Impact of Global Trends on Ülemiste Smart City and its Companies

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Executive Summary

The aim of this project-based research is to present how global trends are affecting the city of Ülemiste, a significant innovation and development hub in Tallinn, Estonia.

The study will analyse how new global trends—such as substantial demographic shifts, increasing health awareness, increasing societal polarization, and other external context-related issues—are affecting the growth and business dynamics of smart cities using the PESTLE (Political, Economic, Social, Technological, Legal, and Environmental) analytical framework.

In addition, we explore the idea of the "smart city" paradigm shift in urban development and how these cities have evolved from their initial technology-centric model (Smart City 1.0) to a more inclusive and progressive citizen-centric approach in Smart City 3.0 and where Ülemiste City stands now based on the key factors of this smart city 3.0 framework, and how much of a gap Ülemiste city needs to overcome in order to achieve the indicators of success in transforming into a smart city 3.0

Finally, this study offers practical strategic recommendations to Ülemiste City and its related companies in accelerating towards the global trend of citizen-centric or communities centric smart city development.

Keywords: Smart City 3.0, Six Pillars of Smart City, Citizen-centric innovation

Introduction and Project Purpose

The project-based research utilizes PESTLE analysis to comprehensively assess the external and internal factors that influence the strategic direction of Ülemiste City. The primary objective is to deliver actionable insights that promote sustainable development, drive innovation, and enhance the quality of life for both the city's businesses and its residents in the Ülemiste City as a leading smart city example in Estonia, particularly within the global trend toward smart urbanization, sustainability, and technological advancement, which is impacting its growth.

This report fulfills that objective by:
- Analyzing current internal conditions and external macro trends with PESTLE
- Benchmarking Ülemiste City against world-class smart cities
- Identifying scalable and adaptable global solutions for Ülemiste
- Recommending actionable strategies for 2025–2030

Smart City 3.0 Framework: Conceptual Review

The definition of Smart city concept is varied. According to Wikipedia, a smart city is an urban area with the advancement of digital technologies to support operating services and collect data from citizens, devices, buildings, and CCTVs (cameras) through applications including traffic and transport systems, integrated information, and other communities and government services. The foundation of a smart city is an urban environment that utilises ICT (Information and Communication Technology) and another related technology to enhance performance, operation process efficiency and quality services of the city to urban citizens[1].

Characteristics of a Smart City

Smart cities encompass several key attributes, themes, and infrastructure components. These attributes, known as smart city characteristics, highlight their unique features. These themes, often referred to as foundational pillars, are critical to the sustainable progress of cities. In addition, infrastructure is a critical element that offers the operational framework needed for any smart city. This section will discuss these characteristics in the context of standard smart city implementations.

Smart cities are characterized by a combination of attributes that function harmoniously. As noted by Saruja et al., most proposals for smart cities emphasize four primary attributes, namely sustainability, quality of life (QoL), urbanization, and intelligence[2]. These primary attributes include several sub-attributes. Infrastructure and governance, waste and pollution management, energy conservation, climate change response, social challenges, economic considerations, and health are sub-attributes of the sustainability attribute.

Sustainability refers to the ability of a city to successfully manage urban operations while maintaining a balanced ecosystem in all these areas. On the other hand, the financial and emotional well-being of city dwellers is referred to as their quality of life (QoL). In addition, the technological, financial, infrastructural, and governance changes that occur when rural areas are replaced by urban areas are the primary focus of the urbanization attribute.

Moreover, smart city development is heavily influenced by the notion of sustainability, which has been a central theme in urban development since the 1980s. The three-pronged approach, which recognizes the interdependence of these components, is in line with the sub-attributes of sustainability[3,4,5].

In consequence, cities in modern societies increasingly rely on natural resources to thrive. Consequently, it is imperative to examine the impacts of non-renewable resource depletion. For smart cities to be sustainable, energy sources and natural heritage must be preserved[6] .

Smart City 3.0 goes beyond technological enablement (Smart City 1.0) or private sector partnerships (2.0). It prioritizes people-centric, co-created solutions[7]. Core pillars include:

- **Smart People:** inclusive education, creative workforce
- **Smart Governance:** participatory decision-making, open data
- **Smart Mobility:** multimodal, carbon-neutral transport
- **Smart Environment:** resilience, renewable energy, green space
- **Smart Living:** health, well-being, cultural vibrancy
- **Smart Economy:** innovation clusters, digital entrepreneurship

This report uses the 3.0 model as a framework for assessment.

Ülemiste City – Current State

Ülemiste City, near Tallinn Airport in Estonia, has grown from a neglected industrial region to one of Northern Europe's most ambitious business campuses. It was founded by AS Mainor and other private investors in the early 2000s.

Ülemiste aspires to contribute significantly to Estonia's economic growth by creating a dynamic, innovation-driven environment that includes employment, education, and lifestyle. It's home to more than 500 companies in diverse sectors (technology, finance, education, health, logistics, etc.) and 17,000 talents. However, new challenges are brought about by global changes like the trend towards remote work, climate change, and geopolitical instability. This project research-based analysis Ülemiste City's background, its current opportunities and risks, the influence of global trends, key stakeholders involved, and strategic recommendations for sustaining its future success.

Background of Ülemiste City

Ülemiste City was founded in the early 2000s by private investors led by AS Mainor, who began redeveloping the former Dvigatel industrial territory. The vision was to establish a business and living environment that combined work, education, and an urban lifestyle. Over two decades, Ülemiste has evolved into a strategic hub that supports Estonia's ambition to become one of the world's most digitally advanced societies.

Ülemiste City today embodies a "Future City" concept which:

- ·Focusing on green urban development (eco-friendly buildings, smart mobility).
- ·Prioritising digital infrastructure (5G, IoT, AI-based solutions).
- ·Supporting lifelong learning (partnerships with universities, innovation hubs).
- ·Creating a wellness-centred environment (healthcare access, recreation, public spaces).

Over two decades, Ülemiste grew into a strategic hub supporting Estonia's ambition of becoming one of the world's most digitally advanced and innovation-driven societies, and based on the performance data, Ülemiste City campus's turnover surpasses €2 billion annually, making it Estonia's third-largest economic contributor after Tallinn and Tartu.

Influence of Global Trends

Global trends have a direct impact on Ülemiste's future development. The strategic development of Ülemiste City is especially dependent on several identified key areas. Global changes sped up by the COVID-19 pandemic and continuous digital transformation are reflected in these trends[8]. Globalization also increases competition among innovation hubs, requiring Ülemiste to continuously innovate and improve its ecosystem.

Area	Relevance to Ülemiste City
Geopolitical Shifts	Necessitate stronger digital sovereignty, security measures, and diversified international partnerships.
Economic Volatility	Demands financial resilience, adaptive business models, and flexible real estate offerings.
Social Expectations	Young professionals seek sustainable, flexible, and healthy urban lifestyles.
Technological Advancement	AI, IoT, 5G, and Smart City technologies offer opportunities for urban innovation and efficiency.
Regulatory Changes	Growing focus on green standards (e.g., EU Taxonomy), GDPR compliance, and ESG reporting impacts operations.
Environmental Pressures	Cities must consider circular economy initiatives, such as waste and water management, sustainable energy transition, and materials recycling.

Key Stakeholders

Ülemiste City's development is driven and influenced by several actors brought out down below. Close collaboration among these stakeholders is critical to maintaining momentum towards a resilient, inclusive, and future-ready urban community.

Stakeholder	Role
Government Authorities	Urban planning, policy support, infrastructure investment.
Private Investors	Financing expansion projects and sustainable initiatives.
Businesses	Providing services, employment, R&D, and innovation.
Citizens and Residents	Demanding high-quality living, health, education, and cultural amenities.
Academic Institutions	Supplying skilled talent, collaborative research, and knowledge transfer.
NGOs and Advocacy Groups	Promoting inclusivity, sustainability, and social cohesion.

Overview of Current Opportunities and Challenges

PESTLE	Current opportunities and challenges
Politics	Rising global fragmentation and the emergence of new power centers are reshaping trade, technology, and investment flows, creating space for smart cities to tap into green innovation and digital growth – but these shifts are shadowed by escalating geopolitical conflicts, disrupted supply chains, and weakened alliances, demanding fast, resilient, and secure urban strategies.
Economics	Ülemiste's open, innovation-driven economy is well-positioned to benefit from smart city market growth, nearshoring, and ESG investment trends – but global instability, talent shortages, and rising capital costs demand stronger economic resilience, flexible policies, and alignment with EU strategies to stay competitive and future-ready.
Social	Remote work, global talent flows, and rising health awareness are reshaping urban life and expectations, pushing cities like Ülemiste to offer greater flexibility, inclusivity, and well-being – but with Estonia's shrinking workforce and growing reliance on international talent, these shifts also intensify competition, strain housing and services, and risk deepening inequality, demanding smart, people-centered strategies to stay resilient and attractive.
Technology	Ülemiste's rapid integration of AI, IoT, and smart mobility presents major opportunities to lead in digital innovation, sustainability, and economic resilience – but these gains are challenged by the need to scale technologies beyond pilots, address rising cybersecurity threats, close digital skill gaps, and ensure inclusive access to prevent widening social and technological divides.
Legal	Remote work, smart tech adoption, and EU climate laws are reshaping legal demands for cities like Ülemiste, creating pressure to modernize work rights, protect citizen data, and meet strict sustainability targets, while also navigating regulatory gaps, public distrust, and aging infrastructure through clear, ethical, and future-ready governance.
Environment	As cities like Ülemiste face growing climate pressures, circular economy strategies such as smart waste systems, energy-efficient buildings, and real-time environmental monitoring offer a path to sustainable growth, but scaling them requires overcoming outdated infrastructure, improving waste management, and aligning with EU climate goals through strong governance and digital innovation.

