3CTECH
Profitable Sustainability

Energy Efficiency Alone is Not Enough

34th West Coast Energy Management Congress

Energy Efficiency is Crucial

40 years ago, in response to energy crises, energy efficiency (EE) measures were introduced to mitigate petroleum production shortages and associated skyrocketing fuel costs. Since then the United States has continued to make significant improvements in energy productivity. After the oil shocks of 1973 and 1979 the need for these significantly accelerated improvements brought to the nation's attention our vulnerability to energy supply disruptions.

"U.S. economic output expanded more than three times since 1970 while demand for energy grew only 50%." — *ACEEE, Laitner et al. "Long-Term Energy Efficiency Potential"*

Petroleum has been the major source of primary energy, rising from about 38% in 1950 to 45% in 1975, and then declining to about 40% in response to the energy crises of the 1970s. The transportation sector is dependent on petroleum, mainly gasoline.

When the crises ended, the perceived value of energy efficiency declined.

Oil prices had been low and stable throughout the 1990s. Starting in 2004, they became volatile again due to perceptions of upcoming inability of the industry to meet increasing world demand.

Energy policy has been a recurring issue for Congress since the 1970s crises.

Fast forward to the 21st century where climate change and resource depletion can no longer be ignored. The evidence is clear and we have scientific consensus that climate-warming trends over the past century are very likely due to human activities, mainly the burning of fossil fuels.

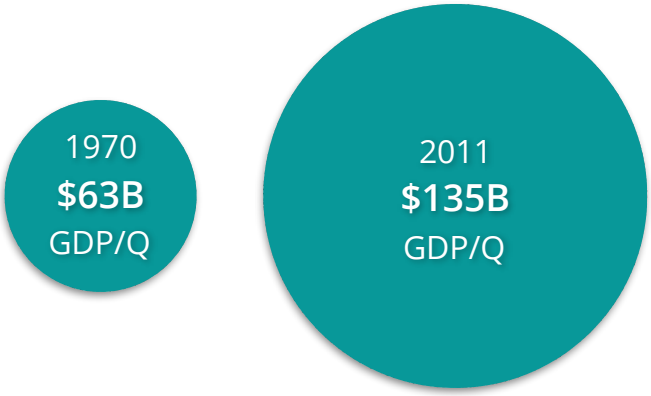
Global climate change has caused a series of severe events, such as extreme weather, disasters, water rise, temperature rise, ocean acidification, drought, impact on crops, etc. The consequences of global warming are difficult to predict but certain effects (intense rains, flooding, etc.) seem likely and will be occurring more often in the future.

The decrease of fossil fuel reserves and emissions caused by energy generation and use has prompted a variety of policies at the state, national, regional, and local levels, as well as actions by governments, companies, and nonprofit organizations.

"if energy productivity had remained constant since 1970 [when about 68 quadrillion Btu (Q or quad) were consumed], the U.S. would have consumed 207.3 quadrillion Btu in 2007, when it actually only consumed 101.6 quads." — *Rocky Mountain Institute*

Consequently, the magnitude and scale of energy efficiency techniques and measures applied in various industries has soared. Everybody has jumped on the EE bandwagon because they see it as a means to cut costs and emissions, and to build a profitable business.

Energy productivity since 1970s

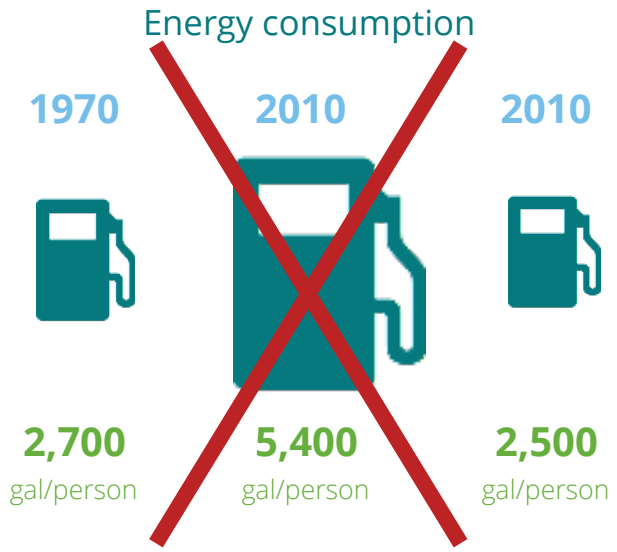


Calculations based on EIA, "Annual Energy Outlook 2012."

