

IBM Institute for Business Value

The emergence of the eco-efficient economy

*The IBM Eco-efficiency Jam 2010:
Key messages from a global online discussion on eco-efficiency*



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By Susanne Dirks and Dr. Constantin Gurdgiev

In early 2010, IBM brought together leaders from various businesses, institutions and geographies to determine the actions to build a sustainable future. The consensus: eco-efficiency will be the biggest economic “game changer” for organizations over the next 20 years. To get there will require stakeholders – public, private, institutional and others – to collaboratively address the key drivers, challenges and opportunities of the emerging eco-efficient economy.

What practical actions can be taken today and in the near future to create a more eco-efficient and sustainable economy?

To answer this question, IBM brought together 1,600 business executives, government officials, non-governmental organization (NGO) leaders, journalists, analysts and environmental experts from more than 60 countries for the first-ever IBM Eco-efficiency Jam.

Eco-efficiency is broadly defined as the delivery of competitively priced goods and services that satisfy human needs – while progressively reducing the environmental impact and resource intensity of goods and services throughout their lifecycle.¹

The objective of this global Eco-efficiency Jam, a 51-hour, online interactive event, conducted by IBM and the Economist Intelligence Unit, was to discuss the primary drivers, opportunities and challenges associated with the continued advancement of eco-efficiency, as well as share best practices.

What is a Jam?

A Jam is a collaborative and interactive concept invented and refined by IBM. It represents an online conversation over a defined period of time across a number of main discussion forums. The potential audience can involve thousands of people, all of whom can participate “virtually” from anywhere in the world at any time while the Jam is active. Through mass collaboration and conversation, guided by informed moderators and facilitators, a Jam acts as an open generator of ideas and discussions. Since 2001 IBM has hosted more than 30 internal and external Jams, with the results used to inform values, strategy and agenda for change and innovation.

The IBM Eco-Efficiency Jam is an example of sustainable collaboration across geographies and organizations. IBM’s Special Events Infrastructure estimated that the Jam consumed approximately 93.6 kilowatts of energy, producing approximately 158 kilograms of CO₂ emissions. Considering a single 747 flight from New York City to Paris produces approximately 1,487 kg of CO₂, imagine what the CO₂ emissions would have been if Jam participants from all over the world had travelled to this meeting... !

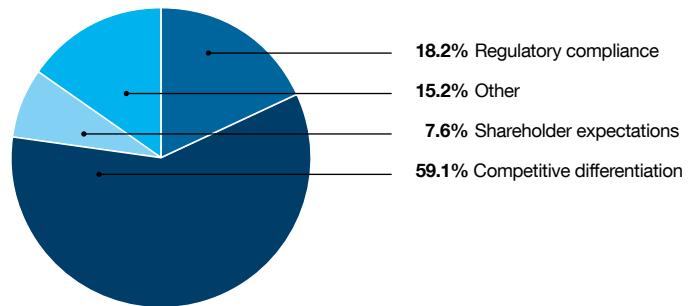
Three core conclusions emerged from the collaborative discussion:

- Eco-efficiency is poised to become the biggest economic game-changer for organizations over the next 20 years.
- Direct and collaborative action from a range of stakeholders will be needed to address the challenges and opportunities posed by eco-efficiency.
- There is a strong imperative for stakeholders to advance the eco-efficient economy.

The emerging eco-efficient economy

Jam participants clearly asserted the need for a fully self-sustaining economic system, which would be supported by new sources of revenues, generate new demand and create new markets for eco-efficiency.