POLITICS

The global order is entering a new phase of fragmentation and multipolarity. Economic interdependence now comes with heightened exposure to geopolitical tensions, policy uncertainty, and shifting alliances. Growing fragmentation is distorting trade and capital flows while driving up costs like inflation, emphasising the need for more coordinated policies[1], and concerns over durability of partnerships are reshaping traditional notions of global security[2]. While globalization persists, it is evolving – led by rising powers and non-aligned countries that are increasingly reshaping influence across trade, capital, and people[3]. The U.S. remains dominant but stagnant, as China and the Global South gain ground[4,5]. Reflecting this shift, the EU's latest emphasizes safety, competitiveness, and democracy, while reducing focus on climate policy in response to changing geopolitical realities[6].

These changes highlight the importance of Smart Governance, Smart Economy, and Smart People – pillars that enable agile decision-making, economic adaptability, and cultivate an adaptable, globally minded workforce. This section explores how Ülemiste can strategically respond to political complexity by aligning its development strategies with the Smart City 3.0 framework to ensure investor confidence, company supply chains, and energy security.

Changing and emerging global power centres

The United States' leading role in global market integration is weakening, especially with Donald Trump's return to the presidency.
Unlike the 2018 trade tensions, current protectionist policies – such as a universal base tariff – target all tensions, not only China[7]. These are increasing uncertainty, slowing growth prospects, and casting doubt on the U.S. as a reliable ally [8]. In response, many countries are reevaluating their security ties and seeking new alliances[9]. Internally, over half of Americans see their country's influence declining, while rivals like China, Russia, Israel, India, and Iran are gaining ground[10]. The shift is driven by the domestic polarization, inequality, and "America first" measures, including withdrawal from international agreements, and cuts to foreign aid[11]. Europe is particularly concerned, as Trump's favorable stance towards Russia may undermine NATO security commitments and support for Ukraine, with the U.S. contributing 16% of NATO'S budget[12]. With U.S. leadership in question, emerging powers are intensifying competition and geopolitical tensions[13].

The global balance of power is gradually tilting towards Asia, with China leveraging U.S. instability to asset global leadership and challenge West[14].
By presenting itself as a stable alternative, China can encourage previously sceptical countries to reconsider their stance[15], and appeal through initiatives like the Belt and Road to countries dissatisfied with the current order like India, Indonesia, South Africa, Turkey, and Brazil[16]. China also sees Europe as a strategic counterweight to U.S. influence, though engagement is shaped more by U.S. pressure than Chinese investment[17]. It is also advancing alternatives to Western institutions like BRICS[18], and aiming for technological leadership by 2030, as seen in breakthroughs like DeepSeek AI[19]. Its rise in green tech, innovation, and capital markets is making

it vital for global growth[20]. Yet, economic and security concerns, especially in Europe, are driving efforts to de-risk and diversify. Ultimately, China's long-term influence will depend on how it navigates internal economic slowdowns and rising global scrutiny[21].

India stands at a critical crossroad, navigating geopolitical rivalries and technological shifts while reinforcing economic sovereignty.

It presents itself as "a friend to all", maintaining ties with both the U.S. and Russia, and is set to become the world's third-largest economy by 2027[22]. With rapid growth, India has the potential to lead in high-tech sectors such as space tech, AI, and digital finance.[23] Though seen by the U.S. as a counterweight to China, doubts remain about its global ambitions. India's assertiveness at the WTO – amid U.S. retreat – has drawn criticism from Global South peers, potentially limiting its trade influence. Therefore, 2025 is a key year to align its policies with its vision of becoming a developed nation, strengthen Global South priorities, and shape the BRICS economic agenda.[24]

ASEAN is rapidly emerging as a global economic powerhouse, projected to become the fourth-largest economy by 2030, driven by its young, tech-savvy population and a digital sector expected to reach $1 trillion dollars[25].

Despite being overshadowed by larger powers, it has shown resilience through global turmoil, leveraging innovation and inclusivity to advance digital transformation, sustainable development, and EV production[26]. Its growth is led by Vietnam, the Philippines, Indonesia, and Malaysia, fuelled by strong demand, digital innovation, green finance, and supply chain shifts from China[27]. With solid fundamentals, diversified investments, and balanced international partnerships, ASEAN is well positioned to navigate global challenges like the U.S.-China rivalry and unpredictable U.S. leadership[28].

Africa is shifting from geopolitics to geoeconomics, driven by frustration with Western double standards, a growing preference for alternative partnerships[29].

Holding around 30% of the world's critical minerals, Africa is becoming central to clean energy supply chains and EV battery production, placing them at the heart of strategic competition[30]. Seeking greater autonomy, African states are asserting themselves more in global governance, and turning away from Western aid towards deeper ties with China, Saudi Arabia and the UAE [29]. By 2025, Africa is expected to provide a quarter of the global workforce, with its long-term significance lying in sustainable development, urbanization, export growth, economic diversification and digital innovation in sectors like fintech and e-commerce[30].

Smart cities are increasingly becoming geopolitical playgrounds themselves due the adoption and reliance on strategically important technologies.

As smart technologies evolve into soft power, they become critical assets in global tensions, with countries promoting their digital solutions to influence narratives and gain economic and strategic leverage. Such as with China's Belt and Road project – issues have arisen with technologies like Huawei's 5G networks that are facing scrutiny in the U.S. over national security

threats and data access. For example, the Huawei-built smart city in Mauritius, intended as a "digital brain", with Huawei-built submarine cables leading to it, could potentially allow China to tap into Indian and Western communications in the Indian Ocean.[31] While European perspectives on this issue are divided, some cities such as Valetta in Malta, Monaco, and Serbia are adopting Huawei's systems[32]. However, Huawei has withdrawn from projects in Valenciennes, due to operational difficulties in the French market, and from Duisburg, as it was blocked due to security assessments by the German government. Other examples include Kuala Lumpur in Malaysia, where China's Alibaba's "city brain" solutions could provide China an advantage in territorial disputes by granting access to infrastructure and data that could be integrated into warfighting maps. [31]

Smart City 3.0 Connection:
- **Smart Economy:** The weakening of U.S. leadership and rise of protectionism increases market unpredictability, making it crucial to be adaptive through diversifying trade partnerships or strengthening existing, looking into new emerging markets, and investing in growing sectors like green tech and digital finance.
- **Smart People:** As talent flows shift into and out of emerging economies with strong digital skills, smart cities must attract global talent through inclusive policies and partnerships with foreign universities, enabling two-way knowledge exchange that strengthens competitiveness and future-readiness.
- **Smart Governance:** Fast changing politics require smart cities to be geopolitically aware, leveraging emerging market opportunities while aligning with EU strategic goals to enhance resilience and engaging in smart city networks to gain new insights.

Current and potential flashpoints shaping the world

Russia's invasion of Ukraine in February 2022 triggered major economic disruptions and marked a turning point in the global balance of power.
Energy markets were destabilized due to Europe's dependence on Russian oil, inflation surged, and the global stock market declined, intensifying pressure on businesses and supply chains already weakened by the pandemic[33]. While EU economies have adapted through diversification and renewables, concern remains that a prolonged conflict, combined with rising defence costs, could delay recovery and strain public finances[34]. Although Russia has failed to realise its strategic ambitions, it has expanded presence in the Global South and strengthened ties with China, Iran and North-Korea. The shift poses a new geopolitical challenge for Europe on how to strategically position itself, which is further exacerbated by warming U.S.-Russia.[35]

The conflict in Gaza, which began in October 2023, and its spillover effects in the Middle East, has had major implications for regional stability and global foreign policy, highlighting the challenges of navigating international crises[36].
Economically, the Middle East's role as the source of 60% of the world's energy has led to higher energy prices, disrupted supply chains, and increased operational business costs[37]. Attacks on commercial vessels in the Red Sea have halved maritime trade volumes, affecting stability of

logistics and access to key goods[38]. The conflict has triggered strong diplomatic concern worldwide over the stability of rule-based international order[39], while raising fears in countries like Ukraine that Russia might exploit the situation to reduce international support[40].

Taiwan, a critical hub in the global semiconductor supply chain, is becoming a major geopolitical flashpoint as China's global ambitions grow amid U.S. trade tensions and the Russo-Ukraine war, during which it has closely monitored Western unity.

The island produces one-third of the world's chips and 90% of the most advanced. These microchips are critical for further AI, 5G, IoT, and automotive systems advancements, powering firms such as Apple and NVIDIA.[41] With chip market projected to reach $1 trillion by 2030[42], Taiwan's strategic importance in economic stability and technological progress is immense. As China's potential claim on Taiwan by 2027 gains plausibility[43], concerns grow over the credibility of U.S. protection and risk of disruption to global value chains, innovation, and investor confidence.

Ülemiste Smart City's resilience could potentially be significantly shaped by geopolitical issues with the Russia-Ukraine war presenting an immediate challenge.

