Sustainable Societies
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Introduction

DEVIN STEWART: I'm Devin Stewart from the Carnegie Council.

Welcome. It's great to see such a fantastic, high-quality audience, as well as an extraordinary panel. It is really wonderful to have these three speakers and Tom Stewart, who is chief marketing officer from Booz & Company. He's a maestro at moderating. It's a great honor to turn it over to Tom to steer the program today.

Thank you very much, Tom.

Remarks

THOMAS STEWART: Thank you.

I will begin with the usual disclaimer. I have done a couple of these things for the Carnegie Council, and Devin and I, if we are cousins, we are cousins by parents and grandparents and great-grandparents who appear not to have known one another. Who knows what might have happened in the borderlands of Scotland way back when, but it's merely a coincidence.

It is not, however, a coincidence—that's a pretty good segue—that we are here at the Carnegie Council, whose basis and *raison d'être* is ethics in international affairs.

It is not coincidental that we are talking about sustainability in the context of ethics, because if you start talking to people about the issues of ethics, the issue of sustainability almost inevitably arises. It is in the absence of sustainability, or when it is threatened, that it becomes harder and harder to behave in an ethical manner.

There was a book published a couple of years ago by Harvard professor Benjamin Friedman called *The Moral Consequences of Economic Growth*. It's quite simple: economic growth produces moral consequences that are for the good. When economic growth is not there, when it's *sauve qui peut*, when we don't feel that sense of sustainability, that's when we start acting according to our basest and often most destructive instincts.

If you then think about the question of sustainability from a corporate and societal point of view, you very quickly come to the question of cities. Cities are, as Sartaz will tell you in a minute, where we are at as a human species, more and more. The epicenter or the battle for a sustainable society will be won or lost in the cities now existing and coming into existence in the world.

If you think about cities, you have to think about the whole system of a city, which we'll try to talk about.

Among other things, you have to think about two particular parts, which are: getting into and moving around in cities. Sustainable mobility is one thing. The other issue is the physical built environment and the actual

construction of a city.

I'd like to ask the audience a quick question in thinking about how you came here today, once you were inside the city. If you came by plane into the city, that's another question. Once you were inside the city, even though it's a rather misty, raw autumn day, how many of you walked to today's lunch?

[Show of hands]

That looks like about six.

How many rode a bike?

[Show of hands]

How many took a subway or bus?

[Show of hands]

A substantial number.

How many of you took a taxi or a car?

[Show of hands]

Actually about the same number as walked.

What's interesting here is we actually had about six or eight people who walked; the majority took some sort of public transportation; nobody took a bicycle; nobody came by pogo stick, I'm assuming; and then a sort of equal number came by car.

I dare say that if we were having this meeting in Houston, we would have raised our hands quite differently. Almost everybody would have said they came by car.

I also dare say that if we were having this meeting in Amsterdam, we would have raised our hands differently. A great many, probably the majority, of us would have come by bike.

The point that I'm trying to make is that issues of mobility are issues of choice. They vary. Pretty cool cities, like Amsterdam, can make very different choices. Let's take another city where people might have come by car, Los Angeles. You can live in a city that has an urban kind of cool feeling and have very different choices about transportation.

I'd also like to ask a quick question about buildings.

How many of you people live in a building—I don't care whether it's an apartment, residential home, your own home, whatever it is—where there has been a substantial investment in energy efficiency? I don't mean fluorescent light bulbs. I mean some sort of substantial investment either in the way it was originally built, or something you have done, or your landlord has done?

[Show of hands]

Three.

And the rest of you it's sort of "residence as usual," right? Compact fluorescent bulbs, and maybe a little double-glazed windows here and there.

How many of you in your office buildings work in an office building that is a LEED-certified [Leadership in Energy and Environmental Design] office building or is in some way substantially more energy efficient? How many of you people live in the office building of the future today?

[Show of hands]

One.

We have a long way to go, and we have a lot of opportunities.

Immediately to my right is my colleague Sartaz Ahmed. Sartaz is a principal at Booz & Company. She works with clients in the energy and infrastructure sectors on critical issues relating to energy, carbon, and sustainability. She participated in writing quite a number of articles for us, white papers, viewpoints, and articles on the topic, and has studied it very thoroughly. She is going to lead us off with a little bit of the story of urbanization and some of the particular sustainability challenges that it presents.

SARTAZ AHMED: Thank you, Tom. Thank you, everyone. I'm happy to be here.

I work in the energy sector and basically look at both the supply side and the demand side.

On the supply side, I look at even the dirtiest of the dirty, coal, which is sort of essential for providing us with energy today. I also look at renewables, everything from solar to wind.

On the demand side, the focus is on trying to understand how we use energy, other ways of using energy more efficiently, and understanding the impact on the environment.

The way this study came about is that we started by looking at technology and trying to understand if we could use technology to reduce the way we use energy and, therefore, lower our carbon footprint.

That took us to the question of demand. Where is demand growth? It links to population growth and economic growth, as Tom said.

In terms of population growth, all eyes turn to the developing world. We always hear the numbers: the billion people in China, the billion people in India, and the rest of the developing world.

What was curious is when we started looking at the population growth and about where these people were going to live. Today 50 percent of the world's population live in urban areas and in 2050 we expect that 75 percent of the people will be living in urban areas.

Why do we care about urban areas?

- They provide opportunity for economic growth, amongst other things. There are cool cities in the world where there are cool things to do.

- Beyond that, it's about economic growth. With economic growth comes more consumption and at times, much more energy consumption as well. We want bigger homes. We like buying more gizmos. We all want our iPads and iPhones.

Today, urban areas account for about 70 percent of the energy consumption of a region. We can make different choices of how we power our cities.

In France, they rely mainly on nuclear power. 70 percent of their electricity is from nuclear power, so their carbon footprint is very different. In the U.S. today, 50 percent is from coal, which is slightly dirtier. In China, about 70-80 percent is from coal, so significantly dirtier. Unless you find cleaner options, that is going to continue in the near future.

As with everything else, cities also tend to evolve. Today, when we think about the developing world, we think about Beijing and Mumbai, and we think all these people are going to go and live in these cities.

What we found is that people are moving to the so-called second-tier, third-tier, and even fourth-tier cities, not the cities which have populations of 10 million, but a population of maybe less than 5 million. Most of the growth is expected in cities of less than half-a-million.

According to our estimates—again, this is predicting things 30 years out, so I may be a bit off—we expect that there will be about 3,000 new cities.

The emissions profile of the energy use of a city is determined very much by how the infrastructure is developed early on in a city's life. That carries on to the growth phase. Eventually, when it's a mature city, the energy profile is set by what? The investment choices that were made very early on.

Given that there are all these new cities that are going to come into being, we have a tremendous opportunity to make the difference right now, given what we know about climate change and the possible impact that it could have on the future.

Based on our estimates, we found that we could be spending about $350 trillion over the next 30 years in infrastructure. We took a slightly narrow focus: We just looked at buildings, residential and commercial; and mobility, how do you move goods and people.

