Empowering Youth on Smart Cities with AI Solutions to Community and Urban Challenges Towards SDG 11

Mustafa Zaouini†, Lee Chana, Ruben Frank, Kim August
AI in Africa
Johannesburg, South Africa
mus@fliptin.io

Joao Pita Costa, Davor Orlic, Mihajela Črnko
IRCAI, Quintelligence
Ljubljana, Slovenia
joao.pitacosta@ircai.org

Yousef Rahmani
ToumAI
Rabat, Morocco
odin@toum.ai

Rayan Kassis, Swethal Kumar
EnergyAED
London, UK
rayan@aed.energy

Luka Stopar
Solvesall
Ljubljana, Slovenia
luka.stopar@solvesall.com

Sohaib Souss, Wahid Laleeg, Yassine Bounouader
SLTVERSE
Casablanca, Morocco
sohaibsoussi@gmail.com

Asmae Lamgari, Maroja Zoubir, Hajar Doukhou
University Mohammed V (UM5)
Rabat, Morocco
asmaelamgarim@gmail.com

Ouidad Mochariq, Zahira Elmelsse, Chaimae Fadil
ENSA National School of Applied Sciences (ENSA-M)
Marrakesh, Morocco
o.mochariq3846@uca.ac.ma

Abstract / Povzetek

Achieving Sustainable Development Goal 11 − ensuring cities are inclusive, safe, resilient, and sustainable − remains a pressing global priority. In this pursuit, Artificial Intelligence (AI) has emerged as a transformative driver of urban innovation, enabling policymakers, academic institutions, and industry stakeholders to make data-driven decisions for complex urban systems such as housing, transportation, energy, and infrastructure. Despite its potential, the vast scale, variety, and fragmentation of urban data, coupled with the rapid evolution of AI technologies, create significant challenges in converting SDG 11-related information into practical solutions. This paper reports on the results of the AI4SDG11 programme, which combined expert community building, knowledge exchange, and competitive challenges. The programme brought together 50 students and 30 startups I 15 locations worldwide, to develop AI-driven solutions targeting key aspects of urban sustainability. Using diverse machine learning techniques, participants addressed challenges including intelligent mobility systems, efficient waste management, smart and efficient urbanism, and climate-resilient urban planning. Conducted in 2025, this initiative formed part of a youth-focused innovation challenge co-organized by AI in Africa, the International Research Centre on Artificial Intelligence (IRCAI), and GITEX, with the goal of promoting interdisciplinary innovation and strengthening regional AI capacity for sustainable urban development.

Keywords / Ključne besede

Machine learning, text mining, large language models, community engagement, urbanism, mobility, AI competition, AI Community

†Corresponding author

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1 Introduction

Established by the United Nations as an essential goal for the forthcoming 2030, the Sustainable Development Goal 11 (SDG 11) — *"Make cities and human settlements inclusive, safe, resilient and sustainable"* — reflects a critical global commitment to improving urban living conditions amid increasing urbanization, population growth, and environmental stress. With more than half of the world's population now residing in cities—and projections estimating two-thirds by 2050—the urgency of building sustainable urban environments has never been better fit. In this context, AI has emerged as a transformative tool capable of reshaping how cities are planned, managed, and experienced. AI technologies offer powerful capabilities to harness vast amounts of urban data, generate predictive insights, and support evidence-based decision-making. From optimizing public transportation systems to monitoring air quality, improving waste management, and enabling climate-resilient infrastructure, AI is at the forefront of innovative urban solutions worldwide. However, the deployment of AI in support of SDG 11 varies significantly across regions, influenced by differences in digital infrastructure, data availability, institutional capacity, and local priorities [1].

In Africa, AI is increasingly being applied to address urban informality, mobility challenges, and infrastructure gaps. For instance, AI-powered geospatial mapping tools are being used to identify informal settlements in rapidly growing cities such as Nairobi and Lagos, helping governments to improve service delivery and urban planning [2]. In North African cities, machine learning models have been developed to optimize water distribution in drought-prone areas and to improve traffic flow in congested urban corridors. AI is also being tested for predictive waste collection and smart energy use in off-grid communities. These solutions are particularly valuable in regions where resources are limited, and where rapid urban growth creates pressure for low-cost, scalable interventions [2].