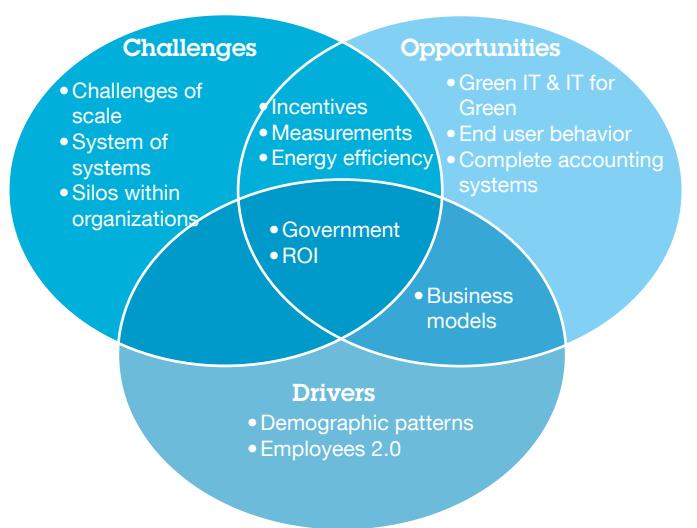
This self-sustaining system requires the evolution of new business models. The common objective today is to achieve environmental savings within a limited space of activities, with minimal capital (CAPEX) and operating (OPEX) expenditures. The future of eco-efficiency, however, will involve data and analytics to design and deploy new technologies in a holistic way to create new economically and environmentally sustainable products and services. These future products and services will offer the opportunity for significant competitive differentiation, prompting Jam participants to identify enhanced competitiveness as a core focus for new eco-efficiency investments (see Figure 1).



Source: Poll of Jam participants.

Figure 1: Benefits of eco-efficiency to organizations.

To create a self-sustaining, eco-efficient economy, stakeholders will need to act on a large and broad set of drivers, challenges and opportunities, including 14 “themes” Jam participants noted as central to eco-efficiency (see Figure 2).



Source: IBM Institute for Business Value analysis of Jam outputs.

Figure 2: The challenges, opportunities and drivers of an eco-efficient economy.

Drivers accelerating the move toward the eco-efficient economy

Jam participants identified a number of drivers of an eco-efficient economy. These include:

- *Changes in business models* – Business models will need to evolve as companies pursue competitive advantage through improved efficiencies and explore new revenue sources related to eco-efficient operations.
 - *Employees 2.0* – A new generation of worker, digitally enabled and networked both inside and outside the office, brings eco-efficiency requirements to the workplace. They have fully embraced the concept of greater workplace mobility and integration. Many see themselves simultaneously as employees and potential entrepreneurs – effecting organizational change via their new ideas, behaviors and expectations.
 - *Demographic changes* – Growing urbanization, increasing demand for density within cities and pressures of economic growth in emerging markets are increasing emphasis on eco-efficiency and resource sharing, as well as recognition of resource constraints.
 - *Governments and policymakers* – Governments and policymakers drive the evolution of the eco-efficient economy through the introduction of policies and/or incentives that promote and encourage efficiency, elimination of waste and reduction of greenhouse gas (GHG) emissions.
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PACE program offers sustainable energy deployment loans

An example of the kind of leadership needed from governments is the PACE (Property Assessed Clean Energy) program pioneered in California.² Under PACE, governments offer sustainable energy deployment loans to property owners that help the markets to price the value of eco-efficiency embedded in the facility. Property owners can finance renewable on-site generation installations and energy efficiency improvements with reduced CAPEX costs. In recognition of the success of the program, it was adopted in thirteen other states, with approval pending in four others. Jam participants identified PACE as a model approach to the challenges of deepening the markets for energy-efficient solutions and attracting third-party financing in commercial buildings.

“[Sustainable economic growth] is at the root of our global socio-eco-economic challenge. We need to revisit our closely held assumptions about the nature of economic growth...”

Jam participant

An eco-efficient economy generates opportunities

Participants identified a number of business opportunities that result directly from the evolving eco-efficient economy:

- Green IT and IT for Green were seen as the key enablers of eco-efficiency, but also core opportunities for business development and growth (see sidebar, *Green IT and IT for Green*).
- Participants viewed the ability to tap into markets for new generations of consumers and new eco-efficiency services as a major business opportunity.
- A better view of the economy is enabled through complete accounting for economic, social and environmental returns from eco-efficiency.

“Simple is the future, and technology convergence creates greater simplicity with huge benefits.”

Peter Miscovich, Managing Director, Corporate Solutions,
Jones Lang LaSalle

Green IT and IT for Green

IT for Green innovation was identified by Jam participants as being the potential enabler of greater efficiencies in:

- Energy (generation, supply and demand management, including smart grids)
- Buildings (smarter buildings technologies, dynamic analytics and integration of live weather, traffic and other forecasts into facilities management)
- Water management (smart metering, demand and supply management, waste treatment, pumping, storage and integration of water systems with energy generation and storage).