We didn't really look at waste and water and other industries that could be situated in cities. It was a slightly narrow focus, but nonetheless there's a tremendous amount of money that is going to be invested in all these new cities over the next 30 years, which provides us with an opportunity to do things differently.

What really matters when you are thinking about doing things differently and shaping the profile of a city?

- Policy obviously has a huge impact; technology; as well as how you finance those new things.

We were talking about LED lighting. It can have a huge impact. Right now it is not quite there; It hasn't come into solution.

The thing about technology is we believe that it comes into solution when it is close to being competitive and you have some sort of a subsidy or a positive push to just tip it over the barrier.

There are different ways of providing this sort of subsidy. It could be something like the stimulus package we saw now, or it could be something much larger, as Tom and Larry were talking about, setting up the hybrid system that supported the development of the automobile industry. We need to possibly rethink how we think about policy.

A couple of examples of how technology and policy are coming into play on how we could do things differently in the future.

There is a city called Dezhou in China. It's called the Solar City. They are trying to harness solar energy for everything, from electricity, to water heating, to moving people, to cars. There are about 100 solar enterprises. Not only does it lower the footprint of the city, but it also provides economic growth.

There is another city called Baoding, called the Green Electric Valley, similar to the Silicon Valley. It has 200 new companies manufacturing wind turbines and other new energy technologies that are supplying not only the demand in China, but also the rest of the world. It's lowering the emissions profile of the city and also providing economic growth.

Another example, which most of you may have heard about, is Masdar, the ultimate in urban greenfield. This is a city in Abu Dhabi. The aim is to have zero impact on the environment and to have over 1,000 new companies. It's very much in the R&D phase. It's about innovating and finding solutions for the future.

The common theme in these three cities is obviously there is a lot of effort. There is a government policy supporting it. They are trying new technologies and then there is financing from the government. These are the new cities.

What can we do about the existing cities? It's obviously a lot harder as we grow older to change. It's the same thing with cities. Once we are set in our ways, it's difficult to change, but a couple of positive examples come to mind.

There is a city called Freiburg in Germany. They have decided that they are going to go on a sustainable path. They have changed their building codes. They are focusing on energy efficiency. They are focusing on renewable energy, and also on mass transit and providing bikes. But the ultimate goal is to make the city livable. It's not to take away from this, but it's to achieve the dual goal of sustainability and livability.

There is the example of Malmö, which was a shipbuilding city in Sweden. It used to be called "dirty old Malmö." In 1994 they decided they needed to do something differently. The focus was about making it a better place to live in, not just being sustainable and green. There were similar sorts of options around residences, about reducing your energy consumption, doing things more smartly, and taking care of the built environment. In terms of movement, providing options where you don't have to rely on the internal combustion engine and gasoline, but possibly bikes and renewable fuels.

In the United States we have the example of Portland. This two-pronged approach of looking at reducing the energy consumption in buildings and providing people options on how to move about without relying on gasoline to the extent that we do.

In summary, there is a challenge out there. There is a tremendous amount of population growth. We expect that this decade will be about urbanization. How do you solve or meet this challenge?

Obviously, policy, technology, and financing will play a role. However, these are not sufficient in themselves. It has to be about not only addressing sustainability, but also livability and providing economic opportunity.

THOMAS STEWART: I'm a math-challenged individual. I heard you say and I think my math is right, that right now half of humankind lives in cities and 70 percent of energy is consumed in cities, right?

SARTAZ AHMED: Yes.

THOMAS STEWART: Which means that an urban dweller is more than 40 percent more energy-consuming than somebody who is living in the country. As more of us move to the cities that are like the cities we are building today, we will become energy hogs.

SARTAZ AHMED: Yes.

THOMAS STEWART: If you move to a human population that is 75 percent urban, and the urban citizen of tomorrow is as energy-consuming as the urban citizen of today, we are literally cooked. Is that right?

SARTAZ AHMED: Yes. Unless we are using nuclear energy and renewable energy.

THOMAS STEWART: All right. Unless we can radically change the energy mix or we can radically change the energy consumption, or some combination of the two. We've got to do something different if we are going to live in an urban area.

SARTAZ AHMED: It will have to be a suite of solutions.

THOMAS STEWART: All right. Business as usual will not—

SARTAZ AHMED: Hot possibly.

THOMAS STEWART: Will be hot, yes.

Let me turn next to Larry Burns. Larry is currently an engineering professor at the University of Michigan, and director of the Roundtable on Sustainable Mobility at the Earth Institute of Columbia. He is also the former vice president of R&D at General Motors. He has been a major voice for the reinvention of the automobile. It was Larry who presented the Volt to the GM board a few years ago.

Larry, I'd like to turn to you to talk a little bit about the issues of getting around in cities. When we talk about getting around in cities, we're talking not just about people moving but also about goods and services.

LARRY BURNS: Thank you very much.

When you think about transportation, and in particular the automobile, it's really about the freedom to go where you want to, when you want to, with the people you want to travel with, carrying the goods that you would like to take with you.

The real challenge is one of sustainability. Typically, the focus of that discussion is on energy and environment; safety, which is truly an ethics issue, with 1.2 million people a year dying on roadways—these are pedestrians and motorcyclists as well as people in automobiles; and affordability; and particularly quality of access, which is also an important concern from an ethics standpoint.

When you get to cities, congestion and parking may be more definitive than any of the other four. In fact, the value proposition of an automobile—go where you want to, when you want to—gets compromised considerably when you have significant congestion and you can't find a place to park.

We got thinking about the fundamental genetic makeup of automobiles. In fact, those genes were created over 120 years ago. When Benz drove his first car out of the barn in the late 1800s, it was mechanically driven, powered by an internal combustion engine, energized by petroleum, mechanically controlled, and it was a stand-alone machine. It's interesting that for over a century that fundamental DNA has remained the same. That describes our cars and trucks today.

There's a reason for that. There's a great deal of codependence between the machine (the car), the roadways

that they operate on, and how they are energized.

We think we've entered into a period that is now going to be transformational, with a new DNA: electrically driven machines powered by electric motors, which happen to be three times as efficient as internal combustion engines; energized by electricity and hydrogen, which can go back and forth between each other and can serve different purposes; electronically controlled; and very importantly, electronically interconnected. That connectivity is going to prove to be a major opportunity.

We see a world where cars don't crash. They don't run into each other, pedestrians, or bicyclists. Every car that is being built going forward has GPS systems on it, and the GPS lets you know where your vehicle is relative to another vehicle within a meter. If you share wheel speeds and steering inputs between vehicles, you can predict where they will be within the next 20 milliseconds. Many of us now walk around with handheld devices with GPS. There is a future out there where cars don't crash.

If cars don't crash, you can get a lot of mass out of them, or the weight of the car. That becomes important. I'll illustrate that in a second.

We also see a road where cars can drive themselves. A lot of times people are concerned about driver distraction. Studying automobile consumers led me to believe that driving was the distraction. Why else would someone possibly send a text message driving a 3,000-to-4,000-pound machine at 70 miles an hour if it wasn't more important to send that message than to drive safely?