Economists have estimated that the use of more efficient products and services accounts for 60-75% of the increase in energy productivity since 1970.

U.S. energy productivity and improvements in efficiency have curbed the increase in energy consumption on a per capita basis.

The average home has grown larger in size, vehicles are bigger and are driven more miles, and the use of energy-consuming devices, such as computers or air conditioners, are continuing to grow rapidly.



In 1970 Americans consumed the energy equivalent of about 2,700 gallons of gasoline per person for all their energy use. Extrapolating that rate of consumption to our current economy would result in the amount of approximately 5,400 gallons per person. Yet, the energy use in 2010 was the equivalent of 2,500 gallons per person.

The main factors contributing to the increase in energy productivity over the last few decades are energy efficiency measures, behaviors, policies, investments, and volatile energy prices. However, we would not achieve such significant improvements without innovation, shifts to less energy intensive industries, and outsourcing. These economic changes have affected the buildings, transportation, and industrial sectors.

Energy Efficiency Alone is Not Enough

EE is extremely important but it's only part of the solution. Why?

Energy efficiency saves money but employing energy efficiency alone is like cutting your monthly budget without adding to your paycheck.

Today's businesses can no longer rely solely on utilities.

Energy Gap

The energy production landscape has changed dramatically in recent years, not only in the U.S. but also in other countries.

In 2013 President Obama announced a series of executive actions to reduce carbon pollution, prepare the U.S. for the impacts of climate change, and lead international efforts to address global climate change.

The Clean Air Act (CAA) lays out specific approaches for new and existing sources: a federal program for new sources and state programs for existing sources.

As part of the Climate Action Plan, the EPA was directed to develop carbon pollution standards for the power sector. The EPA finalized two rules under CAA Section 111 to reduce carbon pollution from power plants

and proposed a federal plan for the Clean Power Plan.

- Final Clean Power Plan for Existing Power Plants
- Proposed Federal Plan for the Clean Power Plan
- Final Carbon Pollution Standards for New, Modified and Reconstructed Power Plants

Shaped by years of outreach and public engagement, the Clean Power Plan was announced in 2015.

Carbon Pollution Standards for New, Modified and Reconstructed Power Plants apply to sources built in the future or to existing units that meet specific conditions described in the Clean Air Act. The EPA is establishing separate standards for two types of fossil fuel fired sources:

- stationary combustion turbines, generally firing natural gas; and
- electric utility steam generating units, generally firing coal.

The Regulatory Impact Analysis (RIA) for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants discusses potential benefits, costs, and economic impacts of the proposed guidelines for GHG Emissions.

The proposed rule (Option 1) would have a significant impact according to E.O. 13211: Actions that Significantly Affect Energy Supply, Distribution, or Use. The EPA projects that approximately 46 to 49 GW of additional coal-fired generation (about 19% of all coal-fired capacity and 4.6% of total generation capacity in 2020) may be removed from operation by 2020.

By 2020, the EPA projects a decrease in delivered coal prices and an increase in natural gas prices. The average retail electricity prices are projected to increase.

The need to comply with the EPA's Mercury and Air Toxics Standards (MATS) regulations together with weak electricity demand growth and continued competition from generators fueled by natural gas have led several power producers to announce plans to retire coal-fired facilities.

The U.S. Energy Information Administration (EIA) estimates that between 2012 and 2020, about 60 GW of coal-fired capacity is projected to retire. Other studies estimate that over 70 GW of electrical generating capacity have been already, or are now set to retire.

