Scenario Planning in Small and Mid-Size Legacy Cities: Framework and Tool Adaptations in Youngstown, Ohio

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Abstract

This paper examines how scenario planning frameworks and tools—largely designed for contexts of regional growth—can be adapted for land use and development planning in small and mid-size legacy cities such as Youngstown, Ohio. Scenario planning has traditionally been applied in growing cities and regions to evaluate the sustainability implications of alternative land use plans and policies, and supporting tools have been designed for these contexts. These processes often use a normative approach at the metropolitan scale to build consensus around a preferred long-term vision, aided by tools and metrics that estimate the outcomes of alternative development patterns. Recently, scholars and practitioners have noted scenario planning's promise as a method for addressing uncertainty in urban planning. Applications of exploratory approaches and supporting scenario planning tools are less researched in U.S. legacy cities, where population decline or limited growth present urgent fiscal and social equity challenges.

A Cleveland State University graduate land use planning course partnered with the City of Youngstown to model parcel-level redevelopment scenarios in two embedded transit corridor study areas. To address demographic uncertainty and planning challenges related to limited growth and decline, we tested the utility of (1) a scenario planning framework that includes normative and exploratory elements; and (2) a blended use of two leading analytical tools, Urban Footprint and Envision Tomorrow.

We evaluate current integrated tool capabilities that are well-suited to inform planning efforts in Youngstown and other small and mid-size legacy cities. We also offer recommendations for enhancing the use of scenario planning and supporting analysis tools in contexts of decline, limited growth, and demographic/fiscal uncertainty. These recommendations include the use of frameworks that include normative and exploratory components, the ability to model alternatives for multiple planning scales ranging from corridor to detailed site-level projects, and opportunities for enhanced analytical metrics.

This research offers implications for planning research and practice in legacy cities throughout the Midwest and Northeast regions of the U.S., nearly half of which have less than 100,000 people. Our paper presents opportunities for further scholarship to enhance planning methods for addressing demographic uncertainty in contexts of decline and limited growth, an underdeveloped area of the planning literature. Our findings and recommendations also provide opportunities to broaden the adoption of scenario planning practice in legacy cities.

Keywords: Scenario Planning; Legacy Cities; Shrinking Cities

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Introduction

U.S. legacy cities throughout the Northeast, Great Lakes, and Midwest face the challenge of planning their future in the context of economic restructuring and limited growth or population decline. In addition to the challenges of fiscal sustainability that come with postindustrial decline, including aging infrastructure and shrinking tax bases, successful regeneration requires that these cities address social equity problems such as heightened levels of poverty, unemployment, gaps in educational attainment, and segregation (Mallach and Brachman 2013). While many legacy cities in the northeastern U.S. have recovered, legacy cities in the Rust Belt region of the U.S., including cities such as Cleveland, Detroit, Buffalo, and Pittsburgh, continue to struggle with decline and related challenges (J. Max Bond Center 2015).

Small and mid-size legacy cities between 30,000 and 200,000 residents play a critical role in this story and face unique challenges for their revitalization. Less discussed than their larger counterparts, these smaller cities have experienced decades of disinvestment, and have had a harder time recovering from the 2008 housing crisis. These cities face more extreme conditions than their larger counterparts in terms of population and employment loss, household income decline, growth in poverty, and disparate impacts for people of color (Fox and Axel-Lute 2008). Hollingsworth and Goebel (2017) note that many of these cities lack critical assets such as corporate headquarters or large anchor institutions, and generally have fewer resources at the local level and less access to federal aid. Yet, cities such as Erie, Rochester, and Flint play important roles in their regional and state economies, and are home to significant middle-class populations. These cities present important assets including well-defined, often historic downtowns and key employers such as universities and hospitals. In Ohio, the regions surrounding small and mid-size cities (e.g., Akron, Canton, Dayton, Youngstown, and others) represent one third of the state's population and produce one third of the state's economic output (Greater Ohio Policy Center 2016).

Youngstown, Ohio, is perhaps one of the most distressed small legacy cities in the U.S. Once a city of 170,000 residents at its industrial peak in the 1930s, its population is now estimated to be approximately 65,500 people (US Census 2019). Youngstown's decline has been persistent until recently; the city lost 10 percent of its population between 2010 and 2015 (Hollingsworth and Goebel 2017). Residents living in poverty (32 percent in 2010) and vacancy rates (currently 20 percent of housing units) have steadily increased over the past several decades (US Census 2010, Bowen National Research and Youngstown Neighborhood Development Corporation 2020). At the same time, the city was one of the first to acknowledge its decline and make plans for how it might adapt to these conditions moving forward. The city's current comprehensive city plan, *Youngstown 2010,* was adopted in 2005 and recognized the challenges of decline. It began a process of reorienting for the future as a smaller city and focused on retaining existing residents as opposed to rebuilding the past. Since the plan was adopted, the city has only lost 1,000 additional residents (Campbell 2016). *Youngstown 2010* has been reinforced by additional local planning including an updated zoning code, an adopted citywide housing strategy, neighborhood development assessments, corridor redevelopment studies, and a forward-looking autonomous vehicle transit project.

In 2011, Youngstown and Mahoning County joined eleven other counties in Northeast Ohio to secure a HUD Sustainable Communities Regional Planning Grant that enabled the region to analyze four development scenarios. The resulting regional plan, *Vibrant NEO 2040,* provides a telling story about the choices needed to create a sustainable future in this context. The plan finds that without changes to future development patterns, widespread vacancy and abandonment will progress, and the region's communities will face increasing fiscal stress. The process utilized a scenario-based framework that was perhaps the first of its kind to include zero and negative growth assumptions in its regional modeling, as well as exploratory approaches to account for uncertainties in demographic forecasts.

The City of Youngstown aims to build off the findings of *Vibrant NEO* and update its comprehensive plan in 2022 following the release of the 2020 Census. In particular, the City aims to use scenarios to account for demographic and economic uncertainty, help incorporate fiscal impact analysis into the planning process, and address social equity challenges such as food access, housing choices, employment access, and transit service coverage. While the scale of *Vibrant NEO* is useful for analyzing change at the regional and county levels, a parcel-level analysis is needed to apply these findings to a local comprehensive plan update. Additionally, while *Vibrant NEO* made use of the *Envision Tomorrow* software suite, and the city is familiar with the strengths and weaknesses of this tool for planning in a legacy city context, other scenario-based planning tools such as *Urban Footprint* have emerged since that time. Serving as the motivation for this project, the City was interested in comparing a recently developed tool with Envision Tomorrow to determine a preferred platform for undertaking the scenario planning component of the Youngstown 2010 update.

While scenario planning is widely acknowledged as the state-of-the-art in community and regional planning, scenario approaches and supporting tools were for the most part developed to address planning challenges in contexts of population growth. There remains a critical need to enhance its approach and methods of analysis to better plan for equitable and fiscally sustainable change in legacy city contexts, particularly for the many small and mid-size legacy cities in the Great Lakes Megapolitan Cluster (Nelson and Lang 2011).

In this paper, we conduct a pilot assessment of two leading scenario planning systems to determine their capabilities and limitations when planning for change in legacy city contexts. We (1) describe our process of calibrating and testing parcel-level scenarios in two embedded transit corridor study areas within Youngstown; (2) evaluate the tools' operational capabilities in modeling scenarios and analyzing fiscal impacts, social equity outcomes, and other issues particularly relevant for Youngstown and other small and mid-size legacy cities; and (3) present concepts for potential enhancements for scenario planning in legacy city contexts.

Background

Scenario Planning: History, Approaches, and Tools

Scenario planning, or the use of land development and urbanization scenarios as a means of representing the future, has been employed by community and regional planners for several decades (Xiang and Clarke 2003). Land use-transportation scenario planning processes as they are now conducted trace their roots to alternatives analysis mandated by the Federal-Aid Highway Act of 1962 and the environmental impact reporting required by the National Environmental Policy Act of 1970 (Bartholomew 2007; Chakraborty et al. 2011). The use of scenario for planning at the metropolitan scale was introduced in the early 1990s by regional planning organizations such as Portland Metro, which employed scenarios for the *Portland Metro 2040* plan and pioneered an era of regional vision plans utilizing scenario-based frameworks (ibid). The approach has been more widely adopted since that time, as illustrated by the U.S. Housing and Urban Development (HUD) Sustainable Communities Planning and Implementation grant program which, in 2010, mandated the use of scenarios by its grant recipients (U.S. Department of Housing and Urban Development n.d.). Today, scenario planning is widely acknowledged as state-of-the-art in community planning, particularly at the regional scale in the context of growth management.

Scenarios allow cities and regions to explore alternative futures, and serve as a tool to support collaborative planning workshops for public engagement by enabling diverse interests to explore the consequences of alternative development patterns. Scenario testing and visioning are widely acknowledged as effective techniques for creating a fair and efficient process for engaging stakeholders as part of a collaborative participatory process (Berke and Kaiser 2006). Traditionally, normative approaches have been the dominant framework in scenario planning, where a preferred scenario is collectively selected as a result of the planning process. As part of a successful participatory process, scenario planning aims to support shared perceptions of alternative futures, collective learning about the consequences of these futures, and a shared appreciation for a selected preferred future (Wollenberg et al. 2000).

In recent years, scholars and practitioners have turned to exploratory scenario planning approaches to account for uncertainty in the context of community planning. Scenario planning methods have been critiqued in the literature for being too normatively-focused and ignoring uncertainties such as environmental change and other exogenous events (Hopkins and Zapata 2007). Chakraborty et al. (2011) note that scenarios ought to be used for informing robust and contingent decisions (i.e., decisions that produce preferred results across all potential futures, and futures that may or may not happen, respectively). Shearer (2005) describes how scenarios are equipped to consider events in various operational environments: internal (under full community control), contextual (i.e., external, out of a community's control), and transactional (where a community and its surroundings interact). Similarly, Avin and Dembner (2001) recommend integrating uncertain external forces with controllable internal factors into a scenario analysis that can consider a broad range of future outcomes.

Exploratory scenario analysis has been furthered by the Lincoln Institute of Land Policy, funding research aiming to develop resources, frameworks, and methods for applying exploratory scenarios in practice (e.g., Goodspeed 2020; Roberts 2014; Stapleton 2020). In one example, the Sonoran Institute deployed exploratory methods to plan for climate change impacts of communities in the western U.S. (Sonoran Institute 2016). In another example, Hurricane Sandy recovery planning included the use of hazard scenarios paired with urbanization scenarios.

Scenario planning processes are typically aided by analytic sketch-level spatial planning software tools (i.e., a Planning Support System (PSS) as identified by Berke and Kaiser (2006)) that enable planners to evaluate and report back information on development scenarios using feedback indicators or metrics. As scenario planning has found wider adoption, and through collaboration between practitioners and researchers, supporting tools have grown in analytical sophistication to offer a broader range of capabilities (Holway 2011; Holway et al. 2012). For this project, we utilized Urban Footprint (UF) and Envision Tomorrow (ET), which present notable similarities and differences summarized in Table 1. While other scenario planning tools such as CommunityViz are widely used in practice, the scope of our project limited our testing to two contrasting tools.

Table 1: Select Tool Characteristics

	UrbanFootprint (UF)	**Envision Tomorrow (ET)**
Developer	Calthorpe Associates	Fregonese Associates
Time in use	Since 2018	Since roughly 2005
Availability	Proprietary	Open-Source
Platform	Web-based	GIS and Excel-based
Project Setup	Automated	Manual

UF has received recent attention for its potential to empower a wide range of users by making powerful datasets and analysis tools accessible in a cloud-based format, dramatically reducing the time and resources necessary to conduct scenario planning (Ewing 2019). UF's base canvas includes over 110 million parcels and is arguably the most comprehensive nationwide land use dataset available (UrbanFootprint 2021b). It incorporates data from a variety of commercial and public sources and uses proprietary algorithms to allocate information to the parcel level (UrbanFootprint 2021a). Some of the data sources incorporated in the base canvas include Census data (used to allocate population, households, dwelling units, and employment), CoreLogic parcel data (used to identify land uses and populate dwelling units, employment, and building attributes where available) Point-of-Interest data from supplemental sources, and road data for calculating intersection density (ibid). UF also has a Civic Partnership program in which they acquire and integrate updated data from participating cities (UrbanFootprint 2021b). UF updates its parcel canvas on a quarterly basis and makes weekly targeted updates (ibid). The complete parcel base canvas creation methodology is detailed and is publicly available on UF's website (UrbanFootprint 2020).

In addition, UF includes a variety of built-in analysis tools that can quickly evaluate the outcomes of scenarios across sustainability and livability topics including land consumption, resource use and emissions, walk and transit accessibility, transportation behavior, household costs, risk and resilience, and fiscal impacts. The analysis tools are driven by underlying base canvas and scenario data and are automatically calibrated based on national or regional assumptions, making them easy to use. The model assumptions can also be tailored by users when more precise inputs are available.

In contrast, ET has been in use since the early adoption of scenario planning for community and regional planning. It is highly acclaimed, and has been widely utilized, due to its open-source platform (Fregonese Associates n.d.a.). This makes the software free to use, pending a user's access to ESRI's ArcGIS software and Microsoft Excel. ET's building and place type information, along with its analysis assumptions, are housed in spreadsheets that dynamically link to the tools' ArcGIS plug-in (Fregonese Associates n.d.c.). This architecture offers a highly transparent environment in which users can calibrate detailed assumptions that impact the scenario building and analysis results. A notable downside of this open-source approach is that the setup and calibration for scenario planning is more time and resource demanding. ET also offers several stand-alone analysis tools that are useful for existing conditions analysis. ET's Prototype Builder offers a framework for developing market-feasible building types to utilize for scenario building, and is also useful as a stand-alone tool for site planning.

