



**SUMMIT ON SCIENCE ENABLEMENT FOR THE
SUSTAINABLE DEVELOPMENT GOALS**

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MEETING REPORT ON URBANIZATION STREAM

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SUMMARY

Half of the world's population lives in cities, and the number is expected to grow to 60% by 2030. Although cities take up only 3% on the land on earth, they contribute 60%-80% of its energy use and produce 75% of its carbon emissions.¹

The UN's eleventh Sustainable Development Goal (SDG) focuses on cities and communities, setting a number of targets such as safe and affordable housing and transportation systems, in order to create cities that are a place of opportunity for everyone.²

The urbanization task group that convened on November 29, 2016 as part of the New York Academy of Sciences Summit on Science and Technology Enablement for the Sustainable Development Goals determined that every single one of the criteria or outcomes for urbanization can be encapsulated in the concept of livability, which depends on the quality of life of those who live there.

One of the key areas the task group described where much more research was needed on urbanization pertained to new transportation models, such as car sharing programs and self-driving cars, and what impact they would have on people in cities. There was agreement that academic groups are key players in conducting research, but that academic-private partnerships represent an important model for bringing funding and resources to the research questions.

The task group identified two barriers that if addressed and overcome could greatly support the numerous research questions surrounding sustainable urbanization. One is that the private sector, such as telecommunications companies, possesses enormous sets of data on mobility, energy and other aspects of urban life that would be invaluable to academic research groups but are not, in many cases, available. In addition, the task force stressed the importance of defining a research agenda and key performance indicators (KPIs) for the 17 SDGs.

As much as academic-private partnerships can help advance the research, partnerships between public or government groups and private companies play a critical role in implementing new technologies, as do financial incentives and social drivers. The task group agreed that cities themselves, whether individual cities or networks of cities, can help bring public and private groups together. The Academy could also create opportunities for these groups to collaborate and cross-pollinate, such as through future task groups or by establishing an institute dedicated to urbanization.

OVERVIEW

Achieving the SDGs will require a value chain called R&DDD—research and development, that continues to demonstration, and finally ends with the deployment or diffusion phase. Many research technologies are available that could be superior to current technologies, but are not scaled up and are languishing because

¹ <http://www.un.org/sustainabledevelopment/cities/>

² <http://www.un.org/sustainabledevelopment/cities/>

the final “D” is not taken seriously, said **Jeffrey Sachs**, director of the Center for Sustainable Development at the Earth Institute at Columbia University and Special Advisor to the United Nations Secretary-General on the Sustainable Development Goals, in the opening remarks for the Summit.

The urbanization task group started its discussion at the Summit at the beginning of the value chain. They assumed that there remain open research questions about cities, and proceeded to identify what those questions are, both the practical and theoretical; which entities should be involved in answering them; and which challenges and opportunities are associated with tackling them. The second half of the task group discussion was dedicated to the implementation of new technologies, such as the best strategies for implementation and which groups should be involved in implementation.

The task group was comprised of 17 participants, including three discussion leaders. The participants came from academia, advocacy groups, governmental bodies, and the corporate sector, from software to construction and manufacturing companies.

Stream leads were as follows:

- Guru Banavar, IBM
- Norine Kennedy, US Council for International Business
- Rich Goode (facilitator), Ernst & Young

SCOPE AND OPPORTUNITIES

The key opportunity of a city—livability—measures the condition of the individuals living in the city and whether the majority of individuals in the city are receiving the city’s benefits. These benefits include those of the basic physical infrastructure, such as housing and energy, and the service infrastructure, such as healthcare and education. Beyond those basic services, a host of economic opportunities—including innovation—has to be available for a city to meet the criterion of livability.

A second major opportunity of urbanization that the group identified was resource consumption. The concentration of people and the demand for resources make cities ripe for the sharing economy, whether in terms of sharing housing, appliances, or automobiles. The upshot of a sharing economy is that people could think differently about how they manage energy and materials, driving the city toward greater resource efficiency.

In considering the opportunities of urbanization, the task group agreed that achieving livability and resource efficiency will be more challenging for cities in developing countries. Urban benefits should be extended to a maximum group of residents in these cities, but at the same time, many residents do not even have access to basic services, such as sanitation and reliable electricity.