Regulations causing these closures include the MATS, the Cross State Air Pollution Rule (CSAPR), and the EPA regulation of CO2 emissions from existing power plants.

Nearly 18 GW of electric generating capacity was retired in 2015, a relatively high amount compared with recent years. More than 80% of the retired capacity was conventional steam coal.

"Fossil fuel-fired electric generating units (EGUs) are, by far, the largest emitters of GHGs, primarily in the form of CO_2, among stationary sources in the U.S." — *EPA*

In 2015, for the first time, natural gas combined-cycle plants had a higher average capacity factor than coal power plants. Total electricity demand, excluding demand met by distributed renewable sources, increased from 384 billion kWh in July 2014 to 398 billion kWh in July 2015. Coal-fired generation fell from 150 billion kWh to 139 billion kWh, while natural gas-fired generation soared from 114 billion kWh to 140 billion kWh. Every region of the country has noted the decrease in coal and increase in natural gas. The largest decline in coal-fired generation was noted in the Mid-Atlantic region and Texas. The largest increases in natural gas-fired generation were in the Southeast and Central regions.

The President is calling for 80 percent of America's electricity to come from clean sources by 2035, including wind, solar, nuclear, clean coal and natural gas.

Electric utilities and policymakers have been struggling to find ways to compensate for power plants shutting down.

The unexpected and indefinite shutdown of the San Onofre Nuclear Generating Station has raised questions about California's short-term electricity supply options and long-term contingency plans. Similar issues were raised in the aftermath of the Fukushima nuclear power plant shut down.

Fossil fuels, including natural gas, are part of the stopgap solution to offset the declines in nuclear and coal generation in the short term, but longer-term energy policies are shifting definitively toward efficiency and renewables.

In 2015, the Quadrennial Energy Review (QER) Task Force released its first installment of the Quadrennial Energy Review report entitled, "Energy Transmission, Storage, and Distribution Infrastructure" which examined the Nation's infrastructure for transmission, storage, and distribution, including liquid and natural gas pipelines, the grid, and shared transport such as rail, waterways, and ports.

The first installment of the QER focused on the growing electricity dependencies of critical infrastructures and economic sectors. In addition, it highlighted an

increasing interdependence between the various energy sub-sectors.

The second installment of the QER will provide findings and associated policy recommendations for modernizing the electric grid. These recommendations will help to ensure its continued performance through 2040.

In closing the energy gap, both the demand and the supply side need to be addressed concurrently. Energy efficiency, demand response, renewables, and micro-grids play a key role in helping to diversify and mitigate risks for our power supply future. Other factors include the continuing implementation of conservation measures, behaviors, and investments in clean energy generation and innovation.

According to EIA's Annual Energy Outlook (AEO2015), over the first 10 years of the projection, the total electricity generation capacity additions are roughly equal to retirements. In later years the additions are sufficient to meet most demand growth. However, the study does not include the actual demand data projections. Also, as we can see by the next example, the San Pedro Bay ports, the local conditions and environment may be less optimistic than the global energy outlook.

San Pedro Bay Ports

Since 2011, Kat Janowicz, now the President of 3COTECH, Inc., has been a driving force for the American Association of Port Authorities (AAPA) to include energy discussions in their seminars and events. She has become a frequent speaker at AAPA on energy topics for ports and marine terminals, including sustainable port development and operations.

The Port of Los Angeles (POLA) and the Port of Long Beach (POLB)—the San Pedro Bay Ports—are important transportation junctions that play a critical role in the national economy.

Due to various economic, technological, environmental and regulatory factors progressively affecting the San Pedro Bay Ports, the ports are becoming more dependent on electricity to operate.

The ports face significant energy related challenges that impact competitiveness, national security and resilience, as well as

job creation and environmental goals. Developing and implementing a comprehensive and collaborative energy management plan could help to address these challenges.

In May 2013 POLB adopted a groundbreaking energy policy to guide efforts in securing a more sustainable and resilient supply of power as demand continues to grow. Kat's presentations and meetings with the port authorities, long before the energy policy adoption, as well as her grass roots work and continued support in development of the policy, resulted in further procurements and new industry standards. Consequently, the port has taken action to research, plan, and implement measures to increase efficiency, conservation, resiliency, and renewable energy.