A resilient smart city is one that actively takes preventative measures, and adapts quickly, exemplified by Kyiv. Awarded by the Smart City Expo Awards for its digital resilience during the war, Kyiv repurposed its Kyiv Digital App from everyday uses such as transport tickets and parking into a lifesaving tool. It now provides air raid alerts, shelter locations, information on power cuts, and air quality information. It also works as a mechanism for getting feedback from citizens, and as a platform for launching petitions and reporting war crimes, demonstrating its crucial role in a turbulent environment.[44]

Smart City 3.0 Connection:
- **Smart Governance:** In response to rising geopolitical instability, a smart city must invest in secure, transparent governance systems emphasising crisis management, clear communication systems, and data protection to ensure fast decision-making.
- **Smart Economy:** As geopolitical tensions threaten global supply chains, investor confidence, and energy stability, a smart city must safeguard its innovation capacity by ensuring business continuity through diversification, data-driven decision-making, and support of local entrepreneurship to buffer against external shocks.
- **Smart People:** Smart cities should provide trend monitoring, crisis preparedness development, and upskilling to strengthen business and workforce resilience, while creating attractive conditions to draw in shifting talent flows and investors.

Policy shifts in Europe

The EU is undergoing a strategic shift, prioritizing defence, enlargement, competitiveness, and for the first time democracy as core priority[45].

2025 will be a decisive year for establishing the EU as a credible "third path" in international affairs. Increasing autonomy is seen as essential amid geopolitical tensions, stalled growth, and competition for critical resources. Financial constraints, with increased support for Ukraine, but less for poorer countries, and growing restrictive migration policies, highlight the need to create a more sustainable development strategy to compete with the U.S. and China[46]. With weakening transatlantic ties, climate pressures, and political fragmentation, the EU must boost competitiveness, secure borders, and reduce dependencies[47]. Currently, enlargement remains a key tool for promoting stability and resilience, but will require stronger commitment and flexibility[48]. Meeting these goals demands restored public trust and adequate funding, like an estimated €800 billion annually to enhance competitiveness[49].

Europe, wedged between the U.S.-China rivalry, has responded to the growing strategic importance of enhancing its competitiveness and closing its innovation gap with the mentioned countries by supporting the development of smart cities.

Through initiatives such as the European Digital Strategy and European Green Deal, the EU seeks to strengthen its technological capabilities and reduce dependency on either power while still building alliances with like-minded nations. Amid a complex geopolitical environment with growing concerns over China's industrial advantages, the EU has taken the initiative to adopt regulatory toolkits for 5G security, implement risk mitigation measures for cybersecurity, and establish investment screening methods to protect critical technologies, as well as attempt to negotiate the EU-China Comprehensive Agreement on investment to signal independence from U.S. policies.[50]

Smart City 3.0 Connection:
- **Smart Governance:** EU's strategic shifts underscore the importance of governance models that are transparent, participatory, and resilient. Ülemiste should adapt to geopolitical and economic pressures by fostering trust and allowing for co-creation which must digitally enabled but also citizen focused and flexible.

ECONOMICS

Estonia's open economic model, where trade constitutes 78% of its GDP, makes it vulnerable to external shocks. Ülemiste Smart City's ecosystem, linked to international markets, has felt the impacts from COVID-19, the Ukraine War, and energy disruptions. For instance, the inflation shock of 2022 causing a 23% increase in prices, challenged business models, driving up operating costs, straining budgets, and delaying investments, and tightened monetary policy only further strained capital-intensive firms. Despite this Ülemiste Smart City adapted through EU recovery funding and company led initiatives in automation, AI and smart logistics.

In today's global environment where market conditions are being shaped by overlapping crises, it is important to understand Ülemiste's potential position to support its growth into a resilient, competitive economic and technological hub. In this section we will look at global economic trends and how these developments relate to the Smart City 3.0 model.

Ülemiste Economic Position

Now, the future outlook of Ülemiste Smart City's position could hinge on the bleak position of the global market average, which is seeing moderate growth slower than before the pandemic. Although concerns – such as complex geopolitical uncertainties, with risk indexes reaching new heights, and persisting structural problems such as a weakened investment climate, high youth unemployment, and demographical hurdles – still persist, positive signs like disinflation, better monetary policies, and Europe's GDP that is expected to strengthen to 1.5% in 2026 from a weak 0.9% in 2024 provide some relief[1]. Therefore, reinforcing Ülemiste's economic position underscores the need for diversification, flexible policies, and resilient infrastructure.

Ülemiste Smart City's strategic location near the Tallinn Airport and the upcoming Rail Baltica terminal enhances their role as a regional logistics and innovation hub.
This connectivity supports international investment and cross border talent flows. However, talent shortages in digital, engineering, and green sectors are a growing barrier – intensifying wage pressures and competition for skilled professionals, with stricter EU immigration policies[2], could impact Ülemiste's growth as it engages with academic partnerships and relies on international recruitment. Although there has been a shift in the EU towards creating a more streamlined way to attract new talent from third-world countries by establishing talent pools, providing single permits, and designing more inclusive conditions of entry[3], there could be more done on Estonian government's level for immigration, education, and mobility. This reveals the need for creative and flexible solutions.

Smart City 3.0 connection

- **Smart Economy:** Ülemiste Smart City's global orientation and focus on green digital growth make it a model for future ready urban economies, but increased uncertainty requires vigilance – support for innovation capacity to give it a strategic edge and continuous support for local companies through which global capital can be attracted.
- **Smart Governance:** Aligning policies with Europe's funding schemes, stakeholder–company–people level coordination, sustained investment, and of course initiative can help anchor Estonia in Europe's smart city network.

Estonia's limited population poses risks when it comes to employment. Visa delays, poor retention, and limited recognition of qualifications may hinder progress. To close this gap, Estonia must expand tech education, fast track AI skills and support business led training programs.

Economic Outlook

Global economic forecasts for 2025-2030 show a mixed picture. Growth is in fact expected to be subdued in the near term (around 3.2-3.3%[4] globally and roughly 1% in the EU), all reflecting lingering inflation, high debt, and policy uncertainty[5].

Furthermore, trade disruptions such as shifting tariffs or supply chain bottlenecks are very real and key downside risks. For Ülemiste City this means that there must be a plan for moderate demand and potential shocks. Policymakers should also focus on building buffers and fiscal resilience to weather any incoming economic volatility, if this has not been done already.

Impact and ESG funding have also recently surged in tech and climate related sectors, with The Global Impact Investing Network reporting around 1.57T worth of assets in impact funds worldwide[6]. This shows the demand for investments that produce social and environmental benefits. Sustainable and ESG themed funds also reached record levels, with funds like AUM hitting 3.56T by the end of 2024[7].

On the other hand long term market dynamics are favourable. The smart city economy itself is rapidly expanding, driven mainly by urbanization and technology. With the project 2.5 trillion market by 2030[8], there is a strong implication for advanced urban solutions. Moreover, digital and green finance are also transforming investment flows, as the OECD notes, digital finance innovations are enhancing financial inclusion and streamlining funding access, whereas green finance is challenging its capital into sustainability[9]. Ülemiste City can leverage all of these trends by aligning many of its current or future projects with ESG criteria as well as tapping into EU/Nordic climate funds.

Smart City 3.0 connection
- **Smart Economy:** Ülemiste's ability to align with a projected 2.5 trillion smart city market streghtnes its economic positioning in a globally competitive field.
- **Smart Governance:** Building fiscal resilience and planning for moderate growth or economic shocks shows a forward thinking and adaptive governance model that is aligned with Smart City 3.0 principles.

Global investment patterns are shifting more and more, supply chains are being reshored for reliability and Europe's policies emphasize local digital infrastructure.

Recent analyses note that nearshoring can offer faster, more reliable delivery, shorter lead times, and reduced costs all by keeping production close[10]. Likewise, EU's Data strategy explicitly aims at a single market that ensures Europe's competitiveness and data sovereignty, which includes 2 billion in cloud and infrastructure projects[11].Ülemiste city can capitalize on all of these trends by positioning itself as a stable hub where local industries, green tech firms, and data operators can potentially serve the nearshore demand, and regional digital sovereignty initiatives can attract investment.

The Estonian start-up ecosystem remains robust despite global financing headwinds, with start-ups receiving a record turnover of 3.902 billion in 2024 (a 14.7% rise) even as the overall economy's revenue fell around 1%. Additionally young start-ups grew swiftly as well as scale ups who saw a 25% increase, showcasing a mature ecosystem[12]. Ülemsite in fact already offers many programs and actively invests in start-ups, by expanding initiatives like this and tapping into other programs Ülemiste can channel investments into strategic areas.

Smart City 3.0 Connection:
- **Smart Economy:** Ülemistes ability to align with nearshoring trends and Europe's push for data sovereignty positions it as a strategic hub for activity.
- **Smart Governance:** Adapting to shifting global trends requires foresight into policies and cross sector collaborations. Ülemistes support for start-up growth combined with EU aligned strategies shows how local governance can create local opportunity.

SOCIAL

Ülemiste City must recognize emerging trends to response to the global shift in the concept of smart cities, including significant global social trends—such as the widespread adoption of remote and hybrid work, increased international talent mobility, growing awareness of health and well-being, and the risk of increasing social inequality. Furthermore, these social trend shifts are switching the way people live, work, and interact in urban environments; they are also shifting individual expectations, requiring Ülemiste to redefine what citizens expect from cities.

Commitment to implement the Smart City 3.0 framework is required in Ülemiste City, which prioritizes human-centered development, inclusivity, and smart governance to adapt to these trends[1]. Ülemiste City needs to ensure that its urban strategy promotes diversity, well-being, digital accessibility, and social cohesion in order to continue being a competitive and sustainable innovation hub.[2]

This section will examine and relate the principles of Smart City 3.0 [3,4] to global social trends, then relate them to the unique circumstances of Ülemiste City and identify strategic implications that can be implemented by Ülemiste City.

