

Strong Sustainability by Design

TOWNS AND CITIES



An initiative supported by the IEEE Standards Association

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Strong Sustainability by Design - Version 1 (Draft)

Request for Input

Public comments are invited on the first version of ***Strong Sustainability by Design: Prioritizing ecosystem and human flourishing with technology-based solutions*** that identifies specific issues and pragmatic recommendations regarding sustainability and climate change to achieve “Planet Positivity” by 2030.

This draft compendium has been created by committees of the Planet Positive 2030 Initiative¹ that is supported by IEEE Standards Association (IEEE SA). The Planet Positive 2030 Initiative community is composed of several hundred participants from six continents, who are thought leaders from academia, industry, civil society, policy and government in the related technical and humanistic disciplines. At least one hundred fifty members of this community have contributed directly and have worked to identify and find consensus on timely issues.

The document’s purpose is to identify specific issues and candidate recommendations regarding sustainability and climate change challenges to achieve “Planet Positivity” by 2030, defined as the process of [transforming society and infrastructure by 2030 to:](#)

- Reduce GreenHouse Gas (GHG) emissions to 50% of 2005 emissions by 2030²
- Significantly increase regeneration and resilience of earth’s ecosystems³
- Be well on the path to achieving net zero GHG emissions by 2050 and negative GHG emissions beyond 2050
- Continue to widely deploy technology as well as design and implement new technological solutions in support of achieving technological solutions designed and deployed to achieve “Planet Positivity”

In identifying specific issues and pragmatic recommendations, the document:

- Provides a scenario-based challenge (how to achieve “Planet Positivity by 2030”) as a tool to inspire readers to provide contextual technical and general feedback as part of this RFI.
- Advances a public discussion about how to build from a “Net Zero” mentality to a “Net or Planet Positive” (“do more good”) societal mandate for all technology and policy.
- Continues to build a diverse and inclusive community for the Planet Positive 2030 Initiative, prioritizing the voices of indigenous and marginalized members whose insights are acutely needed to help ensure technology and other solutions are valuable for all. Of keen interest is how we can encourage more in-depth participatory design in our processes.
- Inspires the creation of technical solutions that can be developed into technical standards (IEEE Standards Association, for example ICT and power & energy related standards, IEEE P7800™ series) and associated certification programs.
- Facilitates the emergence of policies and regulations; regulations that would potentially be interoperative between different jurisdictions (countries).

¹ Planet Positive 2030 is part of [The Sustainable Infrastructures and Community Development Industry Connections program](#)

² As described in the [United Nations Climate Change Conference \(COP 21\) Paris Agreement of 2015](#).

³ According to the [High Ambition Coalition for Nature and People](#), “In order to address both the biodiversity crisis and the climate crisis, there is growing scientific research that half of the planet must be kept in a natural state....experts agree that a scientifically credible and necessary interim goal is to achieve a minimum of 30% protection by 2030.” Protection for land and water of “30 x 30 by 2030” was recommended during COP15 United Nations [Convention on Biological Diversity](#).

By inviting comments for *Strong Sustainability by Design*, the Planet Positive 2030 community provides the opportunity to bring together multiple voices from the related scientific and engineering communities with the general public to identify and find broad consensus on technology to address pressing environmental and social issues and proposed recommendations regarding development, implementations and deployment of these technologies.

Details on how to submit public comments are available in the [Submission Guidelines](#).

Comments in response to this request for input will be considered by the Planet Positive 2030 Initiative committees for potential inclusion in the first public edition of *Strong Sustainability by Design* (“*Strong Sustainability by Design*, First Edition”) anticipated to be made available to the general public during the fourth quarter of 2023.

- For further information, learn more at the [Planet Positive 2030 Initiative website](#).
- For our Frequently Asked Questions (beyond RFI submission), [please click here](#).
- Get in touch at: PlanetPositive2030@ieee.org to get connected to a committee or any other reason.
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If you're a journalist and would like to know more about the Planet Positive 2030 Initiative, please contact: Standards-pr@ieee.org

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Strong Sustainability by Design is not a code of conduct or a professional code of ethics. Engineers and technologists have well-established codes, and we wish to respectfully recognize the formative precedents surrounding issues of sustainability and the professional values these codes represent. These codes provide the broad framework for the more focused domain addressed in this document, and it is our hope that the inclusive, consensus-building process around its design will contribute unique value to technologists and society as a whole.

This document is also not a position, or policy statement, or formal report of IEEE or any other organization with which is affiliated. It is intended to be a working reference tool created in an inclusive process by those in the relevant scientific and engineering communities prioritizing sustainability considerations in their work.

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Strong Sustainability by Design is being created via multiple versions that are being iterated over the course of two to three years. Planet Positive2030 is following a specific concurrence-building process where members contributing content are proposing “candidate” recommendations so as not to imply these are final recommendations at this time. This is also why the word, “Draft” is so prominently displayed.

Our Membership

Planet Positive2030, an initiative supported by the IEEE Standards Association as part of the Industry Connections Program, [Sustainable Infrastructures and Community Development program](#) (SICDP) currently has more than 400 experts involved in our work, and we are eager for new voices and perspectives to join our work.

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Towns and Cities

Future Vision

It is 2030. Cities have been transformed into positive innovation ecosystems. The 21st century marked the transition from the industrial to the digital era; from industrial productivity to sustainability focus; from human competition to cooperation. Human knowledge and its expression in technologies are available to accelerate the positive change we now witness.

We live under society 6.0,^{4,5} where human-centric design, urban planning⁶, environmental sustainability concepts, and other technological systems and solutions coexist to provide a more equitable organization of resources within our world. Water and energy are more efficiently used, and we have reached sustainable food distribution worldwide. Our climate change and sustainability efforts have led to a new economic, technological, and human perception of values and collective ethical behavior.

Digital technologies (including artificial intelligence [AI], Internet of Things [IoT], and extended reality [XR]) have enabled intelligent cities, and open education systems have transformed them into equitable hubs of innovation and advancement.

Public health and education, green mobility, and sustainable growth are now shared commodities, accessible to most of the world's population. Fresh air and clean water are available in most cities on planet Earth, notably in the developing world, which is flourishing as the economic systems and models recognize the value of renovation and well-being.

Sustainability is now affordable for everyone.

⁴ “Simona Šarotar Žižek, Matjaž Mulej, and Amna Potočnik, “The Sustainable Socially Responsible Society: Well-Being Society 6.0,” *Sustainability* 13, no. 16 (Aug. 2021): 9186.

⁵ Yuko Harayama, “Society 5.0: Aiming for a New Human-Centered Society: Japan’s Science and Technology Policies for Addressing Global Social Challenges,” *Hitachi Review* 66, no. 6: 558–559, https://www.hitachi.com/rev/archive/2017/r2017_06/pdf/p08-13_TRENDS.pdf.

