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CAPACITY BUILDING FOR SUSTAINABLE URBAN MOBILITY PLANS

# Multi-Modal Plan Scenario Building in SUMPs

**23-24 September 2024**

# Key messages

## How to build a Multi-Modal Plan Scenario in SUMPs?

- Plan the multimodal transport system at the right scale: the **Functional Urban Area**
- Plan at **system-level** with a **multimodal hierarchy** of the network

  **Focus on network**

  1. Need for high capacity, rapid **core** road, public transport and cycle **networks** consistent with the transport demand
  2. Plan the other slower hierarchical levels with **seamless integration**
- Optimize the PT network relating to Land Use and Manage Demand
- Design different scenarios at system-level **with stakeholder input**
- Use the **right tools to evaluate** scenarios and select the best one
- Follow the **right steps**





**Concerning Public transport network**: In the development of Sustainable Urban Mobility Plans (SUMP), planned extensions to the public transport network may initially lack specific details regarding the mode of transport—whether rail, tram, bus, etc. These details are often determined during later stages of the planning process, such as through options appraisal within the SUMP framework or during project-level feasibility studies.

**Concerning Integration of transport and Land use planning** : A key component of the SUMP is to assess and highlight areas where there is insufficient integration between transport and land use planning. While the SUMP can identify these issues, it is generally within the scope of other planning instruments to make modifications to land use policies. However, the SUMP may propose specific developments in the transport system based on consultations and collaborations with relevant land use departments, ensuring that any proposed solutions are aligned with broader urban planning objectives.

**Concerning operational aspects in Scenario Building** : When constructing scenarios within the SUMP, it is essential to emphasize the importance of operational aspects. This includes considering elements such as the hierarchical structure of the transport network, the complementarity and integration of various transport modes, capacity, service frequency, maintenance facilities, and depot locations. In some cases, the differences between competing scenarios may not lie in the physical layout or extent of the public transport network, but rather in the operational concepts that underlie them. Therefore, careful attention must be given to these operational dimensions when evaluating and comparing scenarios.

# Interactive Exercise - Scenarios in SUMP

Discuss in pairs for 5 minutes and be prepared to report back

- Have you ever built or used scenarios in developing a SUMP? What did these scenarios consist of?
- Do you think that working with scenarios essential in creating a Sustainable Urban Mobility Plan (SUMP)? Why or why not?

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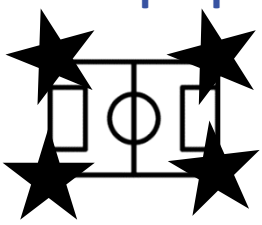
## What is a Scenario in a SUMP?

- It's not a description / photo of today's situation
- It's not a forecast (future as an extrapolation of today's trends)
- It's not a package of projects or measures for the future
- **It's an internally consistent view of how the future "transport system" might work**

## And what is its purpose?



*Insight into bandwidth of realistic future possibilities ('what is the playing field', 'what ambitions seem realistic')*

*Understanding the effect of certain choices within mobility system and what are side effects*

*Appraisal and comparison of different options to choose the best one*



**Understanding What a Scenario Is:**

"There is not always clarity on what constitutes a scenario. A scenario is not an assessment of the current situation, nor is it simply a prediction of the future based on current trends. It goes beyond a collection of projects or isolated measures. Scenarios represent internally consistent visions of how the future 'transport system' might function. Here, 'transport system' refers to the structure, overarching framework, and overall scheme, rather than focusing on highly specific projects or measures. For example, a scenario at the 'system level' might illustrate a hierarchical network of public transport systems with different levels of service, without necessarily specifying the type of rolling stock that will be used."

**Main Purposes of Scenarios:**

**1.Avoiding Tunnel Vision:** Scenarios prevent premature commitment to a single solution.

**2.Insight into Future Possibilities:** They provide an understanding of the range of realistic future outcomes, helping to identify what is feasible and ambitious.

**3.Testing Measures:** Scenarios help to evaluate which measures most effectively contribute to the SUMP's goals and how these measures interact with each other.

**4.Challenging Ineffective Measures:** They enable the identification of measures that do not work, highlighting the need for alternative solutions.

**5.Managing Uncertainty:** Scenarios allow for 'what if' analyses, making it easier to navigate uncertainties.

**6.Stimulating Creativity:** They encourage imaginative thinking and openness to different

ideas.

7. **Appraising and Selecting Options:** Scenarios help in evaluating different options and selecting the most suitable one.

**Using Scenarios:**

Scenarios can be used in various ways. The most common approach is to compare multiple scenarios, assess them through methods like multi-criteria analysis, and then choose the best option. Scenarios can also be used to test the impact of specific measures, identify resulting mechanisms, and uncover potential side effects (e.g., what happens when a road is closed and how traffic patterns shift). These insights can then inform the development of a preferred scenario. Additionally, scenarios can help define the range of possible changes in the mobility system, such as exploring the effects of implementing aggressive pricing or parking policies. These results can later contribute to the creation of a preferred scenario.