On the other hand, in Europe, AI applications in cities often focus on enhancing sustainability, efficiency, and citizen engagement. Examples include real-time public transport optimization in cities like Helsinki and Barcelona [3], AI-based air pollution forecasting in Paris [4], and intelligent energy management

systems in smart buildings across the Netherlands and Germany [5]. Many European municipalities are also investing in AI-driven participatory governance platforms, enabling data-informed urban policymaking that incorporates citizen feedback [5]. Furthermore, [6] highlights how AI can extract and analyze news media information to enhance knowledge and understanding of water-related extreme events, supporting improved disaster risk reduction..

This paper presents the outcomes of a collaborative youth AI innovation programme, including AI mentorship and challenges aimed at exploring the impact of AI on SDGs. It builds on the related initiative initiating the programme in 2026 under the focus of Water Sustainability to progress SDG 6 (see [7] and [8]), and refocuses the approach addressing SDG 11-related problems through applied machine learning solutions. The initiative brought together 50 students and 20 professors across 10 research institutions in North Africa, as well as 30 AI startups and domain experts worldwide culminating in 30 projects and initiatives tackling real-world urban challenges. By leveraging AI and data science, these teams addressed issues ranging from urbanism and mobility to waste management and climate resilience—drawing on lessons and methods from both African and European contexts. The competition, co-organized by AI Africa and IRCAI in a collaboration with GITEX, short for Gulf Information Technology Exhibition, being one of the world's largest technology and innovation events, held annually in Dubai, United Arab Emirates. The event held in May 2024 [7], served as a model for interdisciplinary, cross-regional collaboration in the pursuit of sustainable urban futures.

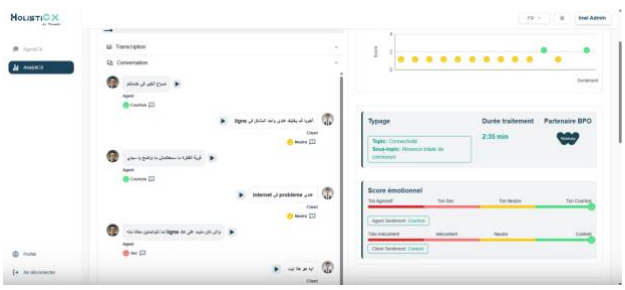


Figure 1: Screenshot of the AI engine ToumAI, winner of the AI4SDG11 startup competition at the inaugurating edition of GITEX Europe, Berlin, as a prime example of the relevance of languages in the resilience of cities and communities

2 AI4SDG Programme Methodology

The AI4SDG Programme, spearheaded by IRCAI under the auspices of UNESCO, in collaboration with AI in Africa and GITEX, is a transformative initiative designed to harness artificial intelligence to address the United Nations Sustainable Development Goals (SDGs). With a focus on capacity building, entrepreneurship, and ethical AI deployment, the programme connects technological innovation with global sustainability challenges, particularly in the Global South.

At the core of AI4SDG is a multi-pronged approach integrating certified training, competitive innovation events, and startup acceleration. Launched through global showcases and pitch competitions at major GITEX events across Africa, Asia, Europe, and the Middle East, the initiative provides a dynamic platform for students, researchers, and entrepreneurs to ideate, prototype, and scale AI solutions aligned with specific SDGs. Previous editions have focused on Water Sustainability (SDG 6) and Sustainable Cities and Communities (SDG 11), while the 2026 programme will extend to all 17 SDGs. The key components include:

- **Research2Startup Competition**: A 4–6 week programme blending AI education, design thinking, and acceleration tracks for startups and university spinouts, culminating in regional and global pitch events.
- **Certified AI for SDG Training**: Professional certification tracks for corporate teams, startup founders, and SMEs, focusing on topics like large language models, AI governance, ethical data practices, and generative AI applications.
- **AI4SDG Lab Accelerator**: A 3–6 month cohort-based programme supporting university-originated AI startups through mentorship, technical workshops, and investor networking, culminating in a high-profile Demo Day at *GITEX Global*.

The programme not only equips participants with practical AI competencies but also facilitates access to global networks, funding opportunities, and collaboration through GITEX's innovation ecosystem. It champions responsible AI development by emphasizing ethics, transparency, and inclusivity, while offering tangible incentives such as certifications, cash prizes, MVP co-development and impactful international exposure through IRCAI and GITEX channels. In doing so, AI4SDG acts as a catalyst for fostering the next generation of AI-driven changemakers committed to creating impactful, scalable solutions for a sustainable future.