⁶ <https://www.15minutecity.com/>

Introduction

Towns and cities are the physical spaces where public policies are affected, and human actions impact our planet. Current literature points out that innovation ecosystems are the proper organization to harness positive actions that improve human life and foster sustainable development,⁷ stemming from the implementation of innovation in the urban space that prioritize attention to the responsible and sustainable use of technologies to protect and improve life on our planet. These innovative systems should be implemented to help leverage clean energy solutions, rebuild the legacy fossil-fuel urban infrastructure, redesign urban space mobility, manage food and waste, and guarantee fresh air and clean water.

Communities share in the responsibility of working toward a net-positive future; therefore, fostering sustainable and regenerative communities and promoting community solidarity and social responsibility are also key priorities.

⁷ Philip Budden and Fiona Murray, "Strategically Engaging with Innovation Ecosystems," *MIT Sloan Management Review*, 20 July 2022, <https://sloanreview.mit.edu/article/strategically-engaging-with-innovation-ecosystems/>.

Issue: Need to harness positive innovation ecosystems

Background

The coordinated actions of government, academia, entrepreneurs, and social agents can transform cities and towns into “positive” innovation ecosystems.⁸ These innovative urban spaces demand that we act now as most of the world’s population will live in the cities and towns of the developing world in the 21st century. Social concerns within the planning and execution phases of a transition toward positive innovation systems can be alleviated by the integration of an ethical approach to social issues and the inclusion of all groups represented within cities.

The need for positive innovation ecosystems is a unique opportunity and perhaps the ultimate target for leaving a multigenerational legacy to the planet. By 2050, more than 70% of the world’s population will live in cities.⁹ Therefore, we must positively act now as most of this human density will be concentrated in developing countries with limited resources.

The 21st century marks the transition from the industrial to the digital era—from productivity to sustainability, from competition to cooperation. Such bipolarities—a concept from the past—ideally must cede their place to diverse innovation that benefits the population in cities and towns worldwide. As information flows freely, at lower and lower costs, knowledge will be available to accelerate positive change in ways unprecedented until now but, more importantly, not properly imagined or projected into the future.

The power of technology can be leveraged to impact the planet positively. AI, IoT, and computing technologies are the key to optimizing the use of renewable energy and to reducing CO₂ emissions by streamlining and redirecting resources in an efficient fashion.

Within the realm of digital advancement and future economies, new businesses and organizations based on human-centered innovation driven by the common good should continue to evolve. Existing organizations should also begin to act in the public interest instead of supporting reliance on fossil fuels,¹⁰ heavy industries, and solutions that cause more damage to the planet. Support from governments and funding agencies should go toward business entities, operating within the city scope, which target public-interest innovation rather than only profit and monetary value.

Positive innovation ecosystems integrate, and the diversity of knowledge via multiple stakeholders (government and nongovernment organizations, i.e., community leadership and organizations, academia, investors, corporations, and social entrepreneurs)¹¹ that share common values and seek to build innovation ecosystems in which their coordinated and collaborative action drives cities to a sustainable present and increasingly positive future.

⁸ Francesco Paolo Appioa, Marcos Limab, and Sotirios Paroutis, “Understanding Smart Cities: Innovation Ecosystems, Technological Advancements, and Societal Challenges,” *Technological Forecasting and Social Change* 142 (May 2019): 1–14.

⁹ “Goal 11: Sustainable Cities and Communities,” UNDP, The SDGs in Action, <https://www.undp.org/sustainable-development-goals/sustainable-cities-and-communities>.

¹⁰ Zero Cool [pseud.], “Oil is the New Data,” *Nature*, no. 9, 7 Dec. 2019, <https://logicmag.io/nature/oil-is-the-new-data/>.

¹¹ Budden and Murray, “Strategically Engaging With Innovation Ecosystems.”

Cities and towns are the home of all aspects of human life and of all our technologies: water supply, energy, transportation, health, education, and all other public services and private activities. The need for changing the supply and adding sustainability to the value chain of all these technologies significantly affects the way we live on a frail yet resilient planet.

Recommendations

1. Technology must be applied and deployed for the benefit of the urban environment and humankind, always respecting the diversity and rights of the people's historic and harmonic connections to their land and environment and treating cities as an interlinked landscape of human and technology ecosystems.
2. Although all technology may be dual (or even multimodal), we can find ways to prioritize the "planet positive" use of our knowledge and technologies. Thus, planet-centric actions shall be the vectors that accelerate innovation and sustainable change in developed and developing countries and, more importantly, in the cities that invite most of us to live in them.
3. We need to define an agenda, a strategy, and actions for positive innovation ecosystems. Drawing inspiration from the literature on innovation ecosystems¹² and sustainable economics, positive innovative ecosystems extend the underlying idea of innovation ecosystems to respond to the challenges of building ethically aligned, sustainable, cooperative, diverse, equal, inclusive cities and metropolitan areas where socioeconomic development is truly focused on constructing and preserving the planet and raising sustainable living standards, especially in the developing world.
4. A positive innovation ecosystem agenda demands a change in our innovation culture: from building the most effective business or political models to promote positive innovation ecosystems, in which we all seek to preserve, recover, and leverage our accumulated, distributed scientific knowledge and resulting technologies (e.g., AI, clean energies, block chain, new materials, and sustainable supply chain optimization) for the true benefit of our planet and future generations.
5. The design and implementation of positive innovation ecosystems must take into consideration moral, cultural, and ethical values, many of which we assume can be universally accepted, although we must respect individual cultures and peoples.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

¹² Fiona Murray and Scott Stern, "Accelerating Innovation-Driven Entrepreneurial Ecosystems," in *Innovation and Public Policy*, National Bureau of Economic Research Conference Report, Austan Goolsbee and Benjamin F. Jones, eds., (Chicago, IL: University of Chicago Press, 2022).

Issue: Need to leverage clean energy solutions

Background

Cities need to provide affordable and easy-to-access carbon-free energy while deploying sustainable smart monitoring systems to enable real-time monitoring of emissions to track our progress. Cities and towns should also use smart energy systems and IoT to protect vulnerable populations from power outages¹³ and provide them with heating and cooling.

Access to clean energies in our towns and cities remains a challenge faced by cities and towns in both the developed¹⁴ and the developing world. Technologies allowing for smart monitoring systems¹⁵ are crucial to providing solutions, and their equitable application across countries and continents is fundamental to the well-being of the planet. The affordability of wind and solar power plants, compared with fossil fuel plants, makes them an easy choice for energy grid expansion.¹⁶

Cities and towns should aim for a planet where the use of energy, such as in buildings, transportation, and manufacturing, is all carbon neutral. The progression to electrification requires addressing our current grid system, eliminating wasted energy.