In October 2013 Governor Brown signed AB 628, the first legislation that requires energy management plans for harbor and port districts.

Since there is a strong competition among ports, intensified by globalization, expanding local neighborhoods, and the challenges presented by larger container vessels, there is no surprise that port authorities are looking closely at each other for inspiration. Soon after a new energy policy was adopted by POLB, the neighboring ports—including the Ports of Los Angeles, Oakland, San Diego, and Portland—initiated procurement processes to develop similar energy management programs.

"Sustainability must be a value shared across departments, industries, and neighborhoods, and I'm very proud to see the Port of Los Angeles investing in the Harbor Area's sustained health with renewable power sources."— City of Los Angeles Mayor Eric Garcetti.

The ports have conducted studies on electricity consumption and evaluation of energy management strategies.

Currently the San Pedro Bay ports estimate their energy demand will quadruple in the next years due to shore power, automation, electric equipment and vehicles. Demand is being fueled by lease and regulatory requirements, which includes rules that require ships to connect to shore power at berth to cut emissions.

The local utilities will not be able to guarantee the power supply. Therefore the

ports are seeking alternative solutions to meet growing demands. Furthermore, the electrical grid is aging and the ports must protect against vulnerabilities to potential regional outages.

Energy Island

The Port of Long Beach Energy Island is an initiative, rather than a physical island, consisting of a set of innovative strategies focused on ensuring resiliency, reliability, and economic competitiveness for the port complex and its tenants. The "island" will encompass a clean, distributed power generation; modular self-generation systems; and strategies for load control, energy storage, and low carbon technologies.

The initiative strives for energy security and operational resiliency with its ability to operate in an interconnected mode or as grid-independent in times of emergency or outage. Other advantages include long-term energy cost stability, clean fuels for mobile, stationary uses, and reduced demand for grid power.

A recently negotiated agreement with Southern California Edison includes a 15 percent discount on electricity rates for container, stevedoring, and shipping entities. It's expected to save maritime users $350 million over 24 years.

Improved air quality due to electrification of the equipment and a reduced carbon footprint will benefit the entire 3,200-acre port district and the local community.

Five 'Energy Island' Goals:

- ADVANCE GREEN POWER
- USE SELF-GENERATED, DISTRIBUTED POWER WITH MICRO-GRID CONNECTIVITY
- PROVIDE COST-EFFECTIVE ALTERNATIVE FUELING OPTIONS
- IMPROVE ENERGY-RELATED OPERATIONAL EFFICIENCIES
- ATTRACT NEW BUSINESSES, CREATE JOBS, INCREASE REVENUE, AND REDUCE COSTS

The team is now identifying opportunities and assessing initial technologies and strategies. The timeline is set. The initiative's framework is expected to be in place by 2017, design and specifications for project solicitation by 2022, followed by construction and operation.

The planning phase includes various programs for the port's tenants, vendors, and other stakeholders. For example, tenants interested in demonstrating emerging energy technologies at their sites

or vendors of emerging technology with applicability to the seaport industry may apply for funding partnership with the Port.

"Our guiding principles are security, sustainability and resiliency… Energy Island captures a number of measures we've already been developing, and it creates a framework for exploring the larger universe of possibilities to advance real energy solutions."

— Rick Cameron, Port Managing Director of Planning and Environment

The port, in collaboration with local community and consultants, provides education, resources, and reports to the public and interested parties.

Environmental Achievements

For years environmental challenges were stalling major harbor development projects in San Pedro Bay. The *Green Ports* idea, now a global trend, sprung from litigations and protests challenging environmental impact reports, particularly related to air pollution. Green Port Policies—adopted later—shifted environmental focus from regulatory compliance to long-term commitment for cleaner and greener port operations. One of the landmark measures enacted under the policy includes the San Pedro Bay Ports Clean Air Action Plan (CAAP).