We began to explore how we might create cars that can drive themselves. If you know where you are with GPS and digital maps—and the digital maps are becoming enormously information-rich—you know what's around you with 360-degree sensing and vehicle-to-vehicle communication sharing data between vehicles. Your car also knows where it wants to go or where you want to go with software and algorithms.

You begin to think about these electrically driven vehicles and the ability to have cars drive themselves. That led to this idea of what we're calling the Mobility Internet.

We all know about the Internet of information. That's the one we use every day. There's another Internet that's coming forth quite fast. It's the smart grid, or you might call that the Internet of electrons.

The Mobility Internet is the Internet of atoms. It has to do with knowing everything you want to know about: Where everything is, where everyone is, where they want to go, where you want these goods to move, and taking advantage of that information in real-time in order to connect us much more efficiently, with much less variation in travel time than the way we're connected today.

I talked about the growth of automobiles in Shanghai. I didn't mention the electric scooters. Last year 25 million electric scooters were sold in China. Think about that step from an electric scooter to a full-blown automobile. There is some big white space there that might give us an opportunity.

You start with electrification, driving the cars electrically. There are all kinds of advantages in the design of the automobile in doing that. You then bring in this connectivity. The intersection of those two gives you that new automotive DNA that I talked about.

You bring in urbanization electrification. You think about smart grids and charging infrastructure. Urbanization and connectivity allows us to talk about the Mobility Internet and dynamic pricing markets. Now you're charging for that differential space of roadway that you occupy in an instant and seconds.

It's sort of like parking when you're stopped, but now you're doing it in real-time movement of the vehicle. The way we show in the animation is how those cars can go through the intersection [See video]. Everybody has a reserved space time path through the city and no one else will intercept that path at that instant in time. We put that together, and to the notion of reinventing personal urban mobility.

This is the book [*Reinventing the Automobile*] that grew out of that, with Bill Mitchell, my colleague Chris Borroni-Bird from General Motors, and myself. Unfortunately, Bill passed away recently, but he was a renowned professor in architecture, urban planning, and information technology at MIT.

Let me talk about this vehicle [Volt] just one last minute.

Today, when we drive our automobiles, 25 percent of the energy in a gallon of gasoline actually makes it to the wheels to propel the vehicle. Seventy-five percent of that energy is lost as heat when it's combusted out the exhaust pipe and through friction.

These automobiles that we drive today tend to weigh 3,000-to-4,000 pounds to move people around that weigh about 150 pounds. So 5 percent of the mass of movement is the person and the rest is the vehicle. Five percent of 25 percent is 1 percent. One percent of the energy in a gallon of gasoline is actually being used for the mission of moving a person from point A to point B.

When people say, "We have an energy challenge," I say, "No, we don't. We have a system design challenge. We have enormous opportunities to change that."

These vehicles, the ENVs [Emission Neutral Vehicle] that we're talking about in this book, weigh 750 pounds with the person in it. That's a reduction of one-fourth at least. And the electric drive is three times as efficient. Three times four is 12. There's a 12X opportunity to transition to this class of personal mobility machine in cities.

They park in one-fifth the area that a car parks in.

They won't crash because of the connected vehicle technology that we have.

You may have picked it up in the first animation. You can park them in your closet. This is a fashion item. [Laughter]

That's what you really have to appeal to. You have to give consumers a value proposition.

When you add it all up—because these can't be stolen because you can track them with GPS, and the parking efficiency—it is about one-fifth the total cost per mile to move around in a vehicle like this as it would be for an automobile.

We think there's a great opportunity to address the serious concerns on roadway fatalities, energy consumption and CO2, and, very importantly, the quality of life of cities. We're hoping that we can move this to market as quickly as possible.

Thank you.

THOMAS STEWART: Thank you. It's totally cool, gee-whiz stuff. We're going to go to some things that don't move in a second.

One of the things that is startling is the degree of transformation. When you said a 12X opportunity, you can compare that to improving CAFE [Corporate Average Fuel Economy] standards or miles per gallon. If we can get from 35 miles a gallon to 70 miles a gallon, we're going to be doubling the opportunity, which is trivial in comparison to what we're talking about here. It's pretty cool stuff.

Earlier this year, I was involved with Shell on its Eco-Marathon, which is a contest among college students to identify experimental vehicles that get very high miles per equivalent of a liter of fuel. Sometimes they're solar, sometimes they're hydrogen, sometimes they're gasoline.

The leading car in the German version this year was actually this little cigar-shaped car that got the equivalent of 7,000 kilometers on one liter of fuel, which somebody pointed out is the distance from Paris to Moscow and back. If you thought about what Napoleon could have done with that, life would have been a lot simpler—although the roads probably weren't very smooth and you probably wouldn't have gotten real driving on real roads.

Let me pass the baton over to Joan Krevlin. Joan is a fellow of the American Institute of Architects. She is a founding partner of BKSK Architects and has specialized in community design for decades. She, among other things, designed the Queens Botanical Garden Visiting Center, which was the first public building in New York City to receive a Platinum LEED designation.

Joan, talk to us about the stuff that doesn't move in cities.

JOAN KREVLIN: Cars are way cooler than buildings.

In some ways when we look into the future, we're almost looking to the past in terms of how we rethink how we design. Technology isn't always our solution. In some ways, moving away from technology is a better approach for buildings.

Why do we care about buildings when we talk about sustainable cities?

If you look at energy use, buildings consume 40 percent of all the energy used in our country, generate 40 percent of all the carbon emissions, and use about 40 percent of the world's materials. So the act of living, creating, and

inhabiting buildings has a huge impact in our energy use.

These numbers really compel us to recognize that changing the way how buildings are created and operated can make a huge impact in the threats of climate change.

The phrase "sustainable architecture" has been around. The first thing to say is, what do we mean by sustainable architecture and how do we define that terminology?

One of the best ways is a phrase that has been coined some time ago, which says that sustainable architecture is "a design that improves the quality of life today without diminishing it for the next generation."

I appreciate your reference to the notion of quality earlier, because that's something that we'll talk about when we look at how we make buildings that are more energy-efficient, more resource-wise, but also have a real qualitative aspect attached to it. In some ways, in the way that we make buildings and live in buildings, we've forgotten that and we want to connect back.

The sustainable design principles really include:

- The ability to optimize size potential. To really look at the land on which we're building and how we impact that as a habitat; How we think about water use, water falling on that site; and how we think about building orientation.

- How we minimize nonrenewable energy consumption. Before we minimize nonrenewable energy consumption, we first have to think about how we build in ways that are much more efficient. We make a building that needs less energy, and then we look to nonrenewable energy consumption to kind of fill that gap. First, it must have a lower demand, because we think about the envelope of how we build, and right-sizing what we build. When we've sort of got that to its best equation, how do we fill that gap of energy needs with more renewable sources of energy?

- How we protect and conserve water.

- How we enhance the indoor environmental quality.

- Then, the one that is often forgotten in the discussion but is really key, is how do we optimize operational and maintenance practices. Often we can build well, but if we don't have a building that actually is functioning the way it's supposed to, much of that effort can be lost. Really understanding how we build, how we bring maintenance folks into thinking, how we use our buildings and care for our buildings is part of the equation.

