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EXECUTIVE SUMMARIES

INVESTING IN CITIES OF THE 21ST CENTURY:
Urbanization, Infrastructure, and Resources

BUSINESS AND ENVIRONMENT INITIATIVE, Harvard Business School

FACULTY CO-CHAIRS
Rebecca M. Henderson
John D. Macomber
Forest L. Reinhardt

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ABOUT THE BUSINESS AND ENVIRONMENT INITIATIVE

The Business and Environment Initiative at Harvard Business School seeks to deepen business leaders' understanding of today's environmental challenges and to assist them in developing effective solutions.

We aspire to help leaders think clearly about the design of economic and political institutions that enable firms and societies to thrive while maintaining the physical and biological systems on which they ultimately depend.

SPEAKERS:

JOHN D. MACOMBER, Senior Lecturer of Business Administration, Harvard Business School

DAVID MILLER, former Mayor of Toronto; former Chairman, Clinton C-40 Cities

DEAN NITIN NOHRIA, Dean of the Faculty, Harvard Business School

OVERVIEW

The population of the world's cities will double by 2030, and at that time more than half of humanity will be urban. This will occur in the face of increasing scarcity of basic resources like land, energy, clean air, and clean water. While cities are the major user of these resources, cities also are the organizing core for dramatic advances in resource productivity and sustainable infrastructure. These advances, many led by private sector investment and entrepreneurship, can result in dramatic environmental and economic benefits.

CONTEXT

After Professor Macomber summarized the conference's key ideas, Dean Nohria shared from his life experience about the role that cities play, and described HBS's ambition to speak to the most important problems in business and society. Mr. Miller then shared observations from his experience as Toronto's mayor and from chairing C40.

Already overcrowded and facing tremendous challenges, cities will continue to grow.

Many of the world's cities are overcrowded and already "stretched to the max." Cities face enormous challenges in not having enough land, water, clean air, energy, or places to put waste. And cities already produce 80% of the world's carbon emissions. Yet during the lifetime of today's children, the population of cities is expected to double, from its current level of three billion to six billion.

Cities are engines of economic progress and prosperity.

Every day, people continue to pour into cities. Nitin Nohria said the reason for this migration is because, "The truth of the matter is that there's no other choice. Economic development centers around cities. They're the engines of economic progress."

> *"Cities are the places where people see economic opportunity . . . they are, in fact, the engines of prosperity."*
> – Nitin Nohria

The challenge is creating cities that will continue to be engines of prosperity while at the same time being more sustainable.

Cities have the ability to act, and in doing so are producing solutions that connect the environment and the economy.

Cities don't have to wait for agreement to international treaties or development of national policies in order to take action. Under the leadership of strong, activist mayors—who are closer to citizens—cities can craft regulations, collect taxes, affect building permitting, and set a wide range of policies that produce near-term results.

> *"If you have a strong mayor and a good city government, you can actually make real change very quickly."*
> – David Miller

The reality is that cities are acting independently and collectively to produce solutions that have environmental and economic benefits. Among the examples discussed were:

- *The C40.* Mayors of the world's 40 largest cities have come together in partnership with the Clinton Global Initiative to address the issue of climate change. The idea is to address environmental challenges in a way that helps build a strong economy. The C40, currently chaired by New York City mayor Michael Bloomberg, has balanced representation from both the developed and the developing world. The C40 is advocating, sharing success stories about what is already happening in cities, and working together to create uniform standards in emerging areas, such as charging stations for electric vehicles.
- *India's major cities.* In Dean Nohria's view, 25 years ago India's major cities of Calcutta, Delhi, and Bombay (now Mumbai) felt like they had no place to grow and there was no place for a car to move. Today, there are 10 times as many cars in India and these three cities have made tremendous progress. Once considered unthinkable, Calcutta built a metro, which has dramatically changed the city and reduced pollution. Delhi's leadership mustered the political will to convert the city's public transportation system to compressed natural gas, which over five years decreased pollution in a palpable way and transformed the city.
- *Denmark and Copenhagen.* About 35 years ago, after the first oil crisis, Denmark decided it did not want to be dependent on foreign oil and decided that all electricity in the country would be generated from coal. The country was successful in implementing this strategy, but 25 years later realized it was the wrong strategy and switched course. The country then made the strategic decision to pursue renewables and it is underway in implementing this strategy, with progress in wind, geothermal, and other types of renewable energy. This combination of forward thinking and political organization has helped this cold, energy-poor country remain competitive in the global arena.

- *Toronto's deep-lake water cooling program.* Near Toronto is Lake Ontario, which has deep water that is cold year round. A company in Toronto, Enwave, has laid pipes in Lake Ontario that use the cold water to cool 60 of Toronto's office towers during the summer. This has a massive impact in reducing greenhouse gasses. The innovative technology being used, which was developed by a Spanish company, now is being studied by a company in Copenhagen that wants to run pipes into the oceans to cool buildings in warm countries. Developing and commercializing this technology will provide environmental benefits and create jobs. Toronto was able to accomplish this in part because the electric utility is owned by the city—one example of a way to allocate benefits and costs of this major investment program.

These examples are ways that cities are taking action to simultaneously produce environmental benefits, develop new industries, and create jobs—and enhance their economic effectiveness as well.

The challenges of cities in the developing world are taking place right now.

The challenges in the developing world are remarkable and they are happening today. The cities of the 21st century are being built right now in the developing world—not next year, but right now. These cities must seize the opportunity to be economically, socially, and environmentally sustainable.

The core infrastructure of these cities—power, water, transit, waste—is at the center of both environmental quality and also economic competitiveness. Cities that can harness public and private capital and competency to build out resource-efficient infrastructure will be far more competitive than their less prescient peers looking into a rapidly urbanizing 21st century.

The conference shows Harvard Business School's focus on the most important problems affecting business and society.

A priority at HBS is to speak about the most important problems in business and society, to be a place where the most important conversations occur. Along with being an intellectual leader, HBS will continue to be a convener, bringing together influential experts in different areas collectively to produce imaginative ideas. And HBS is tackling these problems in a collaborative, multidisciplinary way.

Already an extraordinary amount of work has taken place at HBS, and the Business and Environment Initiative is making great progress. This conference is another step in advancing the conversation about business and the environment.

While business is not the sole answer to all of the big problems of the world, none of the world's problems will be solved without the involvement of the business and investment community. Many of these problems—and opportunities—are best approached in highly inclusive manner incorporating the work of many areas of expertise. Investing in cities of the 21st century—notably around infrastructure—is just one of the areas in which HBS is leading thought and action with respect to business and the environment.

JOHN D. MACOMBER (MODERATOR)

John Macomber is a senior lecturer in real estate at Harvard Business School. His professional background includes leadership of real estate, construction, services, and technology businesses. He is the former chairman and CEO of the George B. H. Macomber Company, a large regional general contractor and a principal in several real estate partnerships in Massachusetts.

At HBS, Macomber teaches Finance and Real Property courses in the elective curriculum, including Real Property Asset Management; Real Estate Development, Design, and Construction; and Sustainable Cities: Urbanization, Infrastructure, and Finance. He is part of the teaching team for the Building Green Businesses field study seminar. Macomber also teaches Real Estate Sustainability, Strategy, and Finance at Harvard's Graduate School of Design.

Prior to coming to HBS, Macomber was a lecturer at MIT in Civil Engineering and Real Estate. He is chair or a co-chair of Executive Education programs including Real Estate Management, Real Estate Executive Seminar, and Develop India: Real Estate Strategies for Growth.

In the community, he is active with the Young Presidents' Organization (YPO), Boys and Girls Clubs of Boston, the Appalachian Mountain Club, and Mount Auburn Hospital. He serves on the boards of Boston Private Bank and Vela Systems.

DAVID MILLER

David Miller is a leading advocate for the creation of sustainable urban economies. In addition to being a strong and forceful champion for the next generation of jobs through sustainability, Miller advises companies—and governments—on practical measures to make this happen.

As chair of the influential C40 Cities Climate Leadership Group from 2008-2010, Miller was instrumental in demonstrating the practical and real change cities are already making and can continue to make as they fight climate change and create green jobs. In this capacity, Miller worked with the World Bank, OECD, the Club de Madrid, and other national and international organizations to strengthen the capacity of city governments worldwide to act.

As mayor of Toronto from 2003-2010, addressing climate change was a top priority for Miller. In July 2007, the city of Toronto released a wide-ranging Climate Change, Clean Air, and Sustainable Energy Action Plan that included over 100 actions to reduce the city's carbon footprint. In October 2009, the Power to Live Green outlined step-by-step how Toronto will reach 80 percent reductions in greenhouse gas emissions based on 1990 levels.

Under Miller's leadership, the city of Toronto allocated $4 billion to climate change related projects and programs. Major projects to meet the city's 80 percent reduction in greenhouse gas emissions included over 120 km of new light rail to add to Toronto's transit system, which is the third largest in North America; Tower Renewal, a project designed to a create jobs, promote local food production, and revitalize communities through energy efficiency improvements on over 1,000 high-rise residential buildings; and Live Green Toronto, which places community workers in neighborhoods across the city to identify, raise funds for, and work with residents to implement innovative new programs in all parts of the city.

Miller is a Harvard-trained economist and, professionally, a lawyer.

NITIN NOHRIA

Nitin Nohria became the tenth dean of Harvard Business School on July 1, 2010. He previously served as co-chair of the Leadership Initiative, senior associate dean of faculty development, and head of the Organizational Behavior unit.