Cities should also strive to be healthy environments for all their citizens, where currently heat waves combined with power outages due to climate change make it difficult to manage. Some metropolitan areas in the world have already begun to hire heat response and mitigation officers,¹⁷ as well as climate change officers,¹⁸ to tackle the existing mitigation and adaptation issues within the energy sector.

Recommendations

1. Transnational funding of solutions in research and development (e.g., batteries and material) is needed to support community centers that provide clean energy solutions within cities and towns worldwide.
2. Governments in developing nations should prioritize funding schemes for research and development of renewable energies, harnessing the potential of clean energy sources.

¹³ Jeff St. John, "A Grassroots Coalition Turns to Solar and Batteries to Help New Orleans Cope with Disasters," *Canary Media*, 11 July 2022, <https://www.canarymedia.com/articles/clean-energy/a-grassroots-coalition-turns-to-solar-and-batteries-to-help-new-orleans-cope-with-disasters>.

¹⁴ Robert Pollin, "Nationalize the U.S. Fossil Fuel Industry to Save the Planet," *The American Prospect*, 8 April 2022, <https://prospect.org/environment/nationalize-us-fossil-fuel-industry-to-save-the-planet/>.

¹⁵ Mauricio A. Ramirez-Moreno et al., "Sensors for Sustainable Smart Cities: A Review," *Applied Sciences* 11, no. 17 (Aug. 2021), <https://doi.org/10.3390/app11178198>.

¹⁶ David R. Baker, "Renewable Power Costs Rise, Just Not as Much as Fossil Fuels," *Bloomberg News*, 30 June 2022, <https://www.bloomberg.com/news/articles/2022-06-30/renewable-power-costs-rise-just-not-as-much-as-fossil-fuels#xj4y7vzkg>.

¹⁷ Brandon Loomis, "Phoenix Names a Heat Officer, with a Goal of Easing the Risk of Rising Temperatures," *Arizona Republic*, 7 Oct. 2021, <https://www.azcentral.com/story/news/local/arizona-environment/2021/10/07/phoenix-hires-heat-officer-cool-city-ever-warming-future/6029086001/>.

¹⁸ "Our Fight Against Climate Change," Mayor of London/London Assembly, Programmes and Strategies, Environment and Climate Change, <https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/climate-change>.

3. Cities and communities should improve the organization, planning, and infrastructure related to energy policies in developing countries (although developed nations face similar challenges¹⁹).
4. Urban areas should create incentives to drive change in the current behavior of most citizens in developed and developing nations toward the use of clean, renewable energy sources.²⁰
5. Planning and development experts should plan and build carbon-neutral heating/cooling of buildings and the movement of transportation vehicles.²¹ Heat pump adoption should be encouraged and incentivized to save energy.²² Emphasis in the global North overall with respect to energy is on reducing excess energy use and especially focusing on sustainability.²³
6. Key technologies to focus on include heat pumps,²⁴ refrigeration, micro grids, community solar,²⁵ grid-enhancing technologies,²⁶ energy storage, and demand-side management.²⁷
7. Key policies to focus on include racial/gender/disability justice, and economic incentives to first help make the cost of living more affordable, and then address the concept of cost of living overall, e.g., for necessities like food and shelter in a planet positive world).²⁸
8. Smart charging²⁹ and advanced energy storage³⁰ are needed to ensure a wide spread of electric vehicles (EVs)³¹ and to harness the power of parked EVs,³² in addition to appropriate network planning to balance renewable energy supply and demand.

¹⁹ "2050 Long-Term Strategy," European Commission, Climate Action, EU Action, Climate Strategies and Targets, https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2050-long-term-strategy_en.

²⁰ Daniel Crow, Insa Handschuch, Gabriel Saive, and Leonie Staas, "Behaviour Change: Strategies and Case Studies for Reaching Net-Zero by 2050," EnergyPost, 8 Nov. 2021, <https://energypost.eu/behaviour-change-strategies-and-case-studies-for-reaching-net-zero-by-2050/>.

²¹ Anthony Cuthbertson, "€2 Billion Underground 'Water Battery' Turns on in Switzerland," *Independent*, 5 July 2022, <https://www-independent-co-uk.cdn.ampproject.org/c/s/www.independent.co.uk/tech/water-battery-switzerland-renewable-energy-b2115898.html?amp>.

²² Matt Malinowski, Max Dupuy, David Farnsworth, and Dara Torre, *Combating High Fuel Prices with Hybrid Heating: The Case for Swapping Air Conditioners for Heat Pumps*, [CLASP (Cooperative Labeling and Appliance Standards Program), 2022], <https://www.clasp.ngo/research/all/ac-to-heat-pumps/>.

²³ Jason Hickel and Aljosa Slamersak, "Existing Climate Mitigation Scenarios Perpetuate Colonial Inequalities," *The Lancet Planetary Health* 6, no. 7 (July 2022): e628–e631, <https://www.sciencedirect.com/science/article/pii/S2542519622000924>.

²⁴ John Matson and Chris Potter, "Clean Energy 101: Heat Pumps," RMI (Rocky Mountain Institute), Buildings, July 2022, https://rmi.org/clean-energy-101-heat-pumps/?utm_campaign=organic&utm_content=1658160844&utm_medium=social&utm_source=linkedin.

²⁵ Alison F. Takemura, "What is Community Solar? And How Can You Sign up?" *Canary Media*, 8 July 2022, <https://www.canarymedia.com/articles/guides-and-how-tos/what-is-community-solar-and-how-can-you-sign-up>.

²⁶ Russell Mendell, Mathias Einberger, and Katie Siegner, "FERC Could Slash Inflation and Double Renewables with These Grid Upgrades," RMI (Rocky Mountain Institute), Electricity, 7 July 2022, <https://rmi.org/ferc-could-slash-inflation-and-double-renewables-grid-upgrades>.

²⁷ Patrick Sisson, "The Future of Urban Housing is Energy Efficient Refrigerators," *MIT Technology Review*, 23 Feb. 2022, <https://www-technologyreview-com.cdn.ampproject.org/c/s/www.technologyreview.com/2022/06/23/1053662/energy-efficient-refrigerators-urban-housing/amp/>.

²⁸ "Policies for the People," The Chisholm Legacy Project, <https://thechisholmlegacyproject.org/policy-exchange/>.

9. We need to plan and build healthy cities with active transportation, clean air, clean water, safe food, minimal criminal activities, effective garbage and waste disposal, and sustainable use of clean energy sources.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

²⁹ Jaap Burger, Julia Hildermeier, Andreas Jahn, and Jan Rosenow, *The Time is Now: Smart Charging of Electric Vehicles*, (Regulatory Assistance Project, Apr. 2022), <https://www.raonline.org/wp-content/uploads/2022/04/rap-jb-jh-smart-charging-europe-2022-april-26.pdf>.

