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IAEE Energy Forum

Second Quarter 2013 International Association for Energy Economics

President's Message

The IAEE conference season has been relatively quiet during the period after New Year, and at present I am looking forward to the ELAEE conference in Montevideo in early April. That does not mean that the IAEE itself has not been very busy, and my admiration for the work of previous presidents and the untiring work of Dave Williams and John Jimison continues to grow. One of the major tasks of the Association has been to survey its members. I am deeply indebted to the hard work of Peter Hartley and to Iva Hristova and colleagues for developing and then analysing the survey. One of the highlights (and there were many) was the finding that almost half the members are Professor or senior management rank – we are clearly a very distinguished Association. It is also reassuring to hear that The Energy Journal continues to be highly regarded (it clearly dominates the set of journals against which it was compared) and widely read, while more than 80% of those responding agreed that the new journal Economics of Energy and Environmental Policy (EEEP) was a worthwhile addition and fulfilled a need for a less technical journal that also covered environmental issues relating to energy.

I was suddenly called in to help referee articles for EEEP over the past month as the editor-in-chief, Jean-Michel Glachant, had to take time out for major heart surgery, which I am delighted to report has been successful. Again I am impressed with the help provided at short notice by colleagues so that we can continue this very worthwhile activity. Reading submissions and interacting with the writers reinforced my view that if we are to make an impact as energy economists we need not only to base our arguments on sound empirical and theoretical foundations, but we need to be skilled in telling the story the evidence reveals. I am repeatedly reminded of that when supervising PhD students on the subject. I count myself lucky that the Cambridge Electricity Policy Research Group, with which I have been working for over 20 years, has attracted excellent students, many of whom now fill important academic and professional positions. Although undertaking a PhD probably seems interminable when you are in the middle of it (and long compared to the time you will subsequently have to write articles or consultancy reports) I have been impressed with how many students who struggled initially to make sense of the subject eventually clicked and started producing really exciting papers. It has been remarked before that undergraduates (at least at top schools) are often far better at writing clearly and to the point than PhD students, who seem to lose that skill as they read turgid academic articles. The challenge that EEEP poses them is to reacquire those expositional skills while building on the solid research they have had time to undertake.

Thinking about students brings me to another important initiative that past-President Lars Bergman is launching. The IAEE Energy Economics Education Initiative is to improve first our knowledge about what energy education courses are on offer and then to identify "best practice" models. In Bergman's words "a well-developed set of relevant educational alternatives today is a necessary condition for the existence of an active community of high quality academics and energy professionals tomorrow. And such a community is a necessary condition for the future development of IAEE." I could not agree more, and reflect on the experience of our own research group, where I think two conditions were critical to its success with our PhDs. First, we were lucky in having a critical mass who met each other at weekly seminars and our thrice annual conferences, not to mention the IAEE conferences where they frequently won "best student" prizes.

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Editor: David L. Williams

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Second, the subject has been so intellectually lively over the past decade and across the world that they were excited by the problems that called out to be addressed. The combination of social engagement and intellectual excitement inspired them, and a measure of both is their enthusiasm in coming back to our internal conferences as well as the IAEE meetings.

That leads me back to the impressive programme of upcoming conferences. I feel lucky to be President in a year in which there is a meeting in Montevideo in April, where I hope to visit the Iguacu falls and the Itaipu dam. I am disappointed not to be able to attend the Nigerian meeting in Lagos, as I am engaged on Government advisory work over that period, but I am busy planning to attend Daegu and Anchorage, in two parts of the world that I have yet to visit. I look forward to meeting many of you at one or other of these exciting meetings. You can always check on what is coming up at http://www.iaee.org/documents/2010/IAEE-Affiliate_Master_Calendar.pdf .

David Newbery

IAEE Mission Statement

The International Association for Energy Economics is an independent, non-profit, global membership organisation for business, government, academic and other professionals concerned with energy and related issues in the international community. We advance the knowledge, understanding and application of economics across all aspects of energy and foster communication amongst energy concerned professionals.

We facilitate:

- Worldwide information flow and exchange of ideas on energy issues
- High quality research
- Development and education of students and energy professionals

We accomplish this through:

- Providing leading edge publications and electronic media
- Organizing international and regional conferences
- Building networks of energy concerned professionals

Editor's Notes

This issue of the *Forum* continues our focus on energy efficiency. We'll conclude our look at energy efficiency in the third quarter issue and then turn to the topic of energy independence.

Douglas Reynolds introduces us to Alaska from an energy perspective and describes what it's like to live and work in an environment where minus 40 degree weather is the norm. He provides encouragement for attendance at the 32nd annual North American Conference in July in Anchorage.

Michael C. Trachtenberg and Gal Hochman write that increases in wealth and electricity use over the last 30 years are related to consumption and CO_2 emissions. Satisfying increased demand while limiting CO_2 demands novel changes in accounting, responsibility and efficiency.

Andrew Warren posits that all energy bills should have block tariffs which rise the more is consumed. Instead as of now in the UK, bills decrease the more fuel is consumed. Read more.

Markus Groissböck , Emilio López , Eugenio Perea, Afzal Siddiqui , and Adrian Werner write that ambitious EU efficiency targets provide challenges and opportunities for public buildings. Optimisation-based decision support may assist building managers to find cost-effective solutions while mitigating risk from market and technological uncertainties.

Julia Harvey provides an overview of the potential impact of declining retail rates and increasing efficiency standards in ERCOT, whereby lower costs may induce customers to increase their electricity consumption, potentially exacerbating the resource adequacy concern.

Rafal Kasprowicz reports that energy transformation in Poland has been in progress since the beginning of the 1990s and was triggered by basic changes in the Polish economic system. He discusses how energy efficiency in the Polish economy has changed during this time.

Bernadett Kiss and Luis Mundaca note that transaction costs hinder energy efficiency in buildings. By providing an insight into the nature and the scale of these costs, public policy intervention has more potential to reduce them.

Saeed Moshiri reports that Iran implemented a wide-ranging energy price reform through which energy subsidies were to be removed in 2010. He reviews the energy market and the energy price reform in Iran with a focus on energy efficiency.

DLW

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2013 IAEE International Conference

16 -20 June

Daegu, Korea

Korea Resource Economics Association (KREA)
Korea Energy Economics Institute (KEEI)

Invitation to Daegu, Korea

We are pleased to invite all IAEE members to the 36th IAEE International Conference which will be held at Daegu Exhibition and Convention Center (EXCO) in Daegu, Korea on June 16-20, 2013. Our theme is "Energy Transition and Policy Challenges" and proposed topics of the plenary sessions will include:

- Energy Challenges and Global & Regional Cooperation
- North-East Asia: China, Japan, Korea, Russia, Taiwan and North Korea
- Climate Change and Policy Challenges
- Renewable Energy and Smart Energy Systems
- Urban Energy Systems
- Realizing the Potential of Energy Efficiency
- Unconventional Oil and Gas: Technology and Perspectives

Hoesung Lee

General Conference Chair

Call for Papers

Authors wishing to make oral presentations at the 36th IAEE International Conference at Daegu, Korea, must submit an abstract in PDF format, maximum 2 pages in length, via conference website(www.iaee2013daegu.org) or e-mail to the Program Committee (program@iaee2013daegu.org). The deadline for abstract submission is extended to January 31,2013.

To encourage participations from government agencies and energy-related industries, we add another type of presentation, 'Government and Industry Studies,' in addition to the usual type 'Current Research.' 'Government and Industry Studies' type is for those who want to share current activities and case studies from industry and government sectors.

Authors will be asked to choose between two types of presentations: 'Current Research' and 'Government and Industry Studies,' when you submit your abstract via conference website. If you choose to send your abstract via e-mail, please indicate your type in the abstract.

Key Dates:

- *Abstract submission deadline : January 31, 2013*
- *Notification of accepted abstracts : March 8, 2013*
- *Full paper submission deadline : April 12, 2013*

Suggested Concurrent Session Topics

Energy Cooperation
- Global Cooperation
- Regional & Inter-regional Cooperation
- Super-Grid
- Role of International Energy Institutes and Agencies
- FTA and Energy Cooperation
- Energy Cooperation among North-East Asian Countries
- Energy Issues of North Korea

Energy Transition
- Structural Changes in Energy Supply and Demand
- Transition towards Low Carbon Options
- Centralized v.s. Distributed
- Government's Role on Energy Transition

Climate Change and Policy Challenges
- Carbon Trading Markets and Carbon Pricing
- Technology Options
- Government's Role on Climate Change
- GHG Emission Limitation Regime
- Financing Low-Carbon Economy

Smart Energy Systems
- Economics of Smart Grid
- Smart Metering
- Energy Storage Options
- Fusion of Energy and IT Technologies
- Designing Urban Energy Systems
- Electricity Vehicles and Smart Grid

Electricity
- Electricity Markets and Prices
- Impact of Shale Gas to Power Generation and its policy
- Role of Nuclear Power
- Industrial Structure of Electricity Industry
- Transmission and Distribution
- R&D and Emerging Technologies

Conventional and Unconventional Gas
- Economics of Shale Gas
- Future Perspectives of Unconventional Gas
- Decoupling and Regionalization of Natural Gas Prices
- Natural Gas Development Issues
- Trading and Shipping/Pipeline of Natural Gas

Global Petroleum Supply and Market Efficiency
- Volatility of International Petroleum Prices
- Role of Strategic Oil Reserve
- Market Efficiency Issues
- Petroleum as a material
- Unconventional Oil and its Future

Future of Coal
- Forecasting Price and New Demand for Coal
- Utilization of Low-quality Coal
- Technology options including Gasification, IGCC and CTL
- Economics of CCS Options

Renewable Energy; Markets, Drivers and Technology
- Government's Role for Promoting Renewable Energy
- Technology Innovation and Grid-Parity
- Intermittence Problems and Economic Solutions
- FIT and RPS
- Financing Renewable Energy

Energy and Material Efficiency
- Potential of Energy Efficiency
- Energy Efficiency and Conservation
- Material Efficiency Measures
- Integrated System Efficiency

Energy Entrepreneurship
- Business Portfolio
- Risk Management
- Management Strategy
- Human Resource Development
- Market Power
- Global Leadership and CSR

Energy Policy and Planning
- National and Regional Energy Planning
- Tax and Tariff
- Energy R&D Policy
- Energy Resource Development Policy
- Fuel Changes in Transportation Sector

Energy Modeling
- Energy Data, Modeling, and Analysis
- Modeling Technology Development
- Analysis on Energy Market and Industry
- Integrated Energy System Modeling

Energy and Economy
- Sustainable Development
- Energy Poverty and Economic Development
- Access to Energy
- Reform of Energy Intensive Industries

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Tour Program

The city of Daegu, where the 2013 IAEE International Conference will be held, is a placeleading to numerous cultural heritages and tourist spots with excellent transportation network. We prepare several tour programs for participants of the conference. First, exclusive pre-tour programs such as 1-day tour to visit the UNESCO World Heritage Sites near Daegu will be offered for participants who arrive early to Daegu (from 15th to 16th of June). During the conference (from 17th to 19th), half-day tour programs to visit the inner-city of Daegu and its vicinity as well as walking tour to visit downtown heritage and oriental medicine market will be offered for both our delegates and accompanying persons. Technical tours are scheduled on Thursday (20th of June) for all the participants, including tours to visit UNESCO World Heritage Sites, Daegu old downtown areas as well as industrial complex areas such as POSCO, Hyundai Heavy Industries Co., Ltd., and KOGAS.

And finally, for those who wish to prolong their time in Korea, other tour programs will be also offered to delegates. Unforgettable tours such as the tour of DMZ; the most heavily militarized border in the world, and visiting of Jeju island; the most well-known natural tourist attraction in Korea, are just two of the exciting tour sites you can choose to enjoy and explore.

You can easily sign up for any of the tour programs through our conference registration website or on-site tour desk at EXCO, our conference venue, during the conference. All of our tour programs are prepared in cooperation with Daegu Conventions & Visitors Bureau. For more information about tour programs, please visit our Daegu IAEE International Conference website at www.iaee2013daegu.org.

Students

IAEE is pleased to announce its 2013 Best Student Paper Award. A top prize of US$1000 will be given for the best paper in energy economics. Three runner-up prizes of US$500 each will also be given. All four winners will receive a waiver of registration fees to the Daegu 2013 International Conference on June 16-20, 2013.
Students may submit a paper for consideration in the Awards. To be considered for the IAEE Best Student Paper Award, please follow the guidelines in Daegu Conference website (www.iaee2013daegu.org). You must be a full-time student and a member of IAEE in good standing.
The paper submission has different requirements and a different deadline. The deadline for submitting a paper for the Student Paper Awards is March 8, 2013.

Also, students may submit an abstract for the regular concurrent sessions. The deadline for abstracts is January 31, 2013.

Students may also inquire about our scholarships covering conference registration fees. The Daegu 2013 conference organizers are offering a limited number of registration fee scholarships to offset the conference registration costs only to students who will be presenting a paper at the conference. All travel and accommodation costs associated with attending the conference are the responsibility of the recipient.
Students who do not receive a fee scholarship may still attend the conference at the reduced student registration rate. In order to qualify for the student rate, please submit a letter stating that you are a full-time student and are not employed full-time. Please visit Daegu Conference website (www.iaee2013daegu.org) for full details.

Registration

The registration fee includes admission to all sessions, conference documentation, daily lunches, welcome reception at EXCO, awards dinner at the Hotel Inter-Burgo EXCO, and cultural events at Daegu Hyanggyo (Confucian Academy). All documents and name badge can be obtained from the on-site conference secretariat, open for the duration of the conference. Online registration for the 36th Annual IAEE International Conference will be open in January 2013. A confirmation will be sent upon receipt of payment.

	Early (until March 31, 2013)	Late and On-site
Speakers/Chairpersons/Discussants (members)	650 USD	750 USD
Speakers/Chairpersons/Discussants (non-members)	730 USD	830 USD
IAEE Members	850 USD	950 USD
Non-Members	1,000 USD	1,100 USD
Full-Time Students	400 USD	450 USD
Guests (Spouse/Accompanying Person)	300 USD	350 USD

World Natural Gas Markets and Trade: A Multi-Modeling Perspective

Edited by Hillard G. Huntington and Eric Smith

This special issue is an important outgrowth of the Stanford University Energy Modeling Forum (EMF) 23 working group. The volume explores nascent modeling efforts to represent international natural gas markets and trade for improving the understanding of key policy and investment decisions. Although formal modeling is not required to describe the growth of liquefied natural gas or the role of spot markets, decision makers can gain powerful insights from these frameworks.

Following the editor's introductory and overview chapter, the volume includes 12 technical papers by participants in the EMF study. Seven chapters provide unique perspectives on the regional price, volumes and trade estimates from individual modeling frameworks. These systems include competitive models of world natural gas markets as well as strategic models of European markets with market power. The remaining five chapters cover important topics discussed by the working group during the study.

The range of issues is comprehensive and intriguing: trans-Atlantic price convergence, the linking of oil and gas prices through future gas-to-liquid (GTL) capacity additions, the critical role of Middle Eastern natural gas supplies, the extraordinary potential for Russia supplies if key constraints can be overcome, potential collusive behavior by Russian and Middle East exporters, the dynamics of transportation and storage capacity adjustments in response to market power opportunities, European markets reliance upon Russian natural gas exports, the interrelationship between resource constraints and market power, reserve appreciation in known North American fields, and improving insights and decisions through use of quantitative models.

Order online at: http://www.iaee.org/en/publications/specialorder.aspx
ISSN Number 0195-6574

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Alaskan Energy Issues

By Douglas B. Reynolds*

Editor's note: The 32nd Annual North American Conference will be held July 28-31 in Anchorage, Alaska at the Hotel Captain Cook. This will be the first time the North American Conference has been held in the U.S. but outside the lower 48 states. Doug Reynolds, a long-time IAEE/USAEE member and an Alaskan resident, tells us what it's like to live and work in a place where temperatures reach 40 below and what you'll be missing if you don't make the effort to attend this meeting.

For those of you thinking of coming to Alaska for the 32nd Annual IAEE North American Conference in Anchorage, Alaska, let me take a moment to welcome you to Alaska. Alaska is big, it is beautiful and it has some of the most incredible energy issues of anywhere in the world. If you love energy, nature and the "Last Frontier," then do not miss this conference. However, if you come to this conference, you will come in the summer at a beautiful time of year when most of the energy issues we deal with are not so apparent. In that vein, here is an explanation to help you understand some of the unique energy issues we grapple with here in Alaska, and specifically in Fairbanks, Alaska, the rest of the year.

A word to the wise, for those of you in Europe: one airline, Condor Air, offers a weekly flight direct from Frankfurt, Germany to Fairbanks, Alaska, and Anchorage, Alaska. Condor also offers connecting flights from everywhere in Europe to Frankfurt via Lufthansa. So come early or stay late for the conference, or even why not make a month out of it? Enjoy the many sights, go fishing, biking, canoeing, boating, mountain climbing or heli-skiing. If you come up to Fairbanks, I will introduce you to energy research facilities at the University of Alaska Fairbanks, and invite you in to see my coal boiler used for space heat. You can rent a car and stay at camp sites all over Alaska. You can try some muktuk if you're lucky, reindeer sausage, grilled "wild" Copper River salmon, or even some halibut or moose. Also Santa Claus can be visited year round in North Pole, Alaska, which oddly enough is just south of Fairbanks.

Unfortunately, the Northern Lights are not visible in the summer as the Midnight Sun hides their colors, but Denali (Mt. McKinley) can be visited as can many other amazing places. For those of you who wonder how it is the rest of the year here in Alaska, here is a taste[1]:

In the 1970s, I knew energy was the key to the world's future, and I assumed like most economists that new technology would come to the rescue. After all, we know that necessity is the mother of invention. I have now come to a very different conclusion: rather than invention, necessity is the mother of adaptation, and counting on technology to solve a crisis is at best a fifty-fifty proposition. But counting on adaptation to solve a crisis is 100 percent reliable. Adapt and thrive. So, I took it upon myself to adapt ahead of time and find the most successful strategy to use less oil, partly as a research experiment, partly to make a significant lifestyle change at my own pace, and partly to explore a new future.