Youngstown and the Northeast Ohio Planning Context

Youngstown Historical Context

The discovery of coal in the Mahoning Valley ushered in the Youngstown's ascension as an industrial center in the early 19th century. Youngstown was connected to the steel centers of Cleveland and Pittsburgh in the mid-19th century via two canals, the Ohio and Erie and Pennsylvania and Ohio. The railroad's arrival soon after provided the infrastructure and connectivity for Youngstown's rapid economic growth. The Mahoning Valley's storied steel mills were established in the late 19th century and included Youngstown Sheet and Tube, Republic Steel, U.S. Steel, and Sharon Steel (Posey 2016). By the 1930s, Youngstown was one of the fastest growing cities in the country. The city's projected growth at the time warranted the construction of infrastructure for a future expected population of 250,000 people (Campbell 2016).

Like many other small and mid-size legacy cities founded on manufacturing, Youngstown was a place of opportunity for migrant factory workers and their families (Hollingsworth and Goebel 2017). Youngstown's growth was fueled by European immigrants drawn to the city by its coal and steel industries beginning in the 19th century, and later by African Americans and Puerto Ricans who had migrated to Youngstown in search of factory jobs. Youngstown's location, located at the midpoint between Cleveland and Pittsburgh, as well as between New York and Chicago, also supported the city's rise to prominence. However, after local iron ore deposits were depleted in the early 20th century, Youngstown's landlocked location soon presented competitive disadvantages to iron and steel producers in cities located directly on Great Lakes shores.

Youngstown Sheet and Tube closed its largest mill on September 19th, 1977, a day that is referred to as "Black Monday" in the region and credited with giving "birth to the Rust Belt" (Alperovitz 2017). Its closing produced extreme levels of economic distress. Over the next five years, 50,000 manufacturing jobs, or over half of those that existed in 1976, were lost in the

Mahoning Valley (Guerrieri 2017). Mahoning and Trumbull counties have lost over 100,000 residents, or nearly 20 percent of its population, since 1970, with losses exceeding 50 percent of those living in Youngstown since that time.

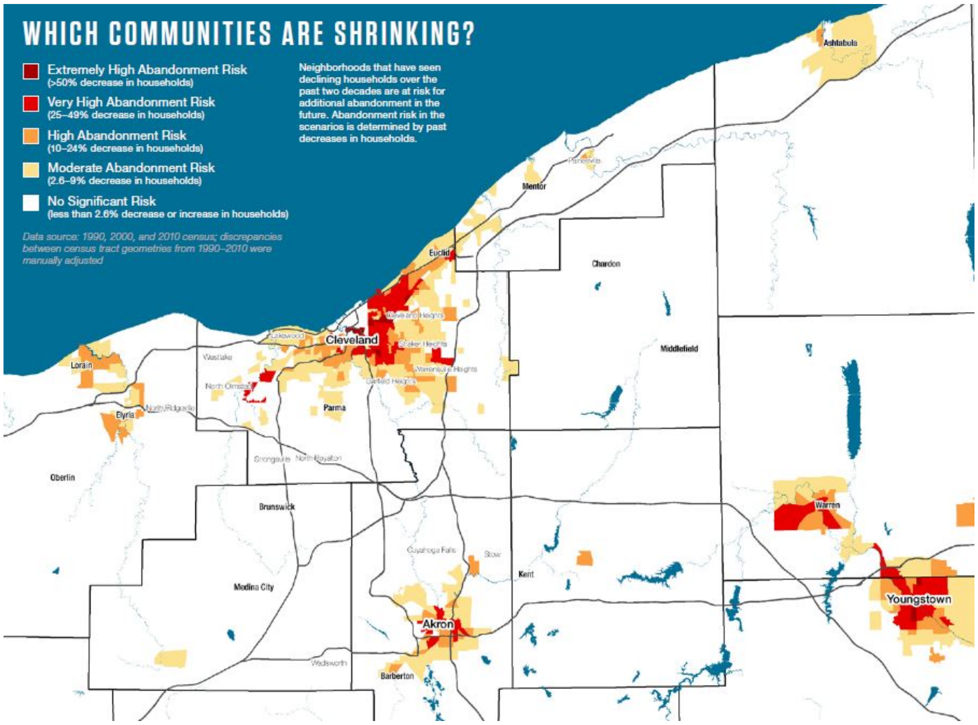
Stark economic restructuring, accompanied by population and employment loss, has produced myriad planning challenges in Youngstown, many of which are shared by other small and mid-size legacy cities. While historically these smaller Rust Belt cities have received less attention than well-known cases such as Cleveland and Detroit, research has recently discussed how planning and policy might address the unique challenges presented by smaller postindustrial cities. In particular, Fox and Axel-Lute's 2008 report *To be Strong Again: Renewing the Promise in Smaller Industrial Cities* and Hollingsworth and Goebel's 2017 report *Revitalizing America's Smaller Legacy Cities* identify the planning challenges and opportunities in these cities. Hollingsworth and Goebel (2017) evaluate Youngstown as a low-performing case due to persistent vacancy and abandonment, fiscal imbalance, neighborhood disinvestment, distressed housing values and ownership levels, and an aging population with high levels of unemployment, poverty and low educational attainment, among other factors.

As discussed by Morrison and Salling (2019), the decline or regeneration of legacy cities is largely tied to their broader regional conditions. Thus, Youngstown's challenges are related to the economic conditions found in the wider region of Northeast Ohio. Northeast Ohio contains seven legacy cities (Cleveland, Akron, Canton, Lorain, Elyria, Youngstown and Warren) that together lost 45 percent of their population from 1960 to 2010 (Northeast Ohio Sustainable Communities Consortium and Sasaki 2014). Over the same time period, the population of the 12 counties that make up the region experienced virtually no population change, only increasing by 2 percent. Thus, since 1960 the region has undergone a process of deindustrialization paired with suburbanization and outward migration, often referred to as 'regional churn,' in which some communities have prospered and grown, while older, central cities have declined. Areas of abandonment in Northeast Ohio are pictured in Figure 1.

<u>Youngstown Planning Context</u>

In this context, Youngstown took the novel step of creating a citywide plan that accepted the idea for a smaller city, replacing a 1974 plan that was based on growth and expansion, and largely obsolete. Adopted in 2005, the *Youngstown 2010* plan aimed to redefine the city's role in the new regional economy by focusing on current economic strengths such as the healthcare and education sectors, improve the attractiveness of Youngstown as a place to live and do business (i.e., 'Clean and Green'), direct resources to engage with and stabilize neighborhoods, convert vacant land into productive green space, and leverage existing assets such as a historic downtown center, the Mahoning River waterfront, and Youngstown State University (City of Youngstown 2005; Campbell 2016). The City updated its zoning code ordinance in 2013 adopting the Youngstown Redevelopment Code as a tool for implementing the citywide plan (City of Youngstown 2013).

Figure 1: Legacy City Abandonment in Northeast Ohio



Source: Vibrant NEO 2040, Northeast Ohio Sustainable Communities Consortium, 2014

In the wake of the housing crisis, the Youngstown Neighborhood Development Corporation (YNDC) was created in 2009 to help address the citywide plan's goal of neighborhood reinvestment and stabilization. Part of the organization's mission is to identify neighborhoods where stabilization is more feasible and rehabilitate the housing in these areas. In more deteriorated neighborhoods characterized by abandonment, the group has focused on prioritizing demolitions and finding new uses for the land (Campbell 2016). YNDC conducted a Housing Conditions Report in 2014 to measure and document levels of housing stability across the city. The group also created 13 Neighborhood Action Plans between 2014 and 2017 to address housing and property issues, followed by a 2019 Impact Analysis to measure progress in improving neighborhood health and stability (Youngstown Neighborhood Development Corporation 2019). Most recently, the YNDC completed an updated Housing Conditions Analysis and Strategy Report to improve housing conditions moving forward. Notably, the efforts of YNDC have reduced vacant properties from 3,514 in 2016 to 1,841 in 2019, representing a 50 percent reduction over three years (Youngstown Neighborhood Development Corporation et al. 2020). The report notes that thousands of occupied properties in the city are still in poor condition and at risk of becoming vacant or abandoned.

In 2014, the City participated in the Vibrant NEO planning process with leaders from across Northeast Ohio to develop an aspirational shared vision for the region and a set of tools to support aligned planning and resource allocation to build a "healthier, more economically competitive, and socially equitable region" (Northeast Ohio Sustainable Communities Consortium and Sasaki 2014). Utilizing a set of scenarios to explore alternative paths forward, the process found that under current trends of modest growth paired with current approaches to land use and infrastructure development, the region would face unprecedented challenges by 2040. Under the plan's "Trend" scenario, the region would experience:

- Regional churn, in which population and jobs would continue to spread out, with continued out-migration from long-established cities and suburbs to newly developed communities on the fringes of the region;
- Widespread abandonment of homes and businesses;
- Threats to the region's natural resources due to land use decisions and infrastructure investments;
- Rising costs from maintaining current development practices that would place every county in the region at significant financial risk, with local governments facing a need to spend more tax dollars than they take in.

Vibrant NEO 2040 utilized scenario planning to engage residents in developing a set of alternative scenarios for the future. The alternative scenarios were leveraged to account for uncertainty and how alternative policy approaches might interact with varying demographic conditions. The process utilized four scenarios for framing these discussions:

1. *Trend:* What if the region's growth and policy approaches stay the same?
2. *Grow the Same:* What if the region's rate of growth increases and development policies and priorities remain unchanged?
3. *Do Things Differently:* What if the region's growth stays the same but development policies and priorities change?
4. *Grow Differently:* What if the region's rate of growth increases and development policies and priorities change?

The scenarios with increased levels of growth assumed that population and jobs in NEO grew at the same rate as the rest of the country from 2013 to 2040 (in other words, that the region captured its 'fair share' of national growth). Scenarios with altered policies and priorities were assumed to emphasize redevelopment, infill, and compact development via:

- Focusing on reinvestment in established communities;
- Limiting development in environmentally sensitive areas;
- Using existing infrastructure wherever possible;
- Increasing the proportion of mixed-use, walkable development;
- Expanding public transportation and multimodal networks; and
- Prioritizing growth near established communities.

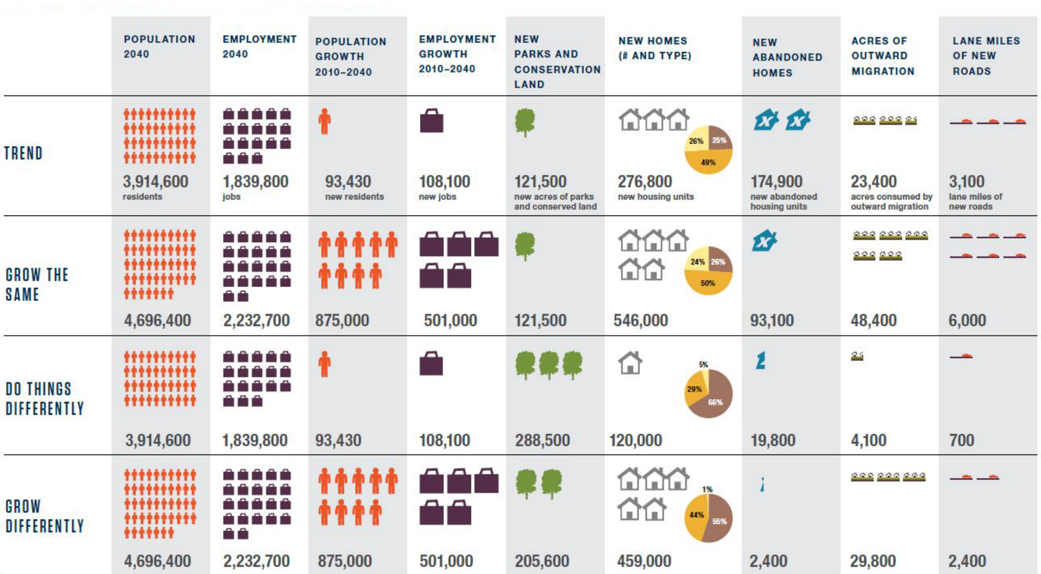
The scenario framework, illustrated in Figure 2, allowed for testing the independent benefits of policy and priority change and different levels of growth, as well as the potential interactions between normative development approaches and possible demographic futures (e.g., to evaluate whether policies that are effective in a low growth scenario continue to perform well in a high growth scenario).

Figure 2: *Vibrant NEO 2040* Scenario Framework

Source: Vibrant NEO 2040, Northeast Ohio Sustainable Communities Consortium, 2014

Vibrant NEO 2040 utilized the Envision Tomorrow scenario planning software to support the scenario-building process and evaluate the consequences of each alternative trajectory for the region. To our knowledge, the process was the first of its kind to incorporate zero and negative growth areas into a scenario planning analysis, which allowed for the assessment of consequences related to central city decline as part of the process. Also notable was the development of a regional Fiscal Impact Tool to evaluate the financial trade-offs the region might have to make to achieve its aspirations. Figure 3 illustrates examples of analytical outputs as they were presented in the *Vibrant NEO 2040* report (Northeast Ohio Sustainable Communities Consortium 2014).