Remote work adoption

The COVID-19 pandemic accelerated the global shift toward remote and hybrid work, fundamentally changing how people use office spaces and engage with cities.[5]

Smart City 3.0 Connection:
- **Smart Living & Smart People:** Flexible work enhances residents' quality of life and demands strong digital skills, requiring cities to adapt spaces for evolving work patterns.[6]
- **Ülemiste City Context:** Ülemiste City, traditionally office-centred, faces the need to redesign urban spaces to meet hybrid work expectations. Static, large-scale offices risk becoming obsolete without adaptation.

Strategic Implications:
- Transition traditional offices into modular, co-working, and mixed-use spaces.
- Promote digital work hubs that support remote collaboration.
- Enhance infrastructure for home-office and hybrid work models [7].

Demographic Shifts: Growing International Talent Pools

The movement of global talent—students, entrepreneurs, and professionals—adds cultural vibrancy but also poses integration challenges for cities.

Smart City 3.0 Connection:
- **Smart People & Smart Economy:** Diverse, globalized workforces drive innovation and entrepreneurship, but successful integration is critical to sustainable growth.[8]

- **Ülemiste City Context:** Ülemiste benefits from Estonia's e-residency programme and digital openness, attracting international students and professionals. However, language barriers, cultural inclusion, and housing shortages pose emerging challenges.

Strategic Implications:
- Develop inclusive language services and multicultural community programmes.
- Ensure affordable housing availability.
- Foster inclusive work environments through public-private ·collaboration.[9]

Health consciousness

Cities are increasingly expected to support physical, mental, and environmental well-being through healthy urban design and wellness-oriented services.

Smart City 3.0 Connection:
- **Smart Living & Smart Environment:** Citizens demand greener spaces, wellness infrastructure, and mental health support services. Cities are expected to enable healthy lifestyles through planning and policy.[10]

Strategic Implications:
- Ülemiste can invest in more public green areas, wellness-oriented amenities, and smart monitoring of air quality and noise levels. Businesses can tap into this trend by offering wellness tech solutions or fitness-friendly office ·environments.[6]

Societal polarization and pay gaps

Urban innovation can widen social divides if access to housing, skills, and services is not inclusive —particularly between digital elites and lower-income groups.

Smart City 3.0 Connection:
- **Smart Governance & Smart Economy:** Tackling inequality requires inclusive governance models that promote social cohesion, digital inclusion, and equitable access to services. [11]
- **Risk & Mitigation for Ülemiste City:** Rising housing costs, digital divides, and uneven access to upskilling could create a polarized workforce. Mitigation could involve subsidized housing initiatives, digital literacy programmes, and partnerships with universities for inclusive education.[12]

Strategic Implications:
- Provide digital literacy and upskilling programs
- Explore subsidized housing and inclusive education ·models.[13]

TECHNOLOGY

Fast adoption of smart technologies driven by IoT and AI is strengthening Ülemiste City's role as a leading smart business district in Tallinn, Estonia, home to nearly 500 companies. With its ICT-heavy economy, Ülemiste is central to Estonia's digital growth, where digital transformation plays a key role in economic resilience. While Ülemiste hosts many technology firms and supports Estonia's digital ambitions, broader and more inclusive adoption across the private sector and local community is still needed. Real-world pilots in AI, IoT and robotics are underway, but scaling these requires shared platforms, interoperable systems, and citywide deployment. Rapid development also demands adaptability, reskilling, and digital inclusivity to prevent marginalizing less tech-savvy groups.

Ülemiste City's technology ecosystem – centered around AI & automation, IoT integration, smart mobility, and cybersecurity –drives urban efficiency, sustainability, and a high quality of urban life. The diagram maps current focus areas and future goals for each domain, illustrating how data flows between IoT sensors, AI systems, and mobility services, all safeguarded by cybersecurity. These connections will be looked at in the context of global trends and aligned with the Smart City 3.0 model.

AI is increasingly embedded into our urban systems, from predictive maintenance to demand forecasting.

In Ülemiste Smart City, this trend is reflected by initiatives such as AI integration across its building management and mobility – R8 Technologies AI system optimizes HVAC and lighting, reducing energy use and emissions, and Fyma's AI powered mobility analytics allows real time traffic insights to be gathered without extensive physical infrastructure. Globally, AI is projected to contribute up to 600 billion to European GDP by 2030[1]. Further down the line, AI can help reach sustainability goals, gather new insights for urban development, and save time and money with automation[2] – buildings that incorporate AI-driven management systems can reduce energy consumption by 8%[3]. Additionally, facilitate implementation digital twin initiatives to enhance waste management or air pollution, such as Singapore, Amsterdam or Houston have done – the growing number of cities using digital twin solutions could save 280 billion dollars by 2030[4]. Therefore, to stay ahead Ülemiste should move from pilot projects to full scale implementation, invest in shared AI platforms, and leverage digital public infrastructure.

IoT forms the backbone of future smart city infrastructure – thousands of interconnected sensors monitor occupancy, energy use, air quality, and mobility.

These devices feed into AI platforms providing Ülemiste the possibility to optimize systems such as heating, ventilation, traffic flow, and pedestrian safety. Globally, the IoT market projected to grow to $1.06 trillion by 2025 and $1.5 trillion by 2029, driven largely by U.S with innovations in smart vehicles and home technology[5]. For Ülemiste Smart City, expanding IoT solutions opens up potential for predictive data-based analytics for maintenance in transportation, energy efficiency, e.g. smart grids and automated streetlights, sensor-based waste collections, real-time safety alerts, and pollutant monitoring lowering operational costs. Barcelona, for instance, cut streetlight

energy use by 30% with IoT, while Dubai uses it to reduce water and energy costs.[6] Therefore, Ülemiste's growing integration of IoT and AI reflects a broader shift towards data-driven, sustainable, and efficient urban management. Enhancing the collection of data and its availability for the "Radar" dashboard to support real-time decision making can open up huge possibilities for both companies and the community. Key next steps should include sensor coverage, developing open and interoperable IoT, which simultaneously require more focus on privacy and security, well-structured infrastructure to support maintenance capacity, and the community's trust.

With 56% of global population currently residing in cities – and this figure expected to reach 70% by 2050 – smart mobility is emerging as both a practical necessity and a promising market.
Growing urbanization requires well established infrastructure to reduce traffic congestion and meet environmental targets.[7] The smart mobility market is projected to exceed $490 billion by 2034, highlighting the potential of investments in micromobility, EV infrastructure, and AI-guided traffic systems to support Ülemiste's growth[8]. Ülemiste has already tested autonomous solutions like AuveTech's self-driving shuttles and Clevon's delivery robots, aligning with global trends. Leveraging IoT, AI, and data opens the door to develop solutions in Intelligent Transport Systems (ITS) or Mobility-as-a-Service (Maas) market, though successful project-building will require good stakeholder communication and flexible design to pass the pilot stage, as not all solutions may scale. The shared mobility market, projected to reach $500 billion to $1 trillion by 2030, also offers opportunities for ride-sharing applications. For example, Oregon's cloud-based vehicle ecosystem integrates vehicle data and public data using cellular V2X technology to enhance safety and mobility.[7] Ülemiste should aim to build integrated mobility platforms that connect public transit, shared vehicles, and real-time navigation tools.

As digital infrastructure powered by AI, IoT, and data analytics expands, so do the cyber risks.
In smart cities, these stem from the blending of digital and physical systems, the mix of old and new technologies, and the increasing interconnection of urban services – all of which must be understood to effectively manage the evolving threat landscape.[9] Despite only 15% of Europeans expressing concern about their country's cyber defence capacities, the risk landscape is shaped by geopolitical instability, complex supply chains, increasingly difficult compliance, and AI-powered threats with 66% of organizations seeing AI as the biggest cybersecurity disruptor. Also, 72% report rising cyber risks such as ransomware, 47% cite generative AI allowing more widespread attacks, and 42% mention the likes of phishing. Yet only 14% feel adequately staffed to meet these challenges.[10] Ülemiste must adopt a holistic cybersecurity approach: a digital trust framework ensuring secure identity and connection management, privacy embedded into systems from the ground up, advanced threat intelligence powered by AI and behavioural analytics, active resilience through simulations, and continuous development of cyber-skills in the workforce[9]. This also requires encrypted data streams, device segmentation, and stronger operational overview. Estonia's national cybersecurity framework, including NATO's Cyber Defence Center, offers a solid foundation. To stay ahead, Ülemiste should enhance its Security Operations Center (SOC), introduce continuous stress testing, and address vulnerabilities in outdated IoT devices.

Technology is only as effective as the workforce that is using it and how well it's implemented.
While AI's long-term impact is clear – potentially adding $4.4 trillion in productivity through corporate applications – the current landscape remains fluid. Managers today underestimate employee AI usage by three times, and nearly half of employees view generative AI as the most valuable skill, yet feel their companies are adopting it too slowly. Despite 92% of companies planning ongoing AI investments, only 1% believe their investments have paid off.[11] This highlights the urgent need for upskilling to ensure a smooth AI transition. With 70% of job skills expected to change by 2030, key areas include AI literacy, and human-centric skills like leadership, negotiation, and empathy.[12] The Ülemiste "Training Credit" platform should be updated to make sure it aligns with the World Economic Forum's Reskilling Revolution. As automation accelerates, Ülemiste must continue investing in digital equity which includes areas like accessible learning platforms, AI and data science training for SMEs, and including of non-tech sectors in digital transformation.