When I got to Fairbanks, Alaska, I initiated a personal search for ways to use less oil. As it just so happens, Fairbanks is one of the most perfect places in the world to carry out just such an experiment simply because the Fairbanks economy is intensely dependent on oil. Not only is there a major oil pipeline and refinery near town, but also the majority of residents use fuel oil to heat their homes and consume gasoline to drive their cars to work and around town. However, contrary to what you might expect in an oil producing state, Fairbanksans pay more for gasoline than most Americans even with a refinery nearby. Additionally, the town is heavily dependent on tourism and mining for employment—industries which rely on cheap oil fuels to transport tourists, employees, and machinery. According to the weather service, we have 100% probability of snow on Christmas. So, how to adapt?

On a cold day in Fairbanks, it can reach 40 below zero (Fahrenheit or Centigrade) and be pitch dark. The sun doesn't rise until midmorning. In spite of this, I have managed to bicycle to work nearly every day to save fuel and money. I wish I could tell you of the beautiful snowy scenery I pass on the bike path and along the river, or of the ways a simple black spruce looks covered in snow, where the best thing is that the snow makes even a dark early morning seem brighter than you'd expect, but really it's a tough ride. I wear heavy snow pants, a parka, gloves, boot gloves, a face mask, and a helmet fitted for ear warmers. I also have studded bike tires, which cost more than studded automobile tires. I have two front head lights, one on my helmet and one on my bike handle bars, as well as front blinkers, and I have two blinker lights behind me and reflective tape all around; yet still drivers do not always see me.

As I roll along, the cold is often so bitter, that my tires actually begin to flatten as the cold reduces tire pressure. I have to make sure that the tires are pumped

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See footnote at end of text.

to at least 60 psi (4 bars) or they become so pudgy and resistant to motion that it takes twice as long as normal to get to work and I become worn out. Also as I go, my breath fogs up my face and freezes so that ice begins to build up around my eyes, but I have found it impossible to wear goggles or glasses because they fog up instantly and you can't see. One of my graduate students found a solution, though, using snorkeling gear. Needless to say my eyelids and face freeze over a little, and I look strange as I come in from the cold with ice all over my face and eyebrows.

As far as using my bike for other needs, I don't ride my bike to the store or take my kids in my bike trailer in the winter. Besides the severe safety issues of being hit by an on-coming car were I to ride my bike in the dark with kids in the back trailer, my kids would complain the whole way and possibly suffer frost bite if they had to ride very far in 40 below weather. I do know a mom who manages to bike her kids to pre-school in winter here, but for most people bicycling just isn't a viable alternative to a car.

One winter, I had a different challenge as far as commuting was concerned. I did some consulting in downtown Fairbanks, so I had to be in several places around town during the week which meant I couldn't ride my bike as easily. I would put in 40 hours a week at the university and then 20 hours at consulting. I ended up taking the bus to the university and then another bus to the downtown consulting and then sometimes back again to the university before going home. Unlike Europe or the rest of the world, though, most bus systems in America leave a lot to be desired. The main problem is that Fairbanks is not a large community. Few people rely on the transit system, so there is no need for lots of buses. Even so, the lack of buses was easy to solve.

First I would go out and wait for the first bus from my home in 40 below weather wearing all my winter clothing. There was about a 40 minute delay between the bus to campus and the next bus to downtown, so I had time to run to my office, check my email, and to try to take care of campus business before I ran—and I mean ran fast—to the next bus. Once I caught the downtown bus, I rode to my consulting office.

During the long leisurely 25 minute ride to downtown, I used the time well. I read reports, graded papers, or wrote analyses. I could have focused on the "time waste" factor since I could have covered the same distance in fewer than 10 minutes by car door to door; but instead, I came to realize that efficiency wasn't about how my environment caters to my needs, or about finding technology that adapted to what I needed, it was more about how I adapted to my environment and the existing technology. Often a passenger on board would say to me, "Wow, that sure is a long report you're reading," or "That sure is a lot of grading you have to do," and they would ask for more details. So sometimes I got work done on the bus and sometimes not, but there was a sense of community that I don't get alone in my car which in many ways made up for the downsides.

Another energy problem that all of Fairbanks and other cold climate challenged cities face is the high cost of heating. Most people in Fairbanks use fuel oil to heat their homes, a very expensive fuel, and the bills are dragging many folks under. I, too, used to heat my home with fuel oil and sometimes wood. However, I wanted something cheaper realizing that I was one of the few who saw the future and the difficult changes that people were soon going to have to make. Sure, I added insulation to my house and participated in weather-proofing programs offered by the state, but quite frankly in Fairbanks that just isn't enough. Luckily there is a world class coal mine a hundred miles southwest of town by rail, which offers Fairbanks access to cheap coal land that led me to buy a coal-fired, hydronic boiler for my backyard.

This coal system automatically feeds coal to a burning chamber every time extra heat is called for by the house. It was expensive, well over $15,000 dollars after all the installation, but the reduction in fuel costs have made up for that. After all, I knew of another energy conscious professor who spent somewhere over $30,000 to better insulate his house and save money. So I spent less initially and expect to save more annually.

The interesting thing about Alaskan coal is that it is sub-bituminous, low grade coal, because it is a "younger" coal and still has much water within it. This has a disadvantage, however, as the coal is of a lower energy content per pound, although it is cleaner to burn than anthracite coal, like that found in West Virginia, because the Alaskan coal has less sulfur. However, Alaskan coal cannot be burned in an indoor coal stove as easily as anthracite coal. It works best burnt in a separate outdoor boiler where coal dust can be contained and the burn temperature can be kept high. The thing of it is, while fuel oil is delivered at close to $4 per gallon of gasoline equivalent (GGE) as of this writing, coal is deliverable at about $1.50 per GGE. Even though the coal does not burn as efficiently as fuel oil, it still saves half the energy cost of fuel oil.

I eventually added an insulating shell around the boiler to reduce the need to fill the coal bin and haul away the ash as often, and I heightened the chimney to make it more efficient and even cleaner burning. In fact those changes made the boiler about twice as efficient and half as smelly. The only big problem I experienced was on a New Year's Day when I had to work outside at 40 below for four hours to loosen the auger mechanism. While most people have not gone to the lengths I have to deal with our energy crisis, many folks have indeed recognized that they are going to have to take steps down that path.

I sat on a committee for energy options in Fairbanks in 2008 to discuss these looming concerns of expensive heating fuel oil coupled with an extremely cold, stagnant atmosphere in the winter with temperature inversions. The temperature inversions cause coal and wood burning particulates as well as pollutants from vehicle exhaust and diesel buses (though not the downtown coal power plant that has a scrubber to clean the particulates) to remain in the atmosphere close to the ground where we breathe them in. The particulate matter from wood and coal and the myriad of other pollutants creates particles as small as 2.5 microns that have been shown to be unhealthy. Yet, with fuel oil so expensive and with natural gas unavailable in Fairbanks, the only cheap heating options available are those which pollute—wood or coal. The question for the committee was, what if most every family in Fairbanks were forced by the high cost of energy to rely on wood or coal heat? Clearly particulate matter would be horrendous. Thus, the entire town sits on the front lines of the world's energy and environmental crises. Some residents have already chosen, and soon others will choose, to switch from fuel oil to coal boilers or wood stoves. Others will continue to pay extremely high fuel oil prices which are reaching and exceeding $5,000 a season.

So the committee for energy options advocated bringing natural gas to town. Three options were vetted. One was the construction of a small diameter natural gas bullet pipeline from Prudhoe Bay to Anchorage, which would go past Fairbanks and provide relatively cheap natural gas for both major metropolitan areas. That could take six years from start of construction to finish. Another option was to put super cooling liquefied natural gas (LNG) modules on the North Slope, turn the North Slope's natural gas into LNG and then truck the LNG to Fairbanks, which would take two years of development. A third option was to drill for natural gas about a hundred miles west and build a small eight-inch pipeline from there to Fairbanks. That would take three years, if they found natural gas, which they haven't.

One other option that was discussed was to use the heat from our downtown coal fired power plant to warm up homes and businesses—district heating. Already hot steam and hot water from the power plant is piped around the Fairbanks downtown area in order to heat houses and buildings—often called cogeneration. The problem is many more houses could use that heat source if more pipes were laid, but our commission determined this alternative to be too expensive. A cheaper alternative, which I saw used in the former Soviet Union, was to put pipes above ground rather than underground all over the city. It's ugly, but cheap. The Soviets did it often.

In the end it was up to the various financial and commercial interests as well as the more politically powerful Anchorage metropolitan area to determine which option would materialize. A recommendation for the two year LNG option was pushed, but because the commercial interests needed time and incentive to try their options, nothing was done with the recommendation. Fairbanks lost a year of time and headed into greater environmental and economic decline, but that is typical. Energy transitions by their nature are divisive, expensive, and economically devastating. There are no easy technologies, no cheap solutions, no clear path—only extremely difficult and painful adaptations. (to bring you up to date, it is now 2012 and still none of these options discussed above have materialized in Fairbanks)

You'll be wondering why I haven't mentioned the golden boys of the energy debate, "alternatives." Our local energy committee did in fact look at some other interesting options for Fairbanks, such as solar, wind, geothermal and nuclear power. Most of these don't adequately address the heating needs of Fairbanks because they just can't work here. A small scale "micro-nuclear" plant option would take five to ten years to permit and again would not address the heating needs of Fairbanks. In the end various and obscure ideas only heightened the realization that no energy resource worked nearly as well as oil. But more critical is that if you view Fairbanks as a microcosm of the world, the world's economies are on a path to energy crisis just like Fairbanks. No one on the committee liked the idea of coal boilers, but they realized more houses would soon be making the switch to the detriment of the Fairbanks air quality as was the case when wood and coal were the Fairbanks fuels of choice and necessity 70 years ago. A similar reality confronts the world as it inevitably chooses coal and the consequential global climate change results.

Alaska did conduct a program to add insulation and sealing to houses. I participated, and sure enough after I added insulation and sealed it up, my indoor humidity levels skyrocketed and I got iced windows and the beginnings of mold problems. So I have intentionally reinstalled air leaks. There are systems you can install called Heat Recovery Ventilators (HRVs) in use in Fairbanks and elsewhere, but bear in mind that these cost thousands of dollars to install and use energy themselves, making the ultimate costs high.

These anecdotes suggest that there are no easy answers to high energy costs. People will simply have to pay more for energy including electricity and will have less money for vacations, for recreational equipment for consumer goods, and even for necessities. These are the hardships we face.

Rather than waiting for that man-on-the-moon technological breakthrough or the perfect hydrogen fuel cell car, it is better to just go ahead and start right now to change your lifestyle. Prepare to change your job, prepare to accept lower wages, prepare to live in a house with other families, prepare to use alternative transportation, or prepare to use coal to heat your home; just don't prepare for the easy life that technologists have promised.

Ultimately, people will make do. We were made to adapt. Americans and people around the world survived the Great Depression, world wars, and other atrocities and crises. Now people will have to manage again and with environmental problems to boot. This is not a statement on the ways in which you will have to adjust, but a statement on the likelihood that you will be forced to adjust. When I taught in Kazakstan, a student told me, "It could be fun for everyone to live in a yurt." And so it will be. Just remember to wear your reflective gear and smoke respirator safety mask and be prepared for a different way of life.

Now here is my challenge to you: attend our July 2013 IAEE conference and take time to ask the Alaskans you meet about energy.

Footnote

[1] Portions of this are excerpted from Reynold's book, *Energy Civilization: The Zenith of Man.*

Welcome to IAEE's Newest Institutional Member

IAEE is pleased to welcome Singapore's Energy Market Authority as an Institutional Member. The following profiles EMA and some of its activities.

The Energy Market Authority (EMA) is a government agency under the Ministry of Trade and Industry. Our main goals are to ensure a reliable and secure energy supply, promote effective competition in the energy market and develop a dynamic energy sector in Singapore. Through our work, we seek to forge a progressive energy landscape for sustained growth.

EMA organises the annual Singapore International Energy Week (SIEW). This is an event which brings together the world's leading conferences, exhibitions, workshops and networking events from across the energy spectrum of oil & gas, clean and renewable energy, smart grids and energy trading - in one week, in one location. The 6th SIEW will be held from 28 October – 1 November 2013.

Smart Energy, Sustainable Future

Energy Efficiency: The Critical Systems Lifetime Measure

By Michael C. Trachtenberg and Gal Hochman*

Introduction

Two major societal changes have occurred over the last 30 years that demand attention. One is the dramatic growth in the number of people worldwide who are wealthy and the surprising extent of their wealth. The second is the increased dependency of people throughout the world on electricity as a primary energy source or apparatus with a critical energy component. This is best appreciated via the spread of personal electronic devices and the incorporation of electronics as starters, controllers and monitors in systems driven primarily by other fuels.

Affluence is and has been a prime driver for political power and consumption throughout history. Each generation expects to be richer than the one before. Enabling societies, common to great empires (democratic or not), promote both wealth accumulation and vertical mobility. The post-WW II economic democratization dramatically increased vertical mobility enshrining it as a totem of a desirable society. We can conclude that these trends are going to continue and at an increased rate. In the absence of extreme economic events, wars or natural disasters people do not willingly decrease their standard of living.

Problem

Personal (and corporate) wealth is a critical value as the wealthy use a grossly disproportionate fraction of goods and services and emit a non-linearly disproportionate amount of carbon dioxide (CO_2) NTNU (Hertwich and Peters 2009)[1], independent of country boundaries. The NTNU data show that for individuals with an annual per capita income of $10K or less their average per capita CO_2 emission is 1 metric tonne. However, as per capita annual income increases to $1M, the per capita CO_2 emission rises 15-fold with an average increase over that income range of 7X. Thus, to a first approximation, 14% of the people in the world (the affluent) emit as much CO_2 as do the remaining 86% of the populace. This increase, while evident for all forms of consumption, is not uniform across consumption categories, e.g., food increases far less than does transportation. Despite these data the general idea that an improved planet rests on an ever-widening distribution of an ever-improving standard of living continues unabated. The objective of making ever more people ever wealthier implies ever-increasing pollution and an ever more imperiled ecosystem, i.e., a transfer of resource benefits to humans and burdens to all non-human systems, though with an obvious and ultimate adverse effect on human beings. The business as usual (BAU) strategy is one of "kick the can."

A key question then is how to support these trends without also compromising the environment by increasing the amount of greenhouse gases and other pollutants released into our atmosphere, oceans, streams and land. The environment is not a stand-alone proxy for forests and ocean, etc. but the very real ecosystem on which modern society is predicated, i.e., the infrastructure of the social fabric (e.g., NYC subway, train and vehicular tunnel systems). Traditional responses to this conundrum are salvation via "technology" and more unfettered capitalism as innovation is "hindered" by regulations in every sphere, i.e., unleash the creative "juices." While popular we consider such comments as superficial at best, counter to existing data and divisive at worst.

Approach

We propose three integrated approaches to achieving the goal of increasing affluence without further damage to the ecosystem, i.e., of achieving long-term benefits without incurring unacceptable short-term costs:

1. Changes in counting and accounting,
2. Changes in systems wide energy efficiency measurement and performance, and
3. dramatic increase in development, promotion and use of green energy.

Importance of Energy and Energy Efficiency

The most critical supply element for any society is energy – fuel, food and water (the ultimate reactant). The four essential energy characteristics are current availability and price, and anticipated change in future availability and price. Because of their emotional criticality each of these supply elements is heavily

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See footnote at end of text.

subsidized (directly, indirectly and via externalities), preserved as critical stores, and supported by considerable military might, all devoted to maintaining a constant supply.

The value of energy is in the work it can support. Thus energy efficiency along the entire supply-demand chain can be seen as an efficiency exercise targeted at converting the smallest number of source Joules into the largest number of product - Joules/sec or heat or chemical reactions. System efficiency thus corresponds to the overall energy cost needed to achieve a given end, over a defined period. This means that each step in the supply and demand chain exhibits a quantifiable degree of efficiency. However, typical measurements are highly siloed, often top down approximations, and commonly do not represent system values [http://en.wikipedia.org/wiki/Life_cycle_analysis].

On the supply side, key actions are the processes wherein fuel is conditioned to be transformed from raw fuel-stuffs, through extraction, transformation, storage, transport, and local redistribution, each with its attendant losses and inefficiencies, to provide a fungible, energy-dense product that is available on demand 24/7 (Figure 1) with electricity as a preferred energy carrier. On the demand side the operations include local storage, distribution, and a multiplicity of end uses - each with its attendant losses, wastage and inefficiencies. The difference between the theoretical energy available from the raw fuel-stuff to the end use is termed the *beneficial energy*, here defined as Output = *f* (inputs), i.e., µ*energy; thus a greater value for µ corresponds to more energy efficiency. Conversely, the less efficient this system, the more primary energy has to be used to realize the desired end work product.

Among the key insights from this diagram are 1) the many opportunities for efficiencies on both the supply and the demand side, 2) the fact that progressively more efficient end-use profiles can dramatically affect the ratio of centralized vs. distributed energy production, and 3) the idea that energy investments can be redistributed to future benefits.

Cost of Energy

Energy efficiency's contribution to overall energy price is substantial but limited. For example, (Gillingham, Newell et al. 2009) showed that estimates of overall cost-effectiveness of efficiency standards for residential appliances is $3.3 billion/quad saved in 2000, while cost-effectiveness of Demand-Side Management is $2.9 billion/quad. Those authors argued that if all of the energy savings were in the form of electricity, their estimates would suggest cost saving of 3.8 cents per kilowatt-hour and 3.4 cents per kilowatt-hour for appliance standards and utility Demand-Side Management, respectively.