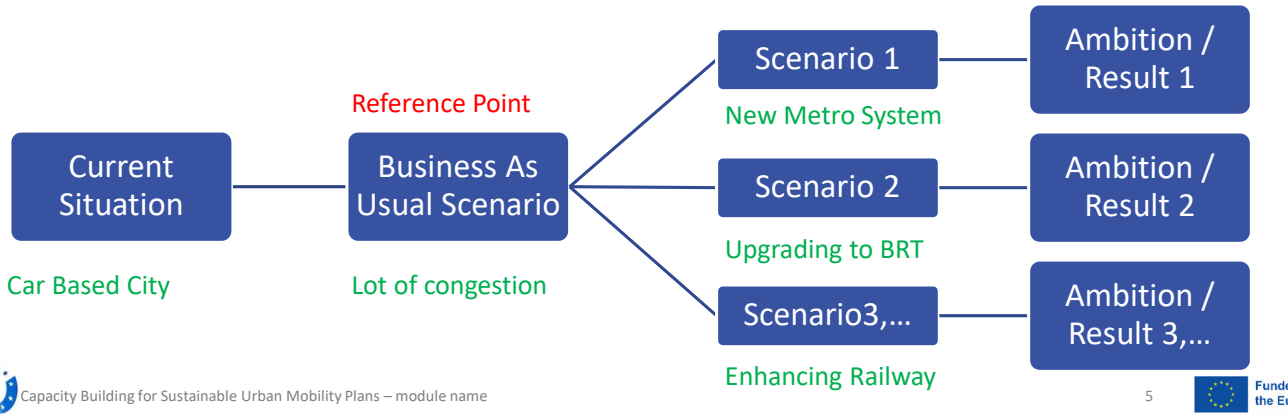
**System-Level Scenario Development:**

When developing scenarios, we focus on proposing a vision for the development and operation of the city's transport system. This vision is then expanded into a set of organizational, operational, and infrastructure measures. At the system level, scenarios explore different configurations of the overall transport system, including under-used parts of the system. For example, scenarios might consider high-speed or high-capacity corridors served by trains, trams, metros, or even buses, as well as alternative land-use options designed around these transport modes. Additionally, these scenarios would consider how the 'feeder' public transport system integrates with the primary corridors. These different configurations are what we refer to as scenarios in this context."

https://civitas.eu/resources/city-specific-urban-mobility-scenarios-d31

## Ingredients of Scenarios in SUMP

- Core-network and feeder network
- Demand management
- Land use & Spatial planning
- Price mechanism (parking policy, road pricing)
- Ingredients that increase sustainable modal share






Examples of scenarios :

* new roads, widening or narrowing roads, new cycle lanes or bus lanes

* promoting hybrid working, reduce or move car parking

* densification in the city or expansion outside the city,
* adding amenities for residents in neighborhoods, other
* types of residential target groups

"The diagram starts with the **Current Situation**, which represents the present state or baseline of the system being analyzed. From this point, an extrapolation is made to predict the future under the assumption that no significant changes or interventions occur. This predicted future state is termed the **Business As Usual (BAU)** Scenario.

The **Business As Usual** Scenario serves as a reference point, showing what the future would look like if current trends and behaviors continue unchanged. This scenario is crucial for understanding the baseline against which other potential futures can be compared. Importantly, the BAU scenario should not only be used as a comparison but should also provide some of the most critical elements for further analysis, helping to identify areas where intervention is most needed.

It's also important to note that when estimating greenhouse gas (GHG) emissions, the reference point is the current position, not the BAU scenario. This approach aligns with the EU SUMP Topic Guide on Decarbonisation (also covered in Module 10), ensuring that GHG estimates are based on the present situation rather than projected trends.

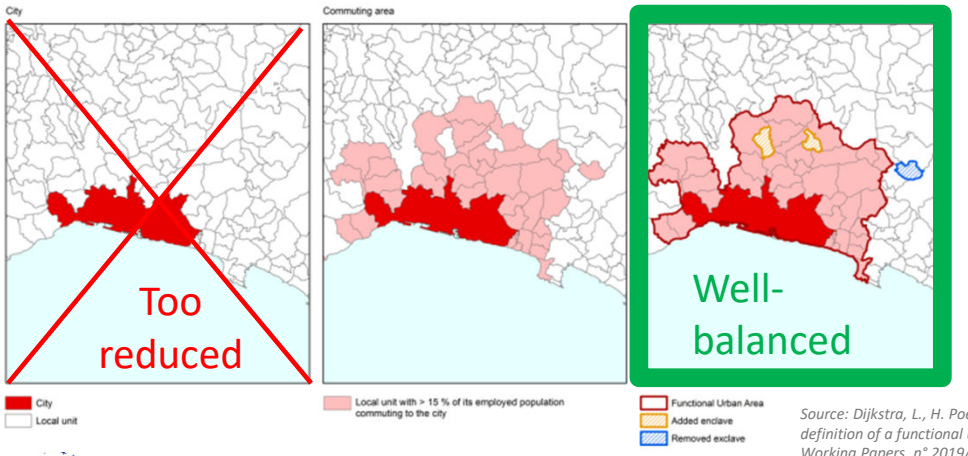
From the Business As Usual Scenario, several **Scenarios** are derived. Each scenario represents a different possible future that results from making specific adjustments or

interventions compared to the Business As Usual Scenario. These adjustments could involve changes in policies, strategies, technologies, or other influential factors.

Linked to each scenario are specific **Ambitions**. These ambitions denote the desired goals or outcomes that stakeholders aim to achieve under each respective scenario. By comparing these scenarios and their associated ambitions with the Business As Usual Scenario, decision-makers can evaluate the potential impacts of different strategies and make informed choices about the best paths forward."

# The Importance of Functional Urban Area (FUA)

- What is a FUA ?
  - Definition: Region that consists of a densely populated city (or urban core) and a commuting zone where at least 15% of the working residents commute to the core for employment. (source OECD).
  - Purpose: Integrates urban planning and resource management efficiently.




In a SUMP, the **Functional Urban Area** is the right scale to plan the multimodal transport system !

*Source: Dijkstra, L., H. Poelman et P. Veneri (2019), « The EU-OECD definition of a functional urban area », OECD Regional Development Working Papers, n° 2019/11, Éditions OCDE, Paris*



A Functional Urban Area (FUA) is a broader concept that includes a city and its surrounding areas, which are economically and socially connected to it. This broader scope allows for more effective urban planning and resource management. It is crucial to address future travel demand based on (the future) Functional Urban Areas, which consist of densely inhabited urban areas and less densely populated commuting zones.

Which FUA characteristics will favor the realization of the ambition of a SUMP?

**1. Clear Boundaries and Governance:**

- A well-defined FUA has clear geographical limits that outline the central city and its surrounding commuting zones. This clarity is essential for effective governance and planning.
- Efficient administration within an FUA means that there is a cohesive approach to governance, where different municipalities and administrative units work together seamlessly. This coordination facilitates unified decision-making and policy implementation, which is crucial for managing urban growth and infrastructure.

**2. Integrated Infrastructure:**

- A key feature of a good FUA is seamless transport and connectivity. This means having a well-developed transport network that ensures easy movement of people and goods across the entire area, connecting the central city with its suburbs and beyond.
- Coordinated public services, such as health, education, and emergency services, are also vital. These services should be efficiently distributed and accessible to all parts of the FUA, ensuring that residents receive consistent and reliable support regardless of their location within the area.