3 AI-enabled Innovation Advancing SDG11

The joint IRCAI, AI in Africa and GITEX competition served as a global platform for surfacing innovative AI-driven solutions to SDG 11 challenges, bridging the ideas of PhD researchers in North Africa with the entrepreneurial agility of startups worldwide. Among the standout innovations emerging from the competition were AI-powered geospatial mapping systems for monitoring informal settlements, predictive analytics for optimizing urban transport routes in congestion-prone cities, and machine learning models for forecasting waste generation to improve collection efficiency. Several projects addressed climate resilience, including early-warning systems for urban flooding and AI-assisted tools for assessing heat island effects and guiding green space planning. From energy-efficient building design algorithms to citizen engagement platforms that use natural language processing for policy feedback, the competition highlighted the breadth of AI's potential to make cities more sustainable and inclusive. By uniting academic depth with market-ready solutions, the initiative not only identified promising prototypes but also laid the groundwork for scalable interventions adaptable to diverse urban contexts..

ToumAI. A holistic multilingual AI platform designed to bridge the digital divide in Africa by enabling voice-driven customer experiences in low-resource languages, advancing SDG 11. Built on a compound AI structure that saves computing

power compared to foundational LLMs, the system supports speech-to-text, text-to-speech, emotion analysis, churn detection, and predictive insights across African dialects such as Swahili, Amharic, Yoruba, and Darija. By integrating AI-powered voice agents, IVR optimization, and multilingual analytics, ToumAI delivers inclusive, real-time, and cost-effective communication for telco, banking, and transport sectors (see Figure 1). Its innovation lies in industrializing underrepresented African languages for AI applications, ensuring accessibility for populations historically excluded from the AI revolution.

AED EnergyAED. An AI-enabled renewable energy storage system that converts electricity into high-temperature heat (up to 800° C) using salt-based thermal bricks, providing 24/7 clean power and heat without combustion. Unlike batteries or diesel, the system delivers up to 24 hours of dispatchable energy at lower cost, using safe, stable, and modular 10MWh units. Applications include microgrids, telecoms, industrial heat, and desalination, making it particularly suited for regions with unreliable energy supply. By enabling baseload renewable energy, AED Energy strengthens critical infrastructure and advances SDG 11 while reducing dependence on diesel.

SolvesALL Mobility. Delivery district planning and optimization machine learning tools that support smarter urban logistics impacting the sustainable of cities and communities. Its Postal POI system uses algorithms to automatically design delivery districts, balancing workload, reducing overlap, and minimizing travel time. Leveraging GPS trace analysis, stay-point detection, regression models, and crowdsourced field data, the system learns delivery micro-locations, service times, and accessibility factors (e.g., stairs, obstacles). By integrating these AI-driven insights, SolvesAll enables cost savings, operational efficiency, and improved registry accuracy−demonstrated by expected multimillion-euro annual savings for postal operators− while offering scalability to sectors such as waste management and ATM/vending machine logistics.

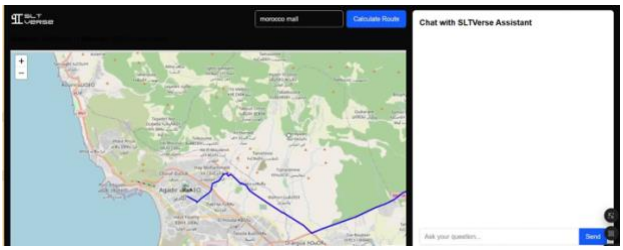


Figure 2: Screenshot of the SLTverse engine, winner at the AI stage of GITEX Africa 2025

SLTverse. This smart city solution introduces an AI-powered travel app that supports SDG 11 by enhancing safety, sustainability, and cultural engagement in tourism. At its core is an AI Route Advisor that leverages structured mobility data—spanning cost, CO_2 emissions, safety, time, and distance—to recommend optimal transport options. This is strengthened by a Retrieval-Augmented Generation (RAG) framework, which combines vector search, large language models, and workflow orchestration to deliver fast, contextual, and multilingual guidance (see screenshot at Figure 2). The system's AI assistant adapts to real-time inputs such as weather, safety alerts, and user preferences, ensuring tailored and secure travel recommendations. Beyond mobility, the platform enriches tourism through VR-based storytelling with avatars narrating site histories, and employs metadata-driven personalization supported by visual analytics (route maps, CO_2 vs. cost comparisons, safety heatmaps). Collectively, these AI innovations position the app as a smart city enabler that aligns sustainability, cultural engagement, and traveler well-being.