Smart City 3.0 Connection:
- **Smart Economy:** Ülemiste's use of AI and IoT to optimize services and infrastructure can fuel economic resilience, innovation, and digital entrepreneurship – these reduce costs, improve efficiency, and create new business opportunities.
- **Smart Governance:** Real-time dashboards can help foster participatory governance and provide transparency. Secure cybersecurity practices support agile urban management and shows trustworthiness.
- **Smart People:** Emphasis on AI training and reskilling helps build an inclusive, future-ready workforce, while human-centric skills must be fostered to ensure people – not just systems – remain at the centre.
- **Smart Mobility & Environment:** Smart transport models improve liveability and support carbon-neutral goals, while solutions such as sensor-based waste collection, smart grids, and pollutant monitoring reduce operational costs.

LEGAL

Smart cities are operating within an evolving legal landscape where new and emerging regulations including remote work policies, data protection, AI governance, and environmental mandates all shape how urban districts function. Remote and hybrid work raises questions that involve cross border employment rights, non-EU talent, and worker protection rights, all of which require clear legal frameworks in place to balance flexibility and well being. Furthermore, GDPR compliance and Europe's Data Strategy demand transparency, data minimization, and secure handling of citizen information across different IoT and AI platforms. As AI continues to be further used in urban services, liability, and privacy concerns will continue to intensify therefore challenging Ülemiste to implement adaptive legal safeguards. Environmental laws may impose stricter emission targets and circular economy requirements, and waste management regulations. This section will examine how Ülemiste city can align its legal strategy with Smart City 3.0 priorities promoting transparent, participatory governance, safeguarding citizen rights, as well as ensuring both compliance and a supportive environment for growth.

Remote Work Regulations and Their Impact

Remote work has been seemingly quite popular post COVID-19, with it becoming a normalized method of working, therefore requiring both employees and employers to redefine rights and responsibilities.

A significant issue is working beyond contracted hours. In fact, according to the European Working Conditions Telephone Survey (2021) and Eurofound, while 45% of businesses have a disconnected policy in place, 80% of employees still report being contacted outside of working hours.[1] This has legal and health implications, over 30 million people globally suffer from depression and work-related mental health issues. Recognizing this the EU Parliament is pushing for legislation on the right to disconnect with countries such as Belgium, Croatia, Greece, Ireland, Portugal, Slovakia, and Spain have already adopted laws such as this.[1]

Despite these challenges, studies show that remote work can enhance autonomy, which in turn boosts productivity, motivation, engagement, and innovation. The remote workforce in Europe is expected to reach 60% by 2025, suggesting lasting change in how cities and companies may organize workspaces.

The urban development shift from remote work also impacts Ülemiste, as there are now more demands for modern workspaces. Ülemiste city in fact is already adapting to these trends as they have already incorporated these modern workspaces that support both productivity and wellbeing into their city. They offer outdoor work zones, walking paths, and relaxation areas in the rooftops of their buildings.

Example: San Francisco is at the top of the list in the United States of America as one of the smartest cities for 2025. One key element that they have applied is remote work where they offer 70 coworking locations around the city with another 149 free Wi-Fi hotspots in order to make sure their professionals have the possibility to connect and work wherever they please.[2]

Challenges and Solutions
- **Infrastructure Gaps:** Around 30% of remote workers lack adequate home technology.[3]
- **Regulatory Inconsistency:** Only 30% of European countries have detailed legislation covering remote work topics like hours, health, and data security.[3]
- **Vacant Office Spaces:** With fewer people in offices, cities face increased vacancies and underutilization. Shift is also happening in buildings, with offices including more amenities for workers. However, issues arise with repurposing buildings as it's more costly than building a new one.[4]

Smart City 3.0 Connection:
- **Smart People & Smart Governance:** Digital autonomy for workers that are backed by correct legal safeguards ensuring they do not work overtime, can ensure their well being while also being productive.

GDPR and Smart City Data Protection

As smart cities continue to integrate more IoT and sensor-based technologies lead to an increasingly large reliance on vast data collection for traffic analysis, energy usage, and public behaviour monitoring.

While this data is essential for smart city functionality it also raises many issues with legal and ethical concerns about privacy, surveillance, and transparency of the data of its citizens within the city. In Europe, GDPR (General Data Protection Regulation) is the leading framework to address these issues which have been brought above. Smart cities must align with the following GDPR principles: transparency, data minimisation, and accountability. However, applying these principles can be quite complex due to the scale and variety of data collected within these cities, and oftentimes ensuring public understanding is often lacking.

Anonymisation is critical as smart cities typically may have broad datasets for planning. GDPR also demands an existence of secure systems with well documented data flows, as well as strong collaboration with reliable tech providers is essential.[5]

Ülemiste city, as a smart city themselves must treat GDPR as an area of requirement but also a guiding framework for ethical digital transformation. Examples of other countries such as Dublin, Athens, and Barcelona have demonstrated the benefits that arise when strong GDPR alignment is used. Benefits such as increased citizen trust, clearer data strategy, and stronger partnerships with tech providers. Therefore, given the diverse ecosystem within Ulemiste having a good approach to data ethics is crucial. Barcelona for example has appointed a dedicated Data Protection Officers (DPOs) to oversee ethical data usage. Perhaps Ulemiste could think of a similar model to ensure compliance.[6]

Examples: Barcelona has implemented smart lighting, waste systems, and transit tech, while also ensuring data is anonymised and securely kept. Singapore employs IoT for public safety and energy management with clear data governance. They emphasize a strong data protection framework. Toronto Quayside Project faced initial backlash from public over data concerns leading to a new model of governance.[7]

Challenges and Solutions
- Public resistance: Citizens may be sceptical of pervasive data collection in public areas
- Data breach risks: Without strong systems in place, smart cities face cybersecurity issues.

Therefore, data anonymization, clear communication between parties, and DPO roles all can help mitigate these risks and strengthen public confidence.

Smart City 3.0 Connection:
- **Smart Governance & Smart Living:** When smart cities prioritize transparency and partake in ethical data practices, they build citizens trust the data and it also enables smarter public services.
- **Ülemiste City Context:** Ülemiste city can ensure that its citizens are informed about the data which is gathered.

EU Sustainability Laws and Urban Development
Urban environments are major contributors to climate change and in fact are responsible for up to two thirds of GHG emissions and 80% of energy consumption.
In response to this the EU's Fit for 55 package requires member states to reduce emissions by 55% by 2030.[8] From 2014 to 2020, the EU has already invested over 155 billion in urban development, with 17 billion directly aimed at sustainable strategies. This commitment further continues from 2021 to 2027 with a key focus on five policy goals: Smarter, Greener, More Connected, More Social Europe, and Territorial Development.[9]

Ülemiste city already has integrated sustainability throughout their platforms tracking CO_2 footprint, electricity, water usage, etc. Showing that they already know the importance of this area. These tools that have already been set in place align with EU requirements and show the readiness of Ülemiste to meet future legal goals as well.[10]

Example: The Barcelona green deal is a plan set in place with a period that starts between now and up to 2030 where a sum of 672 million euros will be invested to carry out specific actions which are tailored around sustainability. Plans in place that help foster circular economy and ecological transition, this was done because the city has declared a climate emergency and has approved a set of measures which offer ecological solutions. These measures were designed

with hopes of preventing climate emergencies from generating new inequalities in social aspects of competitiveness. Additionally, they are also planning to use the city as a key for new economic activity. Since urban planning policies are an important tool for generating new innovative hubs, Barcelona is looking to adapt these spaces to generate new economic activity from a local's perspective.[11]

Challenges and Solutions
- **Unrealistic Targets:** Climate goals can be difficult to reach sometimes without proper coordination in place.
- **Public Distrust**: Campaigners have criticized the EU for favoring large corporations in drafting sustainability laws without public consultation. Major oil and gas firms reportedly influenced discussions.[12]
- **Aging Infrastructure:** Many European roads, tunnels, and buildings are decades old and not designed for today's demands.[13]

Smart City 3.0 Connection:
- **Smart Environment & Smart Economy:** Legal tools set in place will help enforce accountability within smart cities while also enabling there to be innovation in urban design.
- **Ülemiste City Context:** Since Ulemiste already has environmental indicators in place, they can potentially position themselves as pioneers in the region.

ENVIRONMENT

As cities across Europe strive to become smarter and more sustainable, the concept of a circular economy has emerged as a powerful economic and environmental model for addressing global resource constraints, reducing waste, and enhancing long-term resilience. The rise of climate change and extreme weather impact requires smart cities to adapt their infrastructure to reduce future risks, and successfully integrate environmental resilience into their core planning to ensure long-term sustainability.

This section explores global environmental developments in through the lens of the Smart City 3.0 framework, with a focus on how Ülemiste City is aligned with global circular economy and sustainability goals by promoting green urban development.

Circular Economy

The circular economy is about closing loops and regenerating systems – not just minimizing harm but creating net positive impact.

For a smart city like Ülemiste, this aligns with its vision of a high-tech, future-proof urban district where technology and sustainability go hand in hand. With the urban population to double by 2050, advancing circular economy worldwide is essential to unlock 1.8 trillion euros worth of global growth by 2030[1]. Estonia's circular economy rate (use of secondary materials) as of 2023 was 18.1%, which is well over the EU 27 average of 11.8%[2], highlighting a good use of circular models where companies reuse materials, reduce waste, and extend product life cycles. These practices not only lower input costs but also protect businesses from supply chain disruptions and price volatility and provide a strategic advantage among climate risk and shifting consumer expectations. Ülemiste City has begun integrating circular principles in waste sorting, energy systems, and urban planning, but although much has been accomplished there's room for scaling, and as a test city Ülemiste could be one of the forerunners of circular economy innovations in Estonia.