**3. Balanced Development:**

- A balanced FUA promotes equitable socio-economic growth across its regions. This involves addressing disparities and ensuring that development benefits are shared widely, preventing any areas from lagging behind.
- Sustainable urban planning is another hallmark of a good FUA. This involves making long-term plans that accommodate growth while preserving environmental quality, reducing carbon footprints, and ensuring a high quality of life for all residents.

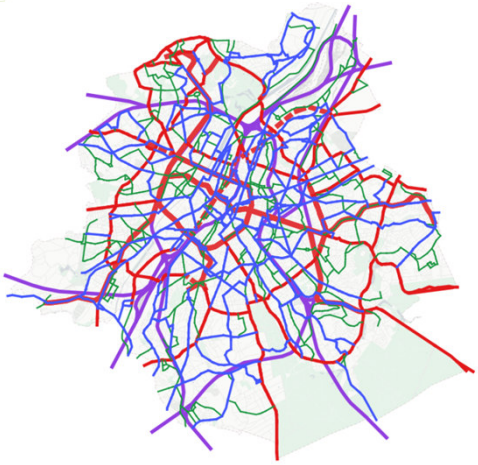
**Notes on the picture :**

A functional urban area can be defined in four steps:

1. Identify an urban centre: a set of contiguous, high density (1,500 residents per square kilometre) grid cells with a population of 50,000 in the contiguous cells;
2. Identify a city: one or more local units that have at least 50% of their residents inside an urban centre;
3. Identify a commuting zone: a set of contiguous local units that have at least 15% oftheir employed residents working in the city;
4. A functional urban area is the combination of the city with its commuting zone.

## Brussels Good Move : System-level with a Multimodal Hierarchy of the Network

Brussels' Public Transport



- PLUS
- CONFORT
- QUARTIER (= District)
- PLUS (Railway)

Brussels' car system-level network

*Source: https://mobilite-mobiliteit.brussels/en/good-move/good-network*



Hierarchy of the Public Transport (PT) System Network in Brussels – Current situation (updated 07-2021)

**1. Public Transport Core Network (PLUS):**

•**Function:** Acts as the primary public transport network, handling the largest share of urban travel across key corridors.

•**Characteristics:**

- **High Capacity and Speed:** Designed to move large numbers of passengers efficiently with high average speeds.
- **Reliable Infrastructure:** Features robust and comfortable infrastructure, including dedicated lanes and modern stations.
- **Priority Measures:** Given precedence over other transport modes to maintain timely and efficient service.
- **Frequent Services:** Buses and trams run at high frequencies, ensuring a maximum wait time of 15 minutes.
- **Extended Service Hours:** Operates from early morning to late night, covering weekends to meet diverse user needs.

**2. Public Transport Complementary Network (CONFORT):**

•**Function:** Extends the core network's reach to areas not directly served by PLUS, ensuring comprehensive coverage.

•**Characteristics:**

- **Supplementary Coverage:** Connects various zones within the city and

suburbs, providing access to areas outside the core network.

- **Flexible Integration:** Adapts to different urban and suburban areas, supporting a smooth transition between various transport modes.

**3. District-Level Service (QUARTIER):**

•**Function:** Focuses on local transport within districts, ensuring close and convenient access.

•**Characteristics:**

- **Localized Service:** Tailored to the specific mobility needs within neighborhoods, providing detailed coverage.
- **Integration with Urban Spaces:** Ensures seamless connections to local points of interest and integrates well into the public realm.

# Different types of system-level PT core network

Radial network :

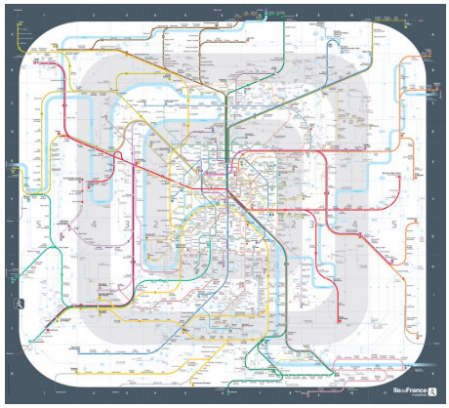
Chicago example


Grid network :

Mexico example


Complex network :

Paris example



The system-level approach means that we do not focus on specific schemes (e.g. a metro) at this stage



Source: https://cirano.qc.ca/files/publications/2020RP-28.pdf



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**Radial Network (Chicago Example):** The radial network is defined by railway lines that converge towards a central point, typically a downtown hub. This structure is ideal for cities where many travelers are commuting to and from a central business district. It provides straightforward, direct routes into the heart of the city. However, it may not facilitate efficient movement between peripheral areas without passing through the center.

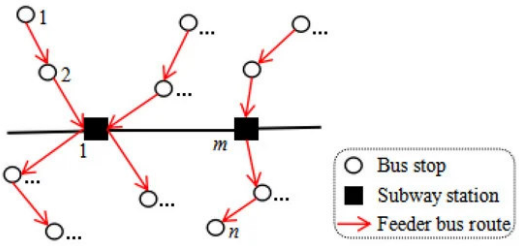
**Grid Network (Mexico City Example):** In a grid network, railway lines form a grid pattern with intersecting routes, creating multiple direct paths across the city. This design offers flexibility, allowing for easy transfers and various travel routes between different parts of the city. It provides balanced connectivity, supporting both local and long-distance urban travel without over-relying on a single central point.

**Complex Network (Paris Example):** The complex network combines radial and grid elements with additional circular routes and interconnections. This creates a highly integrated system that supports diverse travel patterns. It allows for extensive coverage across the city, facilitating both central and cross-city travel without the need to transit through the central area. This structure is efficient for cities with multiple high-demand areas and dense urban development.

**System-Level Approach in SUMP:** A system-level approach in Sustainable Urban Mobility Plans (SUMP) focuses on optimizing the entire PT network rather than individual lines. This ensures comprehensive coverage, enhances connectivity, and supports seamless travel across different urban zones, making the network more user-friendly and effective.