Green IT was recognized as a primary opportunity for energy improvements, as well as operational and CAPEX efficiencies in data management, mobile offices, networking and cloud computing.



Challenges on the journey towards the eco-efficient economy

In addition to identifying drivers and opportunities of the future eco-efficient economy, Jam discussions also focused on significant challenges that need to be resolved before the power of the new economy can be fully leveraged:

- Silos within organizational structures act as barriers to achieving greater returns on eco-efficient investments. Jam discussions identified a number of silos relating to separation of management functions, work shifts and organization. For example, differences in incentives and objectives often arise among owners, management and tenants of buildings, reducing eco-efficiency, as well as financial and socio-economic returns on investment.
- There are challenges of scale and a need to create incentives sufficient to allow deployment of eco-efficient technologies and solutions to smaller businesses and households.
- A holistic approach is needed for eco-efficiency. The focus should be on bringing together and optimizing formerly separate systems (i.e., energy grids, transportations networks, water distribution, etc.) into an eco-efficient system of systems that is interoperable, integrated and intelligent. A system of systems approach to eco-efficient investments, in the view of Jam participants, can significantly increase financial, environmental and socio-economic returns over isolated technological solutions.

“To be able to optimize the footprint of a whole city, it is not enough to know the footprint of the different city areas (individual and public transport, energy, water, waste ...). In addition to this, you will have to know the interrelation between those areas. Otherwise, the optimization of one area might lead to a negative impact in other areas.”

Jam participant

Converging drivers, opportunities and challenges calling for action

In analyzing the Jam, we found five areas at the intersection of the drivers, opportunities and challenges identified in Figure 2 (see page 2). Action is required in these areas to support an eco-efficient economy:

- Measuring the financial and socio-economic returns on eco-efficiency investments is an opportunity and a potential driver to engage new investors and consumers.
- Striking the right balance in government policies between regulations and incentives is a key opportunity and driver to enable growth in an eco-efficient economy. Government policies also face challenges relating to the issues of scale (i.e., transmitting incentives to smaller stakeholders), coordination of policies and metrics across different public organizations and geographies.

“One of the big initiatives of companies that take seriously a sustainable future is developing collaborations – within their industries (and supply chains) and even amongst their competitors.”

Jeff Hittner, Deputy Chair and Director of Research, Corporate Eco Forum

- Achieving energy efficiency requires addressing issues across production, transmission, storage, consumption and conservation. These are both challenges and opportunities.
- Incentives and regulation, often a challenge today, need to be better and holistically aligned with the overall objectives of eco-efficiency, providing an opportunity to expand the markets for eco-efficient products and services.
- The ability to accurately, timely and on-demand measure the impact of improved eco-efficiency will be the key to achieving an eco-efficient economy – this is a challenge today, but an opportunity tomorrow.

Jam participants, representing segments from throughout the global economy, are aware they have key roles to play in enabling, driving and benefiting from an eco-efficient economy. Recent global recession has strengthened the emphasis on delivering financial and economic returns to investors. This requires strong leadership from the primary stakeholders in the eco-efficient economy.

The role of key stakeholders in the emerging eco-efficient economy

Key stakeholders have important roles to play in the development of the eco-efficient economy, including:

- *Government and policymakers*, who enable eco-efficiency through addressing challenges of regulations, incentives, measurements and scale, while acting upon opportunities to achieve returns on public investment.
- *Public and private enterprises*, which are seen as enablers of eco-efficiency through their capacity to address challenges of siloed organizational structures, systems of systems, incentives and measurements. In addition, public and private enterprises are well positioned to act on challenges of scale and investment opportunities presented by eco-efficiency.
- *NGOs*, which act jointly with government and public and private enterprises in raising awareness and facilitating change.
- *Investors*, who act upon the challenges of incentives and measurements, while looking for opportunities to obtain returns in eco-efficiency investments.
- *Consumers and employees*, who, acting in response to changing incentives and aided by improvements in measurements provided by other stakeholders, look for their own returns on investment.