His intellectual interests center on human motivation, leadership, corporate transformation and accountability, and sustainable economic and human performance. He is co-author or co-editor of 16 books. His most recent, *Handbook of Leadership Theory and Practice*, is a compendium dedicated to advancing research on leadership based on a colloquium he organized during HBS's centennial celebrations.

In *Paths to Power: How Insiders and Outsiders Shaped American Business Leadership*, he chronicles how leaders from different backgrounds rose to power in American business. This is a companion book to *In Their Time: The Greatest Business Leaders of the 20th Century*, which draws lessons from some of the most celebrated American business lead-

ers of the 20th century. The third book in this trilogy of historical studies of leadership is *Entrepreneurs, Managers, and Leaders: Leadership Lessons from the Airline Industry*.

Dean Nohria is also the author of over 50 journal articles, book chapters, cases, working papers, and notes. He has served as an adviser and consultant to several large and small companies in different parts of the world. He has been interviewed by ABC, CNN, and NPR, and cited in *BusinessWeek*, *The Economist*, the *Financial Times*, *Fortune*, the *New York Times*, and the *Wall Street Journal*.

Dean Nohria has taught courses across Harvard Business School's MBA, Ph.D., and Executive Education programs. He also served as a visiting faculty member at the London Business School in 1996.

Prior to joining the Harvard Business School faculty in July 1988, Dean Nohria received his Ph.D. in management from the MIT Sloan School of Management, and a B.Tech. in chemical engineering from the Indian Institute of Technology, Bombay (which honored him as a Distinguished Alumnus in 2007).

MODERATOR: **JOHN D. MACOMBER,** Senior Lecturer of Business Administration, Harvard Business School

SPEAKERS: **MARTIN FLEMING,** Vice President, Business Performance Services, IBM Corp.

DAVID GAGLIANO, Director, Customer Solutions, Cisco

DAVID MILLER, former Mayor of Toronto; former Chairman, Clinton C40 Cities

RICHARD RAVITCH, former Lt. Governor of New York

OVERVIEW

More than half the world's population now lives in urban centers. Resource-efficient infrastructure helps people to get to and from work and school, power their homes, prepare their food, and live their lives in a productive, contributory manner. However, there are so many competing interests—and such a lack of capital—that what seems apparent in theory can be very challenging in practice. This panel explored many aspects of this conundrum. For example, interconnecting urban infrastructure systems with technology is one way to make cities more attractive places to live and work. Some of the challenges associated with these new information infrastructures include privacy issues, alignment with socioeconomic interests, and articulating a sustainable business benefit to local stakeholders.

Another point of view is that the United States has realized that its massive transportation infrastructure is underfunded and deteriorating. Major capital infusions are the only viable solution. (Everyone wants better infrastructure, but no one wants to pay for it.) Emerging markets face similar problems if they build large highways and traditional infrastructure. The business challenges include: a) finding solutions today to avoid that scenario in the future, and b) mobilizing the capital to pay for the solutions.

CONTEXT

The panelists discussed the competitiveness of cities and the importance of both information and physical infrastructures.

The competitiveness of cities is directly related to their quality of life—and their efficiency.

More than half the world's population now lives in urban centers. Cities enable businesses to come together and to stimulate innovation. A high quality of life attracts top talent and transforms cities into crucibles of innovation.

Research has shown that reducing transportation congestion and improving the availability of water contribute to economic growth and improved competitiveness. Despite these facts, city managers recognize that the demand for services is increasing at a faster rate than services can be delivered. Unless changes are made, the quality of life in cities will decline.

> *"Competitiveness is going to be key because cities are battling to attract the best minds, the best businesses, and to produce a high quality of life for citizens."*
> – David Gagliano, Cisco

Smart, connected communities are one way to obtain efficiency gains and to improve the standard of living.

In many communities, the energy, transportation, and safety systems are silos with no connectivity. When systems become interconnected in real time, however, efficiency gains are possible. Many cities are creating a meshed fabric of services related to traffic, employment, and police services.

- *Transportation services.* Linking the transportation system with first responders is one example of a meshed fabric of services. When ambulances respond to an incident, it is possible to turn all the traffic lights on their route green. Meanwhile, congestion pricing systems have been deployed successfully in Singapore, London, and Stockholm. After Stockholm introduced its system, the city saw a 20–22% percent reduction in congestion and a 14–15% reduction in emissions.
- *Job centers in Sao Paulo, Brazil.* Sao Paulo is transitioning people from poverty to the middle class. This has required a huge shift in the information infrastructure. When students graduate from high school, they turn to government job centers for career opportunities. In the past, job centers were not connected to the school system. Providing automatic access to school records has eliminated thousands of manual transactions each day.
- *New York City's Compstat system.* The Compstat system has made policing more community-oriented and focused on migrating hotspots. The system collects all the crime reports and does a predictive analysis of where activity will likely move next. This enables the police department to redeploy its resources on a day-to-day basis.

Smart, connected communities also could use the information infrastructure to handle exceptions and save money. For example, when schools in Washington, D.C. were closed for a week due to snow, the lights and heat were still on. Simple policy-based exception handling could have turned these off after motion sensors recognized that no one was in the building.

Private-sector companies are partnering with communities on energy-saving initiatives.

A relatively new business model is emerging in which private-sector businesses partner with communities to improve energy efficiency. An energy-efficiency program can save between 25% and 40% of a building's operational energy costs. If that savings is extrapolated across all the public buildings in a community, the cost savings can be significant.

However, the upfront cost for instrumentation, facility-monitoring controls, and analytics is more than a community can typically capitalize. As a result, some businesses are proposing to community leaders that they can capitalize the investment in exchange for 60% of the cost savings. The worst that can happen to the community is that the savings are small, but they are always cash-flow positive.

Although introducing an interconnected mesh of services is not technologically challenging, it raises major privacy issues.

The optimization systems used in urban contexts do not pose technical challenges. However, large volumes of data about commuting patterns and home energy usage contain significant personal information. As a result, privacy is a major issue.

When congestion pricing was proposed in New York, for example, there was considerable opposition to the placement of cameras on the streets. This was perceived as an invasion of privacy. The public was more accepting of tolling bridges.

> *"There are massive volumes of data being generated by these new systems, which open up significant security and privacy issues. Organizations like IBM and Cisco are spending a lot of time focusing on how to address that effectively."*
>
> – Martin Fleming

Privacy concerns and opposition to policies such as congestion pricing illustrate the non-technical challenges faced. In many instances, the key issue to be overcome is not one of technology; it is aligning the various stakeholders.

Information infrastructure projects must provide a sustainable business benefit and be aligned with socioeconomic interests.

When companies pitch information infrastructure projects to cities, just having a better system is not sufficient. Projects must offer a significantly better approach than the entrenched system. The goal is to provide a sustainable business benefit, as well as a net positive benefit for citizens and the key stakeholders.

Proactive involvement of stakeholders is essential. This may mean interacting with players from the political or industrial community. Technology companies such as Cisco and IBM work closely with city leaders to identify low-hanging fruit, as well as more challenging efficiencies.

Solution benefits should be aligned with each city's interests. Issues that are a key concern in one region may be less relevant in another. In the Middle East, for example, energy efficiency is a low priority since fuel costs are low, but water conservation is a major issue. In addition, the socioeconomic aspects of optimization projects must be considered. In Brazil, the government is subsidizing the use of energy to transform the economy. As a result, stakeholders felt it was inappropriate to track down energy leakage.

Despite the political aversion to government spending, revitalizing the U.S. transportation system requires additional revenue.

Cities need adequate infrastructure to thrive. Creating this infrastructure requires paying for it, and support is often lacking for doing so.

In the United States, the transportation system is dramatically underfunded. This is evident in the growing number of deteriorating bridges. A government commission estimated six years ago that it would take $3.5 trillion to maintain the country's surface transportation system. Since then, the response by the federal and state governments has been minimal.

Over the past 20 years, the political dynamic is one where spending is bad and politicians are generally averse to any tax increases whatsoever. The discussion needs to be changed to focus on investing in the future of America. If the issue can be tied to jobs, it may be possible to win support.

In reality, governmental revenues are essential to revitalizing America's infrastructure. There is no magic bullet; these funds can come from either user charges or tax revenues. Mr. Ravitch commented that it was illusory to think that private capital could substitute for funds derived from user fees or taxes. About 85% of infrastructure investment in the United States is paid for via bond issuance at the state level. Public/private partnerships are not a panacea; both bond issues and PPPs eventually need to see a path to revenue to repay the investment. In one manifestation of this issue, since cities cannot rely forever on real estate tax revenues, Ravitch predicted that within five to seven years, most major cities will have regional tolls on roads that were formerly provided to the public without a direct charge.

> *"There are a lot of things that can affect revenue at the margin, but unless you collect more taxes you are not going to be able to stop this fiscal decline."*
>
> – Richard Ravitch

Infrastructure projects in emerging markets bring new opportunities, but ongoing maintenance is a concern.

In emerging markets, infrastructure projects can be transformational. C40 has been working with the World Bank to support building cities in a more sustainable way. Sao Paulo, for example, now generates 9% of its electricity from landfill methane recapture. In the past, people picked garbage from the landfill. In the future, those people's children may work as technologists at the methane plant.

Emerging markets also present opportunities for technology companies. IBM recently spent time in China's Hunan Province, where three cities are being built. While significant progress has been made, the Chinese have not had experience with large-scale systems and need technological assistance.

Although new cities appear world class if huge roads and traditional infrastructure are built, in the future community leaders will find that these systems are not sustainable. The challenge is to find solutions today to prevent that.