# Feed the Core Network: Enhancing Connectivity through SUMP

- Concept of "Feeding the Core Network"
  - Feeder Systems: Link local areas to core PT network.
  - Supporting Mobility: Comprehensive coverage and accessibility.
- Role of SUMP
  - Integrated Planning: Balanced network, support core.
  - Long-Term Vision: Align with urban development and sustainability.
- Designing Effective Feeder Systems
  - Tailored Routes: Connect neighborhoods to core stations.
  - High Frequency: Minimize waiting times.
  - Accessibility: Inclusive for all users.
- Enhancing Connectivity
  - Multimodal Integration: Cycling, walking, shared mobility.
  - Flexible Services: On-demand shuttles, microtransit.




*Source: Cao Y, Jiang D, Wang S. Optimization for Feeder Bus Route Model Design with Station Transfer. Sustainability. 2022; 14(5):2780.*

*Source: Deutsche Bahn*



**1. Concept of "Feeding the Core Network":**

- **Feeder Systems:** Smaller transport modes and services that link local areas to the core public transport network.
- **Supporting Mobility:** Ensures comprehensive coverage and accessibility, making it easier for residents to reach major transit lines.

**2. Role of SUMP**

- **Integrated Planning:** SUMP focuses on creating a balanced transport network where local services effectively support the core network.
- **Long-Term Vision:** Aligns feeder services with broader urban development and sustainability goals.

**3. Designing Effective Feeder Systems:**

- **Tailored Routes:** Develop routes that meet the specific needs of different neighborhoods, connecting them to the nearest core network station.
- **High Frequency and Reliability:** Ensure frequent and reliable feeder services to minimize waiting times and enhance convenience.
- **Accessibility:** Make feeder services accessible to all users, including those with disabilities and those in less densely populated areas.

**4. Enhancing Connectivity:**

- **Multimodal Integration:** Combine cycling infrastructure, pedestrian pathways, and shared mobility options to support feeder routes.
- **Flexible Services:** Use flexible transport options like on-demand shuttles or

microtransit to complement fixed-route feeders.

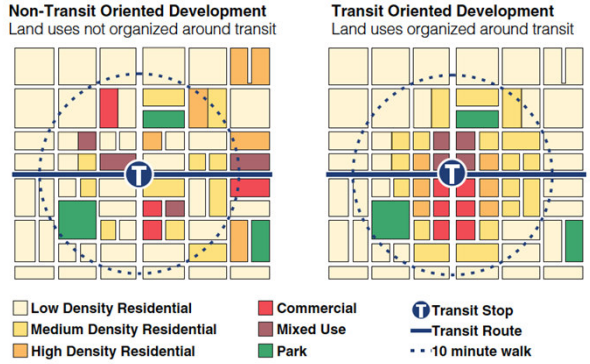
# Optimizing PT and Land Use Integration and Demand Management

Land Use Planning

- Impact on Transport:
  - Reduces travel distances.
  - Increases the viability of public transport.
  - Enhances walkability and cycling options.

Demand Management

- Strategies: Congestion Pricing, Parking Management, Incentives for Sustainable Transport
- Impact on System:
  - Reduces congestion.
  - Balances transport demand across modes.
  - Supports environmental sustainability.




Seattle Planning Commission: "Transit Communities" report

*Source : City of Seattle, Office of Planning and Community Development "Block44: Example of Transit Oriented Development"*



**Land Use Planning:**

- **Definition:** Strategic development of urban spaces to optimize transport efficiency and accessibility.
- **Objective:** Encourage high-density, mixed-use developments that reduce the need for long commutes and promote public transport use.

**Demand Management:**

- **Definition:** Policies and measures designed to influence travel behavior and manage transport demand.
- **Strategies:**
  - **Congestion Pricing:** Charges for driving in congested areas to reduce traffic and encourage alternative transport modes.
  - **Parking Management:** Limited and priced parking to discourage car use and promote public transport.
  - **Incentives for Sustainable Transport:** Benefits for using public transport, biking, or walking.

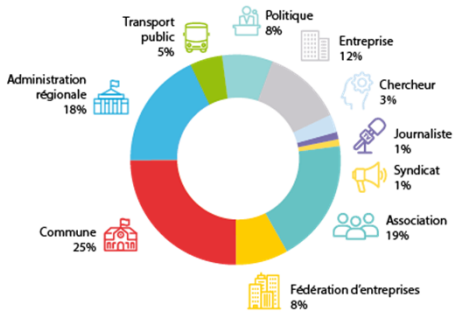
**Transit oriented development :**

- **Concept:** A concrete example of land use planning.
- **Impact on Transport:** By reducing the need for long commutes, this concept directly supports the reduction of travel distances and increases the viability of public transport, walking, and cycling. Integrates development around PT nodes/hubs to support multi-modal trips

# Engaging Stakeholders in Developing Transport Scenarios

- Importance of early Stakeholder Engagement in the **scenario definition** and the **selection process**
- Key Stakeholders:
  - Local governments and authorities.
  - Transport operators (e.g., national rail infrastructure companies).
  - Businesses and commercial organizations.
  - Community groups and residents.
- Benefits of Stakeholder Engagement:
  - Inclusivity
  - Better Planning.
  - Enhanced Acceptance

*Diversity of stakeholders who contributed to the participatory process*






*Source: Bruxelles Mobilité*



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**Importance of Stakeholder Engagement:**

- **Definition:** Involving various stakeholders (public, private sectors, and community groups) in the planning process.
- **Objective:** Ensure diverse perspectives and needs are considered, leading to more comprehensive and accepted transport solutions.
- **Key Stakeholders:**
  - Local governments and authorities.
  - Transport operators (e.g., national rail infrastructure companies).
  - Businesses and commercial organizations.
  - Community groups and residents.
- **Benefits of Stakeholder Engagement:**
- **Inclusivity:** Ensures that the interests of all user groups are represented.
- **Better Planning:** Leads to more informed and realistic scenario planning.
- **Enhanced Acceptance:** Increases public and organizational buy-in for proposed changes and developments.

**"Good Move" participatory process :**

Mobility is a critical issue for the Brussels-Capital Region. With the Good Move initiative, the Government launched a participatory process in October 2016 to develop its new regional mobility plan. This dynamic approach involved a wide range of Brussels and Belgian stakeholders—public, private, and non-profit sectors, as well as citizens—in a

collective effort to find innovative solutions to mobility challenges.

The chart illustrates the diversity of participants who contributed to shaping the vision during the forum in April 2017. Notably, this stakeholder gathering played a key role in defining several scenarios that were instrumental in the development of the Good Move plan.