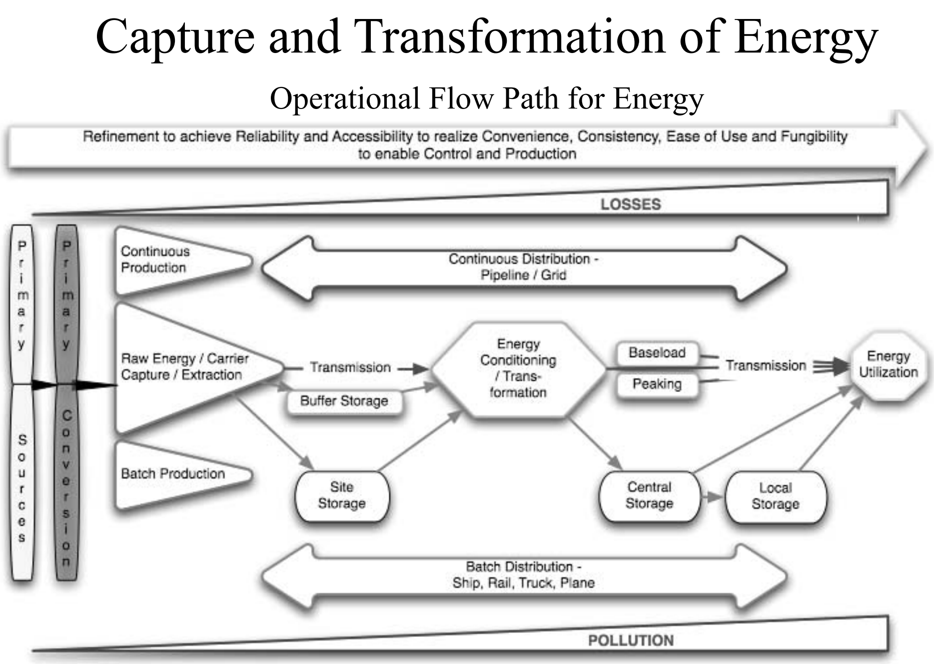

Figure. 1. Summary flow of energy processing, storage, distribution and use.

Offsets by subsidies and externalities only makes the fractional contribution of efficiency that much less potent. These offsets impose biases in the overall system performance – at times desired, at times grandfathered, at times a perverse redistribution of wealth. These biases, whether by design, secondary to social or economic rules, by self-serving behavior, or by chance, slow the rate and magnitude of incorporation of innovative change into the BAU. A low cost for energy (as might be facilitated by increased efficiency) is not necessarily a desirable consequence from a systems perspective, as it will promote inefficiency including vampire energy and delay efficiency innovation. "Necessity is the mother of invention," here the English proverb has been defined as "when the need for something becomes imperative, you are forced to find ways of getting or achieving it" thus including all of the key actions – invention, innovation, introduction and incorporation (Oxford Dictionaries).

Innovation

A major question in today's world is how to most effectively introduce innovation in large, risk-averse industrial systems, such as power plants, to achieve the most efficient (system level) energy production, delivery, and use that maximizes benefits while minimizing work, use of materials, pollution, ecodamage, etc. Pollution control regulations are a poor substitute for systems management and for a culture of excellence. Fundamentally, energy producers do not attempt to solve a vexing problem. Solving the innovation problem is important to achieve real improvement in energy use needed to support broadening and deepening of affluence. The McKinsey Report (Dobbs 2011) addressed the benefits from efficiency and reducing energy use. What is critical is the relatively low cost and the benefit/cost ratio. As long as costs (burdens) can be pushed along to the final consumer there is no driver for component performance. To achieve this, accountability must be changed at every step in the process. Current supply chain efficiencies are top down driven when we need either a bottom up approach or one mandated on a system-wide basis by government or industry (commonly working together) to assure uniformity of performance and to mitigate the risk of and undue benefit realized by free-riders. In the U.S. compliance is commonly voluntary, not so in other democratic states, the difference being the relative strength of government vs. business interests.

Paths to Drive Innovation

One path to promoting and realizing energy efficiency rests on changes in counting and accounting. There is much discussion concerning the validity and utility of GDP (or its variants) as a measure of beneficial economic activity since the neutrality of the measure treats all transactions equally a situation akin to the number line having no negative numbers. While there are many alternate "green"-GDP metrics they often incorporate a "feeling state" and other normalized humanitarian values that make them contentious to one group or another. Part of the new metric we advocate is based on component and system efficiency (there are some similarities to EIO-LCA and other analyses); this will be discussed in a separate paper.

Neutralizing all subsidies and externalities is another step in this direction, save those immediately needed during the infancy of a technology. Assembling and assigning distributed fractional costs is another. Imputing costs imposed on nature is a third (see below). This last may be accomplished by assuming the cost of complete restoration. This allows the ability to impute environmental damage cost by means of alternative replacement. None of these measures likely will be more than 70% accurate, if that, but they are a good start towards developing appropriate methods and measurements. This is a good example of where the excellent should not kill the good.

A particularly valuable change is exercising full, immutable accounting, achieved through a variation on traditional double entry bookkeeping. Traditionally every asset is matched by a liability inasmuch as the corporation is a construct owned by its investors. Here an analogy is made such that every benefit has listed an offsetting cost. The parallel idea is that nature per se is not owned by an individual or group but is a fund from which one makes withdrawals and is obligated to make in kind remuneration While we are not asserting a return (continuance for many religious groups) of such a non-secular relationship,we are asserting that the current "man as god" value set is a typical subject/object relationship where abuse and devaluation of the object is inherent. Moral suasion is not a viable path to remedy this inherent deficit. Assigning a value to ecosystems has been particularly difficult to accomplish. It can be done if the value of industrial processes needed to realize a full systems-wide, full value, zero-base were used as the imputable cost. The value would be argued but a judgmental and insurable value would be achieved over time.

Personal responsibility, by piercing the corporate veil, is a most effective enforcement strategy. Reconsideration of Directors and Officers insurance is the ready vehicle for such changes. Immutability is a central consideration as current accounting methods are, to be kind, flexible; they present a rationalization that is used to tell a desired story, in other words propaganda parading as plausibility. This flexibility and fungability is very costly – accounting, as a transactional cost, accounts for 45% of the U.S. national income under ordinary conditions (Wallis and North, 1986) and far more in acquisition costs. In addition, as evidenced by write downs commonly seen after mergers or purchases of collateralized debt instruments in the recent economic collapse, and in all prior collapses, even the most sophisticated purchasers are readily duped by a variety of accounting "procedures" (Reinhart and Rogoff, 2009).

Carbon dioxide remediation is one example to be considered. There are three pathways to address the problem; one being carbon capture and storage (CCS), a second carbon capture and conversion (CCC), and a third, decreased carbon production. The last is critical if electric vehicles were actually to contribute to decreased CO_2 emission instead of transferring the load to stationary power plants, as is the current situation. Path one and two are designed to support the continued use of hydrocarbon fuels and hydrocarbon combustion systems, particularly in the production of electricity. Path two diminishes carbon dioxide release through recycling, but the reductive energy has to derive from some exogenous source and in view of the second law will cost more than was derived in the primary oxidation. Path three provides for alternative electricity production methods.

Each of these paths can be compared along economic and energy taxes using a fully costed, non-subsidized, non-externalized, worst-case model on a zero-basis, all expressed in terms of μ, system-based energy efficiency. If, for example, carbon capture and storage would impose a dollar cost of \$20-25/MWh for a coal burning power plant and \$14/MWh for a natural gas burner and a loss of 20-25% of current delivery capacity; this is equivalent to about \$43-45/tonne of CO_2 for capture and an additional \$5/tonne for transportation and initial storage. The last value assumes BAU transaction costs but given the contentious nature of the process transaction costs for saline aquifer storage will be far greater than for oil displacement storage and could add several more dollars to the cost. The coal-fired plant provides an additional cost transfer in terms of medical and ecosystem damage that is on the order of several hundred billion dollars annually. If that burden were avoided the dollars could be used to buy solar, wind or tidal energy, or lessened line loss, etc. The result would be to provide the same level of electric power for the same dollars but without the human and ecosystem damage. This approach focuses on achieving the beneficial end in the most expeditious manner while avoiding make-work options. It should be noted that the presence of a raw energy source and the ability to harvest it while necessary is not a sufficient argument to use it. Were it otherwise the country would be fully denuded of trees, as once was the case for eastern old growth forests.

The last path, permanent decrease in carbon production could be achieved by redirecting the carbon tax imposed on electricity produced by hydrocarbon combustion as an investment either for green energy research development and engineering or for green energy installation. Thus, much as the energy industry is funding portions of the smart grid and improved household appliance efficiency, it would underwrite the disappearance of coal and oil-fired power generation. This is not a life-threatening situation for corporate entities involved in energy reduction as they have been expanding into alternative energy for some time. Rather it forces a redistribution of their portfolio to mutual benefit. It will impact on their profits for some initial period but such is the cost of being a licensed oligopoly.

A further examination looks to the issue of where one is placed after implementing such a policy. For example, following a CCS regimen for a decade the situation is status quo. Thus, CCS represents the beginning of a recurrent cost cycle to no improved position. CCC on the other hand could reduce the amount of oil or natural gas used further along a production chain. However, it is critical that the energy form used to achieve this benefit is green, neutral of another hydrocarbon. Either of the first two paths present obvious advantages. This is especially the case for path two, if waste heat could be harnessed to facilitate the conversion of CO_2 to methanol or CO or another beneficial compound.

Thus the availability and price of fuel is nominally the limiting element in maintaining a given standard of living. But this is way too simple as price, like all fractions, hides more than it illuminates. Given a certain price (\$/MW, for example) the real issue is the cost (\$) that can be managed by decreasing cost per MW or decreasing the number of MW needed for the task. Our argument is that the best position is to hold the line on cost (or even to increase it thereby promoting innovation) while improving efficiency in order to decrease energy costs and to devote the differential to next generation energy production and a cleaner environment. In sum, efficiency allows an improved standard of living combined with a decrease in CO_2 emissions today and into the future by the use of carbon tax funds to develop new, non-polluting, low risk energy supplies. Maintaining the price, or even increasing it not only obtains efficiency but it also mitigates growth in consumption.

Summary

The purpose of this work is to introduce the idea of an integrated, systems-wide efficiency measurement for energy-related processes. We examine how this concept can be applied to energy systems and consider how this idea would impact energy policy.

As noted, the object of an energy system is to realize work – movement, heat, chemical reaction, information processing, etc. – that can be performed at any time or distance arbitrarily separate from the time/space locus of the primary energy source. Energy will be reported in Joules, work as Joules/sec. The energy transformation, transmission/distribution, storage and use steps are shown in Figure 1. In order to yield consistent energy accounting the energy value of subsidies is subtracted from the energy output;

similarly the cost of clean up to a zero-base is also subtracted so that no externalities are allowed. For example, if natural gas escapes during well drilling, the energy cost of remediation is subtracted from the overall energy output. Similarly, all of the work lost, medical impairment and attendant costs, are subtracted from the effective energy output from a coal burning power plant. This approach normalizes the energy efficiency of a given energy source over its lifetime.

Traditionally, pollution was seen as the cost for standard of living. Technology was assumed to remediate pollution if, as and when economically justified. We propose a third way that is removed from the pollution/standard of living trade-off. Our path involves integrated, system wide and inherent efficiency to provide more benefits with less pollution. Changes in counting and accounting reinforce this new path and promotes new innovations. The move to green energy avoids fully dealing with the problem of greenhouse gas remediation altogether by replacing current hydrocarbon-based power plants based on the inverse of their efficiency. That is, increasing standard of living for ever more people can be most effectively attained by three steps: 1) introduction of a fully transparent counting and accounting system, 2) rewarding companies on the basis of the engineering efficiency of their processes, and 3) deliberately transforming the energy supply from one based on hydrocarbon fuels to one based on solar, wind, and tide, geothermal and fusion - at the expense of all other fuel-stuffs. To repeat more succinctly – more transparency, more honesty, more efficiency, more collective good, more growth, a more broadly available improved standard of living.

Footnote

[1] See also http://carbonfootprintofnations.com/content/wealth_and_responsibility/

References

Dobbs, R. (2011). Resource revolution: meeting the world's energy, materials, food and water needs, McKinsey Global Institute.

Gillingham, K., R. G. Newell, et al. (2009). Energy efficiency economics and policy, National Bureau of Economic Research.

Hertwich, E. G. and G. P. Peters (2009). "Carbon Footprint of Nations: A Global, Trade-Linked Analysis." Environmental Science & Technology **43**(16): 6414-6420.

Reinhart, C. M. and K. S. Rogoff (2009). This time is different: Eight centuries of financial folly, Princeton University Press.

Wallis, J. J. and D. North (1986). Measuring the transaction sector in the American economy, 1870-1970. Long-term factors in American economic growth, University of Chicago Press: 95-162.

Energy Efficiency: “The Number One Priority”

By Andrew Warren*

“Energy efficiency”, maintains UK energy and climate change secretary Edward Davey, “is my number one policy priority.” A very sensible priority, given that the cheapest and most ecologically valuable fuel is that which we don’t use.

So, if gas and electricity charges are levied at rates that seem deliberately to discourage frugality, it must be a priority to reverse such a perverse price signal.

And perversity describes precisely how all fuel bills are calculated. Look at your own gas or electric bill. The initial kilowatt hours consumed each month are charged at around three times the price of subsequent units. The result is that those who practice careful consumption are penalised. Whereas there is effectively a volume discount on profligate energy consumption.

Now opinion formers like Which? are overtly hammering the absurdity of thrifty consumers “paying more than a third extra per unit than someone who uses twice as much”.

Both practically, and in particular psychologically, this is no way to impress upon consumers the value of energy conservation: this is prima facie not the way to alter perceptions of value.

Equally it is not the best way to help poorer households: Consumer Focus have found that 85% of low income households consume less energy than average, and therefore pay more per unit. With over five million households now in fuel poverty, there is a real urgency to turn the price signals round. Instead of being many times more expensive, the initial amount of energy usage should be priced at a lower rather than higher rate.

This concept, the ‘Rising Block Tariff’, could be implemented in a number of ways. As in the conventional model, energy companies could be obliged to increase the unit price of the energy they sell in a series of consumption ‘blocks’. The more you consume, the more you pay. No longer would the frugal be out of pocket.

Equally, the concept can be mimicked through providing each customer with a cheap, even free, block of energy or an annual credit on their bill. The cost to the energy supplier of these blocks or credits would be made up for in higher unit prices. Again, the fewer units you consume, the less you would pay for the average unit of energy.

Derek Lickorish, who chairs the English Fuel Poverty Advisory Group, (of which I am a member) argues that the first 700 kWh of consumption should bear none of the costs from energy and climate change policy - effectively government mandated costs. The next 400kWh would attract these levies. And should a customer exceed 1100 kWh (700+400kWh) all these units plus the additional kWh consumed should attract additional levies. He draws the analogy with income tax thresholds, where those earning over £100k lose personal allowances.

By using regulation in this way, the proportion of funds collected to underwrite the basic needs of fuel poor households and subsidise fuel saving measures could be increased, with impunity. No longer could it be said that these policy costs were harming the fuel poor. Instead, only the profligate would underwrite them.

People would retain the right to use fuel wastefully, even excessively, just as now. The difference is that the more they use beyond the basic amount, the more they would pay for doing so via ever increasing kilowatt hour unit costs. Conversely, people could avoid high costs by moderating use. That moderation could be achieved by installing energy saving measures enabling significant provision of energy services without excessive use of fuels - or simply doing without unnecessary energy services, such as plasma televisions, hot-tubs and patio heaters.

Tim Yeo is chairman of the Commons select committee overseeing Edward Davey’s department. Twenty years ago, when he was environment minister, he acknowledged the absurdity of offering lower rates for extra expenditure. He recognised that what people wanted to buy from an energy company was not a commodity, equating kilowatt hours with detergents or soap flakes. It was services like light, heat, motive power. Which could mostly be provided satisfactorily burning fewer units of power.

He pressed for the introduction of rising block tariffs. Sadly he did not succeed at the time, quite possibly because climate change and energy policy were run by different government departments. But also because the pressing need to reduce energy consumption was scarcely acknowledged politically.

Now both policies are under the same management. Now is the time to reverse these absurd incentives for profligacy.

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Improving Energy Efficiency and Risk Management in EU Public Buildings

By Markus Groissböck, Emilio López, Eugenio Perea, Afzal Siddiqui, and Adrian Werner*

Why Energy Efficiency in Buildings?

National and regional authorities worldwide have passed legislation in order to mitigate climate change. For example, the "20-20-20" targets of the European Commission include a 20% improvement in energy efficiency by 2020 relative to 1990 levels (EU, 2008; EU, 2009). One pathway for this objective to be achieved is via improved operational and retrofitting practices in existing buildings. Since the building sector is responsible for nearly 40% of the energy consumed in the EU (EU, 2011), sectoral improvements could make a substantial impact overall.

Contemporaneously, electricity-sector deregulation in most industrialised countries aims to improve economic efficiency by providing more transparent price signals to producers and consumers (Wilson, 2002). Indeed, unlike the hierarchical, vertically integrated paradigm, the deregulated one facilitates more decentralised decision making. On the one hand, this creates incentives for building managers to respond to market conditions by adjusting their set points in the short term (taking into account weather forecasts and occupancy levels) or by retrofitting in the long term; yet, on the other hand, they will have to guard against volatile energy prices and to trade off both investment and operational decisions over time. In effect, consumers need better decision support for potentially conflicting objectives, e.g., lowering energy costs, managing risk, and improving energy efficiency.

From the perspective of public building managers in the EU, an optimisation approach based on modelling energy flows may enhance decision making. In particular, our preliminary results based on data from test sites in Austria and Spain (as part of the EU FP7 EnRiMa project) indicate how dynamic zone temperatures for heating via conventional radiators and heating/cooling via HVAC systems reduce energy consumption by 10%. This is possible by responding to external conditions and internal loads while taking into account the thermodynamics of the heating/cooling system and the building's physics. Longer-term savings from retrofitting may also be possible and are being investigated.