> *"I think the challenge in the emerging world is that it seems to be world class if you build massive roads and all the traditional infrastructure in a city. But it's a model that we know 20 years from now won't be sustainable."*
>
> – David Miller

Other Important Points

- *Utilities and renewable energy.* Utilities deploy smart systems to profit from efficiency gains. Utilities see no business case for renewable energy sources because there is no financial benefit for them.
- *Smart devices and customer segmentation.* When smart devices are deployed, one challenge is building a sizable consumer segment that is willing to alter consumption patterns to obtain savings. Consumer segmentation is challenging for utilities that have been monopolies for so long.
- *Low-tech solutions.* Cities can implement thoughtful, low-tech programs, instead of building expensive new infrastructure. To prevent sewage overflows, Portland, Oregon charges residents who install concrete driveways instead of gravel.
- *Intelligent Utility Network Coalition.* IBM created this group, comprised of utilities from around the world. Members exchange best practices related to policy issues.

JOHN D. MACOMBER (MODERATOR)

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MARTIN FLEMING

Martin Fleming—an economist and strategist—is vice president, business performance services, at IBM Corp.

Fleming leads a team of professionals who create tools and capabilities for improving IBM business performance, resulting in increased revenue growth and improved organizational leverage. To understand the behavioral economics of IBM, the team creates new data sources, applies advanced analytic techniques, deploys new business processes, and drives resource reallocation to achieve IBM's 2015 financial goals.

Previously, within IBM Corporate Strategy, Fleming led IBM's Smarter Planet strategy development and execution with a focus on energy, climate change, and Smarter Cities.

Fleming also has led IBM's Emerging Business Opportunity program, supporting innovation within IBM and its clients and providing management and measurement of innovation-led initiatives.

Fleming also has led IBM's Global Sales and Distribution's strategy and planning activities and led IBM's strategy development and implementation for IBM's global business partner community.

Prior to joining IBM, Fleming was a principal consultant and the technology practice leader at Abt Associates in Cambridge, Massachusetts. He was also vice president, strategy, for Reed-Elsevier, Inc., the Anglo-Dutch information company. Fleming began his professional career at the System Dynamics Group, Alfred P. Sloan School of Management, Massachusetts Institute of Technology.

His work has been published in a number of professional journals and other publications, such as the *New York Times* and the *Wall Street Journal*.

Fleming holds a Ph.D. and an MA in economics from Tufts University and a BS cum laude in mathematics from Lowell Technological Institute.

DAVID GAGLIANO

David Gagliano is director of Customer Solutions within Cisco's Solutions Design Center office, applying his broad background in enterprise IT systems architecture in aligning customer business challenges with transformational enterprise solutions. Since joining Cisco in 2006, Gagliano helped create the global Business Transformation practice, and now co-leads both Cisco's Winning in Architecture and Smart+Connected Communities programs. He has over 27 years' experience leading complex systems engineering, integration, and applied research and development projects that leverage cutting-edge technologies. This technical expertise is balanced with strong strategic planning, technology forecasting, business, and customer skills.

Prior to joining Cisco, Gagliano served as an organizational CTO and technical fellow at Northrop Grumman (NG), responsible for leading corporate initiatives in Services Oriented Architectures and Semantic Interoperability while overseeing applied research in mobility, security, and wireless technologies. He has authored over a dozen papers on subjects as diverse as telemedicine, enterprise services architectures, wireless data transmission, video compression, object-oriented programming, web development, virtual reality, and nanotechnology.

Gagliano holds a CIO University Certificate from the General Services Administration, an M.S. in technology management from George Mason University, and a B.S. in computer science from Ohio University. He serves by invitation on the GMU TechMan Industry Business Council, providing guidance and formally evaluating the Masters Capstone competition. His international work experience includes multi-year field positions in North America, Europe, and Southeast Asia.

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Miller is a Harvard-trained economist and, professionally, a lawyer.

RICHARD RAVITCH

Richard Ravitch served as lieutenant governor of the State of New York from 2009 through 2010.

Ravitch began his career as an attorney for the Government Operations Committee of the House of Representatives in Washington, D.C., from 1959 to 1960. He then joined HRH Construction Corporation as a principal and was responsible for supervising the development, financing, and construction of over 45,000 units of affordable housing in New York; Washington, D.C.; Puerto Rico; and other locations. In 1975, Governor Hugh Carey appointed him to serve as chairman of the New York State Urban Development Corporation, a financing and development agency with 30,000 housing units under construction.

In 1975 and during the following year, Ravitch assisted New York City and State officials in resolving the city's defaults. In 1979, Ravitch was appointed chairman and CEO of the Metropolitan Transportation Authority (MTA), overseeing the operation of the New York City subways and buses, the Long Island Railroad and MetroNorth commuter lines, and the Triborough Bridge and Tunnel Authority. Ravitch completely reorganized the MTA and its functions. For his work at the MTA, Ravitch was awarded the American Public Transit Association's Individual of the Year Award in 1982. Following his MTA service, he led an effort to recapitalize The Bowery Savings Bank and helped to arrange for its acquisition. He serves as principal partner in Ravitch Rice & Company LLC with Donald S. Rice, a lawyer and business partner.

Ravitch was the first chairman of the Corporation for Supportive Housing. In 1999, Ravitch was appointed to serve as co-chair of the Millennial Housing Commission, which led a diverse group of 22 housing experts in an intensive 17-month process to rethink America's affordable housing policy.

Ravitch is a graduate of Columbia College and received an LLB from Yale University School of Law.

WATER—POLICY, PRIVATIZATION, AND ENTREPRENEURSHIP

MODERATOR: **REBECCA M. HENDERSON,** Senator John Heinz Professor of Environmental Management, Harvard Business School

SPEAKERS: **JOHN BRISCOE,** Gordon McKay Professor of the Practice of Environmental Engineering, Harvard School of Engineering and Applied Sciences; Professor of the Practice of Environmental Health, Harvard School of Public Health

BERTRAND CAMUS, CEO, Suez Environmental N.A. and United Water

ANAND SHAH, Co-Founder and CEO, Piramal Water Private Limited

JAIME AUGUSTO ZOBEL DE AYALA, Chairman and CEO, Ayala Corporation

OVERVIEW

There is a huge and growing public need for access to safe water globally. Massive market need presents a potential opportunity for business, but many barriers make the space a risky place for private-sector investment.

Yet successful models do exist, including win/win public/private partnerships that accomplish society's goals in ways that are profitable for companies. For more business interests to capitalize on water opportunities, however, new paradigms and innovations in delivery models—as well as leadership in business and government—will be required.

CONTEXT

Professor Henderson led the panelists in a discussion of the business opportunities and challenges associated with expanding access to safe water.

There is a huge and growing public need for access to safe water: a potential opportunity for business.

Many view ready access to safe drinking water as a basic human right, because water is necessary to sustain life. But the ideal that water should be a free resource accessible to all contrasts starkly with practical realities. Much of the developing world today lacks 24/7 access to drinkable water.

> *"Water is not a business. It's much more than that; it's life."*
>
> —Bertrand Camus

While the problem exists with urgency today, climate changes in coming years are bound to exacerbate it. More erratic precipitation patterns, melting glaciers, and shifts in sources of water supply will bring new supply challenges. Shrinking glaciers in the Himalayan Plateau will affect the lives of billions of people who depend on this source for agricultural and drinking water.

Population growth patterns projected over coming decades will further tax water distribution systems.

> *"The broader issue is a Malthusian one of having only so much water, climate change, more and more demand, and a lot of unknowns."*
>
> —John Briscoe

Private-sector ventures in the water business tend to involve high levels of risk.

These pressing issues call for private-sector innovation. The technology already exists to improve water access, as several panelists noted. But serious issues in water supply, pricing, and the politics of water present challenges for its commercialization. Consider:

- *There are large costs associated with supplying water.* Rarely is water delivery appropriately priced relative to the capital investment required. "In the water chain, nothing is accounted for appropriately," said Mr. Shah. Professor Briscoe noted a distinction between financial cost and opportunity cost. Recovering financial costs is essential for effective management of infrastructure. But in agriculture—the biggest water user—opportunity costs are far larger than financial costs and it is opportunity cost, not financial cost, which is key for allocative efficiency. Where there are well-established, transferable water rights, market prices reflect opportunity costs. The outstanding example of these mechanisms at work is Australia. During the protracted drought market prices increased from 5 cents per cubic meter to 100 cents. Water was voluntarily re-allocated from low- to high-value uses. A 70% reduction in water availability caused little aggregate economic impact in an irrigation-based economy in the Murray Darling Basin.
- *There are large costs that people without ready water access routinely pay.* These are measured not just in financial terms but in health and longevity, time, productivity, social stability, and income inequality. People who don't have access to safe water for drinking or agricultural needs recognize its true value. While typically poor, these people are willing to pay dearly for access to it. In that sense, there is an immense market opportunity—one often overlooked by business, given the type of communities where it exists.

> *"Water is not free for anyone in the world, but in places like India it's a healthcare cost, or a productivity cost, or a longevity cost."*
>
> —Anand Shah

- *Political/regulatory environments are often inhospitable to profitable investment in water delivery.* Water business ventures tend to be risky for private partners. A review of concession contracts show that for other utilities, such as energy, telecommunications, and transportation, only 4–5% have failed, versus 35% for water. A great deal of infrastructure capital must be tied up for the long term in uncertain geopolitical and regulatory/legal environments. Water systems often come last in the sequence of privatizations (such as in Chile), because water delivery is such a complex and sensitive business.