We have seen in the last ten years what I'd say is really a sea change. The Queens Botanical Garden project that you mentioned was something that we were brought in to design in 2000. It took eight years to actually build it, because it's a city-funded building. In that period of time we saw a real sea change in the architectural and the building profession about how people really looked at and understood sustainable design.

It's interesting to look at what allowed that sea change to happen. It helps us to think about how we then go forward for yet what's got to be even more of a critical change.

It starts in many ways. It starts with the U.S. Green Building Council. They were really probably the driving nonprofit force that pulled together a consortium of manufacturers, architects, engineers, government organizations, and contractors, and began to look at "How do we redefine the conversation?"—or actually, not even redefine—"How do we set up to have a way to talk about sustainable building practice?"

They launched in 1998 the first LEED rating system. You probably all know what LEED is by now, but it's Leadership in Energy Environmental Design. It's really a green building ranking system. That's a point system that has become sort of the national benchmark for design, construction, and operation of high-performance green buildings.

What it did is it gave a common language to the building industry. Instead of saying, "Oh yeah, my building's green," or, "I'm doing this," it became a standard by which things could be looked at and evaluated. In doing so, it sort of set a market trend that allowed us to know what we needed to do in many ways to achieve certain green standards. It let the whole building industry have a common language to talk to itself about products that were needed and ways to evaluate energy use so that there could be a movement forward.

LEED is always looked at in these five categories, and it ties back to the original criteria I said earlier: sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.

Within that point system, there was a range of standards that you could achieve, that allowed clients, builders, and architects to set goals that were appropriate to their particular building and achieve certain sustainable standards.

It allowed for a huge market transformation. That is in many ways what has propelled the sea change that, with this common language, we see almost a mainstream thinking about the language of green building.

The first question actually is: How did this happen? What made LEED the successful vehicle that it was? What can we then learn from it? LEED is a flawed system. It's not a perfect system, and we'll talk about some of the downfalls of it. But what made it so successful?

It was very clever in a way. Part of it is that it was market-driven. It was kind of balanced in a philosophy of street-smart practices that were understood, that were achievable now, with pushing into more innovative technologies. You could come at it from known technologies and you could push the boundaries, so there is a way to come into it from different perspectives.

It rewarded competition. We are all a little bit competitive. By having this point system, you can talk to your client about whether they wanted to be certified silver, gold, or platinum. We are a competitive society, and that ability to either meet a standard that allowed you to spend more or less money to achieve these goals was useful.

It also pushed a little competitive urge—if you get that extra two points, you can be in gold. It allowed them to push the conversation. It was kind of clever in picking up our own competitive nature.

It was actually essentially a consensus-focused metric. The decision-making was made up from across the board in the industry, it wasn't as top-down.

It also had third-party verification. There was an outside evaluator of whether your design process and then your built product met certain kinds of criteria.

In the 12 years since LEED first introduced itself, it allowed itself to go through several iterations of how it changed its standardization. It became the language of sustainable architecture.

There are other rating systems that are around, and we'll talk about some others in a minute, but the LEED system allowed something to hold onto and to propel this conversation.

In the earlier days you'd sit down with your consultants and your team and you'd have very interesting conversations about how you could really affect the design and shaping of a project in ways that were very conceptual. You'd really think about the form abd siting of your building and the way air and daylight moved through it.

Then, like many things, it turned into how do you get a point, and it became point-driven. It's a problem they have corrected, but it used to be that you could get the same point for having a bike rack outside of your building as you could for having a very expensive, complicated, multi-control air-conditioning system. The cost of a bike rack and maybe a shower were different.

In the newer-looking LEED system, many of those things have been addressed. It's a little bit generic. It wasn't as regionally and locally focused. Things in urban environments are very different in terms of more rural environments.

It has begun to evolve and it has corrected a lot of the issues. The USGBC [U.S. Green Building Council] is very focused now on how we look to see what's really working. They are looking after the fact to see if these kinds of innovations that we are doing are really doing what they are supposed to do in terms of reducing energy use and cost. Making sure that the things we set out to do are actually happening is something that really now is a great focus of conversation. Looking at how we do an assessment of what we have done is very much a part of the conversation.

It's kind of a way to look at something that says, "We know the standard of how we build, and by what percentage can we do better?"

There are many in the sustainable field who are saying that's not really good enough. We really need to set a different kind of standard that allows us to rethink how buildings integrate with the ecology, the natural world in which they exist.

A good example of it is what's called the Living Building Challenge, which is another arm that grew out of USGBC's efforts. It's really looking to push products even further, providing a different kind of model, that is really changing the paradigm of how we build. It is looking for net-zero energy building, so that the building is actually either producing as much energy as it's consuming or producing more energy than it's consuming. We are changing the equation of how we think that buildings work.

Net-zero water use, replacing habitat that's disturbed—and not making these things optional. In that system of evaluating buildings, all of those things are prerequisites, everything is mandated. With LEED, the ability to pick and choose and kind of contour what makes sense for your particular project, gets you off the hook on some things while solving other problems.

What the Living Building Challenge is really trying to do is not just make buildings perform better against a kind of understood standard, but to really rethink how we understand the role that buildings can play.

When I was recently looking at the list of prerequisites—prerequisite means you have to do it—one of their prerequisites is "beauty and spirit," which is kind of interesting. The way it reads in their language is the project "must contain design features intended solely for human delight and the celebration of culture, spirit, and place appropriate to the function of the building." That's interesting, that's a nice thing to say.

Then I asked myself: Who is really deciding whether or not you have reached that kind of goal? It gets a little tricky in there, in terms of these qualitative aspects of who decides whether we've met that kind of standard.

Yet, it does address something that we see. For those of us who have been thinking about the changing way that we build buildings, it really does talk about an aesthetic of sustainability. That's not only an important factor of what we do but, as architects, in some ways one of the most compelling.

It is really changing how we think about our building in relationship to the natural forces.

I have a favorite little book, that's called _Thermal Delight in Architecture_ by Lisa Heschong. It's a very small book. It's really lovely reading. It talks about the hypothesis that the thermal function of a building can be used as an effective design element.

In the way we have now insulated and thought about buildings, as these kind of sealed environments that we can air-condition and seal from any outdoor forces, we have forgotten that when we look at thermal qualities—warm, cool, humid, airy, radiant, all the conditions outside—those actually become really useful design tools and qualitative aspects of how we experience the places that we're in and the places that we are building. It becomes a rethinking of how we think about our buildings in the places that we build.

We all know this. We live in the city, and we probably turn on our air conditioning. Many people in this room probably go every summer to their country house where they really love the fact that they can sit on their porch and have a nice breeze, fall asleep to the sense of a breeze wafting over you. Looking at indigenous cultures, looking at the way courtyards have been used, the way hearths have been used—all of those things that were part of vernacular architecture are the things that we long for often when we go to vacation spots, that sense of connection.