Analysis of the Jam shows that two particular sets of stakeholders – government and policymakers, and public and private enterprises – have the most influence over the development of the eco-efficient economy (see Table 1).

	Government and policy-makers	Public and private enterprises	NGOs	Investors	Employees	Consumers
Role in driving eco-efficiency	Very high	High	High	Low	Medium and rising	Medium and rising
Role in addressing challenges	High	Very high	Low	Medium	Medium and rising	Medium and rising
Role in capturing opportunities	Low	Very high	Low	Medium and rising	Medium	Medium

Source: IBM Institute for Business Value analysis of Jam outputs.

Table 1.

The role of government and policymakers: a need for renewed leadership

As core stakeholders, government and policymakers have critical contributions to make as eco-efficiency drivers. Specifically, Jam participants pointed out they should:

- Lead by example – for instance, enable integration and collaboration between public services and systems
- Step up leadership in regulatory and policy initiatives at local, national and international levels
- Focus on economic and urban sustainability by driving forward eco-efficiency through smarter cities objectives
- Introduce and renew incentives that will promote eco-efficiency and innovation at the enterprise level, including both incremental and radical innovation
- Engage with enterprises and NGOs in developing comprehensive and interoperable frameworks for measuring, benchmarking and communicating environmental impact information.

Jam participants also expressed strong belief that active public/private partnerships, as well as transparent and measurable government leadership, can help in achieving eco-efficient economic growth.

The role of private and public enterprises: the front line of eco-efficiency

As referenced in Table 1, Jam participants broadly agreed that enterprises should play a stronger role in driving eco-efficiency at investment, operational and employee levels. This requires public and private enterprises to:

- Deploy Green IT and IT for Green to improve eco-efficiency of operations
- Collaborate with governments in developing and implementing new measures and benchmarks to more accurately measure eco-efficiency impact
- Develop a more holistic approach to measuring returns on investment and accounting for eco-efficiency benefits
- Engage in active transformation of business models to:
 - Facilitate interoperability and collaboration across organizational structures
 - Develop new, eco-efficiency-related revenue streams
 - Remove silos and other barriers to eco-efficiency
 - Address water, energy and other scarce resources constraints.

“The attributes that we believe that most organizations are looking for are: simplicity – make the programs simple to understand and apply for; consistency across geographies – many organizations have their infrastructure (buildings, datacenters, IT equipment, etc) located in multiple states, regions, countries, or service territories. As such, they would like to have programs [that can] be applied for; whether [the programs are] in Northern or Southern California or in New York or in Hong Kong. [They are looking for] broad applicability across project types – where possible. If the program design is performance-based as opposed to prescriptive, then it is easier to apply for the incentive for a wide range of projects – whether [the program is] a server virtualization project or a lighting system change or a building energy management solution.”

— Jam participant

Areas of growing importance to enterprise leadership:

- Energy storage (including batteries technology and kinetic storage)
 - Infrastructure (IT and building infrastructure interfaces, threshold controls, assets optimization, tracking and verification of energy efficiency, incorporation of renewable energy sources and storage into buildings, smart grid development, macro system, and benchmark eco- and energy-efficiency in buildings)
 - Green IT and IT for Green (energy and thermal assessment, modular data center design, advanced cooling, on-site co-generation, virtualization and consolidation, active energy management and tiered storage)
 - Addressing demographic change (advanced meter management systems for utilities, network automation and analytics, power generation optimization, transport and road management, advancement of telematics, strategic water data management, smart water infrastructure and metering solutions)
 - Strengthening consumer incentives (hybrid vehicles, electronic devices with smart energy-saving features, employees' fleet management solutions).
-

As Jam discussions indicated, eco-efficient technology companies have significant innovation pipelines that must be developed and deployed to enhance the benefits of an eco-efficient economy.

The best practices recommendations from the Jam

Based on input from the extensive online discussions, we have identified a set of best practices we believe will help enable stakeholders drive toward an eco-efficient economy:

1) Leverage innovation to deliver “green” infrastructures that are highly efficient and overlay the physical infrastructure with digital intelligence – In the view of Jam participants, this applies across all types of physical assets, from data centers, to buildings, to vehicle fleets. In addition to leveraging energy-efficient technologies and design methods, leading organizations are focusing on increasing the overall efficiency of asset utilization through techniques such as virtualization of IT assets, the introduction of mobility centers and consolidation of distribution centers.