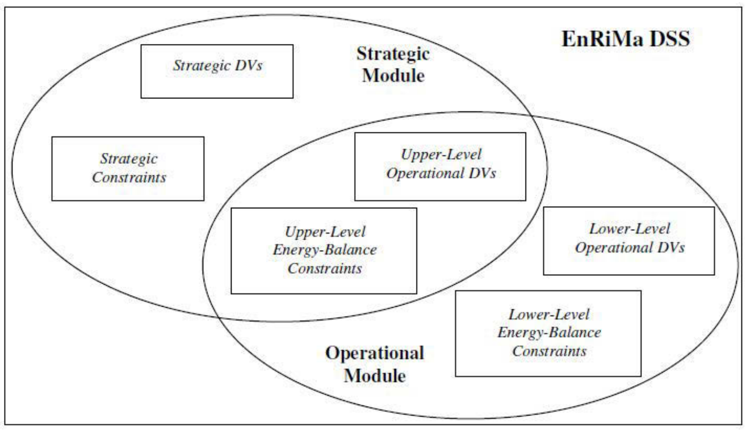

Figure 1. EnRiMa DSS Schema

A Dual-Level Approach

The EnRiMa decision support system (DSS) considers short-term (operational) and long-term (strategic) problems in distinct, but linked, modules (Figure 1). The former assumes that building equipment and shells are fixed, and the building manager must meet various energy demands over time by procuring energy from diverse sources, e.g., energy markets or on-site production. This leads to upper-level operational decision variables (DVs) and energy-balance constraints. It is also the approach used in most optimisation-based treatments, e.g., King and Morgan (2007) or Marnay et al. (2008), which essentially adapt large-scale models, e.g., Hobbs (1995), to the building level.

We extend this approach by focusing on energy services (instead of demands) for a building's occupants. For example, while it may be natural to think of demand for lighting or other electricity-only end-uses, heating or cooling services are more natural to cast in terms of comfort, i.e., a desirable temperature or range. Unlike traditional optimisation methods for building energy management, which estimate heating and cooling demands exogenously, we assume that these demands arise endogenously based on the building manager's desirable temperature range, thermodynamics of conventional radiators or the HVAC system (e.g., how heated water or air affects the zone temperature), building physics (e.g., how the shell retains heat over time), solar gains, external temperatures, and internal loads (e.g., number of occupants and level of activity). These lower-level

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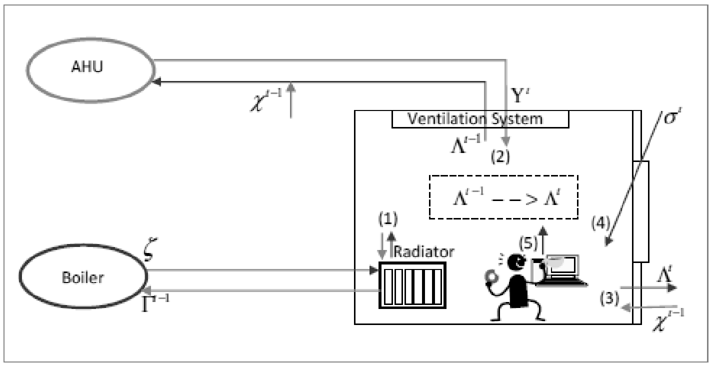


Figure 2. Lower-Level Operational Model

energy-balance constraints also lead to lower-level DVs, i.e., flow rates of air or water and use of natural ventilation, which not only vary with current conditions but also anticipate future ones in order to allow for pre-heating in the winter (Figure 2). Such lower-level energy-balance constraints together with the lower-level DVs may be run independently or in conjunction with the upper-level energy-balance constraints and operational DVs to constitute the operational module that minimises the cost or the level of energy consumption. Finally, our approach is in contrast to how traditional building energy management systems operate, i.e., by adjusting air or water flow in heating and cooling systems in response to pre-determined triggers, viz., large deviations in the zone temperature from the set-point temperature.

In the long term, both the building envelope and the installed equipment may be replaced, which is handled by the strategic module. Its novelty compared to existing investment models at the building level, e.g., King and Morgan (2007) or Marnay et al. (2008), is in addressing uncertainty in both energy prices and technology performance. Indeed, volatile energy prices and technological change may expose building managers to risk and deter energy-efficiency investments. Thus, the strategic module provides a way to make such long-term decisions under uncertainty while also allowing for financial contracting to hedge against risk. In contrast to the operational module, the strategic one abstracts from the details of equipment thermodynamics and instead captures operational effects through upper-level energy-balance constraints.

Preliminary Results

The lower-level operational module is run for two EU public buildings: Centro de Adultos La Arboleya (in Siero, Asturias, Spain), which belongs to Fundación Asturiana de Atención y Protección a Personas con Discapacidades y/o Dependencias (FASAD), and Fachhochschul Studiengänge Burgenland's Pinkafeld campus (in Pinkafeld, Burgenland, Austria). Both sites currently buy all of their energy (electricity and natural gas for FASAD and electricity and district heating for Pinkafeld) at regulated tariffs from local utilities. Thus, in the short term, there is no price uncertainty facing these consumers. Nevertheless, they face a challenge in reducing energy consumption given their existing building configurations. We focus on the case for Pinkafeld as the findings are qualitatively similar for both sites.

Assuming that the building manager's desired zone temperature range during a typical winter day for Pinkafeld is 19-22°C during peak hours (and 16-17°C during off-peak hours), we capture the extent of energy savings from using dynamic temperature set points for the radiators and HVAC system. We run the lower-level operational module under three cases: fixed-mean temperature (FMT), fixed-lower temperature (FLT), and optimisation within desired zone temperature ranges (OFP). The FMT case mimics existing building operations in which the zone temperature is maintained at the target level (in this case, the mean of the ranges given). FLT provides a more conservative way to run the heating system, i.e., by targeting the lower limit of the desirable range. By contrast, OFP is a true optimisation that determines hourly zone temperatures and, thus, the desired set points for the heating system throughout the day in a cost-minimising manner. In a similar spirit, a dynamic approach that trades off cost and comfort for an HVAC system only is taken in Liang et al. (2012).

The OFP case results in daily energy consumption of 632.79 kWh, which is a 10% reduction from the FMT case. When the rigid temperature requirement is set to the lower limit, the total energy consumption is 638.78 kWh, which is 1% higher than in the optimised case with less user comfort. Hence, the optimisation approach proposed here may support building operators in trading off energy costs and user comfort (Table 1).

Case	Space Heat Demand (kWh)	HVAC Electricity Demand (kWh_e)	Cost (€)
FMT	696.11	5.77	56.74
FLT	631.07	7.77	51.83
OFP	629.15	3.64	51.05

Table 1
Summary of Resutls

Figure 3 indicates how the zone temperatures change during the day relative to the external temperatures in the FMT case. Note that the estimated and required temperatures are coincident because of the lack of flexibility. Due to high solar gains in the middle of the day and the rigid temperature requirement, the HVAC system needs to be operated, which creates relatively high electricity consumption in comparison to the OFP case. The pattern is similar for the FLT case (Figure 4)), and there is again no difference between the estimated and required temperatures. By contrast, the OFP case allows the zone temperatures to drift within the acceptable range, thereby taking advantage of the solar gains and reducing the need for the HVAC system (Figure 5). For example, between 6 AM and 8 AM, the cumulative space heat demands are 154.31 kWh and 155.04 kWh for the OFP and FLT cases, respectively, as the flexibility to ramp up the radiator gradually in the former case reduces energy consumption. Similarly, between 6 PM and 7 PM, the flexibility over the radiator's operations means that the space heat demand is 42.19 kWh in the OFP case as opposed to 43.39 kWh in the FLT one. Thus, total space heat demand is reduced by approximately 1.92 kWh.

Surprisingly, even with a lower fixed temperature setting as in Figure 4, the energy and cost savings are not as high as with an optimisation within a temperature range. In effect, the flexibility of the building's conventional heating and HVAC systems to respond to environmental (and, potentially, market) conditions is valuable from both economic and energy-efficiency perspectives. This is encouraging for managers of public buildings and policy-makers alike: with the right kind of decision support, energy savings of up to 10% are possible simply from better operations without any changes to the existing building or equipment.

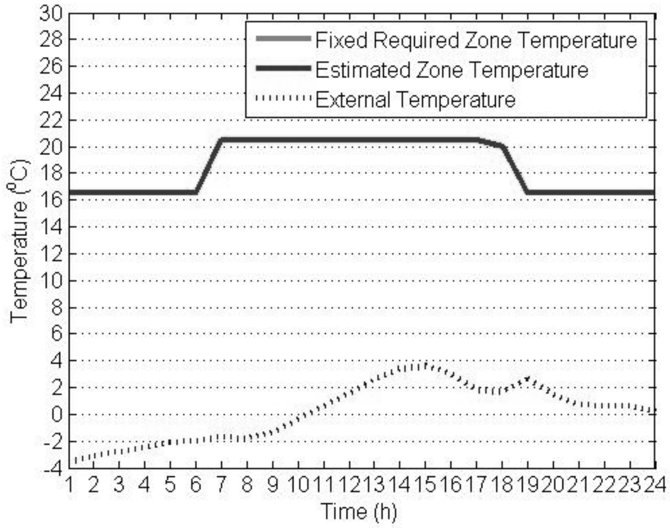


Figure 3. Mean-Temperature Operations

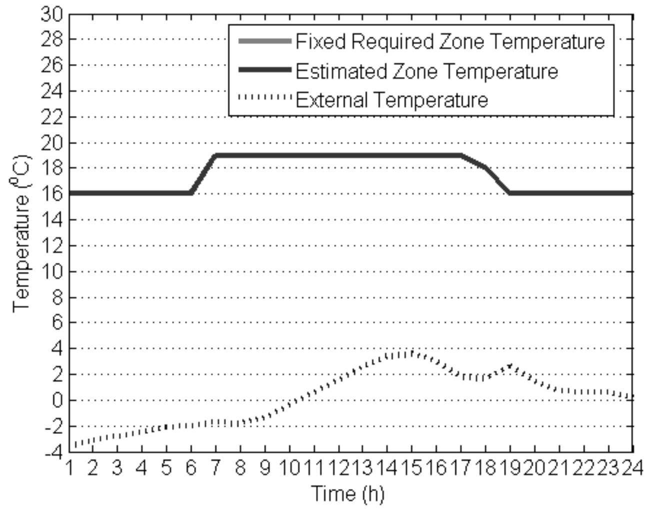


Figure 4. Lower-Temperature Operations

Next Steps

The EU's "20-20-20" targets will require not only improvements in supply-side technologies but also reductions in energy consumption. Market-based incentives for consumers, e.g., real-time pricing, along with better decision support may deliver such savings without sacrificing comfort. The EnRiMa operational module illustrates how optimisation may be combined with lower-level details about building physics and equipment thermodynamics to enable set points for conventional radiators and HVAC systems to respond to anticipated environmental conditions. We find that 10% savings in energy consumption are possible even with flat tariffs relative to static temperature set points. Additional policy insights about the benefits of real-time pricing could be obtained by running such a module under stochastic prices.

For future work, validation of the energy-balance equations at a laboratory facility will prepare the DSS for implementation at the two test sites. Ultimately, the objective of the EnRiMa project is not only to demonstrate that energy savings are possible at the building level but also to integrate the DSS with the buildings' ICT systems in order to verify via audits the extent of the savings. Indeed, in order for this research to contribute to the "20-20-20" targets, a business model based on services provided by a DSS will have to be developed. Quantifiable savings at real buildings of public use could, thus, be the first tangible step in this direction.

At a strategic level, the DSS could also provide insights about equipment retrofits while taking uncertainty in prices and demand into account. Higher investment costs

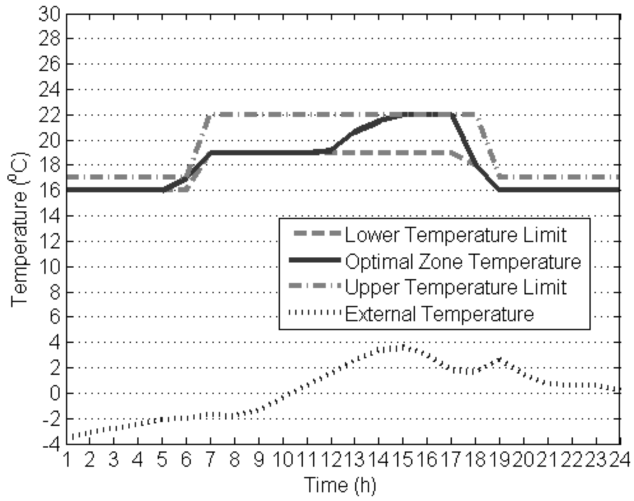


Figure 5. Optimal Operations

for more efficient technologies may deter building managers from purchasing such equipment if they cannot evaluate their operations adequately. The strategic module would enable building managers to assess the trade-off between the costs of investing in equipment and the costs of running it efficiently. Moreover, an optimisation-based DSS would help building managers to find a customised portfolio of diverse technologies and measures complementing each other during day-to-day operations. Taking into account uncertainty, the strategic module of the DSS will ensure that such a portfolio of technologies and equipment is not adapted to optimal conditions but will perform well (if not optimally) in a variety of situations. Finally, similar to the operational module, the strategic module could be used for policy analysis, e.g., in setting CO_2 prices or building codes, to obtain long-term efficiency improvements.

References

EU (2008), *Energy Efficiency: Delivering the 20% Target*, COM(2008) 772 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0772:FIN:EN:PDF).

EU (2009), *Directive 2009/28/EC of the European Parliament and of the Council* (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF).

EU (2011), *Position (EU) No 10/2011 of the Council at First Reading* (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:123E:FULL:EN:PDF).

Hobbs, B.F. (1995), "Optimization Methods for Electric Utility Resource Planning," *European Journal of Operational Research* 83(1):1-20.

King, D.E. and M.G. Morgan (2007), "Customer-focused Assessment of Electric Power Microgrids," *Journal of Energy Engineering* 133(3): 150-164.

Liang, Y., D. Levine, and Z.-J. Shen (2012), "Thermostats for the SmartGrid: Models, Benchmarks, and Insights," *The Energy Journal* 33(4): 61-95.

Marnay, C., G. Venkataramanan, M. Stadler, A.S. Siddiqui, R. Firestone, and B. Chandran (2008), "Optimal Technology Selection and Operation of Commercial-Building Microgrids," *IEEE Transactions on Power Systems* 23(3): 975–982.

Wilson, R.B. (2002), "Architecture of Power Markets," *Econometrica* 70(4): 1299-1340.

The Potential Impact of Declining Rates and Increasing Efficiency in Texas

By Julia Harvey*

Peak energy demand consumption in ERCOT is projected to exceed generation resources by 2015. In light of resource adequacy concerns within the region, potential drivers of the growing load segment represented by residential electricity consumption should be evaluated and integrated into load forecasting efforts. Residential cooling is one of several major contributors to ERCOT peak load, increasing to over 50% of total peak during the hottest summer conditions. Thus this end-use presents a prime target for efficiency analysis, and its use should be assessed in light of policies that motivate customers to conserve during peak periods.

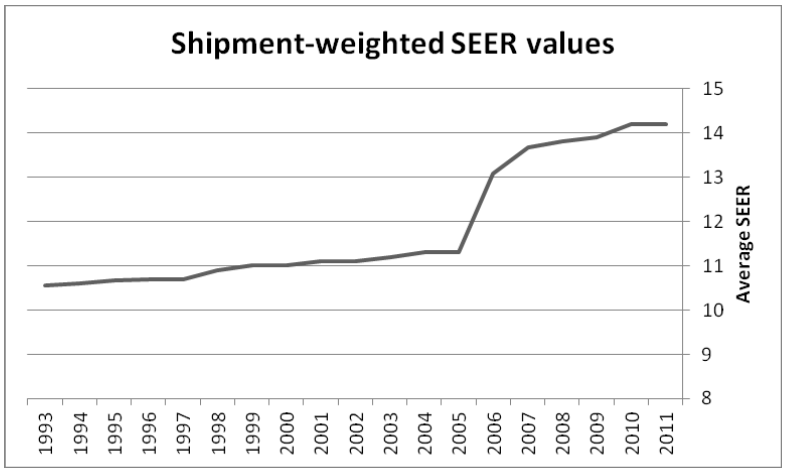
This article examines how the reciprocal trend of declining retail rates in Texas and increasing appliance efficiency standards, particularly those associated with Central Air Conditioning (CAC) units, may hypothetically impact residential consumption by producing a wealth effect in which an increase in perceived wealth is accompanied by an increase in spending. This argument centers on the hypothesis that the reduction of electric rates seen over the past three years and higher average seasonal efficiency ratings, as measured by Seasonal Energy Efficiency Ratio (SEER), may together produce a rise in consumption. The wealth effect of a decrease in electricity prices will induce lower thermostat settings which will overwhelm the reduction in consumption resulting from increasing CAC efficiency standards, leading to a net increase in energy consumption. As shown in this analysis, increasing CAC SEER ratings may in fact be compounding this trend.

Retail rates in the deregulated ERCOT market in Texas have declined 18% since 2006.[1] This trend is counter to that shown by national residential electricity prices, which have increased approximately 25% since 2005.[2] According to price theory, a change in retail rates will have an implied demand elasticity associated with it, in that customers will adjust to changes in price by adjusting their consumption of electricity. Extensive research has been conducted in an attempt to estimate long-run price elasticity, which is a normalized measure of how the usage of electricity changes when its price changes by one percent. The adjacent table includes the long-run residential price elasticities estimated in the literature.

Reference	*Residential Long-Run Price Elasticity*
EIA Model (2003)[3]	-0.49
Dahl and Roman (2004)[4]	-0.43
Bernstein and Griffin (2005)[5]	-0.32
Itron Brown Bag Seminar (2006)[6]	-0.21
National Institute of Economic and Industry Research (2007)[7]	-0.25
Paul, Myers and Palmer (2009)[8]	-0.40
Shu and Hyndman (2010)[9]	-0.42

Range of Residential Long-Run Elasticity Estimates

As retail rates have fallen in ERCOT, a negative elasticity value would indicate a proportionate increase in consumption. Average retail electric rates for customers in August of 2006 were \$0.126/kWh, decreasing to \$0.105/kWh by August of 2011.[10] The expected increase in consumption due to lower prices may be partly offset by increased SEER standards in place for CAC systems. An average SEER value for each age range was determined using historical Air Conditioning, Heating, and Refrigeration Institute (AHRI) shipment-weighted data, given the age distribution reported by customers in Texas in the Residential Energy Consumption Surveys (RECS) conducted by the U.S. Energy Information Administration. The distribution of reported CAC age released in the most current RECS report is assumed to be consistent for other years of the analysis. The average SEER value is a weighted average of these AHRI average SEER values. Although the AHRI data is based on national sales data and not on regional or market-specific information, the national data should be reasonably close to the averages for the majority of CAC owners in Texas. The change in SEER rating over time can be seen in the first figure on the next page.