When you look at how you think about those as elements of design, that we connect how we think about buildings to season and daily change and connections to that climate, it's one thing that really enriches our sense of place. We have this kind of qualitative thing that comes with the metrics of trying to look at performance that actually is enriching and makes for a better place-making.

We talked about the Queens Botanical Garden. Just to talk about that project very briefly, it was a project for a garden that's in Flushing, Queens. It's probably the densest county in the city, with the greatest ethnic diversity in the whole city. The Queens Botanical Garden, a 39-acre garden, which is the hidden botanical garden because nobody's ever heard of it, really serves as a backyard to many of the people who live in that dense urban environment.

They had always seen it as a place where people, plants, and culture came together. That was their mission.

They redefined their mission to be a place that could showcase themselves as stewards of the environment.

They did a whole series of workshops with all their different constituents who came there, from all around the world, and found that water was a real common element, that everybody related to water. Then they got a capital fund and they did a master plan that was based on this notion of water.

We got hired as architects to build their first capital project. We were building a building that was going to represent the new mission of a garden—it was a building, so we weren't making a garden.

We were trying to really speak to what at first we saw were these dual missions: how do you acknowledge all this diverse culture that is sharing this space, and how do you showcase themselves as stewards of the environment? We realized that they were really one and the same, that in many ways cultural communality came from realizing that, no matter where you were from, everybody had daily rituals and connections to the natural environment that resonated for them. We designed a building that really tried to do that.

It received a LEED Platinum, so it hit lots of matrices—its geothermal system, its photovoltaics. It has an air-conditioning system that has variable controls. It hit a lot of the metrics of performance that were essential to having a high-performing building.

What it also really did was it connected visitors who came to the building, to their sense of place, much like the inner garden did.

There's a large roof that collects the water that falls on the site. A rainy day is a good day to be in the garden. You hear it falling. The rain is then collected on this roof and brought down into a cleansing biotope, which cleanses a lot of the pollutants out of it. That becomes the water course that runs through the site and the building that spoke to the water that everybody wanted on the site.

We get to say that a rainy day is good day to be in the garden. It's not a bad day. It's a nice day to be there.

There is a wood [brise-soleil](#) that filters the light. The skin of the building, the bar of the building, is made up of a wood brise-soleil which is like open Venetian blinds with glass doors sliding behind, so that that skin in the building becomes almost like a layer of clothes. You can open and close it in various ways so that you can connect to the breezes and you can deal with the sun in various ways**.** You have these incredible shadows that fall on the floor from the way the sun moves in the building. You're aware of moving light, changing light, and changing seasons, in a way that's kind of lovely.

That kind of qualitative aspect of how we think about place is a way that green design really allows us to engage with our clients.

The point I want to make about that building is the ability to take some of the metrics of performance and turn them into something that has a qualitative impact that can really change how we build and really change the quality of life.

THOMAS STEWART: What we have heard is fabulous, and I love the image of the garden and the building, and how it becomes internal and external.

I don't know how many of us are city mice, but I am very much a city mouse, and maybe a city rat at this point. I remember when my daughter was two-and-a-half years old and we went up and had a house in the country. It was early August. I live on 96th Street on the East Side, so we've got two hospitals on either end of the street, and buses, and so on and so forth. We have a fairly noisy street. My daughter had gotten quite used to all of that.

When we came up to the country, she was not used to the sound of the crickets. At one point, she was trying to go to sleep on an early August night, and billions and billions of crickets were chirping loudly outside her door. Finally she said, "What's that noise?"

I said, "It's crickets, honey."

"Tell them to stop."

But she got used to it fairly quickly, the aural delight of country life.

Questions and Answers

THOMAS STEWART: Each of the panelists have described a vision of the future. Larry Burns described an amazing sort of choreography of automobiles of the future, Joan Krevlin described buildings of the future, Sartaz Ahmed described some of the requirements of the new future.

As we discovered earlier when I was asking you about the houses we live in, and the offices we work in, we also live very much in the present. There are also some issues of sustainability in cities and societies that have to do

not with what we invent and discover in the future, but also how we retrofit what we have and what we live in now.

I'm wondering, if you think about priorities, what is the opportunity in the green retrofit or the sustainability retrofit of existing systems and the urban infrastructure? How do we improve what we live in and transport ourselves in now, while we invent those opportunities for the future? Does anybody want to take that up first?

SARTAZ AHMED: There were a couple of examples in Freiburg and Malmö. Those were existing important cities where they have a vision of the future. They really want to reduce their carbon footprint. It's a long-term opportunity.

THOMAS STEWART: Was it a key changing in incentives? Something's got to get people saying, "I can get to 'business not as usual' while living in my same old digs." Something's got to change the equation here.

SARTAZ AHMED: A lot of it is policy about how you shape things, policy that provides the economic viability, but also its the financing to make these changes.

THOMAS STEWART: Larry, how important is this opportunity?

LARRY BURNS: We're talking about challenges that have massive scale. The only mechanism I know for how to scale the solutions to a level that matters on global energy consumption and greenhouse gas emissions is the market. In simple terms, the answer is greed.

THOMAS STEWART: How big is the retrofitting opportunity in transportation?

LARRY BURNS: We need to be driving towards solutions when the consumer value exceeds the market price and the market price exceeds the supplier cost, and do that in an unsubsidized way. When you hit that tipping point, when you get that right, then people in the course of living their everyday lives, because they simply like the new solution, are going to gravitate there, and the capital is going to flow there for the new solution.

The key is to really deeply understand people as consumers. We don't consume energy for the sake of consuming energy. We consume it through the food we eat, the water we drink, the way we shop, educate ourselves, move around and interact, and how we make things. There is an enormous amount of waste in how we do that today.

We need to find these new mechanisms that lead us, not through greed but through self-interest, to the opportunities that truly exist.

I don't think we are going to be able to take a step from all of the technology that exists today in brownfield cities and pull that off.

As an engineer, I like to design the simplest experiment possible. One of the things I am working on at Columbia University in my role as the director of the Roundtable on Sustainable Mobility is to try to find a place where we would be a new town, and we can begin to integrate the convergence of all of the building technology, energy technology, mobility technology, and very importantly the information technology, and create that commercial ecosystem where suppliers come together with real people living in real communities, because it's about learning cycles. It's getting out there, getting started, learning, and making it better. That's a path we can lead to. We are exploring this right now in Changxing Island near Shanghai and Babcock Ranch, Florida.

I'm very optimistic by nature. These problems are solvable. We have huge opportunities to do it and there's going to be a lot of business growth that comes with those opportunities.

THOMAS STEWART: You're fundamentally thinking that the brownfield opportunity comes from showing the greenfield of the future and then going back from the future to retrofit the present, rather than going forward from the present to the future?

LARRY BURNS: Yes.

JOAN KREVLIN: That's a really important question for building. If we look at the fact that 85 percent of the buildings that we're going to occupy in 2030 exist today, we're looking at really having real change. We have to look at how to deal with the building stock that we have.

There are certain initiatives. From that case, it's regulatory, it's policy, and then it's market-driven.