RESEARCH AND DATA

One of the research questions identified was the impact of new models of transportation on urbanization. A couple of new models have recently come on the scene—the electric or low emission car and the car

sharing model, as exemplified by programs such as [BlaBlaCar](#) in Europe, in which people who are driving long distances can sell seats in their car. The task group discussed how the car-sharing model will complement trains as a transportation system, because, for example, cars can travel between smaller cities and to destinations that trains may not go. The model of self-driving cars is also likely to become a big player in the next five or so years. It is an open question how these new models will change the transportation landscape in cities.

Specifically pertaining to self-driving cars, the artificial intelligence behind this technology raises a slew of different questions, in terms of mobility, the economy, the environment, other industries, and the workforce. How will self-driving cars, for example, displace drivers and what will job retraining look like for this sector?

One of the great strengths of cities is their ability to foster the convergence and cooperation of various industries—their ability to serve as a locus for a cross expertise approach. It will be critical for various entities—academic groups, corporations, and NGOs—to come out of their silos and speak a common language in order to make progress toward the urbanization SDGs.

Academia was held up in the task group discussion as an entity with enormous potential to build evidence, particularly in answering practical questions around urbanization. At the same time, the sector was identified as a possible barrier to data generation, because academia tends to be disconnected from applied science and to move at a slower pace than other entities. For instance, in regards to urbanization, academic groups might think of city spaces as divided along class lines, which is an outmoded mindset.

However, there are some examples of successful academic partnerships, and those have provided evidence that could potentially attract more members of the private sector to invest and thus attract more resources. A shining example of a successful endeavor undertaken by an academic-private partnership involved research suggesting that working in a green building is associated with higher productivity.

In this case, the academic partner adhered to the tight deadline of their corporate partner, which was necessary for continued funding of the study. In return, the corporate partner helped publicize the results in order to help them reach a broader audience beyond readers of peer-reviewed academic journals. The task group decided it could play a key role in laying out a list of practical research questions around urbanization that academic groups in particular could use as a guide.

Healthcare was identified as a sector that could lend itself well to public-private partnerships. Between medical universities, healthcare systems, and insurance providers, there are massive amounts of clinical data at the ready. It would be possible to bring data from these entities together, and analyze them in partnership with software companies and gather real-world evidence to answer myriad questions such as about which drugs are effective against which diseases.

Although in many cases it is clear what the important research questions are, there are challenges in accessing the datasets to answer those questions. Large telecommunication companies and the likes of Google and Apple have massive datasets and the task group agreed that it would be invaluable to many research questions—such as how people move through cities and buildings—to be able to analyze those

datasets. They agreed that data is the new gold, and that among the most useful datasets would be those that pertain to mobility, energy, green buildings, health, and education. The group stressed that it would be useful to have a list of the datasets that are available along with those that are not available, such as smart meter data and building energy use, and for which recommendations should be made to private sector entities to share the data with academic research communities.

Working with datasets could enable backcasting, in which a desired outcome is envisioned and programs and policies are planned to allow its realization. The task group stated that this approach will be critical for the success of the SDGs in general. Following a backcasting approach, research groups would indicate the end result they would like to achieve so that they would be able to influence which data are collected, how the measurements are taken and the questions they would like to ask of the datasets. Establishing mechanisms for sharing datasets could also have the benefit of helping cities realize the data they should keep better track of us, including GIS data and data on energy assets, such as the energy embedded in buildings. In addition, because data has value, the point was raised that the entities that generate the data—the cities themselves—could share in their value.

In order to guide the type of data that should be collected, the task group hit upon the importance of assigning a research agenda and key performance indicators (KPIs), which do not currently exist, to the 169 subcategories of the 17 SDGs. These KPIs, which could be created by a separate task group, could help foster partnerships and opportunities for cross-fertilization between entities rather than contributing to the problem of silos. For example, if two groups were collecting two sets of data about the same system in a different way, both datasets could be collected at the same time, and probably in a more precise way, by a central source. Another potential benefit of KPIs is to promote the ability to backcast, because they would state specific questions, such as how the carbon emissions from a building impact human health. Experts would have to collect data to answer that question, upon which experts in turn could act.

On the downside, selecting KPIs will be challenging because they have to involve measurements that can be reliably made across disparate contexts, are universally applicable, and possible to aggregate. In addition, while the KPIs will need to focus on issues that affect cities as a whole, such as a city's carbon emissions reduction target, it will also be important to find ways to communicate to individual groups and companies why that target is important to them. For instance, whereas combatting climate change may be too big to get a certain community's attention, they may find the impact of carbon emissions on climate resilience or health more relatable. In putting together any such list, it will also be worthwhile to take a survey of the KPIs that are already out there and determine if some could lend themselves to SDGs, rather than starting from scratch.