While greater SEER values should theoretically reduce kWh usage, the SEER standard increase actually compounds the price reduction and thus consumption increase induced by lower rates. Assuming the only cost driver is the price de-

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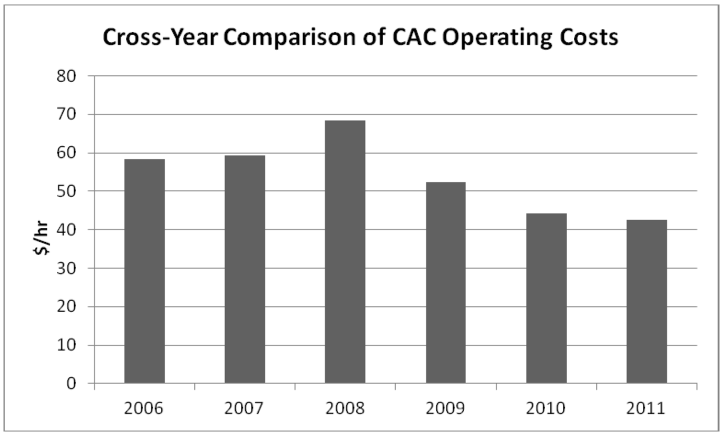
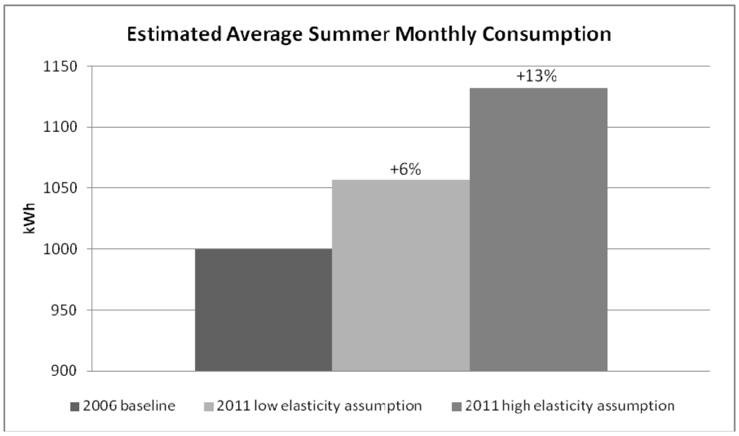
See footnotes at end of text.

crease and SEER increase from August 2006 to August 2011, the operating cost per hour drops by almost 30%. The decrease in CAC operating costs will likely continue as SEER averages increase. This trend is shown in the figure at mid-page.



A cost reduction in CAC operation due to increasing SEER and decreasing retail rates is not an undesirable thing in itself. Low electricity bills allow consumers to maintain safe temperatures in their homes during extreme summer weather conditions. However, greater average unit efficiency may encourage customers to reduce thermostat settings in the interest of comfort and may promote behavioral inertia as it relates to conservation. Applying the highest and lowest elasticity values seen in the literature (-0.21 and -0.49) to a hypothetical single family dwelling summer monthly consumption of 1,000 kWh (and ignoring the impact of any other independent variables), we can estimate the potential increase in consumption over time due to reductions in the estimated operating cost. Consumption projections are estimated by calculating the impact of price elasticity on the percentage change seen in CAC operating costs, incited by decreases in retail rates and increases in average SEER. This produces the following potential average monthly electricity usage increases, wherein greater kWh consumption produces similar electric bills.



Although reduction in retail rates may produce an increase in consumption, it is worth noting that the combined effect of lower prices and reduced electrical needs for air conditioning might permit Texans to spend the dollar savings on things other than electricity. However, these other expenditures may also be likely to eventually lead to higher energy consumption. Indeed, according to the 2009 EIA RECS report, the residential per square foot energy consumption in Texas increased 17% from 2005 to 2009.

While additional research is needed to assess the contribution of price, SEER, and other exogenous variables to changes in per capita energy use and demand, this basic analysis points to a wealth effect that may be driving residential cooling load in ERCOT. Along with greater penetration of more efficient appliances and home weatherization upgrades, policies, programs, and enabling technologies could help support residential conservation rather than consumption during critical peak periods. Policies that facilitate dynamic pricing, real-time electricity monitoring, direct load control and other load management initiatives may help offset the resource insufficiencies driven by residential cooling load.

Footnotes

[1] Rate data based on an average of all rates offered by Retail Electric Providers in Texas, and 1000 kWh per month usage, Public Utility Commission of Texas, Competitive Markets Division, Retail Electric Service Rate Comparisons, http://www.puc.state.tx.us/industry/electric/rates/RESrate/RESratearc.aspx

[2] Energy Information Administration, Average Retail Price of Electricity to Ultimate Customers: Total by End-Use Sector, 2002-July 2012.

[3] Energy Information Administration, calculated from the following price path scenarios using NEMSAEO2003: AEO99: S.H. Wade, "Price Responsiveness in the NEMS Building Sector Models," in Energy Information Administration, Issues in Midterm Analysis and Forecasting 1999, DOE/EIA-0607(99) 1999.

[4] Dahl, C., and C. Roman. 2004. Energy Demand Elasticities – Fact or Fiction: A Survey Update. Unpublished manuscript.

[5] Bernstein, M.A., and J. Griffin. 2005. Regional Differences in Price-Elasticity of Demand for Energy. The Rand Corporation Technical Report.

[6] Itron. "Accounting for Price in Your Forecast – Measures and Metholodologies," Brown Bag Seminar. 2006.

[7] National Institute of Economic and Industry Research. 2007, The Own Price Elasticity of Demand for Elec-

tricity in NEM Regions. Tech. rep., National Electricity Market Management Company.

[8] Paul, Anthony, Erica Myers and Karen Palmer. 2009. A Partial Adjustment Model of U.S. Electricity Demand by Region, Season, and Sector. Resources for the Future Discussion Paper.

[9] Fan, Shu and Rob Hyndman. 2010. The Price Elasticity of Electricity Demand in Southern Australia. Department of Economics, Monash University.

[10] Rate data based on an average of retail rates offered assuming 1000 kWh per month usage, Public Utility Commission of Texas, Competitive Markets Division, Retail Electric Service Rate Comparisons, http://www.puc.state.tx.us/industry/electric/rates/RESrate/RESratearc.aspx

IAEE/Affiliate Master Calendar of Events

(Note: All conferences are presented in English unless otherwise noted)

Date	Event, Event Title and Language	Location	Supporting Organization(s)	Contact
2013				
April 22-23	6th NAEE/IAEE International Conference *Energy Resource Management in a Federal System: Challenges, Constraints & Strategies*	Lagos, Nigeria	NAEE/IAEE	Adeola Adenikinju adeolaadenikinju@yahoo.com
June 16-20	36th IAEE International Conference *Energy Transition and Policy Challenges*	Daegu, Korea	KRAE/IAEE	Hoesung Lee hoesung@unitel.co.kr
July 28-31	32nd USAEE/IAEE North American Conference *Industry Meets Government: Impact on Energy Use & Development*	Anchorage, Alaska	USAEE/IAEE	USAEE Headquarters usaee@usaee.org
August 18-21	13th IAEE European Conference *Energy Economics of Phasing Out Carbon and Uranium*	Dusseldorf, Germany	GEE/IAEE	Georg Erdmann georg.erdmann@tu-berlin.de
2014				
June 15-18	37th IAEE International Conference *Energy and the Economy*	New York City, USA	USAEE/IAEE	USAEE Headquarters usaee@usaee.org
September 19-21	4th IAEE Asian Conference *Economic Growth and Energy Security: Competition and Cooperation*	Beijing, China	CAS/IAEE	Ying Fan yfan@casipm.ac.cn
2015				
May 24-27	38th IAEE International Conference *Energy Security, Technology and Sustainability Challenges Across the Globe*	Antalya, Turkey	TRAEE/IAEE	Gurkan Kumbaroglu gurkank@boun.edu.tr

32ND USAEE/IAEE NORTH AMERICAN CONFERENCE · JULY 28-31, 2013 · ANCHORAGE, AK · HOTEL CAPTAIN COOK

"To keep on doing business, the modern company still needs a franchise from society, and the terms of that franchise still matter enormously."
– John Micklethwait and Adrian Wooldridge, *The Company: A Short History of a Revolutionary Idea**

CONFERENCE OVERVIEW

As the global economy follows a precarious path to full recovery, the challenge of meeting growing energy needs in an increasingly volatile world with finite resources becomes ever more urgent. All parties—from governments and non-governmental organizations to energy producers and consumers—have a stake in fostering smarter energy development and use that minimizes adverse environment effects and consumer costs. The 32nd USAEE/IAEE North American Conference will address the issues, challenges, and opportunities of industry-government relations as the stakeholders strive to meet their respective goals for commerce and society.

Although private industry carries out most energy development, governments—charged with reflecting the broad spectrum of society's values—create the context in which development occurs. Consequently, the relationship between industry and government is central to the question of how to promote energy development and use that is efficient and environmentally sound. Countries, states, provinces, and communities around the world seek to unlock their energy resource potential, encourage new technologies, and assure equitable distribution of benefits. Industry holds the necessary technical expertise and experience. Industry-government relations will be crucial in determining where and how the world's energy resources are developed, and which products are brought to market at what price. That evolving relationship will influence everything from fiscal systems and consumer costs to climate change and environmental health.

Alaska is an appropriate setting for a conference addressing the issues, challenges, and opportunities of industry-government relations in energy use and development. As one of North America's great energy producing regions, Alaska has a long history of dynamic industry-government relations. Alaska's role in satisfying energy demand features prominently in energy policy debates both nationally and internationally. The conference will bring together energy researchers and practitioners to explore these themes through a series of plenary sessions, concurrent sessions, and a poster session. The conference will also provide networking opportunities through informal receptions, breaks between sessions, public outreach, and student recruitment. A selection of offsite tours will be offered to highlight Alaska's uniquely beautiful environment as well as the state's role in the North American energy supply chain.

TOPICS TO BE ADDRESSED INCLUDE:

Unconventional and Frontier Oil and Gas Development

- Oil and Gas Shale Development: Hydraulic Fracturing
- Heavy Oil and Oil Sands
- Arctic Opportunities and Challenges
- Oil Spill Prevention, Response, and Contingency
- Regulation of Offshore Development
- Ice-Breaking Tanker Technology

Petroleum Fiscal Regimes

- Oil and Gas Taxation and Investment Risk
- Balancing Government Take with International Competitiveness
- Fiscal Federalism and Revenue Sharing
- Petroleum Wealth Management

Natural Gas Supply and Demand

- Global, National, and Regional Gas Supply and Demand
- LNG Projects, Trade and Shipping
- Evolution of a Global Natural Gas Market

Global Petroleum Security and Prices

- OPEC Policies and Political Instabilities
- Strategic Oil Storage Policies
- Changing World Energy Supply/Demand Balance

Renewable Energy: Markets, Drivers, Economic Viability

- Renewable Portfolio Standards (RPS) and Market Penetration
- Economic and Environmental Assessment of Large Hydroelectric Projects
- Financing Renewable and Alternative Energy
- Trends in Wind and Solar Electric Generation
- Development of Geothermal, Tidal and Wave Resources

Electricity Generation and Distribution

- Electricity Pricing, Fuel Pricing and Policy
- Innovation in Distributed Generation and Storage
- Smart Metering and Smart Pricing
- Post-Fukushima Future of Nuclear Power
- Technology and Regulation for Isolated Electricity Systems

Climate Change and Environmental Issues

- Effects of Voluntary and Unilateral Mitigation Programs
- Impact of Drought on Hydroelectric Generation
- Emission Standards and Coal

Natural Gas – Bridge Fuel to More Natural Gas?

- Shale Gas Revolution and Water Issues
- LNG Trade
- Global Gas Contracts vs. Spot Market Trading
- Role of Gas in Meeting Renewable Portfolio Standard or CO_2 Emission Standards

Energy Efficiency

- Building Controls and Cost Allocation
- Energy Efficiency Rules for Government Sponsored Home Loans
- Motor Vehicle Efficiency Standards
- Energy Efficiency in Fishing, Forestry, and Ecotourism

Alternative Transportation Fuels and Vehicles

- Natural Gas Fuel (CNG & LPG)
- Ethanol and Biodiesel
- Electric and Hybrid Vehicles

Energy and the Economy

- Transmission Infrastructure for Distributed Electric Generation
- Economic Impact/Forecasting Models

Energy and Economic Development

- Energy Sustainability and Economic Growth
- Environmental Regulation in Developing Countries
- New Energy Technologies to Reduce Wealth Disparities
- Aluminum Smelting and Energy-Intensive Industries
- Access to Energy

Role of Government: Issues in Energy Regulation and Uncertainties

- Incentive Mechanisms, Subsidies
- Financial Regulations and their Impacts on Energy Trading
- Regulation of Pricing of Carbon Emissions: Impact on Energy Markets
- Environmental Regulation and Permitting
- Public Utility Price Regulation with Limited Buyers and Sellers

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32ND USAEE/IAEE NORTH AMERICAN CONFERENCE

PLENARY SESSIONS & SPEAKERS

The 32nd USAEE/IAEE North American Conference will attract noteworthy energy professionals who will address a wide variety of energy topics. Plenary sessions will include the following:

- Energy Development in the Arctic
- A Short History of the Development of the Oil Industry in Alaska
- Natural Gas Markets
- Isolated Dedicated Power Grids: Making Them Work
- Unconventional Oil and Gas Development
- Managing Resource Wealth
- Developments in Electricity Generation and Distribution
- Arctic Transport: Technology and Opportunities
- The Interconnection Between Industry and Government
- 2013 BP Statistical Review of World Energy
- Petroleum Fiscal Regimes
- Industrial Energy Use and Efficiency

SPEAKERS INCLUDE:

Irena Agalliu
Managing Director, IHS CERA

Leah Cuyno
Senior Economist, Northern Economics, Inc.

Mark J. Finley
General Manager, Global Energy Markets and U.S. Economics, BP

Matthew Foss
Executive Director, Economics and Markets Energy, Alberta Department of Energy

William Furlow
Senior Manger Business Development and Planning, Society of Petroleum Engineers

Roland R. George
Board Member, National Energy Board

Scott Goldsmith
Professor Emeritus, Economics, University of Alaska Anchorage

Bill Harris
Sr. Petroleum Engineer, Wagner & Brown, Ltd.

Marianne Kah
Chief Economist, ConocoPhillips

Skip A. Laitner
Principal and Independent Consultant, Economic and Human Dimensions Research Associates

Roger Marks
Principal, Roger Marks & Associates

Karen Matthias
Managing Consultant, Council of Alaska Producers

Kenneth B. Medlock III
Fellow in Energy & Research Economics, Rice University

David Newbery
Professor Faculty of Economics, University of Cambridge

Larry Persily
Federal Coordinator, Alaska Natural Gas Transportation Projects

Surjay Rajan
Director, Upstream Research & Global Gas, IHS CERA

Douglas B. Reynolds
Professor of Economics, University of Alaska Fairbanks

John R. 'Jack' Roderick
Author, *Crude Dreams: A Personal History of Oil and Politics in Alaska*

Benjamin Schlesinger
President, Benjamin Schlesinger & Associates LLC

Ethan Schutt
Senior Vice President for Land and Energy, Cook Inlet Regional, Inc.

Nick Szymoniak
Project Economist, Alaska Natural Gas Transportation Project

Branko Terzic
Executive Director, Deloitte Center for Energy Solutions

Frances Ann 'Fran' Ulmer
Chair, U.S. Arctic Research Commission

TRAVEL DOCUMENTS

All international delegates to the 32nd USAEE/IAEE North American Conference are urged to contact their respective consulate, embassy or travel agent regarding the necessity of obtaining a visa for entry into the U.S. If you need a letter of invitation to attend the conference, contact USAEE with an email request to usaee@usaee.org. The Conference strongly suggests that you allow plenty of time for processing these documents.

VISIT OUR CONFERENCE WEBSITE AT: WWW.USAEE.ORG/USAEE2013/

Anthony J. Finizza

April 1, 1943-December 6, 2012

I first met Tony Finizza in the spring of 1979 when I interviewed with Atlantic Richfield in Los Angeles. I still can see him sitting across his desk from me on the 40th floor of the ARCO Tower, asking thoughtful questions, with a wry sense of humor. A couple of months later I joined ARCO, and Tony and I quickly became close colleagues and good friends. We remained that way even after he eventually became my boss, and after we each left ARCO.

We also became partners in crime--well actually, in crime fiction. We both were great fans, and over the years we delighted in uncovering good writers we hadn't read to share with each other at birthdays and Christmases. We even took a couple of fiction writing courses together at USC. Over time, our crime fiction sharing expanded to include books about historical and future economic and financial developments, which helped feed our professional interests. And there were other books, too. For example, when ARCO transferred me to Dallas in 1982, Tony gave me a me a set of books on "How to Talk Texan," so I could communicate to folks there about what I was "fixin" to do, and to folks there outside of ARCO, that I was in the "awl bidness."

Tony was a great fan of data, so of course he kept track of all the books he read and movies he saw by year—a habit of his I quickly picked up. We used to compare numbers at the end of each year, and not surprisingly, his numbers were always larger than mine.

Tony also was a blue blood—Dodger blue, of course. He was a long time Dodger fan and, if I remember correctly, saw Sandy Koufax's perfect game against the Cubs in 1965 at Dodger stadium. Tony took me to my first Dodger game and then signed me up as well. (I think the first time I met Carol, his wonderful wife to be, they were sitting behind home plate at a Dodger game.) When he eventually moved to Orange County, he adopted the Angels, too, though the Dodgers were his first baseball love. And of course, he kept track of the scores and winning pitchers for the games he attended—another habit of his I picked up—and at season's end we compared our won-loss records. Naturally, I usually came in second.