³⁰ G. Kamiya et al., “Energy Storage” IEA Technical Report, <https://www.iea.org/reports/energy-storage>

³¹ <https://spectrum.ieee.org/vehicle-to-grid> Michael Dumiak, “This Dutch City is Road-Testing Vehicle-to Grid Tech,” *IEEE Spectrum*, 27 June 2022, <https://spectrum.ieee.org/vehicle-to-grid>.

³² Kevin Delaney, “Harnessing the Power of Parked EVs,” *Cisco Newsroom*, 27 June 2022, <https://newsroom.cisco.com/c/r/newsroom/en/us/a/y2022/m06/harnessing-the-power-of-parked-evs.html>.

Issue: Need to transform legacy fossil-fuel urban transportation and infrastructure

Background

Towns and cities must rebuild and plan the urban space from the legacy of the fossil-fuel industrial era and foster the transition into sustainable urban ecosystems.

In towns and cities worldwide, communities must rebuild and refurbish their living spaces from the legacy of the first fossil fuel phase of the Industrial Revolution into sustainable communities that provide a good life for all people. CO₂ emissions must come down to net zero to avoid further climate warming far beyond the pre-industrial temperature levels safe for agriculture and earth ecosystems.³³ As noted by The Royal Society, “If emissions of CO₂ stopped altogether, it would take many thousands of years for atmospheric CO₂ to return to ‘pre-industrial’ levels.”³⁴ Meeting the climate crisis, therefore, requires bringing people together to care about each other and all life on the planet.³⁵

Cities and towns should strive to achieve net 50% of 2005 emissions by 2030, reengineering power grids with cheap solar and wind energy and accelerating transportation with electric vehicles—cars, trams, scooters, and bikes. “Estimates suggest that cities are responsible for 75 percent of global CO₂ emissions, with transport and buildings being among the largest contributors,” according to UNEP.³⁶ Older industrial cities need to be rebuilt for energy efficiency, with walkable neighborhoods. The megacities should be redesigned from the ground up with consideration for energy-efficient housing, including both heating and cooling systems, and well-designed parks and green infrastructures that connect humanity with nature.

Buildings already account for a significant share of emissions, and new construction for expanding urban areas could increase this ratio. According to Natural Resources Canada, for example, “Commercial and institutional buildings account for approximately one eighth of the energy used in Canada.”³⁷ Building heating systems are estimated to emit 2.5 billion metric tons of CO₂ (out of a global total of 40 billion) from fossil fuel boilers; global cement and steel production accounts for approximately 6 billion metric tons combined.³⁸

Other estimates show “mobility” as accounting for ~60% of an estimated 12 billion metric tons of global CO₂ emissions due to petroleum in 2019, out of more than 42 billion metric tons from all sources.³⁹ To minimize travel emissions, commuter suburbs with low-density housing must be designed close to jobs and work hubs,

³³ *The Net Zero Transition: What It Would Cost, What It Could Bring* (McKinsey Global Institute, Jan. 2020), <https://www.mckinsey.com/business-functions/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring>.

³⁴ “Climate Change: Evidence and Causes, Question 20,” The Royal Society, <https://royalsociety.org/topics-policy/projects/climate-change-evidence-causes/question-20/>.

³⁵ Reference the Care chapter in the Global Methodologies committee.

³⁶ “Cities and Climate Change,” UNEP, Resource Efficiency, What We Do, Cities, <https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change>.

³⁷ *Major Energy Retrofit Guidelines for Commercial and Institutional Buildings: Office Buildings* (Natural Resources Canada, 2015), <https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oe/buildings/pdf/MERG-Office-EN.pdf>.

³⁸ Net Zero Transition, McKinsey, 76.

³⁹ Net Zero Transition, McKinsey, 9.

but they should also allow conservation areas with natural habitats, green ecosystems services, and organic agriculture within the urban and peri-urban landscape.

The existing opportunities for reducing greenhouse gas (GHG) emissions vary widely depending on transportation, logistics, communications, and legacy infrastructure. Removing or not introducing high-pollution motor vehicles is essential, but cities must still tackle improving the quality of life for all citizens. A mixture of electrical vehicles (including trucks and scooters, as well as passenger vehicles) bikes, trains, buses, and possibly automated vehicles can be combined with urban planning that ensures that the megacities of the future allow all people to find jobs near their homes⁴⁰ or to commute with more sustainable means of transport.

To achieve this, citizen groups must be engaged to actively support the return to net zero.⁴¹ Reuse-and-reduce groups, which advocate for local circular economy waste control,⁴² including e-waste,⁴³ should collaborate with manufacturers to support the decrease of waste in the production cycle.

Groups that sponsor nature education clubs for children should collaborate with groups working on protecting and regenerating green space in and near towns and cities. Neighbors working together in community gardens should collaborate with food waste reclamation groups to eliminate hunger. Clean air monitoring groups should chart the overall emission reduction progress and collaborate with city officials to make sure all neighborhoods have clean air.⁴⁴ Housing groups should collaborate with companies that improve heating and cooling systems in existing buildings and provide energy-efficient housing for all.

Recommendations

1. Optimization of urban transportation is necessary to limit CO₂ emission and commuting times. Alternative means of transportation and “last mile” solutions should be considered within the redesign of legacy transport and logistics infrastructures.
2. Cities should offer common infrastructures allowing for networks, security, desks, and other needs available for locals to use as their working spaces. These infrastructures would increase the possibility of working from home or from nearby common office spaces.
3. The use of public transport, powered by renewable fuel, should be incentivized, making it readily available in cities and towns, mostly free, and connecting hubs of urban activities (e.g., offices, schools, and government services). In addition, added greenery to public transit stations would mitigate climate change heatwaves.⁴⁵ Furthermore, public transit should be run to reduce the need for a car, e.g., if you

⁴⁰ “What is the Most Sustainable City in the World?” *Going Green*, YouTube video, https://www.youtube.com/watch?v=fsWr0LfM_uQ.

⁴¹ “Our Goals for 2030: Build Healthy Cities,” The Nature Conservancy, <https://www.nature.org/en-us/what-we-do/our-priorities/build-healthy-cities/>.

⁴² ISWA (International Solid Waste Association), <http://iswa.org>.

⁴³ “International Cooperation,” US EPA, <https://www.epa.gov/international-cooperation/international-e-waste-management-network-iemn>.

⁴⁴ “List of Partners,” AirNow, <https://www.airnow.gov/partners/>.

