of South Mountain Village to inform the future. Hence, there were several ways in which the vision honored the historical canals, the washes, and aesthetics of this area of the city, thus demonstrating and celebrating attachment to place.

Finally, the two visions also scored similarly in their mechanisms for enhancing sustainability, although their differences in focus were pronounced (Fig. 9c). Both visions paid particular attention to the availability of green and

public spaces, transportation, as well as the conservation of cultural and natural heritage. The two visions presented an improved transit system that prioritized walkability, as well as public and active forms of transportation. Interestingly, the regional vision mentioned the light-rail train (LRT), which for years was a contentious issue associated with the gentrification of South Mountain Village (and did not appear in the village vision). Likewise, both visions promoted conservation and access to green spaces and spaces of cultural significance and, in particular, they wanted to preserve or restore water habitat for general enjoyment but also as an integral feature of flood management. Neither vision considered remedying pollution nor access to adequate housing.

The main points of divergence between the two visions with regard to SDG11 were in how each addressed participation. As noted earlier, the village vision contained mechanisms to include community voices in decision-making, whereas the regional vision mentioned the implementation of a civilian conservation corps. Another point of divergence between the two visions is the relative importance of buildings and materials. The regional vision considered a wide variety of infrastructural elements to address flooding ranging from the use of permeable pavement, to retention basins, to turning highways into waterways during flooding episodes; whereas the village vision only contained a few mentions of using locally sourced materials for rain capture.

Discussion

Visions across scales

There are different motivations for constructing visions at multiple scales. A key reason is to account for the heterogeneity of experiences and views of actors operating at scales that range from the local to the global (Kok et al. 2007; Biggs et al. 2007; Mistry et al. 2014; Pereira et al. 2020). Indeed, in the past 2 decades, we have seen several initiatives adapting global storylines to local conditions. For instance, several studies have developed country-specific scenarios based on the shared socio-economic pathways, which are global narratives used by the International Panel on Climate Change, IPCC (see, e.g., Frame et al. 2018; Chen et al. 2020). In a similar vein, other work has explored the implications of adapting the Nature Futures Framework storylines to the national context (see, e.g., Rosa et al. 2017; Pereira et al. 2020). Yet, these studies are fundamentally different from our approach in that they start with a common, global, storyline that then gets adapted and translated onto a specific context. While there is value and advantages to keeping some consistency among storylines across scales, these approaches also impose a set of parameters within which the local future narratives are to be developed.

In our case, alignment between narratives and across scales was less important; hence, we chose not to structure the conversation along a specific storyline. Instead, we provided participants with a minimal pitch about the theme that their vision should explore and we let them build their imagined vision through conversation. In many cases, the narrative took distinct turns as participants grappled with the issue presented. As mentioned earlier, the heat vision of South Mountain Village that initially started as an exploration of adaptation to extreme temperatures soon became a heat equity vision more concerned with addressing the unequal distribution of negative heat impacts and governance capacity building.

As the example above demonstrates, our approach prioritized developing narratives that reflected the issues and opportunities perceived by actors working at different governance scales. The subsequent cross-scale analysis of resilience, equity, and sustainability revealed differences in priorities. In general, the visions that were developed at the regional level aligned with a green sustainability agenda, whereas the visions developed at the village level aligned with a social agenda. The contrast is particularly salient in the results of the sustainability assessment based on the targets of SDG11, but also in how equity mechanisms, specifically for participation, were more present in the village visions than in the regional visions. This is also colored by the historical relationship between the City of Phoenix and South Mountain Village, which is one characterized by indifference and neglect if not outright segregationism (Bolin et al. 2005; York et al. 2014). Indeed, the southern part of Phoenix only became formally annexed to the city of Phoenix in the 1960s; prior to that, the area lacked basic urban services such as appropriate sewage, and the general lack of urban planning had encouraged the establishment of industrial land uses in central and south Phoenix (York et al. 2014). It is therefore not surprising that South Mountain Village representatives often feel the need to advocate on behalf of their community in decision-making spaces. We see this in the way that South Mountain Village visions contain mechanisms for influencing decision-making and for building leadership capacity at the community level, as well as in the insistence that the future visions should reflect the rich past and the specific traditions of the Latinx, Black, Indigenous, and Japanese communities that have historically shaped this village.

More generally, the results highlight the political dimensions of anticipatory exercises, which are seldom made explicit (Mazé 2019). Yet, the decision of what constitutes desirable futures for cities remains a political act. Determining the scale of a scenario vision, sometimes called ‘bounding the issue’, is often framed as a practical exercise, that is, out of necessity and to simplify complex situations, future visions are constrained temporally

and spatially. Temporal dimensions generally range from short- (~5 years) to medium- (~10–25 years) to long-term visions (~50 or more years), whereas spatial bounding uses biophysical attributes to determine the focus of the visioning exercise, where boundaries may be ecological (e.g., watershed, biome) or administrative (e.g., city, county, or combinations). For example, the megadrought affecting Phoenix that inspired the *Desert Wetland* vision has driving forces in the reduced precipitation and snow-pack hundreds of kilometers away in the Colorado Rocky Mountains affecting all six states of the Southwest, so it was framed as a regional vision. Yet, one can appreciate that there is a host of other factors affecting the choice of scale, including data availability, political relevance, ability to intervene, relationships with stakeholders, prior work, and the timing of the visioning exercises.