## Example scenario 1 - Phased Implementation under Budgetary Constraints

1. **Limited Resources and Localized Projects**: The city faces financial constraints and localized projects, causing political budget battles.
2. **Current System and Urban Sprawl**: The system is a patchwork of slow local lines, leading to long travel times, increased car use, and urban sprawl.
3. **Modelling Insights**: A metro is too costly and slow to implement, while a BRT network, though less effective, achieves faster results (under 2 years).
4. **Advantages of BRT**: BRT offers short-term gains, lower costs, flexibility for upgrades, and reduced risk of prolonged construction.
5. **Strategic Balance**: Balances short-term and long-term gains, emphasizing rapid, well-distributed measures for socio-economic development.



The 3 following examples are fictional scenarios designed to represent real-world measures and existing challenges faced by urban planners and city managers. These examples aim to provide a comprehensive understanding of the complexities and considerations involved in urban transportation planning.

Each example is presented in two formats:

**1.Full-Length Explanation (Story)**: This format (in commentary) provides a detailed narrative of the scenario, describing the specific challenges and considerations a city faces.

**2.Summary Slide**: These slides sum up the initial situation of each city and highlight the main challenges

In this city with limited financial resources, there are a few significant infrastructure projects on the drawing board, but they remain highly localized and are backed by local interests, resulting in endless political battles over the best way to allocate budgets. The current system is more a patchwork of local service lines than a true network. Performance in terms of commercial speed is low, leading to very long medium and long-distance urban travel times, which results in massive car use for all trips to and from the periphery. This, in turn, tends to accelerate urban sprawl.

The city has a relatively homogeneous and classic density of housing and activity (with density decreasing from the center). Therefore, it appears that a star-shaped structuring network could provide an interesting systemic solution. Modeling has shown that the beneficial effects on modal shift will only really be achieved with a complete star-shaped network due to the network effect. A phased approach by line, which would take too long, would therefore not be optimal. Furthermore, modeling has clearly shown that a

metro, with its high commercial speed, would bring about a better modal shift, but its high cost would clearly lead the city into a budgetary deadlock, likely extending the construction over decades. The option of a star-shaped BRT (Bus Rapid Transit) network, although generating less modal shift, is ultimately more relevant since the gains, although lower, can be achieved in a much shorter timeframe (less than 2 years).

Additionally, this option has the advantage, in case of economic recovery (which is also planned), of being able to upgrade BRT axes to tram axes if demand proves too high.

The chosen approach prioritizes:

•Short-term gains despite being lesser

•Reduced costs while still allowing actions across the entire territory

•Reduced risk of prolonged construction phases depending on funding availability and political contingencies

•The possibility of evolving in stages: BRT, improvement of rolling stock, increased frequencies, new lines, transitioning to tram, improvement of rolling stock, increased frequencies, new lines

However, if transitioning to a metro is ever needed, it will have cost more in the long run (but perhaps the city wouldn't have been able to develop as quickly if it had chosen the metro initially).

There is a balance between lower short-term gains/higher long-term gains (especially if funding is stretched) and the ratio of modal shift per million invested.

"The socio-economic development of a city is more likely to amplify with rapid and spatially well-distributed measures."

## Example scenario 2 - Leveraging Existing Infrastructure

1. **Nationally Managed Railway**: The city's star-shaped railway network is managed at a national level, focusing on profitable long-distance routes, with little consideration for urban needs.
2. **Paradox of Underutilization**: Despite having railway lines consuming much city space, they are not used for urban travel. Instead, the city plans to develop a metro and tram network, which competes with trains over medium distances.
3. **Need for Coordination**: Significant collaboration is needed between national, regional, and local authorities to align objectives and better use the railway for urban transport.
4. **New Suburban Focus**: The railway operator is tasked with developing a suburban offer that complements the existing urban transport network.
5. **Cost Concerns and Analysis**: The high potential costs necessitate using models and multi-criteria analysis to determine the best approach.



The city in question has a star-shaped railway network that crosses the city in various directions. The railway network is managed at a national level (the railway operator and the infrastructure manager are accountable only at the national level), leaving the city with little influence over its strategic organization. Urban needs are not well addressed because the railway strategy is oriented towards more profitable long-distance routes.

This situation creates a paradox: despite having structuring railway lines that consume a lot of space within the city, the city does not consider using them for urban and suburban travel. Instead, it plans to develop its own structuring metro and tram network, which will have significant financial and environmental impacts (investment costs and space consumption) and will partially compete with the train over medium distances, as simulations have shown.

This analysis of the competitive impacts between the train and the urban public transport network sparked a broader reflection on the use of rail in the city. Significant collaboration between national, regional, and local authorities, as well as transport operators, was required to align fundamentally divergent objectives. Following this consultation, the railway operator was assigned a new mission to develop a structuring suburban offer, considering complementarity with the existing public transport network. A new scenario emerged, developing the local service network around the railway network.

This scenario raises serious operational challenges (how to combine intercity and suburban offers?), as well as necessary investments in the railway network and equipment: improving signaling and safety (increasing frequencies), doubling tracks (bypasses for fast trains), bridges/tunnels to create connections between railway lines

and/or exploit capacity margins better, opening new stops, and adapting rolling stock for urban service (acceleration/deceleration, platform-level boarding, wide boarding doors, etc.).

Therefore, it is uncertain whether this scenario is the best if costs explode, highlighting the importance of using models and conducting a multi-criteria analysis based on objective criteria.

## Example scenario 3 - Balancing Ambition and Feasibility

1. **Existing Metro Line and Proposed Second Line**: The city has an East-West metro line and seeks to build a North-South line, facing opposition over demand and resource allocation.
2. **Opposition and Resource Allocation**: The opposition argues that the project diverts resources from other neighborhoods needing improved service.
3. **Tram Network Restructuring**: Introducing the new metro line will necessitate restructuring the underperforming tram network to create new connections.
4. **Two Development Visions**: One scenario focuses on a costly, localized improvement generating economic growth and densification, while the other invests in the tram network to improve coverage, speed, and capacity.
5. **Objective Analysis Needed**: Modeling and multi-criteria analysis will objectively assess both proposals.