Figure 3: *Vibrant NEO 2040* Scenario Metrics



	Population 2040	Employment 2040	Population Growth 2010–2040	Employment Growth 2010–2040	New Parks and Conservation Land	New Homes (# and Type)	New Abandoned Homes	Acres of Outward Migration	Lane Miles of New Roads
TREND	3,914,600 residents	1,839,800 jobs	93,430 new residents	108,100 new jobs	121,500 new acres of parks and conserved land	276,800 new housing units (26% / 25% / 49%)	174,900 new abandoned housing units	23,400 acres consumed by outward migration	3,100 lane miles of new roads
GROW THE SAME	4,696,400	2,232,700	875,000	501,000	121,500	546,000 (24% / 26% / 50%)	93,100	48,400	6,000
DO THINGS DIFFERENTLY	3,914,600	1,839,800	93,430	108,100	288,500	120,000 (5% / 29% / 66%)	19,800	4,100	700
GROW DIFFERENTLY	4,696,400	2,232,700	875,000	501,000	205,600	459,000 (1% / 44% / 55%)	2,400	29,800	2,400

Source: Vibrant NEO 2040, Northeast Ohio Sustainable Communities Consortium, 2014

The Need for the Current Research

The City of Youngstown aims to build on the findings of *Vibrant NEO 2040* for its citywide plan update following the release of the 2020 Census. The City anticipates that the focus of the 2010 plan update will be Center City Youngstown—a compact regional employment center consisting of the central business district, the campuses of Youngstown State University and Mercy Heath—and the principal transit corridors that connect Center City Youngstown to city neighborhoods and suburban employment centers. Titled "Core and Corridors," this strategy will enable the city to focus its code enforcement, housing, retail development, and business attraction/retention programs on sites that are accessible to city residents by transit.

The City aims to use scenarios to account for a range of demographic and economic possibilities, incorporate fiscal impact analysis into the planning process, and address social equity challenges such as food access, housing choices, employment access, and transit service coverage. While the scale of *Vibrant NEO 2040* was useful for analyzing change at the regional and county levels, the plan is less helpful for translating scenarios to the local or neighborhood level for more detailed planning and implementation. Thus, a parcel-level analysis is needed to apply these findings to a local comprehensive plan update.

Because *Vibrant NEO 2040* made use of the *Envision Tomorrow* software suite, the city is familiar with the strengths and weaknesses of this tool for planning in a legacy city context. However, other scenario-based planning tools such as *Urban Footprint* have emerged since that time, and could potentially offer advantages for modelling and analyzing parcel level scenarios. Serving as the motivation for this project, the City was interested in comparing a recently developed tool such as *Urban Footprint* with *Envision Tomorrow* to evaluate their capabilities, and ultimately determine a preferred approach for undertaking the scenario planning component of the Youngstown 2010 update.

Methods

Research Questions

Based on the City of Youngstown's desire to translate the *Vibrant NEO 2040* regional vision to the local implementation scale via scenario planning techniques, this paper focuses on answering the following research questions:

- How might the city design a scenario-based framework that can assess redevelopment alternatives at a detailed scale of analysis and account for uncertain future growth?
- How can existing scenario planning tools be applied and adapted to effectively support planning in Youngstown and other small or mid-size legacy cities?

Scales of Analysis: Corridor, Node and Site

CSU graduate students formed teams to conduct scenario planning over the course of an academic semester. The class tested a scenario framework and blended use of the tools at three scales of analysis. First, we tested scenarios at the corridor-wide scale, examining two corridors and their surrounding ¼-mile walking distance buffer areas. Second, based on the findings of the corridor analysis and an assessment of redevelopment opportunity sites, each planning group identified a transit-oriented development (TOD) node of interest within their corridor area to model and analyze in more detail. Third, each planning group identified a specific site that could serve as a catalyst project location within their TOD node, and modeled shorter-term redevelopment alternatives for that site.

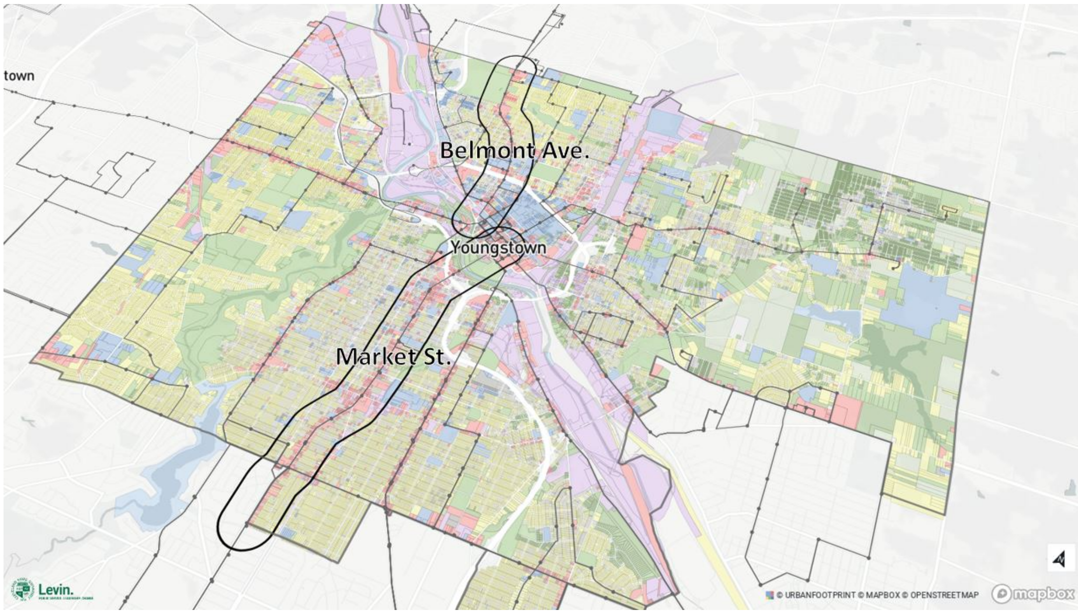
1. Transit Corridor Study Areas

We tested the scenario planning approach and tools in two pilot transit corridor study areas: Market Street and Belmont Avenue, pictured in Figure 4. We chose these corridors as pilot study areas for several reasons. The City has an interest in prioritizing transit-oriented redevelopment projects in order to encourage transit use, support investments in transit service, and create new housing and employment opportunities for non-automobile households. Both corridors are served by transit and have been identified as redevelopment priority locations in the city due to their existing transit service. The corridors are major commercial thoroughfares that connect the north and south areas of the city and adjacent communities to City Center Youngstown, US-422, and the interstate highway system. Belmont Avenue travels approximately 2 miles north from central Youngstown to Liberty Township, and serves downtown employers and residents, Youngstown State University, the Mercy Health Youngstown campus, and the Belmont Avenue commercial corridor in Liberty Township. Market Street spans approximately 2.5 miles south from downtown Youngstown to Boardman Township, where Market Street continues and includes retail destinations such as the Southern Park Mall, the Southwoods medical center, Akron Children's Hospital, and the Mercy Health Boardman campus.

Both corridors are currently being studied by local planning organizations due to their redevelopment potential within Youngstown's vision of 'smart shrinkage.' The Eastgate Regional Council of Governments (Youngstown's metropolitan planning organization) recently completed a corridor plan for Belmont Avenue as part of its Corridor Planning Program initiated in 2019 (Eastgate 2020). As stated in the plan, the Corridor Planning Program is intended to complement the development of Eastgate's 2050 Metropolitan Transportation Plan and "assist its member communities in improving the viability and adaptability of a transportation system built in and for a different era" (ibid). The goals of the Belmont Avenue Corridor Plan include (1) increasing the accessibility of the existing transportation network and emphasizing multi-modal transportation options; (2) supporting economic development; and (3) offering solutions for transportation issues along the corridor (ibid).

Both corridors were included in a 2019 market analysis of commercial corridors prepared for the YNDC and Youngstown's Economic Action Group. The study found that there is unrealized potential for additional development and economic growth within key areas along Youngstown's commercial corridors (Novogradac Consulting 2019). In the summer of 2020, the U.S. Department of Transportation awarded $250,000 to the Western Reserve Transit Authority (WRTA, Youngstown's transit provider) to create a comprehensive transit-oriented development plan for the Market Street corridor that will support economic development, concentrate real estate projects, improve transit service, and make street improvements for bicyclists and pedestrians (U.S. Senator Sherrod Brown of Ohio 2020).

Figure 4: Transit Corridor Study Areas – Market Street and Belmont Avenue



Source: UrbanFootprint

2. Transit-Oriented Development (TOD) Node Study Areas

Based on the findings of the transit corridor scenarios and input from local stakeholders, each student planning group modeled more detailed scenarios for a TOD redevelopment node within their corridor. The TOD nodes selected for our analysis are pictured in Figure 5, and briefly described here to demonstrate their varied conditions.

- **Market Street and Indianola Avenue:** This intersection lies at the heart of the Uptown District in South Youngstown, which was once the center of the city's nightlife. Remnants of its past are still present today, including brick paved sidewalks with benches and street trees, and the storied Uptown Theater which hasn't been utilized since the 1990s. Automobile-oriented commercial buildings have replaced much of the historic built environment in this area, whose revitalization has been challenged by real and perceived issues of crime and safety. Nearby neighborhoods are some of Youngstown's most disinvested, with high levels of poverty and vacancy, presenting opportunities for improving access to transit and community services. Many sites in the area are owned by the City's land bank program, creating opportunities for community-oriented development partnerships.
- **Market Street and Hughes Street:** Located at the northern end of Market Street prior to crossing the bridge over the Mahoning River to downtown, this location was selected due to its relatively high redevelopment potential. It features larger sites available for purchase with attractive riverfront views, a high level of proximity to downtown, and easy access to the nearby freeway.

- **Belmont Avenue and Rayen Avenue:** Located on the fringe of the Youngstown State University campus and near downtown, this area features large sites with redevelopment potential, many of which are publicly owned. The location offers opportunities to expand housing options near campus for students, many of whom do not own a vehicle and might be likely to utilize transit.
- **Belmont Avenue and Crandall Avenue:** Located north of the Mercy Health hospital campus, this area is characterized by its relatively stable neighborhoods. Many parcels facing Belmont Avenue in this area are underutilized or vacant, and present redevelopment opportunities. Recent investment in the node includes a VA Hospital under construction at the time of this study.

<u>3. Catalyst Development Sites</u>

As a last step in their process, each student planning group selected a specific site within their TOD node to investigate further as a catalyst development site. These sites were envisioned as a 'first step' in generating new residents and jobs within the identified TOD nodes, and were immediately available for redevelopment. Site-level alternatives were explored for these sites, which included programmatic, regulatory, and financial feasibility considerations. At this scale of analysis, students were able to explore the implications of zoning and parking requirements, as well as detailed questions related to implementation and redevelopment tools.

Figure 5: Transit-Oriented Development Nodes

Source: UrbanFootprint

Scenario Planning Framework: Exploratory and Normative

Our scenario planning framework builds off the *Do Things Differently* and *Grow Differently* scenarios developed during the *Vibrant NEO 2040* process. Both of these scenarios assume that regional development policies and priorities will change to reinvest in central cities such as

Youngstown. *Do Things Differently* assumes that current regional growth trends will continue to 2040 with only modest levels of growth. *Grow Differently* assumes that Northeast Ohio begins to capture its "fair share" of national growth; thus, this scenario is based on a growth rate through 2040 that is equal to the national average.

For this project, we characterize the two plausible growth scenarios as 'limited growth' and 'accelerated growth,' shown on the vertical axis of Figure 6. Much like the *Vibrant NEO 2040* framework, this axis of our framework is the exploratory component. Because demographic change through 2040 is uncertain, our scenarios account for two contrasting levels of growth and development in the Youngstown corridors. For this pilot study, we did not explore zero growth or negative growth scenarios for the corridors, primarily because one of our base assumptions is that both corridors will benefit from reinvestment in the coming years. This is based on the findings of the regional framework, progressive local planning efforts over the past decade, and a stabilizing population in Youngstown since the 2008 housing crisis. Noteworthy is that while the level of growth is largely exogenous and dependent on factors outside of the City's control, it can also be influenced by policies and priorities at the city and regional levels. For example, while the City's overall growth over the next 20 years might be uncertain, citywide planning will also impact what share of change happens within the corridor areas.

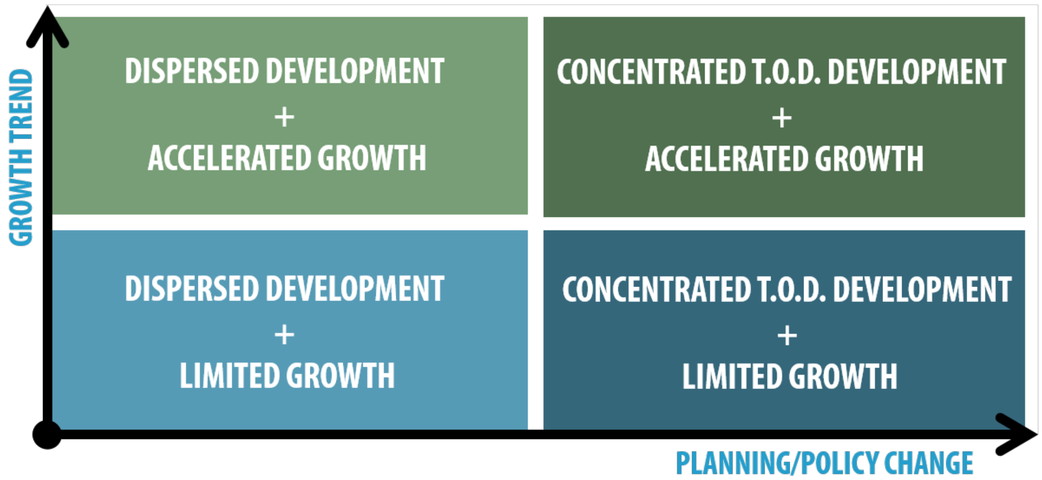
Our definition of "limited growth" is based on the *Do Things Differently* regional scenario, which envisions regional growth continuing at the current pace, but with greater shares of this growth occurring in existing communities. For the purposes of this pilot study, we assumed that approximately half of the city's growth under these conditions would occur in the transit corridor areas, which would amount to one quarter of the city's growth occurring in each corridor. Our definition of "accelerated growth" is based on the *Grow Differently* regional scenario, which envisions the region growing at the national growth rate and with greater shares of this growth occurring in existing communities. Once again, based on local planning priorities, we envision approximately half of the city's growth occurring in the corridor areas, or one quarter of this growth occurring in each corridor. Table 1 summarizes the allocation targets we utilized for the exploratory growth trends.