⁴⁵ Emma Johnson, “All Aboard for Nature: Improving Outdoor Access Through Public Transportation,” EESI (Environmental and Energy Study Institute), 29 July 2021, <https://www.eesi.org/articles/view/all-aboard-for-nature-improving-outdoor-access-through-public-transportation>.

are able bodied. Ride/taxi services should be available for older persons, the disabled, and those with small children. Public transit should also be made more affordable to increase its use.⁴⁶

4. Innovations should be implemented in the sphere of building construction, operation, and heating and cooling, which produce a large share of GHG emissions. The use of heat pumps, district heating, and biomass boilers for heating, as well as of innovative building methods like carbon-sucking concrete,^{47,48} should be considered and implemented, alongside smart grid and network solutions, which significantly reduce GHG emissions.
5. Smart energy grids and utility systems that are efficient and reliable, as well as based on renewable sources, should be implemented within cities.
6. Waste disposal and treatment systems that are a source of methane and N₂O emissions should be reduced in favor of circular economy solutions and reuse technologies.
7. Urban populations that are vulnerable to sea-level rise and extreme weather events—drought, floods, wildfires, hurricanes, and tornadoes—should be offered housing alternatives that are safe and not vulnerable to climate change consequences.
8. Housing should be retrofit into carbon-positive places, including decentralizing renewable energy to local districts/suburbs. Insulation and design should cater to an energy consumption reduced to a strict minimum.
9. Smart charging and advanced energy storage should be implemented to facilitate wider spread of EVs, in addition to appropriate network planning to balance renewable energy supply and demand.
10. To significantly reduce noise pollution from vehicles (e.g., planes, cars, and buses),⁴⁹ research and development, as well as funding support, should be offered to study electric planes and vehicle systems that require further technological advancements.

⁴⁶ “Less Traffic Jams with a 9-Euro Ticket. Analysis of TomTom Data. Economy,” News in Germany, July 2022, <https://newsinGermany.com/less-traffic-jams-with-a-9-euro-ticket-analysis-of-tomtom-data-economy/>.

⁴⁷ Shanti Pless, Stacey Rothgeb, Ankur Podderm, and Noah Klammer, *Integrating Energy Efficiency into the Permanent Modular Construction Industry*, NREL Buildings Integration Research, <https://www.nrel.gov/docs/fy20osti/75516.pdf>.

⁴⁸ Heather Clancy, “Carbon-Sucking Concrete is Capturing Attention and Funding,” GreenBiz, 6 May 2021, <https://www.greenbiz.com/article/carbon-sucking-concrete-capturing-attention-and-funding>.

⁴⁹ Kathleen Meininger, “Community Noise Lab Studies Urban Pollution, Environmental Injustice,” *The Brown Daily Herald*, 25 Feb. 2022, https://senseable.mit.edu/news/pdfs/20220225_TheBrownDailyHerald.pdf.

Technological Insights and Recommendations

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Issue: No guarantee of fresh air and clean water

Background

Cities and towns should provide fresh air and clean water to their populations for sustainable human health and well-being. This challenge must be solved while coping with the extreme weather events caused by climate change, like more frequent and damaging floods^{50,51} and wildfires,⁵² which threaten our existing water treatment and air quality infrastructures.

“Air pollution is the greatest environmental threat to public health globally and accounts for an estimated 7 million premature deaths every year. Air pollution and climate change are closely linked as all major pollutants have an impact on the climate and most share common sources with greenhouse gasses,” according to the UN Environment Programme.⁵³ Clean water and sanitation is, therefore, UN Sustainable Development Goal 4.⁵⁴

The sustainable use of natural resources could help cities prevent a scenario in which people are deprived of clean air and have limited or no access to clean water. Cities are already making their own climate action plans in support of the Paris agreement for clean air.⁵⁵

Sustainable urban life depends on an effective health system. Clear water and fresh air are the key to improving public health. They depend on clean public and private transportation systems, a secure water supply, and energy efficiency. Watersheds should be rebuilt to help with water availability, maybe even by restoring natural systems like beaver colonies.⁵⁶

To create a healthier world, where future generations are more self-reliant and have the capacity to achieve the goals of a fair living standard, we need to focus on the conservation of natural resources and on aiding those facing economic challenges with guidance on reversing environmental degradation.

The idea of being deprived of fresh air or drinking water should be a thing of the past. What should exist is a world with freedom and empathy, where every life is valued, and every human being has the capacity to choose life over death. Therefore, environmental scarcity and air pollution should be our starting points.

⁵⁰ Manuela Andreoni, “Why Pakistan Was Hit So Hard,” *New York Times Climate Forward Newsletter*, 30 Aug. 2022, <https://www.nytimes.com/2022/08/30/climate/pakistan-floods.html>.

⁵¹ Christopher Flavelle, Rick Rojas, Jim Tankersley, and Jack Healy, “Mississippi Crisi Highlights Climate Threat to Drinking Water Nationwide,” *New York Times*, 1 Sept. 2022, updated 4 Sept. 2022, <https://www.nytimes.com/2022/09/01/us/mississippi-water-climate-change.html>.

⁵² M. D. Flannigan, B. J. Stocks, and B. M. Wotton, “Climate Change and Forest Fires,” *The Science of the Total Environment* 262 (2000): 221–229.

⁵³ “Pollution Action Note: Data You Need to Know,” UNEP, Air, Pollution Action Note, 7 Sept. 2021, updated 30 Aug 2022, <https://www.unep.org/interactive/air-pollution-note/>.

⁵⁴ “Goal 6: Clean Water and Sanitation,” UNEP and the Sustainable Development Goals, Why Do the Sustainable Goals Matter?, <https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-6>.

⁵⁵ “Clean Air Accelerator,” C40 Cities, Feb. 2022, <https://www.c40.org/accelerators/clean-air-cities/>.

⁵⁶ Ben Goldfarb, *Eager: The Surprising, Secret Life of Beavers and Why They Matter* (White River Junction, VT and London, UK: Chelsea Green Publishing, 2018).

Actions should be implemented to immediately address air quality in urban areas around addressing cars, trucks, and buses—one of the largest sources of bad air quality in urban areas globally is traffic-related air pollution.

Urban ecosystems need to value nature⁵⁷ and truly appreciate what it means for humanity and how it has shaped, structured, and conditioned human life. The people of the modern world should effectively reconnect with nature. Scarcity of resources within the cities should not stretch to the point of clean air and water, and those should be affordable to all human beings to prevent diseases and to increase the quality of human life. The quality of human existence within urban areas should be addressed, especially within districts that suffer consistent water shortages and within housing areas with unhealthy air conditions.

Recommendations

1. Technological solutions must be implemented to increase the ability to retain water in the soil and prevent flooding in cities.⁵⁸ To do so, wider collaboration between actors from the rural and urban spheres will be needed, due to the capacity of agriculture and forest ecosystems to alleviate the environmental pressures on cities from both flashfloods and droughts.
2. The water supply to cities and the water quality within all urban districts need to be considered fundamental human rights, regardless of purchase power and capacity.
3. The provision of clean water and air should be a consistent element of all planning and zoning policies that compete for space within the urban areas with consistent methodological assessments for the impact of new developments.
4. Responsibility for clean water and air should be taught from a young age with consideration to water waste and transport efficiency to ensure that precious resources are available for all city dwellers.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

⁵⁷ Ehsan Masood, “More Than Dollars: Mega-Review Finds 50 Ways to Value Nature,” *Nature*, 15 July 2022, <http://www.nature.com/articles/d41586-022-01930-6>.