> *"Many think water should be a free resource. . . . But we have serious issues in supply [that will affect] how we price it, deliver it, and manage the politics and commercialization of water going forward."*
>
> —Rebecca M. Henderson

Several panelists said that water was like oil in prior decades. Its challenges are not yet widely understood, but certainly call for increased public attention and innovative solutions.

Successful private-sectors models do exist, showing the power of business to address the great social need.

In Manila, an innovative public/private partnership has proven a win/win/win for:

- *The Philippines government*—which had been unable without private-sector help to provide adequate water access to much of the city's population.
- *Manila's people*—access to clean water 24/7 increased from 70% of the city's population in 1997 to 100% today. There was little public opposition to paying for the service, given the great improvement in the quality of water access.
- *Ayala Corp.*—which runs a thriving water-delivery concession business thanks in part to strong political leadership from then-President Ramos, in part due to the well-structured concession agreement and regulatory process and to excellent business strategy and execution. The model allows the company to capture profits from efficiencies (Ayala lowered the percentage of non-revenue water from 63% to 11%).

> *"We like to think that the Philippines model is an example of how it can work, which might be applicable for other countries."*
>
> – Jaime Augusto Zobel de Ayala

In remote Indian villages, Piramal delivers water via a unique franchise model. Local business owners sell water to their neighbors, sourced locally from water they purify using company-provided equipment. Customers purchase water in the quantities they need via prepaid cards at ATM-like kiosks, adding money to cards via cell phones, online, or at drugstores.

Professor Briscoe noted two groups of companies entering the "water space" (especially relating to growing scarcity and deteriorating quality of the resource itself) in growing numbers: 1) firms whose social license to operate is threatened by water quality or scarcity issues (which includes beverage, food, energy and chemical companies) and 2) technology solutions providers whose innovations are improving water quality (e.g., through the application of nano-technology), productivity (e.g., developing new, more productive seeds), and management (much greater use of information technology).

To effectively address water challenges, innovation, new paradigms, and leadership will be required.

For business to capitalize on water opportunities, many areas need to be addressed—new distribution paradigms, public education, political leadership, and investment-friendly regulatory environments.

Mr. Shah believes delivery-model innovation is most urgently needed to address water supply problems. People typically think of water as a utility in the traditional sense, requiring complex and capital-intensive infrastructure such as pipelines, metering, and billing systems. Large systems like that are not financially or physically practical in remote villages in emerging markets. Required are new paradigms that consider above all the needs of the customer. "Micro-utilities" that distribute water over short distances—above the ground, where quality can be ensured—make more sense.

Mr. Shah predicts two big changes in delivery. There will be less delivery of potable water via pipes. The traditional model of pipes carrying drinkable water is inefficient; much is wasted on clothes washing, for example. Two tiers of water quality will be delivered separately. He also expects a revolution in agricultural production that will save much water. In India, 87% of water is used for farming; inexpensive new techniques like laser-leveling the land can reduce water consumption by 50%.

Panelists also mentioned as critical to effectively addressing water-supply challenges the need for:

- *Political leadership.* To attract private enterprise, governments should limit investors' risk and enable profitability via regulatory policies, legislation, and terms of public/private partnership contracts.

- *Engagement by the private sector.* There is much technical innovation, almost all in the private sector. The private sector is also engaging in institutional innovation (witness Manila Water), which is producing results at a large scale. In some instances the private sector is partnering with willing governments to bring process innovation into once-sluggish public water–management systems.
- *Public education.* Awareness needs to be raised regarding water-supply challenges and the private-sector innovations that can address them, particularly in countries where elections replace public officials every few years.

> *"If we want politicians making the right decisions, we need to explain, explain, explain."*
>
> —Bertrand Camus

Harvard Business School is helping its students reflect upon the business opportunities and innovation challenges.

The environmental crisis makes the role of business leaders more complex. They now need to manage not only their organizations but also politicians, social interests, NGOs, and more.

HBS's new Business and Environment Initiative is exploring issues at the intersection of business and environment. The 300 students who participate are reflecting on the opportunities for business and the innovation required to meet the social and business challenges in the water space. They are figuring out ways they can play major roles in the commercialization of water. The Business and Environment Initiative is developing a partnership with the Harvard Water Program to catalyze new partnerships between business, governments, and academia.

REBECCA M. HENDERSON (MODERATOR)

Rebecca Henderson is the Senator John Heinz Professor of Environmental Management, with a joint appointment in the General Management and Strategy units. Professor Henderson is also a research fellow at the National Bureau of Economic Research. Her work concerns how organizations respond to large-scale technological shifts, most recently in regard to energy and the environment. She teaches Leadership and Corporate Accountability and the field-study seminar Building Green Businesses in the MBA Program.

From 1998 to 2009, Henderson was the Eastman Kodak Professor of Management at the MIT Sloan School of Management, where she ran the strategy group and taught courses in strategy, technology strategy, and sustainability. She received an undergraduate degree in mechanical engineering from MIT and a doctorate in business economics from Harvard.

Henderson sits on the boards of Amgen and IDEXX Laboratories, and she has worked with members of both the Fortune 100 and small, technology-oriented start-ups. She was retained by the U.S. Department of Justice in connection with the remedies phase of the Microsoft trial, and in 2001, she was named Teacher of the Year at the Sloan School. Her work has been published in a range of scholarly journals, including *Administrative Science Quarterly*, the *Quarterly Journal of Economics*, *Strategic Management Journal*, *Management Science*, *Research Policy*, the *RAND Journal of Economics*, and *Organization Science*.

JOHN BRISCOE

John Briscoe is the Gordon McKay Professor of the Practice of Environmental Engineering and Environmental Health at Harvard University, where he directs the Harvard Water Security Initiative and is on the faculties of the School of Engineering and Applied Sciences, School of Public Health, and John F. Kennedy School of Government. He teaches undergraduate and graduate courses on water management and development.

His career has focused on the issues of water, other natural resources, and economic development. He has worked as an engineer in the government water agencies of South Africa and Mozambique, as an epidemiologist at the Cholera Research Center in Bangladesh, and as a professor of water resources at the University of North Carolina. In his 20-year career at the World Bank, he held high-level technical positions (as the bank's senior water advisor) and managerial positions (country director for Brazil, the World Bank's biggest borrower).

He received his Ph.D. in environmental engineering at Harvard University in 1976 and his B.Sc. in civil engineering at the University of Cape Town, South Africa in 1969.

In addition to his native South Africa, he has lived in the United States, Bangladesh, Mozambique, India, and Brazil. He speaks English, Afrikaans, Bengali, Portuguese, and Spanish.

Briscoe has served on the Water Science and Technology Board of the National Academy of Sciences and was a founding member of the major global water partnerships, including the World Water Council, the Global Water Partnership, and the World Commission on Dams. He currently serves on the Global Agenda Council of the World Economic Forum, on the High Level Advisory Committee for the Murray Darling Basin Authority, as a member of the Council of Distinguished Water Professionals of the International Water Association, and as senior water advisor to McKinsey & Company. His recent consultancies include work for the World Bank, the Asian Development Bank, the U.S. National Intelligence Council, and the National Water Commission of Australia. In recent years, he authored the World Bank's Water Sector Strategy, the Brazil/World Bank Country Partnership Strategy, and the Oxford University Press books *India's Water Economy: Bracing for a Turbulent Future* and *Pakistan's Water Economy: Running Dry*.

BERTRAND CAMUS

Bertrand Camus serves as CEO of United Water's nationwide water and wastewater operations. These encompass both regulated and non-regulated businesses. In addition, he is CEO of Suez Environnement North America.

Prior to joining United Water, Camus served as director of internal audit for Suez Environnement, United Water's parent company. In that capacity, he was responsible for overseeing compliance within the group's operations in 30 countries around the world.

In addition to expertise in finance, long-term investment, and sustainable development, Camus has a wealth of experience in international water operations. He served as chief operating officer of Aguas Argentinas, an affiliate of Suez Environnement. In that capacity, he was responsible for overseeing water and wastewater operations, which served 8 million people living in Greater Buenos Aires.

Before joining Aguas Argentinas, Camus held various business development positions with Suez Environnement. As business development director of Southeast Asia, he was based in Kuala Lumpur, where he was involved with the development of new contracts and acquisition of companies in Malaysia, Indonesia, the Philippines, Thailand, Vietnam, and Korea. Prior to that, Camus was based in Paris where he served as director of international projects. His accomplishments included public-private partnerships in Budapest and Casablanca.

Camus began his career in project financing at Banque Nationale de Paris, where he structured and implemented funding for large infrastructure projects throughout the world.

He is a graduate of Ecole Nationale des Ponts et Chaussées, where he received a degree in civil engineering. He is also a certified internal auditor.

ANAND SHAH

Anand Shah is a co-founder and CEO of Piramal Water Private Limited, a start-up social enterprise designed to sustainably provide clean drinking water to rural villages in India. Shah came to Sarvajal, the brand under which the business operates, from the Piramal Foundation, where he served as CEO and helped incubate a number of social ventures.

American-born and a graduate of Harvard College, also fluent in Hindi and Gujarati, Shah started as a high school teacher and helped found the Match School in Boston before moving to India and helping establish a number of social impact organizations since 2001. Shah was a co-founder of Indicorps, a member of the Aspen Institute's Global Leadership Network, a TEDIndia Fellow, a former coordinator of the Club of Rome's tt30, and served on the board of several innovative organizations including Indicorps, KaosPilot International, and Unltd India.