The city is trying to regulate building audits so that buildings have to do energy audits. What they're not quite there on yet is to mandate the fixes once you identify where the issues are. Having both a benchmark in the

performance of existing buildings, and having that become available public information, so that as people are making market decisions about what buildings to buy or to live in, they can then understand the energy cost of the buildings that they're in.

From a building point of view, we have this building stock that absolutely has to be addressed. It's going to be a combination of policy and then economic incentive to really address it in any meaningful way.

There is also a huge opportunity when you look at, for example, all the roofs in the city. It's a great unexplored area in terms of green roofs and urban agriculture. We have a whole other playing field that's at a high level.

How we deal with water management—and we're not talking about [drinking?] water here, because that's a whole other conversation, particularly in the city, but in terms of how we manage the water that falls and how we're going to deal with rising sea levels.

How we use roofs as a way to deal with both storm water management, urban agriculture, urban heat island effect—there is a lot of opportunity to address certain problems by looking at that new lay of the land,in a way.

THOMAS STEWART: One of the things you mentioned reminded me of a story that happened to my brother-in-law, who was involved in a program in the city during the Arab oil crisis and the Carter Administration. There was a lot of money that came from Washington and went to Albany that was to be offered to landlords for fundamental building improvement kind of things such as new furnaces, new windows, and weatherstripping.

One of my brother-in-law's responsibilities was to try to take some of that money from Albany and give it to landlords. One of the real difficulties he had in certain parts of Manhattan was to identify a landlord, because the landlord existed inside a shell corporation within a shell corporation within a shell corporation. The tax incentive that that landlord might be offered for weatherstripping was nothing compared to the tax incentive he got from the tax avoidance he got from this set of shell corporations.

Just as much energy as is wasted in an internal combustion automobile, is about as much of this weatherstripping opportunity that actually managed to trickle down to windows in the city. You've got to get your policy structure right and other kinds of transparency right even to be able to make those changes.

QUESTION: Good afternoon. I'm Larry Bridwell. I teach international business at Pace University.

I want to ask you to compare the future of democratic India and democratic USA to communist China in being able to do this reengineering. As you probably know better than I do, China right now is really advanced when it comes to electric batteries and high-speed trains.

In terms of the massive reengineering, is a government where the technocrats make the decisions and the communist government implements them going to be more effective than democratically paralyzed India and the United States?

LARRY BURNS: It's a phenomenal question, because the rate at which things are moving in China is just unbelievable.

I'm fundamentally concerned about the U.S. political system, it just seems to be at a standstill with the decision-making that we need to take us where we need to go.

Personally, I don't think anything needs to be invented to solve a lot of the sustainable mobility challenges that we're addressing.

In China, they can simply decide that's the direction they're going to go in and they pull together the collective will—whether the word "will" is appropriate in that context I'm not sure. This marrying of the communistic system with capitalism and a market-driven economy is really pretty remarkable. You can't argue that it hasn't worked in the sense of the rate at which that economy is growing.

We need a direction in our nation. We need policy. I'm not just going to simply say energy policy, because I don't think the issue is simply an energy issue. It's an issue with respect to how we lead our lives.

To put this in perspective, I remind myself almost every day that the smartest 25 percent of the people in China equal the population of the United States. They are extraordinarily capable engineers. The execution of what's taking place there is first rate. We need to have some good dialogue on your question, because we are going to get left behind if we don't watch it here.

THOMAS STEWART: Sartaz, you've worked in both places.

SARTAZ AHMED: Yes.

To Larry's point, maybe the solutions that are developed in China or in places like the Middle East, where the government dictates things, will come into solution, and once they come into solution, will be adopted by the United States and India. So both sides work.

THOMAS STEWART: I would like to hear somebody speak up for the opportunity to be less than directed on this. Let's hope we can get to that question.

QUESTION: Hi. I'm Michelle Fanzo from Four Corners Consulting.

Much of the work I do is in the developing world, so my question is more towards the developing world. Globally, urbanization each year is expanding at 4.2 percent right now. That probably isn't going to stop any time soon. The majority of those people living in cities are in developing countries.

What I've heard the panel discuss is that forward-thinking policies and market capital seem to be the levers for moving sustainable cities forward. How does that overlay with the developing world, which doesn't have much money and often doesn't have forward-thinking governments?

SARTAZ AHMED: There are small examples.

When we have looked at it, we haven't seen broad policy efforts the way we have seen them in China. We have seen small-scale solutions, be it with solar cooking stoves, battery leasing to provide energy, or solar panels for electricity. There are small-scale solutions that we have seen, but not the broad policy push that obviously we've seen in China and to a certain extent in Brazil.

THOMAS STEWART: It's interesting. This is not an urbanization issue per se, but as I understand it, the single biggest thing you could do for carbon consumption and air quality in India is get kerosene out of cooking stoves. There are billions of these little cooking stoves in villages and in cities, and the removal of kerosene would be a massive improvement in air quality. Get kerosene and manure out as cooking fuels. There may be a lot of low-tech solutions there.

Do you know much as you look at cities, and particularly the urbanization issue in Lagos, or wherever?

JOAN KREVLIN: This is a not-informed answer, but a gut answer, which is to not look at the models of success that we've generated here. Developing countries look to what seems excellent: success or prosperity. We've sort of set a paradigm of what sophisticated buildings look like. They are a false paradigm in a way. They make no sense in lots of places.

We look back at more indigenous forms of architecture to learn lessons from. I always am then concerned that what we have modeled is bad behavior here. How do we change what that model looks like so that you can go to the larger cities in different parts of Africa and you can see some of the things that look like they could be buildings lifted from Houston and put in Kigali, and you think, "Why is that?" Because it's kind of a model of what prosperity looks like or what a model of development looks like. It's somehow debunking what quality looks like.

THOMAS STEWART: I think it would be very interesting. One of the things that terrifies me is we have a model of moving from rural squalor to urban squalor, or urban sustainability to urban squalor and to a favela [shanty town]. Yet, we also see these images in Korea, India, China, Turkey and various other places around the world of these greenfields of amazing sustainable cities being built.

I guess the question is: Can we get from the village to a city, without going through the favela sort of phase? Can we leapfrog beyond that? I don't know of too many glorious examples of it, and we ought to find them.

LARRY BURNS: Columbia's Earth Institute has a Millennium Villages and Millennium Cities program. They are trying to work at these exact issues.

Einstein once said, "The best design is the simplest one that works." That is a very important area to be solving problems, because it's driving simple solutions that should transfer back to the developed world. If you can become a very efficient oven for those purposes, why not bring it back to the developed world?

THOMAS STEWART: That's one working with a lot of other business opportunities. That's interesting. The bottom-of-the-pyramid-up design and developing country designs working in other business areas. It should work there.

QUESTION: Hi. I'm Luciana Marulli-Koenig from the United Nations. The question is directed in particular to Joan Krevlin.

Could you possibly expand a bit more on the best practices that might have been adopted also in developed countries to keep the people living in the country as a sustainable society with access to services and so on? To answer my own question, something like that was done in Norway.