Table 1: Growth Trend Allocation Targets

	Limited Growth Scenarios	Accelerated Growth Scenarios
Corridor Population	+ 500-600 residents	+ 1,200-1,500 residents
Corridor Employment	+ 500-600 jobs	+ 1,200-1,500 jobs

The horizontal axis of our framework reflects a normative variable of redevelopment planning and policy in the corridor areas. We characterize these as "dispersed" and "concentrated" approaches to development. Dispersed development reflects an opportunistic infill approach in which redevelopment projects are evenly distributed throughout the corridor area without a spatial planning focus. Concentrated development reflects a TOD spatial planning approach that focuses change in walkable nodes based on transit stop locations.

Figure 6: Framework for Youngstown Transit Corridor Scenarios



Blended Tool Use: UrbanFootprint (UF) and Envision Tomorrow (ET)

Our testing of the tools took an integrated approach, which attempted to identify and leverage the strengths of both tools for planning across multiple scales of analysis. Thus, our approach was not experimental in the sense of applying each tool in isolation and then comparing the results.

We took a blended approach for several reasons. The primary reason was to ensure a feasible project scope. The project took place over the course of an academic semester, which required training students in land use concepts and using the software prior to conducting the analysis. Thus, we determined that replicating the analysis across two software platforms would neither be feasible nor necessary for testing the tools. Second, the class took place during Covid-19 restrictions, which required that the work be conducted remotely. This presented limitations in terms of how the tools could each be applied in the context of remote collaboration. We found that as a web-based tool, UF offered substantial advantages for remote student collaboration since the projects could be accessed via the internet from multiple locations simultaneously (more on this later). Third, our research of the tools prior to scenario building provided a sense of how they might each be leveraged for their strengths, which our findings will describe in more detail.

The student planning teams utilized UF for sketch-level scenario building at the transit corridor and TOD district scales of planning. Based on our preliminary research of the tools, we anticipated that UF would offer several advantages for planning at these larger scales, including:

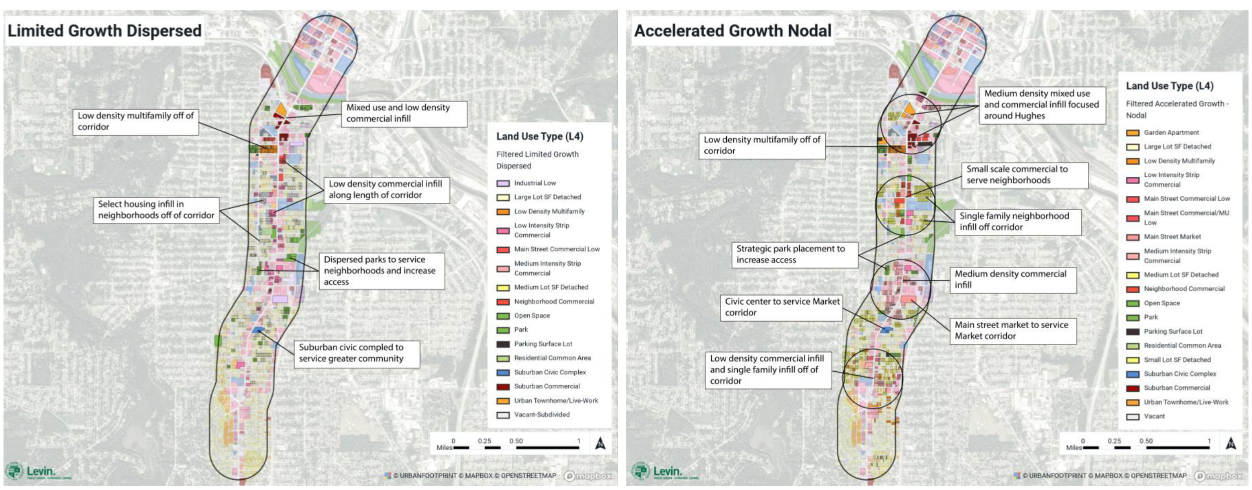
- **A web-based platform:** UF allowed student groups to collaboratively build scenarios over the internet, an essential advantage for working remotely.
- **Low-overhead project setup:** UF allows users to quickly define a study area and utilize the software's parcel-based land use layer, building types and demographic information. UF also includes a wide variety of supplemental data that can be used for existing conditions analysis and to inform scenario building.

- **Pre-populated building library:** UF includes a wide variety of pre-defined building and place types in its components library. This provided a helpful starting point for students as they built scenarios.
- **Easy to use interface and 'plug and play' analysis tools:** UF's scenario building interface is highly streamlined and automatically produces summary data for each development scenario. A range of ready-to-use analysis tools can quickly estimate and compare scenario impacts and outcomes. Outputs are displayed as aesthetically-pleasing charts, and for some metrics, analytical maps are automatically generated.

In contrast, as a desktop-based tool, ET presented substantial challenges for collaborative scenario building in a remote learning context. With manual project setup and calibration, ET likely would have required a longer project timeframe and demanded more resources when preparing for scenario building. Additionally, ET's GIS and Excel-based platform is not as streamlined or user-friendly as the UF interface, and would have required more training and expanded software access for students. For these reasons, UF served as our primary scenario planning tool at the corridor and district/node scales of geography. This was paired with the use of the ET Prototype Builder to test project alternatives for specific development sites within the TOD nodes.

<u>Scenario Planning Process</u>

Figure 7: Corridor Scenarios Built with UF



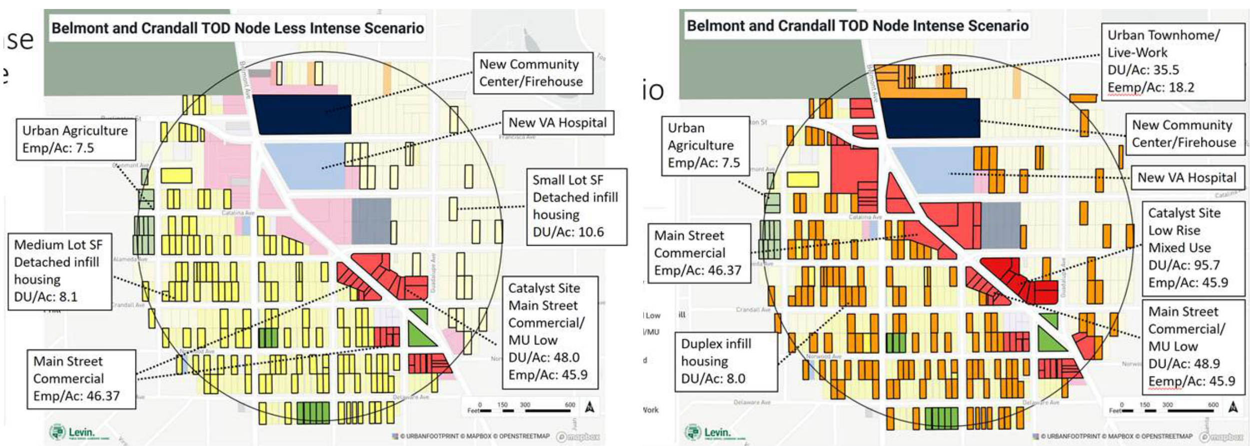
Source: UrbanFootprint

Prior to scenario building, the students conducted an existing conditions analysis to identify key planning issues presented by the Youngstown corridors, including strengths, weaknesses, opportunities, and threats to be addressed by the project. Student teams utilized UF and public data sources to conduct this initial analysis. Public data included information from the US Census Bureau (e.g., Decennial Census, American Community Survey, LEHD Origin-Destination Employment Statistics, and the Census OnTheMap tool), US EPA (e.g., Smart Location Database, Toxic Release Inventory), US HUD, the Trust for Public Land, Ohio Department of Natural Resources, Mahoning County, Eastgate Council of Governments, Youngstown's Real Property Information System (RPIS), and others. UF was particularly useful during this stage of the project due to its wide variety of existing conditions data layers and analysis tools.

Each student team utilized UF to build four scenarios for their assigned corridor using the scenario planning framework previously described. Figure 7 provides examples of corridor scenarios that illustrate the contrast between normative variables (dispersed versus concentrated development patterns) and exploratory variables (limited versus accelerated growth) that were investigated. A low growth, dispersed corridor scenario is shown on the left, and an accelerated growth, concentrated TOD node scenario is shown on the right.

Based on the findings of their corridor scenarios, each planning team utilized UF to develop two detailed scenarios for a TOD node within their corridor. These scenarios compared lower and higher levels of growth within a ¼ mile radius area of redevelopment centered on a transit stop. Examples of low and high growth TOD node scenarios are illustrated in Figure 8.

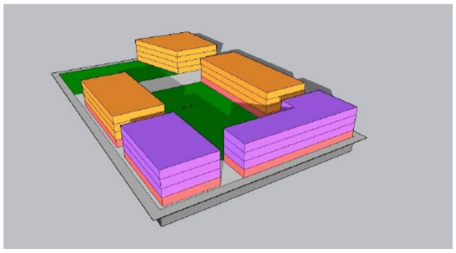
Figure 8: TOD Node Scenarios Built with UF

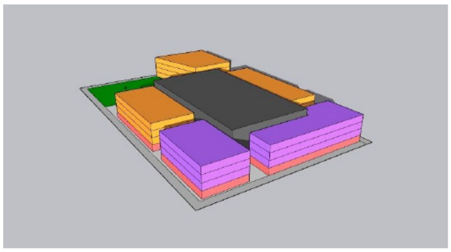


Source: UrbanFootprint

Lastly, each student planning team utilized ET to develop catalyst project alternatives for a specific site within their assigned TOD node. While UF presented several advantages for sketch-level planning at the corridor and district scales, we found that the ET Prototype Builder tool offered nuanced capabilities for exploring alternative project configurations at the site scale. While the Prototype Builder is typically used to develop building components as inputs for scenario modeling with ET, it can also be used as a standalone tool for developing basic building proformas and site plans that consider both physical form and financial feasibility. In addition, the tool includes a linked Building Modeler plugin for SketchUp Pro that generates a 3D massing model based on the information entered into the spreadsheet model. Example building model alternatives developed by students are illustrated in Figure 9.

Figure 9: Site-Level Alternatives Compared with the ET Prototype Modeler





Property	2 Level Underground Parking	5 Level Structural Parking
Lot Area:	3.3 acres	
Stories:	4	
Residential %:	58% (132,388 sf)	
Retail %:	19% (43,369 sf)	
Office %:	23% (52,499 sf)	
DU/Ac:	53 (159 dwelling units)	
Jobs/Ac:	71 (214 jobs)	
FAR:	2.05	3.25
Total Parking Spaces:	723	619
Rate of Return*	**12.2%**	**11.9%**
Total Construction Cost:	**$55,262,906**	**$47,258,597**
Subsidy (10% off construction – Federal Opportunity Zone):	*-$5,526,291*	*-$4,690,697*
Final Construction Cost	**$49,736,615**	**$42,567,900**

Source: Envision Tomorrow Prototype Modeler

Results and Discussion

Small and Mid-Size Legacy City Planning Issues to Address

Prior to building scenarios, the student planning teams analyzed the existing conditions in the Youngstown transit corridor study areas using Urban Footprint and public data sources. This first stage of the research process resulted in the student teams identifying key planning issues in the corridor areas, and these would inform the remainder of the pilot testing. We believe that these issues reflect similar challenges and opportunities found in other small and mid-size legacy cities, and they form the basis of our assessment of scenario planning capabilities in these contexts. A summary of key planning issues delineated by students are summarized in Table 2. Planning challenges and threats are identified by a (–) in the table, while strengths and opportunities are indicated with a (+).

Table 2: Key Youngstown Corridor Planning Issues

Demographics	
–	Declining city and county population, uncertain future trajectory
–	Aging population and out-migration of younger population
–	High percentage of population living below the poverty line
Economy & Fiscal Health	
–	Shrinking tax base to pay for city services and infrastructure maintenance
–	High unemployment rate
–	Wage-income mismatch between residents and nearby employment opportunities
–	Low employment diversity
+	Abundance of small businesses and wide range of workforce and business development resources
+	Large employers including Youngstown State University and Mercy Health
+	Access to regional markets
Environmental	
–	Large number of underground storage tanks potentially requiring remediation
–	Lack of tree canopy and high urban heat index
–	Lack of park space and park access
+	Opportunity to reuse vacant lots for green stormwater infrastructure, tree planting, and urban agriculture
Housing	
–	Widespread corridor vacancy above the citywide average
–	Aging housing stock requiring rehabilitation
–	Low levels of housing ownership and high rent burden
–	Lack of housing options for very low income and higher income households
+	Surplus detached single-family housing stock
Land Use & Development	
–	Abundance of residential and commercial vacancy presents challenges for neighborhood stability and requires rehabilitation or demolition strategies
–	Lack of neighborhood retail and entertainment amenities
–	Cost of new construction challenged by financial feasibility given low market rents
+	Federal Opportunity Zones provide a significant development incentive
+	Local zoning code encourages mixed-use development
+	Several development projects in-process or in the pipeline at TOD node locations
+	Concentrations of public, non-profit, and private land ownership provide opportunities for land assembly
+	City-owned land bank and vacant properties provide redevelopment opportunities
+	Partnership opportunities with non-profit organizations such as the Community Corrections Association
Transportation & Infrastructure	
–	Relatively low levels of vehicle ownership in the corridor areas
–	High prevalence of surface parking lots
–	Deteriorated sidewalks and streets designed for automobiles, built environment generally is not supportive or safe for pedestrian uses
+	Public transportation service with connections to downtown and neighboring jurisdictions
+	Access to highway and regional transportation network
Community Services	
–	Lack of access to recreation centers and community facilities
–	Lack of access to healthy food sources
–	High crime rates relative to citywide averages
History & Culture	
+	Proximity to large historic districts, riverfront, downtown, landmarks
+	Storied history with physical and cultural assets

Current Tool Capabilities and Potential Enhancements

While not exhaustive, in this section of the paper we describe the most notable strengths and limitations of the scenario planning tools based on our blended pilot testing in the Youngstown corridors (summarized in Table 3). When applicable, we recommend potential enhancements for using the tools in small and mid-size legacy cities. It is worth noting that we did not identify, nor did we attempt to identify, a preferred overall tool for scenario planning in small and mid-size legacy cities. Rather, we sought to identify each tool's strengths and limitations in order to inform a blended use of the tools based on the scale and goals of the analysis. In our pilot testing, we found that integrating the tools in this way allowed us to leverage each of their strengths, and was a powerful approach for planning in the Youngstown transit corridors. We expect that these capabilities are relevant for applying the tools in other small and mid-size legacy cities.