An important barrier to conducting urbanization research is the lack of funding for applied science questions, such as how cities can use data to make decisions and apply new technologies. The task group dedicated discussion time toward describing a funding framework for groups in the non-private sector working on important questions that do not have a clear path to profit.

Funding models were discussed among the group that involve government agencies, corporations funding competitions and philanthropic activities, such as companies donating money through their philanthropic

divisions. In a multi-city competition, the city of Columbus, Ohio, was awarded \$50 million in Smart City grants from the federal Department of Transportation in 2016 to develop transportation systems, including self-driving cars and electric vehicle charging stations. The task group discussed spillover benefits, such as contributions from private sector groups to Columbus, which more than doubled the money the city received. The competition also stimulated communication between participants about mobility and urbanization.

Another example of a competition model is the Kaggle Competition, which not only awards a monetary prize to the winner, but also provides all participants with datasets. Participants are asked to use those datasets to develop solutions to a particular problem. This approach speaks to the fact that, although it is important to explore open-ended questions, many practical questions can only be solved once the right dataset has been obtained. Companies such as IBM and United Technologies provide datasets along with funding to universities to address specific questions; the task group concluded that that model should expand to include more corporations and universities.

In an example of a philanthropic activity, IBM donates money to a handful of cities worldwide each year through its Smarter Cities Challenge to improve how those cities deliver services and invest in infrastructure, and to help them bridge gaps between their agencies.

However, ideas that arrive on the scene by way of challenges or competitions created to solve a specific problem often need time to be scaled up before it is possible to know whether the economics are feasible. However, funding is typically not maintained for this demonstration period and the ideas quickly fade away in a matter of a couple years. The task group brought up the possibility that cities could try to create models, similar to a subsidy program, where they could support new technologies for a certain amount of time until they have scaled up to a point that they could be economically feasible.

IMPLEMENTATION AND PARTNERSHIPS

In addressing the question of what are the best ways to implement new technology, incentives quickly shot to the top of the list. To underscore this point, the urbanization task group discussed some differences between photovoltaic (PV) uptake in two countries, Germany and Turkey. Even though Turkey receives more solar radiation than Germany and its cost of electricity is at least as high, it has much lower rate of PV implementation than its Northern European counterpart because no policies exist in Turkey that guarantee people who install PV systems can feed energy into the grid and offset their electricity bill. Instead, they have to store the energy and distribute it inside their building, which is very difficult

In the United States, the financial incentives for installing a PV system in your home are highly favorable and there is an abundance of services to help consumers understand how much they could gain for their effort.

Even more powerful than policy and legislation as a force for implementation are social and economic drivers. For instance, in Germany, there is a political push for all cars to be electric by 2020. However, the task group raised the question whether this will be met with too much social or economic opposition, as the shift from CO₂ burning engines to electric engines has been associated with big layoffs and could lead to

even bigger shifts in infrastructure and workforce. Meanwhile, in the United States, the importance of social and economic drivers has been exemplified by car sharing programs such as Uber and Zipcar. Their success is due to the fact that college grads don't have the money to buy a car and are living in cities where parking is limited, and was unexpected by the automobile industry, which is now scrambling to invest in these platforms. Similarly, the fact that natural gas is more abundant and cheaper than coal will continue to push the United States away from a coal-based economy regardless of the policies or regulations (or lack thereof) around coal.

At the same time, the task group discussed situations where legislation plays an important oversight role in platforms that are socially and economically driven. For example, although Uber is a highly successful business model, it has received scrutiny regarding its insurance and social benefits for its drivers. And self-driving cars, which the task group anticipate becoming an important player in the transportation landscape in coming years, could introduce a number of social issues, including environmental problems if legislation is not created to prevent consumers from having their cars drive around in circles rather than pay for parking.

An obstacle that is especially pertinent on the residential level is the fact that people typically do not live in a building long enough to receive a return on investment for high efficiency systems. The task group mentioned the need for alternative sources of funding for these systems, such as through PACE financing, which offers payment plans to building owners. As energy efficient technologies become more widely used, the payback time will decrease.