The city already has an East-West metro line built in the 1990s. For years, it has been struggling to construct a second North-South line. The opposition questions the necessity of this project, citing insufficient demand, and regrets that it monopolizes all the city's resources and attention while other neighborhoods also need improved service.

Additionally, the introduction of the new metro line will require restructuring an already extensive but underperforming tram network by creating new connections.

There are thus two scenarios with two different visions for the city's development. The first focuses on a costly but relatively localized radical improvement, which is expected to generate economic dynamism and densification in the affected area (albeit with some delay due to the lengthy construction period). The second scenario, with the same or even a smaller budget, aims to invest heavily in the tram network to improve its coverage, commercial speed, and capacity (especially along the corridor intended for the metro).

Again, modeling tools and multi-criteria analysis will help to objectively assess the socio-economic impacts of the two proposals. Which one generates the most modal shift, at what cost, within what timeframe, with what environmental impact, and with what equity?

# Interactive Exercise - Imagining Scenarios

- Work in groups 4-5 people for 15 minutes and be prepared to report back
- Choose a city you know well (at least one of you)
- Choose one of the three examples to find inspiration to propose one scenario (or more) for your City
  - Start by stating the objective (we propose to focus on modal shift as a means to deliver congestion reduction and pollution reduction objectives)
  - Incorporate the key messages from the presentation into your reasoning
  - Think system level (intermodal structural networks, strategic measures)
- Discussion: answer the following questions about your scenario
  - Explain why you can say that your scenario is at system level?
  - How does your scenario achieve the objective?
  - How is your scenario adapted to the specific characteristics of the city?



Learning objective:

Understand what a scenario is through action and confrontation with peers, experience the process of defining a scenario.

## Appraisal of Scenarios - Objectives and Criteria

- **Objective**: To ensure that scenarios are evaluated for their environmental, social, and economic impacts, and their ability to achieve specific SUMP objectives.
- **Methods**: Utilize impact assessment to measure direct and indirect effects, and achievement assessment to ensure alignment with predefined goals and Key Performance Indicators (KPIs).
- **Criteria for assessing Scenarios**:
  - Environmental Sustainability
  - Social Inclusivity
  - Economic Efficiency

Example of Objectives and KPI :

| Objective | KPI |
|---|---|
| Reduce GHG's emissions | % reduction in CO2 emissions by year 20XX |
| Improve accessibility to Public Transportation | % of population within 500m of transit stop |
| Boost economic productivity | % reduction of average commute time |



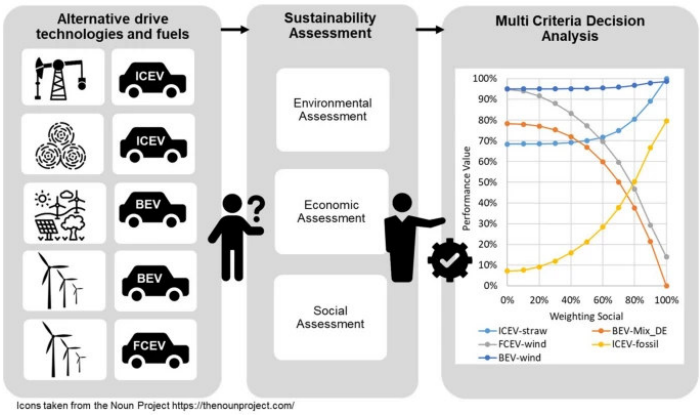
- Objective of Scenario Appraisal:
  - The primary objective is to evaluate scenarios to understand their impacts and ensure they align with the predefined goals of SUMPs. This involves looking at their effects on environmental, social, and economic aspects of urban mobility.
- Methods:
  - Impact Assessment: This involves measuring the direct and indirect effects of each scenario. It helps to identify how each scenario affects various aspects of urban life and the environment.
  - Achievement Assessment: This method assesses how well each scenario meets the SUMP objectives and Key Performance Indicators (KPIs). It ensures that the proposed scenarios are not only impactful but also aligned with long-term urban mobility goals.
- Criteria for Assessing Scenarios:
  - Environmental Sustainability: This criterion evaluates the scenario's ability to reduce emissions, improve air quality, and increase green spaces. It ensures that the scenario supports environmental goals.
  - Social Inclusivity: This criterion assesses the scenario's impact on accessibility for all demographics, reduction in travel costs, and enhancement of safety. It ensures that the scenario supports social goals by being inclusive and beneficial for the community.
  - Economic Efficiency: This criterion analyzes the cost-benefit ratio, impact on

the local economy, and potential for job creation. It ensures that the scenario supports economic goals by being cost-effective and promoting economic growth.

- Alignment with Long-term Urban Mobility Goals:
    - The scenarios must align with long-term goals, which include promoting sustainable growth by meeting environmental, social, and economic objectives. This alignment ensures that the urban mobility system is balanced, inclusive, and supports the overall development of the city.

# Quantitative and Qualitative Methods of Scenario Evaluation

- Quantitative Methods
  - Definition: Uses numerical data.
  - Examples: Traffic Modeling, Emission Calculations, CBA, GIS-based analysis.
- Qualitative Methods
  - Definition: Involves perceptions and experiences.
  - Examples: Surveys, Focus Groups, Public Consultations.
- Classification Methods: MCA
  - Overview of MCA
  - Steps: Criteria Selection, Scoring & Weighting, Ranking.
  - Benefits of MCA: Structured and Transparent Evaluation.




*(Source: Haase, M., Wulf, C., Baumann, M. et al. Multi-criteria decision analysis for prospective sustainability assessment of alternative technologies and fuels for individual motorized transport. Clean Techn Environ Policy 24, 3171–3197 (2022).)*



**Quantitative Methods:** Quantitative methods play a crucial role in scenario appraisal by utilizing numerical data and metrics to evaluate the impacts of different scenarios. These methods are focused on objective, data-driven analysis, which helps to quantify the potential effects of each scenario. For example, traffic modeling is used to predict changes in traffic flow and congestion across the urban area, providing insights into how scenarios might alleviate or exacerbate traffic issues. Emission calculations estimate the potential reductions in CO2 and other pollutants, helping to evaluate the environmental benefits of scenarios. Additionally, cost-benefit analysis (CBA) compares the economic costs and benefits associated with each scenario, enabling us to understand their financial viability and overall value.