Table 3: Summary of Tool Capabilities

	UrbanFootprint	Envision Tomorrow
Preparation for Scenario Planning	Reduced Time Demands	Reduced Cost Demands
	Streamlined Plug and Play Analysis	Manual Data Inputs and Calibration
	Supports Web-based Collaboration	Integrates with Existing Desktop Software
Data Integration	Integrated Reference Data	Open-Source Integration Opportunities
	National Parcel-Level Base Canvas	
	Data Upload and Export	
Building Types & Building Information	Pre-Populated Building Type Library	ET Prototype Builder
		Building Type Customization and Calibration
		Tests Financial Feasibility
Access to Opportunity	Streamlined Accessibility Measures	Location Efficiency Tools
Transportation Analysis	MXD Transportation Analysis	Travel models for three geographic scales
Fiscal Impact Analysis	Sketch-level Fiscal Analysis	Regional Fiscal Impact Tool
Housing	Household Costs Analysis	Housing Costs & Balanced Housing Tool
Public Health	-	Public Health Assessment Tool
Ideal Application	Sketch-Level Scenarios for Larger Geographies	More Nuanced Scenarios for Smaller Geographies

Preparation for Scenario Building and Remote Collaboration

One of the important distinctions between the two tools is their software formats and delivery methods. This has implications for project setup and calibration, and the time and resources required to prepare for scenario planning. These considerations played a major role in determining how and when each tool was leveraged during our pilot testing.

UF's web-based format offered several benefits that complemented the remote course format. Students were able to access their UF projects from home using their own computers, which did not require them to install any additional software. Multiple users can access a UF project simultaneously, which allowed students to collaboratively build scenarios on a shared virtual interface. While there are still opportunities to enhance the collaborative functionality of UF, the students reflected that UF's web-based platform was perhaps the most critical feature for making scenario planning feasible while working remotely.

The other element that made UF attractive for our class project was its 'plug and play' characteristics, which reduced the overhead and time required for scenario planning preparation. With UF, preparing the parcel base layer is as simple as uploading a shapefile of the study area boundary. The base canvas for scenario building is automatically generated and queries land use information from UF's national parcel dataset when creating a new project. UF includes building and place type libraries that allow users to quickly start building scenarios. Once scenarios are built, UF's analysis tools can be run with the click of a button. These streamlined features made our ambitious project feasible within a short timeframe.

In contrast, ET is a desktop tool, meaning that users must install and run the software plugin with GIS and Excel on their individual computer. ET is also open-source, making the software free to download and the underlying coding editable. While this offers software transparency and reduces the financial cost of scenario planning, it demands more from users in terms of project setup and calibration. Thus, ET is not a 'plug and play' tool like UF. Prior to scenario building, users must obtain local data to provide inputs for the scenario base canvas, and each building prototype must be designed and calibrated. Standalone analysis models offered by ET also require some expertise and input data to execute results. Due to our time and remote learning constraints, the class determined that leveraging UF to create and analyze corridor and district scale scenarios would be a practical choice due to its web-based, 'plug and play' interface.

Data Integration

One of UF's unique advantages is its capability to support scenario planning with supplemental datasets that can be added as map layers to projects. This feature allowed us to obtain much of the existing conditions information from within the software platform itself. UF's base canvas provided foundational parcel level information, including population, employment, and housing unit data, all at a finer granularity than what can be obtained from public data sources. In practice, cities or organizations that are low on resources, staff, or expertise could realize substantial benefits just from the data access that comes with UF, which reduces the time and resources required to conduct scenario planning. While not exhaustive, Table 3 summarizes some of the integrated data that we utilized when planning in the Youngstown corridors.

Table 3: Urban Footprint's Integrated Reference Data

UF Data Layers	Relevance for Youngstown Corridors
Base Canvas	Parcel-level building, population and employment information
Census Planning Database	Demographic and Employment Conditions
Fair Market Rents	Housing Conditions
Public Housing Buildings	
Schools, Day Care Centers, Nursing Homes, Hospitals, Urgent Care Facilities, Emergency Services	Identifying assets and measuring access to opportunity: Community services, healthy food, recreation, cultural resources
Supermarket Locations, National Farmers Market Directory, and Food Access Atlas	
Parks	
Historic Places, Religious Sites	
Smart Location Database	Access to employment opportunity, jobs-housing and wage-income balance
Low Poverty Index, Concentrated Areas of Poverty	Social Equity
HOLC Redlining Areas	
Environmental Health Index	Environmental Justice & Health
Toxic Release Inventory	
Opportunity Zones	Redevelopment Incentives
Public Transit Lines and Stops	Transit-Oriented Development
Bicycle and Pedestrian Paths	
National Walkability Index	
Building Footprints	Urban Design & Built Environment

UF is also an adaptable tool when data is not already included with the software, which occurred in our case with transit data. Given our project's focus on transit-oriented development, and the importance of coordinating redevelopment with transit access, it was particularly important that our scenario building platform included up-to-date public transportation information. Youngstown's transit provider, the Wester Reserve Transit Agency, is a relatively small transit system, and at that time was not yet incorporated into UF's transit data layer. This held significant implications since many of UF's accessibility and transportation analysis measures are based on transit stop locations and transit headway times.

The challenge was resolved quickly with reliable support from UF. We provided UF with WRTA General Transit Feed Specification (GTFS) data, and their customer support team quickly incorporated the local transit information into UF's data platform. Thus, UF's cloud-based data offers a substantial advantage in that it can be updated quickly with localized data if provided to UF customer support.

We also encountered outdated vacancy information in UF's base canvas. This was expected because the City of Youngstown tracks vacancy on a much more regular and detailed basis than most cities, reflecting the importance of this information for local planning in Youngstown. The YNDC has conducted four citywide vacancy surveys since 2008, completing the most recent survey in 2019. As part of these surveys, YNDC categorizes vacant properties by their condition (Youngstown Neighborhood Development Corporation 2018). The City also conducts citywide grass cutting, which cuts grass at vacant properties that are not maintained by their owners (Youngstown Neighborhood Development Corporation 2017). Part of this program involves recording the location of grass cutting activities, which serves as a regularly updated data point for current vacancies in the City. Both the surveys and grass cutting data are publicly available on Youngstown's Real Property Information System (Youngstown State University 2019).

We addressed this challenge by updating the UF base canvas manually, which was a relatively straightforward process. A new UF beta collaboration feature then enabled us to replicate the updated base canvas across each of the student group's projects. Given UF's high level of user support and its opportunities for civic partnerships, data such as Youngstown's vacancy information could also be provided to UF for more formal integration into their nationwide dataset. UF representatives expressed an interest in updating parcel information for us as needed.

A final example can be provided with the underground storage tanks (USTs) found throughout the Youngstown corridors, which are a potential source of environmental contamination and can present feasibility challenges for redevelopment projects. UF's platform allowed UST locations to be easily incorporated to inform redevelopment suitability considerations. UF users can add supplementary spatial information to a project via a shapefile upload, which quickly converts GIS data and adds it as a layer in the UF platform. Likewise, any of the spatial data included with UF can be exported as a shapefile, creating a user-friendly crosswalk with other GIS platforms.

In contrast to UF, as an open-source tool ET does not include supplementary datasets. Most of the information needed to use ET is publicly available, but this process requires additional time to obtain the data and calibrate the ET scenario assumptions.

Building Types and Building Information

Another asset of UF as a scenario building tool is its library of building and place types. Since our class was building scenarios at the parcel level of detail, we utilized *building* types (as opposed to *place* types, which represent broader categories of development with mixtures of buildings and public right-of-way included). UF comes pre-equipped with over 100 building types and underlying components that contribute to its 'plug and play' use. Unlike ET, which in most cases requires users to develop their own building prototypes prior to scenario building, UF allows users to start building scenarios quickly with a menu of building types suitable for a variety of contexts (examples of UF building types include High Rise Mixed-Use, Urban Townhome, Suburban Multifamily, Garden Apartment, Large Lot Single Family Detached, and myriad others). Thus, students were able to start building scenarios by identifying the building types in UF's library that were most suitable in character and scale for the Youngstown context. This generally included buildings with 'main street' qualities and compatible 2-4 story building heights and Floor-Area Ratios (FARs) between 0.5 and 2.0.

UF's building types are based on real-life precedents. For example, the Garden Apartment component is based on affordable townhomes found in Denver's Stapleton development. UF components and building types can be modified and saved as user-defined building types, which are then added to the UF library for that project. Building type inputs include general land use and density categories, site coverage (percent of parcel area occupied by the building footprint, surface parking, vegetation, etc.), parking spaces by category, building floor area allocation (percentage or square footage dedicated to dwelling units, non-residential employment space, etc.), and building envelope (number of floors and building height). With these inputs, each UF building type has a corresponding FAR, residential and employment density, total parking and parking density.

Students reported that UF's building type library for the most part provided a selection of development types that complemented the target densities and character for the Youngstown corridors. At times, when the UF building library did not provide a representative component, student teams developed their own custom building types. Students also reported that a substantial portion of the UF building library consisted of typologies from larger cities with higher densities than what would be appropriate or allowed by code in a smaller city such as Youngstown. The UF building type library is somewhat biased toward the West Coast U.S. context, and particularly California cities. Building type components include projects from California cities such as San Francisco, Los Angeles, San Jose, Sacramento, Oakland, Berkeley, and Fresno. There are several buildings from Seattle, Denver, Portland, Austin, and a handful of buildings from other places such as Nashville and Cincinnati.

As students became familiar with the building type assumptions, we began to think in more detail about how UF building typologies might vary from the current and future urban form of the Youngstown corridors. Buildings from Los Angeles or San Francisco were too dense, while buildings from suburban contexts were too auto-oriented. Students noted that the dwelling unit sizes of western U.S. buildings were larger than what the Youngstown market demanded. Often UF building types had too little parking to satisfy Youngstown's level of automobile use or zoning code requirements. Other building types included underground or structured parking, which isn't often financially feasible for development projects in Youngstown. Thus, while the UF building library was a significant asset while getting started modeling scenarios, students noted that if we had more time, further calibrating building types to the local context would be a priority. Since building characteristics are arguably one of the most essential inputs to scenario building, we hypothesized that careful calibration of these elements might impact the scenario outputs in a substantial way.

Students also reported limitations with UF when attempting to modify and calibrate building types. The building type inputs are primarily focused on physical variables such as height and area. Noteworthy is that there are no financial inputs or considerations incorporated in UF building types, and that parking is defined on absolute terms (total spaces for the building) as opposed to per-unit or per-square foot definitions as they are often articulated in zoning code parking requirements.

In contrast, ET does not include an integrated library of building types, but users can download a sample of 50 building typologies from the ET website (http://envisiontomorrow.org/downloads). While this provides a helpful starting point and an alternative to designing building prototypes from scratch, these building models must still be loaded into ET's Scenario Builder spreadsheet and assigned to development types prior to scenario building. While less ‘plug and play’ than UF’s building library, we found that the ET Prototype Builder was incredibly useful for thinking about individual development projects and further calibrating building typologies. This is because the Prototype Builder spreadsheet pairs physical and financial considerations to produce market feasible building typologies that reflect local conditions.

In the Youngstown context, estimated return-on-investment produced by the Building Prototype models allowed students to estimate market rents for a project, or consider gap financing tools that could be leveraged to support a project’s implementation. Due to Youngstown’s market conditions, which are characterized by low rents, low incomes, and low redevelopment activity, decisions regarding individual projects, particularly shorter-term catalyst projects, were critical and could not be fully addressed using UF’s sketch-level building types. Instead, ET’s Prototype Builder supported conversations about potential development subsidies or financing tools that might be leveraged in place of property tax abatements, which all too often produce additional fiscal strain for small legacy cities such as Youngstown.

Access to Opportunity

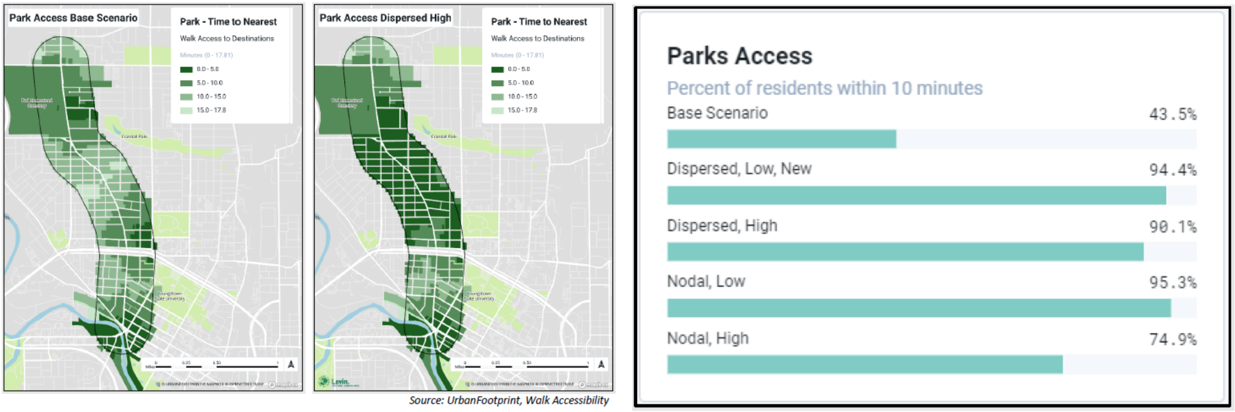
Given our focus on promoting pedestrian and transit access in the corridor areas, the ability to measure access to various forms of opportunity was compelling information for our project.