Beyond the factors that go into bounding an issue, the choice of temporal, spatial, or administrative scales in visioning shapes the conversation and discursive possibilities, highlighting and obscuring what and who is relevant to the future of a place. For example, choosing to develop long-range futures, which are inherently more uncertain, minimizes the importance of present conditions and thus can be used to destabilize the influence of powerful present-day actors and structures whose role could be less relevant 100 years from now. Likewise, the choice of scale predisposes participants to bring into consideration specific issues, that is, local controversies may be bypassed by shifting the conversation to larger levels, and global politics may be ignored by focusing on smaller levels. We note this in how our two sets of visions dealt with the highly contested LRT extension proposed to join the downtown core of Phoenix to the south along the central corridor of South Mountain Village. Fear of gentrification and the loss of business revenue during the construction phase versus the need for more public transit options colored the debate, which was in full swing at the time of the workshops. In the resulting *Connected and Mobile* vision that considered the future of mobility in South Mountain Village, the LRT was largely ignored, and the vision focused instead, somewhat surprisingly, on the restoration of the water flow to the Salt River as a possibility for public transit. When the LRT did get mentioned in the vision, it did not operate efficiently due to the very high temperatures of 2080, and it had led to gentrification in the adjacent neighborhoods. By contrast, light rail was depicted in several of the regional visions, including some that did not deal with mobility explicitly, as part of the urban fabric, and it was seen as a regional infrastructural asset rather than a source of gentrification. Thus, spatial scale and scope have immense implications for both the problem and solution spaces considered and how they are treated.

Our analysis of scenarios across scales serves to illuminate alternative positionings with respect to desirable urban futures. Inasmuch as future visions may be used to guide and justify actions (Luederitz et al. 2017), we need to be aware of the implications of scale and cross-scale interactions. Similar to Avelino (2017), who proposed a framework to examine power in sustainability transitions, we note in our analysis that visions created at different governance scales can interact in complementary, synergistic, and antagonistic ways when considered together. For example, we see that urban green infrastructure had elements at the local and regional scales that complemented each other, e.g., neighborhood pocket parks can be part of a larger green corridor that crisscrosses the city with multiple benefits at both scales. By contrast, we observe that transportation solutions may be contentious, because they tend to create winners and losers, e.g., region-wide transit projects may benefit the region at large but be unwelcome by local businesses in the short term. This emphasizes the need for critical and pluralistic approaches to future studies that span across different and overlapping spatial scales and for corresponding analytical tools to explore trade-offs and synergies that may not be immediately obvious.

Limitations of the assessment tool

We add a final reflection on the limitations of the RESQ tool as a method to assess future visions. The RESQ was created to be used alongside quantitative assessment methods, such as modeling outputs (see, for example, Iwaniec et al. 2020; Sampson et al. 2020; Ortiz et al. 2021), to consider the implications of alternative future pathways more holistically. Consequently, the strengths and limitations of the RESQ assessment tend to be complementary to those offered by the outputs of quantitative methods used to explore future visions. For example, the RESQ can capture nuanced understandings of resilience, equity, and sustainability as presented in the future visions, but it is not designed to do the hypothesis testing that quantitative models can do. In addition, because the RESQ uses deductive logic to assess the meanings of resilience, equity, and sustainability, it may miss dimensions that may have emerged from the visioning exercise themselves, but that have not been previously captured in the literature, or perhaps meanings that are specific to one context. On this note, like other tools developed for assessing and comparing scenario visions, the RESQ works best when used in a comparative and iterative manner, and it can be used as a step toward the development of indicators tailored to each city. Our group has used the results from RESQ assessments in subsequent workshops to point out potential strengths and weaknesses of each future vision and explore the consequences of alternative pathways, as well as

guide further conversation in refining the visions (Mannetti et al. 2021).

Conclusions

As we move toward more uncertain urban futures, visioning can be used as a tool for framing issues, exploring the solution space, and considering the possibilities for transformative action toward more desirable futures. The RESQ assessment is a qualitative tool conceived to identify the degree to which future visions contain mechanisms for increasing resilience, equity, and sustainability. As a proof of concept, we applied the RESQ assessment tool to explore the extent to which mechanisms for building resilience, equity, and sustainability were present in 11 visions co-produced at two different scales in Phoenix, AZ. Based on our assessment, mechanisms for building resilience were similar across scales; however, the equity and sustainability assessments showed different emphases depending on the scale at which the vision was constructed. In our case, village visions were more concerned with empowering local voices, and regional visions were more concerned with advancing sustainability. Mismatches such as the one that we observed in our data point to the political nature of visioning and suggest the need to consider critically what issues are factored in and out of the visioning agenda through the choice of scale and further, how latent conflicts and synergies may be expressed through the visioning process.

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Data availability We make reference to several publically available reports in the text that contain the data that we have used for this analysis.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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