Public and private enterprises are using intelligent management of business information and processes to address rapid data growth, as well as optimize efficiency gains from new investment and existing resources. Finally, leaders have realized that they must be able to monitor, actively manage and provide visibility to energy usage and savings in order to incent behavior modifications and drive adoption of efficiency programs to individual employees and consumers.

2) Implement sustainable solutions that promote resource efficiency and reduce the environmental and social impact of operations – Jam participants said this can be best achieved by aligning the strategy for “doing well” with the strategy for “doing good.” This best-practice approach will help create loyalty from clients and employees. Public and private sector leaders are applying lean and Six Sigma principles to reduce energy and water usage, GHG emissions and waste generation across their operations, from product design, to manufacturing, to distribution and marketing. Working across the supply chain to provide greater traceability and transparency, they are reducing costs while enhancing their reputations and growing market share. Programs that focus on workforce management to reduce paper use, promote remote collaboration and other forms of “dematerialization” can lead to lower travel, real estate and office costs. Additionally such programs can address the demands of Employees 2.0 and enhance the organization’s appeal to recruit top talent.

3) Embrace intelligent systems that use open standards to provide near realtime information for better management of the infrastructure, water quantities, or; even, entire transportation systems – Examples mentioned by Jam participants include best practices in the management of public and private transport, streets, bridges, intersections, signs, signals and tolls. A “systems of systems” approach to product creation and improvement increases eco-efficiency for the end user (consumers and employees). Several examples of “systems of systems” applications, such as appliances that use less water and energy and smaller, smarter electronic devices that offer end-users improved access to eco-efficiency data and analytics, were mentioned by Jam participants (For additional details, please see Appendix, page 12.)

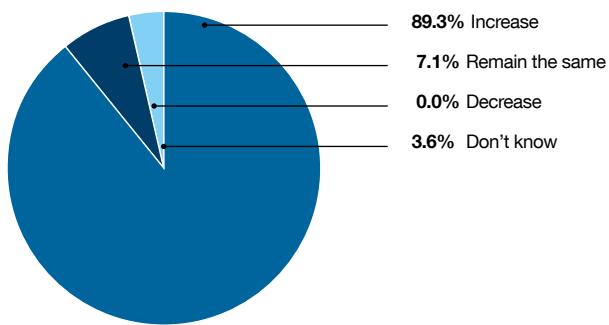


An imperative to act now

As our analysis shows, stakeholders must act now and decisively to advance the eco-efficient economy agenda.

The global economic crisis imposed new constraints on public financing of eco-efficiency investments that place an important imperative on governments and policymakers to seek new avenues for financing public investment in eco-efficient technologies and processes, as well as designing new incentives for private investment and innovation.

However, despite the fiscal constraints, Jam participants expressed a strong view that the next 20 years will be the age of the eco-efficient economy. Consistent with this belief, the majority of Jam participants expect eco-efficient investment to accelerate over the next two-to-three years as the economic crisis wanes (see Figure 3).



Source: Poll taken during Jam

Figure 3: Expected sustainability investments by Jam participants over the next two-to-three years.

“The bad news is that a culture change is required if we are to imbed eco-efficiency and sustainability mindsets in the workplace. The good news is we know the leadership steps and practices to effectively accomplish culture change.

We need to inspire people with an exciting vision of where we want to be; assess where we are against the vision; engage important stakeholders on how to create strategies to close the gap between current reality and the desired visionary future; build a compelling case for the necessary changes; mobilize and empower employees to make it happen and communicate/celebrate early wins; and imbed and align the measurement and management systems with the behaviors required.

If we do these proven steps, we will create a culture of “green.”

