Teacher's Guide

<u>Simulation Guide</u>

The following are **key metrics** in the simulation, which affect the final state of each student's city:

1. **Sustainability Index**: Measures how environmentally friendly the city is, based on green spaces, waste management, and renewable energy usage.
2. **Economic Growth**: Represents the city's economic stability, growth, and prosperity, based on energy production, infrastructure, and industrial development.

Asset Breakdown:
Each decision impacts multiple aspects of city life, and understanding how these elements interact is crucial to achieving balance (numerical values presented in separate document: **Assets' data***):

Access to Public Transport:

- **Bike Lanes and Bike Sharing**:
  Sustainability: +12
  Environmentally friendly and great for reducing emissions, but only effective in smaller areas. They provide moderate support for green spaces (+6) but don't significantly impact housing, waste, or energy production.
- **Electric Bus Fleet**:
  Sustainability: +18
  Significantly reduces pollution (+12) and energy consumption but requires substantial investment in infrastructure. It offers minimal support for green spaces (+3) but slightly decreases overall energy production (-3).
- **Metro System**:
  Sustainability: +22
  Fast and efficient, providing the best public transport solution (+18), but costly. Large-scale construction can reduce green spaces (-3) and energy production (-6) due to infrastructure demands.

Housing:

- **Affordable Housing Units**:
  Sustainability: -2
  Solves inequality issues by providing housing for a growing population (+18), but may lead to urban sprawl, slightly reducing green spaces (-2) and energy (-2). Positive impact on waste management (+3) by improving living conditions.
- **Eco-Friendly Apartments**:
  Sustainability: +10
  These are energy-efficient and sustainable (+18), improving green spaces (+4) while also reducing waste and boosting energy production (+6). However, high construction costs limit access for lower-income citizens.

- **Co-Living Communities**:
  Sustainability: +6
  Encourages communal living, enhancing social well-being through shared spaces (+12) and moderate green space improvements (+4). It supports energy efficiency (+3) but may not appeal to everyone.

Green Spaces:

- **Urban Parks**:
  Sustainability: +22
  Parks offer the highest positive impact on green spaces (+18) and slightly improve housing (+3) and public transport (+3). However, they take up land that could be used for infrastructure development.
- **Rooftop Gardens**:
  Sustainability: +11
  These gardens reduce urban heat (+12), contributing to green spaces, and also slightly improve energy production (+6) and housing (+2). However, their recreational use is limited.
- **Community Gardens**:
  Sustainability: +11
  Great for social engagement, these gardens improve green spaces (+12) and promote local food production. They also slightly boost energy (+4), but require community upkeep.

Waste Management:

- **Recycling Centers**:
  Sustainability: +12
  Essential for reducing waste (+18), but they rely heavily on citizen participation. They have minimal influence on housing, transport, green spaces, or energy production.
- **Waste-to-Energy Plants**:
  Sustainability: -6
  Converts waste into energy (+17), supporting energy production, but risks emitting pollutants and slightly reducing overall sustainability (-6).
- **Composting Facilities**:
  Sustainability: +9
  Promotes sustainable agriculture and waste management (+11), but has limited impact on housing, transport, or energy production. It helps in creating green spaces (+3).

Energy Production:

- **Solar Farms**:
  Sustainability: +23
  Clean and highly efficient (+23), solar farms greatly improve energy production and slightly enhance green spaces (+3) and housing (+3), but depend on favorable weather conditions.
- **Wind Turbines**:
  Sustainability: +23

Wind energy provides another powerful source of renewable energy (+23). However, they require significant space and can be visually intrusive. Limited direct impact on housing, transport, or waste.

- **Energy-Efficient Buildings**:
  Sustainability: +12
  These buildings reduce long-term energy consumption (+11) while slightly enhancing housing (+12) and green spaces (+3). They require higher upfront costs but are a key asset for sustainable cities.

Simulation Case Scenarios for Sustainable Cities:

1. Green Tech Innovation Hub

- **Features**:
  - Focus on **solar farms** and **wind turbines** for energy production.
  - Widespread use of **energy-efficient buildings**.
  - Moderate development of **eco-friendly apartments** and **community gardens**.
  - Public transport focused on **electric buses**.
- **Outcome**:
  Your city leads in clean energy and energy efficiency, with a highly sustainable power grid. However, challenges remain in housing affordability and green space development.
- **Personalized Message**:
  "Your city has achieved remarkable success in reducing carbon emissions through renewable energy and energy-efficient buildings. However, it still needs to improve its housing affordability and increase urban green spaces to better balance environmental sustainability with livability."
- **Asset Characteristics**:
  - **Public Transport**: Electric buses reduce pollution but need a robust charging infrastructure.
  - **Housing**: Eco-friendly apartments are sustainable but expensive to build, limiting affordability.
  - **Green Spaces**: Community gardens enhance social engagement, but the city lacks large-scale parks for public health.
  - **Waste Management**: Strong recycling systems but underutilized waste-to-energy options.
  - **Energy Production**: Reliant on renewable energy, which can be vulnerable to weather fluctuations.
  - **Economic Growth**: Moderate, driven by high-tech industries like renewable energy.
- **Risks**:
  - Energy shortages due to reliance on variable renewable sources.
  - Rising real estate prices and limited housing could cause social inequality.
- **Similar Cities**:

- ○ **Reykjavik, Iceland**: Dominates clean energy but struggles with housing shortages.
- ○ **Freiburg, Germany**: A solar energy leader with sustainable infrastructure, but faces housing challenges.

2. Industrial Economic Powerhouse

- **Features**:
  - ○ Significant investment in **affordable housing** and **metro systems**.
  - ○ Heavy focus on **waste-to-energy plants** for waste management.
  - ○ Limited development of **green spaces** and **renewable energy**.
- **Outcome**:
  Your city has achieved strong economic growth through industrialization and affordable housing development but suffers from environmental sustainability issues, including poor air quality.
- **Personalized Message**:
  "Your city is an industrial powerhouse with a thriving economy and affordable housing options. However, it still needs to improve its green space development and reduce pollution to ensure long-term health and sustainability."
- **Asset Characteristics**:
  - ○ **Public Transport**: Metro systems are efficient but can reduce green spaces and require significant investment.
  - ○ **Housing**: Affordable housing improves economic equity but may lead to urban sprawl.
  - ○ **Green Spaces**: Lack of parks reduces air quality and overall livability.
  - ○ **Waste Management**: Waste-to-energy plants efficiently manage waste but may produce harmful emissions.
  - ○ **Energy Production**: Limited renewable energy options.
  - ○ **Economic Growth**: Driven by industrial expansion and housing development.
- **Risks**:
  - ○ Pollution and environmental degradation may cause long-term health issues.
  - ○ Heavy reliance on non-renewable industries may be unsustainable in the future.
- **Similar Cities**:
  - ○ **Shanghai, China**: An industrial hub with extensive transport infrastructure but struggles with pollution.
  - ○ **Detroit, USA**: Historically a manufacturing leader but faces challenges with urban decay and sustainability.

3. Green Space Paradise with Housing Crisis

- **Features**:
  - ○ Extensive development of **urban parks** and **community gardens**.
  - ○ Limited **affordable housing** options, primarily focusing on eco-friendly apartments.
  - ○ Public transport consists mainly of **bike lanes**, with limited metro or bus infrastructure.

- **Outcome**:
Your city is a green paradise, offering numerous parks and sustainable living options, but struggles with housing affordability and public transport accessibility.
- **Personalized Message**:
"Your city is an oasis of green, offering residents beautiful parks and sustainable living options. However, it still needs to improve its housing availability and public transport systems to support a growing population and economic development."
- **Asset Characteristics**:
  - **Public Transport**: Bike lanes are great for the environment but limited in scope, affecting accessibility.
  - **Housing**: Housing shortages lead to economic inequality.
  - **Green Spaces**: Parks and gardens improve air quality but consume valuable land for housing.
  - **Waste Management**: Composting and recycling are well-established, but large-scale waste management could be improved.
  - **Energy Production**: Small-scale solar solutions, but not enough to meet the needs of a growing population.
  - **Economic Growth**: Low due to limited industrial and housing expansion.
- **Risks**:
  - Housing shortages could lead to homelessness or social unrest.
  - Economic stagnation due to limited focus on industry and commerce.
- **Similar Cities**:
  - **Portland, USA**: Extensive green spaces but faces a housing affordability crisis.
  - **Vancouver, Canada**: A highly livable city with strong environmental policies but high housing costs.

4. High-Tech Smart City

- **Features**:
  - Focus on **metro systems**, **electric bus fleets**, and **energy-efficient buildings**.
  - High investment in **co-living communities** and smart **waste management systems**.
  - Moderate development of **rooftop gardens**.
- **Outcome**:
Your city is a modern, high-tech hub with advanced infrastructure and innovative solutions, but still struggles with balancing green spaces and ensuring housing equity.
- **Personalized Message**:
"Your city has embraced cutting-edge technology to provide efficient public transport and smart waste management, offering a high-tech living experience. However, it still needs to improve in expanding green spaces and ensuring equitable housing for all citizens."
- **Asset Characteristics**:
  - **Public Transport**: Metro systems and electric buses provide fast, low-emission transport.
  - **Housing**: Co-living communities are efficient but may not appeal to everyone.