Professionally, Tony was a first-rate economist and strategic thinker. (His auto license plate for many years was "MV=PT", the quantity theory of money.) He received a B.A. in mathematics and M.A. in finance from UC Berkeley, and a Ph.D. in economics from the University of Chicago, writing his Ph.D. dissertation on demand estimation under Henri Theil. After brief stints at Northern Trust and Data Resources, Inc., he joined ARCO and quickly rose through the ranks to serve as Chief Economist for most of his career there. At the same time, from the early days, he was very active in the IAEE and the USAEE, and successfully served as the first USAEE President (1992-93) and then IAEE President (1996).

As ARCO's Chief Economist he led development of the annual long-range plan political, economic, technology and energy assumptions, including oil and gas price forecasts, and the supporting studies and analyses. He reported to corporate executive leadership and was a sought after and trusted advisor. And he always kept his sense of humor. As he used to tell me, "give 'em a price or give 'em a year, but never give 'em both." But of course he had to anyway.

After leaving ARCO Tony taught at UC Irvine and was a very successful independent consultant, as well as a senior economist with EconOne. And in 2005 he published a book on Life's Economic Wisdom, which he dedicated to his "wife Carol, who inspired it and to [their family] Michele, Michael & Eric, Patrick, Kelly & Billy who I hope will benefit from it."

Tony made a difference in the lives of many, and he very much will be missed.

I reached out to some of Tony's good friends and colleagues in our USAEE/IAEE family to help honor him, and I'd like to thank them for their thoughts. These folks included Guy Caruso, Kathy Cooper, Carol Dahl, Dave DeAngelo, Les Deman, Tilak Doshi, Ted Eck, Fereidun Fesharaki, Michele Foss, Hill Huntington, Fred Joutz, Marianne Kah, David Knapp, Peter Jaquette, Jim Ragland, Jim Sweeney, Phil Verleger and Dave Williams. With apologies for my light editing and selections, these are provided on the following page.

Arnie Baker

Remembrances of Tony Finizza

Tony was a man of substance who understood energy economics well both from a corporate and academic viewpoint. He also was a man who didn't take issues to extreme and wasn't hung up on theories and concepts. He had a relaxed view of life and our discipline. He often cautioned me not to get carried away and helped me to think of the world of energy economics from a perspective of real life and practicalities, rather than just hard methodology and theories. He enjoyed the work because he enjoyed life and he had an excellent attitude. He saw humor in everything and was able to look on the lighter side of the issues. He was an anchor in our world of energy economics and IAEE.

Tony was in the vanguard of petroleum and energy economics in the 1970s and 80s. Whenever I heard Tony speak at conferences or talked with him one on one, I always came away with the feeling that this was someone I wanted to emulate. The energy economics profession owes him a lot.

I'm certain Tony had no enemies or even acquaintances who didn't realize how special he was. He never had an angry thought or word. He was a very sound economist whom we all listened to carefully. I saw him last at his Dana Point home. He was very happy there and never complained about the cards he had been drawn. I will miss him.

My all time favorite memory of Tony was the incredibly funny, pointed lunch talk ("Why Were We Wrong?") he gave at the Houston Conference along with Adam Sieminski and Jim Smith. That was an all time best. I told him many times after that he missed an outstanding career in comedy or, at least, after dinner speechmaking! And he told me once that he had actually harbored ambitions of being a humorist. I've never heard anyone come even close to beating that, and I've heard lots of good things in my life.

I thought of Tony as a warm, wonderful, loyal, and very smart colleague. I wish I had seen him over the past few years; I just didn't realize that he was fighting such a battle.

Tony was always fun to be around. His great sense of humor turned every occasion into laughter at some point--even the most serious energy economics issue. He will be sorely missed. We were lucky to have him as a friend and colleague.

I remember talking with Tony in the early 1990s and getting good advice on some modeling project while he was ARCO's chief economist. I appreciated his taking the time while being an IAEE/USAEE pooh bah as well. This is probably one of the reasons I decided to stay in the organization--because of the conversations with analytical people in the markets who would help me understand how to make econometric models more realistic.

I first met Tony in 1971 when he was working for Data Resources Inc. in Chicago, Illinois. His office consisted of a desk and a massive rack of electronic gear that connected DRI clients in Chicago to the computer in Lexington, Massachusetts. He had to be a Houdini to keep the temperamental computers working while doing his job. Through it all he kept his sense of humor.

In the winter of 1995, as an ARCO new hire and newly arrived foreigner in California on an H1B visa, having Tony as my boss was the best thing I could have had. He not only guided my work with a light, sure touch of pragmatic advice when needed, but he also leavened the work environment with a dry wit and charm that was an essential part of his character. For me, in the first throes of discovering work and life in America, Tony represented the best of America. He combined an old world charm, ferocious humor, an insatiable curiosity (in particular about all things oil and energy), and above all, an enduring sense of decency and gentle manners.

Many of us have benefited from working with Tony as an energy professional. I enjoyed my experiences as a client of DRI, a co-sponsor of various Energy Modeling Forum studies and as a council member of IAEE and USAEE, both for which Tony served as President. For the latter, I'd add that Tony's leadership and organizational skills contributed greatly to the respective organization's professional success.

Tony's character had an extra unique dimension—a sort of spontaneity, out-of-the box thinking, expect the unexpected, zest for life, and perhaps just zany—much like a character out of an S. J. Perelman New Yorker short story. As one example, Tony and I were part of a small group of energy professionals (mostly IAEE members) invited to Moscow around 1990 to exchange ideas with our Soviet energy peers. We'd been advised to bring American cigarettes for purchasing Soviet products. Tony took on and relished his role as our group's chief arbiter, going the extra mile to secure many items for us. The most memorable were model replicas of the then 'stylish' Soviet Zil limousine, which looked like large, boxy, black Checker Taxi cabs. Tony pursued their purchase throughout our trip and over most of Moscow. I still have my Zil and my fond memories of Tony.

Some of Tony's many IAEE friends

Energy Efficiency of the Polish Economy

By Rafał Kasperowicz*

Introduction

The energy transformation in Poland has been in progress since the beginning of the 1990s. It was triggered by the restructuring of the Polish economy as a result of liberalization. As Poland entered an era in which resource depletion and environmental protection became major socio-economic issues, the structure of the power industry has changed radically. The traditional, rigid approach – according to which, only the existence of a strong monopoly could guarantee the proper operation of the energy industry – had failed, and the market was increasingly liberalized. Energy efficiency has become one of the key factors determining the country's economic development. This issue is present in all aspects of business life, from sectoral approaches to households.

In Poland, there is still a high potential for energy saving, which may be achieved through the application of significantly lower resources as was the case in more developed countries. We must not let pass this opportunity and we have to undertake relevant and effective action in the sphere of energy-saving policy.

The aim of this article is to show the changes in energy efficiency of the Polish economy and to answer the question whether Polish economic growth has been energy efficient.

Energy Consumption and Polish Growth

The problem that was formulated in the introduction may be addressed from two perspectives:

- Firstly, is the need to study changes in energy consumption by industry over time and compare them to changes in GDP – This will allow us to establish the energy-intensiveness of economic growth in Poland;
- Secondly, the above results may be compared with other, more developed economies – in order to identify the potential for futher development of energy efficiency in the Polish economy.

Year	Growth Rates GDP	PEC	EEC	Energy Efficiency Index PEC/GDP
1995	100.00	100.00	100.00	0.91
1996	106.27	103.65	103.00	0.88
1997	113.84	102.20	102.73	0.81
1998	119.48	95.60	102.73	0.72
1999	124.87	93.34	102.25	0.68
2000	130.21	88.76	104.45	0.62
2001	131.72	89.93	104.76	0.62
2002	133.67	88.98	103.69	0.60
2003	138.87	90.88	109.09	0.59
2004	146.24	90.87	110.90	0.56
2005	151.53	91.94	112.90	0.55
2006	160.96	96.39	116.36	0.54
2007	171.94	95.90	114.63	0.50
2008	180.72	97.64	111.73	0.49
2009	183.61	94.21	109.15	0.46
2010	190.70	100.67	113.42	0.48

Table 1. Estimated Selected Variables for the Polish conomy.

In order to accomplish the above, selected economic variables obtained from the Eurostat database for the period from 1995 to 2010 were analyzed. The gross domestic product, published in millions of euro, was put in constant terms using the Eurostat price index (based on 2005=100). The energy variables included were primary energy consumption in TOE (PEC) and electrical energy consumption in TOE (EEC). All data were rebased to 1995=100.

Table 1 and Figure 1 present this data along with a calculation of the energy efficiency index.

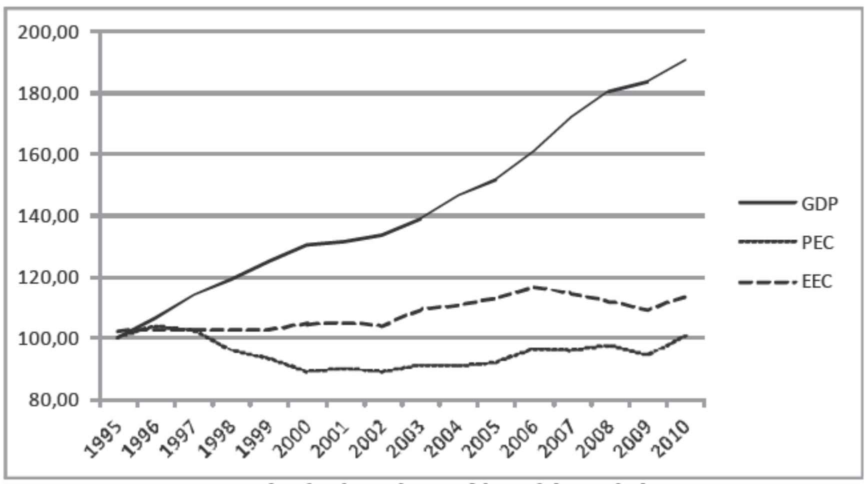

Figure 1. Growth of Selected Variables of the Polish Economy

From the table and figures we conclude that:

- Over the 16 year period, Poland's real GDP increase about 91%.
- During this period Poland's consumption of primary energy first declined, then stablized and finally rose so that in the end it was essentially unchanged.

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- The trend of electricity consumption was basically upward for the period under study; in the end, showing growth of almost 13.5% for the period.

The facts presented above indicate that economic growth in Poland has been energy efficient. In general, Poland's GDP doubled without an increase in the amount of energy used. This is confirmed by the energy efficiency index which fell from 0.91 to 0.48 in the period under study. Thus, the consumption of electricity in the production of a unit of GDP fell over the sixteen years, resulting in half as much energy being needed at the end as was required at the beginning.

	Growth Rates						Energy Efficiency Index		
	GDP U15	GDP U27	PEC U15	PEC U27	EEC U15	EEC U27	Poland	U15	U27
1995	100.00	100.00	100.00	100.00	100.00	100.00	0.91	0.19	0.22
1996	101.74	101.85	104.01	103.77	103.75	103.69	0.88	0.19	0.23
1997	104.51	104.66	102.86	102.39	104.48	104.14	0.81	0.19	0.22
1998	107.55	107.76	104.77	103.10	107.13	106.49	0.72	0.19	0.21
1999	110.72	111.00	105.02	102.44	108.90	107.61	0.68	0.18	0.20
2000	115.00	115.34	106.17	103.15	111.85	110.65	0.62	0.18	0.20
2001	117.41	117.78	108.80	105.78	114.78	113.63	0.62	0.18	0.20
2002	118.79	119.35	108.31	105.46	115.71	114.55	0.60	0.17	0.20
2003	120.33	121.14	110.78	107.99	118.88	117.77	0.59	0.18	0.20
2004	123.18	124.18	112.36	109.20	121.59	120.27	0.56	0.17	0.19
2005	125.49	126.72	112.32	109.30	122.33	121.09	0.55	0.17	0.19
2006	129.37	130.91	112.03	109.51	123.84	122.71	0.54	0.16	0.19
2007	133.34	135.15	110.46	108.13	124.27	123.17	0.50	0.16	0.18
2008	133.39	135.61	110.18	107.96	124.54	123.31	0.49	0.16	0.18
2009	127.55	129.74	104.71	102.36	118.47	117.38	0.46	0.16	0.17
2010	130.15	132.48	107.82	105.61	123.70	122.37	0.48	0.16	0.18

Table 2. Selected Variables for EU Economies

As far as electricity is concerned, despite the increasing use of energy-saving technologies in industrial enterprises and households, the demand for electricity is steadily growing.Therefore, it is appropriate to say that more and more primary energy is being used for electricity purposes. Electricity consumption has a long-term upward tendency, but the growth rate is significantly lower than the growth rate of GDP. This is the result of the use of more and more energy efficient appliances in industrial enterpises and households.

Table 2 along with Figure 2 provide data to compare Poland's energy performance with that of the 15 original EU counitires (U15) as well as the current 27 countries (U27).

The table and figure show the energy efficiency of the Polish economy in a slightly different light. Study of the table diagram shows:

- Poland has enjoyed much stronger GDP growth than either of the two EU groupings—near 91% vs percents in the low thirties
- At the same time Poland's primary energy consumption has been significantly less—not growing all vs six to eight percent for the EU as a whole.
- However, energy efficiency is still behind that of the Union—48% compared with 16 to 18%. But, while Poland's efficiency is behind the Union the trend is notably encouraging.

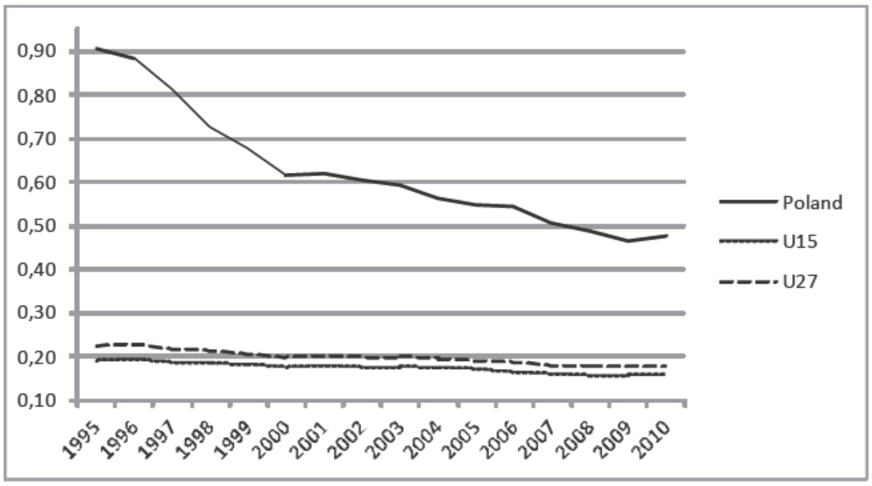

Figure 2. Energy Efficiency (PCT/GDP)

Conclusions

The analysis shows that economic growth in Poland is energy efficient. However, the energy efficiency of Poland's economy compared with the EU developed economies is at a relatively low level. What is a positive phenomenon is that the production of a unit of GDP requires less and less energy, which shows the right direction for future development. The relatively lagging level of energy efficiency indicates that in Poland there is a high potential for speeding up economic growth by implementing action connected with the increase of effective energy use. The actions aimed at increasing energy efficiency should be undertaken in all sectors and spheres of activity. They should include not only the increase of energy efficiency in the area of production, but also the use of energy in other fields (e.g., the household sector or city transport).

Transaction Costs of Energy Efficiency in Buildings – An Overview

By Bernadett Kiss and Luis Mundaca*

Transaction costs (TCs) are costs not directly involved in the production of goods or services, but unavoidable and often unforeseeable costs that emerge from contracting activities that are essential for the trade of such goods and services (Coase, 1960). In the field of technology change, TCs are often referred to as unmeasured costs that prevent the adoption of new technologies. TCs are often understood as costs occurring ex ante to the arrangement and implementation of technologies and ex post in relation to the monitoring and enforcement of contracts (Matthews, 1986). TCs can act as a critical market barrier by making new technologies seem more expensive than conventional ones. Transaction costs are surrounded by high conceptual and methodological complexity.

Energy efficient technologies in the building sector, which can be ostensibly hindered by TCs, are of high importance in terms of climate change mitigation. The building sector accounts for approximately 31% of global final energy use and 33% of energy-related CO_2 emissions (Ürge-Vorsatz, D., Eyre, N., Graham, P., Harvey, D., Hertwich, E., Jiang, Y., et al., 2012). There is, however, a huge potential to improve building energy performance and, consequently, reduce CO_2 emissions. In the EU, the full cost-effective energy saving potential of 27% by 2020 lies in the residential sector (EC, 2007)[1]. On a global scale, it is estimated that efficient technologies can deliver a 30% cost-effective GHG-emission reduction by 2020 (Levine, M., Ürge-Vorsatz, D., Blok, K., Geng, L., Harvey, D., Lang, S., et al., 2007). However, in order to tap this potential, TCs need to be better understood and ultimately reduced.

What is known about the nature (origin) and scale (order of magnitude) of TCs in energy efficiency projects?

When it comes to the *nature* of TCs, multiple sources have been identified. Transaction costs of implementing energy efficiency arise throughout the entire life-cycle of projects: in the planning, implementation and monitoring phase. TCs can be conceptually categorized as the cost of a) search for information (due diligence), b) negotiation, c) approval and certification, d) monitoring and verification and e) trading (Mundaca, Mansoz & Neij, 2011). TCs in the building sector mostly arise as a result of project formulation, search for partners and/or feasible technical and financial solutions, contract negotiations and monitoring the performance of the installed equipment (Kiss, 2012). These TCs can hinder the implementation of energy efficient technologies, for instance, preventing real estate developers from entering the energy efficiency market (Lee & Yik, 2002).

Regarding the *scale* of TCs, several studies have attempted to provide empirical estimates for the building sector. For instance, and as a proportion of investment costs, TCs for lightning technologies are estimated to be 10%, for improved cavity wall insulation 30%, and in the range of 20%-40% for energy efficiency measures carried out by ESCOs in the residential sector (Mundaca, 2007; EastonConsulting et al., 1999). In Sweden, TCs in the building sector are estimated to be 20% of the investment costs (Ürge-Vorsatz, D., Eyre, N., Graham, P., Harvey, D., Hertwich, E., Jiang, Y., et al., 2012). TCs are sometimes also expressed in monetary terms or work load (time) (Björkqvist & Wene, 1993). In any case, all estimates of TCs are subject to uncertainty amongst others due to the performance of the technology, accountability, reliability and accuracy of data sources and the methods of monitoring and quantifying TCs.