**Qualitative Methods:** While quantitative methods provide numerical insights, qualitative methods involve non-numerical data that focuses on perceptions, experiences, and judgments. These methods are essential for capturing the more subjective aspects of scenario appraisal, reflecting the views and preferences of various stakeholders. Surveys and questionnaires are commonly used to collect feedback from residents and stakeholders, offering a broad perspective on how different scenarios are perceived. Focus groups engage small groups in detailed discussions, providing in-depth insights into specific aspects of the scenarios. Public consultations gather broader community input through meetings or digital platforms, ensuring that a wide range of voices are heard in the evaluation process. These methods help to incorporate the human and social dimensions into scenario appraisal.

**Classification Methods: Multi-Criteria Analysis (MCA)** Multi-Criteria Analysis (MCA) is a systematic approach used to evaluate and prioritize scenarios based on multiple criteria. MCA works by first identifying the key factors that are important for assessing each

scenario, such as cost, environmental impact, and social benefits. These criteria are then assigned scores and weights according to their importance, reflecting the priorities and objectives of the SUMP. By aggregating these scores, MCA allows us to rank the scenarios and identify the most favorable options. The main benefit of MCA is that it provides a structured and transparent decision-making framework, balancing diverse factors to support comprehensive evaluations. This approach ensures that all relevant aspects are considered, leading to well-informed and balanced decisions.

## Focus on Multi-Modal Transport Modelling

- Objective Analysis:
  - Models help objectify political discussions with quantitative analysis.
- Impact Estimation:
  - Models estimate the impact of both BAU scenario and alternative options in terms of trends / key indicators.
- Tool, Not Oracle:
  - Models are tools that simplify reality, not absolute truths.
- Input Quality:
  - Quality of output depends on the quality of input data.
- Challenges with Innovation:
  - Innovative mobility solutions (e.g., shared modes or MaaS) present challenges for models.

***Transport models**: simplified representations of transport supply and demand and their interaction in a given context (e.g., mobility within a city). Transport models are built to simulate the effect of modifications of such existing conditions and thus to give insight in result of choices" – see training module 9 (Demand and accessibility analysis) for more information*



- **Objective Analysis**: Transport models play a crucial role in objectifying political discussions by providing quantitative data. This data helps to ground debates in evidence and allows for more informed decision-making processes. By using these models, stakeholders can better understand the potential impacts of various transport policies and projects.
- **Impact Estimation**: Transport models will help to inform and assess (& estimate the impacts) of both the Business As Usual (BAU) scenario and alternative options in terms of trends and key indicators. By simulating different scenarios, models can predict how changes in population, economic activities, or infrastructure developments might affect urban mobility. This capability is essential for planning sustainable and efficient transport systems.
- **Tool, Not Oracle**: It is important to recognize that transport models are tools designed to simplify reality and are not infallible predictors of the future. They are based on numerous assumptions and exogenous conditions that can affect their accuracy. As such, models should be used as guides rather than definitive answers.
- **Input Quality**: The quality of a transport model's output is directly related to the quality of its input data. High-quality, accurate data is essential for producing reliable and meaningful results. Ensuring robust data collection and validation processes is critical for effective transport modelling.
- **Challenges with Innovation**: Innovative mobility solutions, such as shared transportation modes and Mobility as a Service (MaaS), present unique challenges for transport models. These solutions often involve new and dynamic variables that traditional models may not fully capture. Therefore, continuously updating and

adapting models to integrate these innovations is necessary to maintain their relevance and accuracy.

## Focus on Multi-Criteria Analysis (MCA)

- Role of MCA in Ensuring Comprehensive Evaluation:
  - Holistic Assessment:
  - Structured Decision-Making
  - Quantitative and Qualitative Analysis
- Application of MCA in SUMP:
  - Balancing Multiple Factors
  - Stakeholder Perspectives
  - Scenario Comparison
  - Objective Alignment

| Objectives | Criteria | Scenario 1- *Stand Alone* | Scenario 2- *New Highway* | Scenario 3- *New Highway + Green-Way* |
|---|---|---|---|---|
| ROAD EFFICIENCY | Investment costs (millions of €) | −33 | −2824 | −2924 |
| | Management and maintenance costs (millions of €) | N.A. | −680 | −680 |
| SERVICE PROVIDER BENEFITS | Revenues (millions of total vehicles) | N.A. | 243 | 285 |
| | Business diversification (high = 1, medium = 0.66, low = 0.33) | N.A. | 0.66 | 1 |
| USERS BENEFITS | Cars generalized transport costs (millions of hours saved) | 8.5 | 250 | 275 |
| | Freight vehicles generalized transport costs (millions of hours saved) | 10.9 | 79 | 112 |
| ECONOMIC GROWTH | Tourism promotion: accessibility to inland historical centres (number) | N.A. | 5 | 5 |
| | Tourism promotion: a new green-way road (high, medium, low) | 0.33 | 0.66 | 1 |
| | Freight centres and firms accessibility (number) | N.A. | 8 | 8 |
| QUALITY OF LIFE | Accidents risk (millions of €) | 81 | 1366 | 1608 |
| | Social cohesion (high, medium, low) | 0.33 | 0.66 | 1 |
| LOCAL ENVIRONMENTAL BENEFITS | Pollution (millions of €) | 1 | 67 | 72 |
| | Protected environmental areas (number) | N.A. | 2284 | 2867 |
| | Hydrological risk areas (number) | | 1218 | 1529 |
| | Landslide risk areas (number) | | 1066 | 1338 |
| GLOBAL ENVIRONMENTAL BENEFITS | Global warming (tons of C02*1000) | 148 | 3016 | 3459 |
| | Disability-Adjusted Life Years and usage of primary resources (millions of €) | 61 | 1297 | 1480 |

*Henke, Ilaria & Cartenì, Armando & Di Francesco, Luigi. (2020). A Sustainable Evaluation Processes for Investments in the Transport Sector: A Combined Multi-Criteria and Cost-Benefit Analysis for a New Highway in Italy. Sustainability. 12. 9854. 10.3390/su12239854.*



**Multi-Criteria Analysis (MCA):** Multi-Criteria Analysis (MCA) is a decision-making tool used to evaluate multiple competing criteria in complex scenarios. It helps in structuring and analyzing decision problems where multiple objectives need to be considered, ensuring a comprehensive evaluation of all relevant factors.