⁵⁸ “Improved Water Retention Capacity in the Agricultural Landscape,” Climate-ADAPT, Database, Adaptation Options, 7 June 2016, updated 9 Mar. 2023, <https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/improved-water-retention-in-agricultural-areas>.

Issue: Need to ensure access to food, improve distribution, and decrease waste

Background

In the 21st century, the agriculture industry produces enough food to avoid hunger in the cities and towns of every country.⁵⁹ However, we have been unable to solve hunger in developing nations and underdeveloped regions of developed nations⁶⁰ due to distribution inefficiencies and income inequality, which results in food waste. Moreover, the transport of food and agricultural processes, such as manure management, liming and urea application, rice cultivation, and burning crop residue, result in emissions of carbon dioxide, methane, and other GHGs. Meeting the climate crisis sustainably requires solving the hunger problem while reducing GHG emissions due to agricultural production. Food systems must be made resilient to water shortage, drought, heat waves, and other consequences of climate change, as well as to political conflict and income inequality.⁶¹

Urban agriculture can reduce the pressure on land use and agricultural production outside of cities while improving the quality of life for everyone in urban areas.

Citizen-led initiatives are already developing to help with urban food production and to prevent food waste. Grassroots efforts like Food Shift provide job training and food for the needy, using donated food that would otherwise go to waste.⁶² More than 14,000 Climate Victory Gardens decrease carbon in the atmosphere while hoping to establish a movement for significant vegetable production similar to the victory gardens planted in the United States during World War II.⁶³

At the municipal rather than the individual level, community fridges should be provided where low-income and homeless community members can pick up excess food, e.g., from grocery stores. Municipal composting services should be provided in every city, with compost collection bins in every public building and at every large business. Food waste breaking down in landfills emits a considerable percentage of GHGs, whereas composting prevents this negative impact and instead provides nutritious soil for use in gardens.⁶⁴

Community groups that sponsor nature education clubs and gardens⁶⁵ for children, protect and regenerate green space in and near towns and cities and are critical to sustainable, local food production. Neighbors

⁵⁹ Moira Borens, Sebastian Gatzert, Clarisse Magnin, and Björn Timelin, "Reducing Food Loss: What Grocery Retailers and Manufacturers Can Do," *McKinsey & Company*, 7 Sept. 2022, <https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/reducing-food-loss-what-grocery-retailers-and-manufacturers-can-do?cid=eml-web>.

⁶⁰ Lucy Kavi et al., "Environmental Justice and the Food Environment in Prince George's County, Maryland: Assessment of Three Communities," *Front. Built Environ.*, 18 Oct. 2019, <https://www.frontiersin.org/articles/10.3389/fbuil.2019.00121/full>.

⁶¹ Kelsey Simpkins, "Amid Climate Change and Conflict, More Resilient Food Systems a Must," *CU Boulder Today*, 15 July 2022, <https://www.colorado.edu/today/2022/07/15/amid-climate-change-and-conflict-more-resilient-food-systems-must-report-shows>.

⁶² Food Shift, <https://foodshift.net/our-approach/>.

⁶³ "Climate Victory Gardens," Green America, <https://greenamerica.org/climate-victory-gardens>.

⁶⁴ "Composting Food Waste: Keeping a Good Thing Going," US Environmental Protection Agency, Southeast New England Program, Oct. 2020, <https://www.epa.gov/snep/composting-food-waste-keeping-good-thing-going>.

⁶⁵ "Oakland Community Gardening Program," City of Oakland, Public Works, <https://www.oaklandca.gov/topics/oakland-community-gardening-program>.

working together in community gardens alongside food waste reclamation groups could contribute to eliminating hunger within urban and peri-urban areas.

Recommendations

1. Food should be produced and consumed locally where feasible. Moving farm production closer to cities will reduce CO₂ emissions from food transportation and logistics.⁶⁶ Urban farming could contribute to better quality of food consumed within cities while reducing waste and GHG emissions. This approach increases the resilience of the food supply chain, creating deeper connections between producers and consumers of food in cities and towns, improving logistics and transportation, and reducing CO₂ emissions.
2. Efforts should be made to reduce food waste from production through transportation and retail. The European Union is already implementing waste reduction strategies within its Farm to Fork strategy,⁶⁷ but a global movement must take place within cities that prioritizes waste reduction in the food sector.
3. The UN SDGs Goal 2⁶⁸ prioritizes the end of world hunger, but that will be impossible to achieve without the concerted efforts of all actors within urban areas, including local governments, service businesses, and local communities to reduce waste and to support networks for the management of food consumption and waste in a more sustainable fashion.
4. Urban sprawl resulting in the expansion of cities to consume agriculture areas should be managed to preserve peri-urban greenbelts and areas. Although the current growth of cities is reasonable, the post-COVID-19 ability of workers to perform the same task remotely and the implementation of four-day workweeks within some countries⁶⁹ supports the transition to an urban system under less pressure to grow.
5. Research on technological advances for sustainable food production and on consumer acceptance of sustainable foods, for example, sustainable protein production,⁷⁰ should be supported. Healthy food ecosystems should be targeted and expanded on within consumer-based industries, which should be further incentivized to reduce waste.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

⁶⁶ "Cities Must Help Produce More Food," ARUP, <https://www.arup.com/perspectives/cities-must-help-produce-more-food>.

⁶⁷ "Farm to Fork Strategy," European Commission, Horizontal Topics, https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en.

⁶⁸ "Goal 2: Zero Hunger," UN Sustainable Development Goals, <https://www.un.org/sustainabledevelopment/hunger/>.

⁶⁹ Josephine Joly and Luke Hurst, "Four-Day Week: Which Countries Have Embraced It and How's It Going So Far?" *EuroNews*, updated 23 Feb. 2023, <https://www.euronews.com/next/2022/12/19/the-four-day-week-which-countries-have-embraced-it-and-how-s-it-going-so-far>.

⁷⁰ "Sustainable Protein," World Business Council for Sustainable Development, Food & Nature, Food and Agriculture, Healthy & Sustainable Diets, <https://www.wbcsd.org/Programs/Food-and-Nature/Food-Land-Use/FReSH/Sustainable-Protein>.

Issue: Need to foster sustainable and regenerative communities

Background

Sedentary, exclusive, and extractive city models prevent integrated ecosystems in which humans, animals, and machines coexist and live harmoniously in nature.

Sustainable development on a global scale is possible through the multilevel and interdisciplinary efforts of many people. Although projects dedicated to building smart cities have expanded exponentially in the past few years, we still live in places with fragmented infrastructures, poor value accounting, low-quality services, and artificial barriers between people and their basic needs.