Financing these technologies is at the heart of a cradle-to-cradle, or closed loop, economy. Another piece of this system is recognizing the value in the embodied energy of existing buildings. The task group discussed the argument that the greenest building is the one that has already been built, rather than investing time and energy in demolishing and constructing a new building. Moreover, for the cases where a building is torn down, materials should be repurposed.

Another important piece of the implementation picture will be expanding existing technologies whose benefits may not be appreciated. In one example laid out during the task group discussion, United Technologies, which is the largest transporter of refrigerated goods, found that growing the refrigeration industry in developing countries could help offset climate change. Although it seems counterintuitive, refrigeration can substantially reduce food waste, and thereby reduce the amount of land that is destroyed to produce food. Sustainability groups at United Technologies are currently communicating the need to expand refrigeration with various markets.

The task group homed in on the critical role of public-private partnerships in bringing new technology and infrastructure to fruition. Although it may seem like city projects, such as transportation systems, would have their start in the public sector, this model has proven fraught with challenges, as the task group discussed. There have been conflicts between the different layers of government, from local and state governments, which hold a lot of control in countries such as the United States, up to federal or central governments, which are more powerful in certain other countries. This theme has been observed in cities around the world.

Public-private partnerships can be especially beneficial for projects such as transportation systems in which the public sector lacks the capital and private groups get a lease that ensures them profit for the first several years of operating the system. However, there was also an agreement among the task group that not all public-private partnerships are created equal and some may be inefficient and fail to bring benefits to citizens. For example, a new government administration may be less amenable to a partnership than the previous administration that created the partnership and may not adhere to the terms or manage it well. To safeguard against these possible shortcomings, the task group agreed that it is important for local authorities to be equipped with the tools to properly assess the partnership and make sure it is delivering its intended benefits.

One of the big questions the task group addressed was how to bring the appropriate groups together to create public-private partnerships. Cities—mayors and city councils—should play a leading role as matchmakers to connect the universities, corporations, and NGOs that are willing to participate in partnerships. In fact, groups such as C40, a network of 80 cities worldwide that is focused on fighting climate change, are already making strides in that direction.

An additional benefit to involving cities in the formation of partnership could be to ease the problem of municipalities souring to the idea of smart cities. The point was raised during the task group discussion that some cities have become frustrated with so-called smart technologies and the companies that are pushing them and are dubious that these technologies can really pay off on the large upfront investment. There exist now so many of vendors in this sector that cities have become saturated and have in some cases grown resistant to even suggestions about what they need to do to be a “smart city.” It was agreed that these vendors would do well to place more focus on articulating *why* a particular city would want to participate.

KEY ACTIONS

There was a consensus among the task group that the NYAS also has the potential to play an important role in connecting city representatives, and possibly in organizing follow-up discussions involving representatives from city governments as well as from UN organizations. This role would be akin to the responsibility that the Academy has undertaken to bring together city representatives from around the world to discuss early childhood development. In terms of future urbanization meetings, the task group recommended it would be particularly useful to include a representative from the New York University (NYU) Center for Urban Science + Progress (CUSP), a partnership between the New York City (NYC) government and the university created in response to a challenge by the Bloomberg administration, wherein data from multiple NYC departments are shared with academic researchers at NYU.

Another effective strategy the group explored for bringing together the key players in urbanization was to create a master calendar of all the significant science and technology events and meetings slated to take place globally during the year pertaining to urbanization and the SDGs, which the Academy or future task groups could potentially manage. A particularly pertinent upcoming event is the second annual UN Science, Technology and Innovation Forum to be held on May 15-16, 2017, at the UN headquarters in New York. The possibility was raised that this forum could possibly even be linked to an NYAS follow-up meeting about urbanization. Additionally, the Resilient Cities Series hosted by ICLEI brings together

dozens of mayors, other city representatives, and the U.S. Green Building Council at its meetings. These activities represent an opportunity to learn what other groups are working on, as well as cross-pollinate or combine efforts.

The task group raised the point that, in the push to implement new technologies, it will be important to set priorities because of limited resources. For example, if there is a strong focus on developing public transportation systems, it may be less important to work on expanding the use of electric cars. Meanwhile, there are many cases of disruptive technology that are not being pursued. Some of the examples that were mentioned during the discussion were clothes that can heat and cool the wearer and systems to grow produce in the basement of buildings rather than importing them from other countries.