SOBEK. A federated AI system for flood resilience that addresses the lack of early-warning systems in rapidly urbanizing African cities. Unlike centralized models, it applies federated learning to collaboratively improve predictions while preserving data privacy and sovereignty. Local nodes train specialized models−LSTMs for weather series, GNNs for hydrological networks, and U-Nets for satellite imagery−using geospatial, meteorological, and historical flood data. Model updates are aggregated with FedAvg and refined through station similarity graphs to capture regional hydrological patterns. Despite challenges of data heterogeneity and low connectivity, Sobek delivers more accurate flood seasonality, year, and magnitude predictions, enabling timely early warnings, urban planning, and disaster resilience across Africa.

Ecoguardians. This initiative introduces an AI-powered system to optimize water-saving advertisements in Morocco, advancing SDG 11 (Sustainable Cities and Communities). By analyzing diverse campaign content (videos, images, text, social media engagement, and survey data), the system identifies what makes ads effective and generates improved variations. It integrates computer vision (CNNs) for visual features, language models (BERT/GPT) for text and sentiment, predictive models (XGBoost/Random Forest) for engagement forecasting, and GANs for generating impactful ad variations. Ethical and data-driven personalization ensures campaigns remain responsible, transparent, and locally relevant. Early prototypes show measurable engagement gains, empowering cities to run evidence-based, AI-enhanced awareness campaigns that strengthen sustainable water use.

4 Conclusions and further work

The integration of AI with the SDGs represents a critical frontier in global innovation, particularly as we confront complex challenges in health, education, climate, and urbanization. The AI4SDG programme, as implemented through the collaboration of IRCAI, AI in Africa, and GITEX, demonstrates a strategic and scalable model for aligning technological advancement with sustainable impact. By combining certified training, research-to-startup pathways, and accelerator programs, AI4SDG empowers diverse stakeholders—from students and researchers to entrepreneurs and SMEs—to develop responsible, ethical and context-sensitive AI solutions across the 17 SDGs.

One of the programme's most significant contributions lies in its ability to bridge the gap between academic research and real-world application, particularly in the Global South. Through its global reach and multi-region engagements, AI4SDG not only promotes responsible AI development but also facilitates access to funding, mentorship, and global markets, thereby amplifying the reach and effectiveness of AI for social good. However, while the AI4SDG11 programme has laid a robust foundation, several

avenues remain open for further development, now open to all SDGs. Future work should focus on:

- **Longitudinal impact assessments** to evaluate the sustainability and real-world outcomes of AI solutions emerging from the programme.
- **Expanded participation** across underrepresented regions and communities, ensuring equitable access to AI training and opportunities.
- **Integration of emerging technologies**, such as neurosymbolic AI, edge AI, and federated learning, into training tracks and solution design.
- **Stronger policy linkages** to influence national and international AI governance frameworks through insights derived from grassroots innovation.
- **Enhanced data infrastructure**, including open datasets aligned with the SDGs, to support more accurate, inclusive, and transparent AI development.

The AI4SDG programme highlights the transformative potential of AI when it is purposefully directed toward sustainable development. As the initiative expands and evolves, it will be crucial to maintain a balance between innovation, ethics, and inclusivity—ensuring that AI becomes not just a tool for growth, but a vehicle for equitable and sustainable global progress. At the same time, it is also important to acknowledge the programme's inherent challenges and limitations. Sustaining long-term participation from diverse stakeholders requires consistent resources, local capacity-building, and incentives that extend beyond initial pilot enthusiasm. Scaling successful pilots into broader, systemic solutions often encounters barriers such as fragmented policy environments, limited infrastructure in low-resource settings, and uneven access to funding. Moreover, as AI solutions transition from competitive innovation contexts to real-world deployment, questions of ethical oversight, data governance, and accountability become increasingly complex—particularly in cross-border collaborations. Addressing these challenges will be essential to ensure that the AI4SDG initiative not only inspires innovation but also establishes durable, ethically grounded impact at scale.

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