JAIME AUGUSTO ZOBEL DE AYALA

Jaime Augusto Zobel de Ayala is chairman and CEO of Ayala Corporation, one of the largest business groups in the Philippines, with interests in real estate, telecommunications, banking, electronics manufacturing, water distribution, automotive dealerships, business process outsourcing, and overseas real estate investments. Zobel is a member of the JP Morgan International Council and the Mitsubishi Corporation International Advisory Committee. He is also chairman of the Harvard Business School Asia-Pacific Advisory Board, a member of the Harvard University Asia Center Advisory Committee, chairman of the Board of Trustees of the Ramon Magsaysay Awards Foundation, chairman of the World Wildlife Fund Philippine Advisory Council, and a member of the International Business Council of the World Economic Forum. Zobel was awarded Management Man of the Year by the Management Association of the Philippines in 2006. In 2007, he received the Harvard Business School Alumni Achievement Award, and in 2009, he was a recipient of the Presidential Medal of Merit awarded by the President of the Republic of the Philippines. He was also given the Philippine Legion of Honor with rank of Grand Commander in recognition of his outstanding public service to the country. Zobel was named Best CEO by FinanceAsia for 2009-2010.

Zobel studied at Harvard University, where he earned his BA in economics (with honors) in 1981 and his MBA in 1987.

MODERATOR: **FOREST L. REINHARDT,** John D. Black Professor of Business Administration, Harvard Business School

SPEAKERS: **PHILIPPE DELORME,** Executive Vice President, Strategy and Innovation, Schneider Electric

GREGG DIXON, Senior Vice President, Marketing, EnerNOC

CRAIG A. HUFF, Co-CEO and Co-Founder, Reservoir Capital Group

ANDREAS SCHIERENBECK, President, Building Technologies Division, Siemens Industry

OVERVIEW

Today's cities use 75% of the world's energy and are responsible for 80% of energy-related carbon impact. As a result, looking at cities in the context of energy conservation is essential. Although many technologies can improve energy efficiency, obstacles exist to their implementation. Neither businesses nor consumers have clear visibility into their energy usage and waste; businesses are reluctant to make investments without a rapid payback; and many consumers are resistant to change.

Energy-efficiency measures must be presented in a simple way, with a short payback period. Marketing also can be effective for changing residential consumers' behavior. Given the enormous growth expected in emerging markets, focusing on energy-efficiency efforts there is strongly recommended.

CONTEXT

The panelists discussed how energy efficiency can be promoted in the business world and among residential consumers.

Urban systems are complex, but opportunities exist to improve energy efficiency.

Urban areas are very energy intensive. Today's cities use 75% of the world's energy and are responsible for 80% of energy-related carbon impact. One of the challenges associated with energy efficiency is the complexity of city systems.

Energy networks, waste systems, water networks, and security systems all must function effectively. Bringing the right businesses together to develop the right architecture is important. No single company has the answer. Smart cities will be built by an ecosystem of collaborative and agile businesses.

Mr. Delorme sees three key opportunity areas related to energy efficiency in cities:

1. *Renewable technologies*. Renewable energy is essential for reducing cities' carbon footprints.
2. *Electric vehicles*. Removing the roadblocks to electric vehicles should have a major impact on energy consumption in cities.
3. *Energy storage*. Finding energy storage with acceptable costs is a challenge. Unlike water, storing energy on a mass scale affects the way smart cities are architected.

> *"Energy in smart cities is a huge opportunity. I see the green impact and the P&L coming together. Thanks to technology, change from people, and education, these things are coming together."*
>
> – Philippe Delorme

Visibility into energy usage and waste is needed before improvements can be made.

Energy waste is found everywhere and small changes could make a significant difference. For example, motion detectors could turn down heating and lighting when rooms are unoccupied. Building engineers could fill water tanks at off-peak times or shut down HVAC systems for 30 minutes periodically.

For these types of changes to occur, however, transparency on energy usage and price information is needed in both the business and residential sectors. The cost signals that the average consumer gets with regard to energy usage today are unclear. People and businesses don't know how much they spend.

Although large buildings offer the greatest prospect for energy savings, inertia and competing interests often interfere.

Buildings alone consume 40% of the energy used in cities. That is a larger amount of energy than is used by industrial processes or transportation. Buildings also are responsible for 21–22% of the greenhouse gases in the environment.

Technology is available to dramatically improve the energy efficiency of buildings and billions of dollars can be saved. However, action isn't being taken as rapidly as one might expect. One reason is that people are averse to change. A second contributor is competing interests among stakeholders. For example, a building may be operated by one person, owned by another, and occupied by a third. All have different interests.

> *"Modernizing our industry with energy efficiency in new buildings will probably take 50 to 100 years. We don't have that much time."*
>
> – Andreas Schierenbeck

The energy-efficiency value proposition for businesses must be simple.

Very few companies have hired staff to focus on energy efficiency. While many of EnerNOC's large business customers spend millions on energy, they may lack a deep understanding of energy and power. However, they do understand the difference between a $1 million dollar energy bill and an $800,000 bill.

EnerNOC strives to make energy savings simple for its business customers to understand. It uses the concept of demand response, paying customers to reduce electricity usage during times of peak demand. EnerNOC installs the necessary technology for free and provides customers with data and recommendations about how to obtain greater energy efficiency. Each customer receives a savings check from the company.

Even though EnerNOC customers have real-time technology to monitor energy consumption at a granular level, they often don't use it. The staff already has a job to do. In addition, the energy expense may only represent 1–3% of revenue. Companies will not actively manage this on their own. The value proposition has to be simple and have a fast payback. EnerNOC has found that businesses are looking for projects with essentially an immediate payback of one year or less.

> *"The United States is the technological epicenter of the world. There is a great opportunity to combine information technology with energy management, but only if we make the value proposition very simple."*
>
> – Gregg Dixon

Over a period of five years, LEED certification has become accepted and valued in the commercial real estate industry.

Five years ago, LEED (Leadership in Energy and Environmental Design) certification was introduced to the market. Since that time, it has turned the real estate industry around. Last year in the United States, 60–70% of all new construction of more than $25 million requested partial or complete LEED certification.

A real estate developer who spends $3 billion per year told Mr. Schierenbeck that he now always goes for LEED construction—not necessarily for environmental reasons, but because it makes financial sense. Buildings with LEED certification have a 5% higher market value, with zero to 3% additional cost. LEED buildings are easier to sell, command 20% higher rent, and have 10% fewer problems. The value of LEED buildings also declines more slowly than comparable non-LEED construction.

The residential building segment is fragmented and hard to address, but marketing holds promise for energy-efficiency measures.

The residential building market represents 20% of energy consumption. While the commercial building industry is concentrated, the market for residential buildings (houses and apartments) is fragmented and therefore more difficult to address. One reason is that no one has marketed the value of energy-efficiency measures to consumers in an easy-to-understand manner. As a result, consumers have been slow to make changes such as using compact fluorescent light bulbs, even though they reduce a household's utility bills by 25%.

OPower has started a marketing campaign that leverages the power of social networks. It takes utility data and tells consumers how their energy usage compares to their neighbors. Consumers understand this type of message.

Government action is critical to improving efficiency.

Most governments avoid building and operating power plants. Instead, they provide incentives to the private sector through vehicles like feed-in tariffs. Southern Europe is using feed-in tariffs to provide fair returns for solar investments and Brazil uses them for wind power. Brazil is also using long-term contracts to encourage small hydroelectric plants.

In Africa, Reservoir Capital has found that politicians support power projects because it gets them re-elected. The most dysfunctional region, however, is Eastern Europe and the former Soviet Union. They haven't figured out how to use incentives to attract capital.

In addition to providing incentives, governments also can create programs that promote energy efficiency. For instance, it would be useful to have an Energy Star-type rating on the sides of homes, showing their energy statistics and efficiency. Mr. Dixon noted, however, that investors value the portion of a clean tech or renewable company's earnings that comes from government subsidies differently from other earnings. This is because government funding is uncertain and may go away when the political winds change.

Since emerging markets will use significantly more energy in the future, energy efficiency must be improved there.

Approximately half of the world's energy use today is in developed countries and the other half is in emerging markets. Looking ahead, almost 89% of growth in energy usage will come from less developed countries. This is mostly driven by people moving to cities.

Reservoir Capital has partnered with Coca-Cola in emerging markets where the power is expensive and unreliable. They have built small, efficient power plants at Coke facilities. These plants provide Coke with electricity, and the resulting heat is used to create steam. In addition, chillers generate cold water and the carbon dioxide from the power plants is used to carbonate Coca-Cola beverages. Power plant efficiencies can reach as high as 85%, compared with the usual 35–40%.

Reservoir Capital benefits by making a fair rate of return on these long-term contracts. Coca-Cola avoids having to deal with governments in emerging markets.

> *"About 85% of global energy consumption today is still fossil fuel and the vast majority of that is quite inefficient. Energy efficiency is definitely the place to focus."*
> – Craig Huff

Other Important Points

- *Million-person cities*. Just 200 years ago, London was the only city in the world with one million residents. Today there are more than 400 cities around the world with at least a million people.
- *The Greenprint Foundation*. This foundation is trying to get financial institutions and large portfolio owners to develop an index to measure building performance over time.
- *Energy efficiency and corporate social responsibility*. Some businesses pursue energy-efficiency programs in the interest of reducing their carbon footprints and advancing corporate social responsibility. This is more common among European companies than those in the United States.