The source and the scale of TCs are influenced by a number of factors. There may be internal causes associated to the implementation and operation of energy efficient technologies. The project type and size, technology performance, monitoring activities, and the number of involved participants can determine the specific origins and corresponding scale. For instance, Lutzenhiser (1992) shows that the high number of participants involved in the choice of household technology increased the complexity of transactions and thus related unobserved costs. There can also be external circumstances associated to the implementation and operation of efficient technologies that can trigger the nature and order of magnitude of TCs. For example, contract type, availability and quality of information and resources, policy framework and the presence of trust among involved participants. Finally, methodological factors can also frame or drive the identification of TCs and resulting economic estimates. They are mostly related to conceptual choices, approaches used for quantifying TCs, attributability (who bears these costs), availability and quality of data, and data collection methods. Depending on the variety of factors determining TCs, one can argue that uncertainty is an intrinsic aspect of transaction cost analysis for efficient technologies in the building sector.

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See footnote at end of text.

The building sector, in specific, is a complex sector including multiple participants and multiple transactions resulting in very high TCs in itself. Implementing energy efficient technologies in this sector, further increases the already high and often not encountered TCs. Despite uncertainties, some strategies and policies have shown to have the potential to reduce TCs for improving energy efficiency in buildings. At the managerial level, for instance, procedure standardizing, full life-cycle cost accounting and learning via project bundling are worth exploring. These strategies can reduce costs of search for information and monitoring and verification. From a policy perspective, clear and simple legal frameworks promoting efficient technologies in the building sector can also be an option. This can include streamlined procedures for baseline settings and requirements for monitoring and verification, coupled with testing, extensive information provision and education of building professionals. Despite the academic debate, whether TCs are market failures or not and thus whether policy intervention is required to reduce them or not, there is a high-potential in public policy intervention to reduce TCs in the building sector.

Footnote

[1] Heating energy saving potential in case of high performance retrofitting is in the range of 70-92% (Ürge-Vorsatz, D., Eyre, N., Graham, P., Harvey, D., Hertwich, E., Jiang, Y., et al., 2012).

References

Björkqvist, O., & Wene, C. (1993). *A study of transaction costs for energy investments in the residential sector.* Paper presented at the 1993 Summer Study, Stockholm.

Coase, R. H. (1960). The Problem of Social Cost. *Journal of Law & Economics, 3*.

EastonConsulting. (1999). *Energy Service Companies. A Market Research Study* (No. 64): Prepared for Energy Center of Wisconsin:64.

EC. (2007). *2020 vision: Saving our energy*. Brussels: European Commission, Directorate-General for Energy and Transport.

Kiss, B. (2012). Exploring transaction costs in passive-house oriented retrofitting. International Institute for Industrial Environmental Economics at Lund University.(Unpublished manuscript)

Lee, W. L., & Yik, F. W. H. (2002). Regulatory and voluntary approaches for enhancing energy efficiencies of buildings in Hong Kong. *Applied Energy, 71*, 251-274.

Levine, M., Ürge-Vorsatz, D., Blok, K., Geng, L., Harvey, D., Lang, S., et al. (2007). Residential and commercial buildings. In B. Metz, O. R. Davidson, P. R. Bosch, R. Dave & L. A. Meyer (Eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Lutzenhiser, L. (1992). A cultural model of household energy consumption. *Energy, 17*(1), 47-60.

Matthews, R. C. O. (1986). The Economics of Institutions and the Sources of Growth. *The Economic Journal, 96*(384), 903-918.

Mundaca, L. (2007). Transaction costs of Tradable White Certificate schemes: The Energy Efficiency Commitment as a case study. *Energy Policy, 35*, 4340-4354.

Mundaca, L., & Neij, L. (2006). *Transaction Costs of Energy Efficiency Projects: A Review of Quantitative Estimations.* Report prepared under Work Package 3 of the EuroWhiteCert project.

Mundaca, L., Mansoz, M., & Neij, L. (2011). *Transaction costs of low-carbon technologies: A review of empirical studies*: Report for the DEC-Research Group, Environment and Energy Unit, The World Bank. Lund: International Institute for Industrial Environmental Economics at Lund University.

Sathaye, J., & Murtishaw, S. (2004). *Market Failures, Consumer Preferences, and Transaction Costs in Energy Efficiency Purchase Decisions*: International Energy Studies. Energy Analysis Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory.

Ürge-Vorsatz, D., Eyre, N., Graham, P., Harvey, D., Hertwich, E., Jiang, Y., et al. (2012). Chapter 10 - Energy End-Use: Building *Global Energy Assessment - Toward a Sustainable Future* (pp. 649-760). Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria: Cambridge University Press.

Energy Price Reform and Energy Efficiency in Iran

By Saeed Moshiri*

Introduction

Iran is an energy-rich country possessing 11 percent of global oil reserves and 15.3 percent of global natural gas reserves. Ranked 2nd among OPEC and with a potential for natural gas exports to Europe and Asia, Iran also plays a significant role in the world energy market and the global economy. However, Iran's rapidly growing own energy consumption (about 6 percent per year for the past 30 years) has raised concerns about the country's ability to continue to export oil in the next decade. The main driving forces behind the rising trend of energy consumption are economic growth (5 percent for the past 40 years) and population growth (about 2 percent), and heavily subsidized energy markets (12 percent of the GDP) (Iran Energy Balance, 2010; Central Bank of Iran Economic Indicators, 2011). The latter, along with other factors such as poor management, lack of investment, and structure of the economy with a lion's share of economic activities controlled by government, have led to an inefficient use of energy. The energy intensity index in Iran is one of the highest in the world (twice as much as the world average) and has been increasing on average by about 3.4 percent per year over the past 40 years (Iran Energy Balance, 2010; EIA, 2011). The substantial subsidizing of energy prices over the years has also led to low productivity in the energy-intensive industries, deterioration of environment in urban areas, and a huge burden on the government budget leading to macroeconomic disturbances.

To address the increasing economic and social problems associated with high energy subsidies, Iran implemented an aggressive and wide-ranging energy price reform through which energy subsidies were to be removed in 2010. The main objectives of the reform plan were twofold: to bring the government budget in control and to cut energy consumption. In this article, I review the energy market and the energy price reform in Iran with a focus on energy efficiency.

Energy Market in Iran

The energy market in Iran is highly centralized, with the government owning the oil and natural gas reserves, operating the processing plants, setting production and trade levels, the distribution mechanism, and prices. Iran produces about 1551 Mboe total primary energy including 4 bbl/day of oil and 85 bcm of natural gas (7th in the world). Iran exports about 2.5 bbl/d of oil (4th in the world and 2nd in OPEC) and 3.6 bcm of natural gas (to Turkey) and imports about 5 bcm natural gas (mostly in a form of swap with northern neighboring countries). Iran also has about 38 GW of electricity generation capacity and produces about 190 TWh electricity. The final energy consumption is approximately 1166 mboe with the following sectoral breakdown: household, public, and commercial 37%, industry 22%, transport 27%, agriculture 4%, and non-energy use 11% (Iran Energy Balance, 2010). Figure 1 shows the total primary energy consumption and energy intensity trend in Iran.

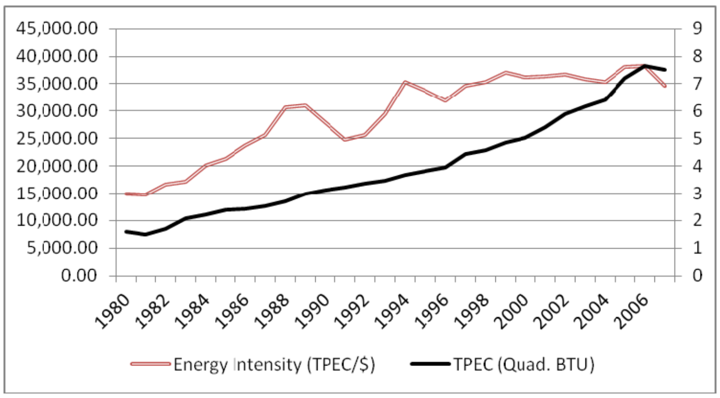

Figure 1. Total Primary Energy Consumption and Energy Intensity in Iran

Notes: Total Primary Energy Consumption (TPEC) is in Quadrillion BTU (right axis) and the energy intensity in the TPEC (BTU) per 2005 US dollar of GDP (market exchange rates). Source:The Titi Tudorancea Bulletin, Global Edition (http://www.tititudorancea.com/)

A scenario study by Moshiri et al. (2012) shows that under the Business-As-Usual (BAU) scenario, total demand for final energy will double by 2030, increasing on average 2.8 percent per year. Manufacturing industries will have the highest growth in demand for energy with an average growth of 3.4 percent per year followed by the residential and transport sectors with 3.2 and 2 percent annual growth, respectively. Demand for energy in other sectors (commercial, agricultural, public) will grow on average 1.7 percent. In the BAU scenario, natural gas demand will have the highest growth rate with about 4 percent growth per year on average. The demand for oil products (fuel oil, gas oil, and gasoline) will grow on average between 1 and 2.2 percent, and demand for kerosene will decrease on average 4.7 percent per year. The study also projects that the CO2 emissions will double under the BAU scenario over the next 25 years.

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See footnotes at end of text.

The price of energy in Iran has been heavily subsidized. The subsidies are as high as 12 percent of GDP, depending on the definition of the subsidy (direct or indirect) and world energy prices. The gasoline subsidy, resulting in a price of 10 cents per liter in 2010, has been one of the most egregious cases. The very low gas prices, along with an increase in population, urbanization, and increasing domestic car production, has increased gas consumption to 70 million liters per day, much higher than domestic production. In 2010, the government drew on the Foreign Reserve Fund to import gasoline to catch up with the increasing demand at subsidized prices. Overall, the energy price index has increased on average by 13 percent per year and the non-energy price index by 16 percent per year for the period 2001-2008. The energy expenditures share of total expenditures by household has declined from 4 percent to 2.7 percent for the same period (IEA/WI, 2010).

The Energy Price Reform

To bring the budget deficit under control and to manage the increasing trend of energy consumption, the government embarked on an aggressive and ambitious energy price reform in February 2010. According to the reform passed by the parliament, the so-called Targeted Subsidies Law, energy (petrol, oil, liquefied gas and kerosene) prices would increase up to 90 percent of the border prices in five years (at least 75 percent of the export prices for natural gas). Electricity prices would also increase to cover production cost. The prices would increase in the first year of the plan so as to bring in between $10 billion to $20 billion in revenues. The allocation of the proceedings was also specified in the law as follows: 50% to be distributed in the form of cash handouts to households, 30% to support industries affected by the energy price hikes, public transportation, and infrastructure, and 20% to cover discretionary expenses.

Gasoline prices quadrupled (from 1000 rials per liter to 4000 rials per liter) for the monthly quota of 60 liters per passenger car and increased by a factor of 7 for over–the–quota consumption[1]. The price of natural gas increased by a factor of 7 (from 100–130 rials per cm to 700 rials) for households and by a factor of 15 (from 50 rials per cm to 800 rials) for power plants. The price of electricity almost tripled from an average 160 rials (1.6 cents) per kWh to 450 rials (4.5 cents) per kWh (Figure 2). The price increases were progressive, and the rates varied among different sectors and regions (Organization for Support of Consumer and Producers, 2012). The parliament passed a budget of 54,000 billion rials for 15 months (44,000 billion rials for 12 months). To reduce the impact of the subsidy removal on low-income households, government distributed 455,000 rials (about $45 given the exchange rate then) per month to individuals who had already registered in a government site online.

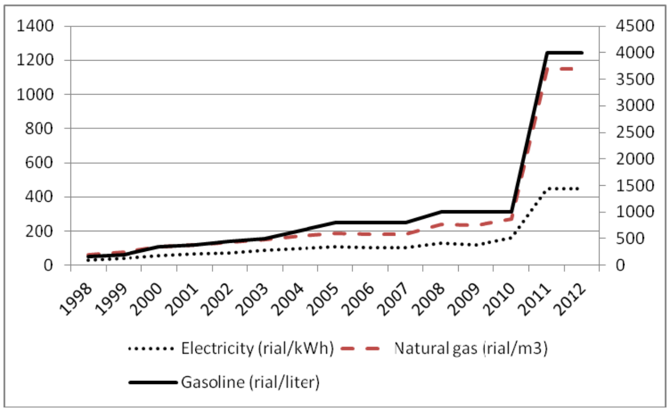

Figure 2. Energy Prices in Iran (rial/unit of energy)

Notes: Gasoline price is on right-axes. The exchange rate in 2010 was US $1=10,000 rial. The electricity and natural gas prices are for residential consumption and the gasoline prices are for the regular gas for the 60 liter monthly quota. Sources: Energy balance (2010) and Ministry or Oil and Ministry of Energy Reports.

The energy price reform was an unprecedented step to increase all energy prices dramatically with short notice. Such huge price changes in energy, which has a low price elasticity of demand, does not usually take place without major social and political unrest, particularly in developing countries, where a significant number of people live below or close to the poverty line and will be adversely affected by sudden price hikes. However, the first stage of the reform was successfully implemented without serious social or economic disruption. The main objectives of the plan were to decrease government spending on energy subsidies, particularly direct subsidies on gasoline, and to lower energy consumption. Both objectives were partially met:

- Government revenue from increasing energy prices was 44000 billion rials, 90 percent of which was distributed to households in the form of monthly cash handouts. The successful administration of the reform through the online self-registration system, the automatic cash payments, and the design of the smart cards for monitoring gasoline consumption on such a large scale was critical in the general acceptance of the reform.
- The energy consumption trend was stabilized after the reform. For instance, gasoline consumption decreased from about 64 million liters per day to 59 million liters per day, despite the fact that about 1 million cars per year were added to Iran's fleet. It is not yet clear how much of this consumption cut was due to a reduction in smuggling and how much was due to a change in con-

sumption behavior. Electricity consumption also declined, but rebounded after few months of the reform, perhaps due to the income effect of the cash hand out. (ISNA, 25 May 2012).

Although the reform has been relatively successful in removing energy subsidies, stabilizing energy consumption, and managing regular cash handouts, its effects on energy efficiency are not clear due to the lack of efficiency programs, inflationary effects of the reform, the lack of support for industry in the transition period, and the lack of a plan for structural changes in the energy market and the economy.

The main problem with the reform program is the lack of a plan for energy efficiency. The energy price reform is necessary, but is by no means a sufficient policy to address the energy problems in Iran. The reform needs to lay out explicitly a program with a specific timeline and measures to achieve energy efficiency. In fact, energy efficiency should be the most important objective of energy reform, as it will ensure lower consumption and more national savings and higher growth in the long-run. Evidence suggests that government efforts at energy efficiency have even declined as policy makers and officials thought price changes would automatically solve the inefficiency problem in the energy market.

A scenario study by Moshiri et al. (2012) shows that the energy saving potential is more than 50 percent in the household sector, and 41 percent in the industry sector over the next 25 years. The removal of subsidies is a prerequisite for instituting energy efficiency measures, but it should be accompanied by a series of non-price policies before it can improve the efficiency level. For instance, the revenue from the subsidy removal can be allocated by offering monetary and non-monetary incentives to producers who adopt energy efficiency measures, such as tax rebates, long term subsidized loans, flexible output pricing, access to foreign exchange at preferred rates, education of know-how, on-the-job training programs, research and development. The subsidy removal revenues can also be allocated to increase demand for high efficiency products through programs such as providing small loans to households for purchasing new efficient appliances,[2] buying back old, inefficient appliances, distributing cheap, low-consumption lamps, providing loans and technical assistance for retrofitting old buildings, and raising public awareness about energy efficiency.[3] For example, one of the policies to promote the use of more efficient appliances is to subsidize the producers of high-efficiency refrigerators and freezers. The policy can provide subsidies to domestic producers based on efficiency increases. A benefit-cost analysis shows that the net benefit of subsidizing high-efficiency refrigerator/freezer production is positive. The amount of subsidy will be equal to the energy savings by higher efficiency refrigerators/freezers for five years[4] (Ismaielnia, 2010).

Energy price reform is a golden opportunity to raise awareness and educate people and businesses about the importance of energy conservation and efficiency measures. It is also a great opportunity to embark on a long-term investment plan for CHP and alternative renewable energies, which are abundant in Iran.

The second problem with the plan is the lack of support for industry. Government did not honour its commitment to support industries as 90 percent of the proceedings of subsidy removal were allocated to the household cash rebate program. Most of the Iranian industries were established long ago, based on the import-substitution strategy in the 1970s and, therefore, relied heavily on government protection through high tariffs and subsidies on capital, taxes, and energy. The removal of energy subsidies placed a huge burden on energy-intensive industries, such as steel and car manufacturing, food and beverages, power plants, and petrochemicals. Although the energy price reform was necessary to revitalize inefficient and non-competitive industries, a sudden energy price shock led to disruption in production and higher unemployment in many industries. Furthermore, the price control policy did not allow industries to raise prices to cover their increasing costs.[5] The price reform should have laid out a detailed plan to support industries during the transition to a high-efficiency stage to avoid the high social and economic costs of increasing inflation and unemployment.

The third concern is the inflationary effects of the reform. The energy price reform is a one-time change in prices, but if the cash rebate encourages higher consumption by low-income households due to higher marginal propensity to consume, and higher wages and inflationary expectations, it may cause a spiral effect. The inflationary effects of the energy subsidy removal started with a lag of about eight months, particularly in energy-intensive products such as food and beverages. Furthermore, a huge depreciation of rial (more than 80 percent) in January 2011 and later in September 2012 spurred inflationary expectations.[6] Although the exchange rate depreciation was good news to exporters of manufacturing and agricultural products, it placed downward pressure on the imports of intermediate goods for those exporting enterprises.[7] The higher inflation will have two major effects on the reform. First, the relative price of energy will decline, weakening its original effects on energy consumption. Therefore, to ensure the desired effect of the reform on energy consumption, the reform should constantly revise energy prices so the targeted relative prices will be met. This may trigger a spiral effect which would have an adverse effect on the entire economy. Second, the real value of cash handouts will decline, and the distributional effect of the plan will be neutralized. The equal payment of the cash rebate to all individuals was intended to ensure that low-income households would benefit more than high-income households, alleviating the overall impacts of rising prices on the poor. The inflationary effect of the reform will erode the distributional effect of the reform, and with it its general acceptance among the people who are affected the most. Government needs to either raise the cash handouts constantly to keep up with inflation rates, or find alternative ways to support the poor. In any case, the revenue requirement for such social net programs will be significant.