As Estonia experiences a considerable amount of rainfall, improving water management and promoting rainwater harvesting systems can support sustainable water use, reduce costs, and help meet environmental goals.

Effects of climate change are increasing sudden downpours in Estonia by 4 percent each decade requiring more efficient for urban infrastructure planning in the case of floods[3]. Expanding LEED-certified buildings and adopting nature-based solutions like China's sponge city initiative, e.g. Shanghai, which uses rain gardens and permeable surfaces, can address flooding, drought, and water pollution by improving rainwater absorption and reuse[4]. Tackling water challenges requires public-private teamwork, smart technologies, and global cooperation to drive such innovate solutions[5], which can be used to create value for the city's communities.

To support the sustainable expansion of Ülemiste Smart City, the usage of materials must be reduced and rethought.

Around 40-50% of an office building's carbon footprint stems from materials like cement and steel, with around 80% of construction-related energy coming from their production[6]. Better strategies are needed for material efficiency – within the EU alone, reusing 546 million tonnes of aggregates yearly could save over €6 billion in new raw material costs. Adopting circular economy practices in construction reduces dependency on imported materials, cuts waste and energy costs, and boosts economic resilience through more efficient resources use.[7] This requires reducing material demand through smarter supply chain design and rethinking infrastructure lifecycles. For example, circular business models like device leasing or industrial symbiosis between companies (sharing by-products and resources) could reduce raw material usage and open new revenue streams. Investing in campus-wide repair, reuse, and recycling infrastructure would also create jobs and reduce environmental impact, supporting Ülemiste's smart and green city identity.

Ülemiste's ambition to achieve carbon-neutral energy consumption by 2030 requires urgent action to reduce and optimize energy usage.

Across Europe, buildings are responsible for 40% of total energy consumption and one-third of greenhouse gas emissions[8]. Addressing this challenge is central to the circular economy concept, which emphasises efficient energy use from generation to consumption, including energy recycling. In the context of ongoing geopolitical tensions and instability in energy markets, ensuring energy security is essential. The adoption of smart energy grids is a key solution for enabling flexible, resilient urban energy systems and facilitating communication between interest groups. These girds, powered by IoT-based technology, offer several advantages: energy storage integration helps balance demand, supports adoption of renewables, and ensures a stable power supply. They also enable the use of distributed resources such as renewables (solar, wind), storage systems, and electric vehicles, helping prevent overloads. Advanced Metering Infrastructure (AMI) allows real-time monitoring, data-driven decisions, and improved grid efficiency. However, IoT systems also introduce new energy demands, which must be carefully managed.[9] Smart rids will gain momentum through continuous global investment, with 5G development enhancing IoT performance[10]. Additionally, the EU's action plan for "Digitalising the energy system" provides a strategic framework to support this transition[11].

Ülemiste city is taking key steps towards waste minimization and increasing circular methods in waste management.

Between 2023 and 2025 the amount of waste produced by employees is expected to rise from 33kg to 57 kg, in response to this Ülemiste city is going to raise their waste sorting and collection efforts from 22.3% to 55%. Signalling a shift in Ülemiste cities' waste management systems. Another initiative that aligns with sustainability, is the phasing out of disposable food containers which was introduced in 2022, and all reusable packaging used on the campus.[12]

At a border level, the EU faces significant waste related issues. As of 2023 municipal waste made up about 10% of total EU waste, with average generation per capita at 513 kg, this remaining unchanged from the year 2000. However, waste treatment still remains uneven with only 48% of EU municipal waste being recycled, and 25% was incinerated, despite the EU's ambition being to reduce landfilling to below 10% by 2035.[13]

Globally, there is an increase in e-waste and construction related waste all which underscore the urgency of circular economy strategies. For instance, construction activities account for 36% of EU waste, and only 20% of global e-waste is properly recycled [14]. These figures alone illustrate the environmental stakes, especially when it comes to areas like Ülemiste city which will continue in the future to expand technologically.

Ülemiste's approach will help reverse these trends as investing in waste sorting infrastructure, eliminating disposables, and promoting reusable systems are all integral to a stronger and more resilient circular economy model.

Smart City Pillar 3.0:
- **Smart Environment:** Ülemiste's circular economy efforts – waste management, reusable systems and smart water use – reflect a commitment to environmental resilience that can be enhanced through by smart grids for renewable energy, green infrastructure (e.g. green roofs, rain gardens), and IoT-based solutions like smart bins and real-time air quality or noise monitoring sensors.
- **Smart Governance:** Environmental planning should be transparent, data-driven, and participatory which. This can be supported by digital citizen engagement, open data portals, AI-assisted urban decision-making tools, and ESG-aligned regulatory frameworks.
- **Smart People & Living:** Ultimately green spaces, clean energy, and sustainable buildings improve well-being leading to a more liveable urban environment. Embedding sustainability into workforce training, education, and community programs ensures long-term participation and awareness.

Sustainability

Sustainability is an area where many smart cities are keen to develop. Urban areas are responsible for around 70% of global CO2 emissions and additionally consume 80% of the world's energy and inevitably lead to a lot of waste[15].

In response to this various EU policies have been established to make urban areas more sustainable, the EU Green Deal, Fit for 55 package, and sustainable urban development policy aimed to reduce emissions. Ülemiste Smart City is a district that has a focus in innovation, and their city already provides real time monitoring using environmental tools which allow them to track data related to CO2 emissions, electricity consumption, water use, and CO2 intensity. Moreover a city like Ülemiste would inevitably emphasize using greener infrastructure methods

and reducing their carbon footprint. Using these strategies is key to achieving the goals that are set in place by Ülemiste and EU plans. By using these methods Ülemiste can become an even better model of a smart city.[16]

One prime example is the sustainability innovation that has happened in Copenhagen, which aims to be the world's first carbon neutral city by 2025. The city has been using a wide range of initiatives that include district heating systems, wind power, and smart traffic systems that prioritizes bikes and public transports. Copenhagen's success does not only stem from strong technological infrastructure that they have but also the strong policy support and the culture towards environmental sustainability. Ülemiste can draw inspiration from Copenhagen by perhaps scaling its efforts and implementing more participatory planning models.[17]

Smart City 3.0 Connection:
- **Smart Environment:** Leverages real time CO2, energy, and water monitoring to drive data informed optimization and reduce emissions, aligning with the EU Fit for 55 targets.
- **Smart Governance:** Utilizing open data platforms to share environmental metrics publicly fosters accountability and enables community lead initiatives that support Ülemiste's carbon neutral ambitions.

Comparative Analysis

Ülemiste City vs. Leading Smart Cities

In this section, we will make a comparison for what Ülemiste City has been done so far with well-known Smart City 3.0 models. It will help to reveal important areas for additional development to enhance remarkable advancements in economic growth and innovation, which will be done by Ülemiste City in the future. Some smart city projects have been chosen for the comparative analysis with the following reason:

Chosen Examples

1 Copenhagen is a pioneer in its goal of implementing urban mobility and climate-neutral sustainability.

2 Amsterdam is concerned about citizen engagement, the circular economy, and the innovation ecosystem.

3 Singapore is a leader in the "Smart Nation" initiative, integrating cutting-edge ICT and autonomous systems.

Table 2: Comparative Overview

Aspect	Ülemiste City (Estonia)	Copenhagen (Denmark)	Amsterdam (Netherlands)	Singapore
Smart Mobility	Developing: aims for 70% sustainable transport by 2035	Extensive cycling infrastructure; 62% of citizens bike daily	Strong multi-modal transport; 38% trips by bike	Integrated smart transport; autonomous buses, EV fleet
Citizen Engagement	Emerging co-creation platforms mainly for workers and students	[Citizen budgeting and participatory design](#)	Robust citizen participation via Amsterdam Smart City platform	Public participation through digital platforms; Smart Nation initiatives
Sustainability	Carbon footprint reduction targets; early-stage solar adoption	Goal: carbon neutral by 2025; district heating and urban greening	Climate-neutral by 2050; circular economy focus	Integrated sustainability in urban planning; water and energy efficiency
Innovation Ecosystem	Strong ICT and R&D sector; increasing focus on AI and green tech	Green tech innovation hubs and cleantech startups	Circular economy and creative industries innovation hubs	Global leader in AI research and cybersecurity; strong government innovation labs
Public Spaces & Inclusivity	Developing green areas and community spaces	Extensive pedestrian zones and inclusive urban design	Strong focus on accessibility and public space equity	Universal accessibility in public spaces; inclusive housing policies

Sources for table: [1, 2, 3, 4, 5, 6, 7]

Ülemiste is ideally situated as one of Northern Europe's emerging centres of innovation. However, Ülemiste still has a way to go before it can fully adopt the Smart City 3.0 model, so let's examine how it currently stacks up against a few global smart cities (Copenhagen, Amsterdam, and Singapore) on a few important pillars:

Table 3: Scoring Ülemiste City on Smart City 3.0 Pillars

Pillar	Justification from Ülemiste City internal data	Score (0-10)**
Smart Mobility	Public transport use is declining (46%), but a goal is set for 70% sustainable transport. Commute time is good. Needs improvement in mobility tech integration.	6
Citizen Engagement	Moderate foreign worker inclusion (12%); strong university-company cooperation, but no clear data on broad citizen participation or community engagement platforms.	5
Sustainability	Strong Green City focus and pollution reduction efforts, but no concrete metrics yet on carbon footprint or energy efficiency at the city level.	6
Innovation Ecosystem	Strong ICT focus, 72% innovation, 36.2% of national R&D, and €200m R&D investments — solid innovation foundation.	8
Public Spaces & Inclusivity	No specific data on inclusivity or public space quality; workforce diversity is moderate, and some community health programmes exist, but there is limited info on inclusive urban design.	5

*** scale: 0 is very poor, 10 is excellent*

Table 4: Comparison scores recap toward Smart City 3.0 Pillars

Aspect	Ülemiste City	Copenhagen	Amsterdam	Singapore
Smart Mobility	6 out of 10	9 out of 10	8 out of 10	9 out of 10
Citizen Engagement	5 out of 10	9 out of 10	9 out of 10	8 out of 10
Sustainability	6 out of 10	10 out of 10	9 out of 10	8 out of 10
Innovation Ecosystem	8 out of 10	8 out of 10	8 out of 10	10 out of 10
Public Spaces & Inclusivity	5 out of 10	9 out of 10	9 out of 10	8 out of 10

(Scored based on public data, smart city benchmarks, and secondary research.)