FOREST L. REINHARDT (MODERATOR)

Forest L. Reinhardt is the John D. Black Professor of Business Administration at Harvard Business School.

Reinhardt is co-chair of Harvard Business School's Global Energy Seminar, a new executive education course for the leaders of firms that produce oil and gas, generate and distribute electricity, or play other important roles in the delivery of energy services. He also teaches regularly in the HBS Agribusiness Seminar.

In the HBS Owner/President Management Program, Reinhardt teaches a core course on Global Markets. Drawing on microeconomics, macroeconomics, political science, and history, the course helps business leaders understand the economic and political environment in which business is conducted, and the strategic opportunities and risks to which globalization gives rise.

Reinhardt recently served as course head for the required MBA course Strategy, which covers topics in industry analysis, competitive advantage, and corporate strategy.

Reinhardt currently serves as the faculty chair of Harvard Business School's European Research Initiative.

Reinhardt is interested in the relationships between market and nonmarket strategy, the relations between government regulation and corporate strategy, the behavior of private and public organizations that manage natural resources, and the economics of externalities and public goods. He is the author of *Down to Earth: Applying Business Principles to Environmental Management*, published by Harvard Business School Press. Like that book, many of his articles and papers analyze problems of environmental and natural resource management. He has written numerous classroom cases on these and related topics, used at Harvard and many other schools in MBA curricula and executive programs.

Reinhardt received his Ph.D. in business economics from Harvard University in 1990. He also holds an MBA from Harvard Business School, where he was a Baker Scholar, and an AB, cum laude, from Harvard College.

PHILIPPE DELORME

Philippe Delorme joined Schneider Electric in 1996. He is executive vice president, strategy and innovation, and has been a member of the Executive Committee since July 2009.

He has held various positions in operations in the United States and France. He started his career as a business engineer and then took an R&D management position within the Electrical Distribution division in France. He led the Electrical Network Automation business from 2000 to 2004. In August 2004, he moved to the United States to lead the Power Monitoring and Control business. Since January 2008, Delorme has been in charge of the company program One, which is the strategic execution plan.

Delorme graduated from the Centrale Paris engineering school and completed an MBA in International Business at Sciences Po Paris.

GREGG DIXON

Gregg Dixon has led various sales, marketing, and business development efforts at EnerNOC and currently leads worldwide marketing efforts to utility and end-use customers. Dixon is primarily responsible for leading the development of EnerNOC's go-to market strategy, product and service development, and the execution of marketing mechanisms that accelerate profitable sales growth and brand recognition through creative and customer-driven insights.

Prior to joining EnerNOC, Dixon was vice president of marketing and sales for Hess Microgen, the leading provider of commercial on-site co-generation systems and services in the United States. As a highly recognized expert in distributed generation, Dixon pioneered efforts to bring more than 100 co-generation systems to leading grocery, hospitality, commercial property, and manufacturing customers and developed Hess Microgen's Internet-based monitoring system, CONIFER. Dixon was also a partner at Mercer Management Consulting, where he advised global Fortune 1000 technology, consumer products, and energy clients on customer and product strategy, economic choice analysis, and new business model development.

Dixon graduated from Boston College with bachelor's degrees in business administration and computer science. He is a Certified Energy Manager, Certified Demand Side Management Professional, and Certified Sustainable Development Professional with the Association of Energy Engineers. Dixon also was voted one of Boston's "40 Under 40" by *Boston Business Journal* as recognition for having established himself as a leader to be watched in the field of energy.

CRAIG A. HUFF

Craig Huff is co-CEO and co-founder of Reservoir Capital Group, a privately held investment firm formed in 1997. Reservoir, based in New York City, employs an opportunistic investment strategy and has over $4.5 billion under management. Huff was a partner at Ziff Brothers Investments prior to founding Reservoir.

Huff currently serves on the boards of many of Reservoir's portfolio companies, including ContourGlobal, Intrepid Aviation, Amerilife Group, AB Resources, and Aspen Aerogels. Additionally, he has been instrumental in the formation and development of a variety of investment firms, including Ellington Capital, Olympus Capital Partners, Rockport Capital Partners, SAB Capital, Ziff/Sandefer Capital, Clearlake Capital, Standard General, Chambers Energy Capital, and several others.

Huff is president of the board of trustees of St. Bernard's School in New York City. He also serves on the board of trustees of the Princeton Theological Seminary and on the board of advisors of the Center for Regenerative Medicine (Massachusetts General Hospital/Harvard Stem Cell Institute).

Huff graduated magna cum laude from Abilene Christian University with a BS in engineering physics and received an MBA from Harvard Business School with high distinction as a Baker Scholar. Prior to HBS, he served in the U.S. Navy as a nuclear engineer and nuclear submarine officer.

ANDREAS SCHIERENBECK

Andreas Schierenbeck leads the Building Technologies (BT) Division of Siemens Industry. As president, Schierenbeck is responsible for the financial, operational, and competitive success of Siemens Industry Sector's U.S.-based building systems and energy efficiency solutions provider.

Having held executive and leadership positions at major global BT business units and other Siemens companies, Schierenbeck brings to his post nearly 20 years of progressive experience guiding companies to profitability and market success. Most recently he served as global CEO for the Building Automation business unit in Zug, Switzerland. Prior to joining BT in 2005 as senior vice president for Fire Services, Schierenbeck was vice president of the Siemens Power & Distribution Substation Automation business. A graduate of Harvard Business School's Executive MBA Program in 2009, Schierenbeck also served as vice president of eu.bac—the European association of building automation and controls suppliers. He is a member of the World Business Council for Sustainable Development and has lived and worked in Switzerland, Austria, Germany, and Colombia.

MODERATOR: **CHRISTOPHER M. GORDON,** Senior Lecturer of Business Administration, Harvard Business School

SPEAKERS: **TYLER DUVALL,** Associate Principal, McKinsey & Company

FABIENNE HERLAUT, President, Ecomobilite Partenaires

DR. LIU THAI-KER, Chairman, Centre for Liveable Cities' Advisory Board; Director, RSP Architects Planners & Engineers Pte Ltd.

OVERVIEW

America's transportation policy does not seem to be keeping pace with future needs. Sound economic principles are often replaced by political pressures and can play little role in planning transportation infrastructure projects. Funding models should be implanted to ensure projects are financially sustainable, including disciplined use of long-term capitalization plans. Innovation is often disincented by outdated planning and procurement models.

That is not the situation in many countries. Singapore and France exemplify much more forward-thinking, innovation-embracing approaches to sustainable transportation-system planning.

CONTEXT

The panelists shared insights on approaches to transportation-system planning in America, Singapore, and France.

U.S. transportation-infrastructure policy is seriously flawed, primarily due to problems of economics.

Mr. Duvall—who for five years headed transportation policy for the U.S. government—sees major failings in America's urban-transport infrastructure policy. The flaws are not structural matters of engineering or design but problems of economics. He identified four problems at the root of U.S. transportation-infrastructure policy:

- *Massive misallocation of resources invested in urban-transport infrastructure.* Over the past 15 years, the ROIs of these investments have collapsed. The problem: The planning process underpinning investment decisions at the metropolitan level is driven by political considerations, not economic ones.
- *Exceptionally weak innovation incentives.* This is true across all aspects of project delivery and operation. Procurement processes are siloed versus integrated. The contract model for mega-projects is outdated, less sophisticated than the model used elsewhere. Construction firms lack incentive to bring the latest innovations into public-sector projects. Technology deployment is very weak, unlike in the transportation systems of Tokyo or Singapore, where the latest technology is everywhere. There are meager financial incentives for government agencies or private-sector entities to bring new technology into urban transport, as they cannot keep any returns from efficiencies. Moreover, the government won't guard competitive secrets. What innovation does occur in urban transport typically happens in spite of government.

  > *"Bring a cool idea to the government, and the government lets it out to everybody. There are weak incentives to do that if you're a private firm with a good idea."*
  > —Tyler Duvall

- *Mispriced assets.* The mispricing of highway assets in particular is enormous. That issue must be resolved before sustainable urban transport is possible in America. Mr. Duvall was involved in an initiative (similar to the Department of Education's Race to the Top) where major U.S. cities could secure federal funding to implement congestion pricing experiments, involving tolls that fluctuate based on real-time traffic congestion. Such schemes work well to alleviate urban congestion (given commuters' ample schedule flexibility) and bring in more revenue. Great programs emerged. But the problem was that most were largely implemented solely for new roads; existing highways were largely perceived as "untouchable."
- *Lack of long-term funding mechanisms for many infrastructure projects.* The gas tax—which is how the federal commitment to urban transportation is funded—is unpopular, but there is nothing to take its place to recapitalize the world's largest transportation network. There are no resources for recapitalizing 50-year-old assets. The absence of a sustainable funding model is a big reason that there are scant private-sector investment flows into U.S. urban transport.

Mr. Duvall sees a few points of hope for U.S. infrastructure policy, however.

Increasingly, economic discipline and tools such as cost-benefit analyses are playing a greater role in transportation infrastructure planning. In America, civil engineers have typically dominated infrastructure project decision making (unlike in Asia and Western Europe, where economic factors are paramount).

Mr. Duvall also is seeing increased private-sector innovation by large corporations such as IBM, despite lack of a reward mechanism that promotes innovation. He believes that the next generation of public/private partnerships will be technology based. "Companies will operate and maintain their technology mechanisms, trying to capture some of the revenue streams in creative ways."

Finally, politicians are becoming more educated about the productivity benefits of infrastructure investments, which suggests more sustainable funding in the future.