By 2030, humanity urban settlements should be transformed into inclusive, sustainable, and regenerative city models in which humans, animals, and machines coexist and live harmoniously with nature. Regenerating forests⁷¹ and creating wildlife corridors⁷² can help to reconnect children and adults with nature and to motivate further social change.

Traditional competitive mechanisms that have produced great advancements within societies have produced negative side effects that prevent the resolution of some of society's greatest problems. Greed and corruption, and the lack of incentive mechanisms to promote a sustainable social architecture, create fundamental barriers to the establishment of an equitable world that prioritizes environmental sustainability. Monopolist pricing structures and artificial scarcity mechanisms cause unnecessary search and competition despite the existing technologies for production and the sufficient capacity to share resources and the economic production output. To resolve the issue for future societies, they need to be educated in a collaborative fashion, which promotes shared responsibility and shared abundance for all citizens.

According to European Commission Report on the future of cities in Europe:

Urban segregation is the unequal distribution of different social groups in the urban space, based mainly on occupation, income, and education, as well as on gender and ethnicity. The quality of life and number of healthy life years differ among these groups, too...Socio-spatial segregation is not negative per se, since it can entail a high sense of local identity and cultural and social capital within a community. However, it can have a detrimental effect on cities' social stability and augment social fragmentation.⁷³

Urban societies need to foster respect for one's' neighbors and not see them as strangers but as supporting friends. Living in a world where we live as close-knit communities, in towns and cities that engage on a

⁷¹ Lela Nargi, "The Miyawaki Method: A Better Way to Build Forests," *JSTOR Daily*, 24 July 2019, <https://daily.jstor.org/the-miyawaki-method-a-better-way-to-build-forests/>.

⁷² "How Sussex Farmers Plan to Create a Wildlife Rich Green Corridor to the Sea," *The Guardian*, 22 July 2022, https://www.theguardian.com/environment/2022/jul/22/sussex-farmers-plan-to-create-wildlife-rich-green-corridor-to-the-sea?CMP=Share_iOSApp_Other.

⁷³ "Social Segregation: How Can Cities become More Inclusive?" European Commission report on *The Future of Cities*, <https://urban.irc.ec.europa.eu/thefutureofcities/social-segregation#how-can-cities-become-more-inclusive>.

face-to-face level, where mutual understanding and respect flourish because of real relationships and communication remains a challenge to today's society. Personal anxiety and isolation no longer have a place in our society, even at the beginning of the 21st century.

Recommendations

1. Cities should be designed based on a sustainable and inclusive social architecture, zoned based on sustainable development and organized based on social cohesion. Modern architecture has the capacity to reflect the needs of the current citizen while maintaining the individuality and style of the region. But a future cityscape should be a co creation between all citizens, regardless of their social and economic standing.
2. Urban planners must include gender and age considerations when remaking infrastructure and transportation to adapt to climate change,⁷⁴ allowing for a more inclusive city experience for both young families and older persons.
3. Although cities represent a microcosm of all economic conditions and social groups, urban segregation should not result in unequal outcomes for different groups in areas such as climate-resilient housing, air quality, and education. They need to provide solutions of equal value for the variety of districts and living conditions that converge within a city.
4. Urban networks must collaborate to foster a homogeneous society that functions as a unified collective intelligence to promote peace, compassion, altruism, and justice while showing zero tolerance toward supremacy, violence, inequity, colonialism, expansionism, and oppressive behavior. Cities should strive to establish platforms for the voices of environmental justice groups, such as West Harlem Environmental Action⁷⁵ and Deep South Center for Environmental Justice.⁷⁶
5. Social media needs to adapt to stimulate and support "local" face-to-face connectivity. An incredible example of what this can look like are the Buy Nothing groups flourishing on Facebook.⁷⁷ To create a new value system for rewarding people for "good"⁷⁸ rather than for superficiality and economic gain (e.g., the "follower's" syndrome).
6. Towns and cities are developed to bring people together, whether meeting up at our central mail drop, on the porch of the general store, at the public library, or at a community event. Therefore, metropolitan areas should come together not only in times of need but also in everyday interactions to allow citizens to feel a part of something that they nourish but also that nourishes their experience.

⁷⁴ Regan F. Patterson, *Gender, Climate, and Transport in the United States*, [WEDO (Women's Environment and Development Organization), July 2021], <https://wedo.org/brief-gender-climate-transport/>.

⁷⁵ WE ACT for Environmental Justice, <https://weact.org>.

⁷⁶ Deep South Center for Environmental Justice, <https://www.dscej.org/>.

⁷⁷ Tilde Herrera, "How 'Buy Nothing' Facebook Groups Are Emerging as Sites for Mutual Aid," *Eater*, 1 July 2022, <https://www.eater.com/23189909/buy-nothing-facebook-groups-mutual-aid-food-distribution>.

⁷⁸ Cecilia Fischer-Benitez, "Volunteer Spotlight: When Tech Is the Last Piece of the Puzzle," *Code For America*, 25 Aug. 2020, <https://codeforamerica.org/news/volunteer-spotlight-when-tech-is-the-last-piece-of-the-puzzle/>.

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Issue: Energy challenges with artificial intelligence and machine learning data systems

Background

Artificial Intelligence (AI) and data-driven solutions can introduce efficiency in heating, cooling, and industrial processes. But since electronic devices also use energy, global communities need to assure that expanded use of computers and computer networks is supported by renewable energy sources and is subject to cost-benefit analysis in terms of energy and e-waste costs, as well as monetary costs.

The current explosion in AI-based solutions to everything is a result of the convergence of greatly increased computing hardware power with graphics processing units in cloud data centers; massive amounts of data from networks of websites, cell phones, and IoT sensors; and advancement in the techniques of machine learning (ML) based on game playing and linguistics research. The insight that neural networks can be used for ML anywhere so that the desired result can be formulated as a winning outcome has resulted in remarkable successes, like the recent result in finding faster ways to do matrix multiply (which is the core of computer implementation of neural networks).⁷⁹

A key component of building sustainable cities and towns is technological diversification based on three main major building blocks: open platforms, machine intelligence, and diversified, reusable resources, all of which can make recommendations in these areas. A valuable resource on this topic is Climate Change AI, a global initiative to catalyze impactful work at the intersection of climate change and ML.⁸⁰

However, data center energy consumption amounts to 1% of worldwide power distribution.⁸¹ It has been a consistent percentage since at least 2010. As AI systems, for the benefit of cities, evolve, changes in the amount of data collected will occur due to IoT (such as connected sensors for city infrastructure and industrial, agricultural, and consumer applications), as well as training and inference of large AI/ML models that could drive data center energy consumption (including processing at the network edge) to much higher levels in a few years' time unless new computer/network/storage/memory architectures are introduced.