*** scale: 0 is very poor, 10 is excellent*

Benchmarking Global Smart Cities

According to the comparison data above, Ülemiste City's performance across the five pillars of the smart city 3.0 framework—smart mobility, citizen engagement, sustainability, innovation ecosystem, and inclusivity—compares to that of smart city leaders like Copenhagen, Amsterdam, and Singapore. The city demonstrates strength in innovation and technology exports, but it needs to increase resilience and citizen engagement to keep up with global leaders. Meanwhile, in the future, the remaining pillars can be further developed and improved.

Evaluation of Current Sustainability

Programs In terms of solar adoption, citizen co-creation, and modal shift in transportation, Ülemiste trails behind, despite having robust ICT-related growth and R&D. Cities such as Singapore, Amsterdam, and Copenhagen have taught us the importance of BIPV (building-integrated photovoltaics), integrated mobility apps, and microgrid zones.

Graph 1. Smart City 3.0 Readiness Comparison.
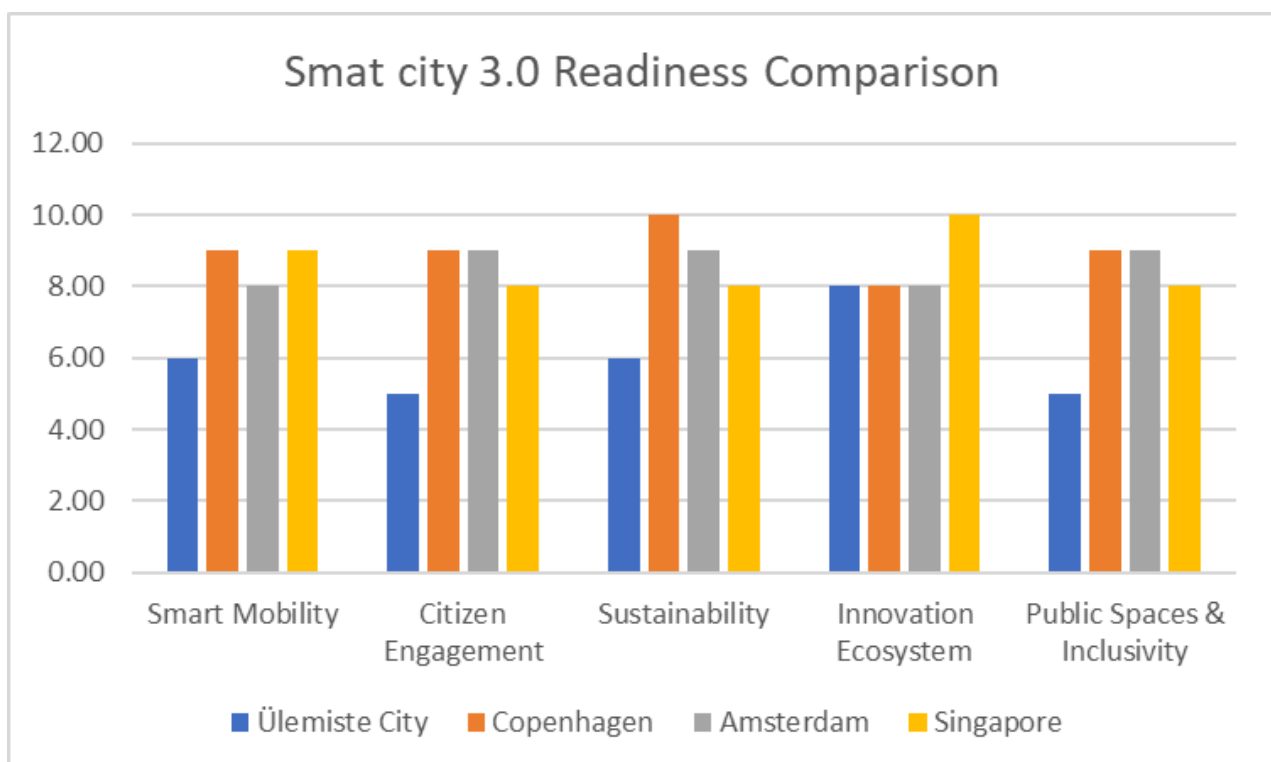
Future State Vision: Ülemiste City in 2030

Based on 2023–2024 internal data and 5–7% conservative annual growth aligned with the Smart City 3.0 framework

Category	2023–2024 Data	2030 Projection (Conservative)	Projection Notes
Workers & Students	18,000 people	~24,000–27,000 people	Assuming 5–7% annual growth
Number of Companies	>500 companies	~650–700 companies	Conservative estimate with increasing innovation and new tenants
Total Revenue	€2.4–2.5 billion	~€3.1–3.5 billion	Based on ~6% annual growth
Export Value	€1.2 billion	~€1.6–1.8 billion	Reflects sustained ICT and service export strength
R&D Investment	11% of turnover (~€200 million)	~€275–300 million	If percentage maintained, total increases with revenue
Public Transport Usage	46% (2024); target 70% (by 2035)	~55–60%	Gradual modal shift improvement toward 2035 target
Foreign Workforce Share	12% of total workforce	~14–16%	With increasing international collaboration and talent inflow

Note:

This approach is based on internal data and aligned with the Smart City 3.0 framework, incorporating a conservative 5-year projection using a conservative growth rate of 5–7% annually over the next five years (2025–2030).

Recommendations

Based on PESTLE analysis and comparisons with other successful and well-known smart cities, we will offer the following recommendations. This recommendation hopefully will help Ülemiste City to encourage smart city enhancement to implement in Estonia.

POLITICAL

- Pursue diversified trade and innovation partnerships in response to rising protectionism and an increasingly multipolar world to enhance resilience and ensure access to critical components.
- Engage with emerging markets like India or ASEAN to access fast-growing sectors such as green tech and digital finance.
- Leverage global talent flows by positioning Ülemiste a flexible, digital-first hub offering upskilling programs and hosting international innovation events to facilitate knowledge exchange.
- Align with EU "third-path" strategic goals (e.g., digitalization and security) by joining smart city networks, tapping into initiatives like Digital Europe and exploring testbed roles for civilian applications – like cybersecurity and secure communications – in defense-related technologies.
- Assess the geopolitical and security risks of adopting foreign infrastructure (e.g., surveillance systems) and invest in secure, locally governed alternatives.
- Develop a "Geopolitical Risk Sandbox" within Test City to simulate disruptions and test digital supply chain resilience using AI and IoT.
- Build digital platforms for rapid crisis response, transparent communication, and citizen engagement to strengthen governance under pressure.
- Maintain investor confidence by clearly communicating risk mitigation, EU alignment, and contingency planning in light of regional security concerns.

ECONOMICS

- Improve access to digital and green innovation funding.
- Expand public-private partnerships to close the technology adoption gap.
- Encourage collaborative models among companies, especially SMEs, to reduce costs and share resources.
- Mobilize digital & green financing by pursuing diversified funding through green bonds, blended finance, and fintech platforms. Design projects that meet SDG and ESG criteria to attract institutional investors.
- Focus on inclusive economic development by designing projects with citizen co-creation and transparency, while aligning with the Smart City 3.0 principles as solutions should improve citizens qualify of life.

- Diversify and upscale the local economy by encouraging Ülemiste firms to enter new emerging sectors and support startups. Additionally, work with universities (e.g. Tartu University, TalTech) to commercialize research.

SOCIAL

Infrastructure & Mobility
- Extend e-bike lanes and tram connections (aim for +20 km by 2027).
- Provide Mobility-as-a-Service (MaaS) apps that offer rewards for eco-friendly modes of transportation.
- Focus on pursuing citizen participation through digital governance
- Introduce the civic tech platform "UC Voice" for reporting, budgeting, and feedback.
- To guarantee open-source governance and transparency, use Decidim-based architecture (https://decidim.org/).

Talent Strategy & Inclusion
- Construct mixed-income co-living communities close to transit hubs.
- Open a digital language and literacy lab for locals and migrant workers.
- Information and Intelligent Systems.
- Increase the number of citywide IoT sensors for energy use, traffic, water quality, and air quality. Include open data dashboards on the UC website's public page.