**Role of MCA in Ensuring Comprehensive Evaluation:**

**1.Holistic Assessment**: MCA allows for a holistic assessment by considering various criteria that are often conflicting. It helps in identifying trade-offs and synergies among different objectives, providing a balanced view of the potential impacts. MCA typically involves applying scores/weights to specific criteria to support the assessment task.

**2.Structured Decision-Making**: MCA provides a structured framework for decision-making, enabling a systematic comparison of alternatives. This structure is essential for dealing with complex urban mobility issues where multiple factors must be weighed.

**3.Quantitative and Qualitative Analysis**: MCA integrates both quantitative and qualitative data, allowing for a more nuanced evaluation. This integration is crucial for capturing the full range of impacts and ensuring that all relevant aspects are considered.

**Application of MCA in SUMP:**

**1.Balancing Multiple Factors**: In the context of Sustainable Urban Mobility Plans (SUMP), MCA is used to balance various factors such as environmental sustainability, social inclusivity, and economic efficiency. By evaluating these criteria simultaneously, MCA helps in developing strategies that are well-rounded and effective.

**2.Stakeholder Perspectives**: MCA facilitates the inclusion of diverse stakeholder perspectives. It allows for the incorporation of input from different groups, ensuring that

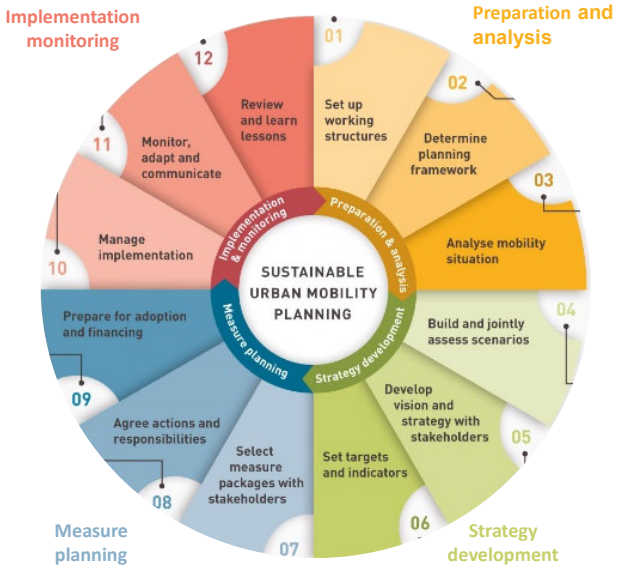
the final decision reflects a broad consensus. This inclusivity is vital for the success of SUMP, as it promotes stakeholder buy-in and support.

3. **Scenario Comparison**: MCA is particularly useful in comparing different scenarios. It enables planners to assess the relative merits of various options, taking into account the full spectrum of impacts. This comparison helps in identifying the most sustainable and beneficial solutions.

**4.Objective Alignment**: By using MCA, planners can ensure that the chosen strategies align with long-term urban mobility goals. MCA helps in evaluating how well different options meet the predefined objectives and Key Performance Indicators (KPIs), ensuring that the final plan is coherent and goal-oriented.

# Steps in Creating a Scenario

- Step 3
  - Analyse present and future problems and opportunities within the FUA
- Step 3 -> 4
  - Determine the key issues to which scenarios should provide solutions
- Step 4
  - Develop future scenarios
- Step 4 -> 5
  - Analyse results and draw conclusions






*Source: Guidelines for developing and implementing a sustainable urban mobility plan, second edition*



Funded by the European Union

Step 3 consists of :

identify indicators / criteria (with stakeholders!)

Identify FUA

Assess your current situation

Consult stakeholders about perceived problems and opportunities

Steps 3-> 4 :

Determine the key issues to which scenarios should provide solutions

Based on assessment of current and future situation (quantitative and qualitative analysis)

Take into account input from stakeholders (e.g. specific concerns arising from interviews)

Define and communicate targets of scenarios

Step 4 involves actually building scenarios, based on forecasts. It is important to base the scenarios on the key issues from the previous step. And to ensure that it is not just about infrastructural scenarios. But the possibilities to reduce mobility in general (influencing demand) and to influence the choice of transport mode (shift from car use to bicycle and public transport use, for example) are also examined. Finally, scenarios can also be given a place in which (after influencing demand and modal shift) efforts are made to reroute transport flows.

Develop future scenarios

Based on steps before

Construct scenarios aimed at influencing mobility needs, changes in travel behavior (behavioral influence)

Construct scenarios focused on changes in mode use (modal shift between modes)

Construct scenarios focused on changes in route choice behavior (within modes of transportation)

Construct final scenarios (e.g. in several steps in multiple rounds or iterations, focusing on selection of the most promising ingredients.

After the scenarios have been built, they can then be analysed, for example with traffic models. An analysis must be made of how the scenarios score on the predetermined indicators. Based on this it is possible to draw conclusions.
Then it concerns the desirability of scenarios, together with any side effects that may need to be mitigated. It may also be that certain ingredients from multiple scenarios are promising to combine into one integrated vision. This paves the way to developing a vision and an accompanying strategy.

Step 4->5: Analyze results and draw conclusions

Use a multi-modal traffic model for comparison of the effects of scenarios

Based on defined indicators and criteria

Use qualitative and/or quantitative methods of scenario evaluation.

Use the MCA

Draw conclusions on the effects of influencing mobility needs, modal shift opportunities and route choice behavior

Construct a resulting integration scenario from the most relevant elements from the previous analysis scenarios
= input for vision development

Keep in mind that the final goal is to derive at a preferred strategy/option on which to further elaborate organisational, operational and infrastructure measures....

# Conclusion: How to build a Multi-Modal Plan Scenario in SUMPs?

- Focus on the **Functional Urban Area** (FUA) for a coherent, **hierarchical** multimodal network.
- Ensure **high-capacity networks** are well-integrated across all transport levels, emphasizing the importance of **seamless connections**.
- Engage **stakeholders** in **designing system-level scenarios**, using **robust tools** for selection of scenarios.
- Use qualitative and/or quantitative methods for **scenario evaluation**. Use the **MCA** for a **holistic assessment**.
- Utilize **feedback** to refine and evolve mobility solutions in line with urban and societal changes.