In 2006, the Ports of Long Beach and Los Angeles took an unprecedented joint action to improve air quality in the South Coast Air Basin by adopting the CAAP, an extensive plan aimed at significantly reducing the health risks posed by air pollution from port-related ships, trucks, trains, cargo-handling equipment and harbor craft. The CAAP creates a framework for reducing emissions, with a key component serving the power needs of yard equipment, ships at berth, and other applications.

"To truly eliminate air pollution, the process for generating energy must be as clean as the energy itself."— Gene Seroka, Port of Los Angeles Executive Director

Other programs include the Technology Advancement Program (TAP), Energy Technology Advancement Program (ETAP), and Advanced Maritime Emissions Control System (AMECS).

Since 2005, the ports have cut emissions, i.e. Sulfur Oxides (SOx) by 97 percent, Diesel Particulate Matter (DPM) by 85 percent, Nitrogen Oxides (NOx) by 50 percent, and

Greenhouse Gases (GHG) by 21 percent, while reporting container growth of 3 percent. In addition, sustainable practices have been incorporated into the ports' planning, designing, construction, purchasing, and operations.

"We are committed to all of you, our customers, our stakeholders, to change the way the Port of Long Beach does business and indeed, the way our entire industry works together…Your Port of Long Beach is well on its way to becoming the port of the future. The future starts now."— Jon Slangerup, POLB CEO

POLB projects and programs—as part of the Capital Development Program—must be developed under tight budget and schedule constraints using innovative designs, integrated new technologies, strong environmental mitigations, and sustainable development practices. As part of its standard project delivery process, the port adopted the risk analysis, assessment and mitigation (RAAM) techniques. RAAM ensures that project risks and mitigations are considered and determines schedule and budget risk-adjusted contingencies.

PortTech Los Angeles

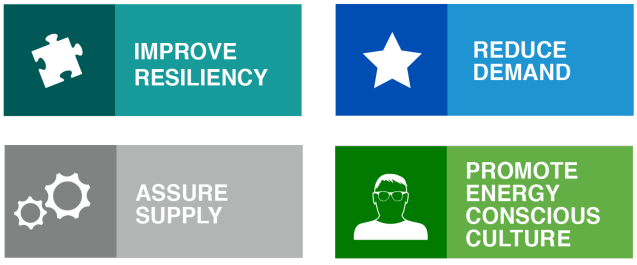
With the rapidly growing need for emerging energy technologies and innovation, PortTech LA—a non-profit organization and a cooperative effort of the City of Los Angeles, the Ports of Los Angeles and Long Beach, and Harbor Area business communities—plays a key role in bringing together entrepreneurs, strategic partners and investors.

Each year PortTech advises and supports 80 to 100 start-ups focused on energy, environment, logistics, transportation, safety, and security solutions.

Energy Strategy

To address issues of energy security we need a holistic energy strategy, policies, and programs that include energy efficiency, availability, reliability, independence, resilience, and innovation.

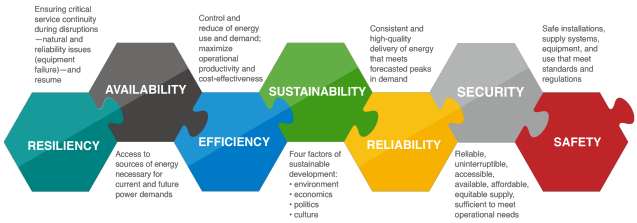
Energy goals and priorities



These days the demand/supply energy gap has become the consumer's problem and some customers may not be aware of this upcoming challenge.