Bob Willard, author, “The Sustainability Advantage”

The individuals, companies, organizational leaders and executives who participated in the Jam all seem to face a similar challenge. How do you generate more business, take out costs and increase the efficiency of existing infrastructures and assets – while being responsive to the growing mandate for an “eco-efficient” economy? The IBM Eco-efficiency Jam showed that despite the challenges, eco-efficiency presents opportunities for business and organizations to thrive. Those who understand and embrace this will find they have deepened their engagement and advocacy with their stakeholders, employees and customers.

“The Jam … focused primarily on business issues and practical actions. Unlike many environmental and climate change debates, this one cleverly sidestepped the science, politics and personal beliefs that get involved.”

David Tebbutt, “Ten board level energy saving and environmental issues CIOs must address: Top tips from the IBM Eco-efficiency Jam.” *CIO UK*. February 4, 2010.

The IBM Eco-efficiency Jam

On January 27-29, 2010, IBM, together with the Economist Intelligence Unit (EIU), enabled senior representatives from public and private organizations worldwide to cooperatively determine the best actions that can be taken to meet the goals for a sustainable future. Far from being a theoretical discussion, the focus was on the actions each individual and organization can take and the benefits that will accrue.

The Eco-efficiency Jam ran for exactly 51 hours, during which 1,600 participants from over 1,000 organizations, in more than 60 countries, logged in more than 3,700 times and engaged in sharing their ideas. The Eco-efficiency Jam involved a diverse group of participants, with 28 percent identifying themselves as holding a C-level role (CFO, CIO, COO, CTO and Chief Environmental Officer), 36 percent as being senior level IT Operations and Management and 28 percent working in IT Strategy roles.

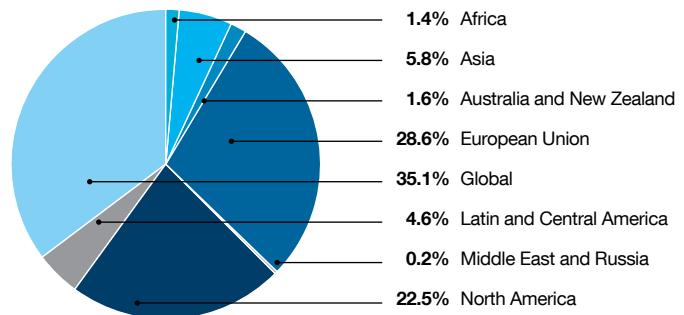


Figure 4: Participants identified by their organizations' primary geographic focus area.

Source: IBM Institute for Business Value analysis of Jam outputs

Appendix

Jam discussions were structured across six discussion forums with each forum featuring a variety of discussion topics.