- ○ **Green Spaces**: Limited to rooftop gardens, insufficient for larger populations.
  - ○ **Waste Management**: Smart systems effectively track and reduce waste, but large-scale solutions are limited.
  - ○ **Energy Production**: Energy-efficient buildings dominate, but reliance on solar or wind is minimal.
  - ○ **Economic Growth**: High, driven by technology and infrastructure development.
- ● **Risks**:
  - ○ Creating a tech-driven city for affluent residents could increase inequality.
  - ○ Insufficient green spaces could negatively affect residents' well-being.
- ● **Similar Cities**:
  - ○ **Singapore**: A highly modernized city with smart infrastructure and limited green space.
  - ○ **Seoul, South Korea**: A tech-forward city with strong transport systems but limited green areas.

5. Sustainable Social City

- ● **Features**:
  - ○ Balanced investment in **co-living communities** and **recycling centers**.
  - ○ Focus on **bike lanes** and **electric buses**.
  - ○ Moderate development of **urban parks** and **community gardens**.
- ● **Outcome**:
  Your city fosters strong social cohesion with equitable housing and sustainable waste management, but more work is needed in energy production to ensure self-sufficiency.
- ● **Personalized Message**:
  "Your city has created a supportive community with affordable housing and sustainable waste management. However, it still needs to improve its renewable energy infrastructure to reduce dependency on external power sources."
- ● **Asset Characteristics**:
  - ○ **Public Transport**: Bike lanes and electric buses reduce pollution but may limit accessibility.
  - ○ **Housing**: Co-living communities promote social interaction but may not be ideal for all demographics.
  - ○ **Green Spaces**: Well-balanced parks and gardens enhance livability.
  - ○ **Waste Management**: Strong recycling and composting systems.
  - ○ **Energy Production**: Needs improvement, with limited use of renewable energy.
  - ○ **Economic Growth**: Steady, with a focus on social sustainability over rapid expansion.
- ● **Risks**:
  - ○ Vulnerability during energy shortages due to limited renewable infrastructure.
  - ○ Community-based solutions may not scale well as the city grows.
- ● **Similar Cities**:
  - ○ **Curitiba, Brazil**: Known for innovative public transport and waste management but needs improved energy infrastructure.

- ○ **Barcelona, Spain**: Strong social sustainability but still advancing in renewable energy adoption.

Reflection Questions for Teachers: Guide the reflection with these questions to ensure a critical and productive discussion:

- **How did your decisions affect the environment of your city?**
- **Were you able to find a balance between economic growth and sustainability?**
- **What sacrifices did you make in one area to improve another?**
- **What were the unintended consequences of your decisions?**

Suggested Assessment

The assessment should focus on students' ability to:

- **Justify their decisions**: Explain why they prioritized certain aspects of city development (e.g., public transport over green spaces).
- **Reflect on outcomes**: Understand and articulate the results of their choices, both positive and negative.
- **Apply real-world thinking**: Relate the simulation to challenges faced by cities today, such as climate change, housing crises, and public transport accessibility.

Evaluation Criteria:

1. **Participation**: Active engagement in the simulation and reflection process.
2. **Critical Reflection**: Thoughtful consideration of the trade-offs and outcomes of their decisions.
3. **Application of Knowledge**: Ability to connect the simulation with real-world urban planning issues.

Reflection and Real-World Connections

In addition to reflecting on their city-building experience, students should consider what they, as citizens, can do to make a difference in their own communities:

- **What can you do as a citizen to support sustainable cities?**
    - Participate in local environmental initiatives.
    - Advocate for public transport improvements.
    - Support policies that promote affordable housing and green energy.

Global Organizations Working on Urban Sustainability:
Introduce students to global organizations and initiatives addressing similar issues:

1. **C40 Cities**: A network of cities committed to addressing climate change by promoting sustainable urban policies.
2. **ICLEI – Local Governments for Sustainability**: Focuses on sustainable urban development through local government partnerships.
3. **UN-Habitat**: A United Nations program working towards socially and environmentally sustainable cities globally.
4. **The Global Covenant of Mayors for Climate & Energy**: A coalition of cities and local governments taking action on climate change through sustainable energy solutions.