UF’s walk and transit accessibility analysis modules streamline a process that would typically require time-intensive geoprocessing in ArcGIS. Students were able to assess corridor residents’ current levels of walk and transit accessibility to transit stops, park space, employment locations, and retail amenities based on network travel distances and transit service information. The tools utilize underlying data from the UF base canvas and transit system data, which allows the analysis to be run with the click of a button.

UF’s recently-released Custom Point-of-Interest (POI) function allows accessibility metrics to be calculated for additional destinations based on a point feature layer of locations. Students utilized this capability to measure accessibility to community services such as recreation centers and healthcare locations. Because food access was an important planning issue, the Custom POI tool was used to measure walk and transit accessibility to various healthy food locations in or near the corridor areas. While UF’s supplemental data layers include a supermarket location layer based on OpenStreetMap data, we utilized local data from a recent Food Justice and Insecurity study by Youngstown Promise Neighborhoods et al. (2020).

The UF accessibility metrics can be used to evaluate and compare scenarios in terms of how they improve community access to various services, amenities, and resources. Access to retail locations, employment opportunity, and park space were straightforward measures to generate for each scenario because the destination information was already incorporated into the UF scenario canvas. Given that many of the planning issues needing to be addressed in the Youngstown corridors are equity-oriented, the ability to assess how various corridor redevelopment approaches might improve access to opportunity for residents was quite powerful and highly utilized by students in their work.

Figure 10: UF Park Access Analysis Outputs



Source: UrbanFootprint

ET also includes a proximity tool which automates GIS geoprocessing based on a feature layer input and a buffer distance defined by the user. This tool can also be used to measure people or jobs within a certain proximity to defined locations of interest. However, it is not as streamlined and harder to use than the UF accessibility tools. We found UF's accessibility functions to be preferable due to their meaningful integration with its scenario building interface, 'plug and play' ease of use, higher sophistication in terms of using network distances, and automatically generating map layers to display the results spatially.

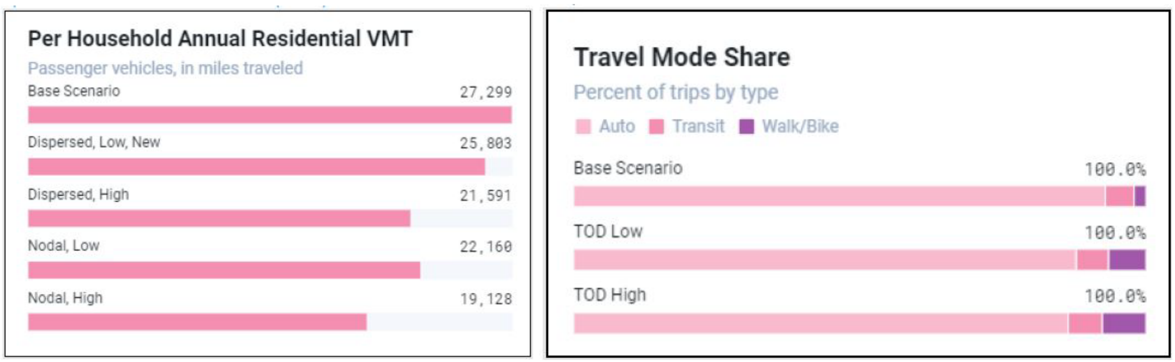
Related to opportunity access, ET also offers a Location Efficiency tool to analyze existing jobs-housing and wage-income imbalances. This feedback can help users address the spatial mismatch of residents and employment opportunities in a study area. For example, a large portion of the jobs in Youngstown's Belmont Ave. corridor are positions at the Mercy Health campus. However, these jobs pay higher wages than many of the jobs held by neighborhood residents. Thus, while the corridor's jobs-housing balance would indicate a high level of employment opportunity for residents, its wage-income imbalance would demonstrate that this is not exactly the case.

Given the power of the UF platform to quickly calculate accessibility on the fly, we feel that there is an opportunity for UF to incorporate additional access measures related to social equity planning goals. This might be done by enhancing the linkages between its scenario canvas and the accessibility metrics. In one of its more streamlined models, UF calculates walk and transit access to employment opportunities by referencing the underlying housing and employment locations in the scenario canvas, and utilizing walk and transit network distances to calculate travel times between these locations. Similarly, access to park space and retail amenities are also streamlined since parks and retail spaces are defined typologies in the scenario canvas.

There are, however, other access measures that are not as straightforward to execute as the employment, park, and retail access measures. These include healthy food access and access to community services, both of which have important linkages to social equity goals in planning, and were particularly important planning issues in Youngstown. Calculating healthy food access required us to create a discrete point feature layer of healthy food locations for each scenario, and define these as target layers when using the Custom POI tool. An enhanced version of this might consider how grocery stores or community-oriented facilities might be defined as distinct use categories within the scenario canvas itself, which would enable the accessibility function to reference these locations without requiring a separate point feature layer. This enhancement would reduce the time and effort needed to run these additional analyses, which we argue are of particular interest for users hoping to assess the social equity benefits of scenarios.

Transportation Analysis

Figure 11: UF Transportation Analysis Outputs



Source: UrbanFootprint

The ability to model how development patterns and land use decisions impact travel behavior was critical for our transit corridor project. It was a key analysis for investigating how land use planning might be coordinated with Youngstown's public transportation network to provide more opportunities for walking, biking and using transit as alternatives to driving. It provided an opportunity to explore how redevelopment approaches under various future growth trajectories might support transit use and non-vehicle households that rely on transit.

UF's sketch-level transportation model is well-integrated with its scenario building platform and is driven by land use variables from each scenario, census demographic data, and transit system characteristics. This information is automatically input and users can run the model with a click of a button, or further calibrate model assumptions if desired. Based on the '7D' characteristics of the built environment, the analysis tool uses the Mixed-Use Development (MXD) method developed by Reid Ewing to estimate the trip mode share and vehicle miles travelled (VMTs) generated by each redevelopment scenario (UrbanFootprint 2019). The results of the transportation analysis also provide inputs for other modules including the emissions analysis and household costs analysis.

ET includes similar travel behavior analysis tools, but they require additional inputs and more manual calibration by the user. Notably, ET offers three distinct travel models depending on the planning scale: A city/regional travel model that includes regional travel and employment shed, a district-level travel model based on the MXD methodology, and a site-level MXD travel model for large individual development projects that include multiple uses. In cases where users have the expertise and access to the necessary data inputs for these tools, they offer similar sketch-level estimates, with the benefit of having regional and project-level models available. While UF automatically creates charts and a map layers to display results from the transportation model, ET's graphic output is limited to Excel charts.

The students utilized the UF travel model due to its ease of use and integration with the UF platform. The tool allowed us to test transit-oriented development alternatives and estimate their impacts on travel behavior. The MXD model produced results that allowed us to identify the redevelopment approaches that would best complement alternative forms of travel. We were initially concerned that the model sensitivity might be too low to reflect subtle differences in scenarios with only small growth or change. However, the model reflected changes in travel behavior for our Youngstown corridor scenarios, including limited growth scenarios.

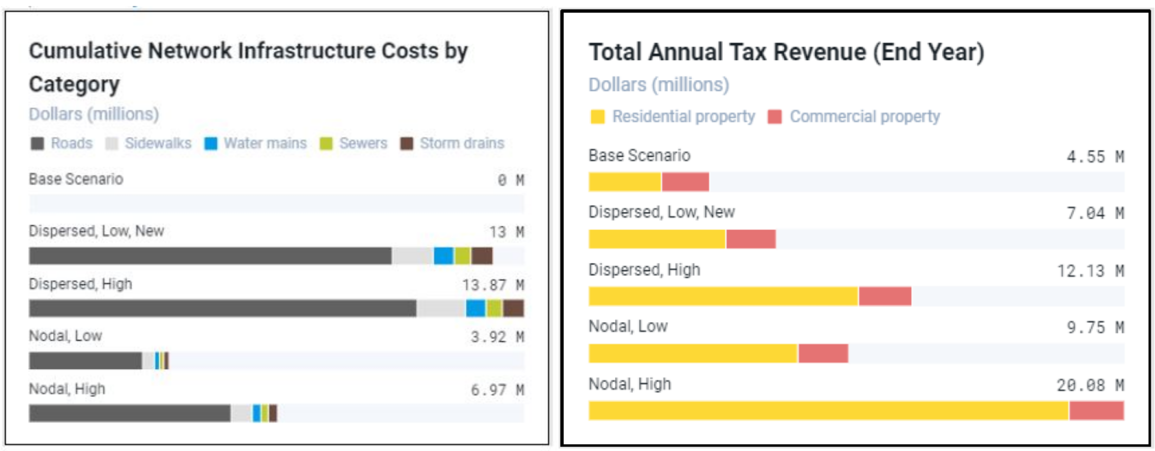
Fiscal Impact Analysis

Understanding the fiscal implications of redevelopment decisions is a critical planning issue in legacy cities, where public revenues have declined as a result of population loss and a shrinking tax base. This is particularly true in small and mid-size legacy cities, where local governments generally have less capacity and lower access to resources than larger city governments. Cities such as Youngstown face challenges balancing their budgets and paying the operating and maintenance costs of existing infrastructure and services. In the context of Northeast Ohio, where regional population has been stable but urban development continues to expand outward, existing infrastructure is underutilized and has become costlier on a per-capita basis in areas that have declined in population. Redevelopment can mitigate this fiscal stress by investing in areas already served by existing infrastructure and prioritizing projects that will positively impact the city's fiscal health. One of the primary goals of *Vibrant NEO 2040* was to establish a regional path forward that makes better use of existing infrastructure through reinvestment and revitalization in existing communities. Our project translates this vision to the local scale by channeling investments to existing neighborhoods and supporting more efficient use of public transportation services.

Both UF and ET allow users to estimate the annual and cumulative fiscal impacts of development. UF's Fiscal Cost module estimates the capital and operational/maintenance costs of network infrastructure (roads, sidewalks, water mains, and sewers) and emergency services (fire and EMS) that would be needed to support the additional households and employees in each scenario. UF's Fiscal Revenue tool estimates the property tax revenue generated by new development. Consistent with UF's other analysis modules, the fiscal tools can be executed on a set of scenarios with relatively little calibration. However, users can modify a variety of input settings to calibrate the analysis, including project timespan, service capacities, local tax rates, property value assumptions, and capital and operating/maintenance cost assumptions. The results of the fiscal analysis tools are particularly sensitive to these underlying assumptions. For example, the fiscal costs of new roads associated with a redevelopment scenario will largely depend on the cost per lane mile values listed in the tool's settings. Although the analysis is pre-populated with suggested inputs, users should spend time confirming that the input values are accurate for their planning area. Similar to its other analysis tools, UF's fiscal cost and revenue models should be considered sketch-level estimates to help compare relative advantages and disadvantages of development scenarios.

The UF Fiscal Revenue tool only considers property tax rates by default, and is based on somewhat rough estimates of property values based on tract-level data. For new development, the analysis is driven by property value assumptions defined in the tool's settings ($/dwelling unit for residential uses and $/1,000 square feet for commercial uses). Additional sources of tax revenue can also be designated by the user. The students found that our scenarios did not produce any additional demand for emergency services. This may have been due to the limited levels of growth presented by our corridor scenarios. The UF fiscal models were still in beta mode and did not yet have a methodology document available at the time of our project. Thus, the lack of emergency service cost estimates may also be fixed by ongoing updates to the tool.

Figure 11: UF Fiscal Impact Analysis Outputs



Source: UrbanFootprint

ET includes a regional fiscal impact tool (ReFIT) that estimates scenario effects on municipal revenues and spending, as well as indirect fiscal impacts to the surrounding region (Fregonese Associates n.d.d.). The tool includes FIPS fiscal lookup tables that help streamline the analysis, but it also requires users to obtain and input some local information.. Like UF's fiscal impact tools, ET's is intended to support a quick and sketch-level analysis rather than provide a high level of precision. ET users also have the option to further calibrate the tool with supplementary data inputs.

One advantage of the ET fiscal model is that it includes cost estimates for a relatively comprehensive set of municipal services, including public safety, education, recreation, and health care costs. In contrast, UF's fiscal cost analysis is more focused on providing a nuanced breakdown of costs related to network infrastructure, but the costs of municipal services are limited to emergency services. In small legacy cities where fiscal balance is often a planning challenge and priority, the costs of *both* physical infrastructure and municipal services are likely important information for decisionmakers and the public to consider during the planning process. ET's fiscal impact tool would be an attractive option for communities that desire the most comprehensive set of estimates related to the fiscal costs of development.

Because of our class's time constraints, we used the UF fiscal models to produce sketch-level feedback on the fiscal implications of each scenario. We found in most cases that nodal approaches to redevelopment, at either level of growth, presented significant network infrastructure cost savings and produced more tax revenue than dispersed redevelopment approaches. If time allowed, we would have utilized the ET fiscal model to supplement the results generated by UF.