Singapore and France exemplify more forward-thinking approaches to sustainable urban transportation planning.

Asia and Europe offer examples of more innovative, effective, sustainable mass transportation systems.

SINGAPORE

Singapore has been transformed over the past 20 years, guided by a master urban plan—of which the mass transit system is one integrated part. The plan has beautified Singapore and created infrastructure that works.

While population density doubled over those years, congestion is minimal and traffic flows well. Most of the population (65–70%) uses public transportation. The government encourages public transportation and discourages car ownership. The transportation system is financially sustainable. The costs have been dropping relative to household income. Train operations are profitable and citizens receive a dividend.

Critical success factors include conditions that promote successful partnerships between public and private sectors. Singapore has a government that delivers on its promises. After setting the strategic vision, the government gives autonomy to the private-sector professionals doing the work. Government credibility and transparency are key. These are accompanied by clear vision, a long-term systematic plan, pragmatic strategies, and public campaigns prior to passing legislation. With minimal interference from government and rules designed to be simple, good ideas get implemented.

> *"If I were to describe the Singapore situation: The government creates a workable stage, leaving it to the private sector to act out the drama."*
>
> – Liu Thai-Ker

City planners' aims can be summarized in five "E" words: environment, ecology, education, egalitarian, and economics.

Liu Thai-Ker is involved in planning mega-cities in China as well—which must be built rapidly. Systematic, integrated master planning is critical to success. The Singapore model is highly transferrable to China, as there is clear accountability in local Chinese governments. In India, the Singapore model might not work as well.

FRANCE

In France, transportation operator SNCF is facing diverse business pressures.

Paris's heavily used mass transit system is old-fashioned and congested. There is tremendous need to revamp the entire structure to improve quality of service.

- Demand has risen rapidly, with passenger counts up 16% from 1995 to 2008.
- Customers increasingly want more and better service: faster, cheaper, and delivering a better customer experience.
- Supply-side challenges are coming from trends that include a rise in carpooling. Car manufacturers are offering a new type of subscription service providing various modes of transportation.

Public transportation is under rising pressure to customize the travel experience. Among the new market entrants are large companies from other industries, such as energy, IT, and telecommunications, that provide travelers with real-time data that gives them increasing options regarding, for example, routes.

> *"Mass transit is becoming customized transit, customized to match the user."*
>
> – Fabienne Herlaut

To address these challenges, SNCF is changing how it thinks about transporting people. Instead of moving people from station to station, a more relevant paradigm is moving people from door to door. To this end, SNCF is launching a number of partnerships with innovative start-ups, providing them with funding and market access.

Today's world of mobility requires partnerships. Competitors have to work together in innovative ways. The winning partnerships will be those that create the most giant and innovative transport systems.

There are diverse opportunities for private-sector innovation in various areas of sustainable transportation.

Ms. Herlaut sees market potential for innovation in GPS technology to provide passengers with more route choice, efficiencies in ticketing experiences, improvements in transportation logistics and infrastructure, "mobility passes" that allow people to travel by various modes of transportation, and energy-saving electric bikes.

But she stressed that rarely are startups in the transportation space profitable without a large partner to help them scale up.

Mr. Duvall sees great opportunity for entrepreneurs on the technology-related operations side of transportation. For example, needed are more IT solutions for real-time pricing of highways based on current utilization, as well as the technology to operate and maintain systems.

Dr. Liu sees electric cars as holding great potential for sustainable transportation. An audience participant described a bike-share program he is involved in as a "massive economic engine." Members of bike-share programs also become members of electric car–share programs. So a car manufacturer that funded bike-share programs would be seeding a future customer base for electric vehicle ownership.

Thinking in interconnected ways such as this is what innovation in sustainable transportation requires.

CHRISTOPHER M. GORDON (MODERATOR)

Chris Gordon is a senior lecturer at Harvard Business School, teaching and writing in the real estate group, primarily on the subject of complex capital projects. He also is a lecturer at the Massachusetts Institute of Technology's Center for Real Estate, teaching a nationally recognized course on project delivery, and serves as an adviser on complex capital projects worldwide.

Prior to his appointment at HBS, he served as the chief operating officer (COO) for the Allston Development Group at Harvard University from 2005 to 2010. In that role, he oversaw all aspects of the development of Harvard's campus expansion in the Allston section of Boston as well as development projects on the historic Cambridge campus.

Before stepping into the role of COO for the Allston Development Group, Gordon was director of capital programs and Logan modernization for the Massachusetts Port Authority. During his decade at Massport, he was responsible for capital programming and project delivery for all capital projects at all Massport facilities, including Logan International Airport (the 13th busiest airport in the world), Hanscom Airfield, Tobin Memorial Bridge, Maritime Terminals on the Port of Boston, and the Worcester Regional Airport. He oversaw the successful completion of the $4.4 billion Logan Modernization Project and as director of capital programs, oversaw a $500 million annual budget.

Gordon has served as a member of the National Research Council's Board on Infrastructure and the Built Environment, a trustee of the Engineering Center Education Trust, and a corresponding editor of the American Society of Civil Engineers' Engineering Management Journal. In 2003, he received the Manuel Carballo Governor's Award for Excellence in Public Service. He was Governor Mitt Romney's appointee as a co-chair of the Special Commission on Public Construction Reform; in 2004, this resulted in landmark reform of all public construction laws in the Commonwealth. Most recently, Gordon served as the chief judge for 2010 for the Engineering Excellence Awards for America.

Prior to joining Massport, Gordon worked for Cambridge Systematics in the Program Management Group, for Bechtel Corporation in the Civil Division, and for H.E. Bergeron as a project manager.

Gordon holds a bachelor's degree in civil engineering from the University of Maine and a master's degree in civil engineering from the Massachusetts Institute of Technology and is a registered professional engineer in several states.

TYLER DUVALL

Tyler Duvall is an associate principal at McKinsey. He joined the company as a senior advisor in the firm's Washington, D.C., office. In his time with McKinsey, Duvall has helped develop the Travel, Infrastructure, and Logistics practice and has assisted with ongoing strategy work in Panama and the State of Georgia.

Prior to joining McKinsey, Duvall ran the policy office at the U.S. Department of Transportation as both the acting under secretary for policy and assistant secretary for transportation policy.

FABIENNE HERLAUT

Fabienne Herlaut is a graduate of Ecole Superieure de Commerce de Paris (1980) and holds an MBA from Harvard Business School (1984).

After graduation from HBS, she joined Bain and Co., a leader in management consulting, in the Boston and Paris offices.

From 1990 until 2001, she worked for Harwanne, a diversified holding company (mining, packaging, electronics), listed in Paris and Geneva, as general manager. She was in charge of managing the portfolio of participations (M&A) and supervising the operational performance of Harwanne subsidiaries, to drive them toward leadership positions.

In 2001, she joined Pechiney as head of corporate strategy and following the Alcan takeover, she co-led the integration between Alcan and Pechiney. In 2005, she joined ArcelorMittal, Flat Carbon division, in charge of business development and partnerships with Nippon Steel (Japan).

In 2007, she joined SNCF as head of corporate strategy and sustainable development, and as a member of the Executive Committee. Currently, she is in charge of creating and developing a SNCF corporate venture fund dedicated to sustainable mobility, Ecomobilite Partenaires, with investments in electric vehicles, last mile logistics, car-sharing and carpooling, and renewable energy.

LIU THAI-KER

Dr. Liu Thai-Ker is an architect-planner. Since 1992, he has been director of RSP Architects Planners & Engineers Pte. Ltd., a consultant firm of over 1,000 people, with 10 overseas offices and projects in 18 countries.

Liu also has been the founding chairman of the Centre for Liveable Cities since 2008.

Liu has served as an adjunct professor at the School of Design and Environment and the Lee Kuan Yew School of Public Policy at the National University of Singapore. He is also an adjunct professor in the College of Humanities, Arts, and Social Sciences at Nanyang Technological University. He is a member of several governmental bodies in Singapore and planning adviser to over 20 cities in China.

As architect-planner and chief executive officer of the Housing and Development Board (1969-89), he oversaw the completion of more than a half-million dwelling units.

As chief executive officer and chief planner of the Urban Redevelopment Authority (1989-92), he spearheaded the major revision of the Singapore Concept Plan and key direction for heritage conservation.

In the cultural arena, he served as the chairman of the National Arts Council from 1996 to June 2005 and the Singapore Tyler Print Institute from 2000 to 2009. He has served as the chairperson of the External Review Panel, Arts Quality Framework (appointed by the Ministry of Education), and is a founding member of the Board of Trustees, Arts and Culture Development Fund, Ministry of Information, Communications, and the Arts.

Liu obtained his bachelor of architecture with first class honours and the University Medal from the University of N.S.W. in 1962, and a master's in city planning, with the Parson's Memorial Medal, from Yale University in 1965. He later attended INSEAD Advanced Management Program in Paris, in 1980. In 1995, he received a doctor of science honoris causa by the University of New South Wales.

Among his awards are the Public Administration Medal (Gold) 1976; the Meritorious Service Medal 1985; the Singapore Institute of Architects Gold Medal; and the Medal of the City of Paris, France, in 2001. In 1993, he received the 2nd ASEAN Achievement Award for Outstanding Contributions to Architecture.

MODERATOR: **JOHN D. MACOMBER,** Senior Lecturer of Business Administration, Harvard Business School

SPEAKERS: **JEFFREY D. BROWN,** Vice President, Project Finance, Summit Power

JOSÉ GÓMEZ-IBÁÑEZ, Harvard Graduate School of Design and Kennedy School of Government, Harvard University

WALTER HOWARD, CEO, Ze-gen, Inc.