NEXT STEPS

In considering which aspect of urbanization needs to be addressed first, the task group mentioned the importance of planning. The majority of urbanization is yet to take place around the world, and most of it so far has been done rapidly with little thought to land use, building codes, and other aspects, particularly in developing countries. Instead planning must be carried out in urban planning offices that incorporate local regulations and best practices.

But even before getting to the stage of planning, the task group agreed that it is key to have a system of systems mindset when thinking about new infrastructure. Every new program can have far-reaching effects that touch every industry and the economy in a circular manner. Further driving home the case for KPIs, the task group stated that carefully conceived KPIs could help entities predict the impact that new infrastructure and technologies could have on various sectors.

It is clear that the issues facing sustainable urbanization are vastly different in developing countries than in places such as the United States. Nevertheless, some of the lessons learned from cities that were developed in the United States and Europe should be considered for cities that are yet to be built. The task group discussed how consumerism was the priority of cities in the post-World War II era, and although consumerism-driven markets and technologies boosted the economy in that era, it may be advantageous now to shift the value towards other areas. For example, just because private vehicles and air conditioning units are prioritized in today's cities does not mean that the cities of tomorrow should necessarily rely on them.

However, the point was raised that it is unrealistic to expect people to sacrifice any comforts—if anything, they are only going to expect more comforts. Instead buildings and infrastructure will have to be created that both meet the high standard for comfort and are highly efficient.

In the last discussion point, the task group tackled the question of what a modern city will look like. Answering the question will involve creating a reference architecture for the sharing of data between city agencies, corporations, NGOs, and other entities. In addition, the planning and operational model of cities will need to be flexible, because as the operation is underway the plan could change, and vice versa.

Keywords or catchphrases that are immediately understandable, such as “all-electric city” could hold great value for communicating the vision of cities to various entities and the general public. Images such as an all-electric city could inspire these groups whose buy-in is important for achieving the goals of new cities.

On numerous levels, the task group reiterated the vital role of considering the human component of cities. A city cannot be considered livable if the human rights dimension is missing, if residents do not have access to housing, decent work, transportation, and clean air and water, as well as public and green spaces. The task group argued that technology could enable and support those services, rather than detract from basic human rights. Additionally, the task group talked about Urban95, an initiative focused on designing city spaces from the point of view of 3-year-old children (who are 95 centimeters tall on average). Following the example of Urban95, urbanization should take into account the types of buildings and infrastructure that families with young children in cities want and how technology and science could be deployed to help them.

OPEN QUESTIONS RAISED DURING THE DISCUSSION

- What are the important key performance indicators (KPIs) for the SDGs and which groups will determine the KPIs for the urbanization SDGs?
- How will new transportation models, such as car sharing programs and self-driving cars, affect people in cities?
- Which datasets from telecommunications companies, Google, and Apple are available to academic researchers and which datasets are not available?
- Which group or groups should maintain a master calendar of events and meetings focusing on sustainable urbanization?
- How might the complex interplay between social forces, economic pressures and public policy be better understood? For instance, why does Germany outperform the United States in solar power even though both countries offer financial incentives for photovoltaic installation?
- Are there examples of smart technologies or implementation approaches that are particularly unpopular among cities?
- What are lessons learned from cities in the United States and Europe that should be considered for cities that are yet to be built?

APPENDIX: WORKING GROUP PARTICIPANTS

Full Name	Title	Primary Affiliation
Pedro Oliveira	Professor of Technology and Innovation Management	Católica Lisbon School of Business & Economics
Guru Banavar	Vice President, Cognitive Computing	IBM
Norine Kennedy	VP, Strategic International Engagement and Energy and Environment	US Council for International Business
Shwetha Shetty	Sr. Director Corporate Strategy Group	SAP
Elliott Harris	Assistant Secretary-General and Head of the New York Office	UN Environmental Program (UNEP)
Ingeborg Røcker	Vice President	Dassault Systèmes
Max Anderson	Executive Director	New Cities Foundation
Elizabeth J Heider	Chief Sustainability Officer	SKANSKA
Rick Samans	Head of the Centre for the Global Agenda	World Economic Forum
John Gilbert	Executive Vice President and COO	Rudin Management Company
Cristina Gallach	Under-Secretary-General for Communications and Public Information	United Nations
Scott Duke Kominers	Associate	Harvard Center for Research on Computation and Society
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