Finally, the fourth issue is the lack of a program for structural changes in the energy market and the economy. The energy market and many industries in Iran are fully controlled by the public sector which does not necessarily allocate resources efficiently. It seems that without serious structural changes in industry and the energy market, through which the private sector will be allowed to play a meaningful role in the economy, energy efficiency will be very hard to achieve.

Overall, the energy price reform in Iran was necessary to control the increasing trend of energy consumption and increase energy efficiency. Although the policy is still in the beginning of its second phase and its overall impact on energy consumption and efficiency is yet to be determined, it was a major prerequisite for any energy efficiency policy in Iran. The cash handout system was also a smart design and helpful in the successful implementation and the public acceptance of the reform. However, to achieve energy efficiency targets, the reform should take steps beyond price reform. It is true that higher energy prices will partly induce energy efficiency, but it will take a long time for energy efficiency measures to materialize because of the required capital and change in habits. However, the relative price of energy must remain high for a relatively long period before its full effects on energy efficiency will be felt. Furthermore, a series of non-price efficiency policies and regulations is needed to facilitate the transition to high efficiency stages. One of the main weaknesses of the reform was that it did not specify clearly the efficiency measures and did not support industry during the transition period.

Footnotes

[1] Given the exchange rate in 2010, the gas price was about US $0.10 per liter, which increased to US $0.40 per liter.

[2] A case study on refrigerator and freezer shows that 44 percent of the refrigerators/freezers in Iran do not have efficiency ranking, that is, their ranks are G below. About 37 percent of the refrigerators/freezers are between D-G and only 0.29 percent A (most efficient). The high share of the low ranking refrigerators/freezers in Iran reflects a high potential for energy saving in this market (Ismaielnia, 2010).

[3] Energy use in household and commercial sector comprises 37 percent of the total energy use in Iran (Energy Balance, 2009). The average energy use in building is 310 kWh per square meter per year, which is 2.6 times more than the energy use in developed countries (120 kWh). 40 percent of the energy use in building is in public sector.

[4] If the average life-time of refrigerators/freezers in Iran is assumed 10 years and electricity price 1010 rials/kWh, with the 12 percent interest rate, the net discounted presented value of the subsidies would be 5,242 billion rials. The benefit-cost ratio would be 3.42 and the internal rate of return 117.8 percent. The project will take 48 month to breakeven.

[5] The recent US - European and UN sanctions on Iran, which have made imports of raw materials and intermediate goods as well as exports difficult, have had additional dampening effect on the industry.

[6] Official statistics by the Central Bank indicate that inflation has increased from 10 percent before the reform to 23 percent one year after the reform. However, prices of some items, such as food and housing, increased more than 50 percent. The price increases after the October exchange rate shock have been much higher.

[7] A firm level study by Moshiri and Darvishi (2012) shows that depreciation of rial has had a negative effect on exports in Iran in 2001-2007, mainly due to the heavy reliance of exporters on imports of raw materials and intermediate goods.

References

Central Bank of Iran, Statistics, http://www.cbi.ir/section/1372.aspx (Retrieved Nov. 4, 2012)

Energy Balance, Ministry of Energy, 2010.

Energy Scenario for Iran (2009), Iranian Energy Association (IEA)/Wuppertal Institute for Climate, Environment and Energy, Wuppertal, March.

Energy Price Reform in Iran (2010), Iranian Energy Association (IEA)/Wuppertal Institute for Climate, Environment and Energy, Wuppertal, February.

Ismaielnia, A.A. (2010), Economic Analysis of Subsidizing High-Efficient Fridge Producers, SABA, http://www.saba.org.ir/saba_content/media/image/2012/04/3588_orig.pdf

ISNA (2012), Iranian Student News Agency, http://old.isna.ir (Retrieved 10, July, 2012)

The Organization for Support of Consumer and Producers, Ministry of Commerce, http://yaraneh.cppo.ir/pages/frontEnd/main.aspx (Retrieved May 20, 2012)

Moshiri, S., F. Atabi, M. H. Panjeshahi, and S. lechtenboehmer (2012), Long Run Energy Demand in Iran: A Scenario Analysis, International Journal of Energy Sector Management, 6, 1, 120-144.

Moshiri, S. and B. Darvishi (2012), Determinants of Entry and Exit of Firms in the Exports Markets, The Case of Iran, unpublished paper.

Member-Get-A-Member Campaign

IAEE's Member-Get-A-Member campaign continues in 2013. IAEE believes you know quite well the value of membership in our organization. Furthermore, membership growth is one of the Association's top strategic initiatives. With your knowledge of our organization's products/services, publications and conferences, we know that you are in the ideal position to help us grow. The process to win rewards for yourself is quick and easy!

Here's How the Program Works:

- For each new IAEE member you recruit, you receive THREE months of membership free of charge.
- New Members must complete the online IAEE membership application form at https://www.iaee.org/en/membership/application.aspx Make sure the member(s) you refer mentions your name in the "Referred By" box located on the online membership application form.
- The more new members you recruit the more free months of membership you will receive. There is no limit to the number of new members you may refer.

Membership Recruitment Period and Additional Incentive:

- This special program will run from February 1, 2013 – June 1, 2013.
- The Member that refers the most new members to IAEE during this timeframe will receive a complimentary registration to attend the 32nd USAEE/IAEE North American Conference in Anchorage, Alaska (this prize may be assigned by the winner to another member, yet must be used for complimentary registration to attend the Anchorage conference only).

IAEE Tips for Success:

- Promote the benefits of IAEE membership - Share your IAEE passion with others! Visit https://www.iaee.org/en/inside/index.aspx for a brief overview of IAEE.
- Connect with colleagues – Invite your co-workers, colleagues and friends to IAEE conferences.
- Keep IAEE membership applications at your fingertips - Please contact David Williams at iaee@iaee.org and request that membership applications are mailed to your attention. Feel free to hand these out on your travels.
- Let IAEE do the work for you – Send us an email at iaee@iaee.org letting us know who should be invited to join IAEE (we need full name and email address) and we will contact who you refer to see if they have an interest in joining IAEE. If the member joins during the timeframe above you will be given three months of membership free per member you recruit!

We encourage all members to help our organization grow. At the same time, you will be rewarded with free membership months and an opportunity to have your conference registration fee waived at a coming IAEE conference.

Thank you for making IAEE the great organization it is!

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Program Announcement

Energy Economics of Phasing out Carbon and Uranium

13th European IAEE Conference
18-21 August 2013 in Düsseldorf, Germany

Hilton Düsseldorf Hotel, Georg-Glock Strasse 20, 40474 Düsseldorf

Dear Energy Colleague,

The ambitious renewable energy policy of the European Union and the German Government has stimulated an unanticipated increase of renewable electricity generation capacities. Likewise the renewable shares in the heating and the transportation sectors are on the rise. New global industries have been created which are flourishing in spite of still uncompetitive costs.

Following the Fukushima nuclear catastrophe, the German government has decided to speed up the phase out of nuclear power in this country. If renewable energies cannot close the generation gap, increased greenhouse gas emissions may be the consequence impacting the European Emission Markets.

The European 13th European IAEE Conference in Düsseldorf will offer the opportunity to discuss these developments and to analyze the policy and its economic, ecological and social implications from an energy economics perspective.

As delegate you will get insights into a unique energy policy experience, can compare it with the energy strategies in other countries across and outside Europe and will contribute with their own analyses to a better understanding of energy systems on the pathway towards sustainability.

Our IAEE affiliate, the *Gesellschaft für Energiewissenschaft und Energiepolitik (GEE) e.V.*, is honored to invite you to the Conference and would be proud if you will join us in August 2013 and contribute to this important energy meeting with your valuable input.

Our host city Düsseldorf in the "Rheinland" is a very interesting place of post-industrial transformation in Germany, perfectly easy to reach right in the center of Europe. You will be able to join offsite events that will give you the chance to experience the diversity of this region and the beauty of its nature.

We look forward to seeing you in Düsseldorf!

Preliminary Program

18 August 2013	18:00 -20:00	Welcome reception
19 August 2013		Student Breakfast, Opening ceremony, Plenary and Dual Plenary Session, Concurrent Sessions, Gala Dinner
20 August 2013		Plenary and Dual Plenary Session, two blocks of Concurrent Sessions, Offsite Event
21 August 2013	Until 13:00	Concurrent Sessions, Closing Session

Plenary sessions

The **(dual) plenary sessions** will be devoted to the following themes:

- European gas markets – towards new pricing arrangements
- Electricity market design
- Support mechanisms for low carbon technologies
- German energy transformation
- Long term planning of infrastructures
- Energy efficiency and consumer behavior

Confirmed speakers include among others:

- **David Newbery** (IAEE President)
- **Lore Smith Schell** (President USAEE)
- **Peter Hartley** (Rice University Houston)
- **Peter Cramton** (University of Maryland)
- **Carlo Andrea Bollino** (AIEE)
- **Christoph Schmidt** (RWI)
- **Hans-Peter Floren** (OMV)
- **Peter Boerre Eriksen** (energinet.dk)
- **Richard Scott** (E.ON)
- **Garrelt Duin** (Minister for economy and energy, Northrhine-Westfalia)

For further information visit http://iaee2013.gee.de

Registration Fees

Participants	Early Registration before May 31 (EUR)	Late Registration after June 1 (EUR)
GEE/IAEE Speakers and Chairs	500	550
Speakers/Chairs (Non-Members)	600	650
GEE/IAEE Members	650	700
Non-members	750	800
GEE/IAEE Full Time Students	250	300
Full Time Students (Non-Members)	300	350
Accompanying persons	200	250

IAEE Conference Student Program

As part of the IAEE Conference Student Program, the IAEE offers the IAEE Best Student Paper Award and IAEE Conference Student Scholarships. If you have any further questions regarding IAEE's Conference Student Program, please visit http://www.gee.de/iaee-european-conference-2013/iaee-konferenz-studierenden-programm/ or contact us via e-mail at: kontakt@gee.de

IAEE Best Student Paper Award
IAEE is pleased to offer an award for the best student papers on energy economics in 2013. The award will consist of a cash prize plus waiver of conference registration fees to attend the IAEE Conference.

OFID/IAEE Conference Student Scholarship
IAEE is offering a limited number of student scholarships to the 13th IAEE European Conference. IAEE scholarship funds will be used to cover the conference registration fees.

Venue

The venue of our conference is the Hilton Düsseldorf Hotel, close to Rhine river. It is easy to reach via DUS international airport, Düsseldorf central station and public transportation (station *Theodor-Heuss-Brücke* U78/U79). The historic center is famous for the "world's longest beer bar" and the boulevard *Königsallee*. Düsseldorf is placed in the "Rheinland", a region undergoing profound socio-economic changes, which are linked to a former transformation in the German energy sector... As Düsseldorf is an important international exhibition center in the heart of Europe, its infrastructure makes it the perfect host city for the 13th European IAEE Conference.

Committees

CHRISTOPH WEBER (Chair)	MARTIN CZAKAINSKI (Sponsorship Committee Chair)	GEORG ERDMANN (Concurrent Session Chair)
CHRISTIAN VON HIRSCHHAUSEN (Plenary Program Chair)	CLAUDIA ESSER SCHERBECK (Local Arrangement Committee)	PHILIPP RIEGEBAUER (Student Committee Chair)

Welcome New Members

The following individuals joined IAEE from 1/1/13 to 3/31/13

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Calendar

14-17 April 2013, 40th Annual International Energy Conference IRCEED at Boulder, CO. Contact: Dorothea El Mallakh, Director, IRCEED, 850 Willowbrook Road, Boulder, CO, 80302, USA Email: iceed@colorado.edu URL: www.iceed.org

16-18 April 2013, FDFC13 Fundamentals & Developments of Fuel Cells at Karlsruhe, Germany. Contact: sara.heimolinna@eifer.org, Organisation Committee, EIFER European Institute for Energy Research, Karlsruhe, Baden-Württemberg, Germany URL: http://fdfc2013.eifer.uni-karlsruhe.de/

16-19 April 2013, LNG 17 at Houston, TX, USA. Contact: Jay Copan, Executive Director, LNG 17, USA. Phone: 919-740-7799 Email: jcopan@lng17.org URL: www.ing17.org

16-20 April 2013, Solar 2013 at Baltimore, Maryland, USA. Contact: Seth Masia, Events Coordinator, American Solar Energy Society. Phone: 1-303.443.3130 Email: smasia@ases.org URL: solar2013.org

16-19 April 2013, World CTL 2013 Conference at Shanghai, China. Contact: Serge Perineau, President, World CTL, 8 rue Mission Marchang, Paris, F75016, France. Phone: 33 607 28 5247 Email: management2013@world-ctl.com URL: http://www.world-ctl.com/program/pdf-program

22-24 April 2013, Oil and Gas Mobility Summit at Sheraton North Houston Hotel at George Bush Intercontinental. Contact: Kim Vigilia, IQPC, 15700 John F Kennedy Blvd, Houston, Texas, 77032, USA. Phone: +44 (0)20 7368 9510 Email: kim.vigilia@iqpc.co.uk URL: http://atnd.it/WGnqf8

24-25 April 2013, Novogradac Financing Renewable Energy Conference at San Francisco, CA. Contact: Jasmene Miranda, Novogradac & Company LLP, 333 O'Farrell Street, San Francisco, CA, 94102, United States. Phone: 415.356.7970 Email: events@novoco.com URL: www.novoco.com/events/conferences

24-26 April 2013, 3rd Annual Unconventional Oil & Gas Summit 2013 at Chengdu, Sichuan Province, China. Contact: Mr. Jordan Chou, Events Coordinator, GICC group. Phone: 86-371-55958175 Email: jordanchou@gicc.org.cn URL: http://www.gicc.org.cn/ug2013/index.as

May 6, 2013 - June 6, 2013, Mining Procurement & Supply APAC 2013 at Crown Perth, Great Eastern Highway,Burswood, WA, Australia. Contact: IQPC, IQPC, IQPC PTY Ltd, Level 6, 25 Bligh Street, Sydney NSW 2000, Sydney. Phone: +612 9229 1000 Email: info@iqpc.com.au

6-9 May 2013, Mastering International Oil & Gas Accounting, Dubai, May 2013 at Ramada Dubai, United Arab Emirates. Contact: Ms Rilla Eas, Senior Marketing Manager, Neoedge Pte Ltd, 469 Macpherson Road, Singapore, Singapore, 368186, Singapore. Phone: +6565579183. Fax: +6565579188 Email: rilla.eas@neo-edge.com URL: http://neo-edge.com/event-line-up/strategic-managment/mastering-international-oil-gas-accounting/

13-16 May 2013, IFRS for Oil & Gas at Dubai. Contact: +65 6325 0211, Infocus International, 141 Cecil Street #05-02, Singapore, 069541, Singapore. Phone: +65 6325 0211 Email: lisa.tan@infocusinternational.com URL: http://www.infocusinternational.com/ifrs

12-14 June 2013, Advanced Project Control at Johannesburg. Contact: +65 6325 0211, Infocus International, 141 Cecil Street #05-02, Singapore, 069541, Singapore. Phone: +65 6325 0211 Email: lisa.tan@infocusinternational.com URL: http://www.infocusinternational.com/projectcontrol

16-20 June 2013, 36th IAEE International Conference: Energy Transition and Policy Changes at Daegu, Korea. Contact: Hoesung Lee, KRAEE, Korea Email: hoesung@unitel.co.kr

24-28 June 2013, Gas & LNG Contracts: Structures, Pricing & Negotiation Masterclass at Port of Spain, Trinidad and Tobago. Contact: +65 6325 0211, Infocus International, 141 Cecil Street #05-02, Singapore, 069541. Phone: +65 6325 0211 Email: lisa.tan@infocusinternational.com URL: http://www.infocusinternational.com/gascontracts

28-31 July 2013, 32nd USAEE/IAEE North American Conference - "Industry Meets Government: Impact on Energy Use & Development" at Anchorage, Alaska. Contact: David Williams, Executive Director, USAEE, 28790 Chagrin Blvd., Suite 350, Cleveland, Ohio, 44122, USA. Phone: 216-464-2785. Fax: 216-464-2768 Email: usaee@usaee.org URL: www.usaee.org

July 29, 2013 - August 2, 2013, Cologne International Energy Summer (CIES) at Cologne, Germany. Contact: Felix Höffler, Prof. Dr., Institute of Energy Economics at the University of Cologne (EWI), Vogelsanger Str. 321, Cologne, NRW, 50827, Germany Email: energy-summer@ewi.uni-koeln.de URL: http://www.ewi.uni-koeln.de/en/research/workshops/

4-6 September 2013, BioEnergy Exhibition & Conference: A Boost For Entire Industry at Jyvaskyla, Finland. Contact: Dan Asplund, Conference Chairman, Benet Ltd, Piippukatu 11, Jyvaskyla, 40100, Finland. Phone: 358-40-718-2026 Email: bioenergy@benet.fi URL: www.benet.fi

16-18 September 2013, 3rd Annual Global Refining Technology Forum at Doha, Qatar. Contact: +971 4609 1570, Mr., Fleming Gulf, Qatar. Phone: +91 962344 0356 Email: ajay.nimbalkar@fleminggulf.com URL: http://www.fleminggulf.com/conferenceview/3rd-Annual-Global-Refining-Technology-Forum/388

8-10 October 2013, Energiemarkten at To be determined. Contact: Janet Smid, Course Manager, Energy Delta Institute, Netherlands Email: smid@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/introduction-programmes/energiemarkten-2

15-18 June 2014, 37th IAEE International Conference: Energy and the Economy at New York City, NY. Contact: David Williams, Executive Director, IAEE, 28790 Chagrin Blvd Ste 350, Cleveland, OH, 44122, USA. Phone: 216-464-5365 Email: iaee@iaee.org URL: http://www.iaee.org/en/Conferences/index.aspx

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