TECHNOLOGY

- Enhance smart city governance with AI, using tools like digital twins to enable scenario testing and informed decision-making in areas such as waste management and pollution.
- Scale AI from pilots to shared platforms that leverage digital public infrastructure and can be used across departments and services.
- Invest in IoT solutions that enable predictive, data-based analytics and integrate systems like smart grids to improve energy efficiency.
- Enhance data collection and availability for the "Radar" dashboard by expanding sensor coverage, ensuring IoT interoperability, and making it real-time operable.
- Provide smart mobility services (MaaS) to meet growing demand, with a focus on flexible design and strong stakeholder collaboration.
- Strengthen cyber resilience by embedding privacy, AI-driven threat detection, and continuous stress testing. Launch legal-tech incubators to support regulatory navigation.
- Focus on inclusive innovation by upskilling the workforce and ensuring AI adoption is both fast and secure across all sectors, e.g. through cross-company AI learning hubs and accessible training platforms.

LEGAL

- As Estonia responds to global geopolitical shifts, Ülemiste must remain agile in complying with evolving legal frameworks. This requires ongoing monitoring of regulatory developments, operational procedures, and security standards.
- Hybrid and remote work trends bring legal challenges, especially in cross border employment, worker rights, tax regulation, and non-EU talent recruitment. Ülemiste must prepare for these shifts by updating internal policies and legal protocols.
- The growing integration of AI in daily services raises critial legal questions around ethics and data protection. Estonia's strong digital infrastructure gives Ülemiste an edge in creating transparent and compliant AI systems. However, the pace of AI adoption demands swift regulatory responses to avoid falling behind.
- Environmental regulations especially those targeting emissions are tightening across the EU. While these laws may be currently stable they may evolve and shift in the future.
- As a smart city, Ülemsite must maintain a high standards in data privacy, cybersecurity, and digital identity protection. Estonia's e-governance strengths offer a competitive advantage, however, advancing technologies will continue to require updated legal frameworkds for ethical data governance.

ENVIRONMENTAL

- Require green roofs on all commercial structures larger than 1,000 square metres.
- Test climate-resilient parks and urban cooling zones in two strategic districts.
- The expansion of the innovation ecosystem.
- Establish a specialised GreenTech Accelerator in association with Mainor and universities.
- Provide grants for innovation based on ESG performance metrics.
- Join the digital twin concept to enhance urban planning, sustainability, and smart technology adoption through real-time data-driven comparison and decision-making, as seen in cases like Helsinki, Singapore and Dublin.
- Implement climate adaptation strategies such as smart grids, permeable pavements, and green roofs.
- Invest in technology-based mitigation systems, including flood sensors, smart drainage, and air quality monitoring.
- Integrate climate resilience into zoning, mobility, and public space design.
- Create exchange programs where companies can share byproducts such as CO_2, and surplus materials.

Implementation Roadmap

Putting our suggestions into practice is an important first step in the long-term strategy for Ülemiste City's continued development. However, since priorities will be a major factor in the decision-making process, we think that Ülemiste City may not benefit from implementing all the recommendations. However, we offer this roadmap that may be taken into consideration for Ülemiste to put future milestones into place and become a renowned smart city on par with those that have already been developed.

Phase		Key Actions	Milestones
Phase 1: Pilot Launch	2025 – 2026	• Launch green energy zones and initiate IoT sensor pilots (smart grids, waste, etc) • Deploy co-creation app (e.g. "ÜC Voice") for citizen input and collaboration • Align internal and external key stakeholders (departments, community leaders, partners) • Scope simulation tool development (e.g. "Geopolitical Risk Sandbox")	• Pilot projects collecting citizen monthly feedback • 3+ actionable citizen pain points addressed with early solutions • Stakeholder engagement sessions completed with agreed roles/responsibilities • Formalized concept for simulation platform
Phase 2: Develop-ment	2027 – 2028	• Expand smart infrastructure deployment based on pilot learnings (e.g., MaaS, digital twins, green roofs) • Launch GreenTech Accelerator and fund R&D clusters focused on green tech innovation • Implement smart governance tools (dashboards, real-time data monitoring) • Launch legal-tech incubators to support AI regulation	• Core smart infrastructure operational in at least 50% of targeted zones • 2+ R&D projects delivering prototypes or policy recommendations • Smart governance dashboard and digital twin project launched for internal decision support
Phase 3: Optimi-zation	2029 – 2030	• Fully integrate digital systems with climate and sustainability strategies • Use AI and predictive analytics to optimize citywide mobility, energy, and resource usage • Secure blended finance (e.g. ESG-aligned funds) • Implement circular economy exchanges and policies to achieve 100% CO2 free and green electricity	• Seamless integration of mobility, energy, and environmental monitoring systems • Data-driven policy adjustments leading to measurable sustainability gains • 100% of electricity sourced from green energy; 100% carbon neutrality; green powered transport • Secured funding from at least two green finance sources

When integrating global trends from the Smart City 3.0 framework and comparing outcomes with other smart cities into projects that the city currently wishes to develop, we have identified several risks or challenges that the city may encounter. These include:

- **Financial Risk:** A high initial investment is required for green infrastructure and digital systems, which can burden available resources.
- **Social Risk:** The digital divide presents challenges in ensuring equitable access to project digital devices and services.
- **Regulatory Risk:** Privacy and data protection issues arise from the extensive use of digital platforms, including compliance with the General Data Protection Regulation (GDPR) and Estonian data privacy laws.
- **Environmental Risk:** Climate variability creates uncertainty that can affect infrastructure performance.

Therefore, it is necessary to take strategic measures to reduce the risks that could arise if Ülemiste follows our recommendations.

Strategic Recommendations (2025–2030)

The recommendations offer Ülemiste City a five-year roadmap for transitioning to the Smart City 3.0 framework, which is quickly emerging as a global smart city trend to strengthen its position as a regional leader in sustainable innovation. Ülemiste can enhance its global competitiveness and resilience by following a proposed strategic roadmap that leverages local strengths and international best practices. However, we realize that some risks are inherent together with the solutions, and some limitations may arise. So prioritising solution design can address this challenge to what Ülemiste City faces in the real conditions.

Phase	Strategic Recommendations
Phase 1: Pilot Launch (2025–2026)	- Launch civic tech co-creation app (ÜC Voice) with gamification to boost citizen engagement - Hold monthly hybrid co-creation workshops to gather feedback on mobility, energy, and digital services - Form multi-sector steering committee with a clear RACI matrix - Set up monthly reporting systems on progress, citizen feedback, and pilot performance - Monitor citizen pain points and prototype low-cost solutions in pilot neighborhoods - Scope the Geopolitical Risk Sandbox to simulate digital disruptions and test resilience - Initiate IoT pilots for energy, waste, and transport monitoring (linked to "RADAR") - Begin AI upskilling programs and explore a digital literacy lab for locals and expats
Phase 2: Development (2027–2028)	- Use pilot data to guide infrastructure scaling (e.g. digital twins, smart girds) - Build green roofs and permeable pavements to manage heat and rainwater - Issue grants to support R&D clusters and host innovation challenge (GreenTech Accelerator) - Deploy real-time dashboards and digital twins for resource planning and optimization - Launch legal-tech incubators to develop secure-by-design protocols and train workforce cyber resilience and data ethics - Pilot smart waste systems (e.g. smart bins) and adaptive street lighting using AI and IoT sensors - Introduce incentives and awareness campaigns to promote sustainability and reaching carbon neutrality - Add emergency response features to civic tech platforms and update contingency plans
Phase 3: Optimization (2029–2030)	- Expand green roof coverage and integrate smart water management systems with real-time monitoring - Define clear KPIs and schedule biannual policy reviews based on data and feedback - Maintain citizen engagement via surveys, apps (e.g. ÜC Voice), and town halls - Secure blended finance (e.g. green bonds, ESG-aligned funds) and position ÜC as a regional leader in smart, sustainable urban innovation - Hold regular steering committee reviews to stay aligned with evolving legal, technological and geopolitical contexts

Summary

In this report we analysed Ülemiste Smart City through the lens of the PESTLE framework (Political, Economic, Social, Technological, Legal, Environmental), while aligning strategic recommendations with the Smart City 3.0 model to further ensure long-term resilience, relevance and competitiveness. These global trends present a unique opportunity for Ülemsite to distinguish itself within the Baltic states as a leading hub for new innovations and partnerships by leveraging Estonia's digital strenghts and aligning with EU priorities.

Key recommendations – such as investing in next-generation networks, fostering startups in green and digital sectors, ensuring data-driven governance, and integrating sustainability into all aspects of developments – are just some of the strategies that can be implemented to realize the vision of becoming leaders within the region and smart city network. The proposed roadmap (2025-2030) outlines foundational steps, deployment phases, as well as continuous evaluation which enables Ülemiste to adapt and grow.

Nevertheless, significant challenges do lie ahead. Ensuring digital equity is essential for inlusive innovation of citizens and talents, while cybersecurity and ethical AI must be carefully managed to maintain public trust. Climate change can pose as a threat to urban resilience if left unaddressed. Financial constraints from an uncertain economic environment could risk Ülemiste's position if improperly adressed leading to gaps through EU programs and partnerships. Furthermore, an increasingly multipolar world can threaten supply chains and investments.

In sum, Ülemiste City has the potential to become a leader within the region by combining Tallinn's innovation ecosystem with forward-looking strategy. By acting on the provided insights as well as maintaining an agile, inclusive governance, Ülemiste can turn global trends into strengths, positioning itself for new growth and sustainability through 2030 and beyond.

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