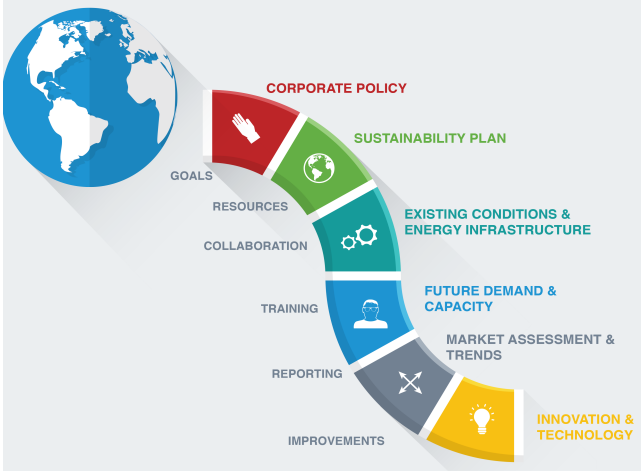
Sustainable energy planning is a strategic imperative for all today's businesses. Challenges are global and more complex,

and require integration of energy considerations into the full range of planning, development, and operational activities.



Organizations with specified sustainability and energy goals and objectives, strategies, roadmaps, and clear accountability, combined with employee awareness and training are best positioned to thrive.

Roadmap to Strategic Energy Planning



Rating systems like LEED and ENVISION exemplify this concept. While LEED has become a globally recognized green building program, infrastructure projects remained unaddressed until the Institute for Sustainable Infrastructure developed Envision. Envision provides a holistic framework for evaluating and rating the community, environmental, and economic benefits of infrastructure projects.

"The Port of Long Beach committed itself to sustainable development in 2005 as a part of its landmark Green Port Policy... With the development of Envision, we have a peer-reviewed, industry-accepted, standard by which we can measure and demonstrate our commitment. Our staff is now able to understand the impacts of their design choices and to tangibly demonstrate the Green Port Policy's contribution to sustainable development."— Doug Sereno, Director of Program Management Port of Long Beach

Summary

While energy efficiency is extremely important, today's energy landscape requires us to look at the bigger picture.

Global climate change calls for significant emissions reduction and consequently a shift towards electrification. With growing electrification energy demand is increasing. At the same time the energy supply is decreasing. Existing power plants are scheduled to retire mainly due to environmental concerns but also due to unexpected incidents. The new renewable generation barely covers the retired production, not increased demand.

As we have just identified an imminent Demand/Supply Energy Gap, we have to take action today.

Some of our clients and associates may not be yet aware of this Gap. What do we typically do when we need more energy? We believe that we will pay higher energy bill. Then we might consider to implement more robust energy efficiency measures.

However it will be extremely difficult to meet our growing demands, if we don't generate enough energy.

As industry leaders, we need to help our customers and associates identify the potential gaps by assessing existing energy infrastructure and future demand.

We need to tackle the energy gap from both, the demand and supply sides. We need to continue maximizing energy efficiency and productivity while encouraging the swift growth of new and clean generation. As we keep flattening the *duck curve*, we have to continue efforts towards energy storage, demand response, and micro grids. Our clients can still experience blackouts with new renewable generation because of our aging and under-maintained transmission and distribution network. Finally, we need to improve our efforts towards resiliency. Backups do not always work. A good example being the failure of diesel backup generators and their restrained fuel supplies during hurricane Sandy.

Energy Sustainability

As we are aiming for an uninterrupted energy flow it is important to recognize the distinct role of energy sustainability in overall energy considerations. While these considerations include sustainable energy, they also include doing more with less, doing the project right, and doing the right project.

About the author

Kat Janowicz, MBA, LEED GA, ENV SP, CEM is a leader, strategist, and entrepreneur with twenty years of international experience in commercial and industrial infrastructure for energy, transportation, ports, oil & gas, sustainability, and environmental projects. She developed business strategies for national and international energy and transportation markets and remains a driving force for energy planning and efficiency procurements.

Kat is the President of 3COTECH, advisor and coach for the PortTechLA and Cleantech Open and a frequent speaker at industry events, including Association of Energy Engineers, American Association of Port Authorities, and USGBC.

3COTECH, Inc. is dedicated to helping public and private clients integrate profitable sustainability, energy, and resiliency into their business operations while improving their bottom line. 3COTECH specializes in strategic planning, risk assessment and management, and process improvements for infrastructure and industrial clients in ports, goods movement and transportation markets.