Jam discussion forum	Top discussion topics	Best practice comments
1. Green IT & IT for Green forum looked at how to optimize energy efficiency of data centers and IT assets	<ul style="list-style-type: none"> • Energy-efficient hardware investments • Design efficient, scalable IT infrastructures optimized for workloads • Measurement and management of energy usage of IT assets • Accurate thermal and energy usage benchmarking • Improve efficiency through virtualization and consolidation of servers, storage and network. 	<ul style="list-style-type: none"> • The greatest cost savings result from better access to realtime information, implementation of advanced analytics and the automation of systems and equipment. • One of the greatest savings came from implementing cold aisle containment in our data center. • To know the energy consumption you have to measure and control it. • We saw an average energy saving of 3,200 kWh per server virtualized. At \$.08 per kWh, that is an annual energy savings of \$256 per server.
2. Energy-Efficient Infrastructure forum examined how to build foundations for eco-efficiency	<ul style="list-style-type: none"> • Management of energy infrastructure requires integrated design and implementation • Modular design (physical and systems) • Energy-efficient lighting, heating systems, water and waste systems, water and power systems • IT advances from workstation to data center energy management • Improved data collection and integration can enable smarter cities and smarter buildings. 	<ul style="list-style-type: none"> • The typical way of managing a building in silos does not work. If you integrate the systems, you must integrate the people and processes. • The St. Regis Shanghai Hotel has integrated more than 12 subsystems to reduce its metric of energy cost to revenue by 40 percent.³ • There is growing evidence that energy-efficient buildings can increase real estate values. • Best practices need to link with the usage plans for the site. We develop one-year, five-year and site master plans for each data center.
3. Sustainable Operations forum looked at how to increase financial and environmental ROI	<ul style="list-style-type: none"> • Optimizing operations to reduce energy and water use • Governance and strategy to develop appropriate environmental strategies aligned with business strategy • Optimizing business processes for increased efficiency • Innovation and optimization of production processes. 	<ul style="list-style-type: none"> • Incorporating “green” and holistic thinking into an enterprise’s end-to-end business processes is about changing mindsets and culture. Embedding new approaches and mind sets in a company sooner or later requires visible support from the top. • We’ve found that the “green lens” can rapidly point to process improvement opportunities that had hitherto been missed by more traditional approaches.
4. The New Workplace forum explored how to decrease the environmental impact of the workplace	<ul style="list-style-type: none"> • Seventy-five percent of the total workforce will be “knowledge worker-based” in five years • Employees 2.0 expect eco-efficiency, while embracing online work systems as the means to aid collaboration • Improvements in energy awareness and changing patterns of end-user behavior. 	<ul style="list-style-type: none"> • Green ideas will fly with the right incentives! Celebrate the owner, the project team and the good deed. • We have environmental sustainability policies, standard procedures, “green teams” and measurable environmental objectives for all managers – and inclusion in job descriptions. So now everyone’s performance review and associated compensation has an environmental component. • Organizations where everyone has their own desk find that peak utilization is in the range 60-70 percent. The technology to support greater mobility (follow-me telephony, thin client, laptops, etc) is proven and mature; most remaining obstacles are organizational and cultural. • Simple tools are available that allow users to calculate the carbon footprint of their own journey to work, taking account of home/work locations and mode of transport.
5. Smarter Industries, Smarter Cities forum analyzed how to make the system of systems work more efficiently	<ul style="list-style-type: none"> • Enabling higher density living and mobility • Optimization of energy efficiencies • Realtime traffic prediction and dynamic tolling • Monitoring and management technologies to help reduce the use of water and related energy. 	<ul style="list-style-type: none"> • The main ways to influence individual behavior is to make the benefits of that behavior visible to both the individual as well as his or her peer groups. • Smart metering projects show that simply by making the cost impact of using electricity visible, the employees will reduce or adjust their consumption to their benefit. • Embracing eco-efficiency means viewing and managing complex systems as integrated systems. This might mean extending the domain of IT to encompass other parts of the physical infrastructure or might mean multiple government agencies cooperating to manage a city’s transportation, utility and security services.
6. Setting Goals & Measuring Performance forum looked how the bar is being raised for compliance and regulation.	<ul style="list-style-type: none"> • Environmental programs require strengthening and wider deployment • Organizations are realizing the importance of setting meaningful goals, value chain mapping and environmental metrics • Measurement and verification of business analytics • Uncovering incentives for energy efficiency. 	<ul style="list-style-type: none"> • Each business leader needs to have the relevant metrics baked into their own (personal and business) scorecards. In this way these metrics will be part of their operational processes and enjoy the attention they deserve. • When setting an operational CO₂ emissions reduction goal, you need to consider what are your key emissions sources, what is the Pareto effect of reduction opportunities, what work has been done to reduce those sources to date, where have opportunities been identified but not implemented and how will current business plans affect the current energy use and emissions inventory. • One of the issues is that the incentive pool is vastly different from one jurisdiction to another. In the end, the best thing companies can do is start collecting more information about how much energy they are using, where and why. That will make them better prepared, even building in some flexibility so they can take advantage of best policies as they arise. • One key reason California has been so successful in adopting energy-efficiency measures is because the utilities offer significant dollar incentives to companies that invest in energy-efficiency strategies.

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Endnotes

- 1 "Terms." Factor 10 Institute. <http://www.factor10-institute.org/terms.html>
- 2 "Property Assessed Clean Energy "PACE" Bonds: Innovative Funding to Accelerate the Retrofitting of America's Buildings for Energy Independence." PaceNow. <http://www.pacenow.org>
- 3 "A Smarter Planet Needs Smarter Buildings." Building a Smarter Planet. A Smarter Planet Blog. IBM. February 10, 2010. <http://asmarterplanet.com/blog/2010/02/smarter-buildings-for-a-smarter-planet.html>



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