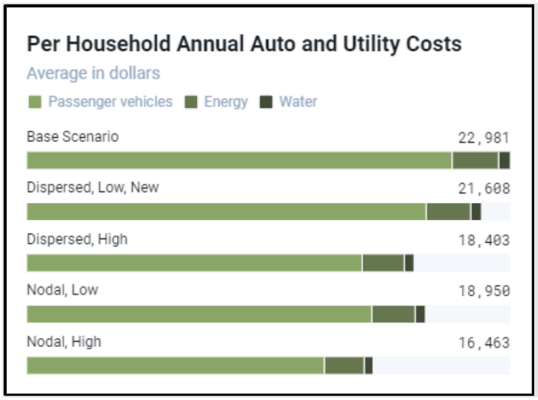
UF plans to continue updating and refining its fiscal impact tools, and their analytical capabilities might certainly expand in the future. Because the UF fiscal impact tools are new and there is not yet a methodology document available for them, we have remaining questions related to some of the details in the fiscal impact results. For example, the Youngstown corridor scenarios for the most part generated reconstruction costs as opposed to capital costs. This was expected, because our project was focused on infill redevelopment, and UF distinguishes this from new development on previously undeveloped land (the latter of which would generate capital infrastructure costs). This presents a $700,000 per lane mile cost savings when comparing the default cost values of $2.2M for capital infrastructure costs versus $1.5M for reconstruction costs. We would like to eventually review the methodology document to better understand how and when reconstruction costs are applied. A potential enhancement might include adding an additional output measure that directly illustrates the cost savings of infill redevelopment compared to development requiring capital infrastructure investments. This might help communicate a significant benefit of reinvesting in existing neighborhoods and communities.

Housing

Housing was a central issue to much of our work in Youngstown. With high levels of vacancy and abandonment, gaps in the housing supply for both lower- and upper-income households, and an urgent need for housing rehabilitation, the challenges are complex. However, based on our pilot testing, there may be room for scenario planning to expand its reach in this area.

The use of scenarios is particularly effective for comparing the implications of expanded housing options, including ‘missing middle’ housing types such as townhomes, rowhouses, small lot single family homes, and other mid-density, mixed income housing choices. Both UF and ET provide opportunities to test housing mixes and understand their implications for land consumption, renter/ownership levels, household costs, and related sustainability outcomes such as travel behavior and fiscal impacts.

Figure 12: UF Household Costs Analysis Outputs



Source: UrbanFootprint

As previously noted, UF's building types are defined by their physical characteristics, and do not include financial information. While there are many types of housing options that can be incorporated into a UF scenario, there is no feedback related to its costs, sales prices, or rents. While our project utilized UF as the principal tool for building scenarios and analyzing them at the corridor and node scale, our analysis related to housing was somewhat limited as a result. UF does include a Household Costs analysis (see Figure 12), which was an important area of feedback for our project due to its inclusion of passenger vehicle costs, which are often vastly unaccounted for. This metric helps to tell a story about the connections between transportation and equity, which had strong synergies with our TOD goals.

However, UF's lack of housing cost information makes it less equipped to discuss topics such as the estimated rent or mortgage levels of new projects. In contrast, ET's Prototype Builder includes financial inputs that can generate important feedback related to housing costs and affordability in the context of scenario planning. ET includes housing metrics such as Owner/Renter Mix, Average Rent, Average Home Price, Average Unit Sizes, Housing Distribution by Income, and Household Income Needed to Afford the Average Home Cost. ET is able to produce this information because its underlying building type models include financial inputs such as project costs and revenues needed to generate a feasible return on investment. Users with a focus on housing and affordability might consider utilizing ET for its more nuanced feedback in this area. Our class found ET's Prototype Builder to be an invaluable tool when testing alternative affordable housing options for their development feasibility in Youngstown.

Another important housing topic in Youngstown is the current supply and demand for various housing products. For example, there is an abundant supply of affordable detached single-family housing in our corridor areas due to high levels of neighborhood vacancy, which exceeds current demand. While this housing is affordable in relation to housing costs in other U.S. metro areas, it is still unaffordable for a large percentage of Youngstown residents with very low household incomes. In addition, aging housing stock will likely require rehabilitation and maintenance costs after being purchased. Maintenance costs are relatively high for Youngstown's aging housing stock, and this is particularly true for larger homes. ET offers a Balanced Housing Model that can effectively address this dilemma. The model analyzes a community's existing housing supply and makes recommendations for a balanced and sustainable future housing stock (Fregonese Associates n.d.b.). This resource can be used as an open-source, stand-alone tool, and could be leveraged to supplement and further inform scenario building decisions in UF.

We recommend that scenario planning tools consider enhancements for housing analysis that would address the many opportunities for adaptive reuse and rehabilitation in legacy cities. In their current form, the tools we piloted categorize development as either greenfield or infill redevelopment. As far as we can tell, there is no current capability or clear method to model adaptive reuse or rehab projects using either tool. If feasible to implement, this capability would provide a way for legacy cities, rich with historic preservation and industrial reuse opportunities, to explore how adaptive reuse might provide benefits such as reduced redevelopment costs. More experienced practitioners might already have a method for incorporating reuse projects by creating user-defined development type assumptions, but a tool such as UF could likely make the process more ‘plug and play’ and accessible to less-experienced users.

In several Youngstown corridor neighborhoods, infill housing and greening over time will need to include a mix of (1) new construction or greening on currently vacant lots; (2) demolition of vacant homes and rebuilding or converting to greenspace; and (3) rehabilitation of vacant homes. Some students approached neighborhood stabilization by modeling development for only specific vacant parcels that presented clear opportunities for new infill housing. One student group created a user-defined building type to represent single family housing rehab projects. ET’s Prototype Builder could be utilized to reflect the estimated $/square foot construction costs of a rehab project, which could test the potential cost savings of neighborhood development policies that prioritize rehab opportunities.

Students identified additional potential features to guide decision-making around housing and neighborhood rehabilitation. One student group suggested a tool that could filter the existing housing stock by age, value, tenure, vacancy status, or other factors, as a way to quickly scan areas for rehabilitation opportunities. Or, perhaps a tool could create a ‘rehab’ development or place type, which could be used to designate broad areas for neighborhood rehabilitation and dynamically apply rehab projects within that area based on parcel-level criteria (e.g., to target vacant housing of a certain age).

Public Health

Based on the public and environmental health issues we identified at the outset of the project, our pilot testing found that UF did not generate as much output information in this area. While UF certainly speaks to these issues by analyzing walk accessibility, travel mode and access to green space, ET more directly addresses the public health benefits related to these improvements. While our scope did not provide us the time to deploy it, a Health Assessment Model is available to ET users. The model is used to “analyze health outcomes for a community based on a variety of demographic and built environment characteristics” (Fregonese Associates n.d.e.). The tool works as an ArcGIS plug-in and can be used to analyze existing conditions as well as future scenarios built within ET.

Like many of its features, ET's Health Assessment Model is not 'plug and play,' and requires relevant input variables from the EPA's Smart Location Database. The model also requires users to track information using an ArcGIS plug-in interface that is more complex than UF's user-friendly web-based tool. If within a user's capabilities, the tool can provide compelling information related to the public health implications of development scenarios, including active transportation benefits that TOD redevelopment would likely support. The tool's outputs include map layers that reflect levels of resident physical activity and health outcomes such as average body mass index.

ET's Prototype Builder also includes opportunities to incorporate green infrastructure into development projects, which could be used to address additional public health considerations in Youngstown. Students reported low environmental health scores in the corridor neighborhoods, which reflected high levels of impervious surfaces, high urban heat island risk, and low tree canopy coverage. Students also identified vacant lots as potential opportunities for implementing green infrastructure projects in the corridor areas. The ET Prototype Builder allows users to estimate some of the environmental and health benefits generated by green infrastructure.

UF might consider incorporating a public health analysis into its platform. We suggest this because such a tool could likely leverage UF's existing transportation analysis outputs and translate them into explicit public health outcomes such as estimated levels of physical activity. UF might also consider incorporating green infrastructure variables into its place type definitions or analysis options. From our perspective, public health measures would be of interest to UF users in legacy cities and beyond. UF's streamlined, web-based platform would likely make the tools easy to use and expand their access to a wider set of users.

Project-Level Feasibility and Financial Considerations

As mentioned earlier, our class tested scenarios for the Youngstown corridors at multiple planning scales. For the last stage of the project, students developed alternative development proposals for a specific catalyst site within their corridor area. While UF's building type library was suitable for sketch-level planning at the corridor and TOD node scales, individual site-level project alternatives required consideration of more detailed building characteristics.

The use of UF was limited at this scale due to its lack of financial feasibility details. UF's building types do not include financial inputs, which was one of the tool's few limitations during our pilot testing in Youngstown. Without associated project costs or target rent levels for development projects, decisions about physical form and building use become detached from financial reality. Market conditions in Youngstown and other small and mid-size legacy cities are one of the primary challenges for planning redevelopment, and project implementation can be challenging due to gaps in financing new construction. Therefore, we felt it was important to identify and develop catalyst projects, or potential 'first steps' in corridor redevelopment, and test their market feasibility and development impacts.

The ET Prototype Builder has the unique ability to place planners in the developer's shoes. The model acts as a simplified proforma that tests a development program for its estimated return-on-investment. While developing an ET Building Prototype requires more of the user's time than modifying a UF Building Type, the former is easy to rationalize as time well spent. It produced the information the students needed to investigate specific short-term redevelopment opportunities in more detail, including their costs, benefits, and potential financing mechanisms that could be leveraged to implement the project. The tool was helpful for finding alternatives to property tax abatements as a gap financing measure, and was indispensable for testing parking arrangements and investigating how parking requirements might be adjusted make redevelopment projects more financially feasible. In many instances, parking requirements in the underlying zoning code posed obstacles for redevelopment project ideas. The students realized through this process that transit-supportive projects might be incentivized by reducing or waiving parking requirements, which would reduce project costs and increase leasable space.

By modeling site-level scenarios to investigate alternative zoning requirements or uses, the students were able to discuss the most immediate opportunities for short term change, which is a critical aspect for planning in a small legacy city. In a context where new development projects are limited, opportunities to catalyze corridor redevelopment is often an immediate priority for stakeholders and the public. An example building proforma summary and corresponding massing model created with the Prototype Modeler SketchUp plug-in is shown in Figure 13.

Figure 13: ET Protype Builder and SketchUp Modeler

Figure 7. Low Growth Catalyst Site Massing Model

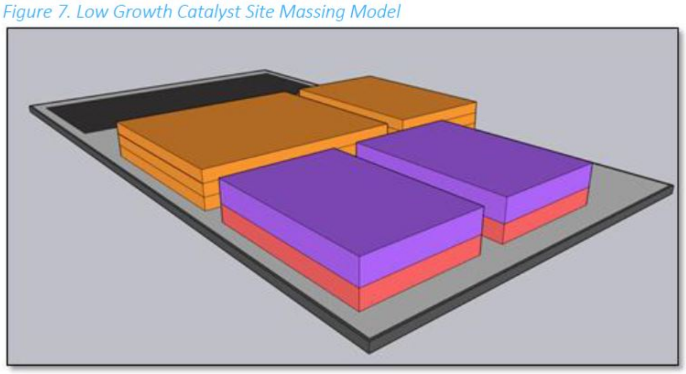


Table 4. Low Growth Catalyst Site Pro Forma Summary

Property	Parking in Surface Lot
Lot Area:	3.3 acres
Stories:	2 (mixed-use) 3 (residential)
Residential %:	74% (88,717 sq. ft.)
Retail %:	13% (15,585 sq. ft.)
Office %:	13% (15,585 sq. ft.)
DU/Ac:	34.8 (112 dwelling units)
Jobs/Ac:	20.8 (67 jobs)
FAR:	1.01
Total Parking Spaces	176
Rate of Return	**12.0%**
Total Construction Cost	**$21,267,202.90**
Subsidy (10% off construction – Federal Opportunity Zone):	*-$2,100,000.00*
Final Construction Cost	**$19,167,202.90**

Source: Envision Tomorrow Prototype Builder

Figure 6. Catalyst Site Low Growth

Source: Envision Tomorrow Prototype Modeler

Conclusions and Next Steps

This paper has described a project completed by the City of Youngstown and Cleveland State University that was driven by a need to better understand how scenario planning might be conducted at the local scale in small and mid-size legacy cities. A graduate planning course pilot tested a scenario-based approach and the use of two supporting tools for transit corridor planning in Youngstown, Ohio. Up to this point, we have described our process and rationale for adopting a scenario framework for the project, discussed our blended use of the scenario planning tools, and presented our findings for how the tools can address critical planning needs in Youngstown and how they might be enhanced. We will conclude by summarizing of our recommendations for scenario planning in the small and mid-size legacy city context, addressing the limitations of our project, and discussing opportunities for further research.

A Hybrid Framework to Plan for Demographic Uncertainty

Our project demonstrates that redevelopment approaches and their anticipated outcomes will often vary depending on uncertain factors such as demographic or economic change. Scenario planning can be an incredibly beneficial approach to planning in small and mid-size legacy cities because it provides the opportunity to discuss and develop plans for a range of plausible future demographic or economic conditions.

We chose to adapt the scenario planning framework used by *Vibrant NEO 2040* for our project, which made hybrid use of normative and exploratory variables when designing scenarios. The hybrid framework approach has been used by other researchers and practitioners (e.g., Goodspeed 2020), and was well-suited to address aspects of uncertainty in addition to normative planning goals in Youngstown. The framework allowed us to explore two plausible growth scenarios for the transit corridors—limited and accelerated growth based on *Vibrant NEO 2040* scenarios—and better understand how TOD and revitalization strategies might be applied in each case.