JOAN KREVLIN: In Norway? I can't speak to that.

QUESTIONER: Any other country.

JOAN KREVLIN: You said two things that are interesting. I don't know that architecture can solve all of them.

One is best practices in terms of how we build and how we live. That is acknowledging the particular conditions of where you are, understanding the conditions of rainfall and solar conditions, and really having a building solution that is appropriate.

The second part of what you said had to do with sustainable societies and access to work. People move from rural areas to urban areas because they have access to jobs and communities, and they don't need transportation, which are all things that allow people to survive. They leave rural areas because they can't sustain themselves.

It's kind of looking at it in a more multi-disciplinary way, in terms of how do we look at the integrated things that allow people to sustain themselves.

Unfortunately, buildings are easier solutions than those larger questions of access to work, jobs, transportation, and food. It's a big question.

QUESTION: There's an opportunity to look at the people that are living in those situations and the innovations that they are driving themselves.

An example of that are the—there's not a delicate way of saying this—trash-picking societies that exist in the favelas and the more destitute areas of those countries. They are actually innovating incredible technologies for recycling and collecting, and their waste systems are much more efficient than ours in New York.

A good example of that is the Coptic Christian collection of people in Cairo, Egypt. They have served as a model for societies in South America and Africa, to not only recycle all of the waste of the entire city, but to create income and build their own cities that are more sustainable and improving the conditions that they live under.

THOMAS STEWART: The value of indigenous solutions. As we were saying, certainly in other areas Western companies have discovered that you don't sell to emerging markets by stripping out features; you sell to emerging markets by designing in and for those markets, and then you can actually bring that stuff back to developed markets.

QUESTION: Howard Levy. My company is Red Rooster Group. We do marketing for sustainable businesses.

This question in some way builds upon what you are asking. In the answer to your proposition, Joan, who will evaluate the aesthetic criteria of that building, the obvious answer seems to be the tenants or residents of the building.

I have noticed a lack of participation in the process by the actual users. For example, in the architecture profession, LEED is top-down by a government agency, and the experts are the architects.

The question is: Where is the role for the people in the process? And the larger context question is: Will the Green Revolution or is the Green Revolution being driven by top-down or by the people?

For example, even with Larry, the question of these amazing cars, is that ultimately going to be imposed by government, or a corporate interest, or by demand from the people?

THOMAS STEWART: Joan, this is your opportunity to answer the question about India and China that was our first question. Where is the *vox populi* in this?

JOAN KREVLIN: I really like your question. It's an important question.

One of the things that we have seen with this slight paradigm shift in how we think about how we build, is that there is a rethinking of the role of the architect. To really build sustainably is a much more integrated process,

with multiple voices at the table necessary to understand what makes for a successful solution. That model of the genius architect no longer really makes sense.

T**HOMAS STEWART:** Are you please telling us that Ayn Rand is over?

JOAN KREVLIN: She is completely over. We can now officially say that's done.

It starts from the top-down team, but then it brings in the user to the mix. What I mean by that is you can no longer solve these kinds of problems if you design a building, then call in your landscape architect, your mechanical engineer, and say, "Okay, now how do you cool it?" They have to be at the table very early, because the solutions really need to grow out of a collective understanding of the problem that needs to be solved.

The user plays a critical role in that. I can't speak for all architects, because architects are a sort of egocentric kind of crowd, but there is a bit of a shift in the thinking that makes you realize that if it used to take a village to raise a kid, it kind of takes at least a large group to create an effective building that's going to serve those needs over time.

There is a shift in thinking about the role of the architect and the importance of seeing that as a more integrated collective process.

THOMAS STEWART: Larry, I want you to pick up this too, because of course the value proposition of the automobile has been, as you express it, that you can go where you want, when you want, with whom you want. It has been very much that sort of equivalent that bicycles are to 12-year-olds what automobiles are to people who are 18 and over. It gives you that sort of individual mobility.

The same question has to do with transportation systems. How much is it the people voting collectively or making decisions collectively about how much freedom they want, how much freedom they will restrict? How do we get this thing done right?

LARRY BURNS: In the auto industry we wrestle with that dynamic between the creative genius of an individual designer and the collective strength of the diversity of a group all the time. You have to work on that.

The automobile is a fashion good. People write songs about the automobile. Prince wrote "Little Red Corvette," he didn't write "Little Red Laptop Computer." There's something to that.

When I get asked, "Why did General Motors go bankrupt?" it's because we lost our focus on the consumer, the customer, and trying to understand really deeply the overall experience that customers have with our product.

I don't think you can go wrong by really deeply focusing on the entire aspect of the customer experience and drive your innovation toward making all aspects positive and getting rid of the negatives. If you get that right, then the consumers will come.

We have to be real careful about it being a democratic decision process, because there is something to be said about individual creative genius that leads to breakthrough ideas. We're balancing it all the time.

One set of tools that I found very refreshing is consumer ethnography. Rather than trying to understand the customer through surveys, you understand them deeply by observing. Oftentimes what you observe is really the key insight. It's not what a consumer says, it's what you can observe and infer from that.

THOMAS STEWART: It's the great Yogi Berra line, right, "You can see a lot just by looking"?

QUESTION: Robert James. I'm a businessman in New York. I have been in the oil business for a long time and I've invested in green energy too. The green I always make money in with tax refunds. The company went broke, but I made money.

My question is this: Under what circumstances do you favor sustainability? Do you at any cost? Do you look at subsidy? How do you measure convenience for example, with bikes? Is it safety, hours saved, desire of the people who want to buy?

I heard somebody mention Abu Dhabi, which would be carbon footprint. I've heard very much about that. At what cost? There's no question that they can do it, but it doesn't make any sense other than politically.

Dr. Burns, you mentioned about urban mobility. I liked what you said at the end about market. But when you're talking about urban mobility and all those cars and cutting up the curbs into New York and so forth, I have no idea—you didn't mention cost there or whether people would buy it.

Ms. Krevlin, you talked about LEED. I have built a museum. Naturally, the people who wanted the museum wanted Platinum. They were shocked when I told them to tell me what the cost would be to make it Platinum. Why is this?

THOMAS STEWART: The cost is the elephant in the room, or the price tag is the elephant in the room. We thank you for putting it right here. Let's talk about cost.

Who wants to grab the elephant?

SARTAZ AHMED: With technology, one of the things that we have said is that it will only come into solution if it is close to being competitive, and the subsidies and policies can push it over.

We don't believe that it will come into solution if there is a huge gap in new technology being competitive with existing technology.

First of all, there is the issue of cost. Also, it has to match the performance of the existing technology.

Our view is yes, if a technology is close to being as good as or better than the existing technology and there is a small cost differential, then subsidies and policy can bring it into solution. It's the whole valley argument.

THOMAS STEWART: The whole thing.

SARTAZ AHMED: If it's close to the bottom of the valley, then subsidies can work. Not if it's right up there.

LARRY BURNS: I led research for General Motors and people would propose projects. One of the first things we would do is ask ourselves: At a mature scale, high-volume mature technology, will it be cost-competitive? In essence, will that pile of molecules cost more than the pile of molecules that we are using today for a solution? If it didn't pass that first test, we wouldn't go down that path.