OVERVIEW

The initiatives discussed in the conference's prior sessions—in water, energy, transportation, and high-tech infrastructure—must be paid for. However, while financing is important, the panelists don't see availability of capital as the issue. Instead, addressing risks such as gaining regulatory approvals for energy projects or securing adequate revenue streams to support new transportation infrastructure are bigger concerns. Capital won't be freed up on a project-by-project level until issues such as these are addressed.

CONTEXT

Following sessions on urban infrastructure, water, energy, and transportation, this panel discussed the financing of major initiatives and the role of public/private partnerships and government.

There are situations where accessing capital is critical to starting and scaling new ventures.

Having used private financing to build successful water and wind turbine businesses, Walter Howard is following a similar model in creating Ze-gen. This startup is a venture capital–funded company that breaks down waste rubber, such as railroad ties, into its component parts and produces a clean, synthetic natural gas used for electricity. It is both a waste disposal business and a renewable energy company.

Mr. Howard said that the key to successful innovative technology ventures is being able to "turn corners." This entails using different sources of funding to achieve various milestones. In the earliest stages, new technology companies typically start with angel or venture funding. Once they develop and prove the technology, they need later-stage private equity.

> *"I think the magic with the technology-driven companies is turning the corners. It is maybe angel funding to begin with or VC. Very quickly you need to transition to PE [private equity] or infrastructure funds."*
>
> – Walter Howard

Ze-gen's plan is to rely on equity funding to demonstrate its technology through two or three initial projects. These projects are located next to existing power plants, which allows the company to cut its capital costs and increase its efficiency. After the company proves success through its initial projects, the plan is to focus on manufacturing licensing that leads the company to be valued on a net income multiple.

With many infrastructure projects and PPPs, capital is not the problem. Other issues such as revenue streams and managing existing capacity are more important.

Agreeing with panelists from prior sessions, Mr. Gómez-Ibáñez said that access to capital is not the main problem for transportation infrastructure in either the developed or the developing worlds. He said there is an understandable bias toward large-scale capital projects, which comes from investors, donors, and companies, all of whom have an interest in building things and realizing a favorable return. Bigger problems are:

- *Revenue streams.* Securing the capital to pay for a new road, bridge, or train isn't the issue. The issue is the lack of ongoing revenue streams. This is a problem in the United States, but is an even greater problem in developing countries. There are two main revenue streams, both of which have issues:
  - *User charges.* Especially in developing countries, the general attitude is that user charges for essential infrastructure should be extremely affordable and accessible. As a result, user charges often are set so low that they don't provide adequate funding.
  - *Taxes.* While cities are viewed as the engines of development, people in cities frequently complain that tax revenues from cities are siphoned off and diverted to rural areas. Few countries (with China being the exception) are investing tax revenue in cities.
- *Managing existing capacity.* While there is often an emphasis on capital-driven solutions to infrastructure problems, in many cases the solution lies in more effectively managing the capacity that already exists. For example, Jakarta is planning a significant investment in a Mass Rapid Transit (MRT) line. However, this line will affect only about 1% of the daily trips in and out of the city (just 400,000 daily trips out of 37 million).

  This focus on the MRT comes as 95–98% of the capacity of the existing system is being badly mismanaged. By better and more efficiently managing Jakarta's existing infrastructure—such as the bus system, which has been badly neglected—there would be a far greater impact than a huge capital investment for a new MRT line.

> *"What would be great is if the kind of energy in this room could be focused not just on capital-intensive projects but on better managing the existing capacity."*
>
> – José Gómez-Ibáñez

Public/private partnerships (PPPs) often are invoked as a solution. Mr. Gómez-Ibáñez's perspective is that PPPs are not a great idea if the only motive is to access capital, which is often the purpose of a PPP. There are in fact better ways to access private capital. The best reason for a public/private partnership is that the private sector is more efficient. For example, an MRT operated by the private sector will be more reliable and will deliver higher-quality service.

For many energy projects, the key barriers aren't financial; they involve mitigating various risks.

As with infrastructure projects, financing is not the barrier for energy projects. Instead, Jeff Brown says that the main issue hindering energy projects is the unpredictable risks associated with various layers of regulatory approval. This turns investors into project managers.

For example, for a $300 million solar project in which Mr. Brown is involved, environmental permits, an approved power sales contract, and transmission all are required for the project to proceed. Each could fall through for a host of reasons, resulting in a loss of some or all of the investment. Thus, the issue is not the capital; it is navigating unpredictable and uncontrollable risks.

> *"In the U.S. people ask why don't we have more wind or solar or transmission. It is not the financing; the financing is not the hard part. The hard part is to somehow find a way to systematically take enough of the horrible risks . . . off the table."*
>
> — Jeffrey D. Brown

Government financing of unproven technologies can be important, but more important is for government to give investors greater certainty by creating a predictable environment.

While Mr. Gómez-Ibáñez and Mr. Brown don't see financing as their major obstacle, other conference attendees described situations where financing is a barrier—and where the government can help overcome this barrier.

An example would be an unproven technology that holds significant promise for society. (This might include the potential to create new industries and to provide environmental benefits.) But, the high risk and the amount of capital required cause private investors to shy away. In this situation, capital from the government may be necessary to help demonstrate the viability of the technology, lower the risk, and attract capital to scale the concept.

The panelists were in agreement that even more important than funding, that governments—especially the U.S. government—can create a more consistent, predictable environment that allows investors to make long-term investment decisions and to fund major works. Absent a predictable set of expectations of project and regulatory risk and ground rules, investors are reluctant to commit capital even though plenty of capital is available.

JOHN D. MACOMBER (MODERATOR)

John Macomber is a senior lecturer in real estate at Harvard Business School. His professional background includes leadership of real estate, construction, services, and technology businesses.

At HBS, Macomber teaches Finance and Real Property courses in the elective curriculum, including Real Property Asset Management; Real Estate Development, Design, and Construction; and Sustainable

Cities: Urbanization, Infrastructure, and Finance. He is part of the teaching team for the Building Green

Businesses field study seminar. Macomber also teaches Real Estate Sustainability, Strategy, andFinance at Harvard's Graduate School of Design.

Prior to coming to HBS, Macomber was a lecturer at MIT in Civil Engineering and Real Estate. He is chair or a co-chair of Executive Education programs including Real Estate Management, Real Estate Executive Seminar, and Develop India: Real Estate Strategies for Growth.

JEFFREY D. BROWN

Jeff Brown joined Summit Power Group, Inc. in mid 2009 and is Summit's vice president for project finance. Summit is a 20-year-old electric power project development with a long track record in gas and wind projects, and the company currently is financing its first photovoltaic solar project and a very large coal gasification/carbon sequestration project.

Prior to Summit, Brown had a long career in infrastructure and energy project financing on Wall Street. Most recently, Brown was a managing director at Merrill Lynch, where his role included managing the Pacific Northwest office as a senior investment banker, and prior to that he served in New York, Seattle, and Hong Kong for Goldman Sachs. His career at those two firms was in the fixed-income area (taxable and tax-exempt bond financing and debt management), focusing heavily on electric utilities, natural gas projects, major infrastructure projects, and interest rate/currency risk management.

Brown began his career as legislative assistant to U.S. Congressman Jim Weaver, where he was responsible for activities pertaining to Federal Power Marketing Agencies, including BPA, TVA, and WAPA.

Brown holds an AB with honors in economics from Harvard College and an MBA (with distinction) from Harvard Business School. As an investment banker, he held registrations under NASD (Series 7, 56, and 63).

JOSÉ A. GÓMEZ-IBÁÑEZ

José A. Gómez-Ibáñez is Derek C. Bok Professor of Urban Planning and Public Policy at Harvard University, where he holds a joint appointment at the Graduate School of Design and the John F. Kennedy School of Government. He teaches courses in economics, infrastructure, and transportation policy in both schools. His research interests are in transportation, infrastructure, and economic development, and he has authored or edited a half-dozen books on these topics.

At Harvard, Gómez-Ibáñez currently serves as the faculty co-chair (with Henry Lee) of the Infrastructure in a Market Economy executive education program at the Kennedy School. He also serves as chair of the Social and Urban Policy Area Faculty at the Kennedy School.

He received an AB degree in government from Harvard College in 1970 and MPP and Ph.D. degrees in public policy from Harvard University in 1972 and 1975, respectively.

Gómez-Ibáñez also has served as an advisor on infrastructure policy to U.S. and foreign government agencies, and to international financial institutions.

WALTER HOWARD

Walter Howard is president and CEO of Ze-gen.

An industry veteran with more than 30 years of global power project development experience, Howard has held CEO, COO, CFO, and SVP executive positions with utility leaders, including General Electric, American Water, U.S. Generating (an affiliate of PG&E and Bechtel), Noble Power Assets, J. Makowski Company, Inc. (partly owned by Duke Power), and Poseidon Resources.

Most recently, Howard served as CEO and director of Noble Environmental Power, where he led Noble in developing and putting into operation 484 wind turbines in New York and Texas. His projects have won Deal of the Year awards in finance and engineering categories in New York, Florida, Massachusetts, and Algeria. Furthermore, Howard has served on the Trade Advisory Committees for U.S. Secretaries of Commerce William M. Daley and Norman Mineta.

Howard holds BSCE and M.Eng. degrees from Cornell University and an MBA from Harvard Business School. He is a licensed professional engineer in the State of New York.