The hybrid framework in our case underlined the importance of normative considerations, which produced measurable benefits even under limited growth assumptions. For example, the benefits of transit-oriented development approaches were generally reflected by the analysis results in both the high and low growth scenarios. This is a positive finding, because it means that smaller cities such as Youngstown can explore TOD redevelopment strategies without relying on growth to drive potential proposals. The hybrid framework allowed us to investigate exactly what TOD approaches would look like at various levels of change and corresponding levels of development intensity. The integration of exploratory factors also challenged our normative assumptions at times. One planning group reported many positive outcomes occurring in their dispersed developed scenarios, which were intended to represent non-TOD planning alternatives. We hypothesized that this might be related to the widespread vacancy that currently characterizes the corridors, which our modest growth scenarios would only begin to mitigate. In some cases, lower density, dispersed development approaches might address broader areas of vacancy than concentrated, higher-density TOD development.

In total, each student planning group explored four future scenarios for the corridor areas, which felt like an appropriate scope given our timeframe. Reflecting on our pilot testing, we think the growth assumptions used for the exploratory scenarios were adequate in capturing two of the most plausible futures for the corridor areas. In retrospect, had it been feasible to expand our scope, we may have also benefitted from exploring a set of non-growth scenarios to test the impact of right-sizing approaches in the absence of population growth.

Blended Tool Use for Planning at Multiple Scales

As described earlier in the paper, we took a blended, or integrated, approach when pilot testing the tools. Rather than using each tool in isolation and comparing their outputs, we applied each tool to our project in a way that leveraged each of their strengths. We discovered additional tool strengths in the process of pilot testing, and using a blended approach allowed us to tailor or expand our analysis in specific areas when needed. It also allowed us to appreciate the differences and synergies between the two tools, and how they are often most powerful when paired to leverage each of their unique capabilities. In the prior section of this paper, we attempted to organize our findings into legacy city planning themes and describe how the tools were able to address each issue. In this section, we summarize how scale might be a determining factor in tool selection.

One of the unique and perhaps most useful aspects of this project was our decision to conduct scenario-based approaches at multiple scales of planning. We initially decided to model scenarios at three scales to explore the alternatives we thought would produce the most compelling information for Youngstown decision-makers and the public. Utilizing scenarios at multiple scales also helped us understand that the scale of planning itself was a critical factor for leveraging each planning tool.

Generally, we found that UF is optimal for sketch-level physical planning of larger geographies, which for our project included corridor areas and transit-oriented development districts. We have noted that UF's user-friendly web-based platform and integrated analysis tools greatly reduce the time needed to prepare for scenario planning. One tradeoff of 'plug and play' capabilities is that the modelling and analysis outputs are often sketch-level in terms of their precision. Our rationale when leveraging UF for our corridor and district scenarios was that quick, sketch-level results were appropriate for these scales of planning. At the same time, UF's 'plug and play' advantages become more pronounced at larger scales, which from our perspective outweigh any of its disadvantages when planning larger areas.

ET, while not 'plug and play,' can generate more nuanced, financially feasible building models that we felt were appropriate to apply at the site level of planning. In the case of Youngstown, specific sites with short-term development potential within the corridor areas generated high levels of stakeholder interest. UF's sketch-level analysis and lack of financial inputs limited the tool's utility at this scale, so we utilized ET's Prototype Builder to develop more detailed, financially feasible project alternatives. The tool allowed students to further develop concepts for an affordable housing project, an adaptive reuse project for a historic theater, and a boutique hotel. It also helped us test whether the projects would be in accordance with current zoning regulations and parking requirements, or identify zoning revisions that would better support

TOD redevelopment. Paired with the Building Modeler SketchUp plugin, students were able to produce massing models of the projects and consider site planning details.

Thus, with ET, the building prototypes provided a critical avenue for designing transit-supportive projects in the context of scenario planning. From our perspective, a blended use of the tools best served our needs to provide a complete picture of the transit corridor scenarios, ranging from broad, long-term corridor redevelopment concepts to supportive catalyst projects that could be implemented in the shorter term.

Project Scope, User Needs, Resources and Goals

In addition to considerations of scale, we feel that tool selection largely depends on the specific needs and goals of a community. While both tools are capable of addressing important legacy city planning issues, they each offer potential advantages depending on the community context. UF's easy to use and impressively well-integrated transportation and accessibility analysis were ideal for exploring the impact of alternative TOD approaches on travel behavior, and analyzing how redevelopment concepts might expand resident access to various forms of opportunity. At the same time, ET can provide more detailed feedback on topics such as housing, municipal service costs, and public health. ET's relative strength in housing analysis is driven by the tool's incorporation of financial inputs in its building models. We consider this feature to be ET's most important capability, and a community prioritizing housing affordability or shorter-term redevelopment alternatives might prefer ET over UF for this reason.

ET's relative nuance in many cases comes with the tradeoff of requiring users to supply the input assumptions and data that drive the tools. In general, ET's open-source platform is less user-friendly, requires more time to calibrate for scenario planning, and requires more spatial planning and GIS technical expertise to fully leverage. ET also requires that users have access to ArcGIS and Microsoft Excel. That being said, an experienced user may prefer the flexibility and ability to tailor or further calibrate an open-source tool. In our case, in which we faced limitations imposed by Covid-19, UF's 'plug and play' web-based platform was ideal for supporting remote student collaboration and reducing up-front student preparation for scenario planning. UF's ease of use allowed us to accomplish our relatively ambitious planning goals within the project's scope and short semester timeframe.

The tools also have cost tradeoffs related to their platform and approach to distribution. UF is a proprietary tool that requires users to purchase a subscription in order to access its powerful web-based platform. In contrast, ET is an open-source tool that is available to download for free. While UF requires an upfront subscription cost, its plug and play capabilities come ready to use 'out of the box' and promise to save users significant preparation time and demand less in terms of user experience and technical knowledge. In deciding which tools to utilize, a community planner will need to consider project scope, timeframe, and the resources and expertise that will be available to support the project. In our case, we were fortunate to have funding from the Lincoln Institute to purchase a UF subscription for the class. In return, we were able to blend the use of both tools and leverage UF's plug and play capabilities to achieve our project scope in a short timeframe.

Further Research: Legacy City Building Library

We envision this project as an early step in expanding scenario planning applications in small and mid-size legacy cities. We believe that the legacy city context holds important implications for tailoring or enhancing scenario planning to address the unique conditions of urban decline through its approaches and methods. For this project, we attempted to uncover some of these possibilities by piloting an approach and use of tools in the context of transit corridor planning. We hope that our findings and recommendations provide ideas for further discussion and research.

One research area we aim to further develop is the calibration of building typologies for scenario planning in small or mid-size legacy cities. As was discussed previously in this paper, UF and ET are perhaps most distinct from each other in how they define building types. While UF provides a large library of predefined building types, ET's Prototype Builder enables users to model building types with more nuance, which includes financial inputs to ensure that the typologies are feasible in its market context. Because building types serve as the underlying architecture for scenarios and their outputs, we began to question how systematic building type calibration might impact overall corridor scenario results.

In subsequent follow-up research, a CSU Master of Urban Planning and Development student research assistant led an effort to formalize a method for further calibrating legacy city building typologies in UF using the ET Prototype Builder. We first created an inventory of the UF building types utilized most by student teams as they created redevelopment scenarios for Youngstown. We then compared the UF building types to ET building prototypes that were previously developed for the *Vibrant NEO 2040* regional scenarios, filled in any missing typologies with real-world precedents found in Youngstown, and created a synthesized list of relevant building typologies for small and mid-size legacy cities. We modelled each of these building types with the ET Prototype Builder to calibrate their inputs and test their financial feasibility in Youngstown.

When calibrating UF's building types, we found that we often had to reduce average dwelling unit sizes to be more compatible with Youngstown's housing market. We also found that in many cases, parking quantity had to be adjusted to conform to Youngstown's development code and parking demand. In other cases, parking had to be converted from structural or underground forms to surface parking, which is considerably less expensive and more feasible for the majority of projects in the Youngstown context. This process produced a set of 20 legacy city ET building prototypes that we know are feasible projects for Youngstown. The most recently completed step was to migrate these ET building prototypes into UF as user-defined building types. Our graduate research assistant documented a methodology for translating ET building prototype information into UF building inputs, which are more focused on general physical characteristics.

After saving these new buildings types in UF, we tested them by incorporating them into a set of corridor scenarios and re-running the analysis tools. To our surprise, preliminary results indicate that calibrating the underlying building types did not introduce substantial changes to the overall UF output scenario analysis results. This might suggest that UF's building type library is already fairly well-suited to model sketch-level redevelopment in small or mid-size legacy city contexts.

We hope to share the detailed results from this analysis in the future. Our eventual goal is to create a legacy city building library that could be shared with tool providers to make this resource available across various scenario planning platforms. In addition, we hope to share a methodology for using the ET Prototype Builder to calibrate UF building types in greater detail and ensure they are market feasible.

At its core, our project was intended to continue a growing conversation about the potential value of scenario planning and supporting tools for the many small and mid-size legacy cities in the Midwest and Northeast U.S. While we used Youngstown as a case study to pilot test a scenario planning framework and the use of popular scenario planning tools in this context, we believe that many of the takeaways identified in this paper are relevant for other legacy cities facing similar planning challenges. We also acknowledge that our project included limitations related to its scope as an engaged class project in the context of Covid-19 restrictions. We hope this description of our process, findings, and recommendations for adapting the tools are helpful for other scenario planning researchers and practitioners, and enthusiastically invite others to build on this research in future efforts.

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Appendix A: Small and Mid-Size Legacy City Building Calibration Table

This table includes preliminary results from our building calibration process, in which we calibrated UF building types using the ET Prototype Builder and translated the adjustments back into UF as user-defined building types. While the changes are relatively modest and pilot testing the new buildings did not introduce any significant changes to the overall corridor scenario results, we aim to further investigate the implications of creating a Legacy City building type library for scenario planning.

Building Type	Building Uses	FAR	Net Res. Density (du/ac)	Avg. DU size (ft2)	Net Emp. Density (emp/ac)	Avg. gross floor area per emp. (ft2/emp)	Parking Density (spcs./ 1000 ft2)	# of Floors
Residential Building Types								
Suburban Duplex	100% Residential	0.34	8	1875	0	0	1.07	2
MSLC Duplex	100% Residential	0.34	8.5	1500	0	0	1.07	2
Garden Apartment	100% Residential	0.93	25.6	1590.3	0	0	1.45	3
MSLC Garden Apartment	100% Residential	0.5	12.21	1515.5	0	0	1.35	3
Large Lot SF Detached	100% Residential	0.59	5.8	3676.9	0	0	0.82	2.1
MSLC SF Large Lot	100% Residential	0.54	7.14	2800	0	0	0.51	2
Medium Lot SF Detached	100% Residential	0.43	8.08	2325.5	0	0	0.86	2
MSLC SF Medium Lot	100% Residential	0.34	8.39	1500	0	0	0.9	2
Small Lot SF Detached	100% Residential	0.58	10.57	2400.5	0	0	0.81	2
MSLC SF Small Lot	100% Residential	0.29	10.91	1000	0	0	0.65	1
Suburban Townhome	100% Residential	0.77	20.17	1661.8	0	0	1.26	2.6
MSLC Townhomes	100% Residential	0.61	32.15	1259.7	0	0	1.32	2
Non-Residential Building Types								
Low Intensity Strip Commercial	100% Commercial	0.18	0	0	9.27	767.97	7.32	1.1
MSLC Strip Commercial	100% Commercial	0.4	0	0	24.15	646.59	3.6	1
Mainstreet Commercial Low	100% Commercial	0.75	0	0	46.37	699.89	0.92	1.2
MSLC Mainstreet Commercial	100% Commercial	0.55	0	0	42.91	504.4	2	1.5
Emergency Services	100% Civic/Institutional	0.34	0	0	18.9	700	1.29	1
MSLC Emergency Services	100% Civic/Institutional	0.34	0	0	24.28	545	1.29	1
Community Service Facility	100% Civic/Institutional	1	0	0	56.01	700	0.57	2
MSLC Medical Office	100% Civic/Institutional	0.78	0	0	91.86	334	2.06	2
Non-Urban Civic	100% Civic/Institutional	0.3	0	0	38.88	300	1.54	2
MSLC Non-Urban Civic	100% Civic/Institutional	0.3	0	0	38.88	300	1.54	2
Office Park Low	100% Office	0.26	0	0	26.94	379.93	4.29	1
MSLC Office Park Low	100% Office	0.3	0	0	18.18	647.64	5.79	1
Warehouse Low	100% Industrial	0.49	0	0	14.39	1331.9	0.85	1
MSLC Warehouse Low	100% Industrial	0.43	0	0	16.64	1022.41	0.18	1
Industrial Low	100% Industrial	0.28	0	0	7.31	1491.37	1.46	1.7
MSLC Light Industrial	100% Industrial	0.47	0	0	17.73	1048.09	0.53	1
Residential Common Area	100% Park/open space	0	0	0	0	0	0	0
Residential Common Area	100% Park/open space	0	0	0	0	0	0	0
Park	100% Park/open space	0	0	0	0	0	0	0
Park	100% Park/open space	0	0	0	0	0	0	0
Urban Agriculture	100% Rural Employment	0.1	0	0	7.5	1,700	3.03	1
Urban Agriculture	100% Rural Employment	0.1	0	0	7.5	1,700	3.03	1
Mixed Use Building Types								
Urban Townhome/Live-Work	92.2% Residential, 7.8% office	1.37	35.46	1521.5	18.17	168	0.31	2.8
MSLC Urban Townhome/Live-Work	94.2% Residential, 5.8% Office	1.65	34.01	1695	11.25	334	0.44	3
Mainstreet Commercial/MU Low	52% Residential, 48% Commercial	1.74	48.04	629.3	45.86	714.01	0	2
MSLC Mainstreet Commercial/MU Low On Site Parking	52% Residential, 48% Commercial	0.66	17.82	713	24.62	504.5	2.73	2
MSLC Mainstreet Commercial/MU Low Off Site Parking	52% Residential, 48% Commercial	1.6	43.21	713	59.68	504.5	0	2