The challenge we have, especially in my industry, was this 120-year-old automobile design that has enormous inertia behind it, with codependence on 170,000 gasoline stations and 4 million miles of road. That's what we are competing against with new ideas.

We believe these new solutions can be cost-competitive and in fact, add more value, rather than it being viewed as a tradeoff. This word "or" drives me nuts. We shouldn't have to pick between this or this. It should be "and." When you look at power of the word "and," when we look at all of these opportunities and pull it together, and get off of the tradeoff mindset and into the synergy mindset, we can deliver these solutions at higher value and lower cost.

THOMAS STEWART: Joan, can we get a Platinum building at a tin price?

JOAN KREVLIN: No. Nor do you need to. The point is trying to figure out what your goals are.

LEED can be a distraction, so we're going to put LEED aside for a second and just talk about how sustainable decisions are often just smart decisions.

The vast majority of them don't necessarily have a cost impact if you're looking at building orientation, how you build an envelope, where you put your fenestration, or how you make material choices.

There are places, particularly when you start to do the layering in of higher-technology solutions, where there is a cost premium. At that point, you really have to do a life cycle analysis and see whether the payback makes sense or whether there are other goals for the institution, whether it's as a demonstration project or a long-term payback that makes sense.

We can get distracted by the high-tech expensive solutions and we really need to look at basic good decisions that don't really have a cost impact. Then there's that whole collection that do have a cost impact, and they have to be evaluated very carefully.

THOMAS STEWART: One of the interesting things is there are some policy questions here. Of course, there are costs that aren't borne by people—there are externalities.

Also there are hidden subsidies. As you were saying at lunch, Ford, GM, Toyota, Shell, Exxon, Mobil, and so on and so forth, haven't paid for those roads. We have. It's a choice we made as a society. We could have chosen other things. There's actually a hidden subsidy there that we have sort of forgotten about, which is all that

infrastructure. We could choose to do it differently, in which case the cost equation might be different. We have made the choice we've got.

We have a question here, and then we're going to have to wrap it up because I want to give everybody on the panel a chance for a one-minute final word.

QUESTION: Jessica Kirk from Gerson Lehrman Group.

My question is for Mr. Burns. As I think about this model with this individual one or two people in the unit, a couple questions came to mind for me.

I understand that in some cultures when they board a bus they all sit next to each other. In the United States, when people board a bus they have this amazing geographical dispersity that self-corrects as people continue to board the bus.

I wonder what you think of the societal implications. In some cultures individual units scooting around works, in some cultures women are often carrying and bringing three or five children along with them—what are the cultural implications and how do those fit in? Obviously, we're not going to retrofit New York probably in the next couple years to do that vision. Where do you think it fits and what are those cultural implications?

THOMAS STEWART: I want to quarrel with your premise. In a New York City bus, people stand right in a clot, right in front of where I try to get to to get to the back of the bus.

LARRY BURNS: It's a fascinating cultural question. People move around and interact, and we're social by nature, and we like to be with the people we want to be with.

I've spent a lifetime observing how people do that. I go to subway stations and we watch people who are complete strangers walking by each other all the time. They're really not interacting. They're not even saying hello. But they're bobbing and weaving and missing each other in a crowd. And your observation on buses.

The technology we're talking about, I could have two of those vehicles. My wife and I and my two children could travel as a family because one of them can follow the other one perfectly. I could be steering the front one and the electrical impulses I'm putting into the wheels are the same ones that are being put into the wheels on the one behind us. It's very interesting about this machine.

A transit bus is 64 people, two rows of 32 people, 16 seats on each side. Thirty-two of these machines have the capacity of a bus. Thirty-two of those machines weigh less than the bus and thirty-two of those machines cost less than the bus. And what if they were shared machines in the city?

It's really how are we interacting today. Are we interacting with the stranger on the bus or are we interacting with our social network? What's going on with social networking? The reason my kids would rather have their iPhone than their car is their social network is so important to them.

Joan made the statement earlier we have to play to the local circumstances. I don't think this is about trying to change someone's culture to fit a technology solution. You have to play to that local circumstance for sure.

THOMAS STEWART: I imagine that you can get connecting doors with these things, like hotel rooms. You could probably set things up so that you could have the equivalent of a station wagon that you could put together like so many Lego blocks with something like this, if you needed to have that. I suppose that could work.

One minute each. As you listened to the conversation here, what is one lesson or idea that you want the audience to take that can actually move the needle on some of these issues of sustainability in cities and sustainable societies?

SARTAZ AHMED: I think there is a tremendous opportunity to do things differently. The moment is now. The technologies are there. It's a question of having the vision to do so.

LARRY BURNS: Let me add to that vision a collective will. We are going to have to find a way to get everybody on the same page and the same blueprint and move forward as quickly as possible. Learn, and make sure that what we learn meets what consumers want and allows people to make some money along the way.

JOAN KREVLIN: I'm going to remember ten years ago, when my daughter was in sixth grade and she had a science teacher who connected them to environmental issues. She had us all marching around City Hall holding signs that said "Use Less Stuff." That phrase "use less stuff," with all the kind of sophisticated talk we use about sustainability, always rings very true to me, that they had it right as young sixth graders.

THOMAS STEWART: I heard a couple of things that were pretty significant.

One, as the twig is bent, so the tree is inclined. Buildings last for a long time. City design lasts for a long time. Decisions we make now will be decisions the consequences of which we will live with or perish by in the years to come.

I was really reminded, Larry, looking at the stuff you had in Shanghai, of the Futurama Exhibit and the Magic Highways exhibits from the 1930s, in which an auto-centric urban paradise was imagined that we realize has turned into something quite different than what was portrayed 70 years ago or so.

To reach that newly radiant city is something that we have an opportunity to do. We've imagined that before, and we really need to make important choices now.

Secondly, it's a systems problem. We've talked about pieces of the system. There are other pieces of the system that are represented but not represented in this panel. IT is not represented in this room, for example, and ought to be. There are even fewer BTUs used in a trip that you don't make because you have telecommuted. When we think about sustainable societies, we are not just thinking about sustainability in terms of carbon, but also health and safety and various other things. There is a whole systems thing in there, and other pieces need to come together.

Finally, I love the phrase that Joan used about the aesthetics of sustainability. That is really important.

We were talking at lunch today about how we talk about our addiction to oil. If you think about the other, much more difficult addiction to shake, it is the addiction to tobacco. Something happened in the aesthetics of tobacco, in the pricing signals that were sent to kids, in the regulatory systems, and in whether tobacco was cool or not cool, and the system changed. Even in France and in Italy, the system changed. There are few benighted places left. It really is remarkable how in a very short period of time something that people would have thought impossible changed.

The impossible is possible if the system lines up in the right kind of way. Sustainability is living well today in such a way that we are not subtracting from the ability to live well tomorrow. If we can get the thing moving in the right direction, we can indeed get there.

With that, I would also like to thank the audience very much for their participation and particularly thank the panel.

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