Many helpful tools in managing complex cities and industries will arise from data-fueled technologies, but not all problems can be solved via data aggregation. We need a conscientious monitoring of the kind of training data used and how outcomes are evaluated to create a sustainable data ecosystem of value to humanity.

Open-source systems harnessing machine intelligence can help humans improve resource efficiency. But we should remain mindful of the waste from our electronic and computation systems (e-waste). Setting up

⁷⁹ "DeepMind's Game-Playing AI Just Beat 50-Year-Old Record in Computer Science," *MIT Technology Review*, 5 Oct. 2022, <https://www.technologyreview.com/2022/10/05/1060717/deepmind-uses-its-game-playing-ai-to-best-a-50-year-old-record-in-computer-science/>.

⁸⁰ Climate Change AI, <https://www.climatechange.ai/>.

⁸¹ *Data Centres and Data Transmission Networks* (Paris: IEA, Sept. 2022), <https://www.iea.org/reports/data-centres-and-data-transmission-networks>.

towns and cities to manage e-waste and other industrial waste carefully is the key to a sustainable future. See the GOSH Manifesto⁸² for ideas on how to open these resources.

Human knowledge should be transferable and accessible. Open-sourced information and knowledge will help this world to be a better place.⁸³ Having open backend platforms that communities can use, and reuse, is a core concept of sustainable advancement. Building on this knowledge is a dream that open-source platforms can achieve. The speed of the technological transformation experienced today should be reflected within the cities of tomorrow, where telecommunications and advanced digitalization systems and sustainable planning should function in cohesion.

Recommendations

1. The benefits and costs of AI solutions must be evaluated using ML, considering both how well the training outcomes match truly desirable results and the expense of the computation resources.
2. Data center energy consumption needs to be reduced through innovations to cool the data center such as better separation of hot and cool air and liquid cooling of hot components, reducing data movement, moving to photonic from current-driven communication, and moving from volatile to nonvolatile memory.
3. The development of open-source software frameworks must be encouraged, standardizing them based on how these technologies can be used with various vendor equipment and systems. Efforts like Public Lab⁸⁴ and the Wilson Center⁸⁵ should be supported to involve everyone in creating solutions.
4. Data-driven solutions should be supported based on energy and central processing unit conservative systems, combining resources across cities to ensure that data are processed more efficiently.

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⁸² "GOSH Manifesto," GOSH (Gathering for Open Science Hardware), <https://openhardware.science/gosh-manifesto/>.

⁸³ Shannon Dosemagen, Writing (website), <https://www.shannondosemagen.com/writing>.

⁸⁴ Public Lab, <https://publiclab.org/>.

⁸⁵ Alison Parker, Shannon Dosemagen, and Ashley Schuett, "Low-Cost and Open Tools for Environmental Decision-Making," *The Wilson Center* (blog), 5 April 2022, <https://www.wilsoncenter.org/blog-post/low-cost-and-open-tools-environmental-decision-making>.

Issue: Lack of urban spaces for work–life balance and a well-being economy

Background

Urban ecosystems must leverage the technologies of smart cities⁸⁶ and a circular economy⁸⁷ in practice to provide more livable shared spaces, prioritizing community and mental health.⁸⁸

The current ecosystem of urban landscapes being measured by economic criteria does not take into consideration the flourishing of human relationships, creativity, and happiness within the urban areas. The capacity for citizens to enjoy art, tourism, and culture is present in planning within large metropolitan areas but is sidelined by industrial growth.

By 2030, humanity will have evolved to a society 6.0, where AI and environmental sustainability concepts coexist to provide a more equitable organization of resources within the world. Technologies that enable smart cities and circular economies should, in practice, provide more livable shared spaces, prioritizing community and mental health, green mobility, smart utility systems, knowledge and ethics, and sustainable societal growth over monetary benefits.

The implementation of AI-driven networks and solutions will remove some pressure from the workforce and introduce an equitable urban space, prioritizing well-being and health over momentary economic gains. With the capacity of technology to transform the labor market and numerous industry segments, and with the implementation of robotics within the service industry and autonomous vehicles populating the streets, the urban economy will also need to evolve to integrate a new understanding of value.

Advanced digital technologies will be important for the planning and redesigning of the urban space, with the main goal of transforming cities into enjoyable urban spaces,⁸⁹ where work, food and services are reachable within a 20-minute walk or cycling radius or paired with carbon-neutral public transport. As a main living space for most of humanity, the urban area will need to integrate within itself additional value-driven systems that improve on the human experience and provide for a healthier, happier society.

Education systems within urban areas should evolve to include the further and more comprehensive understanding of a city as an ecosystem of interlinked technologies, social groups, and economic segments, where the definitions and standards for sustainability, health, and happiness within society are shared and solidified to bring forth an actual post-AI society.

Rather than focusing on establishing an environment for investment and sustaining traditional economic segments, cities must adopt a more advanced approach to integrate the values of well-being, nature-based restoration, and rejuvenation that closely align not only with a more sustainable future but also with the values of an advanced technological society that will be present after the wider adoption of AI systems.

⁸⁶ *Putting People First: Smart Cities and Communities* (US Department of Transportation, 9 June 2021), <https://its.dot.gov/smartcities/SmartCities.pdf>.

⁸⁷ Walter R. Stahel, “The Circular Economy,” *Nature* 531 (Mar. 2016): 435–438, <https://www.nature.com/articles/531435a>.

⁸⁸ Wellbeing Economy Alliance, <https://weall.org>.

⁸⁹ Jeff Speck, *Walkable City Rules: 101 Steps to Making Better Places* (Washington, DC: Island Press, 2018).

Recommendations

1. Knowledge, while widely accessible via digital means, needs to be focused on the introduction of technologically sound and environmentally conscious terms such as *green AI*, *knowledge city*, and *smart utilities* to ensure synced comprehension between wider groups of stakeholders and the actualization of society 6.0.
2. The practice of ethical AI within the urban areas will support the positive impact of these systems on the improved efficiency in the management of systems and infrastructures and will remedy some of the negative side effects that may occur from the misuse of AI in certain areas such as law enforcement.
3. Information, knowledge, communication, and shared planning about urban environmental problems, standards, and solutions should be communicated between different levels of government, nongovernmental organizations, and the public, as well as between people in different parts of the world, creating smart communities within the smart cities.
4. Creativity within the urban space should be incentivized and promoted as much as industrial investment. As most of the world's population will be spending more than 80% of their lives within urban areas, the human experience of these areas should be one of enjoyment and balance beyond the rush.
5. As technologies (including but not limited to AI) continue to evolve, the metrics by which we measure the advancement of an urban society will need to evolve as well to potentially include measurements for well-being, creativity, and presence. Within a technologically advanced city system, sustainability and human well-being are not targets to be achieved but a concurrent condition of the environment.

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